Original Paper

The effect of *Saccharomyces cerevisiae* additive to cattle ration on milk yield of dairy cows

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This research aimed to evaluate the effect of live yeast additive to cattle ration on milk yield of dairy cows. The research was conducted on a dairy farm, on a sample of 265 dairy cows during winter. The dairy cows were fed with a feed containing live yeast of *Saccharomyces cerevisiae* species (CNCM I-1077). The dosage was $2 \cdot 10^{10}$ cfu/head/day. Milk yield and the components of milk were monitored for a three-month-long period – starting one month before the supplementation of yeast to feed and ending two months after. The addition of live yeast to cattle ration had a significant positive impact already in the first month on milk yield (+1.25 kg/day), and the amount of fat (+0.055 kg/day), protein (+0.057 kg/day), lactose (+0.056 kg/day) and milk solids (+0.170 kg/day) contained in milk (p <0.001). The general conclusion of the experiment is, that the *Saccharomyces cerevisiae* additive had an apparent positive impact on milk yield and milk components.

Keywords: dairy cows, live yeast, milk yield

1 Introduction

Ruminants are extraordinarily efficient in the breakdown of fibre particles during rumination and digestion (Clauss et al., 2010), in particular grazers like cattle (Hummel et al., 2008). Most dietary compounds entering the rumen are degraded by numerous anaerobic microorganisms (mainly bacteria and protozoa) present in the rumen fluid. Thus, rumen ecosystem plays a key role in ruminants' responses to their diet (Desnoyers et al., 2009). *Saccharomyces cerevisiae* is a single-celled fungus capable of fermenting carbohydrates that is commonly used as a feed additive in diets of ruminant livestock (Perdomo et al., 2020). Live *Saccharomyces cerevisiae* scavenges ruminal oxygen (Newbold et al., 1996), which reduces ruminal redox potential, favouring the activity of cellulolytic bacteria and lactate-utilizing bacteria (Marden et al., 2008). Live yeast supplementation to the diet has been associated with increased potential to enhance fiber digestion in the rumen and prevention of a decline in rumen pH (Chaucheyras-Durand et al., 2008). This improved rumen environment may lead to increased feed efficiency of dairy cattle (De Ondarza et al., 2010). Supplementation of active dry yeast not only improves ruminal pH, but also affects cows' eating behaviour. Greater fiber digestibility associated with live yeast supplementation increase the appetite and feed intake (Bach et al., 2007). Yeast supplementation to the diet of cows improves feed efficiency and lactation performance (Bruno et al., 2009; Moallem et al., 2009; Marsola et al., 2010; Salvati et al., 2015).

The aim of this research was to evaluate the impact of live yeast additive to cattle ration on milk yield of lactating dairy cows. We hypothesized that supplementation of live yeast to the cattle ration would result to increasing of milk yield.

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2 Material and methods

2.1 Biological material

The experiment took place in breeding conditions on a dairy farm in sub-montane region of Slovakia during winter and lasted for three months. As a sample, 265 dairy cows of the Slovak spotted cattle breed were used in this experiment.

2.2 Feeding and stabling of animals

The animals were stabled in an open housing system with cubicles and bedding, including outdoor enclosures. The air exchange in the stabling was secured by a natural ventilation system. The animals had access to water and food *ad libitum*. Feeding took place once a day, in the morning, while milking, to provide the animals with fresh feed immediately after they leave the milking parlour. During this experiment, a feed containing a live yeast basis agent of *Saccharomyces cerevisiae* species (CNCM I-1077). The dosage was 1 g/head/day($2 \cdot 10^{10}$ cfu/head/day). The yeast was added to the feed by a premix form – the main carrier of the yeast being grain mix. The yeast to grain mix ratio was 1 : 24. The premix dosage in the feed was 25 g/head/day. Yeast was added to the feed of each lactating animal for the duration of the experiment. The contents of the cattle ration remained unchanged throughout the experiment and are shown in Table 1.

Table 1 The composition of the diets before and during live yeast supplementation

Item (in % of original matter)	Before supplementation		Live yeast supplementation	
	early lactation	peak lactation	early lactation	peak lactation
WDG	6.30	7.08	6.30	7.08
Beet molasses	2.10	1.42	2.10	1.42
Canola meal	5.46	4.78	5.46	4.78
Water	8.40	5.31	8.40	5.31
SFM	10.50	8.85	10.45	8.81
Corn silage	54.64	58.41	54.64	58.41
Alfalfa-grass silage	10.50	12.38	10.50	12.38
Wheat straw	2.10	1.77	2.10	1.77
Live yeast premix	–	–	0.05	0.04

WDG – wet destilery grain; SFM – supplementary feeding mixture including the ingredients (as is): 41.50% wheat, 17.60% rape seed meal, 15% rapeseed expeller, 3% rye, 10% corn dried distillers grains, 4.3% chelated mineral mixture, 1.60% urea, 5% by pass vegetable fat, 0.50% salt, 1.50% limestone

2.3 Milk yield and milk components

Milk yield and the components of milk were monitored daily for a three-month-long period – starting one month before the supplementation of yeast to cattle ration and ending two months after. Milk yield was evaluated according to the daily milk yield per dairy cow in kg/day (MYC). Samples of milk for the analysis of the basic components were taken from the cooling tank each day, before the milk was taken to the dairy. The components monitored in milk were: fat content in %, protein content in %, lactose content in % and milk solids content in %. The components in milk were measured using FTIR infrared spectrophotometry.

2.4 Statistical analysis

Statistical analysis of the obtained results was performed in the IBM SPSS Statistics 20 Program. The Analysis of Variance (ANOVA) was used to assess the effect of yeast supplementation month on the monitored milk content parameters and milk yield, with testing the contrasts by means of the Scheffe test at the level of significance $p < 0.05$. The analysis was performed according to the following model equation:

$$Y_{ij} = \mu + M_i + e_{ij}$$

where:
Y_{ij} – an indicator of the milk content or milk yield; μ – the overall mean; M_i – the fixed effect (n = 3; 1 month before yeast supplementation (control), 1st month of yeast supplementation, 2nd month of yeast supplementation); e_{ij} – the random error

3 Results and discussion

Table 2 summarises the impact of the live yeast additive on milk yield of dairy cows. The data collected throughout this experiment prove that the inclusion of yeast in cattle ration had a positive impact on the amount of fat content, protein content, lactose content and milk solids content in milk. An apparent positive effect occurred already in the first month of supplementation of live yeast and persisted in the next period of supplementation (p <0.001). The amount of milk solids increased by 0.17 kg/day after the first month of yeast inclusion. Salvati et al. (2015) report an increase in milk solids content in milk after the addition of yeast at the level of 0.14 kg/day, they also noted a significant increase in other individual components of milk. Al Ibrahim et al. (2010) found a positive effect of yeast supplementation on the fat content of milk in cows in early lactation, that being second and third weeks postpartum. Similarly, De Vries and Chevaux (2014) record an increasing trend in fat content – rise by 0.16%, and milk fat yield – rise by 0.07 kg/day, in cows which had yeast added to their ration by the dosage $1 \cdot 10^{10}$ cfu/head/day, however, no effect on milk protein content or milk fat content was noted in their study. Perdomo et al. (2020) evaluated the effect of different doses of live yeast on the performance of dairy cows (0, 1.42 and $3.76 \cdot 10^{10}$ cfu/head/day). They found that protein tended (p = 0.08) to increase with increasing dose of live yeast. Fat yield tended (p = 0.09) to increase and protein yield increased (p <0.01) linearly with increasing dose of live yeast. Milk lactose concentration did not differ among treatments, but lactose yield tended (p = 0.08) to increase linearly with increasing dose of live yeast. Increase in fats content after the addition of yeast supplement might be explained by an improvement of fermentation in rumen and increased pH, which hinders the *trans*-10, *cis*-12 isomer of CLA production (Choi et al., 2005), and therefore enhances the synthesis of milk fats (Bauman and Griinari, 2001).

Table 2 Effect of the *Saccharomyces cerevisiae* yeast additive on milk yield of dairy cows

Parameter	Control (n = 30)	1st month (n = 31)	2nd month (n = 31)	Significance
Fat (kg/day)	0.814 ±0,048[a]	0.869 ±0.050[b]	879 ±0.026[b]	***
Fat (%)	3.861 ±0.058[a]	3.889 ±0,054[a]	3.928 ±0.071[b]	***
Protein (kg/day)	0.780 ±0.046[a]	0.837 ±0.046[b]	0.841 ±0.029[b]	***
Protein (%)	3.699 ±0.048[a]	3.747 ±0.023[b]	3.756 ±0.028[b]	***
Lactose (kg/day)	1.031 ±0.053[a]	1.087 ±0.057[b]	1.095 ±0.037[b]	***
Lactose (%)	4.892 ±0.055	4.867 ±0.060	4.892 ±0.074	n.s.
Solids (kg/day)	2.754 ±0.146[a]	2.924 ±0.160[b]	2.934 ±0.092[b]	***
Solids (%)	13.062 ±0.097	13.093 ±0.112	13.112 ±0.153	n.s.
MYC (kg/day)	21.08 ±1.05[a]	22.33 ±1.20[b]	22.38 ±0.73[b]	***

MYC – daily milk yield per dairy cow, n.s. – not significant, *** p <0.001, different letters in the same row indicate significant differences among the mean values (p <0.05)

The addition of live yeast to dairy cows' feed had a positive impact on the daily milk yield per dairy cow which increased from 21.08 kg/day to 22.33 kg/day after first month and to 22.38 kg/day after second month (p <0.001). Multiple authors have noted similar figures, when experimenting with yeast in feed and dairy cows. For example, Salvati et al. (2015) conducted an experiment, where he administered yeast to Holstein species in summer period and he found that the milk yield increased by 1.3 kg/day. Moallem et al. (2009) noted an increase of 1.5 kg/day as a consequence of using yeast supplement. Bruno et al. (2009) report a rise in milk yield of 1.2 kg/day in dairy cows within first 130 days of lactation fed with the yeast additive. Perdomo et al. (2020) recorded that milk yield tended (p = 0.10) to increase linearly, a 1.4 kg/day difference between 0 and $3.76\ 10^{10}$ cfu/head/day treatments, with incremental feeding of live yeast. Desnoyers et al. (2009) in a meta-analysis on S. cerevisiae supplementation to ruminants, estimated a mean milk yield response to yeast of +0.78 kg/day, for a 650-kg cow-equivalent.

4 Conclusions

The addition of live yeast supplement to feed for dairy cows had positive effect on milk yield and fat, protein, lactose and milk solids content in milk of the observed dairy cows.

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