Archives on Veterinary Science and Technology

Research Article

Impact of Reticulorumen Content Temperature and pH on a Cow's Pregnancy

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Summary

The aim of this research communication was to investigate the impact of reticulorumen content temperature and pH on a cow's pregnancy. The study was performed on 20 dairy cows (second and more lactation) Lithuanian Black and White cows. The pH and temperature of the contents of their reticulorumens were measured using specific smaXtec boluses manufactured for animal care using smaXtec animal care technology®. The first insemination was made on average 60 days after calving (±12). The pregnancies were tested with "Easy Scan" ultrasound after 30-35 days after insemination. Those cows which were pregnant were assigned to the PD+ group (n=12) those, and those which were not pregnant - assigned to the PD- group (n=8).

The continuous measurement of the reticulorumen pH and temperature can be used for detection and evaluation of the quality of insemination. A low reticulorumen pH may have a negative effect on cow pregnancy, and a decrease in pH and increase the temperature of the reticulorumen can be interpreted as a risk of SARA, while an increase in reticulorumen temperature can be an indicator of oestrus. Supplemental research results are needed for the confirmation this.

Keywords: Cows; pH; Pregnancy; Rumen; Temperature

Introduction

Fertility in dairy cows has declined over the past five decades as milk production per cow has increased. Many hypotheses have been proposed to explain this, including issues of genetics, physiology, nutrition and management, and these factors have been investigated at the animal, organ and cellular level at critical time points during the productive life of dairy cows [1].

Continuous monitoring of the reticuloruminal pH is advantageous due to the possibility of diurnal recording. Techniques for the continuous measurement of ruminal pH were used for a series of scientific investigations [2]. In order to obtain the collected data, a memory chip either has to be removed via the rumen, or the data is transmitted by a cable to an external unit, which is fixed to the animal [2].

Subacute Ruminal Acidosis (SARA) corresponds to an imbalance between lactate-producing bacteria and lactate-using bacteria, which results in a change in the ruminal pH associated with the prevalent consumption of rapidly fermentable carbohydrates. The susceptibility of dairy cows to SARA seems to be higher for cows in early lactation, probably due to the instability of the bacterial population [3]. In fact, the onset of this pathology corresponds to an imbalance between lactate-producing bacteria and lactate-using bacteria [3]. This disequilibrium is due to a change in the rumen pH, related to the prevalent consumption of rapidly fermentable carbohydrates [3]. Usually, the rumen pH threshold below which acidosis occurs is 5.5 [3]. There is a close relationship between the rumen pH and blood pH. 4 In our study, the blood pH had a lower value in group C, as acidosis is characterized by a blood pH lower than normal [3].

Subacute Ruminal Acidosis (SARA) has been defined as impaired ruminal health, during which a reversible ruminal pH depression occurs. Various analyses of blood, urine, faeces, and milk have been considered and evaluated for this purpose [3], but the results of these studies are conflicting. Reversible decreases in ruminal contractions, faecal consistency, ruminal acetate and acetate to propionate ratio, milk fat content, and milk fat to milk protein ratio were also observed, all of which have been associated with SARA [4].

The aim of this research communication was to investigate the impact of reticulorumen content temperature and pH on a cow's pregnancy.

Materials and Methods

The study was performed on 20 dairy cows (second and more lactation) Lithuanian Black and White cows. The herd consisted of 550 dairy cows in total. All the cows researched were kept in a uniform environment and received a uniform ration of feed suitable for this stage of lactation. The average yield of the cows researched was 30 ($\pm$3) kg/d. Before the study, the cows selected were examined according to a general clinical examination plan, and were completely healthy. Clinical signs of acidosis (diarrhoea, loss of appetite, and weak rumination (on average, 3 times/2 min) were not found. The average somatic cell concentration in the milk of the cows studied was about 250 ($\pm$32) thousand/ml, and the milk urea was 25 ($\pm$4) mg/%. The pH and temperature of the contents of their reticulorumens were measured using specific smaXtec boluses manufactured for animal care. smaXtec animal care technology® enables the continuous real-time display of data such as ruminal pH and temperature. According to the directions of the manufacturer, the boluses were inserted into the reticulorumens with the help of a specific tool. The data was measured with the help of specific antennas (smaXtec animal care technology®). For monitoring the reticuloruminal pH, an indwelling and wireless data transmitting system (smaXtec animal care GmbH, Graz, Austria) was used. The data collected was transmitted using the ISM-Band (433MHz). The system was controlled by a microprocessor. The data (pH and temperature) was collected by means of an analogue to digital converter (A/D converter) and stored in an external memory chip. Due to its dimensions (length: 12cm; width: 3.5cm; weight: 210g), this indwelling system can be orally administered to an adult cow, and it is shock-proof and resistant to rumen fluid. Calibration of the pH-probes was performed using pH 4 and pH 7 buffer solutions at the beginning of the experiment. The first insemination was made on average 60 days after calving ($\pm$12). The heat was identified with specific singular samples of heat (standing reflex, mucus discharge, swelling and reddening of the vulva, etc.). The data were recorded during the all days during the first insemination. The pregnancies were tested with "Easy Scan" ultrasound after 30-35 days after insemination. Those cows which were pregnant were assigned to the PD+ group (n=12) and those, which ware not pregnant, were assigned to the PD+ group (n=8). All the data were obtained by smaXtec messenger® computer software. The test data were processed using the SPSS statistical package (SPSS for Windows 15.0, SPSS Inc., Chicago, IL, USA, 2006). The data were considered reliable from the statistical point of view, when $p<0.05$.

Results and Discussion

In the PD+ group, the average of the reticulorumen pH was 5.99 ($\pm$0.27) in the PD- group-5.80 ($\pm$0.58) ($p<0.05$) (Figure 1).
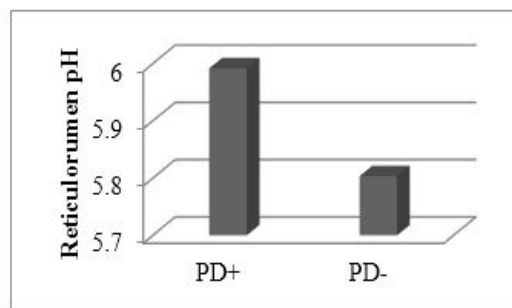

Figure 1: Reticulorumen content pH during the investigation (PD+ - pregnant of first insemination, PD- non-pregnant of first insemination.

Additionally, some studies suggest that a ruminal pH depression alone is not enough to result in the clinical signs related to SARA. Many cases of SARA may not be detected, as the current field diagnosis of SARA is not clearly defined and depends either on ruminal pH point measurements, which are invasive, and due to fluctuations in pH, are not very accurate or sensitive for the diagnosis of a longer lasting pH depression indicative of SARA, or on continuous measurements which require costly equipment, and are primarily suited for research purposes [3]. There is a negative relationship between Reticulorumen temperature and reticulorumen pH during an acidotic episode [5]. Therefore, Reticulorumen temperature monitoring can detect a potential acidotic episode [5]. An increased ruminal pH had a significant effect on the conception rate at first insemination [6]. The FCR depended on the interval from calving to first the AI, BCS before calving, and ruminal pH [6]. In the PD+ group, the average reticulorumen temperature was 38.90ºC ($\pm$0.4), and in the PD- group-39.26ºC ($\pm$0.2) ($p<0.05$) ($p<0.05$). (Figure 2).
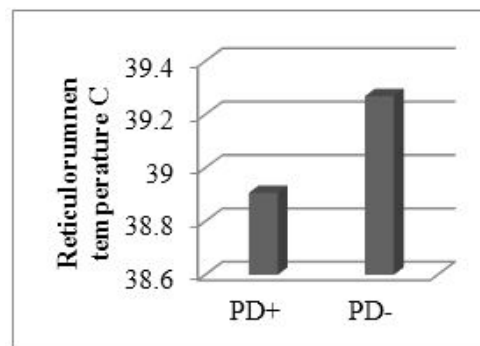

Figure 2: Reticulorumen content temperature during the investigation (PD+ - pregnant of first insemination, PD- non-pregnant of first insemination.

A negative correlation was observed between the pH of the contents of the abomasum and this temperature. The increase in the acidity (decrease of pH) of the contents of the reticulorumen increases its temperature and also increases the temperature of the contents of the abomasum. There is a statistically significant positive dependence between the reticulorumen content temperature

and the rectal temperature. Through measurement of the rumino-reticular temperature, it is possible to predict the health status of a cow's stomach in regard to acidosis [7]. During heat time, the reticulorumen pH average was higher than not during heat time, but this result wasn't statistically significant.

The average reticulorumen content temperature during oestrus was increased. During heat time, it was 40.2ºC (±0.25), and not during heat time-38.92 (±0.13). ($p < 0.05$). (Figure 3).
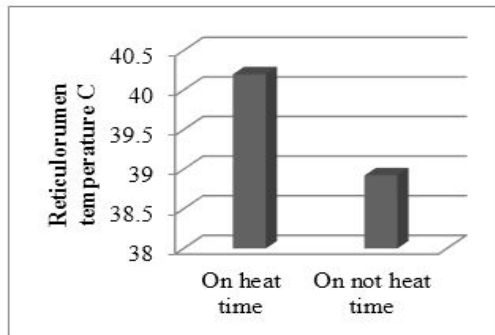

Figure 3: Reticulorumen content temperature during the heat time.

Ruminal temperature decreased the day before parturition and increased at oestrus in spring-calving beef cows and has a potential use as a predictor of parturition and oestrus [8]. Diurnal temperature rhythms were similar before and after oestrus. Vaginal temperature before oestrus (d 11 and 12) was slightly (0.1°C) higher, compared with the post-ovulation period [9]. As a result, automated heat detection systems have been developed. The currently available tools are automated detectors of standing heat, activity-metres and automated in-line systems measuring milk progesterone. Camera-software systems and the monitoring of body temperature are being developed and may also be used as heat detection tools [10]. The ruminal pH nadir had a negative relationship with the corresponding ruminal temperature ($R2 = 0.77$). Therefore, the reticulorumen temperature may have the potential to predict ruminal pH, and thus aid in the diagnosis of SARA [2].

Conclusion

We can conclude that the continuous measurement of reticulorumen pH and temperature can be used for detection of the quality of insemination. A low reticulorumen pH can have a negative effect on cow pregnancy, while a decrease in pH and increase in the reticulorumen temperature can be interpreted as a risk of SARA, similarly, an increase in reticulorumen temperature can be an indicator of oestrus. Supplemental research is needed for confirmation of the results.

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