UDC 636.2:351.9:338.532:346.548 https://doi.org/10.15407/animbiol21.02.061

HERD HEALTH MANAGEMENT IN THE TRANSITION PERIOD

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Transition cow diseases are a multifactorial complex. Veterinaries need reliable indicators to identify risk animals, take treatment decisions or monitor the metabolic state of the herd. The identification and development of prognostic markers, accompanied by sound metaphylactic treatment protocols are needed.

For the trial 80 German Holstein dairy cows (≥2nd lactation, clinically healthy and pregnant) were selected from the herd. The study included an intense analysis of each animal from 14 days ante-partum until 49 days post-partum: daily milk yield, monthly milk content analysis, clinical state throughout the trial, ultrasonography of the liver and back-fat tissue measurement, liver biopsies, blood and urine sampling, rumination and locomotion behaviour. To evaluate a metaphylactic treatment protocol with Butaphosphan and Cyanocobalamin two groups received a treatment with Catosal® at either a low or high dosage (5 ml and 10 ml/100 kg body weight, 10 % Butaphosphan and 0,005 % Cyanocobalamin) and two placebo-groups were formed (5 ml and 10 mL NaCl 0,9 %/100 kg body weight).

We identified "high risk" animals based on their metabolite profiles and that these metabolic alterations were already present prepartum. The cows in the spring-calving group exhibited higher clinical scores (e.g. concerning the genital tract, the gastro-intestinal tract and treatment frequency), fat accumulation in the liver and higher serum fatty acid concentrations, indicative for a more pronounced energy deficit in this group. By the analysis of each group separately at the separate time points the effect of the treatment with Butaphosphan and Cyanocobalamin emerged. In the "high-risk" group a long-lasting effect (day 28 postpartum, 3 weeks after treatment) was observed.

Further analysis is needed to identify the metabolites involved in the alterations observed across the transition period, as well as describing "high-risk" animals and treatment effect with Butaphosphan and Cyanocobalamin and bringing the observed metabolic alterations on a production level.

Keywords: COWS, TRANSITION PERIOD, PREGNANCY, LACTATION, DRY PERIOD

Dairy cow's metabolism undergoes, as in every female mammal, dramatic metabolic changes throughout the period of gestation, giving birth and the onset of lactation (= the transition period) [23, 24, 31].

During the dry period a ration comparably low in energy and protein content is fed and in the common free-stall housing system the daily demand for exercise is relatively low, as well as the contact with humans [18]. At the happening of parturition this situation changes dramatically. The birth itself is comparable to an extreme exertive physical effort, such as running a marathon. However, further accompanied by massive tissue damage due to the expulsion of the foetus [2, 8, 11]. The event of calving does not only implicate physical stress but also affects the animal on various psychological levels. In most housing/management systems calving implicates the separation of the animal from its cohort into a new one (calving pen) and therefore a new environment, various handling procedures by humans (e.g. pushing, calving assistance and milking) plus the pain and unexpected physical happenings during delivery may induce fear and stress [5, 8]. The onset of milk production further causes massive alterations in the mammary tissue. The sudden increase in nutrient and energy demand for milk production causes the re-routing and excessive strain of various metabolic pathways [24].

A physiologically normal negative energy balance is observed during this time, since the animal is not able to adequately increase its feed intake to meet the energy demand caused by the ongoing tissue recovery and milk production [25]. This negative energy balance causes lipomobilisation from the fat depots generated in the previous lactation and dry period [27]. In this transition period the liver plays a key role, responsible for metabolizing the non-esterified fatty acids (NEFA)

originated from mobilized triacylglycerols (TAG), in the beta-oxidation cycle to acetyl-CoA, which is either entering the Krebs-Cycle or being metabolized to ketone bodies [9, 13, 22]. The liver metabolism is therefore accelerated within a few days from a very low-demanding state to the highest demand in metabolic capacity throughout the lactation cycle [5]. Further on, the onset of lactation causes a shift in the mineral household. If not adequately prepared for this situation during the dry period, the risk for imbalances like hypocalcaemia increases [12].

But as mentioned above, the cow is not only confronted with these massive metabolic alterations, but also needs to adapt to a new social structure and housing system in the fresh cow pen, as well as to the new daily routines (e.g. milking, feeding times) [6, 7]. If this area is not adequately designed and managed within the farm's daily routines the cows daily feed intake and resting behaviour will be insufficient [17, 20].

This component is even more accentuated when health problems are already present, such as lameness, preventing the animal from a normal activity and therefore further decreasing the dry matter intake (DMI) [10].

This short summary of factors and aspects illustrates that transition cow diseases are a multifactorial complex. In our modern total confinement free-stall housing systems four main influencing factors are identified: nutritional imbalance, lameness and deficiencies in housing and management (e.g. stocking density, time budgeting, feed supply, professionalism in milking, animal monitoring and general husbandry) [29].

The named factors lead to nutritional imbalances with decreased DMI causing a negative energy balance in a unphysiological magnitude, leading to an insufficient energy supply to support tissue healing and immune defence against infectious diseases [19, 30].

The result is an array of different production diseases which are all somehow interrelated and often with a synergistic action [27]:

— the genital tract is unable to re-shape and heal properly leading to retained placenta, lochiometra, metritis, endometritis [16];

— at the mammary gland severe udder oedema, mastitis and udder eczema may be observed;

— in the gastrointestinal system ruminal microbial fermentation, and peristaltic and absorption processes at various locations (forestomach, abomasum and lower intestines) are disturbed causing malabsorption of nutrients, absorption of toxins, abnormal gas production leading to different clinical signs such as diarrhoea and a displaced abomasum [3];

— a dysregulated mineral household, exhaustion and endotoxemia cause muscle weakness and circulatory problems leading to the inability to arise [12, 21];

— extreme lipomobilisation may lead to ketosis and an overload of the liver with fatty acids (fatty liver syndrome) [15, 24];

— the decrease in the sole fat cushion due to excessive lipomobilisation increases the risk for sole ulcers and an endotoxemia (due to a metritis, mastitis or ruminitis) may induce laminitis [1, 4];

— but also other organ systems such as the lung are at a higher risk for infectious diseases due to the general immune-suppression [19].

As described above, the liver holds a key function in this aspect by metabolizing the fat reserves and thereby supplying the body with energy in this critical period [5, 24]. Observations from farmers and veterinarians, also confirmed by different studies, show that certain cows seem to be more metabolically robust than others [14, 26]. However, underlying pathomechanisms and the reasons for this individual susceptibility are not clear.

To solidly consult their costumers, veterinaries in the field need reliable indicators to identify risk animals, take treatment decisions or monitor the metabolic state of the herd — ideally implemented in cow-site tests. Therefore, the identification and development of prognostic markers, accompanied by sound metaphylactic treatment protocols are needed.

The aim of the study presented therefore is to:

— investigate pathomechanisms in the transition dairy cow disease complex with a special focus on the liver fat metabolism;

— identify possible prognostic markers;

— develop non-invasive methods to determine the liver fat content by ultrasound;

— test a metaphylactic treatment protocol with *Butaphosphan* and *Cyanocobalamin* (*Catosal*®, Bayer).

Materials and methods

An on-farm randomized, prospective, three-fold blinded study was performed on a 660-cow dairy in Saxony (Germany), between November 2015 and November 2016. The cows were housed in TMR-based free-stall system with deep bedding boxes during lactation and deep bedded straw pack during the dry period. During the spring and summer period the dry cows were allocated on pasture. The herd was characterized by an average milk production per lactation of 10,744 kg and a fat and protein content of 3.74 % and 3.33 % during the 12 months of the trial duration.

For the trial 80 German Holstein dairy cows were selected from the herd. Inclusion criteria were: ≥2nd lactation, clinically healthy and pregnant. The average lactation number of the selected animals was 3.9±1.8 (mean ± SD) at the calving in the trial and the 305d milk production in previous lactation was 10,944±2,013 kg. The study included an intense analysis of each animal from 14 days *ante-partum* until 49 days *post-partum*.

To evaluate a metaphylactic treatment protocol with *Butaphosphan* and *Cyanocobalamin* following treatment groups were established: two groups receiving a treatment with *Catosal*® at either a low or high dosage (5 ml and 10 ml/100 kg body weight (BW), 10 % *Butaphosphan* and 0,005 % *Cyanocobalamin*) and two placebo-groups (5 ml and 10 mL NaCl 0,9 %/100 kg BW). The animals were treated at six time points: –7/–6/–5 prepartum and 1/2/3 days postpartum.

To gain a sound and encompassing data set to describe the metabolic and production state of the animals throughout the trial following aspects/variables were documented, sampled and analyzed:

— exact documentation of the production state through daily milk yield measurements and monthly milk content (fat%, protein%, urea and somatic cell count) analysis;

— daily exact documentation of the clinical state throughout the trial using standardized clinical examination and scoring protocols;

— ultrasonography of the liver and back-fat tissue measurement (7x throughout the trial);

— liver biopsies (4x, -14 d, 7, 28 and 32 days peripartum) for fatty acid fraction analysis, histopathology;

— blood sampling (8x) for fatty acid pattern, clinical chemistry, haptoglobine concentrations;

— urine sampling (15x) for clinical chemistry;

— rumination and locomotion behaviour of the animals.

Results and discussion

Especially cows in the group that have calved into the study in spring are conspicuous since their metabolic state seems to be altered to a much lower degree across the calving, compared to animals entering the study in winter 2015 and summer/autumn 2016. Analysis of the ration documentation revealed the feeding of different grass silage silos in the identified time periods, hinting towards an influence of the silo quality on the energy and nutrient supply of the animals.

When analysing the identified groups in regard to their clinical scores, clinical chemistry and histopathological data a clear differentiation according to health status was observed. The cows in the spring-calving group exhibited higher clinical scores (e.g. concerning the genital tract (metritis, endometritis), the gastro-intestinal tract (abnormal feces, abomasal displacement) and treatment frequency), fat accumulation in the liver and higher serum fatty acid concentrations, indicative for a more pronounced energy deficit in this group. It was therefore concluded that these animals may be classified as "high-risk" cohort due to their exposure to an inadequate feed quality. These differences in metabolic state were already present prepartum in the "high-risk" group.

By the analysis of each group separately at the separate time points the effect of the treatment with *Butaphosphan* and *Cyanocobalamin* emerged. In the "high-risk" group a long-lasting effect (day 28 *post-partum*, 3 weeks after treatment) was observed.

Conclusion

The first preliminary results showed that we were able to identify "high risk" animals based on their metabolite profiles and that these metabolic alterations were already present prepartum. Further statistical analysis of the dataset is needed to identify the metabolites involved in the alter-

ations observed across the transition period, as well as describing "high-risk" animals and treatment effect with *Butaphosphan* and *Cyanocobalamin* and bringing the observed metabolic alterations on a production level.

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