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Effect of live yeast culture supplementation on rumen fermentation in lactating dairy goats

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Abstract

Addition of yeast to dairy cow diets might be beneficial for milk production. However, data concerning goats are scarce, especially on the role of yeast on rumen metabolism. Thus, four goats, according to a cross-over design, received successively two diets with or without living yeasts. Animals were in mid-lactation and received a total mixed diet *ad libitum*. For the yeast diet (Y), each goat received 5 g of *Saccharomyces cerevisiae* CBS 493.94 twice a day. Samples of ruminal content were taken every two hours for eight hours after the morning feeding. Yeast addition did not have any statistical effect either on feeding pattern or on concentrations of volatile fatty acids, ammonia, lactate or soluble carbohydrate in ruminal fluid. The pH was numerically higher for the yeast diet compared to the control. Ruminal buffering (BC) capacity of the Y diet was significantly higher than that of the control. The BC increased as pH decreased. Dietary effects and ruminal soluble carbohydrate concentrations explained part of the residual of the equation linking buffering capacity and pH. Yeast addition also avoided some lactate peaks in the first hours of fermentation. This experiment clearly pointed out that the *Saccharomyces cerevisiae* CBS 493.94 yeast has an effect on ruminal metabolism when considering its BC and might have a smoothing effect on the appearance of lactate peaks or on a decreased pH. These effects are of particular interest for those diets which might induce acidosis such as some diets rich in rapidly fermentable energy given to high producing dairy goats in early lactation.

Keywords: *Saccharomyces Cerevisiae* yeast, rumen digestion, buffering capacity, dairy goats

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Introduction

Several experiments using dairy cows or goats have shown that yeast addition to the diet might increase milk production (Gunther, 1990; Piva *et al.*, 1993; Adams *et al.*, 1995; Putnam *et al.*, 1997; Nocek *et al.*, 2003) while other studies did not find any difference (Arambel & Kent, 1990; Chiquette, 1995; Kamalamma *et al.*, 1996; Salama *et al.*, 2002). Studies where yeast has been supplemented to dairy goat diets are limited, in particular, studies where the ruminal mode of action of yeast has been studied (Flachowsky *et al.*, 1993; Hadjipanayiotou *et al.*, 1997; Salama *et al.*, 2002). Furthermore, parameters such as buffering capacity (BC) of ruminal content and lactate concentrations have been either seldom or never measured. These parameters are of particular interest when animals receive diets that might induce acidosis such as diets rich in rapidly fermentable carbohydrates given to high producing dairy goats in early lactation.

Materials and Methods

Four rumen fistulated goats received successively either the control diet (C) or the Yeast diet (Y) in a cross-over experimental design. For the Yeast diet, each goat received 5 g of *Saccharomyces cerevisiae* CBS 493.94 [Alltech Company, Nicholasville, Kentucky, USA] twice a day with a dosing gun. Animals were in mid-lactation and milked twice a day. They received *ad libitum* a total mixed diet containing on a dry matter (DM) basis: 40% maize silage, 10% dehydrated lucerne and 50% of a concentrate (10% wheat bran, 18% maize gluten meal, 10% lupine seeds, 28% sugar beet pulp, 29% citrus pulp, 2% molasses and 3% mineral and vitamins mixture). Water was available *ad libitum*.

After an adaptation of three weeks to the diet, samples of ruminal content were taken from the dorsal part of the rumen of each goat every two hours for eight hours after the morning feeding. About 100 mL were immediately filtered through cheesecloth, pH was recorded and thereafter the BC by means of titration

of 20 mL of rumen juice with 1N acetic acid (Giger-Reverdin *et al.*, 2000) which was performed until the pH decreased from its initial value to 4. The evolution in pH was expressed as an exponential function of the quantity of acetic acid added (in meq H⁺): $pH = a - b \text{ eqH} + c \exp^{-d \text{ eqH}}$

Buffering capacity, or the inverse of the derivative function at the initial pH, is equal to $1/(b + (c * d))$. Samples were kept at -20 °C until analysed for volatile fatty acids, soluble carbohydrates, ammonia and lactate concentrations. Statistical analyses were performed according to the “proc mixed” procedure of SAS[®] in order to take into account the repeated effect on a same day for a given goat. The diet and sampling time effects and their interactions were tested for each variate.

Results and Discussion

Yeast addition did not affect DM intake (DMI) (g DMI per kg body-weight (DMI BW⁻¹)) at any sampling time or any of the rumen parameters measured, except for buffering capacity.

Table 1 Effect of yeast culture supplementation on dry matter intake (DMI) and rumen fermentation parameters

	Control diet	Yeast diet	Diet effect	Time effect
DMI/body weight (g/kg)	32.8	31.3	NS	P < 0.0001
pH	6.09	6.15	NS	P < 0.03
Buffering capacity	0.0299 ^a	0.0448 ^b	P < 0.001	NS
Volatile fatty acids (mmole/L)	152	153	NS	P < 0.01
Ammonia (g/L)	0.0795	0.0867	NS	P < 0.001
Lactate (mmole/L)	0.455	0.207	NS	NS
Soluble carbohydrates(g/L)	4.27	4.67	NS	P < 0.01

^{a, b}Row means with common superscripts do not differ (P > 0.05)

Compared to the control diet, pH was numerically higher with the yeast addition. This tendency is in agreement with other researchers who did not find any impact of yeast on ruminal metabolism (Erasmus *et al.*, 1992; Doreau & Jouany, 1998), while others recorded that yeast increased pH (Kumar *et al.*, 1997; Roa *et al.*, 1997). There was no lactate peak with the yeast supplemented diet that explained the lower lactate value of goats receiving the Y diet compared to goats receiving the C diet. Yeast might have had a smoothing effect on lactate peaks appearance, which is in agreement with other results (Williams *et al.*, 1991). The small increase in soluble carbohydrate concentration suggests that yeast might act on carbohydrate metabolism in the rumen. Furthermore, BC was higher with the yeast diet compared to the control diet (Figure 1).

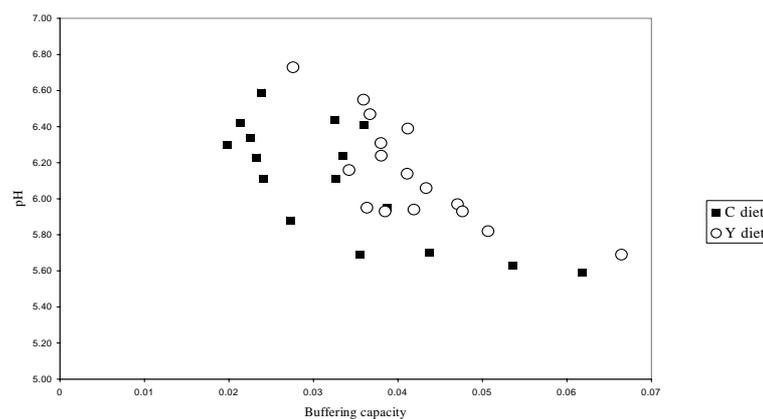


Figure 1 Dietary effect on buffering capacity and pH

Buffering capacity increased as pH decreased:

$$BC = 0.187 - 0.0244 \text{ pH} \quad (r^2 = 0.437, n = 32, \text{RSD} = 0.008484)$$

Dietary effect explained part of the residual of this equation (P < 0.001), such as the ruminal soluble carbohydrates concentration (P < 0.01).

Conclusion

The *Saccharomyces cerevisiae* CBS 493.94 yeast improved BC of the rumen significantly and tended to indicate level of significance to an increase in pH and decrease lactate concentrations. This effect might be more significant for diets higher in NSC than the one tested. These effects are of particular significance for diets which might induce acidosis such as diets rich in rapidly fermentable carbohydrates given to high producing dairy goats in early lactation.

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