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Research Article

# Effect of Selenium Enriched Yeast Culture *Saccharomyces Cerevisiae* Supplementation in TMR of Pregnant Heifers and Cows on the Colostrum Quality

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## Abstract

The objective of this study was to evaluate the effect of selenium-enriched yeast culture *Saccharomyces cerevisiae* supplementation in TMR of pregnant cows and heifers on colostrum quality. Twenty high-pregnant cows of the Czech Fleckvieh cattle breed on the 2nd and higher lactation and twenty high pregnant heifers were divided into 2 groups (control and experimentaleach group of 10 cows).The control group (n = 10) without the Premix "Alkosel"(selenomethionin enriched *Saccharomces cerevisae* (NCYS R-397). The experimental groupn = 10) was with supplementation of premix "Alkosel" in a batch 3 mg/cow and day. The mixed feed ration (TMR) was same in all groups and based on maize silage (10 kg), pea silage (6.0 kg), meadow hay 0.5 kg), barley straw (2.0 kg), and 3 kg mixture (extracted soybean meal – 27%, extracted rapeseed meal – 40%, and concentrate mixture (corn–10%, barley–6%, wheat–10% and mineral mixture– 6%, feed salt – 1%.The premix Alkosel was applied in a mineral mixture. The blood sample from all animals was taken before the start of experiment ca. 23 days before the expected calving and second sampling was carried out within 24 hours after birth. In the blood serum of animals were analyzed immunoglobulin G (IgG), and enzyme activity gamma glutamyl transferase (GMT). Colostrum was collected from all animals at four-time intervals after birth and analyzed on the dry matter content, crude protein and imunoglobuline G (IgG).

All colostrum quality parameters were statistically significantly ($P < 0.05$) influenced by the time of colostrum sampling after birth, especially the IgG content (cows control: 57.35 vs 36.47 vs. 18.29 vs 10.51 $mg.ml^{-1}$ IgG.). The addition of selenomethionine from yeast culture did not significantly affect the composition and quality of colostrum. All colostrum parameters are highly statistically correlated ($P<0.01$). The content of immunoglobulin G, the values of density, dry matter and crude protein in the colostrum were not affected by the addition of selenomethionine from the yeast culture.

The effect of selenomethionine addition on Ig G values in the blood serum of pregnant cows and heifers was also not proven. A positive effect of the age of pregnant cows on the content of immunoglobulin G in the blood serum of older animals was confirmed compared to pregnant heifers at the start of the experiment (19.13 vs 11.17 $mg.ml^{-1}$).

## Keywords:

*Saccharomyces cerevisiae, selenium, pregnant cows, pregnant heifers, blood serum parameters IgG, and GMT, colostrum quality*

## Introduction

The most cited benefit of yeast cultures on ruminal digestion is support of the growth and activity of anaerobic, namely cellulolytic bacteria. Yeasts would utilize residual oxygen introduced into the rumen with feeds, thus contributing to maintain anaerobic environment (Calsamiglia et al. 2006). Moreover, yeast cultures regulate the rate of fermentation, and also by stimulation of lactate-utilizing bacteria yeasts facilitate stabilization of the rumen pH and rumen fermentation (Williams et al. 1991; Kumprechtova, D. et al., 2019; Mirowski, A., 2019, Dolezal, P. et al., 2012; Tun, H. et al., 2020 and other) and nutrient digestibility and milk production (Shakira, G. et al., 2018; Dais et al., 2018; Ferreira et al., 2019 and other).Results of Lin XueYan et al. (2021) showed that *Saccharomyes c*erevisiae and its fermentation products significantly increase the feed intake of peripartum dairy cows, increase the lactose content after 21 days postpartum, and tend to increase milk production, and the digestibility of nutrients. Zontini, A. M. (2021) and Bakr et al. (2015) published their results from an experiment with dairy cows during the transit period and in the first days of lactation, to which they added yeast cultures or their fermentation products. In contrast, Yuan, K. et al. (2015) found in their experiment that the supplementation of *Saccharomyces cerevisiae* during the transit period did not affect milk production and dry matter intake but modulated feeding behavior and metabolism. Similarly, Cermakova et al. (2014) published that postpartum concentration of lactic acid, volatile acids, and ammonia, and pH in rumen fluid did not differ between the treatments. Nevertheless, none of the published studies demonstrated a negative effect of yeast culture on ruminal digestion or animal health.

The aim of this study was to assess the effect of the selenium-enriched yeast culture *Saccharomyces cerevisiae* supplementation in TMR of pregnant cows and heifers on colostrum quality.

## Material and Methods

Twenty high-pregnant cows of the Czech Fleckvieh cattle breed on the 2$^{nd}$ and higher lactation and twenty high pregnant heifers were divided into 2 groups (control and experimental each group of 10 cows). Pregnant cows and pregnant heifers.Cows were housed in a free-stall barn and fed 2 × daily the same TMR (*ad libitum*) with the experimental group receiving supplementation of selenomethionin enriched *Saccharomces cerevisae* (NCYS R-397). The experimental group n = 10) was with supplementation of premix “Alkosel” in a batch 3 mg/cow and day. The premix Alkosel was applied in a mineral mixture. The components, chemical composition and nutritional value of diets/feeding rations are presented in Table 1. Blood was sampled by tapping from vena caudalis mediana into single-use test tubes without addition of anticoagulants 23 days before the expected calving. Blood serum was analyzed for enzyme activity gamma glutamyl transferase (GMT) 23 days before calving and 24 hours after calving. The GMT content was established on an automated analyzer Model Reflovet Plus by using standard procedures in the laboratory of the Mendel University Brno. Immunoglobulin G (IgG) by the Eliza method. Immunoglobulin G was also analyzed in colostrum at 4 different time points (0, 6 12, 24, 48, 72 hours after calving). Samples of colosgtrum were taken by using nursing staff in vacuum cans with a portable milking tract. Subsequently, the samples were frozen and colostrum as an integrated package was transported to the laboratory LABtechnik Brno. In the laboratory was the quantitative determination of Ig Gaccomplished using sandwich, enzyme-linked immunosorbent assay (ELISA). The results were statisticaly analyzed using Microsoft Excel and Statistica 10.0.

## Results and Discussion

Chemical composition and nutritional value of TMR are presented in Table 1.

| Ingredients | Amount |
|---|---|
| Corn silage (kg) | 10 |
| Pea silage (kg) | 6 |
| Meadow hay (kg) | 0.5 |
| Barley straw (kg) | 2.0 |
| Mixture (kg | 3.0 |
| Composition of concentrate mixture | |
| Soybean meal (%) | 27 |
| Rapeseed meal (%) | 40 |
| Corn (%) | 10 |
| Bbarley (%) | 6 |
| Wheat (%) | 10 |
| Mineral mixture (%) | 6 |
| Feed salt (%) | 1 |
| Nutrients | |
| Dry matter (%) | 42.85 |
| Crude protein (CP) (%) | 14.00 |
| Crude fat (%) | 2.42 |
| Crude fibre (%) | 20.29 |
| ADF (%) | 22.50 |
| NDF (%) | 32.85 |
| ME (MJ.kg-1 DM) | 10.47 |
| NEL (MJ.kg-1 DM) | 6.4 |
| Ca (g/kg) | 7.67 |
| P (g/kg) | 3.9 |
| Na (g/kg) | 1.15 |
| K (g/kg) | 15.85 |
| Mg (g/kg) | 2.20 |
| Se (mg/kg) | 0.21 |

The results show that the dry matter content of TMR is lower than recommended by Bouška et al. (2006) and Doležal et al. (2014). The concentration of crude fibre in 1 kg of dry matter was 20.29 % which corresponds to the physiological requirement and production efficiency of dairy cows. With higher fibre contents in feeding rations, or at the introduction of low-quality feeds, intestinal digestion is reduced, rumen motoric activity is slowed down. The content of crude fat (2.42%) and the total content of Acid detergent fibre (ADF – 22.5 %). The NDF content (32.85 %) in TMR was lower than recommended by Suchý et al. (2009). The concentration of ME and NEL is in accordance with the productivity of the pregnant cows. The energy concentration of NEL should be in the range of 6.0-6.5 MJ.kg$^{-1}$ of dry matter. The colostrum quality of groups of heifers and of cows are presented in table 2 and 3 and graphs 1-3. Own colostrum composition is influenced by several factors, such as age, breed, breeding technology, nutrition, standing on the length and condition dry cows. Quality colostrum intake has a major impact on the health of calves from birth to weaning. The components of colostrum (especially IgG) support the growth, development and function of the small intestine, rumen development and have a positive metabolic and endocrine effects. FERDOWSI NIA et al. (2010) reported mean IgG values in colostrum of 78.3 mg/ml$^{-1}$. CERMAKOVA et al. (2014) published IgG values in the range of 55–105 g.l$^{-1}$; (mean 80 ± 15.94 g/l-1 IgG). In contrast, BARTIER et al. (2015) report IgG values in the range of 8.3–128.6 mg.ml$^{-1}$. First heifers had an average IgG value of 62.2 mg/ml and cows in the second and higher lactations had 64.7 mg.ml$^{-1}$ IgG. BAUMRUCKER et al. (2010) state that the variability of the IgG content in colostrum is highly variable and thus the results are often inconsistent.

From the results presented in the tables, it follows that all monitored quality parameters in colostrum have a high statistically significant (P <0.01) correlation with each other, which is also confirmed by graph 3. These mutual correlations, however, are not the same for different sampling time intervals, which is the third of results listed in table 3. The sampling intervals 0–12, 12–24, 24–36 and 36–48 hours after birth. The results (table 3) show that these mutual correlations are not the same for different sampling time intervals. In the collection, in the time interval 0-12 hours after birth, there is a statistically highly evident (P <0.01) correlation between the IgG content and the density of colostrum, and between IgG content and CP content. The correlation between IgG and dry matter content in colostrum is also statistically significant (P <0.05). With an increasing value of IgG, we can observe increasing values of density, dry matter and crude protein. There is a highly statistically significant (P <0.01) correlation between colostrum density and dry matter content and CP. They did not confirm these relationships QUIGLEY et al. (1994). BIELMANN et al (2010) also reached different results. With the increasing value of colostrum density, we can observe increasing values of dry matter and crude protein. The dry matter content is highly statistically significantly (P <0.01) influenced by crude protein in colostrum. As the dry matter value increases, we also observe increasing CP values. In the time interval 12–24 hours after birth, there is a highly statistically significant (P <0.01) relationship between IgG content and density, dry matter and CP. As the value of IgG increases, we can also observe increasing values of density, dry matter and CP. There is a highly statistically significant (P <0.01) relationship between colostrum density, dry matter and CP. The dry matter content of colostrum is highly statistically significantly (P <0.01) influenced by crude protein in colostrum. As the dry matter value increases, we also observe increasing CP values. In the time interval 24–36 hours after birth, it is highly statistically significant (P <0.01) relationship between IgG content and density, dry matter and CP. As the value of IgG increases, we can also observe increasing values of density, dry matter and CP. There is a highly statistically significant (P <0.01) relationship between colostrum density, dry matter and CP. With an increase in density, we can also observe increased values of dry matter and CP. The dry matter content is statistically high significantly (P <0.01) influenced by CP content in colostrum. The interval of 36–48 hours after birth indicates the relationship between the parameters. IgG is highly statistically significant (P <0.01) correlated with the value density, dry matter and CP. With increasing IgG values, we can also observe increasing values of density, dry matter and CP. Colostrum density has a highly statistically significant (P <0.01) effect on CP. As the value of density increases, we can also observe an increasing value of CP. A highly statistically significant (P <0.01) correlation can also be observed indry matter and CP. With increased colostrum solids content, the CP content also increases.

PAVLATA (2009b) indicates that high-quality colostrum should contain a density higher than 1050 kg/m$^3$, which is also confirmed by SLOSARKOVA et al., (2011) and GODDEN (2008). At the same time, he points out similar to QUIGLEY et al. (1994) on a rapid decrease in the density, i.e. also the quality of colostrum after birth.

The effect of the addition of Premix Alkosel – selenomethionine from *Saccharomyces cerevisiae* on blood IgG values from two samplings (23 days before calving and 1 day after calving) is shown in Fig 3. In pregnant heifers, the IgG content in the blood remained approximately the same, while in older cows, a tendency to decrease in IgG content between the two samplings is evident. This may be a result of immunosuppression. A similar tendency was also found by NONNECKE et al. (2003) who reported that the reduction in blood IgG concentration is due to their translocation into the colostrum. The values found by us in primiparous heifers ranged below the physiological range. VRZGULA et al. (1990) give a reference range for IgG in blood serum of 16.2–26.0 g/l$^{-1}$. IgG values in cows in the second and higher lactations were already within physiological limits. A similar tendency was also found by HER et al. (2011), who followed the development of IgG in cows around the time of parturition. According to Vrzgula et al. (1990), the increase in IgG values is often caused by chronic diseases of animals, e.g. hepatopathy, nephritis, leukosis, etc.).

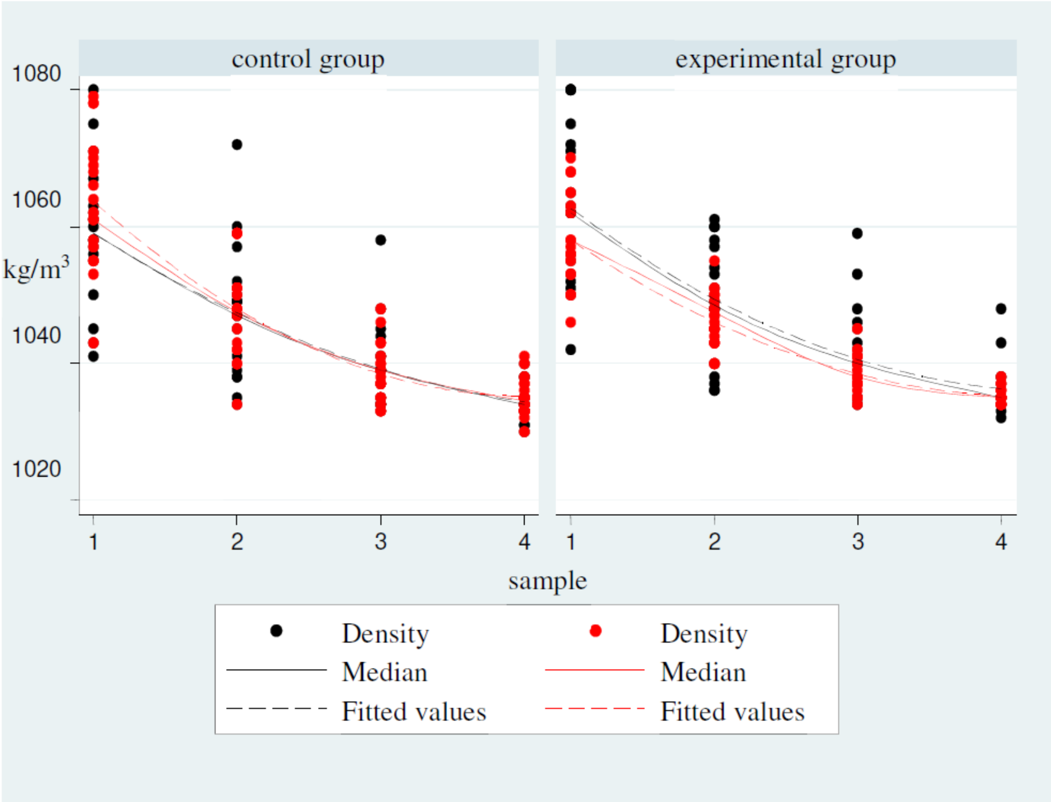


**Fig 1:** Change in colostrum density (kg/m$^3$) over time, in experimental groups (first heifers - black, red curve older cows)

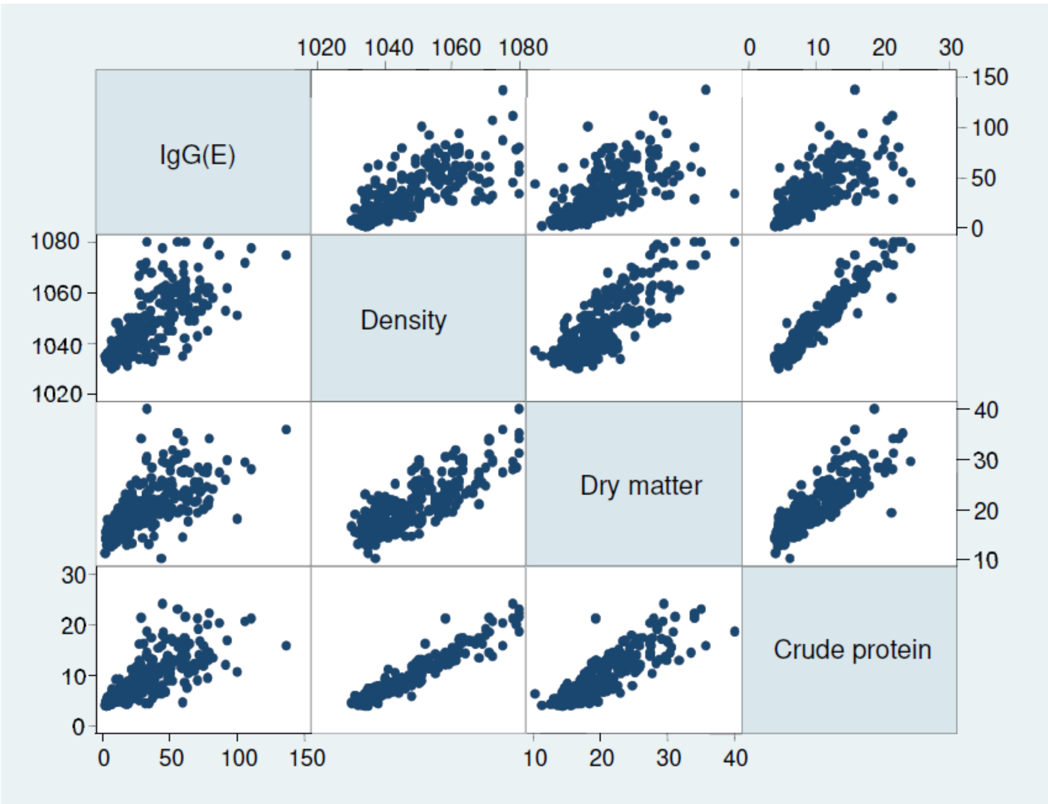


**Fig 2:** Correlation of colostrum parameters without differences in cows age, sampling time and experimental procedure

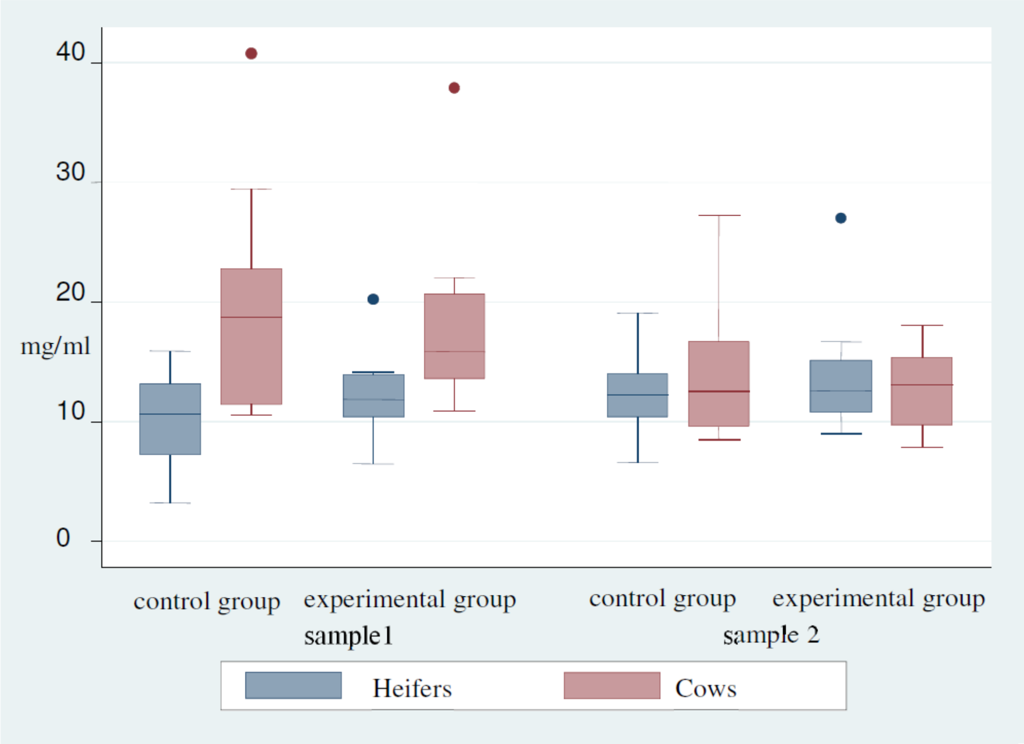


**Fig 3:** Changes in IgG values (mg/ml) in blood serum in pregnant heifers and cows and after calving

## Conclusions

Postpartum concentrations of IgG did not differ between the groups of control vs. experimental. Higher blood IgG was detected by cows on the 2nd and higher lactation than in pregnant heifers. It can be stated that the collection time after birth had a statistically significant effect on the content of all colostrum parameters. The hypothesis of a positive effect of the addition of selenomethionine from yeast culture on the composition and quality of colostrum was not confirmed. The influence of the age of pregnant cows on the content of immunoglobulin G in blood serum and colostrum was confirmed. It is clear from the obtained results that all colostrum parameters are highly correlated.No efektu of selenomethionin from *Saccharamyces cerevisiae* on the colostrum quality was detected.

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