Discovery of a Probiotic to Reduce the Risk of Lactic Acidosis in Cattle

A.S. Leaflet R2194

Fernando Rodriquez, graduate research assistant;
Mark A.Rasmussen, NADC and collaborator, animal science;
Milton J. Allison, professor, collaborator animal science

Summary and Implications

Experiments described here were designed to find a way to reduce the productivity loss that is associated with rumen acidosis. A strain of *Prevotella bryantii* was selected and isolated based on its ability to grow rapidly on starch and to produce organic acids other than lactic acid. Tests with this strain in vitro and in goats and dairy cows support the concept that this bacterium is able to compete for substrate with lactic acid bacteria and that it has promise as a probiotic inoculant to protect ruminants from lactic acidosis.

Introduction

An abrupt transition of ruminants from a forage ration to a high concentrate ration may lead to a major change in rumen microbial populations due to rapid growth of lactic acid producing bacteria (*Streptococcus bovis* and *Lactobacillus sp*.). High concentrations of lactic acid accumulate and cause rumen pH to drop to less than 5.0. The acute lactic acidosis that follows often has severe consequences for animal health. Sub-acute rumen acidosis (SARA) occurs in dairy cows when fermentation of a large intake of readily fermented carbohydrate leads to rapid production of organic acids (including lactic acid). Rumen pH falls to less than 5.6 and remains at this level or lower for a considerable period of time during each day. Experiments were designed to test the hypothesis that ruminal lactic acid production can be inhibited by bacteria that do not produce lactic acid but which are able to compete for substrate with bacteria that produce lactic acid. This approach differs from several currently marked probiotics that depend upon inoculation with bacteria that metabolize lactic acid.

Materials and Methods

Rapidly growing starch fermenting bacteria were selected from a starch-fed continuous culture of a population that had been started with rumen contents from a grain-fed dairy cow. Pure cultures of bacteria were isolated from this population using appropriate anaerobic methods. Isolates were tested for their ability to limit the production of lactic acid when they were added to mixed rumen populations incubated in vitro under conditions designed to simulate induction of rumen acidosis. One of the strains that was selected was tested for its ability to compete with lactic acid producing bacteria in a goat acute acidosis model and also in dairy cows in mid-lactation.

Results and Discussion

Ten pure cultures of bacteria were isolated from 40 individual colonies that were picked from agar roll tubes that had been inoculated with dilutions of a sample from the starch fed continuous culture at 72 h of incubation. Cultures of two of the ten bacteria were able to limit the production of lactic acid when they were added to mixed rumen populations that were incubated under conditions designed to simulate induction of rumen acidosis. One of these strains was selected for further study and this strain (strain 25A) was identified as *Prevotella bryantii*, a well defined rumen species.

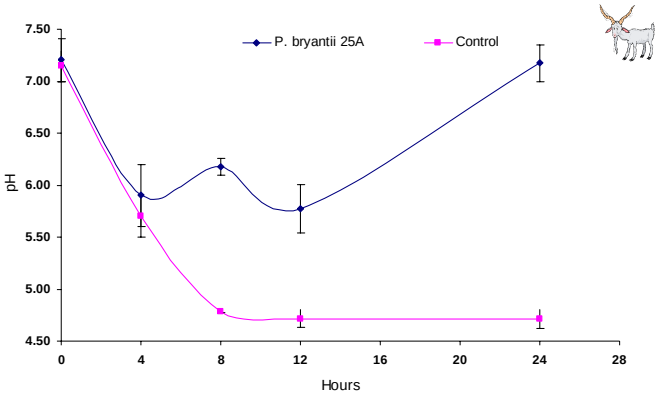
Strain 25A had a growth rate of 0.66 h^{-1}, on the standard starch medium, which means that it doubled its population every 63 minutes. This was a faster growth than the type strain of this species strain B14 which grew with a doubling time of 83 minutes on this medium. Strain 25A produced succinate and acetate as its major fermentation products from starch. Lactic acid was not produced.

Goats with rumen fistulas were adapted to an alfalfa hay diet and then were given a lactic acidosis challenge dose of wheat starch (10g kg^{-1}). Test goats (3) were given an inoculum of strain 25A cells (10^{11} cfu) just prior to the starch challenge, while control animals (3) were given an equivalent amount of mineral salts, anaerobic dilution solution. Measurements of ruminal pH from inoculated and control goats (Figure 1) and measurements of lactic acid in rumen fluid support the concept that strain 25A competed with and inhibited growth of lactic acid producing bacteria.

Ground corn was supplemented to the usual diet of ten dairy cows in mid-lactation. The test group of cows received a daily dose of 12^{12} cfu of *P. bryantii* cells. These animals had higher ruminal pH and less lactic acid at 4h after feeding than did the control group. There was no difference in milk production between test and control group.

Further tests are underway to evaluate the potential for application of *P. bryantii* strain 25A as a probiotic.

Figure 1.


P. bryantii 25A
Control
pH
7.50
7.00
6.50
6.00
5.50
5.00
4.50
0
4
8
12
16
20
24
28
Hours