

# The effect of the yeast, *Saccharomyces cerevisiae*, on the fibrolytic activity in the rumen and on nutrient digestibility in the digestive tract of cows

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## ABSTRACT

The influence of live *Saccharomyces cerevisiae* yeast on the fibrolytic activity in rumen digesta and on total digestive tract nutrient digestibility in cows was examined in a 2×2 Latin square design. The animals were fed hay-concentrate diet alone or supplemented with yeast at the rate of 5 g/d. Addition of *Saccharomyces cerevisiae* decreased the activity of CMC-ase and xylanase when measured before feeding but had no effect on the diurnal variations in activity of these enzymes. The digestibility of dry matter, organic matter, crude fibre, ADF and NDF was not affected.

KEY WORDS: ruminants, yeast, carboxymethylcellulase, xylanase, fibre digestibility

## INTRODUCTION

Interest in the use of live yeast, particularly *Saccharomyces cerevisiae*, as a feed additive for ruminants has increased in recent years. Yeasts increase the number of cellulolytic bacteria as well as NDF and ADF digestion in the rumen (Newbold et al., 1995; Putman et al., 1997). The increase in bacterial number probably results from improvement in the anaerobic status of rumen digesta (Newbold et al., 1996). The mechanism by which yeast cultures act on the microbial population still remains unknown, however. The objective of this study was to investigate the effect of live *Saccharomyces cerevisiae* yeast on the activity of carboxymethylcellulase (CMC-ase) and xylanase in rumen digesta as well as on total digestive tract nutrient digestibility in cows.

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## MATERIAL AND METHODS

The experiment was carried out on two rumen-fistulated Black-and-White Lowland cows in a Latin 2×2 square design. The animals were fed 8 kg of a diet containing, %: meadow hay 87, and concentrate 13 (crushed barley, rapeseed oilmeal, soyabean oilmeal). A dose of 5 g/d live cultures of *Saccharomyces cerevisiae* ( $1 \cdot 10^{10}$  CFU/g) was introduced *via* the fistula directly into the rumen of the experimental animals. The daily ration was given at 8.00 and 16.00 h in two equal portions, whereas the yeast was given once a day. Water was offered *ad libitum*. The preliminary feeding period lasted 4 weeks and was followed by the sampling of rumen digesta. The samples were collected just before and 2, 4 and 8 h after the morning feeding. Mordant ( $K_2Cr_2O_7$ ) at the rate of 40 g/d was given during the last 7 days of the experiment as a marker of indigestible matter. Faeces were collected during the last 5 days. Enzymes were extracted from the rumen contents using  $CCl_4$  according to Huhtanen and Khalili (1992) and used to determine the activities of CMC-ase and xylanase according to Miller et al. (1960). The analyses of feed and faeces dry and organic matter, crude fibre, ADF, NDF, and Cr were performed using standard methods (AOAC, 1990). The digestibility of particular nutrients was calculated on the basis of the proportion of chromium and acid-insoluble ash (AIA) in feed and in faeces. AIA was determined according to Van Keulen and Yang (1977).

## RESULTS AND DISCUSSION

The effect of yeast on the total digestibility of nutrients depended on the marker used (Table 1). The obtained results are thus in agreement with the findings of Miller-Webster et al. (2002).

Table 1. Effect of *Saccharomyces cerevisiae* on the total digestive tract digestibility of nutrients, %. Mean values (n=6)

Nutrient	$K_2Cr_2O_7$			AIA		
	control	yeast	SEM	control	yeast	SEM
Dry matter	73.37	73.69	2.254	70.82	76.97	2.908
Organic matter	77.22	77.74	1.930	74.43	80.39	2.830
Crude fibre	74.21	75.78	1.896	70.91	78.26	3.318
ADF	70.42	71.40	2.628	67.04	75.15	3.892
NDF	78.86	79.38	1.614	76.33	81.71	2.567

SEM - standard error of mean

No differences were found between the total digestive tract digestibility of feed in control and experimental animals. This suggests that live cultures of *Saccharomyces cerevisiae* had no effect on the digestion processes in the rumen or that their influence was masked by greater hindgut fermentation in control - as compared with the experimental animals (Williams, 1989; Williams and Newbold, 1990). Due to this, total tract digestibility studies do not characterize the effect of the added yeast on the digestive processes in the rumen.

Introducing *Saccharomyces cerevisiae* into the rumen resulted in a decrease in carboxymethylcellulase (CMC-ase) and xylanase activity in ruminal digesta just before feeding (Table 2). This finding suggests a negative effect of *Saccharomyces cerevisiae* on the activity and/or number of fibrolytic species of ruminal microorganisms, but not on the digestibility of fibrous nutrients (Michałowski et al., 2003).

Table 2. Effect of yeast on fibrolytic enzyme activities in the rumen content of cows,  $\mu\text{M}$  released reducing sugars/gDM/min

Hours after feeding	CMC-ase			Xylanase		
	control	yeast	SEM	control	yeast	SEM
0	12.48	9.95**	0.612	162.63	138.79**	7.806
2	6.22	5.13	0.653	109.53	104.29	6.088
4	6.18	5.04	0.456	110.94	100.31	5.744
8	7.94	7.49	0.539	127.22	122.44	5.515

\*\* -  $P < 0.01$

It was found that the activity of CMC-ase and xylanase decreased after feeding and then increased and that the yeast did not affect the pattern of these changes. The observed decrease was perhaps a dilution effect of the newly ingested feed, while the increase, of the progressing colonization of feed particles by fibrolytic microorganisms.

## CONCLUSIONS

No relationship was found between the supplementation of feed with live cultures of *Saccharomyces cerevisiae* and the total digestive tract digestibility of nutrients in cows. Nonetheless, the yeast supplement did lower the activity of the ruminal CMC-ase and xylanase. The latter finding argues in favour of changes in rumen microbial populations rather than a decline in the digestibility of fibrous components of the diet. Further studies on the changes in the numbers of cellulolytic bacteria, fungi and protozoa are needed, therefore, to explain the obtained results.

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