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The 1st Ukrainian-Polish Scientific Forum

AGRO BIO PERSPECTIVES

29–30 September 2021, Lviv, Ukraine

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Dear participants of the First Ukrainian-Polish Scientific Forum AGROBIOPERSPECTIVES!

Ladies and Gentlemen!

I am glad to welcome all of you to the Institute of Animal Biology NAAS in the beautiful Ukrainian city Lviv!

Based on long-term cooperation with scientific institutions and institutions of higher education in Poland, we are happy to start the annual Ukrainian-Polish Scientific Forum “Agrobioperspectives” from 2021. The purpose of this, and I hope many future forums, is to establish and strengthen scientific and educational cooperation between Ukraine, Poland and other countries in research across different disciplines: agrobiology, agriculture, veterinary medicine, and ecology. I am convinced that joint regular meetings of scientists, scholars and practitioners from Ukraine and Poland will have a mutually positive result in a worthy representation of agricultural and biological science in our countries at European and world levels, and in the establishment of close international cooperation.

Today’s premiere Forum is designed to focus on the problems of animal husbandry in current environmental challenges. The main topics of the next “Agrobioperspectives”, which will take place next year in Poland, will be identified during the joint round table discussion at the Forum. This year, almost one and a half hundred scientists from 5 countries registered to the Forum. I hope that the Forum will gain weight and popularity and there will be a lot of participants in the future. Their contribution will help to improve not only the agrobioperspectives, but also the global perspectives of modern world.

I wish everyone an effective and productive work, interesting reports, exciting discussions, new acquaintances and scientific contacts! I also believe that you will get good impressions of Ukraine, Lviv and our Institute!

Sincerely,
Chairman of the Forum Organizing Committee
Director of the Institute of Animal Biology NAAS *Yuriy SALYHA*

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Abstracts of
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Associations between ultrasonographic attributes and chemical constituents of skeletal muscles: implications for meat industry and clinical practice

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Accurate monitoring of meat chemical composition at all production stages is one of the top priorities of the modern agri-food industry. In medicine, early detection of biochemical changes in skeletal muscles could greatly improve the diagnosis and treatment of various myopathies. At present, there is no non-invasive method to determine the chemical composition of skeletal muscles in live animals. It is feasible that major chemical constituents of the muscles can be quantified using ultrasound technology. Ultrasonographic images of internal organs and tissues exhibit distinctive echotextural properties. Computerized analysis of ultrasonograms significantly increases the precision of echotexture measurements. We hypothesized that ultrasound imaging combined with computer-assisted analysis of ultrasound images was a suitable method to assess the chemical composition of skeletal muscles. The main goal of our ongoing collaborative research projects is to employ grey-scale ultrasonography and image analyses to examine if there exist quantitative changes in skeletal muscle echotexture that are associated with their chemical composition. These studies employ an array of animal species of veterinary and agricultural interest. The main study objectives are as follows:

Objective 1. To investigate whether first order ultrasonographic image characteristics of skeletal muscles *in situ* (i.e., mean pixel intensity and heterogeneity) are significant predictors of muscle chemical composition including crude fat, crude protein and moisture content as well as fatty acids profiles. Ultrasound images of pectoralis major muscles (broiler chickens, turkeys and geese) and of longissimus dorsi and semimembranosus muscles (cattle and swine) obtained prior to slaughter were assessed using commercially available image analytical software and customized algorithms. The chemical composition of meat samples was determined using the standard AOAC methods, and correlations among echotextural attributes and chemical constituents of each muscle were assessed.

Objective 2. To document the changes in quantitative echotextural attributes of skeletal muscles during the course of experimentally induced neurogenic inflammation and/or their associations with biochemical parameters. Changes in quantitative echotextural variables in skeletal muscles due to induced facet injury in the rat (facet compression at lumbar segments L4-L5 and L5-L6 resulting in the chronic neurogenic inflammation), in non-neurosegmentally (brachial region) and neurosegmentally-linked muscles (femoral muscle groups), and their correlations with the expression of inflammatory regulators (substance P, calcitonin gene related-peptide, calcium/calmodulin-dependent protein kinase II, extracellular signaling regulated kinase 1/2, and PAR 2 protein levels) were examined.

These studies promise to provide the proof of concept for the usefulness of ultrasonographic imaging coupled with computerized image analysis in monitoring the chemical composition of skeletal muscles in live animals. An impact of such a method in the fields of medicine and food animal production may be consequential.

Key words: ultrasonography, computer-assisted image analysis, skeletal muscle composition, myopathies

Development of a standard operating procedure for determining the quality of honey and beekeeping products according to microbiological indicators

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Beekeeping products have found their wide application among the population due to their highly nutritious, taste and medicinal properties. Resolution of the Ministry of Health of December 31, 2011 no. 36 "On the implementation of Articles 6, 44 and 46 of the Law of Ukraine 'On food safety and quality'" states that these products belong to the list of foods that usually have a low level of risk to human health .

At the same time, the Ministry of Agrarian Policy of Ukraine by order no. 491 from 08.08.2012 "On approval of veterinary and sanitary requirements for facilities (objects) for the production of beekeeping products" determines that "11.4. Operators of facilities (objects) must take measures regarding the introduction of risk analysis and control (regulation) systems at critical points (HACCP) or similar food safety and quality systems, in the case of HACCP implementation — continuously support a procedure or procedures based on HACCP principles".

The aim of the work is to develop a standard operating procedure (SOP) for the study of microbiological quality indicators of honey and bee products in accordance with current regulations: SSU 8684:2016. "Honey and beekeeping products. Preparation of samples and dilutions for microbiological research", 8716:2017 "Honey and bee products. Methods for detecting and determining the number of coliforms", SSU 8729:2017 "Honey and bee products. Determination of the number of microorganisms. The method of counting colonies at a temperature of 30°C".

Hygienic standards for microbiological indicators of food safety include the following groups of microorganisms: sanitary-indicative, which include the number of mesophilic aerobic and facultative-anaerobic microorganisms (NMAFAnM), bacteria of the *Escherichia* coli group — BEKG (coliforms), strains of the *Enterobacteria* genus; *Enterococci*, opportunistic pathogens, which include: *E. coli*, *S. aureus*, bacteria of the *Proteus genus*, *B. cereus* and sulfite-reducing clostridia, *Vibrio parahaemolyticus*; pathogenic microorganisms, including bacteria of the genus *Salmonella* and *Listeria monocytogenes*; microorganisms that indicate spoilage of products — yeast and molds, lactic acid microorganisms.

To assess the quality of honey and bee products used indicators in accordance with SSU 4497:2005 "Natural honey. Specifications"; SSU 4662:2006 "Propolis. Specifications", SSU 4666:2006 "Royal jelly. Specifications", SSU 4649:2006. "Honey with phytonutrients. Specifications". Thus, honey with herbal supplements must meet the indicators:

— total number of mesophilic aerobic and facultative-anaerobic microorganisms, 2.5×10^4 CFU in 1 g, not more;
— bacteria of the Escherichia coli group (coliforms), in 1 g, not allowed;
— molds, 1×10^2 CFU in 1 g, no more;
— yeast, 50 KOU in 1 g, no more;
— pathogenic microorganisms, including bacteria of the Salmonella genus, in 50 g is not allowed.

Determination of the presence of other groups of microorganisms is specified in SSU EN 12824:2004 "Microbiology of food products and animal feed. Horizontal method for detecting *Salmonella*"; SSU ISO 7932:2007 "Microbiology of food products and animal feed. The horizontal method of determining the number is probably *Bacillus cereus*. Calculation technique at a temperature of 30°C"; SSU ISO 11290-1:2003 "Microbiology of food products and animal feed. Horizontal method of detection and counting of *Listeria monocytogenes*. Part 1. Detection method", SSU 8710:2017 "Veterinary biological preparations. Probiotics. Methods of specific microorganisms identification".

On the basis of the considered documents for convenience in work we have developed SOP for carrying out research of a certain kind sample, which is structured on such divisions: the name, the purpose, terms and reductions, tasks, safety precautions and environmental protection, procedure — materials and reagents, step-by-step execution, qualitative indicators, reporting documentation, list of normative documents.

Key words: standardization, contamination, beekeeping products

Nutritional methods in the prevention of coccidiosis in broiler chickens — the results of the studies conducted at the National Research Institute of Animal Production in Kraków

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At the National Research Institute of Animal Production in Kraków, a series of *in vivo* experiments was carried out to evaluate the effectiveness of chosen feeding methods in the control of coccidiosis in broiler chickens. The studies were carried out in two directions: nutritional methods as an alternative to in-feed coccidiostats, or as a supportive factor in limiting the potential negative effect of the live anticoccidial vaccine on the growth performance of broiler chickens.

In the first stage of the studies, the effectiveness of single extracts obtained from: garlic, rosemary, sage, marigold, nettle, wormwood, pepper, echinacea, thyme or yarrow was assessed under the conditions of experimentally induced clinical coccidiosis. Based on the results of this experiment, garlic, sage, oregano, echinacea and thyme extracts were selected to compose a herbal extract blend (HEB), which was, subsequently, tested individually or in combination with other feed additives in the further experiments. In subsequent studies it was shown that the HEB used in the amount of 1 g/kg of feed is able to ameliorate the course of experimentally induced acute clinical coccidiosis and stimulates compensatory growth in recovering chickens. The growth performance parameters obtained for the entire rearing period in the group of birds infected with a highly pathogenic mixture of oocysts and receiving the addition of HEB in the diet were comparable to those obtained in the group of birds receiving coccidiostat (diclazuril), and in the group of non-infected birds. The combined use of HEB with other feed additives, i.e. with a synbiotic, acidifier, chitosan or mannan oligosaccharide (MOS), worsened its effectiveness in acute disease conditions, in particular when using additives that acidify the feed or the contents of the digestive tract (acidifier, synbiotic).

The next stage of the studies was to verify the effectiveness of the developed HEB, used individually or together with chitosan or MOS, in conditions similar to the farm. The use of a HEB allowed to obtain, at each stage of rearing, the results comparable to those obtained in the group receiving a coccidiostat and significantly higher when compared to the control, unsupplemented group. The combined use of HEB with other tested feed additives did not bring any further improvements. The above results indicate that the developed HEB can be an effective protection approach for chickens in production conditions with low environmental contamination with coccidia.

In the case of studies on the combined use of nutritional methods and immunoprophylaxis, the most effective nutritional strategies included: increased level of crude protein in the diet, supplementation of the diet with a mixture of herbal extracts, probiotic and chitosan, which alleviated the negative effects of vaccination against coccidiosis, without adversely affecting the process of recirculation of the *Eimeria* vaccine strains, which is a necessary for the development of post-vaccination immunity.

Key words: coccidiosis prophylaxis, broiler chickens, growth performance, herbal extracts, feed additives

Influence of feeding with rapeseeds on fatty acid composition of cows' milk fat

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Nowadays most industrial food products contain significant amounts of saturated, ω-6 and low ω-3 fatty acids. The ratio of ω-6/ω-3 in people's diets before industrialization ranged from 1:1 to 2:1. Now the ratio of ω-6/ω-3 in people's diets in most countries is from 10:1–20:1 to 50:1. Therefore, there is ω-3 fatty acid deficiency in people's current diets, which are factors that prevent the development of coronary heart disease and many other non-communicable diseases. One has established that the ratio in the diet of ω-6/ω-3 as 4:1 reduces mortality of patients with cardiovascular diseases, asthma symptoms, and the intensity of inflammatory processes in rheumatoid arthritis. Increasing the ratio of ω-6/ω-3 to 10:1, these symptoms worsen.

People avoid consuming such food items as beef and milk so as to reduce the consumption of saturated fatty acids and the ratio of ω-6/ω-3 ratio because these products are characterized by a high content of saturated fatty acids and low concentrations of ω-3 acids. However, cow's milk is one of the most useful food items because it contains a lot of easily digestible and amino acid-balanced proteins, minerals, and vitamins.

We know that despite the fact that ruminants receive a large amount of unsaturated fatty acids with feed, the vast majority of them are hydrogenated in the rumen. Various methods are used to reduce the degree of hydrogenation for increasing the content of unsaturated fatty acids in food products obtained from ruminants. One of them is feeding ruminants with oilseeds.

Therefore, the aim of the study was to study the effect of feeding lactating cows in the main diet of crushed rapeseed on the fatty acid ingredients of milk.

One conducted the experiments on lactating cows of the Ukrainian black-spotted dairy breed for 30 days during the winter-stable period. The animals were divided into two groups of 10 cows in each of them on the principle of analogues. One fed the control group of cows with clover hay, corn silage, alfalfa haylage, wheat bran, barley bran, mineral supplements. One fed the animals of the second group with crushed rapeseed in an amount equivalent to 3% of dry matter. The rapeseed used in the research was non-erucic acid and low-glucosinolate. The diets of all groups were balanced concerning energy and nutrients.

The fatty acid composition of milk fat was determined by the Kurko method. The obtained results were processed biometrically using *Microsoft Excel*.

Having analyzed the studies, we can state that feeding experimental animals with rapeseed reduces the content of tetradecanoic, palmitic ($P<0.01$), palmitoleic and saturated ($P<0.05$) fatty acids, while the amount of stearic, oleic ($P<0.01$), linoleic ($P<0.01$), linolenic and unsaturated ($P<0.05$) fatty acids in the milk of cows increased.

Feeding dairy cows with rapeseed reduces the content of medium-chain and saturated fatty acids as well as increases the content of long-chain and unsaturated fatty acids in milk lipids, which has a positive effect on its qualitative characteristics.

Key words: rapeseed, lactating cows, fatty acid content

Major intrinsic determinants and predictors of suprovulatory responses in small ruminants

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Application of assisted reproductive technologies (ARTs) is the most effective strategy to boost livestock genetics and productivity traits. By comparison to cattle, swine and poultry farming, the small ruminant industry continues to progress rather slowly in terms of implementing ARTs, but recent modalities of the superovulatory protocols and the development of minimally invasive techniques of embryo recovery and transfer promise to result in the more widespread use of these methods in commercial settings and biotechnology research. Moreover, a number of improvements in predicting ovarian responses and transferrable embryo yields have recently been reported, but some most frustrating problems associated with hormonal ovarian superstimulation (e.g., tremendous individual variation) still persist. This warrants continued studies of novel approaches to superovulatory treatments in small ruminants.

Key words: small ruminants, ultrasonography, ovarian activity, reproductive hormones, transcervical uterine flushing

Young ostrich hematological indices

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Blood conducts many important functions such as feeding, breathing, protective, also it regulates metabolism and the functioning of different organs of the body. The article presents the results of the research which aimed to study some hematological indices of young ostrich, namely, hemoglobin content, number of erythrocytes and leukocytes, and color index. A leukocyte formula and the surface area of erythrocytes in the blood of ostrich was first determined in the present study.

Hematological parameters were defined by the method of K. Aspanidze (1990) and Pantskhava (1969), and digital material was processed biometrically by the method of Mercury (1970).

The study was conducted on the black (African black) ostrich (*Struthio camelus*) on 10 wings at one, two, three and six months of age. During this period, the hemoglobin content (%) was, M±m: 62.6±0.9; 62.9±1.35; 73.04±0.85; 80.16±0.75. The coefficient of variation (Cv) varied as follows (%): 2.9; 4.3; 2.3; 1.9. As it can be seen from the data, the hemoglobin content increases linearly. However, in the second month it is slightly higher than in the first. Like hemoglobin, also, the number of erythrocytes and leukocytes increased linearly. The mean erythrocyte count (mln) and the coefficient of variation by months were, M±m: 1.164±0.05; 1.333±0.9; 1.544±0.08; 2.074±0.06; and 7.7; 13.5; 9.7; 5.3. As for the average number of leukocytes (thousand) and the coefficient of variation, it changed according to the months as follows, M±m: 20.0±0.095; 20.7±1.04; 35.5±1.46; 34.9±0.45 and Cv: 9.5; 10.0; 8.2; 2.6. The mean of color indicator decreased with age and by months were, M±m: 2.72±0.15; 2.39±0.19; 2.38±0.09; 1.93±0.05. The coefficient of variation was respectively: 11.0; 15.5; 7.6; 4.7.

The study of the leukocyte formula showed that it is neutrophilic in nature, especially with an abundance of segmented neutrophils, and its mean number and coefficient of variation by months were, M±m: 36.0±3.15; 53.2±2.7; 45.4±0.51; 46.4±0.57 and Cv: 17.5; 10.2; 2.2; 2.5.The large number of neutrophils is not in doubt, because their main function is to protect the body from microbes invading it and from the poisonous substances produced by them. As it is known, ostriches are quite resilient and durable.

Quantity of lymphocytes, eosinocytes and basophils was not distinguished by abundance compared to other birds; The same can be said about the quantity for monocytes. Regarding the surface area of erythrocytes, it should be noted that in the first month it averaged 73.5 microns, in the second month 77.2 microns, in the third month — 69.8 microns, and in the sixth month — 57.4 microns. The number of erythrocytes increases, whereas its area decreases. In our case, an exception occurred during transition period from the first to the second month, when on the contrary this rate increases; it is difficult to explain scientifically this process. The remaining months are subject to the abovementioned trend.

The high content of erythrocytes and hemoglobin in the ostrich's blood indicates that the bird's body is metabolizing intensively. The abundance of neutrophils once again proves the greatest tolerance of this bird — its high resistance to both environmental conditions and certain diseases.

Key words: ostrich, blood, hemoglobin, erythrocytes, leukocytes

Targeting granulocytic tumor cells with cholic acid prodrug conjugates

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Targeted delivery of chemical compounds is of great demand as it allows to reduce the dose of chemotherapeutic agents and ensure their targeted entry into tumor cells. While investigating the antitumor compounds based on N-alkylaminoferrocene prodrugs, which enhance reactive oxygen species production in the tumor cells and thus killing them we wanted to add the targered delivery of feature to these next-generation antitumor compounds. The prodrugs were investigated in mouse leukemia induced by myeloid cells of the NK/Ly-RB line. These tumor cells express high levels of myeloblastic antigens CD11b, Ly6C, as well as attributable to granulocytes, in particular neutrophils, markers CD16, Ly6G and neutrophil elastase enzyme. We have previously shown that cholesterol and cholic acid, interacting with the membranes of neutrophilic granulocytes, lead to their activation to form neutrophilic extracellular traps, this process involves the internalization of lipid particles (or lipid molecules) into the cell membrane [High content of dietary fructose stimulates the formation of neutrophil extracellular traps in the biliary system. Bila G, Vishchur O, Bilyy R. *Exp. Clin. Physiol. Biochem.* 2020; 89: 29–35, DOI: 10.25040/ecpb2020.01.029; Neutrophils as main players of immune response towards nondegradable nanoparticles. Bilyy R, Bila G, Vishchur O, Vovk V, Herrmann M. *Nanomaterials.* 2020; 10: 1273, DOI: 10.3390/nano10071273]. This effect was used to provide the targeted delivery of antitumor compounds that were covalently conjugated to the cholic acid residue and aimed to target granulocyte tumor cells.

We used flow cytometry to immunophenotype cells and determine their viability, fluorescence microscopy to determine accumulation of compounds in cells and determine their sublimated localization, induction of tumors in laboratory animals and evaluation of antitumor activity *in vivo*.

NK/Ly-RB cells were co-incubated with N-alkylaminophericen-7-hydroxycoumarin-cholic acid conjugate and fluorescence of 7-hydroxycoumarin residue was observed in the cells by fluorescence microscopy. The signal was localized around the nucleus in the area inherent to the endoplasmic reticulum. The use of dye ER-tracker dye confirmed the co-localization of the signal in the endoplasmic reticulum. Upon entering the cells, the compounds caused an increase in the level of reactive oxygen species, which was sufficient to induce cell death. Intraperitoneal administration of the compound to mice (1 uM every other day, a total of 10 injections) with NK/Ly-RB-induced myeloma resulted in a significant almost twofold reduction in tumor growth rate (as assessed by animal weight), starting on day 9 of the experiment.

Therefore, the ability of neutrophilic granulocytes to interact with cholesterol-derived lipids, such as cholic acid, can be successfully used to target certain compounds to these cells.

The research results are published in the paper: An endoplasmic reticulum specific pro-amplifier of reactive oxygen species in cancer cells. Xu HG, Schikora M, Sisa M, Daum S, Klemt I, Janko C, Alexiou C, Bila G, Bilyy R, Gong W, Schmitt M, Sellner L, Mokhir A. *Angew. Chem. Int. Ed. Engl*. 2021 May 10; 60 (20): 11158–11162. DOI: 10.1002/anie.202100054.

Key words: neutrophil granulocytes, myeloid cells, target delivery, cholic acid, tumors

Catalase isozymes content in granulose layer cells from follicles ovaries of cows

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Catalase (CAT) is an enzyme that destroys hydrogen peroxide and is found in mammalian cells. This enzyme is active in the cells of the granulosa layer of the ovarian follicles of cows. It was found that the activity of CAT in ovarian follicles is not constant and varies depending on the physiological state of the gonad [Bodnar Yu., 2016].

The aim of the research was to study the peculiarities of localization of catalase isozymes in granulosa cells depending on the size of follicles and physiological condition of ovaries of cows.

After slaughter of cows, the ovaries were selected and evaluated by physiological condition [Huzevatyi et al., 1995]. To detect CAT proteins, samples were electrophoresed in 7.5% PAAG, after which the gel plates were stained by the method of W. Wodbury (1971).

It was found that CAT is manifested on the phoregrams by two light unstained (or weakly stained) bands of proteins (CAT1 and CAT2), of different area and electrophoretic mobility. The intensity of the manifestation of isozyme bands is not the same. Thus, the average content of isozymes (CAT1 — 36.7±2.65% and CAT2 — 63.3±2.65%) is characteristic of ovarian cells of "follicular growth". In granulose from the "early" and "late *corpus luteum*", compared with "follicular growth" content of CAT1 in lower on 0.9–1.3% and on 1.0–1.3% higher for CAT2. For ovarian cells of "fresh ovulation" is characterized by a reduced content of CAT1 and increased CAT2. The difference between the minimum and maximum values of isozymes is 6.5%.

The content of CAT isozymes, taking into account the physiological state of the ovary, is influenced by the size of the follicles from which the granulose cells aspirate. In particular, the content of CAT1 in cells from follicles of 4–7 mm of the ovary "fresh ovulation" and less than 4 mm of "early *corpus luteum*" is lower (11.3–13.4%). Accordingly, the content of CAT2 in these cells is as high as possible (86.6–88.7%). Almost the same values of isozyme content were found in granulosa from follicles less than 7 mm "follicular growth", 4–7 mm "early *corpus luteum*" and more than 7 mm "fresh ovulation": CAT1 — 40.8–58.8%, CAT2 — 41.2–59.2%. The difference between the minimum and maximum values of CAT1 is 47.5% ($P<0.05$). For follicle cells less than 4 mm of "fresh ovulation" and more than 7 mm of "follicular growth" and all sizes of "late *corpus luteum*" are characterized by almost the same values of CAT1 — 29.6–36.7%.

Thus, CAT is manifested on the phoregrams by two light unpainted (or slightly colored) bands of proteins, of different size and electrophoretic mobility. The intensity of the manifestation of isozyme bands is not the same and depends to a greater extent on the size of the follicles from which the granulosa cells are removed and to a lesser extent on the physiological state of the ovary.

Key words: isozyms, catalase, granulose, follicles, ovaries, cows

In vitro fertilization of Saanen goat oocytes in non-breeding season with epididymal spermatozoa

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Reproductive cycle of goats depends on the season. Male goats have higher concentration of spermatozoa in ejaculate, better motility and viability of spermatozoa in breeding season. Sexual behavior is also influenced by seasonality. Inability to obtain ejaculate for fertilization of goats in non-breeding season occurs very often. However, out of season breeding give an opportunity to rapidly increase the number of goats on farms. During non-breeding season epididymal spermatozoa could be used. However, embryo development rate after *in vitro* fertilization with epididymal spermatozoa might be low. Therefore, the aim of this study was to evaluate the embryo development rate after *in vitro* fertilization of Saanen goat oocytes with epididymal spermatozoa.

The investigation was performed using epididymal spermatozoa of 3 sexually matured Saanen male goats obtained from slaughterhouse. Sperm motility and viability were evaluated. 37 oocytes from 6 Saanen goats were fertilized with washed epididymal spermatozoa after *in vitro* maturation of oocytes. To evaluate fertilizing ability of epididymal spermatozoa embryo development rate on day 7 after *in vitro* fertilization was calculated.

Epididymal sperm motility and viability in non-breeding season are (27±4)% and (41.3±3.5)%, respectively. Embryo development rate appears to be (32.2±8.3)% which is almost twice lower than embryo development rate after fertilization with ejaculated spermatozoa in non-breeding season mentioned by different research groups (~60%).

In conclusion, epididymal spermatozoa show lower fertilizing ability than ejaculated spermatozoa in non-breeding season, however, implantation rate of embryos obtained after fertilization with epididymal sperm needs to be evaluated.

Key words: epididymal spermatozoa, *in vitro* fertilization, embryo development, goat

Features of infectious and epizootic processes of mycobacteriosis in cattle

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Circulation of nontuberculosis mycobacteria (NTMB) or atypical acid-resistant mycobacteria (AARM) in the environment and in cattle herds leads to paraallergic (false positive) reactions. There were 104 positive tuberculin skin test cows out of 408 tested in cattle farm with “tuberculosis free” status of Volyn oblast.

The goal was to establish the probable source of pathogens as well as some features of the pathogenesis of mycobacteriosis in infected animals.

The epizootological analysis, allergic, clinical, pathological histological, microbiological, biological methods were used.

Previous studies (2017–2019) have established the existence of acid-resistant atypical mycobacteria infection of cows in this particular farm.

During 2020 the NTMB were detected bacteriologically in every out of 5 samples of the raw milk from cows. NTMB were also isolated from the lymph nodes (knee, subscapular and mesenteric) of a 1.5-month aged calve, which was fed with raw milk. Six positive for tuberculin and tuberculin purified protein derivative (PPD) skin test cows were slaughtered diagnostically. There were no tuberculosis-like lesions detected during pathoanatomical observation. Histomorphological studies revealed changes in the lymph nodes: hemorrhage, hyperplasia, atrophy of lymphoid tissue, proliferation and replacement of latter by epithelioid cells and histiocytes. Microbiologically, two species of AARM were isolated from biomaterials (lymph nodes, colon): *M. scrofulaceum*, *M. fortuitum*. The bioassay on the guinea pigs was negative.

The results of research have shown that the epizootic process of mycobacteriosis is persistent in this farm. The source of pathogens is adult animals, with the milk of which calves become infected. In adult animals, the pathogenesis was manifested by an active reaction of the immune system in response to the alternative effects of AARM, which is confirmed both live (tuberculin and PPD skin test) and postmortem (histological, bacteriological) studies.

Further study of the dynamics of NTMB persistence in different age groups of the herd is on time.

Key words: nontuberculosis mycobacteria, paraallergic (false positive) reactions, mycobacteriosis, AARM (atypical acid resistant mycobacteria)

Influence of I, Se, S nanoaquacitrates solution drinking on parameters of young rabbits' body

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The use of nanotechnology to obtain mineral compounds is promising, because the amount of minerals is important, but actually their bioavailability in the digestive tract is limited. However, the mechanisms of some elements carboxylates influence on the animals' physiological systems functioning and the level of transformation of these elements into products and its biological value remain unexplored. The aim of the study was to determine the changes in hematological and biochemical parameters under influence of different amounts of I, Se, S on rabbits' body from 53 to 85 life days.

The investigation was conducted on the Blanc de Termonde breed young rabbits in the vivarium of the Institute of Animal Biology NAAS. The rabbits in control group were fed a balanced granular feed *ad libitum* with free access to water. Animals of I, II, III and IV experimental groups were fed the control group diet and during the day received with water I, Se, S solution at the rate of 2.5, 5.0, 10.0 and 20.0 µg/l of water, respectively. The experiment lasted 45 days, including the preparatory period — 12 days, the experimental period — 33 days. In the preparatory period on the 53rd life day and in the experimental period on the 68th and 85th life days of (15th and 33rd days of feeding supplements) in 6 animals (3 males and 3 females) from the group blood samples were taken from the marginal ear vein. Blood cells were determined on a hematological analyzer *Mythic 18*, for biochemical studies biochemical analyzer *Humalyzer-2000* and standard kits from *LACHEMA* (Czech Republic) were used. Mathematical processing of research results was performed using software (*Stat Soft*, Tulsa, USA). Differences between values in the control and experimental groups were determined using ANOVA, at $P<0.05$ (Bonferroni error).

The changes of leukocytes total number in the animal blood were found after I, Se, S nanoaquacitrates solution drinking were: in the II experimental group decreased by 17.1%, in the III group — increased by 26.2% on the 15th day, in the IV group — increased by 12.0% on the 31st day of the study compared with the control. The erythrocytes number in the rabbit blood of I, II and III experimental groups was higher by 8.1, respectively; 5.7 and 12.0% at the first stage of the study and higher in animals I, II; III and IV experimental groups, respectively, by 18.1; 13.3; 24.5 and 24.9% at the final stage of the study compared with the control group. The hemoglobin concentration in the rabbit blood of the II and III experimental groups was probably higher during the study. The hematocrit value in the animal blood of the I–III experimental groups was probably higher on the 33rd day of the study compared with the control. The total protein content was 15.1% higher on the 33rd day of the study after I, Se, S nanoaquacitrates solution drinking in the amount of 10.0 µg/l of water in rabbits' blood of the III experimental group compared with the control. The creatinine level in rabbit's blood of II, III and IV experimental groups on the 33rd day of the study was higher by 9.2, 15.0 and 15.4% compared with the control group, respectively. The cholesterol content in rabbit blood of III and IV experimental groups was probably higher in the first stage of the study compared with the control group.

Therefore, the results of investigation of rabbit blood indicate a dose-dependent influence of the additives of I, Se, S on the rabbits' body, which may indicate the effectiveness using of minerals nanocompounds in their diet.

Key words: rabbits, blood, minerals, nanocompounds

Hematological indicators of the pig's body after feeding metal salts in the composition of polymer transporter

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To adjust the microelement composition of animal diets compounds of mineral origin are mostly used. In this case, the added inorganic components in the feed are characterized by low (10–30%) digestibility, and the animal body is not provided with the necessary amount of microelements for the manifestation of physiologically determined productive qualities. Complex salts with organic ligands are much more effective than premixes of essential microelements of non-mineral origin.

The aim of this work was to determine the effect of complex metal salts with N-polyoxyethylene derivatives of glutamic acid on hematological indicators of pig organism.

For researches were formed 3 groups of hybrid piglets F-4 (10 animals in each group) after weaning (on 50 days) from sows. Piglets of the control group received full-fledged compound feed which were produced at compound feed plant. Animals of the experimental groups received a similar diet, but the metal salts (Mn^{2+}, Cu^{2+}, Zn^{2+} and Fe^{2+}) were removed from the feed. To premixes of experimental groups were added: I — 5% i II — 10% complex of metal salts ($Fe^{+2/+3}$-, Zn^{+2}-, Cu^{+2}- i Mn^{+2}-) with N-polyoxyethylene derivatives of glutamic acid with molecular weight of the polyoxyethylene fragment 400 Da. The ratio of metals in the produced premix corresponded to their content in the premix of metal salts that were given to control group.

Blood was taken from the ear vein in tubes with heparin during the preparation period, 30 and 90 days after the start of research and the number of erythrocytes (10^{12}/l), the concentration of hemoglobin (g/l) and glucose (mmol/l) were determined.

During research period, regardless of the group of animals, the number of erythrocytes in the blood increased from 7.0 to 10.1×10^{12}/l. At the same time, there were no probable differences between the value of the indicator of control and experimental groups.

The changes were established when studying the concentration of hemoglobin: during the preparatory period, the value was in the range of 124.6−137.6 g/l, after 30 days increased by 2.8−8.5% and after 90 days in the control group was 141.1±2.49 g/l, and in the experimental: in I increased to 168.7±6.69 ($P<0.05$), and in II decreased to 130.5±2.82 g/l ($P<0.05$). The concentration of glucose in blood at the beginning of study in experimental animals was 4.1−4.6 mmol/l, after 30 days increased by 24.1% in control piglets, and in the experimental groups did not change (4.4−4.5 mmol/l) and after 90 days was similar in both control and experimental groups (5.1−5.2 mmol/l). No differences were registered between blood indexes in control and experimental groups during the research.

Thus, during the research no differences were found between the values of erythrocyte count and glucose concentration in blood of animals of control and experimental groups, however, we registered increased concentration of hemoglobin in animals of I group and decreased II of experimental groups.

Key words: microelements, polymers, hematological indicators, pigs

The state of the natural and adaptive immunity of pregnant cows and their calves under the conditions of technogenic contamination and the action of the drug “Pregnavitan”

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In modern conditions of ecological and generative disorder there is a problem of inconsistencies of adaptive capabilities of living organisms in relation to the rapid rates of technogenic contamination caused by anthropogenic activity. This effect on the mother’s body in the period of pregnancy is particularly dangerous, which leads to a decrease in immunobiological reactivity and the emergence of immunodeficiency. Thus, the elaboration of immunotropic agents to increase the immune potential and the adaptive capacity of the body of animals, especially during pregnancy are relevant.

The purpose of this research was to find out the peculiarities of the formation of an immune response in the body of pregnant cows and the calves born from them under the conditions technogenic contamination and for the action of “Pregnavitan”.

The study was conducted in one of the farms on the territory of the Chervonograd mining complex in two groups of cows of the last month of pregnancy which were divided into control and experimental groups of 5–7 animals in each and newborn calves. The cows of the experimental group before 30 and 14 days to the predicted calving intramuscularly injected a complex vitamin preparation “Pregnavitan” (Patent for a utility model 99190 Ukraine, IPC (2015.01) A61K 31/00, A61K 49/00, A61K 36/00). The drug contains: tocopherol acetate, squalene, lecithin, L-methionine, L-arginine, sodium selenite, oils of thistle, sea buckthorns and flax seeds in dose of 0.04 ml per kg body weight, cows of the control group — isotonic solution of sodium chloride in dose 10 ml per animal. Blood samples for immunological and biochemical studies were taken from a jugular vein before the early feeding at 30-, 14- and 7 days before calving and those of the calves born from them in 3-daily age.

It is stated a decrease in the activity of cellular and humoral factors for protecting the body of cows with an increase in gestation, as evidenced by a decrease in serum bactericidal activity (SBA) in animals of the control group for 14 days before calving ($P<0.05$) and tendencies to increase the level of circulating immune complexes (CIC). These changes are probably caused by physiological immunosuppression and the influence of ecotoxicants on the body of animals.

The two-time parenteral administration of the pregnant cows of the drug caused a probable increase in bactericidal activity of blood serum in cows for 14 and 7 days before calving and in their calves for 3 days of life compared with the animals of the control group. The level of serum lysozyme activity (SLA) of in the cows of the experimental group for 14 and 7 days before calving was higher ($P<0.05$) than in the animals of the control group. In this case, a probable increase in phagocytosis indicators and a decrease in the content of CIC in the blood of the experimental group for 7 days prior to calving ($P<0.05$). Positive changes in the population composition of blood lymphocytes are established — an increase in the number of T-lymphocytes (general, active, theophylline-resistant) and in-lymphocytes and increase their functional activity.

In general, the results of the conducted research indicate the positive effect of the preparation of the preparation “Pregnavitan” on the immune function of the body of cows in the last period of gestation and their calves under the conditions of technogenic contamination.

Key words: cows, calf, blood, natural resistance, adaptive ability, technogenic contamination

The effect of plant extract on the hematological and biochemical parameters of the blood in piglets after weaning

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The use of plants and plant extracts to replace synthetic chemicals in traditional animal husbandry, and increased consumer demand for environmentally friendly products stimulate the development of phytopreparations and study of their effects on animals' bodies. The use of environmentally friendly raw materials of plant origin, as phyto-extracts in the production of food additives and preparations, allow to easily and quickly eliminate the deficiency of essential nutrients, activate the body to adverse environmental factors, thereby reducing morbidity and improve animal welfare. Therefore, the goal of our study was to determine the effect of ethanol extract of nettle on the hematological and biochemical profile of the blood in piglets in the critical period of weaning from sows.

The experiment was conducted on a private farm using piglets of a Large White breed. All animals in age of 14 days were divided into 2 groups: control and experimental, each containing 8–10 piglets with a live weight of 5 kg. After weaning, at 35 days of age, the piglets were left in the cages of sows. Feeding up was carried out by a standard diet with free access to feed and water, using a premix from *Sano*. From the age of 14 days and before weaning, 40% of *Urtica dioica* L. nettle extract was added to the standard diet of piglets of the experimental group in the amount of 6 mg/kg of body weight (feeding period — 22 days). The piglets of the control group were fed a standard diet. Piglets blood was taken before morning feeding from the anterior vena cava at the age of 14, 36 (1 day after weaning), and 42 days (7 days after weaning). Hematological parameters (number of erythrocytes and leukocytes in the Goriayev chamber) were determined in the blood and hemoglobin concentration was studied by a hemoglobin-cyanide method. The total protein and glucose concentration in the blood plasma, activities of creatine kinase (CK), alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) were evaluated using the kits *Simko Ltd.* (Ukraine).

Differences between values in the control and experimental groups were determined using the Tukey test, where the differences were considered significant at $P<0.05$. The results were expressed as the mean ± standard error.

It has been shown that a powerful complex of natural biologically active substances in the nettle extract causes activation of erythropoiesis and respiratory blood function (increase in erythrocytes amount). We also observed an antianemic effect (increased hemoglobin concentration), increase phosphorylation and energy (activation of CK, ALP) and protein metabolism (increase in total protein, AST, and ALT activity), immune stimulation (increase in the number of leukocytes), activation of hydrocarbon metabolism (increase in glucose concentration) in the body of piglets after weaning. The studied extract contributed to the activation of anabolic processes and improved digestibility of dietary nutrients, which caused an increase of 10% of live weight and average daily gain and 12% safety of piglets in the experimental group relative to control animals. We believe that it is possible to propose to add nettle extract to the standard diet of young animals to increase the stress resistance and adaptability of their body in critical periods of ontogenesis.

Key words: *Urtica dioica* L. extract, biochemical and hematological parameters, weaning, piglets

Application of the polymerase chain reaction method for animal feeds safety analysis

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The agrobiological sphere applies polymerase chain reaction (PCR) technology at numerous points in product development. The PCR process is similar to the natural process of DNA replication occurring in all cellular organisms in which the DNA molecules of a cell are duplicated prior to cell division. PCR is restricted and targets a specific, relatively short, region of the template DNA molecules. Short, single-stranded, synthetic DNA molecules called the primers give the specificity of the reaction and determine the length of the amplified fragment A single cycle of the PCR and the corresponding temperature profile are typically divided into the 3 phases: denaturation, annealing, and elongation. The kinetics of the DNA reproduction resemble an exponential amplification in which the replicas of distinct length (amplicons) accumulate quickly and outnumber the original template molecules.

Diagnostic testing companies rely on PCR technology to verify the presence or absence of genetically modified (GM) material in a product (qualitative PCR) or to quantify the amount of GM material present in a product (quantitative PCR). Genetic modification of plants leads to improved abiotic stress tolerance, growth and yield, disease resistance, herbicide tolerance, insect resistance or change product quality and pollination control system. Qualitative and quantitative methods are needed for genetically modified organisms (GMO) monitoring of crops imports. Today according to the database The International Service for the Acquisition of Agri-biotech Applications (ISAAA) GM Crop Events List is available 530 events (https://www.isaaa.org /gmapprovaldatabase/default.asp). In particular, the most common GM crops are maize (*Zea mays* L.) — 240 events, cotton (*Gossypium hirsutum* L.) — 67 events, potato (*Solanum tuberosum* L.) — 50 events, argentine canola (*Brassica napus* L.) — 42 events, soybean (*Glycine max* L.) — 42 events. Nowadays, according to the European Union regulations, all the food or forage products containing GMO in a concentration higher than 0.9% need to be labeled. Many common genetic elements of GMOs such as promoters (p-35S, p-FMV), terminators (t-NOS, t-E9) or transgenes (pat, CP4epsps) has been described. The detection methods were developed starting from the molecular sequence specific for the construct used for genetic transformation. In most cases this sequence includes the promoter responsible for the transcription of the whole genome of a Cauliflower mosaic virus named CaMV 35S promoter or 35S promoter and gene originated from *Agrobacterium* sp., which is insensitive to glifosat action and the terminal sequence nopaline synthase (nos).

One of the main factors that reduce the quality of agricultural products can be mold contamination, which can produce mycotoxins that pose a threat to both animal and human health. Traditionally, quantification of mycotoxinogenic fungi occurring on crops includes assessing disease severity or incidence and counting fungal spores. These methods are tedious and time consuming when large samples have to be processed. Several molecular techniques have been developed to detect and quantify *Fusarium* spp., *Aspergillus* spp., *Penicillium* spp. in agricultural products. A number of PCR test systems have been developed for the detection of mycotoxinogenic molds using primer sets having the structure and regulatory genes involved in the biosynthesis of aflatoxins (omt-1, nor1, ver1), fumonisins (fum1, fum13), trichocenes (tri1, tri3, tri5, tri6, tri12, tri13), zearalenone (PKS4, PKS13, ZEB1, ZEB2) and ochratoxin (pks, OTAnps).

Key words: PCR, GMO, animal feed, mold contamination, mycotoxins, product quality

A comparison of the selected population parameters of pheasants *Phasianu scolchicus* in agricultural and urban areas

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Changes in the agricultural landscape consisting of the creation of large-area monocultures, the elimination ofbetween-field trees and shrubs plantations, ponds, etc., contributed to the elimination of natural shelters, lekking sand nesting sites for many small animals species. Against this background, urban and suburban areas often provide better living conditions for wild species than adjacent agricultural areas. Some small animals species, such as the pheasant *Phasianus colchicus*, have adapted to urban conditions characterized by strong human penetration, large numbers of predators from the corvids family, seasonal grass mowing, noise, etc.

The aim of the study was to compare the selected population parameters of pheasants living in the Lublin urban areas and the adjacent agricultural areas in the years 2019–2021. The studies compared the density, escape distance, size of territories, frequency of making tooting sounds and the pressure of predators on the pheasant broods.

The research hypothesis assumed the existence of differences in the analyzed population parameters of pheasants living in urban areas compared to the populations living in agricultural areas.

The statistical analysis was performed using the *Statistica 13.1 PL* software package. The agreement of the distributions with a normal distribution was assessed using the Shapiro-Wilk test. To assess the differences between the averages, the *t*-test was performed for independent samples.

The results of the research showed that pheasants in urban areas are characterized by shorter escape distances (urban: 23.7 m and agricultural: 45.5 m; t=3.851; P=0.001), smaller rooster territories (urban: 5.7 ha and agricultural: 10.6 ha; t = –3.520; P=0.017), higher density (urban: 2.9 pcs/100 ha and agricultural: 1.3 pcs/100 ha), as well as higher pressure of predators on the broods compared to adjacent typically agricultural areas (urban: 80% damage and agricultural: 61% damage; Z=2.51; P=0.0107).

Key words: pheasant, *Phasianus colchicus*, density, escape distance, territories

Induction of ovulation after artificial insemination in rabbits: intramuscular injection of gonadotropin-releasing hormone analogue *versus* intravenous administration of mated doe serum

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Success in breeding animals is a prerequisite for efficient meat production. Food production in the developing world is constantly increasing, but there is still a demand for animal protein supply. Meat from highly prolific rabbits is rich in healthy monounsaturated and polyunsaturated fatty acids. It is a viable alternative to poultry, beef, and pork. Rabbits are reflex ovulators with the ovulatory process triggered by neurohormonal impulses generated during natural mating. When applying artificial insemination (AI), an array of bio-stimulation methods and/or exogenous hormones (e.g., gonadotropin-releasing hormone (GnRH) or its analogues) must be used to induce ovulations in female rabbits. However, the effectiveness of various bio-stimulation techniques is not always satisfactory, and the use of GnRH analogues possesses some drawbacks, including antigenic effects, which may lead to impaired ovarian function, reduced fertility, and high production costs. Therefore, developing an inexpensive, efficient, and safe treatment for ovulation induction in artificially inseminated does is urgently needed.

In the present study, we examined and compared the effects of mated doe serum (MDS) and GnRH analogue (Gonadorelin) administered immediately after AI on circulating concentrations of luteinizing hormone (LH) and fertility in New Zealand does. Forty Artificially inseminated does were allocated to four equinumerous groups that received: 0.2 ml of saline i.m. (Control G), 0.8 μg of Gonadorelin dissolved in 0.2 ml of saline i.m. (Treatment G), 2.5 ml of mixed sex normal rabbit serum i.v. (Control M) or 2.5 ml of mated doe serum (MDS)/doe i.v. (Treatment M).

A peak in systemic LH concentrations occurred earlier in Treatment M compared with Treatment G does (71 *vs.* 107 min post-AI, respectively; $P<0.05$); mean LH concentrations did not vary ($P>0.05$) from the pre-AI values in both control groups. Serum LH concentrations remained higher ($P<0.05$) in Treatment M compared with Treatment G does from 30 to 90 min post-AI but they were greater ($P<0.05$) in Treatment G than in Treatment M group at 120 and 160 min after AI. Gonadorelin and MDS injections both resulted in the same kindling rate of 80% at each of the four consecutive AI's (last three AI's starting 30 days *post-partum*) and it was significantly greater than that recorded in control animals (20%).

It can be concluded that MDS administration is an effective treatment to induce ovulations in rabbits, with the repeatability like that achieved with a GnRH analogue. We demonstrated that a relatively simple, drug-free, and inexpensive method could be used by rabbit breeders to induce ovulations after artificial insemination using the serum of pregnant rabbits. This novel approach can significantly reduce production costs and help provide lower-cost protein for the world's growing population.

Key words: rabbit, neurohormonal reflex, induced ovulatory, GnRH, mated doe serum

Effect of *Avena sativa* extract on antioxidant activity of liver in geese during physiological stress

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The use of antioxidants in poultry feeding helps to eliminate the harmful effects of negative factors of various etiologies. The presence of a complex of biologically active compounds with a wide range of biochemical action of avenantramides has been established in the composition of Avéna Sativa oats. The antioxidant activity (AOA) of these compounds is 10–30 times higher than that of known bioflavonoids. The aim of the study was to determine the effect of oat extract on AOA and fatty acid composition of lipid of liver of geese, the dynamics of live weight of this bird and pterylographic parameters during the physiological stress of contour and juvenile feather formation.

The study was performed on geese of the Danish breed Legart. At the age of 14 days on the principle of analogues was formed control and experimental groups of 26 geese. Throughout the experiment, the birds of the control group were kept on a standard diet, to the diet of goslings of the experimental group from the 14th to the 49th day was added oat extract. Determination of AOA and fatty acid composition (FAC) of liver of goslings was carried out in physiologically reasonable terms: 14th day — completion of postnatal adaptation, 28th and 49th — formation of contour and juvenile feathers, respectively, 56th — presence of formed plumage, stabilization of prooxidant-antioxidant balance. The state of the antioxidant defense system (AOS) was determined by the content of end products of lipoperoxidation, and the activity of antioxidant (AO) enzymes superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPO). The coefficient of AOA (K_{AOA}) was used as an integral indicator of the state of the AOS. The FAC of lipids was determined by gas-liquid chromatography. Statistical processing of the results was performed using the software package *Microsoft Office Excel 2013* and *SPSS v.13* with Student's *t*-test.

It was found that the addition of oat extract to the diet of geese during the formation of feathers significantly increases the AOA of their liver. The physiological stress of contour feather formation in the geese of the experimental group is significantly reduced by reduction the total content of unsaturated fatty acids (UFA) by 2.66 times, while the CAT- and GPO-activity of the liver of 28-day-old goslings of the control and experimental groups did not differ significantly and SOD-activity of the experimental group by 23.5% ($P \leq 0.05$) was lower than the control. Against the background of the formation of juvenile feathers in 49-day-old goslings, the alignment of the FAC of the liver lipids of the control and experimental groups was observed. At the same time, an increase in SOD and GPO activity (at 29.6%, $P \leq 0.05$ and 41.3%, $P \leq 0.01$, respectively) in the liver of geese of the experimental group was found. In addition, in the liver tissues of geese of the experimental group there is an increase in the level of consistency of the dynamics of the studied indicators. Under the action of oat extract, the weight of geese increased at the end of the experiment (by 19.8%, $P \leq 0.05$) and their pterylographic parameters improved.

Thus, under the influence of oat extract, the physiological stress of formation of contour feather is significantly reduced by reducing the content of UFA. The increase of AOA during the formation of juvenile feathers was due to the activation of AO enzymes. Under the action of oat extract AOA of goose liver is also enhanced by increasing of the balance of dynamics of AOS indicators.

Key words: geese, oat extract, antioxidant activity, fatty acid composition

Modern research methods for the study of conditional reflex activity in horses

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The nervous system ensures the existence of the organism by regulating all physiological processes, in particular, the behavior of individual in the environment and its adaptation to changing environmental conditions. The cerebral cortex and adjacent subcortical structures are the structural basis of higher nervous activity, which is responsible for behavior, the formation of reflexes, motivation, emotions, etc.

One of the most important useful traits of horses is their temperament, which undoubtedly depends on the type of nervous activity and the vegetative status of the animals. Experts believe that the main guarantee in animal training is a strong, balanced, mobile type of the nervous system. These animals are highly stress-resistant, it is easy to develop the desired reflexes in them.

Today, there are a number of methods for determining the typological characteristics of the nervous system in farm animals. The scientific school of Professor V. I. Karpovsky developed express methods for determining the type of HNA in cows, pigs, birds. However, the existing methods for studying the conditioned reflex activity of horses are cumbersome to perform and require a lot of time, and human resources. Promising in this aspect is the method of M. P. Petrushka, however, the method allows to define only the strength of the nervous system in horses, that is insufficient to determine their temperament.

Foreign scientists do not use Pavlovian conditioned approach when determining the temperament of horses. Karin Olsson (2007) points out that in the study of behavioral responses in horses today, scientists use inconsistent terminology, mostly not having a clear meaning, which makes it difficult to compare studies.

More often than not, Western scientists use behavioral tests, observer ratings, physiological measures, or a combination of these to study temperament of horses. In this case, the main attention of researchers is directed to emotional reactivity, reactions to people, and learning ability or physical fitness. To assess for these characteristics, tests such as outdoor or arena tests, processing tests, and learning tasks have been developed. However, the disadvantage of these tests is poorly defined terminology, which makes it difficult to compare studies and their results. Temperamental characteristics should be measured in numbers or through well-defined terms, in particular those suggested by I. P. Pavlov. We need to know not only the strength of the nervous processes in animals, but also other characteristics of their nervous system, in particular balance and mobility. Thus, for example, different riding disciplines may not require different temperamental characteristics in a horse.

The study of the literature undertaken indicates the need for additional research on temperament of horses, since there is a lack of knowledge in this field, which is very important and interesting for everyone who works with these animals.

Prospects for our further research are in the development of new modern methods for studying the conditioned reflex activity of horses based on I. P. Pavlov's teaching.

Methodology of risk assessment of possible contamination by mycotoxins in milk and dairy products

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Level of micromycetes infestation of productive livestock feed is a key point in the detection of mycotoxins in milk and dairy products. Detection of certain micromycetes is not always accompanied by showing of mycotoxin presence in a test sample. Micromycetes need appropriate conditions for the synthesis of mycotoxins. In lactating cows, the reticulorumen ecosystem ensures the utilization of the vast majority of mycotoxins that come with feed, and only a small amount is excreted with milk. Some mycotoxins can bind to milk caseins, in which case raw milk products may contain much higher amounts of them than in the initial stage of milk production [Parfeniuk A., 2016].

The aim of this study was to summarize current data on possible contamination of milk and dairy products by mycotoxins, to investigate their spreading and to propose a new methodology for risk assessment of possible contamination in milk and dairy products.

According to recent studies the metabolite M1 is definitely dominant among a wide range of mycotoxins that occur in milk and dairy products [Barreto F. et al., 2019]. There are more than 400 different mycotoxins produced by micromycetes. Despite the fact that there are many mycotoxins, most of them are not described at all. However, mycotoxins that affect the human body, productive animals, and agricultural plants have been emphasized, studied, and systematized quite deeply. There are about 20 types of aflatoxins in nature, however, four of them — aflatoxins B1, B2, G1, and G2 — pose a special danger to humans and animals [Prandini A. Et al., 2009]. There is an urgent need to develop a methodology for assessing the risks of mycotoxic contamination in milk and dairy products.

According to recent studies from a wide range of mycotoxins that may be present in milk and dairy products, the metabolite M1 is definitely dominant [Barreto F. et al., 2019]. There are more than 400 different mycotoxins produced by micromycetes. Despite the fact that there are many mycotoxins, most of them are not described at all. However, mycotoxins that affect the human body, productive animals and agricultural plants have been isolated, studied and systematized quite deeply. There are about 20 types of aflatoxins in nature, however, four of them — aflatoxins B1, B2, G1 and G2 — pose a special danger to humans and animals [Prandini A. Et al., 2009]. There is an urgent need to develop a methodology for assessing the risks of mycotoxins in milk and dairy products.

It is recommended to assess the risks to health, the environment and doing business in the event of a threat of mycotoxicosis due to the consumption of dairy products of dubious quality in four stages.

Stage I — the identification of the producer of mycotoxin, molecules, metabolites in feed, milk and dairy products. This stage involves laboratory testing of samples of feed, milk and dairy products, biological material, history.

Stage II — construction of a sequence diagram. Step-by-step examination of production, study of the main ways and periods of receipt of mycotoxins, establishment and description of symptoms of defeat.

Stage III — assessment of the likely impact of the intensity and duration of mycotoxin and its metabolites on the body, ecosystem (biochemical analysis, pathophysiological and clinical manifestations, toxicodynamics, toxicokinetics). Biomonitoring strategies are considered.

Stage IV — interpretation of research results and decision-making regarding the magnitude of risks and their correction. Risk assessment (for the human body, ecosystem, dairy production and food security of the state). Identification of measures to eliminate risks or minimize them. Corrective action should be proportionate to the projected consequences and ensure that the risk management system is adequate and appropriate.

Thus, the technology of milk and dairy production should be constantly tested at certain critical points for possible contamination of the product. Timely detection of mycotoxins in some key points of dairy production and baby food makes its further technological use impossible and prevents the occurrence of mycotoxicosis in consumers. The technology should be provided with standardized scientifically based measures to ensure control of the level of mycotoxins in raw materials and prevent their entry into baby food and dairy products.

Key words: milk, dairy products, mycotoxins

Slaughter value and meat quality of young bulls of three genotypes fed a semi-intensive system involving flax extrudate

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Several studies have been conducted on diet supplementation with oilseeds to produce beef with enhanced levels of components with potential health benefits. Particularly, the effects of flaxseed supplementation on the fatty acid profiles of meat are well known whereas scarce data are available on how the inclusion of flaxseed in the diet could affect on the slaughter value and meat quality of different breeds of cattle. The use of raw flax seeds in human and animal nutrition is limited by the presence of anti-nutritional substances. Hence, the use of the extrusion process in the processing of flax seeds allows limiting the content of anti-nutritional substances while maintaining their optimal nutritional value.

The aim of the study was to assess the slaughter value and meat quality of Limousine (LM), Polish Holstein-Friesian (HO) and commercial crossbreed (CC) bulls fed with a semi-intensive system with the addition of flax extrudate. The bulls were fed with TMR (alfalfa silage, meadow hay, grain meal) enriched in the last 4 months before slaughter with the addition of flax, in the form of an extrudate in the amount of 8% of the dry weight of the diet.

During the control fattening of bulls between 8 and 23 months of age, the weight gain was monitored, and after slaughter, the dressing percentage and the EUROP classification. Nutritional values (water, protein, fat, ash and heme iron content, calorific value) and physicochemical properties (pH, colour, water holding capacity, TBARS and shear force) were determined in *longissimus lumborum* (LL) and *semitendinosus* (SM) muscles.

LM bulls had the highest warm carcass weight (373.7 kg) as well as dressing percentage (58%), and significant differences ($P<0.05$) were confirmed in comparison with HO bulls (317.8 kg and 53.6%, respectively). CC bulls had the highest daily gains (794.3 g) and body weight (645.9 kg), and the differences in relation to HO bulls were confirmed at $P<0.05$ level. The carcasses of LM and MM bulls were classified in U and R classes, while 83% of HO bulls were classified in the lower quality class, i.e. O. The pH values of the bulls' muscles of all genotypes were at a similar level, and the obtained results indicated the correct course of post-mortem glycolysis without DFD syndromes. The muscles of the LM and MM bulls contained significantly more protein and less fat compared to HO. On the other hand, the muscles of the HO bulls were characterized by the highest lightness (L*; $P<0.05$). The shear force showed a more favorable tenderness of the SM muscle compared to the LL muscle in bulls of all genotypes (average 57 N *vs*. 102 N).

Key words: meat quality, cattle breed, flaxseed

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Investigation into the biological effects of chlorpyrifos chronic intoxication using zebrafish embryos

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Chlorpyrifos (CPF) is an organophosphorothionate insecticide with the chemical name O,O-diethyl-O-(3,5,6-trichloro-2-pyridinyl) used in agricultural and domestic settings for control of pests and mosquitos. The widespread use of CPF worldwide in past decades has resulted in water contamination by this chemical. CPF is difficult to dissolve in water (1.4 mg/L at 25°C), but at the same time, tracking had detected CPF exceeding allowable levels in seawater, rivers, groundwater, and even rainwater in different countries. CPF can affect non-target organisms. In the body CPF interacts with cholinesterase (AChE) — a key enzyme pathway responsible for terminating transmission of many neuronal cell types across synapses, inhibiting its activity. CPF is known to cause behavioural, neurological, oxidative, histopathological, endocrine and other effects even at low doses.

The aim of this study was to investigate the toxic effects of CPF on zebrafish early life stages using their embryos.

D. rerio fish were kept under automatic support of standard conditions (lighting, aeration, heating and water filtration) in 20 l glass aquariums. Physico-chemical parameters of aquarium water were maintained in the following range of values: temperature (t) +26…+28°C, pH –7. *D. rerio* fish weighing 0.2 g ± 20%, aged 60 days were used for the research. Experimental and control groups, 30 individuals each were formed. These fish were placed in aquariums with a volume of 5 liters for a period of 360 hours (chronic intoxication). CPF at the concentration of 0.5 mg/L was added to the water of the experimental group. After intoxication, the fish were returned to normal conditions under which the fish were kept until their puberty (age from 100 days). When the fish reached sexual maturity, they were placed in chambers to obtain caviar. From the resulting caviar the control and experimental groups were formed. In the control group was caviar from females that have not suffered poisoning CPF. The experimental group consists of caviar obtained from females that were incubated with CPF. Immediately after fertilization, the larvae were transferred to Petri dishes with water for observation and morphometric measurements using a binocular microscope. During the day every 3 hours from the moment of fertilization the state of development of the larvae was photographed.

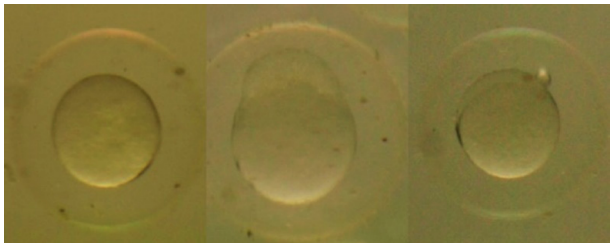

Fig. 1. *D. rerio* embryos development (experimental group)

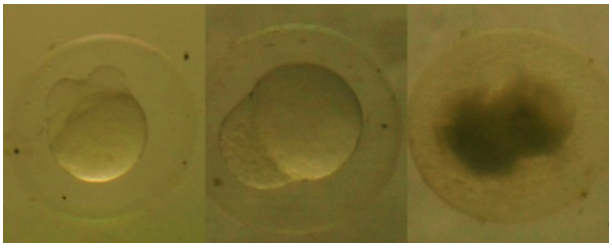

Fig. 2. *D. rerio* embryos development (control group)

It was found that the caviar in the control group after 24 h after fertilization develops normally (the beginnings of tissues and organs are distinguished, the chord is clearly visible). In contrast, we observed the delay of the experimental group's embryos development. In particular, epiboly in the experimental group started 10 hours later than in the control group of fish. Thus, zebrafish embryos can be successfully used for toxicological studies of CPF.

Key words: chlorpyrifos, *Danio rerio*, intoxication, embryo, caviar, larvae

Ecological problems of modern poultry farming

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According to FAOSTAT in 2018, world meat production was pork (35%), chicken (33%), veal (20%) and other types of meat (12%). 342 million tons of chicken meat were produced in 2018, 47% more than in 2000. The leaders in terms of poultry production in 2019 were the United States (23 million tons), China (20 million tons), Brazil (16 million tons), which account for 43% of world production.

The environmental impact of poultry production depends on numerous factors, among which are farm size, production system, diet composition, type of bedding used, etc. It is well known that, if properly managed, waste generated in the poultry production, especially manure and litter, could be a valuable resource, i.e. it could be used as fertilizer, soil conditioner, animal feed, or energy source. However, thanks to the large amount of waste generated (which exceed crop fertiliser requirements), content of harmful elements (such as heavy metals, pesticide residues, pathogens, pharmaceuticals, etc.), and/or unwisely management, poultry waste is often polluter instead of the valuable resource. Thus, producers have to search for environmentally sound ways of waste disposal, which inevitably affects their income.

From an ecological viewpoint, organic waste offer some advantages if compared to mineral fertilizers. In addition to nutrient supply, they improve soil structure, control erosion, and improve water-holding capacity. However, there are also some disadvantages, as unpleasant odors, high content of inorganic phosphorus, which exceeds the needs of plants, release of volatile and reactive organic compounds into the air, etc. The alternative use of poultry waste, as animal feed or as a source of energy, is rather limited due to contaminants and high moisture content. Farmers have to be aware of all these advantages and disadvantages in order to be able to find and adopt acceptable and sustainable solutions.

Some environmentalists often treat poultry less environmental-friendly than other livestock productions, mainly because of the fact that birds nutritional needs should be met exclusively by crops produced on arable land (since they cannot, unlike ruminants, digest cellulose and use less productive land). In the course of life of one chicken 150-200 g of are manure formed per day, to it is necessary to add the polluted litter, incubation waste and a dead bird. However, the poultry production (both meat and eggs) is more environmentally efficient than other meat productions. This is due, among other factors, very efficient feed conversation, high daily weight gain, and lower emission of enteric methane. In addition, the production of one kilogram of beef emits 45 times more greenhouse gases than the production of one kilogram of chicken meat.

Poultry wastewater causes great damage to water bodies. During the operation of a typical poultry farm for 400 thousand laying hens, more than 35 million liters of wastewater are generated per year. The main problem is insufficient treatment of polluted effluents, which, entering rivers and groundwater, contaminate them with toxic substances and pathogenic microorganisms.

Poultry farms are a powerful source of air emissions 1 m^3 of polluted emissions contains 3-20 mg of ammonia, 1–3 mg of hydrogen sulfide, 0.10–0.30% of carbon dioxide, 3–5 mg of dust, 70–900 thousand microbial bodies. Poultry complexes are powerful water consumers. About 3 billion m^3 of untreated water is discharged into surface water every year. According to the WHO, manure and wastewater from poultry farms may be real factors in the transmission of more than 100 pathogens of infectious and invasive diseases.

Poultry production adversely affects the environment in numerous ways — through poor management of manure and litter, waste streams from processing plants (blood, bones, feathers, etc.), birds' carcasses, dust, insects, odor, etc. Furthermore, intensive poultry production is held responsible for the emission of greenhouse gasses, acidification, and eutrophication.

Key words: poultry farming, environmental, pollution, waste

Zinc content in the hay of the cattle ration in farms of different biogeochemical provinces of Ukraine

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Mineral nutrition and the provision of animals with microelements in Ukraine should necessarily be associated with the presence of different climatic and geological zones of the country with diverse supply of mineral elements. Green feed of some biogeochemical provinces is insufficiently provided with certain mineral elements, which can cause microelementosis in animals. On the other hand, an excess of microelements in animal diets and their low assimilation capacity in the body from sulfates, chlorides and other inorganic compounds leads to environmental pollution with heavy metals. Therefore, in order to organize adequate nutrition for animals, it is necessary to establish the actual content of trace elements in feed, identify their deficiency and, on this basis, introduce them into rations.

Hay samples were taken for research from different biogeochemical provinces — Transcarpathian lowland, Transcarpathian foothills, Transcarpathian mountain, northeastern mountain, northeastern foothills, forest-steppe lowland and Polissian, which are located in Transcarpathian, Ivano-Frankivsk, Lviv, Volyn, Khmelnytsky, Vinnytsia, Rivne regions. Samples were taken in small portions over the entire surface of the shed, not less than 10 places, starting from a height of 0.5–1 m. The weighed samples were burned, and the zinc content was determined in the resulting inorganic residue using atomic absorption spectrophotometer C-115 PC (Ukraine).

The findings showed that zinc content in the selected hay samples of the studied zones is distributed unevenly. The highest zinc content in the studied hay samples was found on the farm of Gorokhiv district of Volyn region — 72.08 mg/kg of dry feed weight, and Dubrovytsia district of Rivne region, located in Polissya biogeochemical province. These data indicate that the concentration of zinc in the hay samples from these farms exceeds the norm, which is 40 mg/kg of dry feed weight. However, in other hay samples from Polissya province, the zinc content was almost 40 times lower, which does not meet the need of cows for this element. The lowest concentration of zinc was found in the hay samples from Ternopil district of Ternopil region — 1.51 mg/kg of dry feed weight, and Vinnytsia district of Vinnytsia region — 1.65 mg/kg of dry feed weight, located in the forest-steppe lowland and Polissya biogeochemical provinces, respectively. These data indicate that the hay of these farms does not fully provide animals with zinc.

Within one biogeochemical province, the concentration of zinc in the studied hay samples may differ significantly. In particular, if we compare the concentration of zinc in a single biogeochemical province, its content ranges from 1.51 mg/kg of dry weight in Ternopil district of Ternopil region to 10.98 mg/kg ($P<0.001$) in Gorodok district of Lviv region, which are located in the forest-steppe lowland province. A similar situation, but even more pronounced, was observed in Polissya biogeochemical province.

Therefore, in most of the studied hay samples, the concentration of zinc only partially provides the animals with this trace element.

Key words: hay, zinc, biogeochemical province, cattle

The role of chromosomal variability in the formation of the genetic structure of farm animals

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Chromosome aberrations, or abnormalities, play a significant role in the formation of hereditary anomalies in animals, impaired fertility, evolutionary process and speciation. The mechanism of chromosomal rearrangements has long been unknown and chromosome aberrations have been considered irregular. It is now established that the main source of chromosome rearrangements is the recombination mechanism. The aim of the work is to study the chromosomal variability of certain species of farm animals of the family *Bovidae* and its role in the formation of their genetic structure.

The mammal family *Bovidae*, which includes most species of farm and domestic animals, is of considerable interest in studying the patterns of chromosomal evolution, the level of species chromosomal polymorphism and the factors that cause its formation. This primarily applies to such multichromosomal, difficult for cytogenetic analysis species of animals of the family *Bovidae* as cattle and sheep, as well as wild domesticated species of fauna, in particular river buffalo, which is bred in Ukraine. The evolutionary factor that provides karyotype divergence is the evolutionary potential of intraspecific chromosomal variability in the form of chromosomal rearrangements. Comparison of chromosomes of different species of the *Bovidae* family makes it possible to estimate the number of chromosomal rearrangements in each evolutionary branch. Representatives of *Bos taurus* have preserved the structure of the karyotype, similar in structure to the karyotype of the ancestor of mammals. The karyotypes of *Ovis aries* and *Bubalus bubalis* underwent a "catastrophic evolution" that led to numerous breaks and fusions of ancestral chromosomes.

In the evolution of most mammalian taxa, there was virtually no redistribution of genetic material between large conserved areas that have survived completely. However, it became clear that almost every taxon is characterized by certain conservative areas and specific rearrangements between and within these areas. That is, among the known conservative areas, associations 1/3, 2/8, 5/11 in sheep and 1/25, 2/23, 8/19, 5/28, 16/29 in buffaloes are noted — it is obvious that the distribution of these areas occurred during the formation of these species. In turn, the emergence of new associations is marked by the genomes of a particular taxon species, and these chromosomes are most often involved in aberrations.

Changes in the structure of chromosomes are usually based on primary violations of its integrity — breaks, which, in turn, cause a change in gene localization, accompanied by a change in the genetic program. From the data obtained, we can conclude that individual chromosomes are most prone to breaks and the formation of translocations and we can expect some specificity of the participation of individual chromosomes in chromosomal aberrations of animals.

From the literature it is known about the significant contribution of chromosomal abnormalities in animal pathology, in particular multiple malformations and/or microanomalies of development, infertility, reproductive losses, developmental disorders and a number of hereditary diseases. It is known that as a result of chromosomal rearrangements, new systems of genotypes are created, which contributes to the manifestation of latent genetic variability and the accumulation of genetic reserves in the population. Thus, duplications and breaks in chromosomes provide material for the creation of new genes in the process of natural selection, inversion and translocation contribute to the genetic isolation of new forms in the process of their divergence. In the case of a viable form, homozygous for translocation, it is possible to adapt its carrier to certain conditions of existence and its reproduction.

The analysis of karyotype status of animals with different levels of milk productivity and reproductive function in cattle was carried out. Reproductive disorders in cows and sheep have been linked to chromosome aberrations. A unique chromosomal rearrangement in the form of a Robertson-type translocation involving chromosomes from the 13th and 23rd pairs was found in cows of the Ukrainian red-spotted dairy breed. This anomaly, obviously formed *de novo* and is neutral, it is advisable to use it as an element of the gene pool, maintaining it with the original frequency. The study of the Ukrainian buffalo population revealed a number of chromosomal aberrations, in particular in the chromosome set of a breeding buffalo with normal phenotype and fertility of partial monosomy due to terminal deletion of a chromosome from the second pair (2p-), and in one female — chromosome duplication from the second pair and chromosome in the third pair.

The results of research indicate the need for a detailed analysis of karyotype variability in farm animals, which is the basis for the formation of new knowledge to assess the genetic structure of farm animal breeds, in order to preserve their genetic diversity and establish evolutionary links between them, as well as additional information for practical selection.

Key words: cytogenetic studies, chromosome aberrations, cattle, sheep, buffaloes

The effect of monogens on the body of carp fish

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Fisheries play an important role in meeting the food needs of the population. According to the practice of recent years and the results of ichthyoparasitic studies, almost all fish in the fish ponds of Ukraine are affected by pathogens of invasive diseases, including monogenesis. However, it should be noted that studies on the parasitofauna of fish in reservoirs of the Western region of Ukraine and the effects of various drugs on the immune and antioxidant status of their bodies have not been conducted in recent decades. Therefore, the aim of our research was to study the epizootology and pathogenesis of carp fish monogenoidosis in the gardens of fish farms built on warm waters of cooling reservoirs of Burshtyn and Dobrotvirska TPPs.

The research was carried out at *Rybhosp Burshtynsky LLC* of Ivano-Frankivsk and farm Dobrotvirsky Rybzavod of Lviv region on one-year-old grass carps and silver carps infested with dactylogiruses and girodactylus, and scaly carp affected by diplozoons. The research was conducted in two stages. At the first stage of research, epizootic features of carp fish monogenoidosis in experimental gardens, hematological parameters, blood protein composition, intensity of peroxide processes, state of antioxidant and immune systems of non-infested and infested annual carp fish were studied. In the second stage, the therapeutic effect of the drug "Brovermectin-granulate" and the complex of drugs "Brovermectin-granulate" and the immunomodulator "Avesstimtm" on the body of carp fish in monogenoidosis was studied.

Infectious parasites *Dactylogyrus lamellatus* and *Gyrodactylus ctenopharyngodonis* were detected by parasitological examination in one-year-old grass carp, and ectoparasites *Dactylogyrus hypophthalmichtidis* and *Gyrodactylus hypophthalmichtidis* in one-year-old silver carp with ectoparasite *Eudiplozoon nipponicum*. The disease was registered as a mono- and mixed invasion. The largest outbreaks of dactylogrosis and diplozoonosis in the gardens of both fish farms were observed in May (EI — 20–45 and 10–15%, respectively), and gyrodactylosis — in March (EI — 20–25%). The intensity of invasion by the above-mentioned parasites was also the highest in May: dactylogiruses, depending on the farm, — 7.60–10.30, gyrodactylus — 2.25–2.30 and diplozoons — 2.87–3.10 specimens/fish.

It has been found decreased number of red blood cells, hemoglobin and hematocrit and increased number of white blood cells, suppressed humoral nonspecific resistance and protein synthesis function of hepatopancreas in blood of the same age grass carp, silver carp and carp flake affected by monogenea compared to unaffected fish, and this indicated by a reduction in total protein and its fractions in serum, increased intensity of lipid peroxidation and reduced antioxidant enzyme activity of the system. For mixed invasion of the same age grass carp and silver carp these changes were more significant. It is proved that the use of anti-parasitic drug "Brovermectin-granulate" helped normalize metabolic profile of blood and biological balance in the system POL↔AOS. This simultaneous use of the drug with the immunomodulator "Avesstim" showed no better normalizing effect on the sick fish.

The use of the drug "Brovermectin-granulate" in carp fish affected by monogenesis showed good therapeutic efficacy: extensibility, depending on the species of fish and parasites, was in the range of 60–80%, and intensity — in the range of 79.3–90.4%.

Thus, in monogenoid invasion in the body of carp fish was observed inhibition of protein-synthesizing function, inhibition of humoral and cellular links of nonspecific resistance, increased lipid peroxidation products and decreased activity of enzymes of the antioxidant system.

Key words: carp fish, monogenesis, blood, hepatopancreas, "Brovermectin-granulate", "Avesstim"

Influence of genetic factors on productive longevity of dairy cattle

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Radical genetic improvement of populations of domestic dairy breeds is conducted on the gene pool of the best foreign breeds, in particular Holstein. This approach has significantly improved the milk productivity of cows, however, it led to a significant reduction in their productive longevity, and so on. Therefore, it is important for scientists and specialists to study the influence of certain factors on the duration and efficiency of lifelong use of dairy cattle.

In view of the above, the aim of our research was to study the influence of different genetic factors on the productive longevity of Holstein, Ukrainian Black-and-White and Red-and-White dairy breeds.

The research was conducted by the method of retrospective analysis of primary data zootechnical and breeding records in seven farms with Holstein cows, ten farms with Ukrainian Black-and-White dairy breed and in five farms with breeding Ukrainian Red-and-White dairy cows. Samples included animals whose first calving took place no later than 2008 and which left the herd after at least the first lactation lasting at least 240 days.

It has been established that the indicators of the duration and effectiveness of life-long use of the daughters of long-lived Holstein breed were lower not only than their mothers, but also lower than the average

Such Holstein of the herd descendants of Ukrainian Black-and-White, Red-and-White breeds had a little higher indicators of productive longevity, than the average per herd: lifetime yield was higher by 10.4 and 28.9% respectively, and the number of lactations for life — by 6.4 and 22.7% breeders as Rock 373840409, V. M. Dan 5510544, V. Teksel Kin 393522 (Canadian breeding), E. Samb 3035115974 (Hungarian selection), Lord 661288 (German breeding), Valentin 373840175, Matador 373840109 (Russian breeding) improved productive longevity of daughters by some separate features, and also the breeders of Ukrainian Black-and-White, Red-and-White breeds Abrykos 5806 and Khlor 2052.

The best indicators of productive longevity were the following: purebred animals of domestic breeds in comparison with crossbreeds; cows obtained out of the interlinear selection of parent pairs than intra-linear and inbred animals compared to out bred. Mild and close degrees cows differ markedly in terms of productive longevity from the remote and tight degrees.

The nonadditive type of inheritance cows for the first lactation characterized by a longer duration of productive use and higher lifelong yields than the ones with additive inheritance. During selection of cows with “over-domination” and “domination of the mother” and “domination of the father” the forms of yield inheritance should be preferred since these animals were characterized in most cases by the highest rates of duration of productive use and lifetime productivity.

Animals with mothers, fathers, mother of mothers, fathers of mothers, mothers of fathers and fathers of fathers in their breeding record which had positive values of breeding indices, inherited high yields, but the duration of their economic use was low.

Correlation analysis shows that the most theoretically motivated and practically suitable criteria for forecasting of productive indicators of longevity is the yields of mothers for the first lactation (r = –0.194…+0.084) and breeding indices of ancestor by the father line (F, MF and FF) (r = –0.283…+0.096). At the same time, one-factor dispersion analysis has established that the most significant impact on the productive longevity of dairy breeds were made by the origin of the father (η_x^2 = 9.9–29.3 %, P<0.001), conditional pedigree by Holstein breed (η_x^2= 5.8–34.3 %, P<0.001) and linear affinity (η_x^2 = 4.6–19.8 %, P<0.001).

Thus, the most appropriate criteria for predicting productive longevity of dairy cattle among the genetic factors are the yields of mothers for the first lactation and selection indices of ancestral ancestors (F, MF and FF), and the most significant impact on the duration and effectiveness of lifelong use of cows was the origin of the father of the father, conditional pedigree by Holstein breed and linear affinity.

Key words: breed, cows, productive longevity, genetic factors, power of influence

Economically useful features of cows of different production types of Simmental breed

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It is known that Simmental breed has three main production types: dairy, dairy-meat and meat-dairy. Some authors report also about the meat production type. Animals of each of these types are characterized by various economically useful features, but there are not enough data on them. Fragmentary data on the formation of productive qualities of different animals of production types do not give a complete picture of the desired type of cows of this breed.

Given the above, the purpose of our research was to examine regularity of growth and development, reproductive capacity, formation of dairy and meat productivity, exterior and constitutional features of animals of different production types of Simmental breed.

Studies have been conducted on adult cows and young Simmental breed in Farm *Litynske Ltd.* of Drohobych district of Lviv region using breeding and zootechnical accounting materials and own results of research. Three groups of adult cows were formed for experiments (third lactation) and three groups of bulls and heifers 18 months of age: I group — dairy production type, II group — dairy-meat production type and III group — meat-dairy production type.

It was found that the animals of the studied production types of Simmental breed in the breeding period exceeded the standard of breed. The lowest indicators of live weight, multiplicity of increase in live weight and average daily yield were characterized by dairy animals, and the highest — by meat-dairy. Quite high and reliable ($P<0.001$) influence of production type on live weight of heifers at the age of 6, 12 and 18 months (33.4–36.9%) allows to draw a conclusion about expediency of selection of animals starting from 6 months of age.

Dairy animals were taller and had a longer oblique body length and, as a result, higher values of the indices of long-leggedness, lengthiness and sex index, which is characteristic of dairy cattle. And meat-dairy cows were characterized by deeper and wider breasts, greater shoulder girth, wider hips, and thicker skeleton. Dairy-meat animals took an intermediate place in terms of exterior indicators. The strength of the influence of the production type of animals on the body measurements of cows was in the range of 3.1–41.4%.

The controlled breeding stock was characterized by good reproductive capacity, with the best indicators of reproductive capacity of animals of meat and dairy production type, and the worst — of dairy type.

The yields of cows during the first or third lactation ranged from 4405 to 4959 kg, the fat content in milk — from 3.72 to 3.80% and the amount of milk fat — from 164.1 to 188.3 kg. The highest milk yields (5039–5401 kg) and the amount of milk fat (190.2–204.8 kg) were observed in dairy animals, and the lowest — in the same age cows of meat-dairy production type (3431–3731 and 126.4–141.5 kg respectively).

It was found the dependence of milk productivity of cows on their origin by father and country of its selection. The highest milk yields and the amount of milk fat were observed in animals that came from sires of Austrian selection. The degree of influence of paternal heredity on the phenotypic variability of traits of milk productivity of daughters was 13.9–39.3%, sires breeding countries — 3.1–14.5% and production type — 19.9–71.9%. At the same time, the influence of the father's heredity on the formation of the production type of daughters was 26.2%, and the countries of its selection — 8.2% with $P<0.001$ in both cases.

Lactation curves of cows of the studied production types were quite stable. The highest average monthly milk yields were observed from the second to the fifth month of lactation, and the biggest were mostly in the third month. Animals of dairy production type in comparison with the same age cows of dairy-meat and meat-dairy types were characterized by higher average monthly milkings, more stable lactation curves and higher values of indices of lactation activity calculated by various methods. Among the animals of the studied production types, animals with a highly sustainable form of the lactation curve had the highest milk yields.

The chemical and mineral composition of milk depended on the lactation period and the production type of animals. In particular, in animals of all groups the content in milk of dry matter, fat and dry skim solids was significantly ($P<0.05–0.001$) higher at the end of the lactation period, and in cows of meat and dairy production type was higher compared to individuals dairy and dairy-meat types. The content of protein, lactose and ash in milk did not show any pattern, and the content of calcium and phosphorus was highest at 5–6 months of lactation and in dairy cows compared to animals of other groups. The influence of the production type of animals on the chemical and mineral composition of milk, depending on the component, was 1.6–43.3%, and the lactation period — 9.8–32.9%.

It has been found that bulls and heifers of meat and dairy production type were the best in terms of slaughter qualities. Their pre-slaughter weight was 493.0 and 403.3 kg, respectively, and the slaughter yield was 55.2 and 55.7%. These animals were characterized by higher weight and percentage of first-grade cuts, as well as higher protein and fat content in muscle tissue.

Thus, animals of different production types of Simmental breed differed between themselves on breeding grounds. Dairy animals were taller and had a longer oblique body length, and cows of meat and dairy type were characterized by deeper and wider breasts, larger girth of the chest behind the shoulders and the width of bones in the groats area. They had the best reproductive ability and lethal qualities meat-and-dairy animals, and the worst — dairy, instead the first were noted the lowest milk yields, and the second — the highest.

Key words: Simmental breed, production type, cows, economically useful traits, strength of influence

Peculiarities of the molting process in crawfish of different species

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As all crustaceans, crawfish have external exoskeleton (shells) that limit their growth. Therefore, they have to change their shell to a new one to increase in size. It may seem like a simple process, but it's not. Molting is the most stressful and important period in the life of crawfish. This is the time when they are the most vulnerable and exposed to death. Molting depends on the environment and is controlled by the endocrine system, which is located near the eyes of crawfish (movable stem). This process consists of 4 stages: proecdysis (premolt stage); ecdysis (molting process); metecdysis (postmolt stage) and anecdysis (intermolt period).

Taking the above into account, the research aim was to learn the molting process of *Cherax quadricarinatus* so called Red Claw crayfish and *Astacus astacus*.

The research was conducted in the laboratory of aquaculture of Polissya National University. 20 mature adults of different species were selected to determine the period of molting and liveweight gain of crawfish. They were kept in separate containers with a capacity of 150 liters each.

Annual spawning and molting cycles of crawfish have been studied in the laboratory for 365 days. Mature adults were kept in separate tanks, each containing four females and one male adult at a temperature of 25–27°C.

On average, female *Astacus astacus* spawn three times and molted twice a year, and *Cherax quadricarinatus* did three times. The predominant number of molts of the first type took place in June and September, and of the second one was in January as well.

The molting of crawfish begins with the preparatory stage — proecdysis (preparatory stage before the next molting). At this stage, crawfish intensively absorb calcium from feed and the environment and reabsorb calcium from the old shell.

There was a liveweight decrease of crawfish at the stage of molting due to the discharge of the old shell. For the molting process, crawfish accumulate a large amount of water in their body, which enters the body both through the gills and when absorbed from the outside. The weight of the discharged shell of *Astacus astacus* was: the first molt — 3.81, the second one — 4.16 g, *Cherax quadricarinatus*: the first molt — 4.70; the second one — 5.16, the third one — 5.50 g. The average duration of the ecdysis period was 2.4 hours for the first type of crawfish and 1.9 hours for the second one.

During the metecdysis period, crawfish begin to produce the chitin synthesis enzyme, which is important for creating and strengthening a new exoskeleton. In addition, the calcium released from gastrolith provides calcification of such important parts of the body as the mouth and limbs.

Liveweight of *Astacus astacus* at the beginning of metecdysis was: 43.86 g during the first molt, 47.86 g during the second one, talking about the liveweight of *Cherax quadricarinatus* was 47.51 g during the first molt, 57.89 during the second one and 61.34 during the third one. The first type of crawfish had 3.4 days duration of this period whilst the second one had 3.2 days.

The anecdysis period for *Astacus astacus* was 87.8 between the first and the second molts; 278.4 days between the second and third ones, for *Cherax quadricarinatus* it was 111.6 between the first and second molts, 116.7 between the second and third ones and 145.8 days between the third and the fourth one.

It is worthwhile to say that crawfish molting occurred mainly before the breeding season. At the same time, a certain sequence between spawning and molting was observed. The most common sequence was spawning-molting-spawning as well as spawning-spawning-molting. Transitional spawning extended the time interval between molts but did not significantly affect the molt period. Liveweight during the an ecdysis was positively correlated with the size of the females while did it negatively immediately after the molting.

Summing up what has been said, *Astacus astacus* had longer period between the second and the third molts than *Cherax quadricarinatus*, which resulted in fewer molts per year.

Key words: *Cherax quadricarinatus*, *Astacus astacus*, molting, spawning liveweight

Biological effects of different doses of citrate I, Se, S in broiler chickens in the presence and absence of coccidiostats in feed

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Compounds I, Se, S are important in broiler poultry farming, which significantly affect the vital functions of the organism and its resistance. Stimulating effect on egg productivity of both mineral and organic compounds iodine introduced into the diet of chickens, as well as on the safety of broiler chickens, their growth and meat quality is noted. However, the effect of these compounds in different doses on the growth and development of the organism and its physiological status in the presence of coccidiostats in the diet has not been studied. Therefore, the aim of the study was to elucidate the biological effects of different doses of I, Se, S citrate obtained by nanotechnology in broiler chickens and to determine the possibility of alternative use to antibiotics and coccidiostats.

The research was carried out on broiler chickens of cross ROSS-308, being formed from cockerels and chickens in the control (C) and 5 experimental (E I– E V) groups, 10 in each. Feeding of chickens of all groups was carried out by using standard balanced feeds — starter, grower, and finish. Coccidiostat “Kokcisan 12%” (Slovenia) was added to the starter and grower feed at the stages of its manufacture in quantities of 0.5 kg/t of feed. Coccidiostat was not added to the final feed. To the drinking water of chickens of experimental groups were added different amounts of the citrate solution of I (200 mg/L), Se (50 mg/L), S (300 mg/L) prepared by the nanotechnology method. Chickens of the I group watered the lowest dose of I, Se, S at the rate of 5 µg I/L, 1.25 µg Se/L, 7.5 µg S/L of drinking water, and for poultry of other experimental groups, it was increased in 2 (II), 4 (III), 6 (IV) and 8 (V) times compared to I group. For the chickens of experimental groups, the I, Se, and S citrates were added to drinking water daily for 48 days. Blood was obtained on the 35th and 48th days of the growing season, internal organs — a liver, a heart, a spleen, a stomach, a thymus and a bursa of Fabricius. On the 35th day of the experiment, the increase in the content of cholesterol, triacylglycerols and albumin in the blood of E I, E II and E V chicken groups was established and the reduction of creatinine in E II and E V groups. On the 48th day an increase in the content of cholesterol in the blood of poultry E V as well as urea, albumin, P, Ca — III and E IV groups, general I and T_3 of the experimental chicken groups was observed. Higher rates of liver, thymus and heart mass in the chickens of the E I and E IV groups and their decrease in the E V group were observed, and the liver mass coefficients were in the E II, E IV and E V groups. Adding of I, Se, and S citrates to the fodder of broiler chickens at doses of 5, 10, 20, 30 and 40 µg I/L throughout the period of growing, their biologic influence is different with and without a content of the “Kokcisan 12%”. A more pronounced stimulating effect of a low (5 µg I) dose of I, Se, and S citrates on the growth and development of the chickens’ body during the period of withdrawal of the coccidiostatic from the diet was observed.

Key words: broiler chickens, biological action, citrates of micronutrients

Rabies is a local or global problem?

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Rabies, being a zoonotic viral infectious disease, has been present in humans almost forever, and despite taking further preventive measures, it occurs almost all over the world. It is most common in developing countries, especially Africa and Asia. In those regions where there is usually limited access to healthcare, there is a very high mortality of up to 96%. The first mentions of this disease are found in the Eshnunn Codex dated to the XXIII century BC, but for many years there was no precise diagnosis of the etiology of this disease. It is caused by neurotrophic agents belonging to the genus Lyssavirus, which currently includes 16 classified species. An interesting fact is undoubtedly the fact that bats remain the main host for most *Lyssaviruses*. Rabies virus attacks the central nervous system and the main symptoms are encephalomyelitis. It affects almost all species of warm-blooded animals, including humans, and in the absence of treatment, it most often ends in death.

Until the XIX century, much research was done on rabies. In 1804, Zinke made an experimental transmission of the virus from dog to dog by rubbing saliva from a sick dog into damaged skin. The year 1885 was undoubtedly a breakthrough in terms of limiting the incidence and spread of the rabies virus in humans, when human vaccination was performed for the first time. Since then, enormous progress has been made in both preventive activities and the production of vaccines for animals and humans. Nevertheless, although the species conditions of animals remaining the main reservoir of the virus have changed over time, the epizootic and epidemiological threat is still quite high.

In Europe, in the post-war years, when a number of measures were taken to combat the virus, the epidemiological form of rabies was changing. The common street form, occurring mainly in stray dogs and cats, changed into the so-called a form of forest, found in carnivores, especially free-living foxes. Therefore, at the end of the XX century, due to the wide range of virus occurrence in this group of animals, in many European countries the concept of oral immunization of free-living foxes was developed. The first field research on this issue was carried out in Switzerland in 1978, and another in 1983 in Germany. These actions in many countries have led to a radical reduction in the number of rabies cases. However, this does not mean that the problem has been resolved. Currently, in many European countries rabies does not occur at all or only a few cases are found. In European countries, the number of rabies cases in wild animals has decreased more than 47-fold over the last decade, and in domestic animals the decrease was slightly more than 42-fold. The geographic pattern of the virus distribution has also changed significantly. While in 2010 rabies in wild animals was diagnosed in 25 European countries, after the 10th period it was found only in 5 countries, of which almost 99% of all cases concerned the Russian Federation and Ukraine. In 2010, rabies in pets was diagnosed in 26 European countries, and 10 years later in only 5 countries. As in the case of wild animals, the greatest number of cases, slightly over 95%, occurred in the Russian Federation and Ukraine. Undoubtedly, a very big epizootic problem is the fact that the epidemiological picture of rabies has changed due to its more and more common occurrence in bats. In the last decade, a total of 2,072 rabies cases in this species were diagnosed in Europe, with a clear downward trend. With the change in the epidemiological form, the clinical picture of rabies from bat transmission has also changed, which means that it may be more difficult to diagnose in humans. With the decline in the incidence of rabies in wild animals, the number of cases of the disease in humans has dramatically decreased over the past decade. While in 2010, 74 human cases were diagnosed — most (n=45) in the Russian Federation, in 2019 there was one case in Norway. In 2020, 23 cases of rabies in animals were found in Europe. Nineteen concerned free-living foxes, of which 18 in Poland and one in Romania, and a further three cases were found in bats, all in Germany.

Thus, in Europe, rabies has been successfully eliminated, and although it still should not be underestimated, the risk is much lower than in other regions of the world. Nevertheless, on a global scale, rabies is a serious epidemiological threat, as approximately 60,000 people die annually from it. people. Conducted research and statistics in this regard hail dogs as the main cause of virus transmission. In turn, although vaccines for humans have been available for over a hundred years, limited access to them in some regions of the world (African and Asian countries) causes such high mortality in humans. Thus, rabies is still a serious local problem, however, as indicated by the data from European countries, it is possible to effectively reduce the possibility of the occurrence and transmission of the virus, and thus quite significantly eliminate the epidemiological threat.

Effects of ewe age on oocyte viability and timing of early embryo cleavage

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Reproductive capacity of the female declines dramatically with advancing age. Increasing age is associated with a decrease in both the quantity and quality of oocytes. Therefore, maternal age may adversely affect the development of embryos both *in vivo* and *in vitro*.

Ovaries were collected after slaughter from sixteen Longwool breed ewes aged 8–9 years (I group — "old") and fourteen ewes aged 1.5–3 years (II group — "young") and transported to the laboratory. Cumulus-oocyte complexes were collected from scarified ovaries and *in vitro* maturation was performed in TCM 199 medium supplemented with Earle's Salt, 10% of FBS, and 5 µg/mL of LH/FSH at 38°C for 24 h. After maturation, the oocytes were incubated with thawed, capacitated ram semen for 19 h at 38°C. Following *in vitro* fertilization (IVF), presumptive zygotes were transferred to a 16-well dish containing Cult medium (*Gynemed*) and were cultured and monitored with time-lapse (TL) video imaging for 8 days. Digital images of developing ovine embryos were captured every 10 min by the *Primo Vision TL* system (*Vitrolife*). The following variables were recorded: time from IVF to the attainment of two-cell (t2), three-cells (t3), or four-cell (t4) stage; morula stage (tM); blastulation (tSB); and blastocyst formation (tBL). The duration of the second cell cycle (cc2) and of the complete synchronous cell division (s2) were calculated and developmental anomalies was noted.

A total number of 66 oocytes were obtained and 48 were selected for TL observations after IVF (presumptive zygotes) in I group. Twenty-four zygotes (50.0%) underwent first cleavage division and 5 (10.4%) developed to the blastocyst stage. Sixteen embryos (33.3%) had morphological defects: fragmentation (n=9), direct cleavage (n=7), or asymmetrical cleavage (n=2). In II group, eighty-six oocytes were collected and 64 used for TL observations following IVF. Forty-four zygotes (68.75%) underwent first cleavage division, seventeen (26.6%) developed to the blastocyst stage, and seven embryos (10.9%) had different disorders (fragmentation, n=4; asymmetrical cleavage, n=3). Both the cleavage and blastocyst formation rates were higher ($P<0.05$) for II group but the percentage of embryos with various defects was greater ($P<0.01$) for I group (c^2-test). The average time from IVF to the first cleavage (t2) was 29 h 20 min and 25 h 42 min in I and II groups, respectively ($P=0.02$). The duration of cc2 also differed ($P=0.009$) between the two subsets of embryos studied (4 h 14 min and 11 h 20 min, for I and II groups, respectively).

The present analysis of the morphokinetic data revealed that oocytes collected from "young" donor ewes had greater developmental potential and gave rise to the embryos with fewer aberrations *in vitro* compared with the oocytes obtained from "old" ewes. Moreover, the interval from IVF to the first cleavage and the duration of the second cell cycle were both greater for I group than II group oocytes. The age of the ewe has a significant impact on embryo yields and quality *in vitro*. Sheep *in vitro* embryo production systems and TL imaging provide a useful tool for studying the influence of donor age on embryogenesis in mammalian species.

Key words: oocytes, embryo, time-lapse, ewe age

The state of cellular and humoral immune response in chicken broilers under the influence of the synbiotic preparation in the complex with aqueous solution of iodine and selenium

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In modern poultry industrial farms there are associations of various infectious factors of viral and bacterial nature. They reduce the resistance of the bird's body and the immune response to the introduction of vaccines. Since 2006, in the EU, the World Health Organization is forbidden to use feed antibiotics in poultry farming and livestock. The cultivation of poultry without feed antibiotics forces the use of new means that would suppress the pathogenic and conditional pathogenic microflora, increased the conversion of feed, and also had a positive effect on the immune potential of the poultry. Significant prospects in this direction are opened for the use of probiotics. Synbiotic drugs can be a significant alternative to feed antibiotics and serve as growth stimulants and immunobiological reactivity. The purpose of the work was to find out the influence of the synbiotic drug "Enteronomin" activated by aqueous solution of iodine and selenium, on the state of cellular and humoral immunity of broiler chickens during the period of their cultivation.

The research was carried out in one of the farms of the Lviv region on the chickens-broilers of the cross ROSS-308, starting with 1- to 41-day age. The maintenance of chickens was in poultry houses with free access to feed and water, technological parameters of growing broilers (temperature and light regime) in accordance with the norms of OTP-2005. For studies, 2 groups of chicken broilers were formed: control and experimental groups with 100 individuals in each. The control group of poultry fed standard feed (SC) according to existing norms recommended for the ROSS-308 cross. Chickens-broilers of the experimental group were similarly fed synbiotic drug "Enteronomin" with a dose of 1.0 g per 100. The next set was in 14- and 24-day age (also a dose of 1.0 g per 100/ day, five consecutive days). Before use, the study preparation was activated for 14–16 hours. Water enriched with ions of biologically active iodine and selenium in the form of "Iodis + Se". Together with these broilers of the experimental group, this preparation has flown with water throughout the experiment. For immunological research in chickens took blood at various age periods: 16-, 27-, 34- and 41-day age. The use of chickens in the diet of the synbiotic drug "Enteronomin" in a complex with iodine and selenium led to an increase in the number of T-lymphocytes (general, active and theophylline resistant) and in-lymphocytes in the blood and increased their functional activity by reallocating the receptor apparatus of immunocompetent cells. The positive effect of these immunotropic agents on the indicators of cellular and humoral components of nonspecific resistance of the organism, growth and poultry preservation are stated. As evidenced by higher ($P<0.05–0.01$) lysozymic activity of serum and phagocytic activity of pseudo-reactions in the blood of the experimental chickens in relation to the control group. The optimizing effect of the study preparation on the level of circulating immune complexes in serum is revealed.

Key words: chicken broilers, blood, probiotics, prebiotics, iodine, selenium

Bioperspectives in the treatment and prevention of enterobacteriosis of bees in organic production of beekeeping products

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The animal kingdom has almost 45,000 species of vertebrates and up to 8 million species of invertebrates, among which the main pollinators of ecosystems are bees. The basis of organic beekeeping — obtaining environmentally friendly products. The problem of finding effective organic remedies for the treatment of intestinal infections of bees, which are widespread in apiaries around the world, remains relevant.

The purpose of the work is to search for biomedicines, to develop a scheme for the treatment and prevention of bee enterobacteriosis.

After conducting comprehensive clinical and laboratory studies of unfavorable apiaries of the North-Western region of Ukraine at the at the Department of Veterinary Medicine of Polissya University and at the State Institution "Zhytomyr Regional Laboratory Center of the Ministry of Health of Ukraine" were isolated enterobacteria of the genus *Klebsiella*.

Wellness measures were based on the use of organic drugs — "Enteronormin with Jodis+Se" (LLC "SGP" MBS), "EM® probiotic for bees" ("EMRO Corporation", Japan together with LLC "EM Ukraine"), which include useful microorganisms of different species, and disinfectant "Biocontact-plus" ("Kronos-Agro"). The effectiveness of the applied scheme was determined by statistical processing of the results of a random sample (*Microsoft Excel* and LPG) for 2019–2021 based on the data of beekeeping journals.

Bees were fed diluted with 50% sugar syrup for therapeutic purposes: 0.15% solution of "Biocontact-plus" (300–350 cm^3 of the preparation per 1 family) — 5 treatments every 3–4 days; followed by 2.5–5% solution of "EM® probiotic for bees" (300–400 cm^3 of the preparation per 1 family) — 3–4 treatments every 3–4 days. Thus, the disinfectant "Biocontact-plus" in the indicated concentration has weakly toxic effect, which leads to activation of immune defence of bee organism. Specific microorganisms for bees contained in the "EM® probiotic for bees" modulates the qualitative and quantitative composition of the intestines of the bee.

Prevention application of "Enteronormin with Jodis+Se" at a dose of 20 cm^3 diluted with 200 cm^3 of 50% sugar syrup 3–5 times with an interval of 5 days *per os*. The disinfectant effect of the 1% aqueous solution of "Biocontact-plus" is interpreted by the influence of formaldehyde glutaric, glyoxalenic aldehydes, which cause lysis of bacterial cells, by breaking chemical bonds between components of their cell walls.

During the last three years, the preparations "Enteronormin with Jodis+Se" and "Biocontact-plus" treated more than 70000 bee families. After successful overwintering no clinical signs of dysbiosis have been observed, which confirms the possibility and high efficiency of the use of alternative antibiotic organic means in the treatment of honeybee enterobacteriosis.

Health and preventive measures in organic beekeeping should be aimed at increasing the level of resistance of the bee organism, its rehabilitation, normalization of the qualitative and quantitative composition of the intestinal microflora of insects.

The combined use of drugs of different groups (probiotics and disinfectants) provides a comprehensive impact of their components on different systems of the bee, on mutual synergy, which increases the profitability of apiaries.

Key words: organic beekeeping, prevention, treatment, probiotic, disinfectant

Complex hormonal-vitamin nanosomal preparations of argentum, zinc and copper nanoparticles for effective treatment of cows' endometritis

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Metal nanoparticles use in biology as antibacterial and tissue regeneration agents. They are components of dressings and are used as an effective factor in burns treatment. Silver nanoparticles have a toxic effect on more than 650 species of microorganisms and fungi. Thus, their use in reproductive biotechnology and veterinary practice has considerable interest in the treatment of pathologies of the reproductive system. Silver nanoparticles have low cytotoxicity and general toxicity to mammals compare to the microorganisms, which indicates their safe use in reproductive biotechnology.

Our work aimed to establish the effect of nanoparticles on biological processes for their effective use in reproductive biotechnology. We established the optimal doses of zinc and copper nanoparticles on reproductive cells. The effect of silver, zinc, and copper nanoparticles on the healing of burn wounds in rats was established. The data of the influence of intraperitoneal injections of zinc and copper nanoparticles on metabolic processes and reproductive capacity of rabbits and the toxicological effect of intravaginal administration of silver nanoparticles in rabbits were obtained. The main result of our study is the creation of effective complex hormonal-vitamin nano-preparations for the treatment of cows' purulent endometritis.

We obtained argentum, zinc, and copper nanoparticles with chitosan that have strong bactericidal properties by an improved method. No growth of any bacterial colony on Petri dishes was detected under influence of 10-fold diluted of their stock solutions. Argentum, zinc and copper nanoparticles at a concentration of 0.1 μg/ml showed bactericidal properties to the strains: *Bacillus subtilis* ATCC 31324, *Pseudomonas aeruginosa* ATCC 9027, *Candida albicans* ATCC 885-653, *Escherichia coli* ATCC 25923, *Staphylococcus aureus* ATCC 25922 and *Klebsiella pneumoniae* ATCC 2579. Argentum nanoparticles with chitosan had better antibacterial properties than nanoparticles with polyvinylpyrrolidone and copper nanoparticles were better than zinc nanoparticles. Nanosomal emulsions of nanoparticles have slightly reduced bactericidal properties compared to native nanoparticles due to the smaller contact area of particles with microorganisms. However, the concentration of nanoparticles in nanosomal preparations can successfully inactivate most pathogenic microorganisms in the uterus of cows.

The created complex hormonal-vitamin nano-preparations were tested on cows with endometritis in private farm *Barkom LLC* in Pustomyty district of Lviv region. We used current standard antibiotic shames of treatment as the control. Biochemical and hematological parameters in the dynamics of endometritis treatment were used as indicators of nanomaterials' toxic effects on the cows' bodies. We obtained great efficacy of nano-preparations in the treatment of cows' endometritis. Furthermore, complex hormonal-vitamin nano-preparations lead to effective correction of the reproductive function of animals at the pathology and have a positive effect on reproductive processes repair in comparison with the control (antibiotic treatment).

Therefore, complex hormonal-vitamin nanosomal preparations of argentum, zinc and copper nanoparticles have high efficacy in the treatment of purulent-catarrhal cows' endometritis. The high efficiency and lack of toxic effects make nanosomal preparations promising alternatives agents to antibiotics for the treatment of animal infectious diseases.

Innovative technology in quail egg incubation

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The aim of our research was to find out the possibility of application of helium- neon laser ray in incubation of quail egg, and determine the optimal use of laser ray. For the experiment a laser modified technology with helium-neon system *ЛГН-111*, a continuous mode, monochromatic, coherent red ray; the ray length — **λ** _ 0.63 mmk.

Before incubation, the egg processed with the help of laser ray was re-tested twice. The obtained data of the experiment wasbiometrically processed according to method of Merkurieva. The percentage of fertilization in all five sub-groups was almost the same and it varied between 91.22–92.91%. In the study of incubation, the residues ofthe number of embryos with blood ring in the 1st and 2nd experimental groups was less by 0.85–1.71% than in the 3rd and 4th experimental groups, and less than by 2.04–2.19% than it was in the control group.

Number of dead embryos in the 1st and 2nd experimental groups was 2.25–3.98%, which was less than it was in the 3rd and 4th experimental groups. Also, it was 3.29–4.40% less than in the control group. As for the number of drawn embryos, in the 1st and 2nd experimental groups, it was by 1.50–2.37% less in compare with 3rd and 4th experimental groups, and by 3.26–3.62% less than in the control groups.In the 3rd and 4th experimental groups the residue of incubation is comparatively high, than it is in the 1st and 2nd experimental groups and insignificantly low in compare with control group.

Based the analysis of the obtained data, it becomes evident that the percentage of hatching from laid eggs in the 1st and 2nd experimental groups, which were processed with the help of application of helium-neon laser ray with 2–3 minutes exposition, exceeds by 4.09–7.47% the results of the 3rd and 4th experimental groups. They which were processed accordingly with 5–10 minute exposition (P≥0.99). The percentage of hatching from in the control group is by 7–10% less than in the 1st and 2nd experimental groups (P≥0.999), and 2–3% less than it is in the 3rd and 4th experimental groups. Accordingly, the percentage of hatching from fertilized eggs was 85.13–86.75. This data is 5–7% less in the 3rd and 4th experimental groups, and 10–11% less in the control group (P≥0.99).

The result number of the conditioned chicken in the 1st and 2nd groups was higher by 2.0–2.5 % than in the 3rd and 4th groups and it was higher by 3.0–3.5% in compare with the control group. The repeated experiment proved the results of the 1st experiment results. As it was in the first experiment, the percentage of hatching is higher, 1st and 2nd groups in both cases — when the eggs are laid, and when they are fertilized.

Positive impact on insensitivity of embryo's development was reflected in shortening the time period for incubation in the first experiment. In the 1st and 2nd groups incubation was finished within 402–408 hour interval which is 6 hours less than it was during 3rd and 4th and 5th incubation period in the control groups. Therefore, quail incubation egg helium- neo laser ray with 2–3-minute exposition reduces the number of incubation remnants, improves development of embryo during the whole period. It also reduces the length of incubation, and finally increases the percentage of hatching and the conditioned chicken solution.

Key words: quail, egg, incubation, laser ray, hatching

Therapeutic properties of koumis and prospects of its production in Ukraine

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According to the WHO info, about 8 million people get ill with tuberculosis every year, 3 million of which die. The acute problem of high incidence and mortality of the population requires decisive steps for the prevention of disease prevalence and recovery of humankind. One of the most efficient ways can be the development of dairy horse breeding. Currently, scientists have numerous data from experimental and clinical studies confirming the therapeutic properties of koumis.

The founder of scientifically grounded koumis treatment, Dr. Nestor Postnikov, proved the beneficial effect of koumis on the human body. He defined the main properties of koumis in three words: "nutrit, roborat, etalterat" which means that it "nourishes, strengthens, renews".

Depending on the content of lactic acid, alcohol, and maturation term, koumis can be classified as weak, medium, and strong. It is believed that weak one-day koumis, which contains only 1% alcohol, is not carbonated and foams just a little has the best therapeutic properties. It is important to keep koumis in a glass vessel, in a cool place for no more than five days from the moment of a spill, because it retains its medicinal properties for no more than a week.

Koumis has a strengthening and rejuvenating effect, normalizes metabolism, and influences blood composition in a good way. It also improves heart and blood vessels functioning. It is widely used for the treatment of respiratory diseases, anemia, rickets, scurvy, tuberculosis, it exerts effective influence on neuroses with increased mental and physical tension, stress, and several other diseases. Koumis helps in the treatment of diseases of the digestive system as well. This can be explained by the fact that during fermentation, fats remain unchanged, while protein breaks down into easily digestible products and milk sugar breaks down into lactic acid. Also, koumis contains a huge amount of vitamin C, so it is used to restore gut microbiota in case of dysbiosis. Koumis is often used for stomach diseases treatment. An interesting fact is that if a person with high acidity and a person with low acidity take koumis, then the acidic state of the stomach will normalize in both cases. This product is also used to treat pancreas diseases.

Recent studies have shown the content of vital hormones in koumis and their effect on the body's immune system.

Koumis is also widely used in cosmetology. It has a rejuvenating effect when used for regular face wash or facial masks. Hair masks are also often made of it. Such masks help to prevent hair loss, the hair becomes stronger and shinier afterward. Granulated koumis powder is used in the process of shampoos and soaps manufacturing. Immunostimulating cosmetics are produced for pine mare's milk. Even though koumis is considered to be a traditional drink of the Central and East Asia population, its production is still spreading in European countries, also in Ukraine. We must not forget that the nomads of the Black Sea region mastered the art of making koumis back in the 5th century BC.

Breeding of high-milk mares is very important for the development of koumis production. The selection of mares for milking is carried out by evaluating the animals according to such criteria as body structure, development of the mammary gland and milk veins, health status, age, fertility. Basically, the milk production of mares increases from lactation to lactation and reaches its maximum at the age of 7 to 15 years. The most profitable mares are those that produce more milk per 100 kg of live weight. At the same time, not only the amount of daily milk yield is additionally taken into consideration, but also such factors as the duration of lactation, the milk yield index, and product quality. Selection among stallions is carried out in an even more precise way. During this selection, the productivity of their daughters is taken into account.

In the conditions of stationary koumis farms, when keeping horses only in stables or in stables and on pastures, the best milk productivity was obtained from mares of heavy draft breeds. Studies have shown that it is possible to get a sizable amount of milk from mares of the Lithuanian, Russian, Soviet, Novoolexandrian heavy draft breeds. With intensive milking, mares of the Soviet heavy draft breed are capable of producing up to 25–30 kg per day, and up to 3000–4000 kg of milk during the entire lactation.

The number of mares of the Novoolexandrian breed dominates in Ukrainian koumis farms. Over the years of observation, SOE Dibrovsky Stud Farm no. 62 kept from 27 to 18 milking mares and 7 stallions of this breed. The highest milk yields (12.9 l of average daily milk yield and 1919 l per lactation) were observed in mares of the middle age group (7–11 years), but the milk of higher quality was produced by young mares. Over the years (namely, after approximately 11 years), the quantity and quality of milk tend to decrease.

The largest production of milk and koumis at the level of 6.8 tons was in 2010. In recent years, there has been a steady trend towards a decrease in the production of milk and koumis on the farm for the following reasons: a decrease

in the number of lactating mares, a relatively low selling price of 1 liter of koumis on the consumer market, insufficient promotion and advertising of the therapeutic properties of koumis for children and older people.

The use of mares of the Novoolexandrian Breed breed for the production of koumis requires further study of the qualitative composition of milk, especially considering the importance of fatty acids for increasing the therapeutic and prophylactic effect of koumis.

In Ukraine it is necessary to create its own starter, which would be adapted to the conditions of our state to obtain high-quality koumis. Ukraine must also improve koumis production technology and establish state standards for the assessment of the final product and proper certification. It is needed to organize the production of special milking plants, milking machines, and other equipment to create a material and technical basis for the stable development of productive (koumis) dairy horse breeding.

It is necessary to set up an appropriate scientific center to solve technological issues on the production of standard koumis from high-quality mare's milk, to consider the aspects of production, storage, and transportation of koumis and koumis starter as well; to discuss and research the biological value and medical properties of the product for the recovery of patients; to educate specialists in this field.

Mare's milk and products containing it are more nutritious and of higher quality than products with the addition of ordinary cow and goat milk. Products made of it are environmentally friendly and hypoallergenic. It would be good if more agricultural enterprises which produce mare's milk, koumis starter, and koumis were opened. The widespread use of these products in medicine, everyday life, and cosmetology can be very beneficial.

All this shows is the expediency of the formation of the dairy horse breeding industry, koumis production and consumption in Ukraine.

Key words: mare's milk, koumis, therapeutic properties, Novoolexandrian breed

Changes in rat hippocampus during diabetes

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Diabetes mellitus belongs to a group of metabolic diseases caused by a disorder of insulin secretion. This leads to chronic hyperglycemia causing abnormal functioning of many organs in the body including neurological disorders affecting the peripheral and central nervous system (CNS). Calcium-binding proteins (CaBPs), including parvalbumin (PV), play an important role in the physiology of CNS nerve cells. PV is a buffering protein whose function is to lower Ca^{2+} levels in the cytoplasm. Due to its higher level in the pyramidal cells of the CA2 area of the hippocampus, it is less sensitive to calcium toxicity, which occurs when nerve cells are over-stimulated. Normal PV levels indicate maturity of the cerebral cortex and hippocampus.

The aim of this study was to trace changes in the hippocampus — the center of memory and reasoning — and to evaluate parvalbumin expression in hippocampal neurons of the rat with induced diabetes.

Twelve (n=12) sexually mature male Wistar SPF rats were used in this study. Diabetes was induced in six (n=6) animals by a single intraperitoneal injection of streptozotocin (STZ, 60 mg/kg body weight). The remaining six (n=6) animals were injected intraperitoneally with sterile lemon buffer (100 mmol/L, pH 4.5) containing 0.9% NaCl. For 48 hours, all animals received a 5% glucose solution in tap water.

The animals were divided into two groups (n=6):

1) control group (I group);

2) a study group with experimentally induced diabetes (II group).

All rats were given standard rodent food (30 g/day) for 3 months of the experiment until euthanasia by CO_2 overdose. Brains were collected from the animals and fixed, from which Nissl' stained preparations were made, and immunohistochemical staining was performed (PAP method with antibodies raised against PV). Microscopic images were taken from the specimens and statistically analyzed (ANOVA).

There was a significant reduction in the number of nerve cells and nerve fibers in the hippocampus of the experimental group compared to the control group. Compared to the control group (I), a reduced number of PV positive (PV-ir) neurons ($P<0.05$) was found in all hippocampal fields as well as in the dentate gyrus (DG) of the experimental II group. Compared to the control group, the mean subpopulation of PV ir neurons found in II group was reduced by approximately 63.0% in the fields (respectively CA1 62.7%, CA2 66.7%, CA3 59.3%).

Neurodegenerative changes are observed in the brains of diabetic rats. Abnormalities affect both the number of normal neurons and the entire hippocampus. A large loss of nerve fibers is evident. These changes may result in significant impairment of brain function in the rat.

Key words: diabetes, hippocampus, calcium-binding proteins, parvalbumin, rat

Genesis of conceptual principles of preservation and rational use of farm animals

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Intensive development of stockbreeding in Ukraine, introduction of modern technologies has accelerated the process of replacing some farm animal breeds for ones that are more productive. This process has led to a reduction in the number of aboriginal and native breeds, which are characterized by high adaptability and resistance, viability and plasticity, unpretentiousness to feed, high reproductive and maternal qualities, and so on. Preservation of farm animals is one of the urgent problems of our time, which are in the attention of many scientists, such as Bodo, G. Brem, V. Burkat, B. Veprintsev, I. Guzev, C. Dragonescu, F. Eisner, M. Zubets, M. Ivanov, M. Kravchenko, Yu. Ryban et al.

The purpose of the research is to systematize theoretical and methodological approaches to solve the problem of preservation of farm animals, to generalize perspective ways of their rational use. The study is based on the general principles of historical objectivity, complexity, scientific value, multifactoriality and comprehensiveness. General scientific, interdisciplinary and special historical methods, source and terminological analysis were used.

The basis of classical methods of farm animal preservation was a synthetic evolutionary theory, which establishes the areas of their geographical distribution and centers of origin, the frequencies of alleles responsible for selection traits. These were proposed by Yu. Filipchenko, O. Serebrovsky, M. Vavilov, Yu. Lyskun, M. Kolesnyk et al. The methodological basis of the anthropological concept of animal preservation is the doctrine of the noosphere, the founders of which are E. Leroy, P. Teilhard de Chardin, V. Vernadsky. Later the ecological approach to animal preservation became widespread. E. Odym argued that biological diversity and its components are closely related to ecosystem organization, the dominance of various genotypes is to increase their stability. Rational use of farm animals is based on taking into selection and genetic methods of their breeding. In this regard, M. Ivanov's scientific concepts consist the improvement of cattle on the methods of feeding and keeping, genetic reorganization due to complex reproductive crossing, interspecific and intergeneric hybridization. M. Potemkin considered it effective to take into account the principle of correlation of development and biological relationship of the form and function of organisms. M. Kravchenko attached great importance to selection measures: pedigree selection, linear breeding. F. Eisner proposed a method of cattle preserving and increasing hereditary variability in a closed herd, based on immunogenetic studies of blood.

In recent decades, biotechnological concepts of farm animal gene pool preservation have been developed, which became possible due to I. Smirnov's discovery of the property of sperm after deep freezing, substantiation of efficiency and receipt by O. Kvasnytsky of the world's first piglets-transplants. Thus, evolutionary, anthropological, ecological, synergetic, culturological approaches, as well as selection, genetic and biotechnological methods of stabilization of the number of farm animal aboriginal and local breeds are proposed. Preserving the animal gene pool is based on the development of a methodology for the rational use and long-term storage of the best pedigree resources. Introduction of genetic population monitoring in herds and population control system based on a combination of biotechnological and selection methods of cryopreservation of biomaterial aimed at breeding selection.

Key words: animal breeding, gene pool preservation, breeding, immunogenetics, biotechnology

Application of *Atoxvet* phytocomplex to reduce the negative effects of mycotoxins and stimulation of laying chicken productivity

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Mycotoxins are recognized as one of the most harmful agents for human and animal health. Reduce the negative effects of mycotoxins on animals is possible not only by using sorbents of endogenous substances capable of influencing the processes of metabolism and excretion of mycotoxins. A number of plants and their components acting aimed at the metabolic processes are able to minimize the effects of toxins on the body and promote their rapid excretion.

The aim of the work is to determine the effectiveness of application of the *Atoxvet* phytocomplex to reduce the negative effects of mycotoxins on the body of poultry and stimulate their productivity.

The research was carried out in the conditions of a poultry farm on the population of cross-breed Novogen white in three stages of 10 days. The first stage is preparatory, in the second stage poultry for 10 days was watered water with *Atoxvet* phytocomplex at a dose of 60 g per 1 ton of water with subsequent observation in the third stage. The effectiveness of the phytocomplex application was valued by the indicators of the clinical condition and the level of poultry productivity, as well as the results of studies of morphological and biochemical parameters of poultry blood in different periods of research. In the first stage herewith fumonisins in the amount of 0.11 mg/kg were detected in poultry liver.

Application of the *Atoxvet* preparation within 10 days normalizes the hematological parameters of the blood of laying hens with an increase of blood hemoglobin by 11.5% and hematocrit value due to an increase in the number of erythrocytes. The number of leukocytes decreased, which may be associated with a decrease in inflammatory processes in the digestive tract due to mycotoxicosis.

Compared with the first stage in the second stage after 10 days of the phytocomplex application the average daily death of poultry in the group of 141 thousand hens decreased from 91 to 60 hens and was decreasing 10 days after discontinuation of the preparation. At the same time, there was observed an increase in the percentage of implementation of the productivity plan which led to an increase in the group productivity in the second stage and maintaining its level in the third stage of the research. It should be noted that after 3 days of preparation application in mycotoxicological examination of poultry liver tissue there were not observed the remains of the mycotoxins noted before application of a phytocomplex.

Thus, the *Atoxvet* phytocomplex at a dose of 60 g/ton of water normalizes the course of metabolic processes in the body of laying hens and exhibits detoxifying properties by stimulating the excretion of mycotoxins from the body of poultry. *Atoxvet* during its 10-day application, as well as in the next 10 days, helps to reduce the death of poultry by 54–66% and increases its productivity.

Key words: *Atoxvet*, phytocomplex, mycotoxins, poultry, detoxification

Environmental impact assessment from livestock production

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Livestock is considered as a strategically important branch in the general structure of agricultural production. The activity of large industrial farms and the intensification of the livestock industry, in general, leads to the consumption of large amounts of natural resources and is the cause of many environmental problems.

The purpose of our study is to highlight the negative impact of agricultural livestock waste livestock industry on the environment. The scale of the impact of waste from livestock complexes depends on many factors and is manifested in the pollution of various environments: soil, water, the air within a radius of 15 km.

When forming a sound approach to assessing the impact of animal husbandry on air pollution, it should be noted that the complex structure of specialized livestock farms of industrial type, which are widely used mechanization and automation of production processes is accompanied by many negative consequences: air pollution by dust emissions and emissions of harmful gases; formation in large volumes of wastewater that contains dangerous contaminants (xenobiotics and ammonium ions); formation and accumulation of a significant number of by-products of animal origin (manure, of animal by-products); microbiological pollution of the environment and, as a consequence — deterioration of the epizootic situation; withdrawal of a significant amount of agricultural land for large complexes and their infrastructure; biodiversity loss.

One of the biggest environmental problems of livestock farms is the formation of large amounts of manure and chicken manure due to the activities of animals that contain large amounts of dissolved salts, and after evaporation of moisture remains in the soil, in particular in the form of chlorides. Excess content of sodium chloride and magnesium chloride (NaCl, $MgCl_2$) in the soil causes chloride salinization of soils. When the content of more than 0.03% of chlorides in the soil is the suppression of most plants. Trees are especially affected in the case of deep salinization of soils. The accumulation of sodium sulfate and magnesium sulfate ($MgSO_4$, $CaSO_4$, Na_2SO_4) causes sulfate salinization of the soil. The increased content of ammonium sulfate is the cause of diseases of sheep and cattle as a result of poisoning by grass grown on these soils.

Manure is rich in nitrogen, phosphorus, and other nutrients that, when released into the water, make it unsuitable for drinking water supply, damage wetlands, and aquatic ecosystems. In particular, the supersaturation of nutrients in water causes eutrophication — an excess of nitrogen, phosphorus, and other nutrients, algae begin to actively grow and multiply, there is a “bloom” because algae use oxygen in the water. In the absence of oxygen, fish and other inhabitants of the reservoirs die.

Modern technological innovations make it possible to consider organic waste as an additional source of raw materials. Therefore, one of the promising areas for solving environmental problems and obtaining additional energy resources and at the same time integrated use of industrial livestock waste can be considered the production of biogas from them through the process of methane fermentation. This gas can be used to heat water and prepare the feed. When biogas is obtained without air access, the processed manure completely retains nitrogen in the organic fertilizer (whereas during composting almost half of the nitrogen is lost). In addition, under such conditions, weed seeds contained in livestock waste lose their germination, and pathogenic microbes, helminth eggs, etc. are neutralized. This direction of manure utilization in the conditions of gradual depletion of traditional energy resources is of particular importance: to gain benefits in the form of decentralized production of renewable energy or fuel production.

Key words: environmental pollution, livestock industry, waste disposal and recycling

Assessment of flight distance in alpacas during response to familiar and unfamiliar humans

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Alpacas are social herbivores. Their main breeding direction is production of high quality fiber and also using in recreation or alpaca-assisted therapy. There are various tests to assess temperament and behavioral reactivity of animals, e.g. animal approach test (where an experimenter stands still) or human approach test (where an experimenter comes to animal). Possibility to assess animal temperament is crucial for breeding and rearing, where selection for reproduction is partly based on animal's temperament. Calm animals are easier to handle. In human approach test, flight distance can be measured. Flight distance is defined as the distance at which an animal starts to avoid an approaching human. Length of flight distance may depend on human-animal relationship or temperament of particular individual. The aim of the study was to assess flight distance in alpacas during response to familiar (herd keeper: feeding, cleaning boxes) and unfamiliar (first seen by animals) humans.

Flight distance was measured in 36 alpacas, including 15 males and 21 females. Human approaching to examined individual started from 5 meters, 1 step by second, at an angle of 45° between head and blade, in the direction of left forelimb. When the alpaca began to avoid human approaching, this person dropped the first marker and the second marker was dropped in location where the animal's forelimb was before it went away. The distance between two markers was specified as flight distance with an accuracy to 1 cm. If the human was able to come close to an animal and touched it, the flight distance was specified as 0 cm. In statistical analysis differences between flight distance during response to familiar and unfamiliar humans were evaluated using a Wilcoxon sign test and a correlation coefficient was calculated using Spearman's rank correlation test. Differences in responses of males and females were assessed using U Mann Whitney test.

Usually, alpacas moved away from unfamiliar human (experimenter) when this person was 50–150 cm from them. Flight distance during response to familiar human was slightly shorter than in reaction to unfamiliar one, but it was statistically insignificant ($P=0.968$). Significant positive correlation ($r = +0.597$) between flight distance values during response to familiar and unfamiliar humans was found. Animals' sex did not significantly ($0.511<P<0.797$) affect the reaction to the approach of familiar and unfamiliar humans.

To our knowledge it is the first research on assessment of alpacas' flight distance in Poland. It was noticed that alpacas which reacted with a longer flight distance during response to approach of unfamiliar human, were also characterized by longer flight distance during response to approach of familiar one. This study allows to conclude that individual characteristic of animals mostly determines reaction to approach of familiar and unfamiliar humans. It could be very important practical information for farmers and alpaca keepers who use alpacas in agritourism or alpaca-assisted therapy.

Key words: alpaca, flight distance, temperament, human-animal relationship

Impact of COVID-19 pandemic on the welfare and behavior of companion animals: dogs and cats

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The aim of the study was to assess the impact of the COVID-19 pandemic on compliance with the principles of veterinary prophylaxis by owners of dogs and cats. Information included in the documentation of a veterinary clinic and provided by a survey was the research material. The study was focused on such activities as preventive vaccinations, prevention of external and internal parasites, urine and stool tests, blood counts and biochemistry, imaging diagnostics, castration or sterilization, dental prophylaxis, and cardiological examination (echocardiography). Additionally, the structure of species and numbers of animals visiting the veterinary clinic were analyzed.

The analysis of the collected data showed that 14% of the respondents declared that they had to postpone the veterinary appointment. Approximately 8% of owners had to cancel the preventive veterinary visit due to the COVID-19 pandemic, whereas 12% encountered difficulties related to compliance with veterinary prophylaxis rules. In March-October 2020, when the pandemic-imposed restrictions on many aspects of society functioning, the rate of prophylactic treatments was similar to the level noted in the same period in 2019 before the pandemic outbreak. Additionally, the results of the survey suggested that dog owners are more scrupulous in compliance with veterinary prophylaxis principles in comparison with cat owners. During the 10-month pandemic period, an increase in the range of veterinary services that attracted animal owners' interest and in the number of other companion animal species was observed.

Key words: dog, cat, veterinary prophylaxis, welfare, COVID-19

Regularities of accumulation of nitrate-nitritic nitrogen in livestock products

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An important role in increasing the production of fodder and food crops is given to the chemicalization of agriculture. The intensity of the use of nitrogen fertilizers has become increasingly practical, as it promotes crop growth, increases the content of crude protein, carotene, etc. in feed and, accordingly, increases the productivity of animals.

At the same time, the use of high doses of nitrogen fertilizers, non-compliance with the technology of introducing them into the soil under plants, is accompanied by the appearance of excessive amounts of nitrates in feed, feeding which often caused toxicosis in animals, and causes their presence in livestock products.

The great danger was that nitrates-nitrites are also harmful to humans when they are converted into livestock products.

The issue of obtaining environmentally friendly livestock products (especially milk for dietary nutrition) is acute. The conditions under which these products can be obtained free from pollution by nitrate-nitrites have been insufficiently studied.

According to the obtained data, the ten-day increased intake of nitrates in the body of cows in the feed ration led to a clear increase in the content of nitrate-nitrite forms of nitrogen in milk and urine. Compared with the control (without feeding nitrate additives), the concentration of nitrate nitrogen in milk and urine of experimental animals was two or more times higher. Moreover, in experimental animals in the milk of early milking the content of nitrates was lower than in the milk of lunch or evening milking. The largest proportion of non-metabolized nitrate was excreted in the urine, much less was in milk. When determining the daily dynamics, the highest level of nitrate in milk and urine, due to exercise, was recorded for 4–6 days of the experiment. Prior to that, it gradually grew. In the period between the 7th and 10th day there was a marked decrease in the content of nitrates in milk. Perhaps this is due to the adaptation of the body of experimental animals. As for urine, a similar decrease in nitrate levels was not detected during this period.

In the control during the experiment, the concentration of nitrates in milk and urine fluctuated within narrow limits, creating an almost straight line in the graphical image.

Regarding the content of nitrite ion in milk, in the control its presence was detected only in trace amounts (0.001–0.009 mg/l). In the milk of experimental cows, their level was significantly higher and increased from 0.005–0.01 mg/l on the first day of the experiment, to 0.021–0.042 mg/l on day 4–5, as well as in the following days with some fluctuations.

According to the content of residual nitrate in the tissues of the studied organs of cows taken at slaughter after the end of the body load with sodium nitrate, there were a number: spleen, heart muscle, liver, lungs, longitudinal abdominal muscle, bile. Without feeding nitrate supplementation, its level in the studied organs was 3–7 times lower, and was 0.1–0.6 mg NO_3^-/l. Moreover, nitrite was practically not detected, while in experimental animals their content ranged from 0.099–0.176 mg/kg, except for bile, where it reached a much higher level.

Thus, unequal cumulative growth of nitrate and nitrite levels and their ratio in the studied tissues of organs and biological fluids caused by loading of cows with sodium nitrate were established. The presence of a positive correlation between the degree of loading and the levels of nitrate-nitrite forms of nitrogen in tissues and biological fluids was confirmed.

Physicochemical parameters of milk from goats of different breeds

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Goat breeding is a branch of animal husbandry that breeds goats. Goat products are milk, meat, hides, down, wool, etc.; types of raw materials — rennet enzyme from the stomachs of goats, horns and hooves for light industry products, including buttons, combs, etc.

The purpose of the work was study of physical and chemical composition of milk of goats of Anglo-Nubian and Thuringian breeds in the conditions of the southern region of Ukraine.

The work was performed in *Elika* private farm of Nerubayske village, Odesa region. To study the physico-chemical properties of milk, milk samples from Anglo-Nubian and Thuringian goats were taken from 20 animals (10 animals each). Milk samples from goats were taken at 4 and 7 months of the first lactation. In the selected milk samples such physical properties as color, consistency, odor, freezing point, thermal conductivity were studied according to generally accepted methods [P. V. Kuchenev, N. V. Barabanshikov, 1978].

Digital data were processed biometrically by the method of variation statistics [N. A. Plokhinsky, 1970].

Goats of different breeds on the 4th month of the first lactation had some discrepancy in the physicochemical composition of milk. Goats of the Anglo-Nubian breed predominated goats of the Thuringian breed on the majority of components of milk. Thus, the fat content in the milk of Anglo-Nubian goats was dominated by 1.59% natural or 46.7% relative goats of the Thuringian breed (P>0.99). According to the content of skimmed milk powder in milk, goats of Anglo-Nubian breed had the advantage of 0.98% natural or 12.3% relative percent (P>0.999).

For other components of milk, the predominance of Anglo-Nubian goats was, respectively: for the content of protein — natural by 0.29% or 9.8% relative (P>0.99), for the content of lactose — 0.37% of natural or 7.8% relative (P>0.95). The acidity of milk was also higher by 0.1% or 1.9% (P>0.90). The milk density of goats of both breeds was at the same level. The indicators that are determined organoleptically were the same.

The milk of Anglo-Nubian and Thuringian goats had a white color, a homogeneous liquid consistency and a pleasant milky odor without impurities.

Goats had similar results in the physicochemical composition of milk in the seventh month of lactation. Goats of the Anglo-Nubian breed had better indicators of physicochemical composition of milk in comparison with goats of the Thuringian breed. Thus, the fat content in the milk of Anglo-Nubian goats was higher than that of Turing breeds by 1.64% natural or 47.8% relative (P>0.999). According to the content of dry skim milk residue, this advantage was 0.98% natural or 12.2% relative (P>0.999), the protein content, respectively, 0.28% and 3.3% (P>0.99), the content of lactose — by 0.39% and 8.1% (P>0.95), at the freezing temperature — by 0.06°C or by 11.1% (P>0.999).

The milk of goats of both breeds was white, homogeneous liquid consistency and a pleasant milk odor without any impurities.

The milk of Anglo-Nubian goats at the 4th and 7th months of lactation had some incredible increase in the main components of milk. So, on the 7th month of lactation goat's milk contained more fat on 0.08% natural or 1.6% relative, dry skimmed milk residue — on 0.08% natural or 1.5% relative, protein — on 0.02% natural or 0.6% relative, lactose, respectively 0.07% and 1.3%. A similar trend of variability of milk components at the end of the lactation period, according to the indicators observed in the milk of goats of the Thuringian breed.

Goats of Anglo-Nubian breed in comparison with contemporaries of Thuringian breed, on the 4th month of the first lactation had higher content in milk: fat by 46.7% (P>0.99), dry skimmed milk residue by 12.3% (P>0.999), protein by 9.8% (P>0.99), lactose by 7.8% relative (P>0.95), acidity by 1.9% (P>0.90).

Key words: breed, milk, protein, lactose, fat

The effect of vanadium citrate on platelet characteristics in male and female rats

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The study of platelets (PLT) — blood cells that are an integral part of the coagulation system, allows to assess the health state of both males and females. According to the study by D. Del Principe, the frequency of thrombotic complications is characterized by gender disparities. In particular, females are less likely to have a platelet dysfunction. The mechanisms underlying this imbalance are still poorly understood. It is assumed that hormones, in particular estrogen, may play a key role in such differences. According to the studies of other authors [Miller V. M., et al., 2008], the effect of estrogen and its receptors on thrombogenesis, in particular the differentiation of megakaryocytes, and even directly on the integrity and function of the PLT, is shown. Given the absence of a nucleus, the susceptibility of PLT to such influences is significant and, apparently, is due to the non-nuclear function of estrogen receptors [Del Principe D. et al., 2015]. Platelets and megakaryocytes, the precursors of platelets, express estrogen receptors, which can also explain the greater resistance of females to hormonal changes [Dupuis M., et al., 2019].

The aim of our study was to examine the effect of vanadium citrate on platelet homeostasis: PLT, relative platelet distribution width (PDW), plateletcrit (PCT) and mean platelet volume (MPV).

Female rats during pregnancy and their offspring before puberty (36–37 days) were fed the solution of vanadium citrate at concentrations of 0.03 (II group), 0.125 (III group) and 0.5 μg V/ml (IV group). The offspring of females that did not consume the solution of vanadium citrate were considered control (I group). The material for the study was whole blood of female and male rats, in which PLT, PDW, PCT and MPV were determined on a hematology analyzer *Orphèe Mythic 18* (Switzerland).

As a result of the research, in female and male rats that consumed solutions of vanadium citrate, a decrease in PLT was found in III and IV groups, in particular, in females by 48.05 and 42.94%, respectively, and in males — by 55.04 and 72.46%, respectively, as compared with the control. This is possibly due to the inhibitory effect of vanadium citrate on thrombogenesis. PCT in females decreased in all three study groups: in II — by 40.79, III — by 55.26 and IV — 60.53%, as compared with I group. A decrease in PCT correlates with a decrease in platelet count. PDW increased in II group by 22.75%, as compared with control females, which is due to the increase in the number of young platelets under the effect of vanadium citrate at a concentration of 0.03 μg/ml.

MPV in group II males increased by 11.47%, as compared with the control, which indicates an increase in the number of young platelets and their increased formation. The value of PCT increased in males of group II by 59.1%, but decreased by 36.6% in groups III and IV, as compared with the control.

According to the results of the study, there is a stimulating effect of vanadium citrate on thrombogenesis in females and males at a concentration of 0.03 (II group), but the inhibitory effect is observed at concentrations of 0.125 (III group) and 0.5 μg V/ml (IV group).

Key words: platelet characteristics, vanadium citrate, females and males

Physiological mechanisms of the regulation of erythron and protein in blood of piglets at the development of adaptative syndrome

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The realization of the genetic potential under the conditions of agricultural pig farms depends upon the adaptation possibilities of an animal's organism which is characterized by the imperfection of the compensated mechanisms in early age. The thesis is aimed at the clarification of the condition of the erythronus and protein metabolism in the organism of the piglets of Poltava meat breed before and after the stress ablactation with the introduction of "Biovir" additive as adaptogen into the diet. Starting from 5-day age the piglets from 5- to 45-day old were additionally fed with "Biovir" additive in the form of dry powder with the calculation of 10 mg/kg of the body weight per day. Technological stress associated with animals weaning on the 28th day of piglets' life was complex and included piglets weaning, formation of groups from different clusters. The research material was constituted by the blood selection before the morning feeding of animals through the puncture of vena cava cranialis on the 15th day of life (preparation period), one day after the ablactation (which corresponded to the alert phase, according to H. Selye), 7, 20 and 60 days after the ablactation (which corresponded to different resistance development periods according to H. Selye). All blood components were conducted using the hematology analyzer *MITIKH-18* (Switzerland). Total protein concentration of the blood serum was determined with the help of refractometer RDU. Protein fractions determination (albumen, α_1-, α_2-, β-, γ-globulins) was conducted using the vertical microelectrophoresis in the polyacrylamide gel tubes.

After one (anesthetic stage) and 7 days (beginning of G. Selle's resistance stage), after the echoing, the adaptation of the erythron system was shown by a decrease in the number of red blood cells on the contrary of increasing the mean corpuscular volume and hemoglobin indicating the inhibition of erythrocytopoze with simultaneous macrocytosis, and a decrease in mean corpuscular hemoglobin concentration for 14.0–13.0% that indicated hypochromia. In these stressful periods, the catabolism of protein substrates was discovered, the redistribution of albumins between blood and tissues in the form of a decrease in the total protein content by 6.1–7.1% due to albumin by 14.8–10.0%, and the deficit of the humoral link of the immune response due to reduction of γ-globulins by 29.9–18.7%. In the later stages of the resistance stage (after 20 and 60 days after weaning), there was a stabilization of erythrocytic indices and the development of anisocytosis in the form of an increase in red cell distribution width by 19.0%, with a simultaneous decrease of 6.1% of the total protein content, redistribution of its fractions in the side of the growth of γ-globulins by 18.4%.

It can be concluded that the adaptation of the system of erythronine piglets at the stage of anxiety and the initial stage of resistance was manifested by a reduction in erythrocytopoze, macrocytosis and hypohromy with subsequent stabilization of erythrocytic indices and signs of anisocytosis, whereas in the protein metabolism system a reduction in the total protein content was found due to albumins and γ-globulins from further increase of hepatocytic and immune proteins at the later stages of the implementation of the adaptive syndrome. An effective prolonged way of preventing disorders in the system of erythron and protein of extramarital piglets was the feeding of the additive "Biovir", which stimulated the intensity of oxidative-reducing processes and the exchange of proteins.

Key words: stress, weaning, piglets, adaptation, protein, red blood cells

Metal-resistant bacteria *Ochrobactrum rhizosphaerae* K 3-1, isolated from the lake of infiltrates of Lviv solid waste landfill

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The high metabolic potential of microorganisms allows them to play a major role in the conversion of substances in all habitats. The problem of storage of wastes is one of the biggest and most pressing environmental problems in Ukraine. Microbiological research of solid waste landfill infiltrates has an extremely high potential for biotechnological developments, as microorganisms of infiltrates are involved in the cycle of compounds of lake of infiltrates, form its main physicochemical characteristics and have made a number of adaptations to adverse conditions. The purpose of study was to isolate strain with prospect in biotechnology of remediation of anthropogenically transformed biotopes.

To isolate the strain, an infiltrate sample of the Lviv solid waste landfill (Velyki Hrybovychi village, Lviv region, Ukraine) was plated on an agar infiltrate extract, which made it possible to obtain a pedotrophic microbiota of this biotope. Microorganisms were cultured for 24 h at a temperature of +28…+30°C. Individual colonies were cultured on tryptic soy agar or tryptic soy broth. The strain was selected for its ability to heterotrophic growth using a number of organic substrates as carbon sources, the ability to metabolize compounds of infiltrate and wastewater of the distillery and resistance to salts of copper, cadmium, chromium, iron, cobalt, manganese. Morphological properties of the bacteria were studied using a *Carl Zeiss Axio Lab.A1* binocular microscope and an *Olympus IX73* inverted microscope with a DP-74 digital camera. Endospores were detected by the Peshkov-Trujillo method. Catalase and oxidase were determined using 10% H_2O_2 and strips with N,N-dimethyl-*p*-phenylenediamine oxalate and α-naphthol (*Millipore*, USA) respectively. Amylolitic activity was determined during growth of strain on agar medium supplemented with 1–2% starch was used., lipolytic activity — on medium with tween-20, protease activity was evaluated by ability of bacteria to liquefy gelatine, the ability to fix nitrogen by their ability to grow on Ashby's agar medium. The ability of microorganisms to assimilate organic carbon sources and physiological characteristics were determined during growth on Hiss medium with different carbon sources, with application of *ID 32 GN* kit and *Remel RapID™ ANA II* system. The 16S rRNA gene was amplified using primers 27F and 1492R.

It has been found that the nucleotide sequence of the 16S rRNA gene of the isolated strain *Ochrobactrum rhizosphaerae* K 3-1 is 99.35% identical to the sequence of the 16S rRNA gene of the strain *Ochrobactrum rhizosphaerae* PR17 (according to the NCBI database). Bacteria are resistant to 10 μM Cd^{2+}, 20 mM Fe^{2+}, 6 mM Cu^{2+}, 1 mM Cr(VI), 20 mM Mn^{2+}, 10 mM Co^{2+}. Grow at temperatures of +20…+30°C. The optimum pH is 6.8–7.3. Oxidize elemental sulfur. In the process of amino acid metabolism hydrogen sulfide is released, mercaptans are not formed. Capable of nitrate reduction. They are characterized by phosphatase, aminopeptidase (glycine-, proline-, phenylalanine-, arginine-, serine-, pyrrolidone-) activity. Metabolize D-glucose, L-arabinose, D-ribose, galactose, fructose, mannose, L-rhamnose, lactose, raffinose, D-sucrose, D-maltose, starch, glycogen, N-acetylglucosamine, inositol itaconic acid, suberic acid, malonate, acetate, lactate, L-alanine, L-proline, L-serine, L-histidine, 5-ketogluconate, 2-ketogluconate, 3-hydroxybenzoic acid, salicin, D-melibiose, L-fucose, propionic, capric (decanic), valeric, 3-hydroxybutyric, 4-hydroxybenzoic acid. *O. rhizosphaerae* K 3-1 metabolizes the compounds of wastewater from the ethanol production plant, providing bioremediation of this substrate, because with the growth of the strain in the wastewater of the distillery (4 days, +28°C, aerobic conditions) chemical oxygen demand decreased by 55%, compared to control. Thus, bacteria *O. rhizosphaerae* K 3-1 are promising for use in biotechnology for cleaning contaminated media from organic substrates and heavy metals (Cd^{2+}, Fe^{2+}, Cu^{2+}, Cr(VI), Mn^{2+}, Co^{2+}), and can also be model organisms for studies of adaptation reactions of microorganisms.

Key words: *Ochrobactrum rhizosphaerae*, metal resistance, bioremediation, infiltrates

The impact of feed additives and synbiotics on the activity of hydrolytic enzymes in quails

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Over the past decades, we have witnessed significant achievements in enhancing the genetic potential of new breeds, crosses, and lines of poultry. However, the realization of this potential is impossible without relevant complete feed. In this respect, research of digestion physiology; study and analysis of the impact of nutritional factors on the digestive system, which also functions as a local body of the immune system, offers an opportunity for assessment of its morphofunctional status to create optimal conditions for raising and rational use of poultry and implementation of any adjustments if required. It is particularly relevant for metabolism disorders in birds characterized by lower functional state of the gastrointestinal tract, which emerge during ontogenesis due to switching to lung breathing after hatching, juvenile shedding of feathers, puberty, and peak productivity age.

An essential element of intense modern technologies of poultry breeding is the use of biologically active ingredients, which impact metabolism intensity and digestion in particular. A number of researchers claim that humic substances improve the properties of the electron transport chain in cattle and poultry. Some reports state that organic acids of humic substances help digestive enzymes break down feed in the gastrointestinal tract and improve protein digestion. Synbiotics are recommended for use in the poultry industry for prophylaxis purposes as well as mitigation of gastrointestinal, metabolic, and immunological pathologies. Synbiotics are a new generation of bacterial substances with a combined effect that contain useful strains of microorganisms, lactose, vitamins, sorbents, antioxidants, fatty acids, and immune stimulants. Such preparations enhance metabolic processes, promote absorption of nutrients, and release of toxic agents from the intestines.

Given the abovementioned, the study aimed to measure the impact of *Humilid* feed additive and *Bilaxan* complex synbiotic in quail diet on the activity of hydrolytic enzymes during critical periods of ontogenesis. The study was conducted on Japanese quails aged seven days divided into three groups made of 60 birds each. The quails were kept in a battery cage and fed complete feed per the requirements for their breed. Control group birds were fed standard combined feed with a balanced content of nutrients and biologically active substances; the first test group was fed the same combined feed + *Humilid* feed additive in the amount of 2 mg/kg of body weight; the second test group birds were fed complete feed with *Bilaxan* complex synbiotic in the amount of 0.01 g/bird/day. A biochemical panel was run on samples of duodenal mucosa and chemus of 29-, 41-, and 71-day-old birds.

It has been established that proteolytic activity of enzymes in duodenal mucosa increased with age, while in chemus, the process was the opposite. The dynamics of amylolytic activity in tissues studied increased in birds aged 71 days compared to birds aged 29 days ($P<0.05$). Lipolytic activity decreased in the mucosa and increased in duodenal chemus ($P<0.05–0.01$). A stimulating effect of a biologically active substance and synbiotic on the enzymes studied has been identified ($P<0.05–0.01$). The efficiency of introducing *Humilid* into the diet was higher than that of *Bilaxan*.

Key words: quails, hydrolytic enzymes, critical periods, biologically active substances, synbiotic

Effect of reduction of easily digestible protein in the diet of cows on intensity of microbial protein synthesis in the rumen and formation of the fund of milk protein predecessors

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The new approach to protein normalization is based on the position that the need of ruminants for protein consists of the need of microorganisms in nitrogen, which is met by easily degraded in the rumen protein fractions of forage, non-protein nitrogen sources and the animal's need for amino acids provided by microbial protein and rumen undegraded protein.

The most important criterion for evaluating feed protein is the degree of its breakdown in the rumen, as this value affects the availability of nitrogen for rumen microorganisms, as well as the amount of feed protein available for digestion in the small intestine.

Since it is not always possible to achieve the required ratio of rumen digestible and undigestible protein fractions by selecting feed, regulating protein breakdown by protecting it from degradation in the rumen is one of the scientifically based ways to improve rations for cattle. One of the methods of protecting feed protein from excessive breakdown in the forestomach is formaldehyde treatment of protein supplements.

The experiment was performed by the method of periods on intact cows and cows with fistulas of the duodenum in the first period of lactation. An exchange experiment was conducted during the experimental period. In addition, *in vitro* and *in situ* feed studies were performed.

As a result of the received data it is established that introduction of the protected from disintegration cattle cake into a diet had influence on an exit of available for digestion protein and synthesis of microbial protein in forestomach. This is due to the fact that the intestine got more rumen undigested feed protein. At the same time, the proportion of microbial protein in the chyme of the duodenum was less than in the control period of the experiment. The nitrogen digestion coefficient was 2% higher when compared to the control period. When cows got feeding with the protein protected from degradation, the coefficient of nitrogen digestibility was also higher by 5.4% than in the control period. Nitrogen digestion was also slightly higher. During the experimental period, there was a decrease in ammonia formation in the rumen with a decrease in non-protein and an increase in the proportion of protein nitrogen.

The decrease in the proportion of hard-to-digest protein in the diet led to a slight increase in the concentration of volatile fatty acids in the rumen content and acetic acid rate in the blood. Its absorption by the mammary gland was 28% higher when compared to the control period. At the same time the fat rate in milk increased by 20%.

During all periods of the experiment, milk productivity varied within the physiological parameters of lactation.

Cows with high levels of hard-to-digest protein in the diet used more energy for milk synthesis and less energy for deposition in the form of gains, which is desirable in the initial period of lactation. These animals had a higher level of mammary gland uptake of protein and lipid substrates.

Key words: cows, nutritions, digestibility, degradation of protein, microbial protein

Quality of deconserved bull sperm for the action of nanocitrates Zn, Cu, and Mn in the diluents

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Semen fertility depends of diluent composition in which trace elements play important role. However, the use of trace elements in the form of inorganic salts as diluents is ineffective. This is due to the fact that in sperm, synthetic processes occur at a low level and, accordingly, the inclusion of trace elements from inorganic salts in the metabolism of cells is reduced. In addition, metal ions involved in free radical oxidation of in spermatozoa. One of the ways that can enhance of the use of microelements in ejaculates diluents and ensure their inclusion in the metabolic processes of sperm are use organic forms of metals. However, with an excess of these elements may be impaired mitochondrial function. Therefore, decreases physiological characteristics and fertility of sperm.

Consequently the purpose of this work was to comparatively study the effect of different little doses of required for spermatozoa elements (Cu^{2+}, Zn^{2+} and Mn^{2+}) in the form of nanocitrates upon their introduction into lactose-yolk-glycerol medium for cryopreservation of sperm of bulls on physiological and biochemical parameters sperm after thawing. Purpose of this work was to compare the effect of addition of trace elements as Cu^{2+}, Zn^{2+} and Mn^{2+} in the form of nanocitrates into lactose-yolk-glycerol diluet for cryoconservation of bulls' ejaculates. After semen colection, 4 ejaculates were divided for two parts. First patr was diluted by lactose-yolk-glycerin diluent (should be stated its name and which company produced it)and de second part was diluted by the same diluent with additiws of nanocitrates of Cu, Mn and Zn solutions in concentrations of 2–5 g/l at doses of 0.005, 0.01 and 0.05 ml respectively.

When ejaculates were taken, the following physiological indicators of ejaculate quality were established: volume (ml), sperm concentration (billion/ml), live sperm count (%) and dynamic sperm count (CASA) and survival (h); content of total protein, respiratory activity of sperm, activity of enzyme markers of fertilizing ability — succinate dehydrogenase (SDH, units) and cytochrome oxidase (CHO, units) in deluted ejaculates with introducedminerals. After the ejaculates were diluted, semen was equilibrated for two hours at 4°C and frozen in a container (7 min over nitrogen vapor followed by immersion in liquid nitrogen). The semen was thawed in a water bath at 38°C for 20 sec. The above physiological and biochemical parameters of the sperm of the bulls were redetermined immediately after thawing.

Sperm concentration in diluted bulls sperm was 8.3% of the initial in native ejaculates or ejaculate diluted 12-fold according to technological requirements ($P<0.001$). The number of live sperm decreased by 12.6% compared to fresh sperm ($P<0.05$), and the survival of sperm during incubation decreased by 6.8% or 7.4 hours. Total protein content in 100 ml of sperm decreased by 41.3% after dilution compared to fresh ejaculate ($P<0.001$). Respiratory activity decreased by 11.8% after the ejaculates was diluted. Succinate dehydrogenase activity decreased by 10.7% and cytochrome oxidase activity by 13.0%.

After deconservation of the semen of the bulls, the respiratory activity of the sperm of the is higher in the test samples when 0.05 mg/l Zn^{2+}, 0.005 mg/l Cu^{2+} and 0.01 mg/l Mn^{2+} are added to the medium on 11.7, 3.1 and 11.7% than control group respectively. After thawing semen, the same doses, the enzyme activity was higher. The highest activity among these groups of succinate dehydrogenase was 0.05 mg/l Zn^{2+} ($P<0.05$) when added to the cryopreservation medium (on 31.6% compared to control), and the lowest on 21.8% compared to control when added 0.05 mg/l Mn^{2+}. Cytochrome oxidase activity was highest on 30% when 0.05 mg/l Zn^{2+} ($P<0.05$) was added to the cryopreservation medium. The optimum concentrations of nanocitrates that ensure the normalization of oxidation processes in the diluted bull sperm are: 0.01 mg/l Mn^{2+}, 0.005 mg/l Cu^{2+} and 0.05 mg/l Zn^{2+}. Increasing or decreasing the concentrations of trace elements in the diluent of more or less optimal values inhibits the respiratory activity of the sperm and reduces the activity of citrate dehydrogenase and cytochrome oxidase. Similar to this effect is the dynamic performance of spermatozoa after thawing.

Key words: bulls, sperm, spermatozoa, ejaculate, citrate, succinate dehydrogenase, cytochrome oxidase, respiratory activity

Effect of ethylthiosulfanylate on hematological indicators of rats under the toxic effect of Chromium(VI)

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Cr(VI) is a toxic heavy metal which can easily transport to the cytoplasm of living cells through the anionic channels in the plasma membranes. Cr(VI) generates reactive oxygen species (ROS) leading to oxidative damage of cell macromolecules and components. Cr(VI) action adversely affects erythropoiesis, respiratory function of the blood and puts a burden on the immune system. Therefore, the aim of our study was to investigate the influence of ethylthiosulfanylate on some hematological indicators of rats exposed to Cr(VI).

White male *Wistar* laboratory rats were divided into 7 groups. Animals of the group 1 were intraperitoneally injected with 150 µl of physiological solution daily for 14 days. Rats the group 2 received intragastric injection of 1000 µl of oil daily for 14 days. Animals of groups 3, 4, 6 and 7 were intraperitoneally administered daily of $K_2Cr_2O_7$ in a dose of 2.5 mg Cr(VI)/kg body weight, for 7 (groups 3 and 6) and 14 days (groups 4 and 7). Rats of groups 5, 6 and 7 were intragastrically injected with ethylthiosulfanylate oily solution at a rate of 100 mg/kg of body weight daily for 14 days. All procedures were conducted according to the European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (Strasbourg, 1986) and General Ethical Principles of Experiments using Animals (First National Congress of Bioethics, Kyiv, 2001).The numbers of erythrocytes and leukocytes were counted. The hemoglobin levels were also measured. All calculations were performed mathematically and statistically (one-way ANOVA) using *Microsoft Excel* software.

The number of erythrocytes decreased in blood of rats from groups 3 and 4 relative to the group 1 by 17% and 25%, respectively. However, increasing of red blood cell count was observed in blood of rats in groups 5 and 6, compared to the group 2 by 18% and 7%, respectively. The level of erythrocytes was slightly decreased (by 6%) in blood of rats of group 7 relative to the group 2. We observed only a tendency to increasing of number of leukocytes in blood of animals of all experimental groups, but no statistically significant differences were observed between the groups. The levels of hemoglobin were decreased in blood of rats of groups 3 and 4 relative to the group 1 by 22% and 29%, respectively.

Therefore, Cr(VI)-induced toxicity leads to a decrease of hemoglobin content and erythrocyte number in blood of rats. However, ethylthiosulfanylate action induces increase of red blood cell count and attenuates Cr(VI)-induced decrease of erythrocyte level. Changes of hemoglobin content and erythrocyte number were within the physiological norm in all experimental groups.

Key words: ethylthiosulfanylate, Cr(VI), hematological indicators, rats

Content of total protein and its fractions in hemolymph of bees depending on the level of citrates Mg introduction to sugar syrup

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It is known that bee hemolymph is directly related to all major metabolic processes in its body. The protein content in the hemolymph of worker bees is labile and depends on many factors, the most important of which is the level of protein nutrition, as well as the physiological state and related functional activity of bees. In adult bees, the protein content in the hemolymph is more constant, it varies significantly depending on the season. The highest value is observed in fall and winter. Given the physiological characteristics of bee hemolymph, which are associated with the main metabolic processes in its body, studies have been conducted on the effectiveness of the use of Mg citrate in the spring feeding with sugar syrup.

Research was conducted at the Institute of Animal Biology NAAS on 4 groups of Carpathian breed bees (25–30 insects in each group), which were selected for experiments in laboratory, vivarium apiary. Isolated bees of control (I) group received 1 ml of 50% sugar syrup and 1 ml of H_2O daily; group II (experimental) — 1 ml of sugar syrup with the addition of 1 ml of Mg citrate containing 0.04 mg Mg/l; group III (experimental) — 1 ml of sugar syrup with the addition of 1 ml of Mg citrate (0.02 mg Mg/l); group IV (experimental) — 1 ml of sugar syrup with the addition of 1 ml of Mg citrate (0.01 mg Mg/l). Bees of control and experimental groups were kept in similar conditions of microventilation laboratory thermostat by temperature 30° within 30 days of research. On day 30, bee hemolymph was obtained, and the protein concentration was determined using the biuret method. The relative spectrum of soluble proteins of bee hemolymph was determined by electrophoresis in 7.5% polyacrylamide gel. The obtained digital data were processed using a standard package of statistical programs *Microsoft Excel*.

The results showed that levels of total protein in the hemolymph of research groups' bees were not significantly different from the control. However, under conditions of feeding bees with Mg citrate at a dose of 0.01 mg/l, the protein level was lower by 4%. Results of the study of protein fractions of bees' hemolymph showed that albumin is reduced in III and IV groups ($P<0.01$), the highest content was in the II group. At the same time, there was a decrease in α_1-globulins in the hemolymph of IV group bees, on the background of higher content in II group ($P<0.05$). However, the percentage of α_2-globulins was characterized by a tendency to a higher content in the hemolymph of bees of II, III groups, and was probably higher ($P<0.05$) in IV group compared to the control. Analyzing the changes in the percentage of β-globulins in the hemolymph of bees, a decrease in their level was found in the II and IV ($P<0.05$) experimental groups compared to the control. The percentage of γ-globulins was characterized by a decrease in hemolymph of II group ($P<0.05$) on the background of higher levels in IV ($P<0.05$) experimental group. Such changes may be due to the regulatory effect of Mg citrate on the intake of individual protein fractions from adipose tissue into hemolymph in the absence of protein feed in bees under thermostat conditions, where carbohydrate nutrition prevailed for 30 days of the study period.

According to use of Mg citrate during the feeding of honeybees, the ratio of individual protein fractions of hemolymph changed with a decrease in the relative content of albumin, β-globulin and an increase in α_2- and γ-globulins under the action of 0.01 mg Mg. The effect of 0.04 mg Mg caused an increase in the relative content of α1- and a decrease in β- and γ-globulins in the hemolymph of honey bees of the studied groups. According to results, we can expect an additional study of influences of changes in the protein composition of hemolymph on the development and productivity of bees.

Key words: bees, Mg citrate, proteins, hemolymph, globulins

Minerals composition and quality indexes of production of beekeeping after feeding Ge and Co citrate

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Perspective direction in the enrichment of bees' feed with micronutrients is to use nanocarboxylate biotic metals that increase biological value of their products. Adding to bees' feed compounds of individual elements as metabolic stimulants of organic and inorganic correction affects physiological and biochemical processes of the body, increases productivity and resistance. These mineral components include Co, Zn, Ge, Se, Ag and Cu. The expediency of their use not only in order to obtain a biocidal effect, but also as active nanotechnological compounds, which are much more effective than trace elements in the classical ionized form, has been proved. In this regard, of scientific and practical interest is the study of the effect of different levels of Co and Ge citrates obtained by nanotechnology, introduced into the components of feeding bees, on the content of certain trace elements in their products — in honey to determine quality and bee pollen.

The studies were conducted on four groups of bee colonies, counterparts by weight, strength of family, the age of the queen bee, a family of three in each group. Bees of control (I) group received in spring fertilizing with 50% sugar syrup in quantities of 300 ml/family/week. The second group of bees (experimental) additionally from 300 ml of sugar syrup received 30 mcg Co in the form of citrate, III group from 300 ml of sugar syrup received 60 mcg Ge in the form of citrate, IV group from 300 ml of sugar syrup received 30 mcg Co citrate and 60 μg Ge in the form of citrate. The duration of the watering citrate syrup and Co and Ge was 4 weeks. Samples of bee pollen and honey in which the content of individual heavy metals (Cu, Fe, Co, Cr, Zn, Pb, Cd) was determined on the atomic absorption spectrophotometer SF-115 PC, as well as qualitative indicators of honey were taken for research. Statistical analysis of the results was performed with the definition of averages and install significance ratio for Student.

Feeding sugar syrup with different amounts of citrate Ge and Co are not the same differences led some mineral elements content in bee pollen and honey. In particular, samples cerago observed significantly higher concentrations of Fe ($P<0.001$), Zn and Co ($P<0.05$) compared to controls. There is a tendency to increase the level of Cu in the samples of bee pollen of all experimental groups against the background of a decrease in the content of Pb and Cd ($P<0.05$) compared with the control. In honey observed increased content Fe ($P<0.001$), Co, Cu and Zn, amid falling Cd and Pb, as compared to the control. At the same time, the samples of honey of the experimental groups showed a probably higher level of proline and hydrogen ions ($P<0.001$). This indicates the stimulating effect of sugar syrup and its combination with Ge and Co citrates on microbiological processes in honey and its enzymatic activity during ripening.

According to feeding with sugar syrup of Ge and Co citrates caused a certain corrective effect on the content of Fe, Zn, Cu, Co, Cr and a pronounced antagonistic effect on the level of toxic metals such as Pb and Cd in samples of bee pollen and honey of honey bees. Studies have shown that both separate and complex addition of micronutrient citrates to honey bees leads to multidirectional changes in the content of individual mineral elements in their products. These relationships between mineral elements should be taken into account in the schemes of spring feeding of bees.

Key words: bees, honey, bee pollen, minerals, Co and Ge citrates

The influence of introduction of a mixture of citrates of mineral elements to growth, development and maintenance of broiler chickens

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Currently, one of the most important problems in industrial poultry farming are issues related to the provision of rational mineral nutrition and prevention of diseases of agricultural birds. Providing agricultural birds with high-quality feeds is one of the factors for improving its preservation and productivity. Development of new effective compositions of mineral elements that improve the balance in poultry diet, increase its growth, development and natural resistance of the body are relevant. The prohibition to use in the countries of the European Union of stimulating antibiotics in animal husbandry is a prerequisite for the search for alternative feed supplements. Therefore, the purpose of our research was to study the influence of the mixture I, Se, S citrate in various doses on the body of chicken broilers for introduction with water throughout the full technological cultivation cycle.

The research was carried out on chickens-broilers of the cross ROSS-308. In the 7-day age, control and two experimental groups were formed, 10 individuals in each. The chickens of all groups received standard feed and drinking water from autodrinker. The vaccination of chickens was carried out in accordance with the schemes adopted and recommendations. Chickens of experimental groups to drinking water were added mixture I, Se, S citrate (I — 50 mg/L, S — 300 mg/L, Se — 60 mg/L) made by nanotechnology method. A mixture of microelement citrates was added additionally to drinking water and by aerosol feed processing without coccidiostatics. The chickens of the control group (C) received standard feed and drinking water. Chickens of E I group together with drinking water were obtained a mixture of citrates I, Se, S in the amount of 1 ml. Chickens of E II group received feeds are treated with an aerosol mixture of citrate I, Se, S in an amount of 1 ml. Every 7 days (7-, 14-, 21-, 28-, 42- and 46-day) was controlled by body weight by weighting chickens, as well as preservation, morbidity and feed activity — daily.

The prolonged introduction of a mixture of citrates I, Se and S affects the growth and development of the organism, its resistance and metabolism for 100% preservation of the number of diseases without clinical manifestations. According to the results of the research, it has been established that for 14 days, the body weight of chicken broilers did not significantly change and was at the level of control. In the following age periods chicken-broilers of experimental groups in absolute growth prevailed control group. A similar pattern is noted in chicken broilers and on average daily body weights. In particular, the average daily increase of 1 head over the entire growing period was in E I and — 69.13 g/chicken, E II — 67.5 g/chicken *versus* 65.15 g/chicken in the control group. During the experiment weighing poultry 7-, 14-, 21-, 28-, 42- and 46-daily age was carried out. It has been established that at the end of the experiment (46-day broilers), the largest body weight of the chickens of the experimental group. In particular, the body weight amounted to 3260 g against control 3037 g, that is, the body weight of the chickens of this group was greater than 7.34%. The body weight of the chickens of the experimental group was higher by 3% compared to the control group. Thus, the influence of the complex of citrate of mineral elements on the performance of chicken broilers indicates their high biological effects.

Key words: chicken broilers, trace elements citrates, iodine, selenium, sulfur, body weight, preservation

Hyperketolactia in dairy cows in Poland — prevalence and consequences

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The system of monitoring of subclinical ketosis in Polish dairy herds was introduced into the practice on April 1, 2013, as a part of milk recording system. Briefly, the monitoring system is based on the concentration of milk ketone bodies — β-hydroxybutyrate (mBHB) and acetone (mACE), determined by FTIR method in the test-day (TD) milk samples. Monthly, it considers about 90,000 milk recorded cows, which are within 6–60 days in milk (DIM). Since the start of system, a big dataset has been collected on concentrations of ketone bodies in milk. With these data, the prevalence and consequences of hyperketolactia (HYKL) among milk recorded dairy cows in Poland can be evaluated and analyzed.

The prevalence of HYKL depends on the threshold values used for mBHB and mACE. When mACE ≥0.15 mmol/L or mBHB ≥0.01 mmol/L were considered, 67.7 and 32.3% of all milk samples (about 3.8 M) were defined as normal (NKL) and HYKL, respectively. Percent of samples defined as HYKL in 6–21 DIM was greater than 22–60 DIM samples (43.0 *vs.* 27.6%, respectively). Within 6–60 DIM, HYKL samples originated from 30.2, 28.2 and 35.4% of 1st, 2nd, and ≥3rd lactation cows, respectively. Among all HYKL samples, 50.8, 41.2, and 7.9% were categorized as $HYKL_{ACE\&BHB}$, $HYKL_{BHB}$, and $HYKL_{ACE}$, respectively ($HYKL_{ACE\&BHB}$, mACE ≥0.15 and mBHB ≥0.10 mmol/L; $HYKL_{BHB}$, mACE <0.15 and mBHB ≥0.10 mmol/L; $HYKL_{ACE}$, mACE ≥ and mBHB <0.10 mmol/L). The numbers of HYKL milk samples originated from primiparous cows were especially high within 6–21 DIM, whereas for older cows reasonable numbers were found within 22–60 DIM. From the practical point of view, the prevalence of HYKL depended not only on DIM or parity, but also on the farm size (bigger farm less HYKL), average daily milk yield on TD (higher milk yield less HYKL).

In our second study, based on over 7 M milk samples, we studied the effect of HYKL and different categories of HYKL ($HYKL_{ACE\&BHB}$, $HYKL_{BHB}$, and $HYKL_{ACE}$) on milk yield and composition (on 1., 2. and 3. test day, 305 d lactation) and on some reproduction parameters. The effect of time of detecting of HYKL was also considered (1. or 2. TD). NKL cows produced daily 31.7, 33.2 and 31.8 kg of milk on 1., 2., and 3. TD, respectively, whereas HYKL cows diagnosed on 1.TD produced 29.8, 32.8 and 31.1 kg/d, HYKL cows diagnosed on 2.TD produced 31.0, 30.1 and 30.1 kg/d, and HYKL cows diagnosed on 1.TD and 2.TD produced 29.2, 29.7 and 29.2 kg/d. The worst production consequences were found for cows diagnosed as $HYKL_{ACE\&BHB}$ on 1.TD and 2.TD, i.e. 28.2, 27.9 and 28.8 kg/d. HYKL reduced milk yield in 305 d lactation. NKL cows produced 7928 kg of milk, and HYKL cows on either 1.TD, 2.TD or 1.TD and 2.TD 7697, 7364 or 7216 kg, respectively. Again, the worst production consequences were found for cows diagnosed as $HYKL_{ACE\&BHB}$ on 1.TD and 2.TD, i.e. 7026 kg/d (about 900 kg less than NKL). Either HYKL or different categories of HYKL decreased reproduction outcomes. In conclusion, hyperketolactia among Polish dairy cows is a very important economic problem. Polish monitoring system for subclinical ketosis based on the concentration of milk ketone bodies has decreased the prevalence of ketosis (hyperketolactia) in Poland.

The effect of prenatal exposure to fumonisins on the structure of the enteric nervous system of the rat

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Fumonisins as a group a toxin isolated from fungus *Fusarium verticillioides* has been recently added to the list of corn and cereals contaminants. The most common fumonisins B_1 (FB_1) and B_2 (FB_2) are linked to fatal diseases in certain animals' species, including horses and pigs. Several studies indicated the possible role of fumonisins as neurotoxins in the central nervous system, however its neurotoxicity at the periphery is poorly understood. Meanwhile, the toxins are primarily adsorbed from the small intestine which is controlled by the enteric nervous system. Additionally, the most important question whether neurotoxins are able to cross the placenta barrier is still wide open.

Therefore, in the present study we immunohistochemically assed whether toxication with fumonisins of pregnant rats' results in disturbances in the structure of the enteric nervous system of the newborns. Experimental pregnant rats received the fumonisins FB_1+FB_2 (ratio 2:1) in the diet at dose 60 mg/kg of b.w. (n=5, group 1) or 90 mg/kg of b.w. (n=5; group 2) from the eight day of pregnancy till partition. Control rats (n=5, group C) were fed fumonisins-free diet. 28 days after the birth, the newborns (n=12, one randomly selected male and female offspring from each mother) were euthanized and samples of the duodenum were dissected out. The material was fixed using paraformaldehyde, washed and kept in sucrose solution until the cut with a cryostat into 10 um sections. Next, the sections were immunohistochemically stained with antibodies against Hu C/D proteins (neuronal specific marker) and viewed under an epifluorescent microscope. The ganglia of myenteric plexus as well as submucous plexus were visualized and morphologically assessed. The following parameters were measured: the mean numbers of ganglia (per 1 mm of the tissue), the mean numbers of neurons in particular ganglia, the means size (area, width and height) of ganglia, the mean size (area, diameter) of enteric neurons.

In result, after the feeding pregnant rats with the fumonisin-containing diet (at both doses) we observed in the offspring slight decrease in total numbers of myenteric and submucous duodenal neurons, but these changes were not statistically significant ($P<0.05$). Additionally, we observed a slight increase (but also not statistically significant) in average myenteric and submucous neuron area/diameter. We observed no statistical differences between average numbers of neurons present in a single myenteric/submucous ganglion. Also, the mean numbers, the mean size (length, width, area) of myenteric/submucous duodenal ganglia were unchanged in relation to the control.

The obtained results allow us to suggest that fumonisin given prenatally as a diet component did not substantially disturb the organization of the enteric nervous system in weaned rats. These results also suggest that placental barrier could effectively impair neurotoxic effect of fumonisins.

Key words: fumonisin, enteric nervous system

Serologic studying bovine coronavirus infection in Ukraine

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Bovine coronavirus (BCV) is recognized as the primary etiology of winter dysentery (WD) of adult cows and coronaviral diarrhea in young (3- to 21-days-old) calves. Coronaviral diarrhea of newborn calves is an acute contagious disease characterized by lesions of the gastrointestinal and respiratory tracts. It is accompanied by profuse diarrhea, sometimes with mucus and blood in fecal masses, dehydration, depression and exhaustion. WD is a clinically and economically important disease in many countries including the United States and Canada. It is characterized by high morbidity (50–100%) but low mortality (1–2%) and occurs primarily in adult dairy cows. The bovine coronavirus like and other digestive infectious diseases of cattle are the problem of cattle industry, due to the peculiarities of biology of the viruses, their wide spreading, features of pathogenesis and of clinical sings, and as well as high economic losses.

The aim of our work was to determine the state of the epizootic situation concerning bovine coronavirus among cattle in Ukraine.

The serological methods were used. We investigated 387 sera samples from animals of different age groups of 11 regions in Ukraine. These samples were analyzed for antibody detection to bovine coronavirus by hemagglutination inhibition test and ELISA according to standard protocol.

During 2020 to 2021 studied sera samples from 22 cattle farm of various regions in Ukraine. 73.6% (285 samples) of blood serum of studied were positive to coronaviral infection by haemagglutination inhibition test and ELISA.

Carried out monitoring on dissemination of coronaviral infection in cattle of private farms in Ukraine in 2020–2021 confirmed the presence of this pathogen and its participation in death of young animal. A high percentage of seropositive animals indicates a need for further monitoring and prophylactic immunization of cattle using inactivated vaccines.

Development of dairy productivity of cows of Ukrainian Black-and-White dairy breed depending on different factors

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Further intensification of the selection process with the aim to increase milk productivity of cows causes a need for systematic assessment of animals in herds and populations by the main selection traits and the degree of realization of genetic potential in certain conditions. Therefore, the aim of the work was to study the development of milk productivity of cows of the Ukrainian Black-and-White dairy breed depending on live weight, body measurements of first-calf heifers, linear affiliation, milk productivity of mothers and indicators of reproductive capacity. The research was conducted in four farms for breeding Ukrainian Black-and-White dairy breed in the western region of Ukraine: Sokal (n=2046) and Brody (n=1222) branch of *Molochni riky LLC* and *Selektsioner* breeding farm (n=1418) of Lviv region, *Yamnytsia* breeding plant (n=1217) of Ivano-Frankivsk region. The dependence of the milk productivity on live weight during rearing and after the first, second, and third calving, on live weight, body measurements of first-calf heifers, linear affiliation, milk productivity of mothers, and indicators of the reproductive capacity of cows have been studied based on a retrospective analysis of zootechnical accounting data (during the last 20 years).The formation of milk productivity of the cows was influenced by the intensity of their weight and linear growth during the period of growth, as well as the live weight after the first, second and third calving and the size of the body of the cows after first calving. The correlative variability of the live weight of animals during the period of growth and feeding was 0.018–0.604, the body measurements during the period of cultivation and fertilization — 0.170–0.458, live weight after the first, second and third palates, and infusion — 0.413–0.551, the body measurements of the fetuses and infusion — 0.297–0.478. The most significant impact on the future dairy productivity of the cows was made by their live weight at the age of 18 months (21.6–24.6%) and after the first calving (32.3%), high-altitude measures (17.7–36.0%), the circumference of the chest on the shoulder blades (17.1–36.3%), and the skid length of the trunk (8.7–33.9), and the smallest — the live weight at birth (3.3–5.3%) and the circumference of the heel (8.6–18.2).

The influence of the lines on yield of milk, depending of the farm and lactation, was 9.6—39.0, the fat content of milk — 2.9–32.2 and the yield of milk fat — 9.7–38.8%, the strength father's influence — 6.9–49.3; 7.4–68.4 and 6.8–51.0% respectively. The coefficients of inheritance on the path along the "mother-daughter", depending of the farm and lactation, were within 0.034–0.618, fatty milk — within 0.032–0.762.

The highest yield of milk were in cows, which age of the first fertile insemination amounted to 487–547 days with a live weight of 400 kg, service life period — 120 and more, for dry period — 45–54 and inter calving — 430 days or more. Between the parameters of reproductive capacity and milk yield of cows, different strength and direction of connection are established. The strength of the duration of the service-period on milk yield, the fat content of milk and the yield of milk fat, depending on the farm and lactation, was 9.1–29.5, respectively; 7.0–28.2 and 8.2–29.7, the duration of the interotional period for the same indicators — 9.2–30.9; 9.1–29.5 and 8.8–31.8 and the dry period — 9.3–23.4; 9.3–23.2 and 9.2–23.8%.

Thus, the formation of milk productivity of Ukrainian Black-and-White dairy cows was most significantly influenced by paternal origin, linear affiliation, height measurements, shoulder girth, oblique length of the body, and their live weight after the first calving.

Key words: breed, cows, milk productivity, power of influence

Hydrolytic enzyme activity in quails upon introduction of enzyme mixtures and various sulfur forms into their diet

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Among the biologically active substances that positively impact digestion of substrates and nutrient availability in the feed are enzyme mixtures. Modern feed industry offers various enzyme supplements, yet their efficient use in the diet of poultry of different types, ages, and productivity requires additional research. A promising area of research encompasses the study of the efficiency of introducing nanoforms of micro- and macroelements into feed and feed supplements for poultry. Given the results obtained during the previous research, it appears feasible to look at the potential to include sulfur nanocitrate into the quail diet in place of sulfate, which is used to make up for sulfur-containing amino acids deficiency.

The study was conducted on quails (14-days-old) divided into five groups. All birds were fed balanced combined feed. Control and the 1st test group quails received additional sodium sulfate (0.2%) while the 2nd and the 4th test groups were given sulfur nanocitrate (produced by *Nanomaterials and Nanotechnologies LLC*, Kyiv, Ukraine) in the amount of 50, 24, and 10% of control group levels. In addition, all test group quails were given “Natuzym” enzyme mixture which contains three strains of microorganisms (*T. longibrachiatum*, *B. subtilis*, *A. Niger*) and phytase.

At the end of the study which covered a period of three months, birds were harvested, and liver and pancreatic tissues were sampled to identify proteolytic activity using the method of Kunitz [Kaluniants K. A. et al., 1973], amylolytic activity using the method of Caraway [Dovhan N. et al., 1998], and lipolytic activity using the method of Titz [Kalnitskiy B. D., 1997].

It has been established that proteolytic and lipolytic enzyme activity in pancreatic tissues of quails increased upon adding an enzyme mixture to the poultry diet. The addition of sulfur citrate in the amount of 25 and 10% of element levels in standard mineral premix resulted in 1.4 and 1.5 times protease activity increase ($P<0.05$) and 1.3 and 1.4 times lipase activity increase ($P<0.05$) respectively. At the same time, lipolytic activity in liver tissues decreased in all test group birds compared to the control group, which may be stipulated by the fact that pancreatic lipolytic enzymes are responsible for the hydrolysis of fats. Pancreatic lipase accelerates the hydrolysis of triglycerides, while the role of gastric lipase in hydrolysis is insignificant.

It has been established that the egg mass amount of the 4th test group birds received over test period was the highest (1.4% higher than the control group, $P<0.05$). At the same time, even the smallest amounts of biolement in its nanocitrate form (4th and 3rd study groups) increased shell strength by 35% ($P<0.01$) according to comparable data of control group quails. Eggshell thickness in the 2nd test group birds (additional 50% sulfur from its content in sodium sulfate inorganic salt) was by 25% higher. The introduction of enzyme mixture alone did not significantly impact the shell strength remaining at control group levels.

Thus, the results obtained attest to the feasibility of replacing sulfur mineral supplements in the form of inorganic salt (Na_2SO_4) with nanocitrate of the element in the amount of 10% of its content in inorganic form and addition of “Natuzym” multi-enzyme mixture in the amount of 0.03%.

Key words: quails, lipase activity, protease activity, amylase activity, *Natuzym*, sulfur citrate

The intestinal barrier in health and disease in livestock animals

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Intestinal mucosa is responsible for both absorption of nutrient as well as protect against the penetration of toxic substances, pathogens and other pro-inflammatory factors into host organism. This dual function of mucosa requires a selectively permeable barrier. Intestinal barrier consists of several layers. This include mucus, a habitat for intestinal microbiota, which prevents the adhesion and penetration of pathogens to the intestinal wall, intestinal epithelium, formed mainly by enterocytes, which is involved in development of immunity and finally intercellular junctional complex known as tight junctions, adherend junctions and desmosomes that control paracellular permeability. Numerous factors, such as inflammation or heat stress can affect intestinal permeability due to disruption of intercellular junctional complex. Analysis of gene expression and immunolocalization of intercellular junctional complex proteins, in particular occluding and zonula occludes proteins, can be used as markers for the assessment of endothelial intercellular junctions integrity, and thus may be helpful in distinguishing between normal and impaired intestinal barrier function in livestock animals.

Influence of sulfur compounds drinking on blood parameters and resistance of rabbits

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Nanotechnologies are constantly evolving, and their application is becoming more diverse and specific, in particular to improve livestock production. Therefore, the aim of the study was to determine the changes in hematological, biochemical and immunobiological parameters of rabbits under the influence of sulfur citrate and sodium sulfate on their body 14 days before insemination and for up to 20 days of lactation. Studies were conducted on rabbits of the *Hyla* breed in the conditions of farm. The rabbits of the control group were fed without restriction complete ration granular feed with free access to water. Animals of the I experimental group were fed the diet of the control group and during the day were fed sulfur citrate, at the rate of 8 μg S/kg body weight. Females of the II experimental group were fed the diet of the control group and with water was given sodium sulfate (Na_2SO_4) in the amount of 40 mg S/kg body weight. In the preparatory period on the 10th day from the beginning of the study and in the experimental period on the 20th day of lactation (65 days of feeding supplements) blood samples were taken from rabbits from the marginal ear vein. Determination of hematological parameters was performed on a hematological analyzer *Mythic 18*, biochemical parameters were determined on a biochemical analyzer *Humalyzer-2000*, determination of resistance indicators was performed using a daily suspension of *E. coli*, strain no. 078 and *Micrococcus lysodeikticus*. Mathematical processing of research results was performed using software (*Stat Soft*, Tulsa, USA). Differences between values in the control and experimental groups were determined using ANOVA, at $P<0.05$ (taking into account the Bonferroni error).

It has been found that feeding sulfur citrate at the rate of 8 μg S/kg body weight in the diet of rabbits for 14 days before insemination and up to 20 days of lactation increased the number of erythrocytes by 19.5% ($P<0.05$), leukocytes by 37.5% ($P<0.05$), and granulocytes by 38.3% ($P<0.05$), hemoglobin concentration by 21.0% ($P<0.05$), the average hemoglobin content in erythrocytes by 15.6% ($P<0.05$), the width of the distribution of erythrocytes by 14.7% ($P<0.05$), activated protein metabolism, which was characterized by a higher protein content by 8.5% ($P<0.05$) and the activity of AST, ALT and alkaline phosphatase, respectively, 12.9% ($P<0.05$), 29.6% ($P<0.01$) and 19.8% ($P<0.05$), and a lower content of triacylglycerols by 51.8% ($P<0.05$) in the blood on the 20th day of lactation compared with the control group. The use of sulfur citrate increased the immunobiological reactivity of rabbits for 65 days of the experiment with probably higher levels of FA, FN, SLA and SBA ($P<0.001$), protein-related hexoses ($P<0.05$), sialic acids ($P<0.05$) and ceruloplasmin ($P<0.001$) and immune globulins ($P<0.05$) compared to control. Feeding rabbit females for 65 days of sodium sulfate in the amount of 40 mg/kg body weight was characterized by less pronounced changes in the blood with an increase in the average hemoglobin content in the erythrocyte by 20.0% ($P<0.05$), higher content of FA, PF, SLA, SBA ($P<0.05$–0.001), hexose-related proteins ($P<0.05$) and ceruloplasmin ($P<0.01$). The results of the study indicate the possibility of additional use in the diet of rabbit mats supplement sulfur citrate in the amount of 8 μg S/kg body weight to increase metabolism, immunobiological resistance during periods of increased physiological load.

Key words: rabbits, sulfur, nanotechnologies, blood, resistance

Morphoproductive indicators of the Assaf sheep of local reproduction

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The milk productivity of sheep raised in Moldova is not high. At the Tsigay breed of sheep, the average productivity per lactation is 105–120 liters and at the Karakul breed is 65–80 liters. For improving the milk productivity at the Tsigay sheep, in 2014 dairy sheep of the Assaf breed were imported, whose homeland is Israel, and are mainly bred in Spain, where the climate is the same as in the southern part of Moldova, the Budjak steppe.

The aim of the research was to study, in the natural and climatic conditions of the Republic of Moldova, at ewes of local reproduction, the general development in terms of physique indices, the milk productivity, the study of udder measurements and the effect of the lactation number of ewes on milk production in sucking, milking periods and in general for lactation, as well as the chemical composition of milk.

From the calculated 6 body build indices at ewes of four years of age, the indicators are lower by four indices in comparison with two and three years of age. In comparison with ewes of two years of age: on the transverse by 1.7%; massiveness by 2.1%; for breastfeeding by 6.5% and consistency by 5.6%, and in comparison with ewes of three years of age, respectively, by: 2.7%; 1.5%; 6.0% and 1.5%.

On the second-third month of lactation, the development of the mammary gland was studied on 5 ewes at two, three and four years, which corresponds to I, II and III lactations. Using the obtained data on measurements of the udder itself, the main indicator of its volume was calculated. The highest at ewes in the third lactation is 3717 cm^3, in comparison with ewes of the first lactation, it is higher by 986 cm^3 ($P \leq 0.01$) and by 243 cm^3 higher in relation to ewes of the second lactation. The length and diameter of the teats correspond to the requirements for suitability for machine milking.

Milk productivity for the first 20 days after lambing is the highest 55.96±2.07 liters at ewes for the third lactation. At ewes for the first lactation it is less by 20.74 liters ($P \leq 0.001$) and for the second by 16.06 liters ($P \leq 0.05$) in relation to ewes for the third lactation. During the suckling period at ewes for the third lactation, milk production, as in the first 20 days after lambing, is the highest 240.94 liters. In relation to the first lactation it is higher by 49.22 liters and to the second lactation by 34.14 liters. The duration of the milking period is 135 days for which at ewes for first lactation was yielded 204.08 liters, for the second lactation 219.12 and for ewes of the third lactation 215.25 liters. In general, for lactation, 456.38 liters of milk was received from ewes for the third lactation, or by 60.58 liters more in comparison with ewes of the first lactation and by 30.45 liters from ewes of the second lactation. In all studied periods, at ewes on the third lactation, the indicators are better in comparison with the indicators of the first and second lactations.

For studying the chemical composition of milk from the ewes of the studied groups, milk samples were taken and using the *Lactosan MCC* device were determined the amount of fat, protein, lactose, DSMR, salts and its density. At ewes for the third lactation, the indicators are higher in comparison with ewes for the first and second lactations.

Based on the data obtained, it can be concluded that that sheep of the specialized dairy breed Assaf have acclimatized to the conditions of growing in the Republic of Moldova and can be successfully used by sheep breeders.

Key words: ewes, body build indices, milkiness, chemical composition of milk

Regularities of correlation variability of non-specific resistance and growth intensity of calves

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Nonspecific resistance reflects the protective and adaptive processes of the organism, the hereditary reaction to environmental conditions. The degree of manifestation of protective reactions of the organism depends on the conditions of realization of hereditary potential [Karamaeva A. S., Zaitsev V. V., 2010] and features of development of reactivity of an organism in the postnatal period [Fedirivych E. I., 2003; Korablyova T. R., 2014; Golban R., 2019]. The aim of the study was to examine the relationship between calf growth intensity and nonspecific resistance.

The work was performed in the State enterprise of the experimental farm "Khristinovske" of the Institute of Animal Breeding and Genetics named after M. V. Zubets of National Academy of Agrarian Sciences of Ukraine on heifers of Ukrainian Red-and-White dairy breed (n=34). Regularities of changes in live weight of young animals were determined by average daily, absolute and relative (according to S. Brody) increments. According to the relative rate (intensity) of growth (IG) at an early age (0–2 months) calves were divided into groups: I (intensive, IG>M); II (moderate, IG=M); III (slow growth, IG<M). Bactericidal activity of blood serum (BABS) by photonephelometric cuvette method; lysozyme activity of blood serum (LABS) by nephelometric method; phagocytic activity of neutrophils (PhA) [Chumachenko V. E., 1990] was determined. Statistical data processing and correlation analysis were performed using the program *Statistica 8.0*.

A statistically significant difference in growth intensity in groups of calves was found. Thus, group I outperformed peers of II group by 8.3%, III group — by 24.1% ($P<0.001$). Calves of moderate height predominated in terms of growth intensity of slow-growing calves by 15.8% ($P<0.05$). A study of Spearman's rank correlation showed that calves with high growth intensity at 2–4 months change rank in the period of 4–6 months ($rs = –0.86±0.142$; $P<0.001$). It can be assumed that the growth rate decreases due to the mismatch of growing conditions to the hereditary potential of animals. In a group of calves with moderate growth intensity, a statistically significant inverse rank correlation was recorded for growth intensity between periods of 4–6 months and 6–8 months ($rs = –0.69±0.243$; $P<0.001$). It can be assumed that heifers of moderate growth intensity are more resistant to paratypic factors, which allowed them to maintain the rank of growth intensity longer than in group I calves. Calves of group III retain the rank of growth intensity throughout the observation period of 2–18 months.

The study of the relative variability of indicators of nonspecific resistance and economic and biological characteristics showed a direct relationship with the intensity of growth of heifers in the period 0–2 months and LABS ($r = +0.55±0.144$; $P<0.001$). For the BABS, this dependence was statistically significant at an older age — 12–18 months ($r = +0.32±0.160$; $P<0.05$). A direct relationship between live weight of newborns with PhA ($r = +0.38±0.161$; $P<0.05$) and live weight at 2 months with BABS ($r = +0.33±0.163$; $P<0.05$).

Therefore, heifers of moderate growth intensity have greater hereditary resistance to the influence of paratypic factors than fast-growing peers. Live weight at 2 months is directly dependent on BABS, which indicates the importance of non-specific resistance to realize the growth potential of calves. Individual features of nonspecific resistance of young animals can be a predictor and be used in breeding work from the early postnatal period.

Key words: cattle, growth intensity, nonspecific resistance, heifers

Influence of pig immunocastration on fattening parameters

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Surgical castration without anesthesia or analgesia is common practice in pig production to reduce males' aggression and avoid "boar taint" in meat. "Boar taint" is an unpleasant smell or taste that can be evident during the cooking or eating of pork. Currently, in developed countries, more and more social attention is paid to the broadly understood welfare of farm animals, which is promoted by the social movements, which influencing animal production. Thus, alternative methods of castration are needed to improve animal welfare, as well as to meet consumers expectations. One of them seems to be immunocastration. This method consists of two injections of a protein-conjugated Gonadotropin Releasing Factor (GnRH) analogue, that affects impair testicular function and prevents the pork from having an unpleasant odor.

The aim of this study was to assess the impact of immunocastration on the fattening performance of pigs.

90 Polish Landrace male pigs were used in this study. 30 of them were surgically castrated at 7th day of live (barrows group), and another 60 pigs were randomly divided into two groups boar (30 pigs) and immunocastrates (30 pigs) groups. Immunocastration was performed twice, first around 10 weeks of age, and second 4–6 weeks before slaughter. Animals were kept at the Pig Performance Testing Station (SKURTCh) in Chorzelów under the same housing and feeding conditions. Animals were fattened from 30 to 120 (±2.5) kg of body weight. The following data were collected: test start date, test end date, body weight (once a week) and feed intake during the test period. Based on these data, the length of fattening period, test daily gain (from 30 to 120 kg of body weight), feed conversion ratio (FCR), and daily feed intake were calculated. Differences among groups were analyzed using one-way ANOVA followed by Duncan test.

The results showed the difference between the length of fattening period differ between boars (82.23±10.85) and barrows (89.77±8.25 days) groups ($P<0.01$), but not immunocastrates group (86.54±8.84). Test daily gain did not differ significantly between analyzed groups (barrows — 1015.43±118.19; boars — 1018.90±145.29; immunocastrates 1039.61±117.10).

A significant difference ($P<0.05$) in feed intake during the test period and daily feed intake occurred between barrows and the other analyzed groups. The difference between total feed intake by barrows were greater around 40 kg than boars and 28 kg than immunocastrates. A similar effect was observed in FCR, where a significant difference ($P<0.05$) was noted between barrows (2.84±0.46) and boars (2.61±0.39) and immunocastrates (2.56±0.33).

In conclusion, our results showed a positive effect of immunocastration on fattening traits. Immunocastrated pigs were characterized by better (lower) daily feed intake, total feed intake and FCR than barrows, with positively affects the profitability of pig production.

However, more research is required to analyze slaughter performance, meat quality and economic aspects of using this method in production herds.

Key words: pig, castration, immunocastration, fattening performance, feed intake

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Influence of morphological indicators of testicles in rams of different breeds on the quantity and quality of sperm production

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Sheep breeding is considered to be the main and most productive activity in agriculture of Ukraine. Sheep farming must be intensive, highly productive and competitive. Such is meat, dairy and wool sheep. The experience of foreign countries shows that: 1) sheep breeding can exist and be beneficial for intensive forms of agriculture; 2) only cultivated meat-wool and meat-dairy sheep, which gives high-quality products, can compete with high-intensity branches of agriculture and occupy a certain place in the intensive economy. One of the factors that provide a significant increase in meat and dairy productivity is the availability of livestock, which depends on the reproductive capacity of sheep. Reproductive capacity depends on many factors, including the morphological characteristics of the testes of breeding rams.

However, the impact on the quantity and quality of sperm production of rams of different breeds has not been sufficiently studied, which prompted our research.

The research was carried out on of rams different directions of productivity of 2.5–3 years of age, live weight 85–90 kg. For study, 2 Dorper rams were taken, 3 — Assaf, 1 — Merinolandschaf. The study was conducted breeding season. Quantitative and qualitative indicators of sperm of breeding rams were studied according to the method of I. F. Zayachkovsky and I. V. Smirnova. We determined the following parameters: sperm consistency, ejaculate volume (ml), density and activity (motility) of sperm.

Assessment of sperm quality is an important part of the technological process. It largely depends on the quality of sperm fertility sheep. Before fertilization, you can get an idea of the quality of sperm, to determine some indicators (volume, activity, density) that characterize certain properties.

The main method of research in the production environment is the visual assessment of sperm by density and motility, concentration and resistance, and the percentage of live sperm.

Examining the qualitative and quantitative indicators of sperm of sheep of meat and dairy, meat and wool direction of productivity, some differences were noted depending on the breed.

The obtained results showed that the rams of the Dorper meat direction of productivity in terms of ejaculate volume exceed the indicators of rams of the Assaf meat and dairy breed by 0.1 ml or 20%, and in comparison with the rams of the meat-wool direction of productivity breed Merinolandschaf, respectively, 0.1 ml or 17.8%. Rams of all studied breeds had the highest density of semen. Rams of all studied breeds had the highest density of semen. Dense semen was found in rams Assaf and Dorper and liquid semen in Dorper and Merinolandschaf. The sperm of all breeding rams had a rectilinear oscillating-translational motion. The highest quality semen was in rams of the breed Asaph, which was estimated at a density of 9 points.

The fertility of ewes and offspring depends on the qualitative and quantitative indicators of sperm production of rams of different breeds, so research in this direction should be continued.

Key words: rams, density, volume, ejaculate

Stimulating effect of pheromone at different seasons on sexual function of sows

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Currently, the intensification of pork production is based on achieving the highest reproductive performance through the use of various biotechnological methods of regulating the reproductive function of animals. The method of non-hormonal stimulation of sexual function of sows has recently been increasingly used in pig breeding as an alternative to the hormonal method. Therefore, the aim of our study was to study the stimulating effect of synthetic pheromone (boar odor) at different times of the year on the sexual function of sows. Studies have been conducted on 80 major Landrace sows. After weaning the piglets on the farm at the age of 28 days, the sows of the experimental group (40 animals) were aerosolized with a boar pheromone in the form of *Por Civet* spray (Denmark). Sprayed the drug at a distance of 50−60 cm from the muzzle of the pig for 2–3 seconds every day, before their arrival in the hunt and insemination. The control group of animals (40 sows) was not treated. The indicators obtained in the studies were processed by the method of variation statistics [N. A. Plokhinsky, 1969]. It was found that in the summer during the treatment of sows of the experimental group (40 animals) with pheromone after weaning piglets, for the first cycle in the hunt came 91.3% of animals, including the first 8 days 81.5%, and in the control group (40 sows) 84.1% and 69.8% respectively. In the autumn of the year when treating sows (40 animals) with pheromone, 96.5 % of animals came to hunt, 91.7% of them in the first 8 days after weaning, in the control group the figures were 88.2%, and in the first 8 days 85.9%. The difference in the intensity of hunting in sows of the experimental and control groups was 7.2% in summer and 8.3% in autumn. The results of the experiment show that the treatment of sows with pheromone after weaning piglets increases the fertility by 0.44 (P>0.999) piglets in the first experiment and 0.34 (P>0.95) piglets in the second. This allows to increase the intensity of use of sows by reducing the period of their unproductive retention in the period from weaning to insemination.

In another study, a group of sows were treated with a pheromone 13 days before weaning, in order to accelerate the onset of sexual arousal. The control group of animals was not treated with pheromone. However, the stimulating effect of such treatment is not obtained, most affected by the dominance of lactation. From the group of experimental animals (n=25) during the sexual cycle 17 sows (68%), and in the control (n=29) 19 sows (65.5%) were inseminated.

The stimulating effect of the pheromone at different times of the year is different, the most pronounced stimulating effect on the sexual function of sows is observed in the autumn and less in the summer. Aerosol treatment of sows with synthetic boar pheromone increases their reproductive performance, and as one of the methods of non-hormonal stimulation should be used in pig farms.

Key words: pheromones, sows, seasons, insemination

Characteristics of different schemes for the treatment of microsporia

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Among dermatophytoses, microsporia is the most common. The main causative agent of microsporia is the fungus *Microsporum canis*. The disease is highly contagious and dangerous to humans. Therefore, treatment requires a comprehensive approach that aims to prevent the spread of the pathogen in the environment and increase the body's immune system.

In order to determine the effectiveness of treatment of microsporia with different schemes, studies of the blood and skin of guinea pigs infected with the pathogen *M. canis*.

The examination was performed on 18 infected guinea pigs divided into 3 groups, 6 animals in each group. Animals of the 1st group were treated with the itraconazole antifungal drug at a dose of 5–10 mg/kg every 24 hours for 21 days. The drug was administered orally. Also, the affected areas were treated with a 1% solution of clotrimazole 1 time per day for 21 days. Animals of the 2nd group were local treatments with 1% solution of clotrimazole for 21 days and vaccinated with the *Vakderm* antifungal vaccine twice with an interval of 10–14 days. The animals of the 3rd group were given local the *Micromar* drug on the affected areas of the skin once a day topically for 21 days and fed once a day the *Biogluk* drug for 21 days.

Blood sampling was performed in sick guinea pigs on the 42nd day after infection, as well as during treatment on the 7th, 14th and 21st day after the start of drugs. Skin biopsy was performed on days 7 and 14 after the start of treatment.

The results showed that in the treatment of microsporia with itraconazole and clotrimazole, the inflammatory response of the body was suppressed, as evidenced by a decrease in the number of leukocytes, rod neutrophils, ESR, and an increase in segmental neutrophils. Thrombocytopenia and eosinophilia are noted. The most common cause of thrombocytopenia are allergic reactions. Eosinophils in the blood increase when the body is sensitized by an allergen. Taking into account the same conditions of keeping and feeding of experimental groups of animals, as well as the presence of clotrimazole in all treatments, it can be assumed that itraconazole provokes allergies. During treatment, a slight increase in T-helpers and a decrease in T-suppressors were detected. Histological examinations on the 7th day of treatment showed moderate infiltration in the dermis and slight stratification of collagen fibers. On the 14th day of treatment, the infiltration of the dermis with lymphohistiocytic components with single eosinophils persists, which indicates the course of an inflammatory reaction with signs of allergy.

In the treatment of microsporia with 1% solution of clotrimazole and *Vakderm* vaccine there is a decrease in the number of leukocytes, rod-shaped neutrophils, ESR and an increase in segmental neutrophils, a slight increase in T-helpers and a gradual decrease in T-suppressors. Histological examination revealed that on the 7th day there are signs of exfoliation of horny cells, hyperplasia of the basal layer is absent. On the 14th day there is active hyperemia of the basal layer of the epidermis, but blood vessels in the dermis without signs of congestive hyperemia.

After using the *Micromar* antifungal drug and *Biogluk* immunostimulator in the treatment of microsporia the number of leukocytes, rod-shaped neutrophils, ESR decreases, and segmental neutrophils increase. There was an increase in T-helpers. There is a decrease in natural killers and T-suppressors. The histological structure of the skin on the 7th day of treatment is characterized by visualization of the layers of the epidermis. In the dermis there is an expansion of blood capillaries. On the 14th day single erythrocytes in the dermis are the criterion of normal.

The results showed that the *Micromar* and *Biogluk* drugs do not cause side effects and provide rapid regeneration of the affected areas of the skin.

Key words: microsporia, blood, leukocytes, epidermis, clotrimazole

Fatty acid composition in carp liver and skeletal muscles after vitamin and mineral supplementation

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The role of adequate mineral and vitamin nutrition in proper functioning of reproductive system of female carp especially at pre-spawn period is in the focus of investigators throughout the world Thus, the aim of our study was to investigate the effect supplement with different level of fat-soluble vitamins A, D, E and trace elements selenium, zinc and iodine on fatty acid composition in the liver and skeletal muscles of female carp at pre-spawning period.

Female carp of control group 30 days before the intended spawning were fed with granulated feed. Female carp of first experimental group during the month were fed a similar food with addition that contains 2,500 IU vitamin A, 3333 IU vitamin D_3 and 1.7 mg vitamin E and also trace elements — potassium iodide — 5 mg/kg of food, zinc sulfate — 40 mg/kg and sodium selenite — 0.3 mg/kg. Female carp of the second experimental group were feed with addition that contains 5,000 IU vitamin A, 6666 IU vitamin D_3 and 3.3 mg vitamin E and also trace elements — potassium iodide — 10 mg/kg of food, zinc sulfate — 60 mg/kg and sodium selenite — 0.5 mg/kg.

It has been established that vitamin and mineral supplement to carp diet leads to the increase of the level of mono- and polyunsaturated fatty acids in the skeletal muscle of female carps. Significant decrease of palmitic acid to 14.1% in II experimental group compare to 19.06% in control ($P<0.5$) and simultaneous increase of oleic acid to 50.81%, in II experimental group compare to 44.84% in control ($P<0.5$) was demonstrated. It has been established the higher level of phospholipids in liver and skeletal muscles of carps after introduction of vitamins and mineral supplement. These results suggest the positive changes in lipid metabolism in female carp under influence of vitamin and mineral supplement at pre-spawning period in regard of enhancement of their reproductive function.

Key words: lipid individual classes, polyunsaturated fatty acids, saturated acids, supplement, carp

Bioenergy potential and technological features of animal waste utilization

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It is known that the potential of organic waste of natural origin (biomass) can provide about 10% of Ukraine's total primary energy needs or replace about 5.0 billion m^3/year of natural gas. Statistics on the potential of secondary bioenergy resources of animal origin in Ukraine and Lviv region in particular indicate the need to use them in the agricultural sector (production of organic fertilizers, restoration of soil fertility), or as a replacement for traditional fuels (biogas production) in industries agriculture and more.

The energy potential of biomass of Lviv region was assessed by scientists of LNAU in terms of the level of biogas substitution of natural gas as the main type of fuel in the settlements of the region. The results of the calculations show that the possible replacement of traditional fuel by 2.2 times is exceeded due to the conversion of biomass above the level of its consumption. Moreover, it should be noted that the volume of substitution of natural gas by biogas from livestock waste is 14% of the total, giving way to the volume of energy crops (52%).

In Ukraine today there are no strict requirements for methods of utilization (composting, anaerobic biological, physicochemical or mechanical-biological treatment) of such waste by farms. A large amount of organic livestock waste (manure) remains an unresolved environmental problem. The Food and Agriculture Organization (FAO) estimates that 18% of all greenhouse gas emissions come from livestock, which is more than transport emissions.

An urgent task today is to assess and implement the potential energy potential of the regions of Ukraine in the processing of agricultural organic waste to obtain by-products of biogas and high quality biofertilizers, as well as the state of scientific and technical support for the use of this potential.

The use of existing devices for natural gas for biogas combustion is impossible for the following reasons: reduction of the combustion device capacity by almost 1.9 times and change of conditions for mixing gas jets with air.

The most important calculated value in the conversion of boilers from natural gas to biogas is the diameter of the nozzle holes. When converted to biogas, the range of the biogas jet will be 1.38 times greater than the natural gas jet, which leads to a violation of the distribution of jets in the air stream, reducing the already low resistance to combustion and the tendency to flare.

The main disadvantage of biogas combustion in the furnaces of powerful units is the instability of the volumes of fuel produced, the narrowed limits of regulation of biogas combustion. To ensure reliability due to the variable amount of biogas produced, it is desirable to have a reliable heat supply and the ability to operate boilers on both natural gas and biogas.

When converting natural gas burners to biogas combustion, it should be borne in mind that the normal rate of biogas flame propagation is significantly lower than when burning natural gas.

The following types of burners can be used for biogas combustion: hearth burners for *ДКВР-6,5-10* boilers, or vortex burners for burning biogas and natural gas in steam boilers type *ДЕ-16*.

One of the significant advantages of biogas is the reduction of emissions of harmful substances during its combustion than during the combustion of natural gas. In particular, emissions of nitrogen oxides in the products of natural gas combustion during the transition to biogas combustion is reduced by 40–50%.

Key words: organic waste, potential, biomass, biogas, burning

Phylogenetic analysis of *Streptomyces* genus isolates from the spoil heap of central enrichment factory "Chervonohradska"

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Actinobacteria are often isolated from coal mining sites, mining waste disposal sites.

We have isolated representatives of *Streptomyces* genus near the rhizosphere of *Phragmites australis* (Cav.) Trin. ex Steud., growing near Central Enrichment Factory "Chervonohradska" (CEF) spoil heap. Capability of actinobacteria of adapting to such surroundings indicates on the potential tendencies of their practical usage in bioremediation. Creation and supporting of vegetation on coal mine spoil heaps is the classical method of bioremediation, which enables the decrease of their erosion.

Isolates (CEF-12 and CEF-13), representatives of *Streptomyces* genus, isolated at the Department of Microbiology of Ivan Franko National University of Lviv from the black rock of CEF heap and near P. australis, respectively, were used in this work. Waksman medium was used for the cultivation of microorganisms, g/l: yeast extract — 10; glucose — 10; NaCl — 5; $MgSO_4 \times 7H_2O$ — 0.25; $FeSO_4 \times 7H_2O$ — 0.01. Microorganisms were grown at 28°C in flasks on the circular shaker for 3 days. Glass beads were added to the medium in order to provide the suspension growth of actinobacteria.

Chromosomic DNA was isolated by soft lysis method (Green, Sambrook, 2012). Purification from proteins was performed by the salting out with potassium acetate. DNA was sedimented with isopropanol accompanied by washing with 70% ethanol. DNA was dissolved in the deionized water. 16S rRNA gene was amplified, using universal primers: 27F AGAGTTTGATCCTGGCTCAG and 1492R GGTTACCTTGTTACGACTT (Turner et al., 1999). PCR reaction was performed in 50 µl volume in 2 tubes for each strain usint Taq-polymerase (NEB M0273X). Chromosomic DNA of strains was used as the matrix for PCR reaction. PCR reaction products were analyzed by the electrophoresis in agarose gel and visualized by staining with ethidium bromide. PCR products were purified from the gel using silica columns, analyzed for the concentration of DNA and quality of purification. Products were sequenced from 27F AGAGTTTGATCCTGGCTCAG and 1492R GGTTACCTTGTTACGACTT primers, using *BigDye terminators* mix. Fragments were analysed at *ABI Prism 3130 xl*. Obtained nucleotide sequences (two for every sample, corresponding the transcription of DNA from 27F and 1492R primers) were analyzed for data quality, collected into one sequence for each strain, non-reliable edges were cutted and sequences were analyzed usind BLAST search in *GenBank* database. Nucleotide sequences, which had the identity values over 99% according to BLAST in SILVA database were used for the phylogenetic reconstruction. Multiple alignment was performed in *ClustalW* application. Phylogenetic reconstruction was performed in MEGA X application by the method of maximal probability after 1000 butstrep replications; nucleotide substitution model T92+G+I.

The same species, particularly, *Streptomyces globisporus*, *Streptomyces tanashiensis* and *Streptomyces parvus*, are the closest relatives of isolates *Streptomyces* sp. CEF-12 and *Streptomyces* sp. CEF-13. Nevertheless, the simultaneous phylogenetic reconstruction of these two isolates shows that phylogenetic distance ~0.0037 is present between *Streptomyces* sp. CEF-12 and other bacteria (*Streptomyces* sp. CEF-13, *S. globisporus*, *S. tanashiensis* and *S. parvus*).

Key words: coal mine spoil heaps, *Streptomyces*, phylogenetic reconstruction

Changes in the chemical composition of milk in sheep grazed in mountain pastures in Pieniny

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An important element in extensive agriculture is the management of permanent grassland for pasture animals. Sheep grazing in mountain areas is an example of management consistent with the principles of eco-development. Shepherding stimulates the development of the market of traditional and regional products, as well as the development of cultural tourism. Sheep's milk is characterized by a rich chemical composition and is an excellent raw material for processing into valuable products. The aim of the research was to analyze the chemical composition of sheep's milk during summer grazing in the Pieniny Mountains in the Polish Carpathians.

Milk was collected for the research from 550 Polish Mountain sheep (n=250) and Podhale Cakiel (n=300) grazing in the Jaworki pasture in the Carpathians. Milk was collected twice a month, the first collection was made at the beginning of May and the last one in September. Chemical composition analysis (dry matter, protein, fat, lactose and fatty acid profile) was performed in the collected samples. The obtained results were analyzed statistically.

In the first collection (May), the protein content of the Podhale Cakiel breed was (6.15±0.4%), and in the Polish Mountain sheep (6.085±0.3%). As lactation progressed, the protein content increased. In the last month of milking (September) the protein content in the milk of the Podhale Cakiel was (8.04±0.6%), and in the Polish Mountain sheep (7.7±0.5%).

Analyzing the milk fat content of sheep while grazing in pastures, it was shown that in the first collection (May), the milk of the Podhale Cakiel contained (6±0.4%) fat, and that of the Polish Mountain sheep (5±0.3%). In the last collection (September), the fat content in the milk of the Polish Mountain sheep was (10±0.8%), and in the Podhale Cakiel was (7.55±0.5%). The high content of fat in the milk of the sheep was also associated with the high content of fatty acids, especially polyunsaturated acids (PUFA).

The conducted research showed that the content of CLA in the first sampling was the highest and in the Polish Mountain sheep it was (3.235%), and in the Podhale Cakiel (3.278%). In subsequent samples, the content of CLA was stabilized and in July in the Polish Mountain sheep it was (2.083%). In the last month of the research (September), the CLA content in the milk of the Podhale Cakiel was (2.442%), and in the Polish Mountain sheep (2.35%).

The conducted research showed that with the advancement of lactation, the content of dry matter and protein in sheep's milk increases. In contrast, the fatty acid content was stable. Sheep's milk is a source of natural bioactive substances that promote health on the functioning of the body. Sheep's milk fat contains the most CLA acid, which has antioxidant and anti-cancer properties. A diet rich in polyunsaturated fatty acids contributes to the reduction of the occurrence of civilization diseases. Sheep grazing and obtaining sheep's milk products using traditional methods help protect biodiversity and improve consumer health.

Key words: sheep, milk, chemical composition

The use of inositol for poultry

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Myo-inositol (cis-1,2,3,5-trans-4,6-cyclohexanehexol, vitamin B_8) contained in a phytic acid of plant feeds plays an important role in metabolism. Monogastric animals poorly assimilate inositol phosphorus from phytic acid, so their diets are usually supplemented with enzyme phytase, which breaks down phytic acid into myo-inositol, inositol phosphates, and inorganic phosphate.

Myo-inositol is involved to maintaining of the intracellular calcium level, regulation of insulin receptor activity, takes part in the catabolism of triacylglycerols, lowering blood cholesterol levels, modulating the activity of neurotransmitters. The metabolite of myo-inositol, inositol triphosphate, regulate the synthesis of some hormones such as thyroid-stimulating hormone, follicle-stimulating hormone, insulin, and elevate production of cytokines TNF-α and interleukin-6. In addition, inositol is an important component of cell membranes as a structural lipid. In the absence of inositol, inflammation of the intestinal mucosa, apoptosis and inhibition of cell proliferation, decreased antioxidant capacity are observed. Myo-inositol is important for lipid metabolism, bone formation, reproductive function, skeletal muscle contraction, and nervous system function. Inositols are polyols that act as modulators of oxidative metabolism, helping to decrease the oxidative stress. Inositol stimulates IGF/Akt/mTOR signaling pathway in the myocytes. Since this signaling pathway are responsible for protein synthesis and increased glucose absorption in the tissues, it may be possible to use inositol to improve the growth of animals. Supplementation of chicken diet with inositol increases feed intake, daily weight gain, gain-feed ratio, DM intake and digestibility; elevate concentration of total protein and calcium, and alkaline phosphatase activity in the blood. An important aspect is the effect of inositol on the nervous system. Chickens that receive inositol are less susceptibility to stress.

Despite the rather extensive information on the metabolism, biochemical and physiological effects of inositol in general, information on the results of its use in poultry remains insufficiently studied. In particular, the effects of inositol on the metabolism and productivity of chickens depend on age, physiological condition, type of productivity, composition of the diet.

Phytase is used in the diet of chickens currently; it is added to the feed in the amount of 500 units per kilogram of dry matter. The content of inositol is not normalized yet. However, there is a significant amount of scientific information on the effectiveness of inositol supplements and the positive effect of increasing the amount of phytase additives in poultry diet.

Up to 75% of the inositol necessary for bird is formed from glucose in many tissues and organs, for example, in the heart, liver, and kidneys, however, the introduction of additional amounts into the diet improves the metabolism and promotes higher productivity. There is information on the addition to the diet of chickens myo-inositol in the amount of 0.1 to 7% of dry matter of feed. The optimal amount is about 1%. The positive effect is achieved by increasing the amount of phytase in a fairly significant range. Thus, many experiments have shown that increasing the content of phytase in feed to 5–15 thousand units per kilogram of dry matter has a positive effect on the physiological state and productivity of chickens. This effect is caused by inositol, because the addition of excess phosphorus to the diet does not have such effect.

Key words: poultry, inositol, phytase, metabolism, production

Human hair keratin-based film for biomedical applications

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Keratins extracted from human hair in aqueous solutions can self-assemble into the films which are successfully used in tissue engineering because they have the ability to support and improve cell growth, adhesion, migration and proliferation as well as for controlled drug delivery.

The keratin extract obtained from human hair was used for the production of the films. The hair samples were ground, washed in 1% sodium dodecyl sulfate solution, rinsed for three times with distilled water and dried at room temperature. For keratin extraction we used mixture which consists of 25 mM Tris-HCl, 5 M urea, 2.6 M thiourea and dithiothreitol. Protein extraction was performed at a temperature of 60°C at pH 8.5 for 72 hours. The obtained extraction mixture was filtered and dialyzed against distilled water for three days, protein concentration was determined by colorimetric method using Bradford's reagent. The protein composition was investigated by electrophoresis using the Lemmley buffer. The gels were stained with a 0.2% solution of Coomassie R-250, and then washed with a 7% solution of acetic acid. We prepared two types of films by casting method: keratin-glycerol film prepared from a 4% solution of keratin in distilled water and a 1% solution of glycerol and keratin-based film in the same concentration but without glycerol addition. Obtained solutions in a thin layer were poured into Petri dishes and incubated in a thermostat for 24 h at 37°C. After that, the films were fixed in water vapor for 24 h. Characteristics of the film surface and elemental composition were studied using a scanning electron microscope with an X-ray microanalyzer.

After keratin extraction using DTT we obtained a protein solution at a concentration of 3.75 mg/ml which consists of two polypeptide chains with a molecular weight in the range of 40–60 kDa and proteins with a molecular weight of 10–30 kDa. These proteins were used for film preparing. The keratin-glycerol based film after stabilization in water vapor acquired a gel-like consistency, which is explained by the property of glycerol to accumulate moisture. The keratin-only film was very fragile which is not good characteristic for biomedical purposes. Scanning electron microscopy shows that the surface of the keratin-glycerol film is homogeneous, without cavities and holes, when the surface of keratin-based film without glycerol is not so homogeneous, with a large number of recesses and protrusions. The results of X-ray microanalysis of both types of films indicate the high presence of Sulfur. This is due to the large number of disulfide bonds in the keratin molecule. In addition to Sulfur, such elements as Sodium, Silicon, Sulfur and Potassium were also found.

The obtained keratin-glycerol film due to its better mechanical properties can be used in reparative medicine and tissue engineering.

Key words: keratin, extraction, film, biomedicine, casting

Intoxication of rumen microbiota with hexavalent chromium and its correction by Selenium and carotene *in vitro*

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Due to the widespread use of Chromium in various industries, the level of environmental pollution by Chromium(VI) compounds is quite significant, which creates a risk of their entry into the body of animals. This negatively affects the metabolism and productivity of animals, as well as the quality of livestock products. Chromium(VI) is a metal-carcinogen that is able to directly form reactive oxygen species by interacting with cellular reductants by reduction through the active intermediate forms Chromium(V) and Chromium(IV) to a stable form, Chromium(III). The negative effects of oxidative stress can be prevented by adding increased doses of antioxidants.

The studies were performed *in vitro* using samples of the rumen content from three bulls-analogues of the Ukrainian dairy black-spotted breed. The contents of the rumen were taken two hours after morning feeding using a stomach pump. The filtrate of the rumen content was transferred into McDougall buffer (25 ml of filtrate + 75 ml of buffer) and performed three series of incubations with the addition: Chromium(VI) in the amount of 0.5 ppm as potassium bichromate; 0.5 ppm Chromium(VI) + 0.5 ppm sodium selenite; and 0.5 ppm Chromium(VI) + 0.5 ppm β-carotene. Samples without added compounds were used for control. Vessels with these mixtures were incubated in an atmosphere of carbon dioxide at a temperature of 38°C for 24 hours.

After incubation with Chromium, in the rumen content the amount of microbial mass, concentration of volatile fatty acids, amylolytic activity and pH were decreased. This effect can be explained by the powerful oxidizing action of Chromium(VI). Hydrogen is released during bacterial metabolism, and excess hydrogen can inhibit the growth of some groups of microorganisms, including cellulolytic, for which hydrogen is a strong inhibitor. The addition of potassium dichromate inhibited the formation of ammonia, the reason for this was a decrease in the proteolytic activity of microorganisms, resulting in decreased protein catabolism and deamination of amino acids.

The introduction of sodium selenite affected the hydrolytic enzymes in the incubation medium, in particular activated amylases and cellulases. Selenium decreased the concentration of ammonia and increased the concentration of short-chain fatty acids and cellulosolytic activity.

Positive effects on the growth and metabolic activity of microorganisms were found with the addition of β-carotene, which led to the activation of the intensity the fermentation processes, growing of microbiota mass, increasing the concentration of volatile fatty acids. Amylolytic and cellulosolytic activity of microorganisms and concentration of ammonia in the incubation medium have also risen.

From the obtained results it follows that the addition of sodium selenite and β-carotene stimulates the growth and functions of rumen microorganisms intoxicated with Chromium(VI).

Key words: rumen, oxidative stress, potassium bichromate, sodium selenite, β-carotene

Antiseptic hydrogel bandages for use in veterinary medicine

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Currently, the production of new generation dressings has become a field of chemistry of medical polymers, which is developing rapidly. Modern dressings are significantly different in design and properties from traditional ones. Before these were exclusively textile materials (gauze, mesh, knitwear, nonwoven fabric), but now it is films, film compositions, sponges, hydrocolloids, gels, pastes, and combinations of different materials. The analysis of the literature shows the existing trend of finding ways to create new types of bandages that would retain the functions of their predecessors and, in addition, would have additional functions that would significantly increase their effectiveness.

Therefore, polymer hydrogels as materials for pharmaceuticals and medicine, on the basis of which are developed tools of different physical forms and purposes, are of considerable interest. The topicality and uniqueness of their use are that they have biocompatible properties, do not cause irritation and reactions from body tissues that come into contact with them, serve as a barrier to penetration into the wound of microorganisms, and are gas-permeable, creating an ideal healing microclimate. Hydrogel dressings in the wet therapy of injuries of various origins have already found widespread use in medicine and have shown a significant advantage over traditional dressing materials. In veterinary medicine, moist wound healing has not yet found such a spread.

This investigation aimed to create a hydrogel dressing with antiseptic properties based on polysaccharides with satisfactory physical and mechanical properties for medicine and veterinary medicine during surgery and postoperative wound care.

The developed antiseptic bandage is a hydrogel plate (water content up to 40%) 10÷20 mm wide and 2÷4 mm thick, reinforced with cotton or polypropylene mesh up to 0.3 mm thick and up to 20÷30 mm long. The hydrogel plate is formed based on a mixture of polysaccharides (citrus pectin and sodium alginate). The formation of the hydrogel plate provides its sufficient physical and mechanical properties and the ability to absorb 45 g/dm^2 of exudate. At the same time, the hydrogel plate remains vapor and air permeable, which has a positive effect on the course of skin regeneration processes during postoperative wound care.

The making of chlorhexidine or betadine into the hydrogel dressing provides bactericidal properties. The prolonged release of these drugs from the hydrogel plate into the affected area inhibits gram-positive and gram-negative bacteria development for 100–140 hours. The obtained antiseptic hydrogel dressings provide comfort in use, maintain the water balance of the wound, and to a large extent, prevent physical effects on the injury.

Key words: hydrogel, pectin, sodium alginate, chlorhexidine, betadine

Influence of immunotropic liposomal preparation on forming immune response in weaned piglets

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In pig breeding, the problem of stress is especially relevant. Weaning from sows is stressful for piglets' organisms and causes the changes in non-specific and specific reactions, harmful radicals accumulate in cells. In this regard, it is advisable for piglets in critical growth periods to use antioxidant and immunomodulatory drugs. Diverse pharmacological agents are used in veterinary. Their disadvantage is the short duration of action. It implies the necessity of their permanent injections for the achievement of steady concentration in the bloodstream. Today it is more expedient to apply preparations in the form of liposomal emulsions. Liposomal preparations have a high therapeutic effect, prolonged action, and they are economically sound and safe.

The research aim was to study the effect of liposomal preparation on the activity of T- and B-cell links of immunity in weaned piglets.

One carried out the experiments on two groups of piglets-analogues. Piglets of the control group were injected with isotonic sodium chloride solution and animals of the experimental group — with liposomal preparation in a dose of 0.1 ml/kg of body weight for 2 days before weaning. The preparation is based on vitamins A (9000 IU), D_3 (11000 IU), E (9.0 mg), L-arginine (18.0 mg), Zinc (9.0 mg), Selenium (0.1 mg) and Cobalt (3.0 mg). As the research material the lymphocytes isolated from piglets' blood 2 days before and on the 1st, 5th and 10th day after weaning were used. The total number of T-rosette-forming cells and their subpopulations: active lymphocytes, lymphocytes-helpers, lymphocytes-suppressors were determined in blood. The immunoregulatory index was determined by the ratio of helpers to suppressors, the functional activity of T-lymphocytes was estimated in blast transformation reaction of lymphocytes (RBTL). B-lymphocytes were determined in reaction of complementary rosette formation. One performed statistical result analysis using programs *Microsoft Excel*.

Injections of fat-soluble vitamins, L-arginine, zinc, selenium and cobalt in the composition of liposomal preparation contributed to an increase the relative number of T-lymphocytes in piglets' blood. Reliable differences were obtained regarding the increase of total lymphocytes in piglets' blood on the 5th day after weaning ($P<0.001$) and active lymphocytes — on the 10th one ($P<0.05$).

There was a decrease in the number of undifferentiated forms of active lymphocytes ($P<0.05$) in piglets' blood in the experimental group, in comparison to the control one, on the 10th day after weaning. The relative number of T-helpers in piglets' blood in the experimental group increased on the 10th day after weaning. Injection of preparation on the 10th day after weaning strengthened ($P<0.05$) the functional activity of lymphoid cells of piglets involved in RBTL. Preparation improved an increase in the relative number of B-lymphocytes in piglets' blood on the 10th day after weaning ($P<0.05$).

The obtained results show a stimulating effect of components of liposomal preparation on the activity of regulatory subpopulations T- and B-lymphocytes of piglets. The preparation increases the functional activity of the cellular link of piglets' immunity and, therefore, positively influences on the formation of immune potential.

Key words: piglets, T- and B-lymphocytes, liposomal preparation

The expression of heat shock proteins in fish as a sensitive biomarker of pollution by heavy metals

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Heat Shock Proteins (HSP) belong to the natural biomarkers, which are important indicators for animal diseases diagnostics and/or instrument of analyzing the effects on organism of the habitat deteriorating factors. The contamination of water by heavy metals has adverse effect on fish organism. Even in a small quantity, such heavy metal as lead is very dangerous. The analysis of toxic effects of the lead ions on the level of expression of such heat shock proteins as HSP_{60}, HSP_{70} and HSC_{70} family in leukocytes, liver, brain and gills of the scaly carp was the main goal of our investigation.

Concentration of HSP_{60}, HSP_{70} was determinated by the dot-blot-analysis due to application of monoclonal antibodies against heat shock proteins SAB4501464 (*Sigma*, USA), [5A5] (ab2787) (*Abcam*, USA) and [1B5] (ab19136) (*Abcam*, USA) and polyclonal goat antimice antibodies, conjugated with alkaline phosphatase (*Tropix*, USA). Necessary levels of heavy metals concentrations in all series of experiment were simulated by adding in the water environment of the pool with the fish of lead (in the form of $Pb(CH_3COO)_2 \times 3H_2O$) to reach concentrations in 0.2; 0.5 and 5 mg/dm³. The blood was sampled by Pasteur pipette from the heart of fish. The tissues of liver, brain and gills were removed from the fish and washed by physiological saline solution. After defrosting, the tissue was lysed in the ten- fold volume of the lysis buffer, pH 7.4 (10% N-laurylsarkosine, 10 μM phenylmethylsulfonyl fluoride, 10 μM N-ethylmaleimide in 0.01 M N-phosphate buffer, 0.001% proteinase inhibitor cocktail — *Sigma*, Germany). Lysates were put on nitrocellulose membrane (*Millipore*) in a volume of 3 μl with concentration of total protein approximately 1–5 μg. To detect background indices, the lysis and delution buffers were applied on the membrane. The membrane was blocked for 1 hour by 5% solution of casein. Detection of immune complexes was performed by using of commercial substrate solution for alkaline phosphatase — CDP-Star (*Tropix*, USA).

The concentration-dependent growth ($P<0.01$) of HSP_{60} and HSP_{70} in all experimental groups with applicable lead concentrations was detected applying dot-blot analysis. Comparing with the control group, the concentration of HSP_{60} and HSP_{70} in the white blood cells increased as much as 15 and 98 times, respectively. The highest level of the proteins expression (185.2±12.39 U.S. for HSP_{60} and 252.3±18.64 U.sup.v. for HSP_{70}) was recorded in the liver of fish.

Trace amounts of HSP_{70} were detected in the gills of the fish of the control group. The fish exposed to the lead effects in concentration of 0.2 mg/l was characterized by no significant changes in the content of the investigated proteins, while concentration of lead in 0.5 mg/l and 5 mg/L in water resulted in increase of the studied parameters to almost 5 and 15 times for HSP_{60} and 107 and 144 times for HSP_{70}. It was established that in comparison with the control group, none of the applied concentrations of lead brought on significant changes in the expression of HSC_{70} protein in the investigated organs of *Cyprinus carpio* L.

It could be explained by the fact that HSP_{60} and HSP_{70} belong to the group of stress-proteins affected by wide range of stressors, in particular, the heavy metals. Moreover, HSC_{70} is involved in more specific mechanisms of response on the deterministic stress-induced factors. Thus, the obtained data indicates that stress-proteins are possibly applicable as the sensitive markers of toxic effects of the lead.

Key words: heat shock proteins, HSP_{60}, HSP_{70}, HSC_{70}, dot-blot analysis, fish, lead

Environmental risks and prospects in the field of animal waste disposal

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One of the most pressing problems that needs to be addressed is the problem of animal waste disposal, as the industry is developing rapidly and shows an annual increase in production, and as a result — an increase in waste generation. The main threat to the environment (epidemiological and toxicological) are animal by-products, which include carcasses or part of carcasses of slaughtered, dead animals, raw materials and products of animal origin that are not intended or declared unfit for human consumption, is the cause of infection and contamination of soils, groundwater.

Depending on the degree of risk to human and animal health, causes of death, and the presence of diseases, animal by-products are classified into three categories, and accordingly there are different possible ways of handling each category of such products. Thus, by-products of category I are subject only to disposal, products of category II — can be used for the production of organic fertilizers, composted or converted for biogas used as fuel for combustion, etc., products of category III — can be processed by sterilization under pressure or other equivalent methods and used for the production of animal feed. Only animal by-products that have undergone veterinary inspection and can be used for production after appropriate processing at licensed plants may enter the feed chain.

Equipment for the disposal of animal waste and the production of animal feed also poses a certain threat to the environment, as it is associated with the formation of emissions of pollutants into the atmosphere, such as water vapor, carbon dioxide, nitrogen dioxide, organic dust and methyl mercaptan.

Promising in the field of animal waste management is the use of animal waste disposal complexes with the subsequent production of meat and bone meal and animal feed, where it is possible to use technologies related to cooking, sterilization and dehydration of non-food protein raw materials and confiscations.

By-products other than disposal for animal feed can be processed according to modern technology into organic fertilizers, composted or converted into biogas, processed by pressure sterilization or other equivalent methods and used for pharmaceutical, surgical, industrial or agricultural production. Meat and bone meal can be used as a natural fuel for energy generation, in cement kilns and in the production of renewable electricity.

The potential of using modern technologies for the utilization of livestock waste to solve environmental problems in Ukraine is significant and needs to be developed.

Key words: animal waste, environmental pollution, utilization, ecological risk, utilization technologies

Influence of changes in the diet structure on the fatty acid of cows' milk lipids

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It is a well-known fact that cow's milk contains a relatively small amount of polyunsaturated, including essential (linoleic and linolenic) fatty acids. It is due to the action of enzymes of the symbiotic microflora of ruminants' rumen, and, therefore, polyunsaturated fatty acids are hydrogenated, which leads to a sharp decrease in their number and increase in stearic acid content. This metabolism of polyunsaturated fatty acids in ruminants' rumen causes an increase in the content of stearic acid in milk lipids. One can associate high levels of stearic acid in livestock products and low levels of polyunsaturated fatty acids with people's atherosclerosis development. Instead, linoleic acid has anti-atherosclerotic and anti-cancer effects.

In recent decades, protected fat supplements are used in order to reduce the hydrogenation of polyene fatty acids by enzymes of ruminal microorganisms in the feeding of cattle. One has established that it is possible to change the structure of the diet that is to feed basic and concentrated feeds in different ratios so as to increase the level of unsaturated fatty acids in milk lipids.

After analysis of the above-mentioned information, the aim of our work is a comparative study of the effect of diverse diet structures on the fatty acid composition of lipids in lactating cows' milk.

We conducted the study during a 60-day summer period on cows of the Ukrainian black-and-white breed, divided into two groups of 10 cows in each of them on the principle of analogues. Animals of the control group during this period had a typical basic diet in which the share of green fodder, which included: common couch grass (*Elymus repens*), timothy (*Phleum pratense*), common meadow grass (*Poa pratensis*), white lotus, cow vetch (*Vicia cracca*), white clover, accounted for 70% of nutrients, and the crushed grain mixture: wheat bran, barley bran and oat bran (30% in nutritional value).

Cows of the experimental group had a feed diet in which pasture grass accounted for 90% of nutrients and concentrated feed — 10% of nutrients. One also added mineral supplements to cows' diets in the control and experimental groups. The animals had free access to water.

The fatty acid composition of milk lipids was determined by the Kurko method. The obtained results were processed biometrically using *Microsoft Excel*.

The obtained data indicate that feeding cows with green fodder accounted for 90% of the nutritional value of the diet, and concentrated fodder — 10%. It increases the content of oleic ($P<0.05$), linoleic ($P<0.05$) and linolenic fat acids and reduces the level of stearic acid in milk lipids, compared with the control group, which indicates an increased level of unsaturated fatty acids in the body of animals considering a low level in the diet of cereals.

In summer feeding lactating cows with green fodder, concerning nutrition was 90%, and concentrated fodder — 10%, compared with animals whose diet consisted of green fodder — 70% and cereals — 30% considering nutrition, improves milk quality due to increasing the content of unsaturated and reducing the level of saturated fatty acids in the composition of triacylglycerols in milk.

Key words: lactating cows, diet structure, fatty acids

Selection characteristics of horses of Novooleksandrivska draft breed

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Novooleksandrivska draft breed of horses was bred in Ukraine on the basis of Novooleksandrivsk factory type horses of Russian draft breed of horses. Novooleksandrivska draft breed of horses, officially approved in 1998, is currently represented in Ukraine by very limited livestock. When working to create a new breed, much attention was paid to creating a developed genealogical structure, which includes both male lines and mare's families.

Novooleksandrivska draft breed of horses belongs to small draft breeds. But in comparison with the original Russian draft breed, modern horses of the Novooleksandrivska draft breed of horses are larger, which is due to the use in working with the breed of crossbreeds with the Soviet draft breed, Perseron, Russian and Oryol trotting and riding breeds. All, the influx of blood from other breeds were carried out through the uterus.

Horses of the Novooleksandrivska draft breed are characterized by a harmonious physique, strong, dry constitution, dampness of joints is extremely rare, elongated, powerful body, strong limbs of the correct structure and posture. Great importance is attached to the correct structure of the hooves and the density of the hoof horn, as horses of the Novooleksandrivska draft breed must tolerate long-term grazing and intensive work in different regions of Ukraine, from the steppes of Kherson to the Carpathian Mountains. Goodwill and recoil in work — a distinctive feature of horses of the Novooleksandrivska draft breed. They have high reproduction rates and are undemanding to the conditions of feeding and keeping.

The use of such techniques as breeding in mare families in breeding work is just as important as breeding along male lines, since the animal receives half of the genotype from the mother.

During the study, representatives of 13 old families mares were identified, namely: BORONKI, (06) BRUSNIKI, VERBOVOI, ZAIMKI, ZEMLYNKI, (028) KOVARNOY, (1147) KOLYONOY, KRALI, (664) LUKAVOI, (327) NAIDI, (161) ROCKETS, (0919) TOGI, (0923) TUNGUSKI.

In addition, identified representatives 12 new unregistered families and nest mares. Of these, 9 groups of mares, descended from a common ancestor, meet the requirements of families (47) HERALDIKI, (437) GRECHKI, (1848) KENGI, (1902) LAVES, (166) REPETICIYA, RAZNORYADKI, (176) RUDI, (236) TETIVI, FACTURI. 3 groups of mares, coming from a common ancestor, meet the requirements for nests (LOGUNI 95, 146 NEGI 04, MALUTKI).

Also geological lines of stallion sires were studied. At present, only 3 lines of stallions remain in the breed, namely: (935) KOKETLIVOVO, (1390) TANTALA, (909) GRADUSA. There are no stallion lines left for 2021: (109) GAZONA, (200) CAPITENA, (1111) STYLYA, only the uteri of these lines remain.

Currently, the best representatives of the breed are horses bred in the branch "Novooleksandrivsky equestrian plant no. 64" SE "Horse breeding of Ukraine". To maintain a certain heterozygosity in a breed of horses with a limited gene pool, it is necessary to maintain a branched genealogical structure. It is necessary to continue work on selection and selection assessment of new genealogical branches and their registration as independent families and factory nests.

Key words: horses, draft horses, genealogical structure

Selection features of Carpathian breed bees

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Among the factors that create conditions of human being life process, a significant place belongs to the selection of breeding and productive qualities of bees. A promising area of breeding work in beekeeping is hybridization and the use of interbreed hybrids, which provide a significant increase of productivity in the first generation. Given the above, the aim of our research was to study individual selection features of bees of different genealogical development of the Carpathian breed.

It was formed 6 groups with 10 bee families in each group: I — the control group — the type of Carpathian breed "Vuchkivskyy", 10 bee families; II — research group — the inbred group 2018 ♀ micropopulation "915" × ♂ micropopulation "915", 11 bee families; III — the experimental group — selection cross ♀ line "Sto" × ♂ micropopulation "915", 10 bee families; IV — the experimental group — selection cross ♀ "Vuchkivskyy" × ♂ micropopulation "915", 10 bee families; V — the experimental group — selection cross ♀ line "Troisek 07" × ♂ micropopulation "915", 10 bee families; VI — the experimental group — selection cross ♀ micropopulation of G. Macha × ♂ micropopulation "915", 10 bee families.

The highest indices of Carpathian queen bee fertility were observed in May-June. Queen bees of the selection cross ♀ line "Troisek 07" × ♂ micropopulation "915" in the period from 17 to 28 May 2020 showed the best egg production (1738.5 eggs).

It has been established that bee families did not lose much strength during the winter. The loose of bees in all groups was in the range of 0.066–0.081. At the same time, the lowest indicator bees had in the second group.

Analysis of the hygienic behavior of bees showed 69.7–76.3% of the removal of damaged larvae in 12 hours after the damage of the closed cells. The second group of bees had the highest percentage of removal of damaged larvae. The sixth group of bees cleaned the least damaged cells — 69.7%, which is probably less than bees of the control group by 4.6% ($P<0.05$). After 24 hours of damage, the fifth group of bees had the highest percentage (92.8%), and bees in the sixth group still the lowest (90.9%). However, it should be noted that according to the above indicator, the control group was probably dominated only bees of the third group and this advantage was 1.5% ($P<0.05$).

Bees of the fourth group were the best in terms of resistance to varroosis. The bee families of the inbred cross of micropopulation "915" were the strongest before winter, and bee families of the sixth group were the weakest. The difference between them in this indicator was 4854 individuals ($P<0.05$). Most of the crosses were peaceful and only the bee families of the local Carpathian population and the cross ♀ "Vuchkivskyy" × ♂ micropopulation "915" were vicious.

Bees of the fourth group showed the best results of spring honey harvest — 10.5 kg, which is in 1.5 kg more than bee families of the control group. Bees of sixth group showed the highest indicator of summer honey harvest — 17.5 kg. Bee families of this group had the largest quantity of honey in the results of spring and summer honey harvest (27.7 kg).

Thus, the bees which were got out of the combination of the queen bee and male-bee of micropopulation "915" were characterized by the best resistance to winter, bee families of the second and fifth groups had the best hygienic activity in 12 and 24 hours after damage of the brood, queen bees of the fifth group in the period of May 17 to 28, 2020 showed the best egg production. Bee families of the sixth group (27.7 kg) were characterized by the highest indicators of spring and summer honey harvests.

Key words: Carpathian breed bees, resistance to winter, hygienic activity, egg production, honey yield

The content of phospholipids and their fractional composition in plasma of healthy and ketotic cows

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Ketosis of cows is one of metabolic disorders, causing significant decrease of milk productivity and pretermed sorting out of animals. Lipid metabolism plays a crucial role in the pathogenesis of ketosis, since under the deficit of metabolic energy gluconeogenesis is activated, which covers energy demand using internal reserves, in particular lipids. Majority of experimental papers are dedicated to investigation of the metabolism of neutral lipids. The main attention in our work is directed to examination of the content of phospholipids and their fractional composition in plasma of cows with ketosis, because in our opinion this may be important in exploration of the pathogenesis of the disease as well as in the analysis of the depth of pathological processes and intensity of disease development.

Study was performed in March on ten cows of Holstein breed in their 2nd–4th lactation with milk yield approximately 7.8–8.2 thousands of kg of milk per lactation. Clinical examination of cows was performed and the content of ketone bodies in urine was detected with diagnostic strips, which allowed to establish the diagnosis of ketosis. Laboratory examinations showed that the ketosis was accompanied by hepatodystrophy, secondary osteodystrophy and hypofunction of thyroid gland. The content of phospholipids and their fractional composition (lysolecithin, sphingomyelin, phosphatidylserine, phosphatidylcholine, phosphoinositol, phosphatidylethanolamine, cardiolipin, phosphatidic acid) was determined in plasma of cows using thin-layer chromatography technique. Obtained results were compared to such parameters in clinically healthy animals (n=10) which were kept on the same farm in analogous conditions.

Conducted investigation of plasma content of phospholipids in ketotic cows revealed their significantly lower content ($P<0.05$) in comparison with clinically healthy animals (1.6±0.31 mmol/l *vs.* 0.9±0.07 mmol/l). We suggest that fatty hepatodystrophy, which is concomitant with ketosis, may be the main reason for the change of phospholipid synthesis. Disorders of phospholipid synthesis in case of hepatocytes injury are explained not only by the deficit of lipotropic substances, but also by insufficient formation of ATP in liver cells, which serve as the source of energy for synthetic processes. Conducted laboratory analysis of the fractional composition of phospholipids in plasma of cows showed a range of differences. In particular, in plasma of affected with ketosis cows the levels of phosphatidylserine and phosphatidylcholine were significantly higher (2.8- and 3.2-fold respectively, $P<0.05–0.001$), and the level of phosphatidylethanolamine was lower (by 32%, $P<0.05$). The main reason for these changes is the activation of compensatory mechanisms, directed to reparation of hepatocytes, compensation of energy deficit and detoxication of organism. Moreover, the tendency to lowering of the level of sphingomyelin (by 14%) was revealed. The latter may be used as intermediator in cortisol synthesis, which in its turn is used for intensification of gluconeogenesis. The level of other fractions was not significantly changed.

Changes in plasma phospholipid compositions was revealed in ketotic cows. In particular, relative level of phosphatidylethanolamine was lower, and levels of phosphatidylserine and phosphatidylcholine were higher on the background of decrease of the general content of plasma phospholipids in 1.8 times ($P<0.05$).

Key words: cows, ketosis, metabolic, phospholipid

The influence of biologically active preparations on the reproductive qualities of sows

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The work concerns the study of the reproductive qualities of sows that received, in addition to the main diet, a biologically active preparation (monoprotein) synthesized from brewer's yeast waste. For this purpose, two groups of sows were formed, experimental and control ones containing 5 animals in each group. The preparation was administered in addition to the main diet of sows 30 days before farrowing and 10 days after farrowing at 3.3 mg per 1 kg of feed.

It was found out that the enrichment of rations for pregnant sows with a biologically active preparation (monoprotein) allows an increase in the number of born piglets by 1.6 heads more than in the control group. There were 0.8–0.31 stillborn piglets in the experimental group or 1.0 piglets less compared to the control group. Enrichment of the diets of sows 30 days before farrowing with a biologically active agent had a positive effect on the live weight of the nest at birth and on the 21st day. The average live weight of piglets in the nest of the experimental group was 0.85 kg higher than the average live weight of piglets in the nest of the control group. The average live weight of one piglet at birth in the experimental group was 1.7 kg, and in the control group 1.4 kg, which is 0.3 kg less. Hematological and biochemical blood tests were studied at the beginning and at the end of the experiment, as well as the amino acid, macro and microelement composition of the preparation.

Key words: piglets, live weight, monoprotein preparation, blood, amino acids, macro- and microelements

Fatty acids content control in food products by gas chromatography

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Nowadays, foods are often classified by fat content today. In different food products there is a certain fatty acid composition is characterized for. Manufacturers must include the content of fats, proteins, carbohydrates, fats (saturated, monounsaturated and polyunsaturated) and energy value on the labels in accordance with current law. Plant products such as coffee, oils and soy have a specific interrelation of fatty acids. Mainly they are palmitic, stearic, oleic, linoleic and others. For example, butter has a specific indicator of fatty acids content such as lauryl, myristic, palmitic, stearic, oleic and linoleic and their ratio, which indicates the quality of the product.

Demand for dairy products is increasing through the years, which leads to usage of various substitutes for milk fat. Cheaper animal fats and easily available plant oils are used more often. According to DSTU 4399:2005, butter is controlled by indicators: appearance, mass fraction of fat, β-carotene, microbiological purity, content of mycotoxins and radionuclides. There is no DSTU method for determination of fats (animal or plant) in butter manufacturing products. For example, butter is often replaced by margarine. Margarine contains refined and saturated plant oils. On the other hand, butter is a natural food product that contains only partially saturated animal fat. Therefore, adulteration of butter is widely distributed in food industry.

Hence, it is necessary to develop precise methods of butter control to detect falsification. Different types of fats can be determined by capillary gas chromatography for manufacturing of dairy products. This method is effectively used for evaluation of milk origin and foreign fats detection. In the EU the method of gas chromatography is actively used to control the quality of milk. According to ISO 12966-1:2014 it is recommended to control animal and plant fats in oils by gas chromatography.

GC method for the determination of fatty acids based on the esterification reaction was established by our scientists. The study was conducted by gas chromatograph *HP-6890 Plus* with flame ionization detector. The ZB-FFAP 30×0.32 glass capillary column with an inner coating thickness of 0.25 μm was used for the study. Helium was used as a carrier gas. The method was tested during the analysis of food products (coffee, various oils, soy, confectionery, butter). About 20 samples of butter with different fat content were analyzed. The method was validated by the criteria of specificity, linearity, repeatability and stability. The detection limits of basic fatty acids was established: lauryl 0.04 ppb, myristic 0.02 ppb, palmitic 0.04 ppb, stearic 0.04 ppb, oleic 0.04 ppb, linoleic 0.03 ppb. This method is planned to be used for routine analysis of fatty acids content in food products.

Key words: fatty acid, gas chromatography, validation

Frequency of white stripping myopathy and physicochemical characteristics of pectoral muscles of fast and slow growing chickens

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For many decades, breeders' attention was focused mainly on improvement of chicken production parameters. Unfortunately, as a result of these activities, some lines of broilers developed undesirable phenomena leading to myopathies, changes in meat quality traits, and decreased suitability for processing. The chicken breast muscle proved to be the most susceptible to these adverse changes.

The aim of this study was to determine physicochemical parameters of breast muscles and to diagnose and determine the frequency and severity of white stripping myopathy in fast- and slow-growing broiler chickens.

The experimental material consisted of broiler chickens representing four genetic lines available in Poland (Ross 308, Cobb 500, Hubard Flex and Hubbard JA 957). One-day-old chicks (cockerels) were assigned to four groups (n=400) and placed in pens on deep litter. Fast growing broilers were reared until 42 days of age, while the rearing period of slow growing chickens was 56 days. The birds were fed *ad libitum* with the same complete feed mixtures. At the end of the experiment, 140 chickens from each group were selected for slaughter. Birds were evaluated for the presence and severity of the white stripping defect. Depending on the absence or presence of this myopathy, they were assigned to one of three subgroups: no defect, low or medium severity of white stripping. Moreover, breast muscles of fast- and slow-growing broilers (n=40) were subjected to evaluation of selected quality indicators: pH, L*a*b* color, drip loss, thawing loss, cooking loss, shear force and texture parameters. The results were statistically processed using analysis of variance and the significance of differences between groups was determined by Duncan's test.

The study showed a significant effect of genetic origin of the chickens on the frequency and severity of the white stripping myopathy of pectoral muscles. A significantly higher incidence of myopathy was found in flocks of 42-day-old fast-growing chickens compared with 56-day-old slow-growing broilers. In all flocks of fast-growing chickens, the white stripping myopathy occurred with similar frequency, and only 12% of birds were free from it. In most cases, white striping defect occurred in low intensity, but 7.5–10% of fast-growing chickens manifested medium intensity of this defect. The most favorable results were obtained in a group of slow-growing JA 957 chickens, in which up to 85% of the birds did not show white stripping myopathy. At the same time, the pectoral muscles of the slow-growing chickens were characterized by more favorable quality parameters, manifested, among others, by lower cooking loss (P≤0.01), lower hardness, chewiness and gumminess (P≤0.01) with significantly higher shear force. The study showed the significant effect of genetic line of fast growing broilers on meat physicochemical parameters, while low or medium severity of white stripping myopathy did not affect quality traits.

The results indicate that the white stripping myopathy affects mainly fast-growing broilers, while the slow-growing chickens are less susceptible to this defect. In fast growing birds, low severity of white stripping is mainly a visual problem and does not decrease the physicochemical meat characteristics.

Key words: broiler chicken, slow growing, meat quality, white stripping

The role of synbiotic drugs, iodine and selenium in the regulation of immune function in calves

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The current state of livestock farms, exceeds the adaptive capabilities of animals, leads to the emergence of diseases of different etiology, among which there are functional violations of the digestive canal. Such a situation forced to review many methodological approaches to the prevention and treatment of diseases caused by conditionally pathogenic microflora, and recognize the need to develop environmentally friendly drugs of a new generation that can occupy a prominent place in the system of measures to ensure biological protection of young animals. The most complete requirements may correspond to probiotic agents. However, it should be noted that the simultaneous use of pre-probiotic additives is promising, that is, so-called synbiotics, which, due to the synergistic effect, increase the protective functions of the body and normalize metabolic processes. In view of this, it is up to date on the influence of new immunotropic agents and, in particular, the *Enteronomin* synbiotic drug, iodine and selenium to immune function and performance of calves.

The study was conducted in TF Dmitrov Ltd. "Barkom" on calves of Holstein dairy breed of 10-day age. In the scientific and production experiment, three groups of calves are formed: control and two experimental groups of 15 animals in each. Animals of the control group in 10-daily ages intramuscularly introduced with a 0.9% solution of sodium chloride in dose of 5 ml/animal. The calves of the first experimental group in the specified period were similarly injected by the *Zelris* antibacterial preparation in dose of 1 ml/40 kg of body weight. The calves of the second experimental group were similarly injected with a 0.9% solution of sodium chloride, and also used the drug "Enteronomin", a dose of 3 g per animal/day according to the following scheme: the first time the study preparation was issued with water in a 10-day age — six days in a row, the next set — in 14- and 24-day age also a dose of 3.0 g per animal/day, two consecutive days. Before use, to activate microorganisms, the required amount of the drug was dissolved in an aqueous iodine and selenium solution in a proportion of 1 to 5 and tasted 16 hours at room temperature. The activated preparation "Enteronomin" was used by *per os* calves before the production of milk, as well as in the control in the indicated periods injected a 0.9% solution of sodium chloride. Together with calves of this group, starting with 10- to 65 daily age, introducing aqueous solution of iodine and selenium, the drug "iodis concentrate" in dose of 25 mg of water. In 15-day age, animals of control and experimental groups were intranasally vaccinated with the preparation "Inform-3". In 10-, 14-, 24- and 60-day age from each group of calves the blood sampling was carried out for research.

The positive effect of the synbiotic drug "Enteronomin" in a complex with iodine and selenium on the immune function in calves, in particular, the humoral link of nonspecific resistance of the organism has been shown. As evidenced by higher ($P<0.05–0.01$) bactericidal and lysozymic activity of serum and tendency to reduce the level of circulating immune complexes in serum of calves of experimental groups in relation to control. In addition, a larger mid-daily increase in calves, which used a synbiotic drug has been demonstrated.

Key words: calves, blood, probiotics, prebiotics, iodine, selenium

Effect of *EnzActive MIX* feeding on the piglet hematological parameters

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One of the most actual problem in modern pig production is to increase safety and viability of piglets in industrial breeding. Periods of intensive growth and development are considered the most critical stages of ontogenesis. In addition to technological factors, piglets develop age-related immune deficiencies, which are accompanied with disease development, including gastrointestinal tract disorders. The use of probiotics, new biological regulators of metabolic processes, is of great importance for the elimination of these disorders. These additives, that are based on live microbial cultures, affect the formation of active immunity in piglets, help to digest and absorb nutrients from the feed. Therefore, the aim of our work was to establish the effect of feed additive *EnzActive MIX* within the composed feed for piglets on hematological blood parameters and piglets safety index.

The research was carried out in the farm *Vesela Svynka LLC* located in the Pidhirtsi village, Obukhiv district, Kyiv region, on suckling piglets, which according to the principle of analogues were divided on two groups — control (n=20) and trial (n=20). Piglets of the control group were fed prestarter feed from the age of five days and starter feed from the 45-day age (produced by *Nutrimin Ukraine LLC*). *EnzActive MIX* was added to the compound feed of this experimental compound feed (produced by *Enzyme Company* in *EnzActive MIX* is a highly effective feed product based on live yeast culture *Saccharomyces cerevisiae* with activity ≥1.5×10^{10} CFU/g and enzyme complex (phytase, protease, xylanase, cellulase, α-amylase, β-gluconase). During the experiment, it was measured feed intake and decade weight gain. Blood for laboratory tests was obtained from the cranial *vena cava* of piglets aged 7-, 21-, and 45-day-old. The content of total protein and hemoglobin, the number of red blood cells and white blood cells and the ratio of individual forms of leukocytes in the leukocyte formula were determined in the whole blood according to conventional methods. During the trial, the piglets' growth and safety indexes were monitored. The obtained results of experimental researches were processed by standard methods of mathematical statistics using *Microsoft Excel* software. The probability of indexes was assessed by Student's criteria.

At the results of the study it was established, that the use of the *EnzActive MIX* for piglets of the trial group contributed to an increase in the number of red blood cells, white blood cells, hemoglobin concentration on the background of lower platelet content compared to the control group. Feeding *EnzActive MIX* had a positive effect on blood oxygen function, hemoglobin synthesis, stimulated erythrocytopoiesis and leukocytopoiesis in piglets. The use of the *EnzActive MIX* in piglets of the trial group increased their safety in the suckling period due to a decrease in their disease incidence and death caused by diseases of the gastrointestinal tract of non-communicable etiology. Thus, the use of *EnzActive MIX* helped to activate the digestive processes, which increased the average daily weight gain, increased the safety of piglets and the efficiency of young stock growing.

Key words: probiotic, piglets, hemoglobin, red blood cells, white blood cells, safety index

Influence of NSAIDs on the microbiocenosis of the oral cavity in animals

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In recent decades, the range of NSAIDs (non-steroidal anti-inflammatory drugs) as expanded significantly. They are divided into classes according to their chemical nature, selectivity (by inhibiting the enzyme cyclooxygenase 1 or both isoforms), average dose efficiency, and others. However, the results of research in recent years have revealed their impact on the ecosystems' microbiota of humans and animals. The oral cavity is an anatomical and immunological protective barrier and the most complex ecosystem, sensitive to the action of any chemical, physical or biological factors. Changes in the oral microbiota are considered as indicators of early side effects of eubiosis of the oral cavity. The subject of this study is the effect of NSAIDs on the microbiota.

Studies of the effects of nimesulide — a NSAID which is used to treat acute (short-term) pain, painful osteoarthritis (swelling in the joints), primary dysmenorrhoea (period pains) were performed on male rats. Animals of the experimental group (n=12) obtained nimesulide at a dose of 15.0 mg/kg intragastrically once a day for 14 days. The culture of scraping from the area of the gingival margin of rat's teeth was investigated. Determination of the qualitative and quantitative composition of the microflora was performed by the microbiological method.

To assess the state of the biocenosis of animals in the above-described parts of the oral cavity, we analyzed the data of quantitative indicators of the microbiocenosis, and the identification of microorganisms — causes of inflammatory processes. These include: a) certain species of indigenous bacteria; b) pathogenic and opportunistic species: coagulase-positive and coagulase-negative staphylococci, α- and β-hemolytic streptococci, typical and hemolytic *Escherichia*, *Pseudomonas aeruginosa*, *Klebsiella* and fungi.

According to the obtained results the changes in the state of the microbiocenosis of the oral cavity of rats in comparison with the indicators in intact animals were founded. Thus, the number of non-hemolytic streptococci (3.48±0.83 lg CFU/ml) increased in 1.3 times compared to intact group, gram-positive non-sporeforming bacilli (2.8±0.69 lg CFU/ml) — 1.4 times. The number of α-hemolytic streptococci (3.54±0.71 lg CFU/ml) did not differ from the corresponding indicators of intact group. There was a 2.5-fold increase in the number of coagulase-negative staphylococci (2.56±0.44 CFU/0.02 ml) and coagulase-positive staphylococci (1.8±0.29 lg CFU/ml) in 1.2 times compared with the control. The number of enterococci remained constant in the range of 2.65±0.34–2.78±0.44 CFU/ml. With regard to obligate anaerobes, there was a slight increase in the number of veilonels and prevotels (not more than 1% compared to the control group). Bacilli, molds and *Candida albicans* were isolated in all animals in small quantities.

The non-selective inhibitor of cyclooxygenase nimesulide, by disrupting the metabolism of prostaglandins, causes certain physiological changes in the oral cavity, reflected in the microbiocenosis of the habitat. The changes affect the growth of quantitative indicators of normosymbionts. The imbalance of gram-positive bacteria and the appearance of coagulase-positive staphylococci indicate the risk of putrefactive processes, and the activation of gram-negative anaerobes — the destructuring of the biofilm. All of the above creates the preconditions for the violation of the mucous barrier and the feasibility of biocorrective measures.

Key words: NSAIDs, microbiocenosis, nimesulide

Prophylactic of the calves dyspepsias by the "Enbiotic" in different epizootic conditions of the farms

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Dairy farms have significant economic damage because of calf diarrhea. The causes of diarrhea can be infectious agents. Whon et al. (2021) noted about the activity nontoxicity avtohtone bacteria family *Enterobacteriaceae* in a period of weaning. Mohammed et al. (2019) had fixed that different serogroups *E. coli* can be a cause of the calves diarrhea (in 46.4%). Barua et al. (2019) have told *Rotavirus* and *Coronavirus* can be a cause of the calves diarrhea in 5.11%. Uhde et al. (2008) have experimentally proved that *Cryptosporidia* have its pathogenic action in diarrhea caused in the time of the first calves' month after birth. And both the later colostrums feeding (later than 30 min after borning) and non-compliance of the veterinary, sanitary and hygienic conditions in calves raising are the additional contributing factors in dyspepsia caused. So, the looking of the oral non-antibiotic cures which can rise up the immune resistance of the newborn calves and have efficiency in dyspepsia prophylactic is still actual.

The main aim was the study probiotic feeding supplement "Enbiotic" in diarrhea prophylactic in the first 14 days after born in farms with different epizootic conditions.

Two groups in the dairy farms with different epizootic conditions on the principle of analogs were formed in the experiment. Each group includes 6 animals aged 1–14 days for each of farms. Calves of the experimental group have got with colostrum a preparation "Enbiotic" (dosage 10 mL) ones a day. A control group has not got any supplement in the ration. The pharmacological effect was fixed by clinical methods of diarrhea's present registration.

At the dairy farm with the usual cow's vaccination in the dry period about esherihiosis, *Coronavirus*, and *Rotavirus*, using the "Enbiotic" for the adult animals had its prophylactic efficiency of the calves diarrhea in 100% at the observed period (14 days). At the same time, diarrhea has been observed in 50% of animals in the control group (3 calves). It was fixed at the second post-borning day for the one calf and at the 5th day for the other two animals. Boggy, total oppression, and refusal calves of milk were fixed for the illness animals. The treatment scheme included *Amoxicillin* 15% using or *Trimeratinvet* and *Ketonil*. The cure duration was in 4 days.

At the unfavorable farm by *Rotavirus* and *Coronavirus* infection using the supplement-feeding "Enbiotic" had ambiguous results. For 50% of calves of the experimental group, diarrhea symptoms were fixed. At the same time, supplemental giving "Enbiotic" in dosage 5 mL gave a recovery effect for two calves in 8–12 h. For another one calf was used cure sulfanilamide and one milk-feed portion was changed by rheological solution. The recovery for this one calf was fixed in 2 days. In the control group, diarrhea was fixed for all animals in the first four life days.

So, the pharmacological effect of the feed supplement "Enbiotic" was greatly dependent on the antigen loading on the newborn calves.

Introduction of the feeding supplement "Enbiotic" to the newborn calves in dosage 10 mL once in first 10 days at the epizootic prosperous farm gives the 100% efficiency in diarrhea prophylactic.

For the epizootic unfavorable farm (in *Rotavirus* and *Coronavirus* infection) using the feeding supplement "Enbiotic" had a diarrhea prophylactic effect in 50% for the newborn calves.

Key words: calves' diarrhea, *Enbiotic*, newborn calves, diarrhea's prophylactic

Effect of hop cones and vitamin E on ketogenesis and some blood parameters in transition dairy cows

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After calving, cows usually have a negative energy balance, which accompanied by glucose deficiency and excessive releasing of fatty acids from adipose tissue. The purpose of the work was the correction rumen fermentation in the transition cows to prevent metabolic disorders. For the experiment, two groups of Ukrainian Dairy Black-and-White breed cows were formed, 10 animals per group. The experiment lasted 3 weeks prepartum and 3 weeks after calving.

Animals were fed with balanced diet, which consisted of haylage, silage, barley, wheat, corn, soybean meal, salt, mineral and vitamin premix. The first group was the control. To the diet of second group cows was added 300 mg of α-tocopherol acetate (0.6 g of *Rovimix E-50*) and 1 g/kg of dry hop cones per kg of dry matter.

The concentration of ketone bodies and peroxidation products increased after calving. In a month, their concentration decreased slightly, but was still higher than in dry cows.

Before calving, the tested feed additive reduced the concentration of peroxidation products in the cows' blood ($P<0.05$) without affecting other parameters. Changes that are more significant detected after calving. An increase in glucose concentration ($P<0.05$) and decrease in the concentration of NEFA ($P<0.05$), lipid hydroperoxides ($P<0.05$), TBARS ($P<0.05$), and beta-hydroxybutyrate ($P<0.05$) were observed in the blood of the cows of the experimental group.

A decrease in the concentration of ketone bodies in the blood of cows was found due to the feeding of the addition of hop cones and vitamin E. Particularly significant changes in ketone bodies level were found in the blood taken a week after calving. At the end of the first week of lactation there was observed a statistically significant decrease for β-hydroxybutyrate ($P<0.05$). In addition, taking into account a moderate decrease in the concentration of acetoacetate in the blood of this group cows, the difference in ketone bodies was even more significant ($P<0.01$).

The effect of hop cones and vitamin E on the ketogenesis in the cows before lactation and one month after calving was less pronounced, although the tendency to decrease the concentration of ketone bodies in the blood of animals of the experimental group persists. Thus, before calving, a moderate decrease for β-hydroxybutyrate with a constant amount of acetoacetate were detected. One month after calving, the concentration of both β-hydroxybutyrate and acetoacetate decreased slightly, as a result of which a decrease in the total concentration of ketone bodies became statistically significant ($P<0.05$).

The addition of hop cones and vitamin E inhibits peroxidation and reduces the concentration of ketone bodies in the cows' blood. The supplementation of transition cows' diet with tocopherol acetate and hop cones increased concentration of glucose and decreased concentration of non-esterified fatty acids in the blood plasma. Hop cones and tocopherol acetate can be used as ingredients in feed additives for prevention of ketosis and fatty liver in high performance cows.

Key words: cows, hop cones, vitamin E, blood, ketone bodies, peroxidation

Problems of poultry products pollution by heavy metals

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The problem of safety of poultry products is quite relevant, as far as it is of sufficient importance. Food products have not only consumer properties, but also food value, which depends on the chemical substances contained in them. The part of nutrients is a suitable structural component of the supply of raw materials and food products, but there is another part that is included in the products of the product. Among them, heavy metals are large and quite dangerous in terms of toxicology.

Cadmium and chromium ions enter the body of the bird with food, water and air, accumulate in it and cause an increase in metabolic processes. It is known that these elements have high toxicity, have a negative effect on living organisms, even at very low concentrations, and are able to rejuvenate people.

The study was performed on laying hens cross *Highsex white* with an average weight of 1.5 kg. According to the principle of analogues, four groups were formed — one control and three experimental, eight hens in a group. Laying hens of the control group were fed compound feed and watered without the introduction of heavy metals. Heavy metal salts were added to the drinking water of chickens of the experimental groups for 21 days: the first group — 2 mg/kg body weight of chromium sulfate, the second group — 3 mg/kg body weight of cadmium sulfate, the third group — a combination of chromium sulfate and cadmium sulfate. The chromium and cadmium content in chicken eggs was determined by *Varian AA240Z* spectrophotometer.

It has been established that for the 21-day period of sulfate addition, the protein of the experimental group contains the metal of 1.7 times the amount. When cadmium sulfate was added, its content in the egg whites of the experimental group was 1.8 times higher than in the control group. As for the experimental group, in which the bird received the combined introduction of heavy metal salts, it was observed to increase the content of weight in 2.8 times, and in the case of water — in 1.8 times. The content of chromium in the yolk of the experimental group increased by 2.0 times, while the content of cadmium increased by 2.2 times. In the previous group, where the bird received the combined introduction of heavy metal salts, there was a decrease in the content of chromium in 2.1 times, cadmium — in 3.1 times. As for the study of the shell, the content of the experimental group is 2.3 times, and cadmium is 6.9 times. With the combined supply of heavy metals, the content of chromium increased by 2.4 times, and the content of cadmium was 2.0 times 6 times more than the control.

Thus, the results confirm that the accumulation of cadmium and chromium salts in the diet of chickens promotes the accumulation of heavy metals in chicken eggs.

Key words: chromium, cadmium, laying hens, eggs

Changes in biochemical indices in rats intoxicated with carbon tetrachloride and treated with L-glutamic acid

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Carbon tetrachloride (CCl_4) is a compound that was previously used as a dry cleaning solvent, manufactured chemical and does not occur naturally in the environment. Currently, CCl_4 is frequently used as an well-known model compound in preclinical experiments for xenobiotic-induced hepatotoxicity. Structurally it is a chlorinated hydrocarbon called tetrachloromethane. Pharmacologically, it is a cytotoxic xenobiotic which causes cellular damage by augmenting lipid peroxidation. CCl_4 toxicity does not develop due to the CCl_4 itself. CCl_4 is converted to a highly reactive trichloromethyl (CCl_3) radical by cytochrome P450 enzymes. Many research studies have demonstrated that CCl_4 intoxication is the major source of free radical generation in many tissues such as the liver, brain, kidneys, lungs, spleen and blood. One of the major defensive mechanisms against radical induced oxidative stress is antioxidant defense mechanism. L-glutamic acid is an ubiquitous amino acid present in most foods in either the free form or bound to peptides and proteins. Therefore, the purpose of this study was to investigate the possible antioxidant effects of L-glutamic acid (L-Glu) on CCl_4 toxicity in tissues and blood of male rats.

Studies were conducted on albino Wistar rats (males), weighing 200–220 g. The animals were fed with standard rat pellet feed and drinking water was provided *ad libitum* in clean polypropylene bottles with stainless steel sipper tubes. Rats were divided into three experimental groups. Animals from first and second experimental groups were intraperitoneally exposed to CCl_4. After that rats from the second experimental group were treated with an aqueous solution of L-Glu. Rats of the control group were administered to the appropriate amount of saline. All procedures were conducted according to the European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (Strasbourg, 1986) and General Ethical Principles of Experiments using Animals (First National Congress of Bioethics, Kyiv, 2001). The levels and activities a number of biochemical indicators were determined. Statistical evaluation of the results was performed using arithmetic mean and standard error (M±m) and the variances between groups were tested for significance using one-way ANOVA. The differences were statistically significant at $P<0.05$.

The obtained results suggest that CCl_4 causes oxidative stress in rat tissues, accompanied by a change in the majority of controlled biochemical parameters. The enzymatic activity in tissues of rats treated with L-Glu was restored. Also, changes, which were observed in studied indices showed up to be less significant compared to CCl_4 treated group. Therefore, L-Glu can be used as an effective therapeutic agent for the treatment of CCl_4-induced tissues toxicity. It is recommended to investigate possible relations between antioxidant enzymes activity and lipid peroxidation content under the action of CCl_4 and the role of L-Glu in these processes in further studies.

Key words: L-Glutamic acid, carbon tetrachloride, enzymes, oxidative stress, rats

Influence of various amounts of flax oil on the fatty acid composition of total lipids of thorax tissues and productivity of bees

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Vegetable oils and fatty acids are an energetic, attractive, biologically active and biologically structural material for the body of honey bees. It is still unknown how much vegetable oils and certain fatty acids (saturated, monounsaturated and polyunsaturated) should be in bee diet, which would contribute to higher reproductive and productive capacity of honey bees. Moreover, vegetable oils contain polyunsaturated fatty acids of different kinds, including essential ones, which have different biological, reproductive and productive effects on body of honey bees and bee products. There are also no data in literature on the functional state of bee tissues depending on the above mentioned feed indicators. That is why it is the topic of great interest now.

The aim of the study was to establish the relation between the fatty acid composition and the sorption capacity of thorax tissue and egg laying of queen bees and honey productivity of worker bees with different amounts of linseed oil in a feed additive.

Experimental studies were conducted in the spring and summer in a private apiary in Zastavna district of Chernivtsi region on clinically healthy honey bees of the Carpathian breed (*Apis mellifera Carpatica*). 3 groups of bee families were formed with 3 bee families selected on the principle of analogues in each group. Bee families under control received low-fat flour from natural soybeans of Chernivtsi-9 variety in the amount of 100 g/bee colony/week with the addition of 100 g of sugar syrup (ratio of sugar to water 1:1) for 36 days, and experimental groups I and II — in addition to this feed additive linseed oil in the amount of 10 and 20 g/bee colony/week, respectively. During the experiment, the egg-laying of queens and honey productivity of worker bees were monitored. At the end of the experiment in the thorax tissue samples of honey bees it was determined by content of fatty acids of total lipids, heavy metals and their sorption capacity.

The obtained digital material was processed by the method of variation statistics using Student's test. The computer program *Origin 6.0*, *Excel* (*Microsoft*, USA) was used for calculations.

It was found that as a result of adding linseed oil in the amount of 10 and 20 g to the feed, which consists of low-fat soy flour and sugar syrup, it dose-dependently increases the content of saturated, monounsaturated and especially polyunsaturated fatty acids in both fatty acids with lipids and non-esterified fatty acids. Feed enriched with linseed oil leads to a dose-dependent increase in the concentration of saturated, monounsaturated and polyunsaturated fatty acids of total lipids in the thorax tissue of honey bees in I and especially II experimental groups respectively. At the same time the ratio of polyunsaturated fatty acids ω-3 to polyunsaturated fatty acids ω-6 increases in the thorax tissue of above mentioned bees to a great extent. The increase in the concentration of polyunsaturated fatty acids ω-3 and especially ω-6 leads to a dose-dependent increase in the sorption capacity of the thorax tissue of honeybees of I and especially II experimental groups. The content of heavy metals in the breast tissues of honeybees of the I and especially II experimental groups increases too. As a result, in II and especially I experimental groups of queen bees we get 6.4 and 15.4% egg-laying increase, and for worker bees — we notice 10.7 and 17.5% honey productivity increases respectively.

Key words: honeybees, feed additive, linseed oil, fatty acids, honey productivity of bees

Natural *versus* pharmacological methods of controlled swine reproduction

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Swine reproduction is the most important production area influencing economical efficiency of farm activity. Reproductive potential of gilts and sows comes from several physiological properties, specific for *Sus scrofa* species, including: I. non seasonal polycyclic reproduction; II. large litters coming from polyovulation; III. short reproductive cycle; IV. early reproductive maturation of gilts. All of those elements are genetically determined but can be additionally improved using various environmental factors. The methods of swine controlled reproduction can be divided into 3 types: I. natural methods; II. indirect pharmacological methods; III. direct pharmacological methods.

There are 2 main types of natural treatments. Male effect is well known from many years, however, physiological mechanisms of its action and efficiency still seem to be poorly understood. Early hypothesis of male effect was the action of male pheromones influencing female reproductive organs through olfactory way. The results of modern research showed that boar effect is much more multisensory, including additional stimulation of eyesight, hearing and touch. That is why boar contact cause short acute stress reaction with strong cortisol secretion, followed by elevation of glucose and consequently insulin secretion. Positive effect of boar presence can be visible in earlier maturation of gilts and increased ovulation rate. Insulin seem to be the most important additional stimulus supporting pheromones in boar effect. Insulin is also the most important physiological factor improving ovarian function during stimulus nutrition called flushing. The best effect of flushing is achieved by increasing feed energy intake. The source of energy could be lipids or carbohydrates, wherein the carbohydrates seem to much more effective. The results of research using second life estrus gilts suggest 8% of ovulation rate improved after flushing with soybean oil in comparison to controls, while about 15% after flushing with corn starch.

Indirect pharmacological methods are used mainly as addition of hormones to semen portion straight before insemination. Three main hormones that are used as additives for semen are estradiol, oxytocin, and $PGF_2\alpha$. Oxytocin seems to be more effective in conception rate improving, while $PGF_2\alpha$ is more effective in litter size increasing. All of those additives are important only when traditional, intracervical insemination is used.

The most popular direct pharmacological treatment is the use of chorion gonadotropin mix in intramuscular injection. There are many of market available hormonal preparations, and the most popular proportions are 400 IU of eCG acting as FSH, and 200 IU of hCG acting as LH. There are many results of research analyzing effects of their use and the results still seem to be equivocal. Generally, it is repeatedly confirmed, that the use of exogenous gonadotropins leads to ovarian cyst formation and can decrease embryo vitality. Positive effect is visible in shortened weaning to estrus period length but only in primiparous sows. Ovulation rate seem to be independent from the treatment.

Key words: gilt, sow, reproductive performance, boar effect, gonadotropins

Correlations among ultrasonographic, physicochemical and sensory characteristics of pectoralis major muscles in turkeys reared in a sustainable farming system

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Turkey meat is lean and rich in protein, vitamins and minerals; it is, therefore, an important component of balanced human nutrition. Rising global meat consumption and public expectations have drawn attention to the issue of meat quality. Poultry production systems impinge on meat quality and organic farming has long been associated with superior meat quality in comparison to intensive farming systems. One of the challenges of the contemporary meat industry is to obtain reliable information on meat quality throughout the entire production cycle, which would ultimately provide a guaranteed quality of final products to consumers. Results of earlier studies showed that computerized analysis of muscle ultrasonograms was a promising tool to predict intramuscular fat percentage in live animals. In the most recent study in broiler chickens, a strong relationship between echotextural characteristics of pectoral muscles and several meat quality traits was found. Similar studies do not exist for other poultry species including turkeys. Hence the present study set out to evaluate the associations among echotextural, physicochemical and sensory characteristics of the pectoralis major muscles in turkeys raised in a sustainable farming system and varying in the amount of wheat and oat grain in daily feed rations.

Broad-breasted female turkey poults of the British United Turkeys (B.U.T.) Big 6 strain were randomly assigned to three experimental groups: Control Group — complete feed only; Group Exp. 1 — 5–30% of wheat and 0–20% of oat; and Group Exp. 2 — 5–50% of wheat and 0–50% of oat (n=15 turkeys/group). Digital ultrasonograms of the left pectoral muscle in four different planes were obtained just before slaughter, and first order echotextural characteristics of the muscle parenchyma were computed using the *ImageProPlus*® analytical software. The physicochemical and sensory attributes of pectoral muscles were determined using validated laboratory and analytical methods.

Twelve significant correlations between image attributes and meat characteristics were recorded in Control Group, one in Group Exp. 1, and eight in Group Exp. 2. When the data pooled for all birds, there were twelve correlations ($P<0.05$); all but one correlation (between mean pixel heterogeneity (MPH) and moisture; $r=0.37$, $P=0.01$) were for physical and sensory characteristics. The strongest overall correlation was recorded between MPH in an oblique plane and aroma (intensity) ($r = -0.41$, $P=0.005$).

Ultrasonographic imaging of pectoral muscles coupled with computer-assisted analyses of ultrasonograms is a potential method to estimate or predict certain chemical constituents (moisture) as well as physicochemical (coloration) and sensory (e.g., aroma) characteristics of pectoralis major muscles in organic turkeys. The occurrence and strength of among *in situ* echotextural characteristics and post-mortem traits of turkeys' pectoral muscles are strongly affected by nutrition and scanning plane.

Key words: turkey, pectoral muscle, meat traits, ultrasonography, image analysis

The effectiveness of an improved method of thawing sexed spermatozoa

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It is believed that 50% of heifers and 50% of bulls are born in cattle breeding. The question of the sex ratio of offspring in livestock, in addition to great theoretical interest, is of great practical importance [Shakhova YY, Popkov MM. Influence of artificial insemination on offspring's sex in dairy farming. *Proc. XIV All-Ukr. Sci. Pract. Conf. "Scientific Progress in Animal Husbandry and Poultry Breeding".* Kharkiv, 2020: 106]. Getting more heifers on industrial milk farms is very important. [Shakhova YY, Lisina KH, Khmelkov VM. Patterns of sex heredity in offspring of milk cattle herd. *Sci. Pract. Bull.* Kharkiv, 2017; 117: 244–248]. Today, sex sperm is in great demand. According to the technical requirements in sexed spermatozoa, the proportion of motile sperm is not less than 40%, the number of sperm with rectilinear translational motion is not less than 0.8 million, the dose volume is 0.25 ml, the total sperm concentration in the dose is not less than 2 million, the proportion of sperm with abnormal morphology not more than 20% [Shishkina MA. Effectiveness of sexed sperm appliance in Siberia. *Achiev. Sci. Tech. Agro-Industrial Complex*. 2015; 29 (6): 70–71]. At the same time the efficiency of the use of sexed family is 30–40%. [Usenko VV, Koshchaev AH, Likhoman AV, Litvinov RD. Experience and perspectives of using sexed semen for increasing milk cow herds in Kuban. *Sci. J. Kuban State Agr. Univ.* 2014; 101 (7). http://ej.kubagro.ru/2014/07/pdf/60.pdf].

These works show: the use of elevated temperatures with constant movement of fluid during thawing of sperm in palettes/lined granules contributes to a significant increase in quality and accelerates the thawing process three times.

Under industrial conditions, a water bath with temperature 70°C with constant water movement and exposure for 5 seconds was used to defrost spermatozoa. 54 heifers were artificially inseminated with sexed X-sperm with the presence of 2.0 million motile sperm in a dose of 0.25 ml with thawing in a water bath at a temperature of 37°C without water. 22 heifers (40.74%) became pregnant, 16 heifers (72.70%) and 6 bulls (27.27%) were born. After using an advanced method of thawing sperm doses the artificial insemination of 25 heifers was performed with the same sperm. 19 heifers (76.00%) became pregnant, which is 35.26% more.

The expediency of using an improved method of thawing sperm doses for artificial insemination of cows and heifers with sexed sperm has been established.

Key words: artificial insemination, thawing, sexually transmitted emeralds

Quality of ram spermatozoa in diluent with addition of Cu^{2+}, Zn^{2+} and Mn^{2+} nanocitrate as microelement after thawing

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Cu^{2+}, Zn^{2+} and Mn^{2+} are important minerals for the regulation of sperm metabolism as they are part of the active centers of glycolysis enzymes, mitochondrial respiratory chain and antioxidant protection. At the process of preparation of ejaculates for cryopreservation there are changes the natural content of microelements that disrupt the course of substrate transformation and ATP resynthesize. Balancing the composition of ejaculate diluents with microelements is not effective because a low level of synthetic processes in semen reduces the inclusion of microelements from inorganic salts to the spermatozoa metabolism. One of the ways that can eliminate the disadvantages of the micronutrient salts usage for ejaculate diluents and ensuring their inclusion in the metabolic processes in sperm are organic forms of metals, in particular the nanocitrate.

Sperm from 6 rams of the Texel breed was taken by artificial vagina, with determined the activity and concentration of sperm, diluted with lactose-yolk-TRIS-citrate-glycerol medium. In the process of preparation of ram sperm for cryopreservation in the experimental groups nanocitrates of microelements were added to the diluents in the following doses: Zn^{2+} and Mn^{2+} — 0.0025, 0.005, 0.0075 μg/ml, and Cu^{2+} — 0.00125, 0.0025, 0.00375 μg/ml. After thawing of sperm, the activity, survival, respiratory activity of sperm, activity of succinate dehydrogenase (SDH) and cytochrome oxidase (CO) were determined.

The influence of microelements (Cu^{2+}, Zn^{2+} and Mn^{2+}) in the form of nanocitrates on the quality of the spermatozoa in the thawed ram semen was studied. It was established that the respiratory activity of ram semen was 0.67±0.09 ng-atom O_2/0.1 ml×min. After adding increasing doses of Zn^{2+}-nanocitrates sperm respiratory activity was lower on 44.8–88.1% ($P<0.01$–0.001), comparing to control. When adding 0.00125 μg/ml of Cu^{2+} nanocitrate respiratory activity was on control level (0.60±0.15 ng-atom O_2/0.1 ml×min), when adding 0.0025 and 0.00375 μg/ml it was lower on 57.1 and 85.1% ($P<0.001$). The respiratory activity of sperm is less dependent on Mn^{2+} nanocitrates: the growth of its content in diluted sperm is 2 and 3 times reduces by 28.4–40.3% the value of the index.

The activity of mitochondrial enzymes after the addition of microelements as nanocitrates in thawed ejaculates of rams varies ambiguously. The addition of Cu nanocitrate does not alter the activity of SDH and CO in thawed ram semen. At the same time addition of increasing doses of Mn^{2+} nanocitrate stimulates the activity of SDH of ram spermatozoa: when adding 0.0025 μg/ml to thawed semen activity of enzyme was increased on 37.2%, and when adding more than 0.005 μg/ml — increases by 2 times ($P<0.01$) comparing to control. Similarly, addition of increasing doses of Zn^{2+} nanocitrate increases activity SDH on 59.6–88.3% ($P<0.01$) against the background of a slight increase in CO activity. Survival of spermatozoa after addition of Zn^{2+}, Mn^{2+} nanocitrates in high doses had a tendency to increase, but after adding of Cu^{2+} nanocitrate it decreased ($P<0.05$).

Optimal doses of Mn^{2+} and Zn^{2+} nanocitrates (0.005 μg/ml) have been established, which improve the quality characteristics of thawed ram semen. The addition of nanocitrates Cu in various doses reduces the quality of thawed ram sperm. Therefore, in the process of preparation of ram sperm for cryopreservation, it is advisable to add only Mn^{2+} and Zn^{2+} nanocitrates to diluents.

Key words: microelements, nanocitrate, spermatozoa, ram, redox processes, survival

Introduction of modern biotechnological methods of sheep reproduction — successes of Ukrainian-Polish scientific cooperation

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Nowadays in Ukraine the number of sheep has decreased almost 10 times compared to 1991, so there is a question of more efficient use of sheep with a focus on obtaining high quality meat. Such challenge requires introduction of new breeds for sheep meat production, and use of biotechnological methods of reproduction which allow increase the efficiency of sheep breeding and production

Realization of this challenge were taken on by scientists from Ukraine and Poland. An important aspect of the success of the biotechnological research and its introduction into practice was the establishment of contacts with Polish scientists and the signing of a cooperation agreement between the Institute of Animal Biology NAAS and the Kraków Agricultural University, resulting in a series of joint experiments in the area of reproductive biotechnology of sheep.

During 2001–2015, a joint Ukrainian-Polish team introduced a laparoscopic method for insemination of local breeds of sheep by using ram sperm of the Suffolk breed which is one of the most meat breeds of sheep all over the world. Hundreds of successful inseminations in farms of Lviv and Transcarpathian regions were carried out with effectiveness from 75 to 91%, what is very good result.

In 2016, scientists from the Institute of Animal Biology of the National Academy of Sciences of Ukraine and the Kraków Agrarian University together with the company “Genetics and Breeding” launched a program of industrial breeding of sheep to obtain lamb meat. In the farm “Svitanok” in the Kherson region estrus was stimulated in 200 ewes, 195 of them were inseminated laparoscopically. Fertility was 89.7%. In addition, of the 175 fertilized ewes, ultrasound revealed only 20 singles, the rest were diagnosed with twins and triplets, which indicates high stimulation efficiency, high fertility of ram sperm and the qualifications of specialists.

The second direction of introduction of biotechnological methods of reproduction of sheep became introduction of transplantation of embryos. In particular, in 2017, a full cycle of sheep embryo transplantation was carried out at the Sheep Farm “Kohut” in Lviv region: stimulation of superovulation in Texel ewes, surgical embryo flushing and their transplantation to recipients of Ukrainian Mountain Carpathian sheep breed.

In the future, it is planned to introduce the *in vitro* fertilization method in the practice of modern sheep breeding.

Key words: sheep, laparoscopic insemination, embryo transplantation, Ukrainian-Polish cooperation

Productive traits of laying hens of different crosses

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The poultry industry provides an opportunity to quickly meet the needs of the population with high quality food and to address certain issues of food security of the state. To increase the efficiency of national poultry-breeding and improve the quality of products in the industry should rely on the experience of countries with a high level of development and equipment of this industry. Therefore, the aim of our research was to evaluate the poultry productive traits on farms in Finland.

The research was conducted in the conditions of the agricultural holding "Agrikumppanit" of Finland. Mathematical materials were processed by methods of variation statistics. The comparison of productive traits of laying hens were performed on two crosses — Decalb White and Hisex White, which were kept in similar conditions using the same technology of egg production. Herewith poultry meat and manure are by-products of the industry. Live weight of poultry was determined by weighing before feeding in the morning. Laying of hens were determined using group productivity accounting. The weight of eggs was studied by weighing, the amount of egg mass was determined by multiplying the number of eggs by the weight of one egg.

The study of productive traits of laying hens included the study of their live weight. Thus, it has been found that the higher live weight among the studied poultry was the laying hens of the Hisex White cross. The advantage was 0.16 g in their favor.

In addition, we conducted a comparative evaluation of egg-laying, average egg weight, egg mass yield, preservation of laying hens of the two studied crosses. Thus, the highest egg-laying rates belong to the laying hens of the Decalb White cross. Regardless of the age of the laying hens, 316 eggs were obtained from them at 72 weeks, and 355 at 80 weeks. Instead, they have lower preservation rates — 94.0–94.8%. As for the average weight of eggs, in hens of this cross it did not actually change with age, approaching 61 g.

Slightly lower egg-laying rates are typical of laying hens of the Hisex White cross — 309 and 342 eggs at 72 and 80 weeks, respectively.

However, hens of this cross had a higher average weight of one egg, which ranged from 63.7 to 65 g, and therefore the laying hens of this cross slightly outperformed the previous one in terms of egg mass.

At the end of the productive period, laying hens are culled for further slaughter to obtain an additional by-product — poultry meat.

Slaughter characteristics of laying hens of these crosses differed. Given the higher live weight of laying hens of the Hisex White cross, they outperformed hens of the Decalb White cross for all the considered slaughter rates.

It should be noted that the production of eggs on poultry farms of the agricultural holding "Agrikumppanit" is profitable, and from laying hens with higher egg-laying received a higher profit and level of profitability (excluding funds from the sale of meat as an additional product). The level of profitability of egg production for Decalb White poultry cross was 22.2%, for Hisex White poultry cross — 16.8%.

Based on the results of research, it is established that for profitable activities of the poultry industry and increase the efficiency of eggs production of laying hens should focus on the use of laying hens with a higher level of realization of productive traits.

Key words: poultry-breeding, productive trait, laying hen, cross, Decalb White, Hisex White

Effect of the enzyme preparation “Natuzym” and sulfur citrate on the lipid metabolism of quails

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One of the main tasks of poultry farming is to find ways to increase the absorption of feed nutrients. The production of compound feeds involves the use of feed enzyme preparations, which allow more optimal assimilation of feed ingredients, reduce fattening time and feed costs.

In order to meet the biological needs of poultry in nutrients, legumes are used in its feeding. This results in a deficiency of sulfur-containing amino acids, which is partially compensated by the addition of sulfates in the amount of 0.3%. Given the results we obtained in previous studies, it was interesting to find out the possibility of including sulfur in the diet of poultry in the form of aquacitrate to replace sulfate.

The aim of the work was to develop a method of effective use of exogenous enzymes in combination with various forms of sulfur in poultry to increase productivity and intensify lipid metabolism, improve the nutritional quality of products.

The experiment was conducted in the vivarium of the Institute of Animal Biology NAAS in five groups of quails (16 birds in each group), starting from 14 days of age. All birds received complete feed, balanced in nutrients and biologically active substances. The birds of the experimental groups to the diet were added sulfur citrate — a solution of hydrated and carboxylated nanoparticles of the element in deionized water with its content in the amount of from 10 to 100 mg/liter and also added “Natuzym” is a complete enzyme complex that is universal for all types of diets (with a predominance of bran, cake or meal), where a distinctive feature is the phytase that is part of it.

The content of total lipids was determined by the Folch method, and the division into classes was carried out by thin layer chromatography. It is shown that the amount of total lipids in the liver tissue of quail when added to feed Sulfur in the form of citrate in combination with the enzyme, as in the amount (in terms of the element of its content in the form of inorganic salt) 25% (3rd experimental group), and 10% (4th experimental group), compared with the control group, increased by 6.73% and 1.4 times, respectively. Addition to the diets of quails of the experimental groups of the above additives helped to reduce mono- and diacylglycerols by 13.81 and 15.94% in the 3rd and 4th groups and 1.51 and 1.39 times in the 1st and 2nd, compared with the control. At the same time, the content of triacylglycerols increased by 12.21 and 4.9% in the 1st and 4th experimental groups, and in the 2nd and 3rd groups remained unchanged, compared with controls.

It is known that triacylglycerols are the main components of fat depots, both plant and animal cells. They are usually absent in cell membranes. About 90% of the energy of triacylglycerols is concentrated in fatty acids, the least — oxidized components of fats. Therefore, triacylglycerols are an ideal substrate for energy conservation.

We noted a significantly higher content of non-esterified fatty acids ($P<0.05–0.01$) in the liver tissues of quails of the 1st and 2nd experimental groups by 19.9 and 14.13% with a simultaneous decrease in the 3rd and 4th groups by 5.83 and 13.83%, compared with the birds in the control group. These data indicate the effect of nanoaquacitrate feeding on lipid metabolism in the liver.

Laying of quails during the experiment was the highest in the 4th experimental group, which amounted to 86.10% and exceeded the control indicators by 2% ($P<0.05$). The egg productivity of quails of the 1st–3rd experimental groups was lower than analogues of the control group by 1.59–1.72%.

Therefore, the use of the enzyme preparation in combination with various forms of sulfur improves the productivity of quails and is promising in further studies.

Key words: enzyme, *Natuzym*, sulfur, quails, lipids, phytasis

Sulfur-containing compounds of wool and their role in the processes of wool growth and the formation of physicochemical properties of fibers

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The data on the content of Sulfur in different categories of wool fibers in general and in particular, in their individual structural components, as well as the role of this element in the formation of their physicochemical properties was presented. The main substance of hair fiber is solid keratin — a complex protein compound with high content of Sulfur. Keratin is characterized by high density, poor solubility, resistance to many chemical factors.

It has been shown that wool contains from 0.7 to 5.0% of total Sulfur. Sulfur in wool is found in various sulfur-containing compounds, but cystine holds its largest amount (about 74%). Because of this, cystine plays a crucial role in the synthesis of keratin and the formation of physicomechanical, and therefore technological properties of fibers, in particular their strength. The sulfur balance in wool is made up by sulfur-containing compounds such as cystine, cysteine, methionine, lanthionine, cysteic acid, sulfates and bromine-oxidizing sulfur. The content of lanthionine and cysteic acid in wool is considered to be the result of exposure to a number of renewable and oxidizing agents. The content of sulfur in wool reflects all possible changes in the wool fiber under the influence of various factors (UV-rays, the action of acids and alkalis, nutritional factors, etc.), and its balance becomes negative after the level of cystine decreases in wool.

Therefore, the presented data prove that Sulfur plays an important role in the processes of wool growth and the formation of physicochemical and technological properties of fibers. Keratin synthesis itself is inextricably linked to the intensive use of sulfur-containing compounds, in particular cysteine.

Analyzed data indicate that after pre-oxidation or restoration wool keratin can be divided into two groups of proteins: with high molecular weight and low Sulfur content — fibrillar structure (carboxymethyl keratins, or α-keratosis) and with lower molecular weight and high Sulfur content (carboxymethyl keratines, or γ-keratosis).

The fiber structure contains up to 3% of lipids, which are both free and bound to protein. These structural lipids are components of the cell membrane complex and are composed of ceramides, cholesterol sulfate, cholesterol, fatty acids and sulfolipids. The latter form components with proteins of different strength. It is shown that wool with high content of Sulfur and sulfolipids is characterized by better indicators of physical and mechanical properties, in particular the tensile strength of fibers. The high content of cholesterol sulfate in the lipid composition of the wool indicates that this component is an important determinant in maintaining the integrity of the fiber structure.

Numerous studies conducted on different gender-age groups of sheep indicate that sheep feeding with Sulfur always has a positive effect on the intensity of wool growth and its physicochemical properties.

Key words: sheep, wool, Sulfur, cystine, sulfolipids, structure

Impact of exogenous enzymes and sulfur citrate on intestinal microbiocenosis of broiler chicken

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The optimal run of biochemical processes in the organism is preconditioned by the qualitative and quantitative ratio of specific macro and microelements. Among the biologically active substances that positively impact digestion and nutrient availability of animal feed are enzyme mixtures.

The paper aims to study the impact of exogenous enzymes combined with various forms of sulfur on the microflora of broiler chicken intestines.

The test was conducted at the vivarium of the Institute of Animal Biology of the National Academy of Agrarian Sciences of Ukraine in four groups (20 birds in each) of broiler chicken aged ten days. The birds were kept in cages and fed according to technological requirements. The poultry received combined feed with balanced nutrient and biologically active substance content. Test group birds received "Natuzym" enzyme mixture and sulfur citrate. Samples of blind gut contents were taken after harvesting and placed in sterile dishes. The samples were studied for quantitative and qualitative contents of microflora using cultivation and inoculation of microorganisms onto select media (Endo, Ploskirev's, Saburo, bismuth sulfite, Baird-Parker, Blaurock, Blood Agar). Identification was conducted under morphological, cultivation, physiological and biochemical properties (Olkenytskyi and Simmons media).

Levels of microorganisms from the blind gut of the 1st test group tended to be lower in comparison with the control group. Types of obligate microflora in blind gut contents of broiler chicken were almost the same as those of the control group and included *E. coli*, *Bifidobacterium*, *Lactobacterium*, and *Enterococci*. Blind gut chyme of the 2nd test group chicken (25% sulfur from its levels in standard premix) showed 0.75 CFU/g less *E. coli* than in the control group. In addition, strains with different enzyme activity were redistributed. Namely, the number of *E. coli Enterobacteriaceae* probably increased compared to the control group attesting to unfavorable changes in microbiocenosis. *Lacto-* and *Bifidobacterium*, constituting the main part of microbiocenosis, reached the levels of 10^8–10^{10} CFU/g in said test group birds along with a higher probable concentration of yeast-like fungus and *Proteus* cells. As far as mould is concerned, it was the only group where isolated colonies were identified. Birds of the 3rd test group (10% sulfur citrate from its levels in standard premix) showed a 97 to 3 ratio of normal fermentation *E. coli* to weak fermentation *E. coli* in blind gut contents against the general increase of *E. coli* cells. Cocci levels in blind gut chyme from the total levels of microorganisms in blind gut chyme of the 3rd group broiler chicken matched control group levels. *Bifidobacterium* and *Lactobacterium* levels ranged between 10^9–10^{10} CFU/g. Facultative microflora contained fewer *Candida fungi* and *Proteus* cells which proves positive changes in broiler chicken microbiocenosis.

Thus, the comprehensive introduction of sulfur citrate (10% from its levels in standard premix) and the "Natuzym" enzyme mixture positively impact broiler chicken intestinal microflora.

Key words: broiler chicken, microbiocenosis, *Natuzym*, sulfur citrate

Genetic profiles of Ukrainian breeds of cattle by the BoLA-DRB3 gene

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DNA markers use to researching of biodiversity. The second exon of the BoLA-DRB3 gene of cattle is quite very polymorphic. This allows the use of its alleles to determine genetic variability and genetic profile of breed. The study of biodiversity of cattle allows using the genetic features breed for a wide range of program selections.

The results of the study of polymorphism of the BoLA-DRB3 gene for four Ukrainian breeds are presented: Black-and-White dairy (n=293), Red-and-White dairy (n=131), Gray (n=93), and White-Headed (n=49). The allele frequencies were detected based on the polymorphism analysis of the length of the restriction fragments (PCR-RFLP) of the products of amplification of the exon 2 of the BoLA-DRB3 gene. Isolation of DNA from the samples of blood and sperm was made using standard commercial sets of DNA-sorb B manufactured by *AmpliSens* (Scientific Research Institute of Epidemiology, Moscow, Russia) according to the requirements of modified protocols using a set of reagents for isolating DNA from liquid blood and sperm respectively. The BoLA-DRB3 exon 2 was amplified by PCR using the single-step PCR as modified from Van Eijk (1992) using primers HLO-30, HLO-31 and HLO-32. PCR products were treated with three restriction endonucleases: *RsaI*, *HaeIII* and *XhoII*. Restriction fragments were separated by electrophoresis in 6 or 9% agarose gel. Comparison of patterns obtained using three endonucleases, allows you to identify 54 nomenclature BoLA-DRB3 alleles. The genetic profile of the breed is formed according to the following indicators: the frequency of alleles (P_a) and genotypes (G_a), the total fraction of "informative" alleles (P_a>5%), expected (H_e), and observed (H_o) heterozygosity, Wright individual index of fixation (F_{IS}), general (N_a) and an effective number (A_e) alleles, Shannon's information index (I). Statistical calculations have been conducted in the standard *Microsoft Excel 2013* package using its own programs and integrated *Genalex 6.503* and *StatistiXL 2.0*.

The largest variety in the number of alleles BoLA-DRB3.2 is detected for the Ukrainian Black-and-White dairy breed (N_a=37). Variants 31, 29, 28 are found in the Ukrainian Red-and-White dairy, in White-Headed, and Gray breeds, respectively. In genotypes of Gray and White-Headed livestock, there are alleles "without installed nomenclature": Gray — jba, *jab, *jbb, *nad and *nda, White-Headed — *nab, *mdb, *iab, *gbb, *fbd, *naa, the share of which amounted to 8.9% and 7.1%, respectively.

The total share of "informative" alleles amounted to: Ukrainian Black-and-White dairy — 55.8% (7 alleles), Ukrainian Red-and-White dairy — 77.8% (9), Gray — 69.9% (4), White-Headed — 65.3% (7). Observed and expected heterozygosity, and determined by their values. Individual fixation index had the following values: Ukrainian Black-and-White dairy — H_o=0.922; H_e=0.942; F_{IS}=0.022; Ukrainian Red-and-White dairy — H_o=0.893; H_e=0.913; F_{IS}=0.017; Gray — H_o=0.742; H_e=0.774; F_{IS}=0.041; White-Headed — H_o=0.959; H_e=0.927; F_{IS} = –0.035. The assessment of biodiversity at an effective number of alleles and the Shannon's information index showed that the largest genetic variability is characteristic of the Black-and-white breed (A_e=17.2; I=3.13). White-Headed (A_e=13.7; I=2.93) and the Ukrainian Red-and-White (A_e=11.5; I=2.87) cattle had smaller, but rather high variability rates. The low level of biodiversity was found in a Gray breed (A_e=4.42; I=2.21).

The aggregate analysis of indicators of genetic variability and biodiversity showed that the most genetically inhomogeneous by BoLA-DRB3 gene is the Ukrainian Black-and-White dairy breed. The obtained results substantially replenish the genetic bank of more than 40 world breeds, for which investigated the polymorphism of the BoLA-DRB3 gene by data of the Ukrainian domestic cattle.

Key words: cattle, biodiversity, BoLa-DRB3 gene, alleles

Effect of vanadium and chromium citrates on lipid composition in blood plasma of rats with experimental diabetes

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The metabolism of lipids, carbohydrates, proteins is disturbed by diabetes, thus affecting the quality of life and health. Deviations of lipid metabolism caused by diabetes evolve in different ways. This is the effect of hyperglycemia, peroxide oxidation of lipids and fatty acids in vasoconstrictor reactions, the participation of lipoproteins in the formation of immune vascular damaging complexes and the interaction of lipids with platelets and vascular walls. The available oral hypoglycemic drugs do not have the desired properties, so studies are aimed at identifying more effective and safe prophylactic diabetic drugs. One of these is the compounds Vanadium and Chromium, which act as insulin mimetics and can increase the sensitivity of cells to the hormone. Therefore, the purpose of the study was to investigate the effects of vanadium and chromium citrates on lipid metabolism indices in the blood plasma of rats with experimental diabetes.

Rats weighing 100–120 g were divided into 4 groups: I — control, II — rats were consuming a combined solution of vanadium and chromium citrates at the dose of 0.5 μg/ml and 0.1 μg/ml water as an addition to drinking water; III — diabetes-induced rats drank pure water without additives; IV — diabetes-induced rats were consuming a combined solution of vanadium and chromium citrates at the dose of 0.5 μg/ml and 0.1 μg/ml water as an addition to drinking water. Experimental diabetes was induced in the animals from groups III and IV after a 24-hour fasting period by intraperitoneal administration of 5% solution of alloxan monohydrate in the amount of 150 mg/kg of body weight. Blood plasma was extracted using chloroform-methanol mixture according to the Folch method. The total amount of lipids was determined by weighing the dry residue (gravimetric method). The division of lipids into classes was performed by thin-layer chromatography on silica gel. The received digital materials were processed according to the method of variation statistics using the Student's *t*-test. Changes were considered probable for $P \leq 0.05$.

It was found that the content of total lipids increased in the rats' blood plasma of the III group relative to the animals of the I group, it is can be explained by the mobilization of fats from the depot (the lipomobilization syndrome). The study of lipid classes in the blood plasma of rats with experimental diabetes in group III has revealed an increase in the content of phospholipids, non-esterified fatty acids, triacylglycerols, non-esterified cholesterol — by 45.2% ($P<0.05$), but esterified cholesterol decreased by 12.1% ($P<0.05$) compared with control animals. The effects of vanadium and chromium have changed the ratio of lipid classes in the blood of animals from experimental groups. In particular, a decrease by 5.6% ($P<0.05$) in the content of phospholipids indicates an increased activation of their hydrolysis. The decreased by 24.1% ($P<0.05$) content of non-esterified cholesterol indicates an increase in the functional activity of tissues. This may indicate changes in the processes of esterification and hydrolysis of cholesterol in the body under the influence of biologically active substances. Also, non-esterified cholesterol can be reduced when used for the synthesis of sex hormones and hormones of the adrenal cortical layer. The content of triacylglycerol decreased by 31.5% ($P<0.05$) indicates an increase in the β-oxidation of fatty acids and is associated with their formation in the process of glucose metabolism through L-α-glycerophosphate. It is also known that the rate of synthesis of triacylglycerol changes under the influence of hormones. Thus, insulin stimulates the transformation of carbohydrates into triacylglycerol and *vice versa*.

The introduction of vanadium and chromium citrates into the diet of animals is effective in the prevention of disorders of the lipid metabolism indices in diabetes

Key words: diabetes, lipids, vanadium citrate, chromium citrate

Research work of the Institute of Animal Production in the field of pig nutrition — feed supplements enhancing pig health and productivity

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The presentation shows and summarizes the research conducted in recent years at the National Research Institute of Animal Production on pig nutrition. The aim is to familiarize the participants of the conference with our research works and to initiate possible cooperation.

Since the ban on the use of feed antibiotics in the EU, we are interested in feeding problems of piglets, as young animals with underdeveloped digestive and immunological functions. During the weaning period, these animals are exposed to multifactorial stress and, as a result, deterioration of feed digestibility and diarrhea. The conducted research was aimed at determining the effectiveness of various types of feed additives in stimulating the development of the gastro-intestinal tract, stabilizing the intestinal microflora, improving feed conversion and overall health status. We assessed the effectiveness mainly of herbal extracts, short- and medium-chain fatty acids, fibers, pre- and probiotics.

The second direction of our research is the assessment of domestic feed protein sources that can replace imported GMO soybean meal. There is a growing interest in legume seeds and rapeseed fodder. The research work also covers by-products of the agri-food industry that can be used in feeding pigs as the valuable feed materials.

For years, our Institute has been researching the possibility of improving the quality and oxidative stability of pig meat with the use of dried herbs or herbal extracts. A series of work brought the expected beneficial results. In recent years, consumer expectations regarding the quality and origin of food have increased significantly. Our experiments also follow this direction, and includes not only the feed additives, but also the restoration of native pig breeds, the development of dedicated feeding methods for these animals and finally, obtaining the high quality products manufactured using traditional methods. The native pig breeds are characterized by good health and the meat of high sensory quality, which predisposes them to produce traditional regional products. However, because of slower growth rate and greater fatness, the potential of this breed has not been properly used. The amount of research on native pig breeds in Poland is still negligible.

During the feed study conducted on pigs we use the automatic analyzers for various blood analysis, complete equipment for the preparation and evaluation of histological preparations, especially intestinal fragments, evaluate meat quality parameters (e.g. physicochemical, texture, organoleptic, susceptibility to oxidation). Very interesting is the nutrigenomic aspect of our experiments. We select genes, believed to be associated with metabolic pathways and the expression of these genes after different diets is analyzed. We also cooperate with other scientific units to jointly research the composition of the microflora or the quality of the skeleton.

Key words: pigs, nutrition, feed additives, digestibility, health status

Safety of genetically modified feed materials in animal nutrition — results of studies of National Research Institute of Animal Production in Kraków

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Genetically modified (GM) plants, i.e. plants whose genetic material has been altered using genetic engineering techniques, constitute a significant portion of the crops available on the feed market. In fact, all GM crops grown are transgenic plants, and thus each contains in its genome a DNA construct (transgene) originating from a foreign organism. Even though GM plants have been grown and used for years and have gone through detailed examination prior to commercialization, and despite a number of feeding studies which have proved their safety for animals, the use of GM crops as feed materials still leads to emotional public discussion in some countries. The main topics of this debate are the potential unintended and detrimental effects of transgenic DNA and expressed transgenic protein on metabolic processes in animals and humans.

The aim of series of polish studies, conducted by National Research Institute of Animal Production in Kraków, in cooperation with National Veterinary Research Institute in Puławy, was to evaluate the safety of use of genetically modified feed materials in nutrition of food-producing animals. In the experiments, herbicide-tolerant roundup ready (RR) soybean meal, modified for glyphosate tolerance and corn Bt (MON 810), modified for resistance to the common pest European corn borer, were examined. During the studies the effects of these GM feeds on performance parameters, physiological and health indices of animals (among others immune response), quality of animal origin products, and fate of transgenic DNA in animal organism were evaluated. The experiments were carried out on broiler chickens, laying hens, fatteners, sows with piglets, cows, calves (young bulls), as well as in multigeneration study with rats.

The experimental scheme in all the studies was the same and four dietary treatments were used: I — control (non-modified corn and soybean meal), II — non-modified corn and GM soybean meal, III — GM corn and non-modified soybean meal, IV — GM corn and GM soybean meal.

The studied GM feed materials had no effect on performance parameters, quality of animal origin products, digestibility of nutrients, as well as metabolic and health status of animals. There was also no negative influence of studied GM soybean meal and corn on metabolic and reproductive indices of rats in six generation study. Transgenic DNA was efficiently digested in gastrointestinal tract of animals, so it was not detectable in internal organs, blood, muscles, excreta, eggs and milk.

Summing up, it can be concluded that that commercialized transgenic crops can be safely used as feed for food-producing animals, without affecting performance parameters, metabolic indices or the properties of such products as meat, milk and eggs.

Key words: genetically modified feeds, food producing animals, performance parameters, physiological nad healts status, fate of transgenic DNA in organism

Population-genetic monitoring in the cattle biodiversity conservation system *in situ*

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Sustainable development of genetic resources of farm animals is a guarantee of food security of each state. The globalization of biological diversity narrowing of the animal world has necessitated a shift to genetic resource management that combines traditional and modern knowledge and technology, with an increasing emphasis on product quality, longevity and animal health, and the rational use of natural resources. One of the elements of a systems approach is to obtain objective information on controlled populations and create a database to analyze their structure, plan breeding and research, study genetic processes and maintain optimal variability at the species and individual levels.

The full implementation of measures to preserve the gene pool of livestock in Ukraine can be ensured through the functioning of the national strategy for regulating the development of herds through systematic information, selection and genetic monitoring. The prognostic measure is a comprehensive assessment of the degree of risk of normal development of any breed population, taking into account a range of factors that directly or indirectly affect the viability of animals. The calculated level of risk status of the breed provides information to stakeholders on where and how quickly to take appropriate action.

Monitoring development trends and associated risks to the state of the genetic resources of farm animals is an important element in planning the management of animal genetic resources. Therefore, the aim of the work was to analyze the status and characterization of the existing biodiversity of cattle in agricultural enterprises in terms of development trends and associated risks to genetic resources.

Quantitative and qualitative composition of breeds (populations) of cattle was analyzed according to the State Register of Breeding Entities in Animal Husbandry as of 01.01.2021 and catalogs of bulls for reproduction of breeding stock in 2021. The current risk status (category) was established according to the methodology of the FAO Committee on Animal Genetic Resources (number of purebred males and females involved in reproduction) and the European Association of Animal Production — Animal Genetic Data Bank (EAAP-AGDB) (estimated value of the expected increase in ΣΔF inbreeding in the breed over 50 years of reproduction).

Establishment of current status (categories) of risk of each controlled breed population of cattle of Ukraine. According to calculations FAO recommendations, the following are in critical condition: Carpathian Brown and Blonde D'aquitaine cattle breeds, the number of breeding females in these herds does not exceed 100 animals and a very small number of males. Since 2013, the breeding stock of the Carpathian Brown breed has been concentrated only in households. In danger are Ukrainian Gray, Ukrainian Beef, Southern Beef, Ukrainian Whiteheaded and Lebedyn breeds. Because the breeding population of purebred females and the total size of these populations range from 100 to 1,000, the sperm production of males in most of these breeds kept in breeding enterprises is generally less than 20 sires and the percentage of purebred females is less than 80%.

According to another assessment system of the EAAP-AGDB, the minimum risk of gene pool loss is Ukrainian Whiteheaded and Red Steppe breeds, and the potential danger — Lebedyn, Gray Ukrainian and Polissian Beef cattle.

Thus, according to the results of the analysis among a significant number of breeds in Ukraine, we have assessed the most vulnerable breeds of cattle that are in danger of losing the gene pool.

Key words: cattle breeds, danger state, gene fund, population size

Microbial and antimicrobial-based technologies in the agrobiotechnological industry: science & applications

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Microorganisms are key living organisms on Earth that affecting all aspects of plants, animals, and human lives. Understanding of interactions mechanisms between microorganisms and other organisms is the main priority for both effective controlling pathogen microbes and their successful application in biotechnology. Microbial biotechnology use prokaryotic, eukaryotic microorganisms (bacteria, yeasts, fungi, algae, archaea) for the different substances (antibiotics, pigments, enzymes, mycotoxins, phytotoxins, etc.) synthesis and their application in pharmaceutical, medical, veterinary, and agroenvironmental sectors. Microbial and antimicrobial-based technologies play an essential role in resolving agriculture and animal husbandry modern problems, especially ecological and environmental damages. We discussed the main priorities of microbial technology using in the agrobiotechnological industry in contexts of scientific research of the Genetic and Biotechnology Department, Ivan Franko National University of Lviv. The main aim to search of collaboration points of current and future promising biotechnology research.

In the structure of the Genetic and Biotechnology Department is the Culture Collection of Microorganisms — Producers of Antibiotics that have more than 5000 different microorganisms (typical strains, genetically modified bacteria, and soil microorganisms) from Ukraine (Crimea, Carpathians, industrial areas, etc.) and Antarctica. The huge potential of the Collection intensively is studied and microbes' attractive properties are established. Special attention is paid to the screening of biological active biotechnology products: anticancer, antifungal and antibacterial antibiotics, enzymes, etc. More than 16 new bioactive compounds were discovered, two of them are the new skeleton structures — new families of antibiotics. In our interest is the activation of cryptic genes of new antibacterial metabolites, especially new effective antibiotics against multi-resistant bacterial strains, by using the different physicochemical approaches. We conduct classic genetic investigations: genes engineering of bacteria, the study of gens regulation, and the development of industrial strains.

Another side of our interests is the investigation of antibiotic resistance mechanisms and development approaches for its overcoming by bio- and nanotechnology methods. We syntheses of complexes of ampicillin, cefuroxime, cefotaxime, ceftriaxone, vancomycin, teicoplanin, novobiocin, chloramphenicol, and other antibiotics with metal nanoparticles for increasing their effectiveness to multiresistant pathogens. We obtained also effective antimicrobial nanoparticles without antibiotics that have great potential in the treatment of animal infectious diseases.

Recent promising research devoted to the study of microbes-plants interactions for promoting plants growth that has a great interest in agronomy. We use the potentials of rare species bacteria of Antarctica and Ukraine for increased plants growth, breeding, and protecting against other harmful microorganisms. Positive effects on plant growth of *Umezawaea* sp. Da 62-37 (isolated from the rhizosphere of *Deschampsia antarctica* E. Desv., Galindez Island, Antarctica) were found. These biotechnologies can be applied in organic food productions.

Thus, new microbial and antimicrobial-based technologies have many applications in agriculture and animal husbandry. The biotechnological research strategy of the Genetic and Biotechnology Department, Ivan Franko National University of Lviv has many innovational directions that can be points of research and applications collaborations in the agrobiotechnological industry.

Key words: microorganisms, biotechnology, agrobioperspectives

Vitamin and mineral nutrition of ducks

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Poultry farming is a branch of agricultural production. Its main tasksare the breeding, feeding, keeping poultry to obtain eggs and meat. Increasing the digestibility of feed nutrients is an important factor in reducing their costs, the cost of livestock products and improving the economic efficiency of the industry. Nutrients digestibility is the initial stage of feedinteraction with the body and therefore does not give a complete picture of the impact of feed nutrients on the animal — its condition, reproductive capacity, productivity. The purpose of our study was to determine the efficiency of feed nutrients digestibility by adding to the main diet of 14 kg/t of the developed premix.

"Star 53" cross ducks were selected for the study. The study conducted by the method of groups-analogues. 100 daily ducklings were selected. 2 groups were formed from them — control and experimental, 50 animals (25 males and 25 females) in each, according to the principle of analogues. Age, sex and live weight were taken into account when selecting analogues.The main period of the experiment lasted 56 days. It was divided by bird age into 2 sub-periods: 1–14, 15–56 days each. Physiological experiments were performed individually in order to determine the level of nutrient digestibility and balance of mineral elements in the ducks body at the age of 8–14 and 36–42 days. The bird was placed in individual cagesfor this.

The obtained results showed that the feeding of poultry aged 8–14 days by feed with a vitamin premix content of 14 kg/t contributes to an increase in the level of protein digestibility by 3.2%, fat by 5.1% and NFE by 2.7%. Feeding this feed to poultry aged 36–42 days increases the level of protein digestibility by 4.9% and fiber by 4.8%. In the body of ducklings, the level of calcium content increases by 6.2% during feeding by compound feed with the developed premix, compared with ducklings feedingby compound feed without premix.

According to the study, the addition of a premix to the diet can significantly improve feed conversion and increase the digestibilitylevels of the main feedcomponents, which in turn reduces the cost of 1 kg of product.

Key words: nutrients, macro- and microelements, nutrition, digestibility, vitamin premix, amino acids

Population and genetic analysis of the horse gene pool of Ukraine

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Ukrainian base of horse breeding now consists of 22 study farms and 49 breeding reproductors. The structure of breeding stock is dominated by Ukrainian Warmblood horse, Thoroughbred, Orlov's trotting and Ukrainian trotting, Novoaleksandrovsky draft horses. Other horse breeds are represented in smaller numbers, including the local Hucul breed, which is on the verge of extinction in Ukraine. About 65% of the breeding stock is concentrated in private owners, 35% — on State study farms, affiliates of the State Enterprise "Ukraine Horse breeding". Also, horses are kept by private individuals for rental, sports, tourism, land cultivation, transport in rural regions, recreation, traditional holidays and other cultural events, as well as in a few boarding houses for old animals. So, the scope of use of horses is quite extensive, due to the positive impact on the development of rural and suburban areas, as well as the popularization of a healthy human lifestyle.

Unstable economic conditions, some subjects of breeding business cannot withstand competition, so, compared to previous years, their number has decreased. Accordingly, the number of breeding horses is also decreasing. The import of horses of Western European breeding has increased due to their better rearing and sports training. At the same time, domestic breeds and types of horses that have traditionally developed on the Ukraine with their inherent high adaptive properties are devalued and disappear.

The aim of the research was to identify the originality of the domestic gene pool of horses by breeding and genetic methods. The development is based on breeding and genetic studies of the structure of livestock, which makes up the array of the domestic gene pool of horses and their improvement using domestic and imported horse material of various uses.

The material for the research was a database of documents of primary breeding registration, reports on horse testing, and the results of an expert assessment of the breeding composition of horse breeds of Ukrainian selection. The study of the genealogical structure of breeds by lines, breeding families and nests was carried out by the method of family analysis based on the construction of pedigrees. The assessment of livestock was carried out by an expedition survey of breeding subjects and individuals who own horses.

Comprehensive breeding and genetic studies were conducted to determine the desired type, exterior and productive parameters of horses of domestic breeding in the context of breeds, population and genealogical branches.

As a result of the conducted research, the genetic structure of horse breeds of domestic selection, features of their exterior and productive parameters were determined, genealogical branches (genealogical lines, breeding families and factory nests) were evaluated, and directions for preserving the desired types were developed. A comparative assessment of breed markers of the alleles pool of structural units of domestic horse breeds by the number and frequency of red blood cell antigens was carried out, genetic diversity was determined, and the proportion of homo- and heterozygous genotypes was established.

It has been established that in horse breeds with a limited gene pool, individual and small-group breeding value, prepotency of individual individuals, linear combination and compatibility of parent pairs have a significant influence on the evolution of genealogical lines. The priority role of outstanding producers in the formation of the breeding effect in all the studied breeds is proved both during purebred breeding and during crossing (especially when crossing using an imported gene pool). This fact, however, is characterized by significant economic risk and can cause the disappearance of valuable local lines.

Key words: horses, gene pool, population, breeding, genetics

Roundup exposure affects longevity, body weight and feeding rate in *Drosophila*

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Roundup is a non-selective glyphosate-containing herbicide that acts through inhibition of plants enzyme 5-enoylpyruvilleshikimat-3-phosphate synthase. Due to their ability to accumulate in the environment, glyphosate-containing herbicides circulate in ecosystems and can be included in food chains, showing signs of toxicity to a wide range of non-target organisms.

Therefore, the aim of this study was to investigate the potential toxic effects of *Roundup* herbicide on lifespan, body weight, triacylglycerol content (TAG) and food consumption of fruit fly *D. melanogaster*.

We used the laboratory line of flies W^{1118} *D. melanogaster* as a model. Animals were kept at a constant condition: temperature 25°C, relative humidity 50–70% and photoperiod of 12:12 (day/night). On the 5-day-old flies were placed in demographic cages with a plastic vial filled with 5 ml of experimental food 5%S + 5%Y (5% sucrose, 5% dry yeast, 1.2% agar and 0.18% nipagin). To assess the effect of the herbicide *Roundup* it was supplemented to the medium at the concentration range from 1 g/l to 100 g/l. To determine lifespan, the nutrient medium was changed every second day and the number of dead individuals were counted. Experimental flies were weighted using WTW2 balance (*Techniprot*, Pruszków, Poland). The TAG content was determined by enzymatic colorimetric methods using *Serum Triglyceride Determination Kit* according to the manufacturer's instructions (*Sigma Aldrich*). Feeding rate was determined using colorimetric method by adding to the standard experimental medium non-absorbable blue food dye E133. Graphing and statistical analysis were performed by using *GraphPad Prism* (*GraphPad Software, Inc.*).

We found that *Roundup* at the concentration of 10 g/l and higher reduced the lifespan of males ($P<0.05$), while in females a reduction in the lifespan was observed when *Roundup* was added to the medium at a concentration of 33 g/l ($P<0.05$) and 100 g/l ($P<0.01$). Consumption the medium with *Roundup* at a concentration of 3.3 g/l and higher reduced the body weight of flies in flies of both sexes ($P<0.05$). *Roundup* in the diet reduced the amount of food consumed even at the lowest experimental concentration — 1 g/l in males and females ($P<0.05$). However, *Roundup* supplementation to the food of flies had no effect on the level of TAG storage in the body.

According to the scientific data, glyphosate and surfactants as main components of the herbicide *Roundup* are able to disrupt the respiratory chain of mitochondria, that leads to the disruption of catabolic and anabolic processes, as well as the development of oxidative stress. These events can cause the lifespan shortening and decrease the weight of flies during the experiment. At the same time, our data showed that an additional cause of the negative consequences is decreasing in food consumption and a potential lack of nutrients for the *Drosophila* model.

Key words: herbicide, *Roundup*, toxicology

Development of microelement supplements based on N-substituted glutamic acid for animals feed correction

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When humanity increased cultivation volume of livestock, animals began to eat high-calorie food, but poor on microelements of mineral origin. Therefore, it was a need to adjust their diet with essential micronutrients. High efficiency of assimilation showed the essential micronutrient supplements of new generation, in which the metal ion creates a chelate complex with organic ligand. But in this case, there are questions about the metabolism of such compounds and their toxicity. Search of non-toxic organic ligand with high transport ability of micronutrients ions into the cell are the most actual way of development of highly effective forms of supplements of essential microelements.

The purpose of research is synthesis of new highly efficient complex of micronutrients for animals feed correction based on new derivative of glutamic acid and polyoxyethylene fragments with different molecular mass. These supplements are biodegradable, non-toxic, don't accumulate in the body and this structure provides an effective transport of microelements into the cell.

Based on the previous works the structure of molecules of metal ions ligands was chosen. This structure provides an effective transport of microelements into the cell. Synthetic approach and optimized conditions for synthesis of such ligands were developed. Ligands were obtained using reaction of N-alkylation of glutamic acid by polyoxyethylene esters of monochloroacetic acid, the polyoxyethylene fragments were used in the range of molecular mass 300÷1500. Based on the obtained ligands were developed a method of formation of Fe(II), Mg, Cu and Zi supplements. Studies have shown that the obtained supplements of micronutrients based on mono-substituted polyoxyethylene derivative of glutamic acid form a strong nature complex of salt It can be seen on the peak shift of absorption of liganded Cu(I) compared with ions of copper hydrated with water.

We have got the results of cyto- and general toxicity. Also defined the ability of supplements to transport of microelements into the cell and their efficiency as part of feed as preparations for the correction of the diet of animals. We have also studied the influence of feed with balanced microelement content using obtained supplements on the rats.

Thus, we have showed that doses that provide the necessary physiological activity in the developed supplements are lower than in industrial used supplements. The work describes complete complex of studies and suggests a new generation of highly efficient essential micronutrients.

Key words: essential elements, animals feed correction, glutamic acid

Selection factors of improving Ayrshire cattle breed productivity

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Given the point of view of the world community on the need to reduce livestock in the context of reducing negative carbon emissions and irreversible climate change on Earth, alternative livestock productivity should be considered as an alternative to reducing its numbers. It is with this trend that the dairy industry of the world and Ukraine has been developing in recent years, although due to the growing population of the planet, the demand for dairy products is very difficult to meet, as an alternative — biotechnology, but it is also air pollution. So far, milk production is closely linked to increased livestock productivity due to a number of factors, including breeding. With this in mind, the purpose of our research was to identify certain factors that affect the formation of the genetic potential of livestock productivity and can be used for qualitative improvement of the population. For the research Ayrshire cattle bred in Poltava region was used. The origin of cattle and its belonging to the appropriate genealogical structure of the breed was determined using the pedigrees of animals. The growth of heifers from one to 18 months of age was determined by weighing them monthly on the date of birth. The age of animals in calves, as well as milk productivity for 305 days of lactation were determined using forms of zootechnical and breeding records, as well as their own research. Statistical processing of research results was done using the software pack *Statistica 10.0* [Borovikov V., 2001].

The results of the study showed that the live weight of animals in the breeding process is to some extent influenced by their belonging to the line, but the difference between individuals was not significant, which did not allow choosing this factor as an improvement in livestock productivity. At the same time, the coefficient of variation of live weight of heifers of the studied lines during the growing period, except for one month of age, was in the range of 8–14%, indicating the possibility of improving the trait by selection methods. A more significant conditionality of the live weight of heifers in the process of rearing was carried out by the heredity of the bull, the father of the offspring. Bulls, which belonged to the same line, but had different breeding value and distance from the ancestor, provided different productivity to the offspring, taking into account this factor is recommended to use as an improvement in the productivity of heifers. The age of Ayrshire breed cows in calves did not significantly affect the duration of the lactation period, although it was a side factor in their milk productivity. It was found that the shortest lactation period duration was in cows with the first lactation (374 days) and the longest one was in cows with the seventh lactation (442 days). The duration of the lactation period is negatively correlated with the yield of calves and the length of the period between calvings. The yield of cows for 305 days of lactation tended to clearly increase to the fourth lactation and some curvilinear nature of the trait during 5–8 lactations. It is expedient to keep Ayrshire cows in the herd up to 8 calvings because for 305 days of every lactation after the 1st–2nd they produce much more milk, which is economically advantageous for the producer.

According to domestic and foreign literature sources, these factors can be considered as an alternative in improving the productivity of Ayrshire cattle by selection methods.

Key words: Ayrshire breed, livestock, productivity, influences

Artificial meat production — challenges and perspectives

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The advancement of cell culture techniques and knowledge make cultured meat approaches more real. Based on the cellular ability to differentiate and self-renew, three-dimensional structures are often constructed and composed from cells of animal muscle tissue origin.

To achieve the final product, appropriate culture techniques must be developed: different cell phenotype composition, the composition of the culture medium, time and parameters of incubation, the suitable carrier for cells *in vitro* culture, which can compete with traditional meat production techniques. Nevertheless, the production of "artificial meat" requires multi-disciplinary research in cell biology, myogenesis processes and pre-industrial biotechnology, which must be combined.

A short and convenient protocol for isolation of single-cell muscle fibre progenitors include 1) digestion of muscle fibres with 5 mg/ml collagenase type I solution in 4% BSA in PBS solution, for 1 hour in 37°C with constant shaking 2) filtration through 70 um nylon mesh 3) washing with PBS Mg Ca free. Protocol help to achieve a single-cell mixture of vital cells capable of self-differentiation from satellite-like cells, myoblasts into miotubes. The protocol can be used for successful isolation of adipocytes as well, after adding protectors like (2)-N 6-(2-phenylisopropyl)-adenosine (PIA) or adenosine.

The advantages of the artificially grown meat support approach to the industrial use of laboratory techniques. Artificial meat is associated with less environmental pollution, including lower use of raw materials and available land; and lowered waste production. In addition, synthetic meat improves the quality of the product itself in terms of sensory (e.g. enrichment with ω-3 acids), medicinal and technological features. Artificial meat is safer because it is not associated with zoonotic disease. And it is also available to vegans, including supplementary role to non-meat products. The possibility of strict-controlling meat growing processes might reduce costs, help obtain a higher quality product, safer for the consumer. Furthermore, the heterogeneous cell mixture is assumed to supplement the nutritional and signaling needs of the cultured cells to reduce production costs.

Key words: artificial meat, cell isolation, pre-industrial cell culture

Hormonal interactions between humans and dogs in Search and Rescue (SAR) teams

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Dogs can perfectly recognize human emotions, for example by body language and facial expressions. Mutual understanding is the stronger in human-animal couples the more time they spend together performing the same tasks. This may affect the interspecies hormone relationship.

The study included 41 search and rescue (SAR) teams taking rescue exams of field and disaster specialties. The level of cortisol, which is the main glucocorticosteroid modulating stress reactions in humans and dogs, was analyzed. The biological material used to assess the hormone concentration was saliva collected in a non-invasive way. In total, 164 test samples were collected: two from the dog and two from the handler before and immediately after the exam.

There was a significant positive correlation between cortisol levels in dogs and their handlers. As human cortisol increases so does the cortisol level in his dog. When examining the relationship between cortisol levels in handlers and dogs by gender of a handler, a significant and strong positive correlation was found between pre-exam cortisol levels in female and dog handlers. In the case of male handlers, we can only speak of a certain tendency for a positive correlation of their cortisol and canine cortisol levels before the exam.

There is some hormone interaction in the dog and its handler, at least in the level of the stress hormone. The high level of cortisol in the guide is reflected in the high level of cortisol in his dog. This relationship is stronger in females and female dogs than in males and male dogs.

Key words. dog, human, hormones, interactions, cortisol

Post thawing quality of bull spermatozoa in diluent with additives of microelements linked with polymer-transporter

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The aim of the work was to establish optimal regimes for sperm cryopreservation when using nanocomplexes in environments. A study was conducted to improve the freezing by adding polymers from pseudo-amino acid (PPAA) with Zinc, Mangan and Cuprum to diluent for cryopreservation of bull sperm. The effect of micronutrients (Cu^{2+}, Zn^{2+}, Mn^{2+}) in the polymer-transporters on the survival and fertilization capacity of sperm bulls was investigated. To assess the validity of the Complexes N-derivative PEG-400, ejaculates from 2 to 5 ml, concentration — 0.7–1.2×10^9 cells/ml and sperm activity 7.0–8.0 points were chosen. The ejaculates of sperm, rarefied lactose-yolk-glycerin environment, are divided into three parts with the addition of N-derivatives PEG 400 (N-PEG 400) with content of 1 ml solution: Zn — 0.0319 mmol; Cu — 0.0222 mmol; Mn — 0.0359 mmol. In prototype sperm added 0.01 ml of micronutrient solution in the polymer in concentrations and 100 times lower in ml diluted ejaculate. In prototypes of rarefied sperm determined sperm survival, dynamic indicators, respiratory activity and restorative ability of thawed sperm, activity of enzyme markers of fertilizing the ability of sperm — succinate dehydrogenase and cytochrome oxidase.

It has been established that respiratory activity and restorative abilities of thawed sperm by adding to the dilution of polymers with trace elements depend on the freezing regime. In this case, when you add 0.01 ml of Zn^{+2} N-derivative 400-PEG per ml of sperm, the maximum value (1.11±0.21 ng-atom/min 0.1 ml), when exposed in nitrogen vapors 8 min. Respiratory activity of thawed sperm is high (1.59±0.31ng-atom/min × 0.1 ml C) when the Cu^{+2} N-derivative 400-PEG is introduced into rarefied ejaculate and exposition in nitrogen vapors for 5 min and for Mn^{2+} — 8 min. The restorative capacity of defrosted sperm in the presence of the Cu^{+2} N-derivative 400-PEG is no different and is 0.01–0.02 mv/min × 0.1 ml C, for the 400-PEG (1.11±0.21 mv/min × 0.1ml C) when exposed to nitrogen for 8 min, and for Mn^{2+}-N-derivative 400-PEG — 10 min. High sperm survival and mitochondrial activity are ensured by the addition of 400-PEG-8 min derivatives 400-PEG to the rarefied sperm-derived spermosifia sperm. Between the activity of enzymes (succinate dehydrogenase and cytochrome oxidase) in the ejaculates of bulls and indicators of their quality and fertilizing ability of sperm established a positive connection. The activity of SDH and CCO is positively correlated with sperm survival (r=0.60–0.68) and the number of living sex cells (r=0.40–0.44).

Key words: cryopreservation, equilibration, semen, bull, microelements, polymer transporter

Hydroxycinnamic acids of highbush blueberry — the potential of application

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The quality of human food and the quality of animal feed are factors in human and animal health and well-being. Contaminated food and feed, in particular by mycotoxins are factors that can cause immunosuppression, leading to reduced resistance to infectious diseases, even in vaccinated organisms. The groups of mycotoxins — aflatoxins are among the most dangerous metabolites of the microscopic fungi *Aspergillus flavus* and *A. parasiticus*, as they have pronounced hepatotoxic, mutagenic, carcinogenic, immunosuppressive and embryotoxic properties, and affect humans and all types of domestic animals, especially pigs, ducks and cows. If aflatoxins B1, B2, G1, G2 are present in the feed, then after eating contaminated feed, aflatoxins M1 and M2 may be present in the milk. The search for antidotes for aflatoxins continues. There are reports of high efficacy of hydroxycinnamic acids to reduce the expression of enniatin biosynthesis genes, and thus — inhibition of enniatin production in *Fuzarium avenaceum*. Herbal preparations rich in hydroxycinnamic acids can also have antiaflatoxic properties. The aim of our study was to determine the content of hydroxycinnamic acids in highbush blueberry (*Vaccinium corymbosum*) shoots.

Samples of shoots of *V. corymbosum* L. variety Bluecrop, Bluejay and Elliott were collected directly from the manufacturer *Berry Partner LLC* at the experimental exhibition site in the Lviv region, Ukraine during 2017–2020, in various phenological stages: during flowering, fruiting, after fruiting, the period of preparing (which precedes) for winter dormancy. Shoots were dried in the shade at room temperature (22–24°C) and crushed in a knife mill. The resulting powders of air dried shoots were collected, passed through a sieve with a mesh size of 2 mm and used for extraction. Aqueous extracts of shoots were performed by suspended of material in distilled water (1:10/m:V) under reflux conditions in a boiling water bath for 30 minutes according to State Pharmacopoea of Ukraine. After completing the extraction process, each extract was filtered through Whatman no. 1 filter paper in order to obtain a clear crude extract solution. Subsequently, these crude extracts were subjected to quantitative content of the hydroxycinnamic acids (HCA) by spectrophotometric method (according to State Pharmacopoea of Ukraine). The content of the HCA in percent (%) was calculated in terms of caffeic or chlorogenic acid and dry raw materials.

It was found that the content of HCA in the variety Blujay ranges from 6.87–14.25% ($P<0.05$); in the Bluecrop variety — in the range of 9.39–15.0% ($P<0.05$); in the variety Elliott — in the range of 2.75–10.56% ($P<0.05$) depending on the year and phase of development in which the plant material was selected. The levels of HCA content in the shoots of all studied highbush blueberries varieties indicate their potential biological activity when consumed orally or percutaneously.

Highbush blueberry shoots in the wild are a component of the feed of wild animals and birds. In our opinion, the evaluation of blueberry shoots as feed, taking into account the content of HCA, which can mitigate the adverse effects of mycotoxins, has prospects.

Key words: hydroxycinnamic acids, *Vaccinium corymbosum*

Spectrophotometric determination of ceftiofur hydrochloride in suspensions for veterinary medicine

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Ceftiofur is a third-generation cephalosporin antibiotic with a broad spectrum of bactericidal activity against gram-positive and gram-negative bacteria, including beta-lactamase-producing species and individual anaerobes. It has been approved for use exclusively in veterinary pharmacy. Manufacturers of veterinary drugs in different countries offer drugs based on ceftiofur for parenteral administration in the water-soluble form (based on sodium salt) and suspension (based on hydrochloride), which have some differences in pharmacokinetics.

It is known that the most common method for determining ceftiofur is HPLC, as well as spectrophotometric using derivatizing reagents. It is often more profitable for manufacturers to use spectrophotometry for their routine and control analyzes, given the economic component. Despite the fact that this method has certain limitations. Namely — often lower selectivity for determining the content of the active substance in the presence of excipients of veterinary drugs. The aim of our work was to develop a spectrophotometric method for the determination of ceftiofur in suspensions "Ceftiofur-VS 5%", "Ceftiomast" (*Vetsintez LLC*), "Cefur" (*OLKAR-AgroZooVetService PC*) and "Cefenil" (*Bayer*) without prior separation of components.

Spectrophotometric studies were performed using a double-beam UV-Visible spectrophotometer *UV-2600 Shimadzu* (Japan) and l cm cuvettes were used. All absorbance measurements were performed at ~20°C.

Method validation for the quantitative determination of ceftiofur was carried out according to ICH Q2R, the State Pharmacopoeia of Ukraine and the European Pharmacopoeia.

The method is based on the ability of ceftiofur solutions to absorb light in the UV region of the spectrum at λ = 291±2 nm. The calculation of the content is proposed to be carried out by the method of standard. The defining stage in the development of the method was sample preparation — the optimal solvent was selected — a mixture of acetonitrile — water (50:50), the conditions of extraction of ceftiofur from the oil base — shaking for 3 min, heating in an ultrasonic bath at 40°C for 15 min, stable — 1 h.

Validation of the developed method on indicators of specificity, linearity, correctness and precision was carried out. The spectrum of the placebo solution lacks all the light absorption maxima characteristic of ceftiofur hydrochloride, which confirms the specificity of the developed technique. The determined parameters of the linear dependence of the analytical signal on the concentration of ceftiofur hydrochloride meet the criteria of linearity, precision and accuracy. The limits of linearity of the developed method are 0.7–17.6 μg×ml^{-1} of ceftiofur at R^2 = 0.9993. The value of Δ_{intra} does not exceed the maximum allowable uncertainty of the analysis. It was calculated when checking the intra-laboratory precision. Compliance of all validation parameters with pharmacopoeial acceptance criteria for tolerances of deviation from the nominal value of B = ±10% is a reason to claim that the developed method is suitable for determining the content of ceftiofur hydrochloride in the test suspension.

Spectrophotometric quantitative determination of ceftiofur in veterinary preparations was developed. The calculated parameters for determination of ceftiofur in drugs by the spectrophotometric method are up to the declared validation criteria — specificity, linearity, accuracy, precision and intra-laboratory precision, thus allowing us to state that the developed method is suitable for quality control of this preparation in accordance with the "Quantitative determination" indicator.

Key words: ceftiofur hydrochloride, suspension, spectrophotometry, validation, veterinary drugs

Protein content in rats' blood under the influence of various forms of enrofloxacin

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Administration of antibacterial drugs to animals for therapeutic purposes affects not only microorganisms, but also certain parts of the metabolism. Changes in albumin and globulin protein levels can provide early diagnostic and prognostic information.

The aim of this study was to investigate the effects of the traditional form of enrofloxacin, and PEGylated enrofloxacin (the compound of PEG-400 with enrofloxacin) on the content of total protein (TP) and its fractions in the blood of rats.

Four groups of rats (control and three experimental) were formed to study protein content in the blood. The animals of control group were injected intramuscularly with saline in a volume of 0.03 ml. Rats of the 1st experimental group were injected with enrofloxacin, 2nd — PEG 400, 3rd — PEGylated enrofloxacin. Animals were removed from the experiment on 7th, 14th and 21st days after drug administration. The content of TP in blood plasma was investigated (Lowry, 1951) and fractions of soluble proteins were analyzed by the gel electrophoresis.

7 days after drugs administration the content of TP in blood plasma was 67.0±0.92 g/L in the control, by 5.4% lower in 2nd, and by 6.5 ($P<0.05$) and 3.4% higher in 1st and 3rd experimental groups, respectively. On 21st day of the experiment the TP content was 67.8±0.69 g/L and was higher by 8.3% ($P<0.01$–0.001) in 1st and 2nd groups and by 14.8% ($P<0.001$) in 3rd group.

During the experiment, the plasma content of γ-globulins of rats after the administration of the drugs did not change much and did not differ between the control and experimental groups.

On 7th day β-globulin level was 14.7–15.0% in the control and 1st experimental groups, and by 3.1–5.1% ($P<0.001$) higher in 2nd and 3rd groups. There was no change in β-globulin levels in any of the groups on the 21st day.

The level of α-globulins decreased in the control group and increased in the experimental groups by 1.4% ($P<0.01$) with the administration of the traditional form of enrofloxacin, by 2.3% ($P<0.001$) with PEG400 and by 1.9% with PEGylated enrofloxacin.

Albumin content was 65.4–68.3% in the control and experimental groups on the 7th day. On the 21st day the levels of albumin decreased in the experimental groups by 3.0% (1st), by 2.1% (2nd) and by 2.6% (3rd).

TP content slightly increased after the administration of both the traditional form of enrofloxacin and PEGylated enrofloxacin ($P<0.05$–0.001). However, these changes can be regarded as a slight effect (or no effect) of the investigated drugs on the protein level in animals.

Key words: enrofloxacin, pegylation, total protein, protein fractions, rats

Metabolic adaptations of blood erythroid cell populations and hematopoietic organs in condition of cadmium intoxication

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Cadmium is an environmental toxicant that causes changes in the hematopoiesis of mammals which may belong to the different sensitive ecological groups of the natural and agroecosystems. Taking into consideration that cadmium-induced disorders can affect energy processes, the aim of the study was to investigate the activity of energy metabolism enzymes in erythroblasts of the bone marrow of rats and erythrocytes of the blood of rats and rabbits intoxicated by the long-term introduction of cadmium chloride. The studied pollutant is the environmental factor that intensifies the processes of lipid peroxidation and activates the system of antioxidant protection in the cells. Therefore, studies of metabolic processes and the state of the antioxidant system in erythrocytes as an indicator of metabolic adaptation are appropriate research problems.

The experimental procedure was performed on outbred white rats weighing 160–180 g, held in conditions of the vivarium. Animals were divided into 5 groups: control (C, included 10 individuals) and four experimental (E1, E2, E3, E4 included 5 individuals each). Rats of the experimental groups were intragastrically introduced a solution of cadmium chloride at a dose of 3 mg/kg body weight daily, namely for animals of group E1 introduction lasted during 7 days, E2 — 14 days, E3 — 21 days, E4 — 28 days. The research material included bone marrow tissue and blood.

The effect of cadmium ions on metabolic processes in erythrocytes was studied on the two-month-old male rabbits of the large white breed weighing 1.2–1.3 kg, held in conditions of the vivarium.

Pyruvate kinase, lactate dehydrogenase, glucose-6-phosphate dehydrogenase activities were determined in erythrocyte hemolysates and bone marrow erythroblasts by standard spectrophoto-metric methods based on the application of nicotinamide coenzymes. Erythrocyte hemolysates were used to determine the concentration of products that react with thiobarbituric acid (TBA-active products), the activity of superoxide dismutase, catalase, glutathione peroxidase, and glutathione reductase by standard methods.

It was found that during the 21-day experimental period, the activity of most of the studied dehydrogenases in the erythroid cells significantly changed. Simultaneously, the increasing activity of pyruvate kinase in rat erythrocytes and its suppressing in bone marrow cells took place; lactate dehydrogenase activity increases, and glucose-6-phosphate dehydrogenase decreases in both cell types. Similar dynamics of dehydrogenase activity were observed in rabbit erythrocytes.

The increase in the concentration of TBA-active products become more visible in erythroid cells of the bone marrow than in erythrocytes. The results of studies indicate an ambiguous response of enzymes of the erythrocyte antioxidant system to the introduction of Cd^{2+} into the body of rabbits and rats. An increase in catalase activity ($P<0.001$) under conditions of SOD inhibition ($P<0.05$) may indicate the probable accumulation of H_2O_2 in the erythrocytes as a result of activation of LPO processes in other organs and tissues.

The obtained results indicate changes in the processes of energy metabolism in erythroid cells which are manifested in the suppressed processes of glucose catabolism in erythrocytes and adaptation of the antioxidant system to activation of LPO processes under the influence of cadmium cations.

Key words: cadmium, erythrocyte, bone marrow, energy metabolism, antioxidant system

Environmental enrichment for *Eublepharis macularius* in a different captive environment (terrarium *vs.* rack system)

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Keeping non-domesticated animals is very challenging due to the need to provide them with specific environmental protection and the relatively limited knowledge of such species. In lizard management, there are three main types of captive enclosure: a biotope terrarium, a rack system, and intermediate enclosures. The former type aims to recreate the naturalistic environments and allow natural behavior, while the latter is intended to maximize breeding, i.e. to keep as many animals as possible in a small space, often with limited equipment (low stimuli). The aim of the study was to test the usefulness of environmental enrichments for *Eublepharis macularius* depending on the maintenance method (terrarium *vs.* rack system). We hypothesized that reptiles kept in a low-stimulus environment (rack system) would benefit much more from the enrichments than those kept in a high-stimulus biotope terrarium.

During the study, 21 females were kept in two types of captive enclosure: 9 in the terrarium, and 12 in the rack system. During the enrichment sessions, the geckos were observed for 45 minutes while the enrichments (dry and wet hide, new feeding method, new object) were applied into the enclosure. Reptiles behavior was video recorded for futher analysis.

While the analysis of the video films we noticed four main state behaviors (watch, rest on/in/under, circle the enrichment, climb) and six occasional (event) behaviors that occurred during the enrichment session (lick, sniff, scratch, dig, hunt, manipulate). The involvement of each individual participating in the enrichment session was determined in detail by counting the number of single contacts with the enrichment (touch) and measuring the duration of the contact. Each enrichment used in the study engaged the geckos during the observed time. The environment and enrichment type had a significant effect on the mean latency of the reptile response to the enrichment. It has been observed that, regardless of the way of maintenance, the geckos have shown interest in enrichments related to the possibility of hiding or facilitating climbing. The animals kept in the rack system were characterized by a much shorter latency towards the introduced environmental enrichment items and remained in contact with these items for a longer time.

Despite the explored usefulness of many different environmental enhancements, it is equally important to work continuously on new solutions, evaluate existing ones, and create new complex forms (involving different areas of behaviors) to be able to change the captive environment even day after day, especially for animals kept in the low-stimulus rack system. Although lizards were interested in the enrichments used in the study, it should be emphasized that under rack system conditions, they cannot fully exhibit species-specific behavior due to a significant reduction in the availability of various stimuli (e.g. visual, social, organoleptic, choice opportunity). The results of our research are a simple guide for leopard gecko breeders to improve considerably the diversity of behavior and the welfare of these animals even when kept in the rack system.

Key words: animal welfare, environmental enrichment, reptile, behavior

Index of authors

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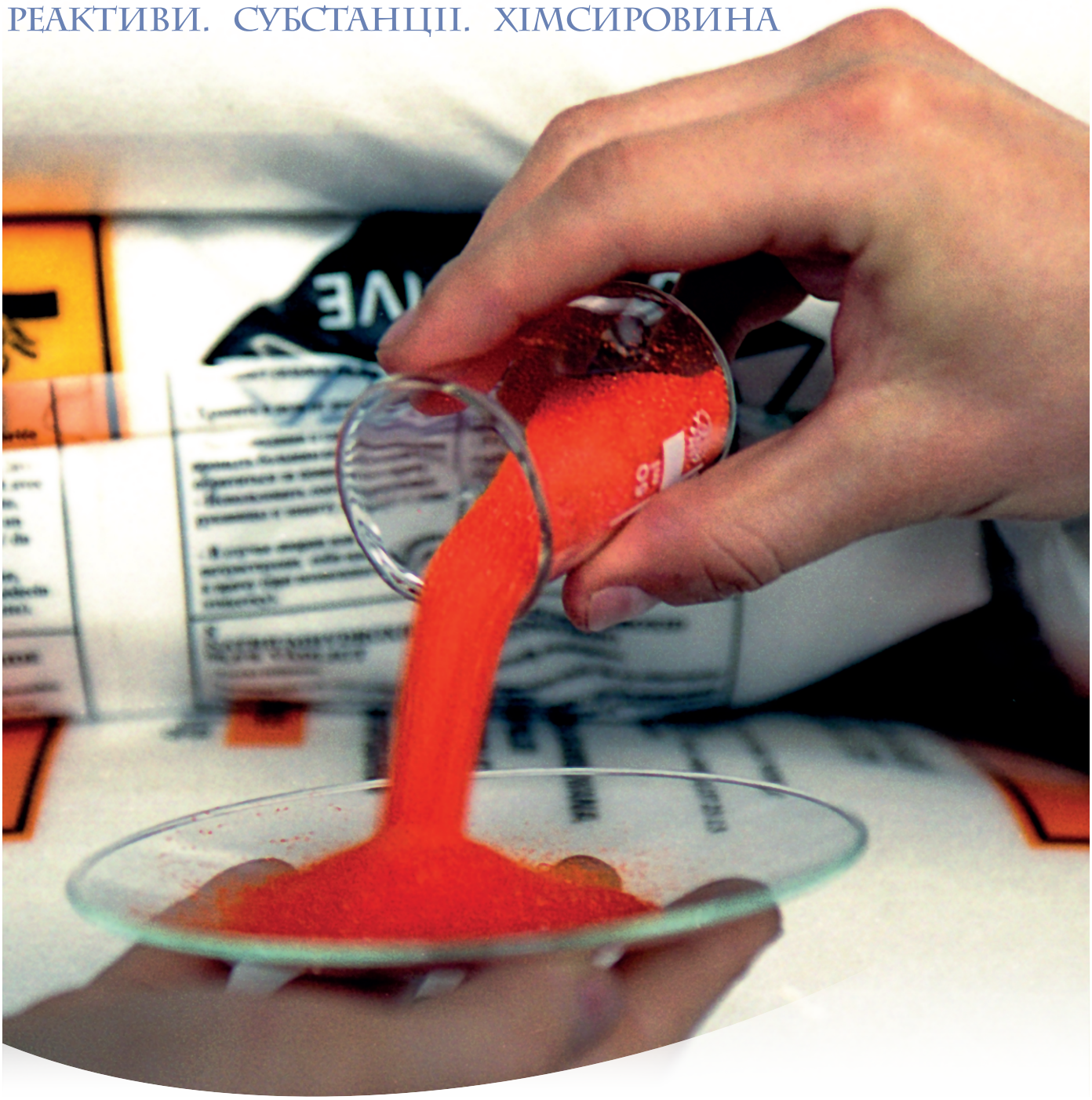

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Пропонуємо організацію і проведення медико-біологічних, фізіологічних, токсикологічних, годівельних експериментів:

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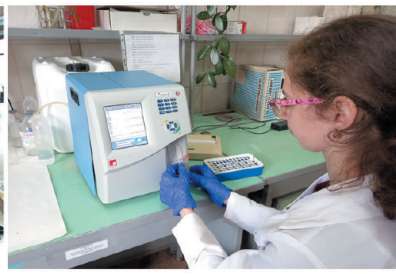
Надаємо кваліфіковану інтерпретацію отриманих результатів.

*Можлива постановка і проведення інших експериментів.







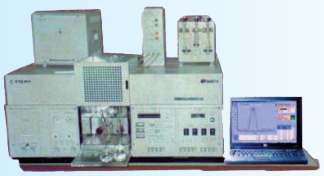
ІНСТИТУТ БІОЛОГІЇ ТВАРИН НААН ПРОВОДИТЬ:

- дослідження біохімічних показників (аналізатор *Humalyzer 2000*, Німеччина)
- гематологічний аналіз (аналізатор *Mythic-18Vet*, Швейцарія)

- мікробіологічні дослідження (посів на стерильність, антибіотикограма, склад мікрофлори кишечнику тварин, мікробіологічний аналіз кормів, води, повітря)
- імуноферментні дослідження (аналізатор *Stat Fax 3000*, Німеччина)

- оцінку репродуктивної здатності тварин, штучне осіменіння, трансплантацію ембріонів
- селекційно-генетичні дослідження
- дослідження кормів
- дослідження молока
- дослідження яєць

- визначення показників якості меду
- дослідження вовни і волосся
- атомно-абсорбційний і атомно-емісійний аналіз концентрації хімічних елементів
- аналіз органічних добрив



** можливе проведення інших досліджень*
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ibis Styles Lviv Center is a hotel of the leading in Europe international hotel operator *Accor* and the first representative of the *ibis Styles* brand in Ukraine. A modern 7-storey building is located in the center of Lviv, at 3, Shukhevycha Street, on the territory included in the UNESCO World Heritage List.

ibis Styles Lviv Center is a bright, modern and stylish hotel with perfect combination of Ukrainian national touch in small details and functional comfort. The hotel started operating in August 2015 that made it the second representative of the *Accor* group in Ukraine and first — in Lviv.

The room capacity of the hotel provides 77 rooms on 7 floors and includes Standard and Premium categories. *Ibis Styles Lviv Center* is ideally equipped to exceed expectations of individual leisure travelers and business tourists, as well as groups. On the ground floor of the building there is a spacious lobby with comfortable sitting area, a business corner, a kids play corner and an Italian cuisine restaurant of the famous Ukrainian chain.

The room rate includes all-you-can-eat buffet breakfast and unlimited Wi-Fi. Bedding quality is proved by world-known brand "Sweet bed" by *ibis Styles* designed exclusively for the brand, and guarantees comfort and high sleep quality. Additional services are available for the comfort of guests such as transfer, organization of excursion tours, flight tickets booking, courier services, etc. Also the ironing room is at the disposal of guests.

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***ibis Styles Lviv Center* is your stylish hotel in the heart of Lviv.**

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