EFFECT OF DIFFERENT SACCHAROMYCES CEREVISIAE YEAST CULTURES ON RUMINAL FERMENTATION, METABOLIC STATUS, AND MILK PRODUCTION IN DAIRY COWS

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Introduction

Interest in commonly used direct-fed microbial such as *Saccharomyces cerevisiae* yeast culture (Sc) as a potential alternative to antimicrobial feed additives has increased in the last 15 years. However research results with Sc fed to dairy cattle have varied. Improvement in dry matter intake (DMI) (1, 5) milk production (2, 8) have been reported when cows were fed Sc. In contrast no differences were found in DMI (6, 7) milk production and milk composition (1, 3, 6, 7, 8) in other studies. Piva (1993) suggested that several factors affect the response of dairy cows to supplemental Sc, such as type of forage fed, forage-to-concentrate ratio, feeding strategy, stage of lactation. Robinson (1995) reported that cows supplemented with Sc appeared to be in better energy balance, as was evidenced by the lower loss of body condition score (BCS). There are variable results about the effect of Sc supplementation on ruminal fermentation in cattle. The ruminal pH decreased (4, 8), not changed (2, 3) or increased (9) after Sc supplementation. The volatile fatty acid (VFA) (total VFA, acetate, propionate, butyrate) production and proportion of VFA-s changed, especially the acetate: propionate ratio (A:P) was found narrower (5). There are several Sc products on the market with different recommendation of dosage and nuances in their manufacturing processes that may have an influence on performance. However very few studies have been conducted to compare Sc yeast culture in the same experimental environment. The aim of the study was to measure the effect of different strains of live and viable *Saccharomyces cerevisiae* yeast cultures (Sc) with different dosage on ruminal fermentation, metabolic status, and milk production in dairy cows.

Material and methods

A lactating dairy ration was formulated to support 40kg/d of milk production with 3.6% fat and 3.2% protein in 2nd lactation according to the NRC recommendations. The nutrient content of the daily ration was the same in each group except for treatment. 125 clinically healthy Holstein-Frisian cows in early lactation were assigned randomly in 5 groups (n=25 in each) and administered with Sc mixed in the daily ration as follows: Group A: control; not treated; B: 20g ($2{,}1x10^{10}$CFU/g) Sc; C:5g ($1{,}7x10^{10}$ CFU/g) Sc.; D:5g ($2{,}5x10^{10}$ CFU /g) Sc.; E:10g ($4x10^{7}$ CFU /g) Sc. daily. The quantity of Sc supplementation follows the recommendation of the Sc. Producer Companies. 12 cows were assigned randomly from each group in order to monitor the metabolic status and ruminal fermentation of the animals. The evaluation of milk production and milk quality was based the data of 25 cows. Blood, urine and rumen fluid samples were taken 3-5 hours after morning feeding monthly; at the beginning and once a month onward till 90th day of the experiment. The biological samples were taken to the laboratory in 2 hours after sampling on +4 ºC. Energy metabolism (blood aceto-acetic acid, Non Esterified Fatty Acid (NEFA), glucose concentration), protein supply (blood and urine urea concentration), acid-base balance (urine and rumen pH, urine Net Acid Base Excretion (NABE)), Volatile Fatty Acid production (rumen fluid TVFA, acetate, propionate, butyrate concentrating and molar proportion) was measured. The milking data (milk kg, milk fat and protein %) was collected monthly recorded by the Hungarian Milk Recording Ltd.

The statistical analysis (General Linear Model test, Last Significant Difference post hoc test) performed by SPSS 8.0 statistical software.

Results

There was no significant difference between the parameters measured in the groups at the first sampling. There was no significant and remarkable difference and change in any metabolic parameter according to energy, protein and acid base metabolism, between the groups and samplings. All the measured parameter varied in the physiological range on the average. There was a significant ($p<0{,}001$) increase in rumen pH, acetate concentration, molar proportion of acetate: propionate ratio and decrease in total VFA in group D and E but not in others. In butyrate concentration and molar proportion in TVFA there was a significant ($p<0{,}01$) increase in group A, a decrease ($p<0{,}01$) in group D and E, but not changed in B and C during the experiment *(Table 1.)*. The concentration of propionate not changed in experimental groups.

Table 1. The effect of Sc on ruminal pH and VFA production (*: p<0,05, **: p<0,01)

Parameter / sampling	A (control)	B	C	D	E
pH 1	6,61	6,80	6,45	6,56	6,76
2	6,84	6,83	6,77	6,90	6,83
3	6,77	6,80	6,92	***7,45***	***7,14***
4	6,67	7,05	6,71	***7,32***	***7,24***
Acetate molar % in TVFA 1	63,72	65,38	64,56	63,63	63,55
2	63,72	64,26	64,45	67,12	64,27
3	64,98	62,48	65,46	***69,96***	***69,21***
4	***61,36****	64,62	63,22	***69,87***	***67,44***
Acetate: Propionate ratio 1	3,24	3,28	3,28	2,97	3,02
2	3,14	3,12	3,18	3,69	3,13
3	3,37	3,01	3,32	***4,19***	***4,03***
4	2,83	3,21	3,09	***4,11***	***3,71***
Butyrate molar % in TVFA 1	10,52	10,49	11,58	11,36	11,43
2	11,22	10,51	11,09	10,52	11,07
3	11,23	10,85	10,80	***8,81***	***9,23***
4	11,90	10,97	11,60	***9,30***	***9,95***
TVFA concentration 1	107,22	101,71	110,34	115,52	109,82
2	88,71	85,37	93,69	80,80	98,60
3	103,54	104,99	92,57	***51,15***	***57,98***
4	113,45	83,87	105,61	***53,34***	***60,86***

Significant (p<0,05) increase detected in milk protein in all treated group, but not in A. There was no significant difference in milk fat % between the groups. The 4% fat corrected milk yield was higher in all treated group than control A, but only group E produced significantly more than control A. The difference between treated groups was not significant *(Table 2.)*.

Table 2. The effect of Sc on milk production and milk composition (*: p<0,05 compared to A)

Parameter / sampling	A (control)	B	C	D	E
4% FAT Corrected Milk kg 1	31,81	32,61	31,31	30,81	31,85
2	31,04	31,00	29,66	31,63	33,04
3	28,45	28,89	28,68	26,55	29,93
4	27,83	31,05	30,17	30,04	***32,58****
Milk protein % 1	3,11	3,15	3,17	3,11	3,19
2	3,19	3,28	3,26	3,23	3,20
3	3,03	***3,19****	***3,21****	***3,27****	***3,28****
4	3,32	***3,39****	***3,46****	***3,43****	***3,46****

Conclusions

No effect detected of the supplemental use of different live and viable Sc yeast cultures in different dosage on energy metabolism, protein supply and systemic acid-base

balance of cows. There was a difference in strength of effect on ruminal pH, A:P ratio butyrate and TVFA production between Sc preparations. In contrast in previous research all the Sc product improved milk protein production. The direction and strength of the effect of Sc supplementation on ruminal fermentation and milk production seems not to be dependent on dosage and live cell concentration of the Sc products.

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