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Farm Advisor

Alfalfa and Forage Conference To Be Held in Reno, NV December 11-13, 2002

Co-Sponsored by the Cooperative Extension Services of Arizona, California, Idaho, Nevada, Oregon, Utah and Washington

This conference is a comprehensive educational program pertaining to alfalfa and forages in western states. The program features a field tour, commercial and educational exhibits, poster session, educational talks, industry seminars, and opportunities for exchange of ideas. The planning committee represented all 7 western U.S. states. A complete registration form and agenda are included in this newsletter.

Worm Farm Looking for Manure

The Royal Family Farm, located near Butte College, is looking for dairy manure to feed its worm farming operation. They will be needing about 15 yards of manure each week. If you are looking for a home for some of your cow manure, call Larry Royal at 530-342-5574.

Yeast Products for Growing and Lactating Dairy Cattle: Impacts on Rumen Fermentation and Performance

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Introduction

The objective of this article is to summarize studies that have been published in the scientific literature that have examined the impact of specific commercial yeast products on rumen fermentation, fiber digestion and/or animal performance.

Yeast products are widely utilized as feed additives for ruminant animals in many parts of the world. There is a widespread belief among dairy and beef producers and ruminant nutritionists that yeast products are beneficial by enhancing dry matter intake (DMI) and overall animal performance. Since yeast products are generally modestly priced, economic barriers to their use are low.

Mechanisms have been proposed to explain why yeast products could stimulate DMI and productivity in growing and lactating cattle. Perhaps the oldest hypothesis is that the yeasts are able to grow, at least for a short period of time, in the rumen thereby directly enhancing fiber digestion and/or producing nutrients that stimulate growth of rumen bacteria, which do the bulk of the fiber digestion.

It has also been suggested that the yeasts utilize nutrients, such as lactic acid. If nutrients like lactic acid accumulated in the rumen, they could suppress bacterial growth and/or suppress DMI by driving rumen pH down. Another possibility is that growth of yeast in the rumen utilizes dissolved oxygen thereby stimulating growth of rumen bacteria that will grow when dissolved oxygen is low.

It seems clear that for these mechanisms to be operative, yeasts in the product have to be able to grow, and possibly reproduce, for at least a short period of time in the rumen. Hence the origin of the debate between 'live' and 'dead' yeast products.

In the 21 experiments reported, the average change in rumen pH was only 1.6%, although 86% of experiments reported an increase.

The alternate mechanism is that it is the yeast culture itself that provides a mixture of micro-nutrients which stimulates bacterial growth in the rumen. The increased bacterial growth increases fermentation of fiber and/or utilization of the end-products of fiber fermentation to prevent their accumulation in the rumen.

Supporters of this theory point to a limited research base showing that when cultures of live brewers or fermentation yeasts are fed to ruminants, there are few, if any, changes to rumen fermentation and/or animal performance. Indeed the view that live fermentation yeasts are ineffective is so widely held that very little research has been completed in the area.

The Published Information Base

The author was able to find a total of 71 published papers that originated largely from North America and Europe, with some papers from India, that were published in a wide variety of scientific journals. The vast majority of these studies, 59, were with whole animals that included cattle (calves, growing animals, bulls, lactating cows, dry cows), growing buffaloes, sheep, and lactating goats. There were also 13 laboratory studies. The corporate groups that sponsored the most research effort were Alltech Inc. (30), Diamond V Mills Inc. (20), Sante Santel Animal (10) and the Chr. Hansen Co. (4). Virtually all of the studies (68) utilized strains of the yeast Saccharomyces cerevisiae, and some companies sponsored research with more than one strain of this yeast.

Articles appeared in numerous scientific journals with the Journal of Dairy Science (39%), Animal Feed Science and Technology (17%) and the Journal of Animal Science (13%) sharing 69% of total articles with the balance divided among 12 other journals. The author does not claim that this listing is inclusive of all research ever published with yeasts and yeast cultures relative to ruminant production. It is the information base that was available, and relevant, in the author's opinion.

Impact of Yeast Products on Rumen Fermentation and Fiber Digestion

The only yeast product that has been sufficiently widely studied to create a database of its effects on rumen fermentation and fiber digestion is the Alltech yeast product 'Yea-Sacc 1026' (1026).

In the 21 experiments reported, the average change in rumen pH was only 1.6%, although 86% of experiments reported an increase. While ammonia nitrogen concentrations increased an average of 3.2% over 18 experiments, only 40% of experiments actually showed an increase.

Total rumen volatile fatty acid concentrations increased 5.4% and lactate concentrations decreased 8.1%, and 65% and 72% of individual experiments, respectively, showed these changes.

In contrast to these modest changes in parameters of rumen fermentation, 100% of six experiments reported an average 42% increase in total viable bacterial counts in the rumen and 86% of seven studies showed an average 20% increase in cellulolytic bacterial counts. An impressive average 95% increase in non-cellulolytic bacterial counts represented an increase in all experiments.

Digestion of fiber, as neutral detergent fiber (NDF), was measured either in vitro for 24 h (outside the animal in the laboratory), in sacco for 24 h (by putting feeds into the rumen of live animals in porous bags) or in vivo (by measuring digestion of NDF in the entire digestive tract of live animals). In vitro data showed little difference in fiber digestion, perhaps reflecting difficulties with this approach to evaluate the impact yeast products, that take several days to have their full effects. In contrast, both the in sacco and in vivo fiber digestions were enhanced, by 6.6 and 3.9% respectively, and increases were reported in 75 and 83% of experiments respectively.

Impact of Yeast Products on Animal Growth and Feed Efficiency

The only product that has been sufficiently studied to create a data base of its effects on growth and feed efficiency is the Alltech product 'Yea-Sacc 1026'. Dry matter intake was increased by an average of only 2.0%, but an increase occurred in 81% of experiments. Body weight gain increased by only slightly more, 3.7%, although an increase was reported in all experiments. While feed conversion efficiency increased a razor thin average of 1.8%, increases occurred in fully 75% of reported experiments.

Dry matter intake was increased by an average of only 2.0%, but an increase occurred in 81% of experiments.

Impact of Yeast Products on Dry Matter Intake and Milk Production

The three products that have been sufficiently studied to create a data base of effects on milk production and composition are the Alltech yeast product 'Yea-Sacc 1026', the Diamond V Mills yeast culture product 'XP' (XP) and the Chr. Hansen yeast product 'Biomate Plus' (BP).

The 1026 and BP products are 'live' yeast products while the XP is 'dead' yeast culture product.

Dry matter intake was increased by an average of 2.1% for 1026, 3.4% for XP and 0.5% for BP and increases were observed in 70, 86 and 60% of studies respectively. Thus XP was most likely, and BP least likely, to stimulate DMI. Increases in milk production were very consistent among products, at about 3.4%, and consistent increases were observed among products, with 80, 86 and 100% of experiments showing increases for 1026, XP and BP respectively.

Milk protein percentage was lower, by 1.3, 0.5, and 2.1% respectively for 1026, XP and BP, and the consistency of the decline was much greater for BP (i.e., 60, 64 and 100% of the time for 1026, XP and BP). Milk fat percentage showed small effects of the three products, and the consistency of the responses were less than 60% in all cases.

The impacts of the three products on diet energy density was calculated assuming the average cows in all studies weighed 600 kg and that they had no net body weight change (as this data was not consistently reported in the experiments). On this basis, changes in the calculated NEl (net energy for lactation) density of the diets were very modest, and consistency among experiments could not be assessed.

Overall Assessment

A substantial amount of controlled research is available on affects of yeasts and yeast cultures on rumen fermentation and performance of growing and lactating ruminants. However, the bulk of this research is restricted to four corporate groups.

In lactating cows, where data are available for three specific products (Yea-Sacc 1026, Diamond V XP, Chr. Hansen BP), the impact on performance is similar, but with subtle differences. While all three products result in an average milk yield increase of about 3.5%, XP shows a consistent increase in DMI while BP does not. The decline in milk protein % occurs for all products, but its extent, and the reliability of a decline, is lowest for XP. XP is the only product that enhances milk fat %, albeit inconsistently and to a small degree.

The quantitative increases in DMI with 1026 for beef (2.0%) and dairy (2.1%) cattle, increases in beef growth (3.7%) and dairy milk production (3.5%), as well as the small, but consistent, increases in beef efficiency (1.8%) and dairy diet energy density (1.5%) are remarkable in their similarity. This similarity between cattle classes is supportive of a consistent impact of yeast products regardless of the base diet.

The exact mechanism responsible for the benefits of these yeast and yeast culture products are not clear from the published data. Nevertheless, data support a stimulation of both rumen cellulolytic and non-cellulolytic bacterial counts, which is consistent with observed increases in fiber digestion and decreases in lactate concentrations respectively.

There is no evidence to support a direct effect of growth of yeasts in the rumen, as there are no differences between the 'live' (i.e., 1026 and BP) yeast products and the 'dead' (XP) yeast culture product. Thus the theory that it is growth of yeasts in the rumen, which is responsible for improvements in performance, appears not to be supported.

Overall, the modest nature of the improvements in rumen fermentation efficiency are consistent with the modest improvements in productivity with these yeast products.

The exact mechanism responsible for the benefits of these yeast and yeast culture products are not clear from the published data.

The yeast products Alltech 'Yea-sacc 1026', Diamond V Mills 'XP' and Chr. Hansen 'Biomate Plus' can be expected to consistently deliver average production improvements of 3.5% of beef and dairy animals, although the individual products appear to differ in how the improvement occurs and individual situations can be expected to vary.

October DHIA Averages for N. Sacramento Valley Herds - 44 Herds

ROLLING HERD AVERAGE	BREED				Overall Average
	Brown Swiss	Holstein	Jersey	Other	
# of Cows	55	318	270	122	278
Lbs Milk	22178	20951	13623	16165	18518
% Fat	3.96	3.59	4.55	4.12	3.93
Lbs Fat	879	753	619	666	714
% Protein	3.38	2.89	3.64	3.31	3.17
Lbs Protein	750	649	497	535	596
Somatic Cell Count (1,000's)	428	350	287	323	330
% Cull	30	31	28	28	30
Calving Interval	14.6	14.5	13.7	14.2	14.3
Average Services/Conception	3.2	3.0	2.6	2.7	2.8
Average days open	156	159	132	158	151
Percent conception at 1st service	24.0	35.6	48.3	41.3	39.4

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