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The effectiveness of the use of Saccharomyces cerevisiae yeast in feeding dairy cows

Maria Czaplicka, Zbigniew Puchajda, Michał Pawlak

University of Warmia and Mazury in Olsztyn,
Department of Cattle Breeding and Milk Evaluation,
ul. Oczapowskiego 5, 10-718 Olsztyn

The study analysed the influence of the addition of live *Saccharomyces cerevisiae* yeast to the diet of Polish Holstein-Friesian cows on fat-corrected (FCM) yield, content of fat, protein and lactose in the milk, and its somatic cell count. Cows receiving live yeast in the form of complementary feed had higher FCM yield and a lower somatic cell count in each period analysed. No effect of the addition of yeast was observed on the content of fat, protein and lactose in the milk. The higher milk yield and lower somatic cell count in the milk indicate that it is advisable to supplement the diet of dairy cows with *Saccharomyces cerevisiae* yeast.

KEY WORDS: cows, yeast, milk composition, somatic cells

Proper cattle nutrition is an essential element of cost-effective production. Satisfactory effects can only be obtained using complete feed prepared from suitable quality bulky and concentrate feeds with vitamin and mineral supplements [9]. The appropriate levels of these components will ensure their optimum breakdown in the rumen, as well as the health of dairy cows and stable yield. The feed additives used and their quantity in the feed ration should depend on the herd, milk yield and the composition of the feed ration [5].

Yeasts are among the most commonly used microorganisms in today's biopharmaceutical, chemical, agri-food and feed industries [3]. They are a natural product which has been used for many years in animal nutrition. Their dry matter contains a large amount of crude protein (35-65%), rich in amino acids such as lysine and threonine. They also have a high metabolic energy content (11-25 MJ/kg), determined by the amount of starch, fat and fibre. Another advantage is their high digestibility, which is about 90% in the case of brewer's yeast [7].

The aim of the study was to determine the effect of adding live cultures of *Saccharomyces cerevisiae* yeast to the diet of Polish Holstein-Friesian cows on their yield and the chemical composition of their milk.

Material and methods

The study was conducted on a family farm in the Masovian Voivodeship. It included 24 Polish Black-and-White Holstein-Friesian cows with an average yield of 6,439 kg of milk per lactation, from May 11, 2012 to May 10, 2013. The herd was divided into two groups: control and experimental. The age, period of lactation and yield of the cows were similar in each group. The animals were kept in an indoor + pasture system, in stalls with shallow bedding that was changed daily.

The cows were milked twice a day with a pipeline milker: in the morning at 5 am and in the evening at 5 pm. The milk flowed directly into a 2,000 litre tank located in a separate room. The tank was washed automatically after each milk collection. Milk collection took place every other day after morning milking and cooling of the raw material.

The research period was divided into two periods with different dietary characteristics: a summer period from 11 May to 15 October and a winter period from 16 October to 10 May. During summer feeding, the cows spent 8 hours a day in the pasture. Immediately after leaving the pasture they were given hay in the amount of 2 kg per cow. After evening milking, all cows received maize silage in the barn in the amount of 20 kg per cow. The feed ration was sufficient to meet the cows' basic nutritional needs and for production of 20 kg of fat-corrected milk (FCM). Cows producing more were given 1 kg of concentrate feed for every 3 kg of additional milk. The concentrate feed contained wheat bran, triticale, extracted sunflower seeds, malt sprouts, extracted rape seeds, sugar beet pulp, sugar beet molasses, calcium carbonate, maize, sodium chloride, dehulled, extracted and roasted soybeans, distillers dried grains, sodium bicarbonate, and magnesium oxide. The experimental group received a supplement of live *Saccharomyces cerevisiae* yeast in the amount of 100 g/cow.

During the winter feeding period, the feed ration consisted of 20 kg of haylage and 20 kg of maize silage. This feed ration was sufficient to produce 17 kg of milk. Cows producing more were given 1 kg of concentrate feed for every 3 kg of milk. As in the summer, the experimental group received a supplement of live *Saccharomyces cerevisiae* yeast with the concentrate feed, in the amount of 100 g/cow. Vitamin and mineral supplements were used in both the summer and winter feeding periods. About two weeks before calving (in both groups), 250 g of glycerol was added to the feed ration of each cow. Twice that amount (500 g/cow) was administered for 7 days after calving. The purpose of the addition of glycerol was to prevent ketosis.

Milk yield, the content of fat, protein and lactose, and somatic cell count were determined on the basis of test-day milking results and analysis of milk samples. The analyses were performed at the laboratory of the Regional Animal Breeding Station in Parzniew. Fat, protein and lactose content were determined using a Milkoscan analyser and somatic cell count with a Fossomatic somatic cell counter. The data analysed, presented in the tables, were obtained from reports on the results of dairy performance evaluations.

The numerical material collected was characterized by means of arithmetic mean ($\bar{x}$), standard deviation (S_x) and the result of Student's t-test. STATISTICA 10 was used for statistical analysis.

Results and discussion

The average daily FCM yield in the herd (24 cows) for the entire study period was 22.36 kg. In the experimental group 24.54 kg FCM was obtained (Table 1). This value was highly statistically significantly greater than the mean obtained in the control group. Similar correlations were observed by for the results from the summer: the yield of FCM was 20.90 kg in the control group and 26.07 kg in the experimental group. These results indicate a highly significant effect of *Saccharomyces cerevisiae* yeast on FCM yield.

In winter, the effect of the live *Saccharomyces cerevisiae* supplement on milk yield was statistically significant ($P \leq 0.05$; Table 1). In the control group, FCM yield was 19.46 kg, which was 3.56 kg lower than in the experimental group. A significant effect of yeast on milk yield, amounting to 0.9 kg FCM, was also noted by Skórko-Sajko et al. [10] between the 5th and 85th day of lactation. A greater (3.0-3.7 kg/day/cow) increase in milk yield following the use of live yeast cultures was observed by Dobicki et al. [2] and Korniewicz et al. [6]; however, this result was not converted to FCM. Increased milk yield in cows receiving live yeast supplements was reported by Williams et al. [12], according to whom the higher yield results from stimulation of feed intake and the effect on rumen metabolism, i.e. a reduction in the amount of lactic acid and an increase in the pH of the rumen contents. Kung et al. [8] did not observe such correlations. In their view, the addition of yeast cultures does not affect fermentation or rumen pH. Sullivan and Martin [11] reported that the use of *Saccharomyces cerevisiae* cultures in the feed ration positively affects cellulose digestion and improves lactate utilization. Erasmus et al. [4], in a study on Holstein-Friesian cows using cannulas, concluded that yeast cultures may alter the amino acid profile of the bacterial protein that passes into the duodenum.

Analysis of the results of average fat content (%) in the milk of the cows showed no significant differences between the control and the experimental group receiving live yeast cultures, in either summer or winter (Table 2). Similarly, Dann et al. [1], in an experiment

Table 1
Daily milk yield (kg FCM) in cows during the two research periods

Period of research		Control group	Experimental group
Entire study period	$\bar{x}$	20.18^{A}	24.54^{B}
	S_x	3.48	4.18
Winter period	$\bar{x}$	19.46^{a}	23.02^{b}
	S_x	2.69	2.84
Summer period	$\bar{x}$	20.90^{A}	26.07^{B}
	S_x	4.14	4.84

Means in rows marked with different letters differ significantly: A – at $P \leq 0.01$; a – at $P \leq 0.05$

Table 2
Fat content (%) in the milk of the cows during the two research periods

Period of research		Control group	Experimental group
Entire study period	$\bar{x}$	4.54	4.73
	S_x	0.58	0.48
Winter period	$\bar{x}$	4.78	4.98
	S_x	0.61	0.34
Summer period	$\bar{x}$	4.38	4.56
	S_x	0.44	0.51

on Jersey cows, observed no differences in fat production during 140 days of lactation. A contrasting finding was reported by Skórko-Sajko et al. [10], who observed a significant effect of a preparation of live yeast cultures on fat content. The milk of cows receiving this additive had higher fat content as compared to the control group. The yeast supplement also had a highly significant effect on fat yield (kg).

Data on protein content (%) in the cow milk in the two study periods are shown in Table 3. During the study period, the value of this indicator was 3.42% on average – 3.33% in the control and 3.50% in the experimental group. In the winter the average protein content of the milk from the experimental group was 3.66%, which was 0.26 percentage points higher than for the control. In the summer, the average protein content in the milk was lower, on average 3.31-3.36% in the experimental group was and 3.26% in the control. The differences were statistically non-significant. Significant changes in protein content in milk following the use of yeast were also not observed by Dann et al. [1] in an experiment on Jersey cows. Skórko-Sajko et al. [10], on the other hand, observed higher protein content in the experimental group between 5 and 85 days after calving.

Table 3
Average protein content (%) in the milk of the cows during the two research periods

Period of research		Control group	Experimental group
Entire study period	$\bar{x}$	3.33	3.50
	S_x	0.24	0.62
Winter period	$\bar{x}$	3.40	3.66
	S_x	0.27	0.76
Summer period	$\bar{x}$	3.26	3.36
	S_x	0.19	0.42

Table 4
Average lactose content (%) in the milk of the cows during the two research periods

Period of research		Control group	Experimental group
Entire study period	$\bar{x}$	4.65	4.69
	S_x	0.13	0.33
Winter period	$\bar{x}$	4.67	4.74
	S_x	0.11	0.23
Summer period	$\bar{x}$	4.64	4.65
	S_x	0.15	0.41

Our study showed no significant effect of the addition of live cultures of *Saccharomyces cerevisiae* on the level of lactose (%) in the milk (Tab. 4). Similar results were obtained by Dann et al. [1] in a study on Jersey cows, in which no differences in lactose production were observed in 140 days of lactation.

The addition of yeast to the cows' feed was shown to affect the natural logarithm of the somatic cell count in their milk. The average value of this parameter was 2.38. It was higher in the control group, at 2.47, as compared to 2.28 in the experimental group (Table 5). The difference was statistically significant ($P \leq 0.01$). A significant effect of live yeast cultures on the natural logarithm of the somatic cell count was also observed in the winter: the values were 2.44 in the control and 2.28 in the experimental group ($P \leq 0.05$). In summer, the effect of the live *Saccharomyces cerevisiae* yeast supplement on somatic cell counts in the milk was highly significant ($P \leq 0.01$), with values of 2.50 in the control and 2.28 in the experimental group. In the experimental group this index remained at the same level throughout the study period. Similar correlations were observed by Dobicki et al. [2],

Table 5
Somatic cells count (LNSCC) in the milk of the cows during the two research periods

Period of research		Control group	Experimental group
Entire study period	$\bar{x}$	2.47^{A}	2.28^{B}
	S_x	0.24	0.16
Winter period	$\bar{x}$	2.44^{a}	2.28^{b}
	S_x	0.23	0.15
Summer period	$\bar{x}$	2.50^{A}	2.28^{B}
	S_x	0.26	0.17

Means in rows marked with different letters differ significantly: A – at $P \leq 0.01$; a – at $P \leq 0.05$

who demonstrated that the addition of dried yeast highly significantly reduced SCC in cow milk. In contrast, Dann et al. [1] found no significant differences in this regard between the group receiving live yeast cultures and the control.

To sum up, dairy cows receiving live cultures of *Saccharomyces cerevisiae* yeast had higher FCM yield and their milk had lower somatic cell counts in each of the study periods. The yeast supplement had no statistically confirmed effect on the fat, protein and lactose content in the milk. The higher milk yield and lower somatic cell count in the milk indicate the advisability of adding *Saccharomyces cerevisiae* yeast to feed for cows.

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