

Studies on the occurrence, pathological conditions,
and reduction method for subacute ruminal acidosis
(SARA) in dairy cows

Abstract of Doctoral Thesis

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Abstract

The objectives of this study were to reveal the impacts of subacute ruminal acidosis (SARA) and to establish preventive measures against SARA, which has become a problem associated with the management for lactating cows in recent years. In this study, a field survey of SARA, using a wireless radio transmission pH measurement system (pH sensor), was conducted, and blood levels of various hormones and compounds related to energy metabolism in cows with SARA were evaluated. Additionally, the preventive effect of wood kraft pulp (KP) was investigated in cows with SARA. The first chapter describes the SARA field study in the Mogami region, Yamagata prefecture, using pH sensors. We demonstrated that the prevalence of SARA 45 days before and after the parturition differed among 5 farms, as it ranged from 29.0 to 77.4%. The results of the field survey suggested that ruminal pH values in herds are influenced by the feeding system (total mixed ration or separated), starch concentrations in feed, diet changes of cows during transition, and other factors. The second chapter describes the investigation of 11 lactating cows, during 2015-2016 at Farm S, presumed to have SARA based on the field survey described in Chapter 1. We continuously monitored ruminal and reticular pH and measured blood concentrations of hormones and metabolites related to energy metabolism. Adiponectin (ADN) concentrations at 4 weeks after parturition correlated with the total amount of time that ruminal or reticulum fluid pH was under the threshold during 1 week after parturition. Additionally, there was a strong correlation between the number of days that SARA was detectable based on the criteria in the 30 days after parturition and ADN concentrations at 4 weeks, and average ADN concentrations at 1 and 4 weeks. These results suggest that ADN may serve as an index to assess SARA.

In the third chapter, we describe calculations of Pearson's correlation coefficient for the association of ADN concentration and ruminal characteristics. There was a negative correlation between mole fraction of acetic acid in rumen and ADN concentrations at 4 weeks post-parturition. The result suggests that ADN reflects the ruminal condition, supporting the conclusion described in the second chapter.

In the fourth chapter, we describe the investigation of the effect of KP feed, which is a nutrient-rich feed that is almost pure cellulose fiber and has a slow digestion rate, on reducing SARA and improving lipid metabolism in cows with SARA. The results suggest that supplementation of KP could improve ruminal and reticular pH and lipid metabolism in cows with SARA, although the effects of KP may depend on the constituent concentrations of feeds.

In this study, we conducted a field survey of SARA and demonstrated that the concentration of ADN, which is an adipocytokine involved in the regulation of glucose and fatty acid metabolism, is associated with ruminal fermentation. Additionally, we demonstrated the possibility of decreasing SARA by feeding KP. In the future, further studies measuring inflammatory markers, cytokines,

and LPS concentrations in the large intestine may assist in clarifying the relationships among SARA, inflammatory response, and ADN. More investigation about impacts of body weight variation and other inflammatory diseases is also required. This report is expected to lead to future studies to determine the effectiveness of ADN as a biomarker for SARA, and the impacts of SARA as a metabolic disease, as well as effective preventive measures against SARA. This study may also contribute to solving the pathophysiology and prophylaxis of SARA.