Pathogenesis of subacute ruminal acidosis in sheep

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Table of contents

Abstract

Ruminal acidosis is an economically important condition in ruminants fed diets with a high energy density. Two forms of ruminal acidosis have been described; subacute ruminal acidosis (SARA), when the ruminal fluid in in the pH range 5.0-5.5 and acute ruminal acidosis (ARA), when the ruminal fluid pH is <5.0. Animals with SARA, when compared to 'normal' animals with ruminal fluid pH >5.5, have increased ruminal volatile fatty acid (VFA) concentrations and decreased lactate concentrations. Animals with ARA have increased ruminal lactic acid concentrations, and lower ruminal VFA concentrations, when compared to 'normal' animals.

The prevalence of SARA in sheep fed diets with a high energy density is unknown. The pathogenesis of SARA is also poorly understood in cattle and sheep. Mechanisms that regulate the ruminal fluid pH include acid buffering by saliva, which contains high concentrations of bicarbonate, VFA absorption through the ruminal epithelium, VFA metabolism by ruminal microbes and by ruminal fluid clearance/passage from the rumen by passage into the more distal gastrointestinal tract. Subacute ruminal acidosis occurs when the regulatory mechanisms that maintain the ruminal fluid pH >5.5 fail. Their relative contribution of absorption of clearance mechanisms to the pathogenesis of SARA is unknown. Adaptation of ruminal microbes and the ruminal epithelium is thought to be essential in reducing the prevalence and severity of SARA Microbial and ruminal epithelial adaptation in the pathogenesis of SARA are poorly understood. The aims of the thesis were to investigate the occurrence of SARA in sheep on diets with a high energy density and to evaluate the role of dietary adaptation in the pathogenesis of SARA in sheep.

The first study examined the prevalence of SARA in sheep fed a range of diets with high energy densities. Between 2 and 16 % of lambs fed a high energy density diet were diagnosed with SARA, but 50% of the lambs were at risk of SARA as defined by a pH range of 5.5-5.8. There was no correlation observed between ruminal fluid pH and lamb growth rate.

. The second experiment was designed to investigate the relative impact of two variables: rumen epithelium adaptation and rumen fluid adaptation. No significant differences could be identified within the power of the experiment. The results also highlighted that lactic acid can be present in the rumen with a ruminal fluid pH between pH 5.0 to 6.0 suggesting that the categorisation of VFA and ARA based upon relative VFA and lactate concentrations may be flawed and that a graded continuum exists.

A further study investigated VFA absorption and clearance from the ruminal fluid of sheep fed a high energy density diet formulated to induce SARA. These results showed an increased absorption rate and an increased ruminal clearance rate with a ruminal fluid pH in the 5.5-6.0 pH range compared to >6.0. However, no significant relationship was found between the VFA absorption and clearance rate and a rumen fluid pH in the subacute ruminal acidosis pH range.

A significant contribution of dietary adaptation and rumen fluid clearance in sheep on the regulation of VFA concentration and rumen fluid pH in the development of SARA could not be identified within the power of these experiments. Further research is required to identify a more consistent model of SARA to quantify the importance of the condition within the sheep feedlot industry.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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