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Effect of yeast *Saccharomyces cerevisiae* feed supplement on milk production and its composition of lactating Holstein Friesian cow from Northern Algeria

Research Article

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ABSTRACT

The objectives of the present study were to determine the effect of adding *Saccharomyces cerevisiae* (SC) yeast culture commercial on milk production, milk composition of lactating Holstein Friesian cows under Algerian conditions. A total of 16 lactating Holstein Friesian cows were used. The control group received basal diet without feed additives and the yeast, SC group received daily 2, 5 and 10 g/day per head. Individual milk samples were collected for analysis of milk composition and bacterial. The results of this experiment showed a significant high milk production in treated groups compared to control group (P<0.05). There is a significant difference between the control and the cows fed different treatments in somatic cells (P<0.001). It revealed that higher of milk protein in three treated groups was recorded than in the control group. The milk lactose content seems to be stable in cows supplemented SC and was practically similar to control group. On the other hand, the content milk fat was low in SC supplemented cows. The bacterial milk analysis was lower for the cows fed supplemented SC than the control group. The obtained results showed that the SC from Algeria can improve the milk production in dairy cows during the postpartum.

Keywords: cows, milk yield, milk composition, *saccharomyces cerevisiae*

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Introduction

Over the two decades, the will to reduce the adding antibiotics in animal diet to enhance production efficiency has strongly agreed. Therefore, many researchers have been aimed to develop alternatives with particular emphasis on the potential use of natural feed additives, one of which is yeast. Yeast culture and yeast by-products (e.g. *Saccharomyces cerevisiae*), as microbial additives, are widely used and approved in livestock nutrition. It has been found a positive effect on the rumen fermentation and production performance in ruminants.

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There are several *Saccharomyces cerevisiae* (SC) products on the market with different recommendation of dosage and in their manufacturing processes that may have an effect on animal performance (Wallace, 1994; Newbold et al., 1996; Stone, 2002). However, research results of the inclusion of SC in ruminants dietary have been variable. The beneficial effects of yeast culture and yeast by products on the rumen environment and production performance of ruminants have been well documented in literature (Dobicki et al., 2007; Phondba et al., 2009), and it has aroused particular scientific interest in feed industry.

Several researchers reported that the dietary inclusion of yeast in animal ration improves the feed conversion ratio, body gains, fattening performance, carcass quality, milk yield and lowers disease incidence (Fuchs et al., 2007; Milewski & Sobiech, 2009). Likewise, Kudrna and collaborators (2007) noted that yeast supplementation significantly improved the milk yield despite reducing the dry matter intake. In another study, the researchers concluded that characteristic, sources, production of probiotics on animal production have increased potentially milk yield and composition under Indian condition (Chandrasekharaiah et al., 2007).

Many studies have shown that the yeast supplementation feed could improves gut health of the animals, which results in increased digestion rate and better growth performance (Frizzo et al., 2010; Kawakami et al., 2010; Frizzo et al., 2011; Ghazanfar et al., 2015; 2018). The use of yeast culture as a dietary supplement has been suggested as source of improvement milk production and composition, and body condition in cows during the peripartum period (Vibhute et al., 2011; Ayad et al., 2013). Thus, Milewski and co-workers (2012) reported that the inclusion of SC yeast in the diet could enhance the quality of milk proteins in lactating ewes.

In the Algeria, the low productivity of dairy cattle is primarily due to forage unavailability, nutritive quality and probably loss or poor genetic potential. Hence, in order to improve the milk production of cows, the breeders distributes the high concentrate quantity during the lactating period. In the context, the adoption of scientific approach in feeding is more necessary. Keeping in view, the objectives of the present study were to determine the effect of adding *Saccharomyces cerevisiae* yeast culture commercial on milk production, milk composition of lactating Holstein Friesian cows under Algerian conditions.

Materials and Methods

As regards to the ethical aspects, the experimental protocol was approved by the scientific committee of the University Hassiba BenBouali (Chlef, Algeria).

Yeast: The supplemented SC (CNCM I-1077, Lallemand Animal Nutrition) marketed by Vetam Company (Mostaganem, Algeria) and contains of live yeast ($20x10^9$ CFU/g).

Animals and feed: The experiment was conducted in a private farm which is located in Chlef province, Algeria (36°10' N, 1°19' E). This study was conducted from 15 May to 15 July 2013 with 15 days of adaptation period. A total of 16 lactating Holstein Friesian primiparous cows were used. All cows calved during a two month period. The animals were divided in four groups as Group-0 (Control), Group-2, Group-5, and Group-10. All of the animals received a same feed ration during the experimental.

The cows in the control group were fed a basal diet without yeast. 2, 5 and 10 grams of yeast per cow per day was added to the feed of the cows in the Group-2, Group-5 and Group-10, respectively. The yeast additives was given in the morning after milking.

Milk production and sampling: Cows were milked two times daily (morning, at 06:30 and evening, 16:30 p.m) during the experimental period. Individual milk samples (100ml) were also collected from afternoon milking (1 p.m.) and kept at 4 °C for further analysis

Analysis of milk composition: Milk viscosity, pH, acidity, fat, protein and lactose contents were analyzed. In addition, somatic cell count (SCC) was determined. Viscosity and pH analysis were performed using Brookfield Viscometer and pH meter (model WTW, Weilheim, Germany), respectively. The acidity was measured according the method described previously by Caric et al. (2000). Fat content is usually based on a butyric acid determination (Glaeser, 2002). Protein and lactose content were analyzed according to Kjeldahl method (AOAC, 2003) and Bertrand method (Budsławski, 1973), respectively. The somatic cell count (SCC) was determined every three weeks using the Malassez Counting Cells.

Bacterial milk analysis: Milk samples were collected in sterilized milk tubes and transferred in an icebox to laboratory. 0.1 ml sample was cultivated on various culture media including Chapman, mannitol, salt agar, at a temperature 37 °C during a lapse time of 48 h. Bacterial colonies were identified, based on colony growth, morphology and appearance, catalase reaction, and gram staining. In addition, coagulase positive isolates were identified based on hemolytic activity, acetoin production (Voges -Proskauer test) and anaerobic fermentation of mannitol (Koneman et al., 1992; Roberson et al., 1992).

Statistical analysis: Data were analyzed using a mixed model for repeated measurements (Statview Software, Version 4.55). Statistical analysis was performed using t-test to compare treated and control groups. The data were expressed as mean ± SD, and $P<0.05$ was considered significant.

Results

The effects of SC supplementation on dairy milk production is illustrated in Figure 1. The production of daily milk recorded in cows received of yeast cell supplement increased slowly and continuously over the time points investigated, however this difference was not statistically significant ($P<0.05$). Control cows (Group-0) had the lowest levels of dairy milk production in period 20-45 days post-partum.

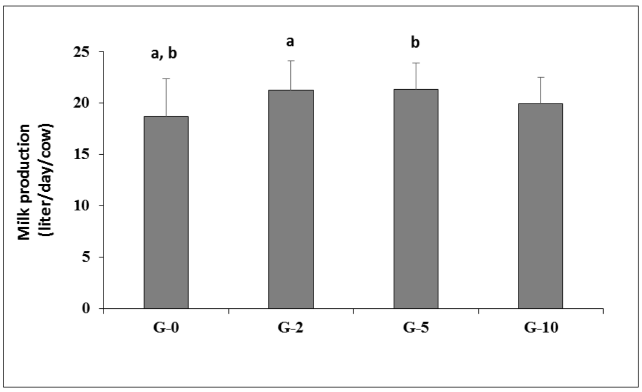

Figure 1. Effect of SC levels on milk production (liter/day/cow) of Algerian dairy cows during the first 60 days post-partum. A significant difference in mean milk production between the SC level treated groups (2, 5 and 10%) and the control group (0%) during the first 60 days post-partum is indicated by letters (a,bP < 0.05).

The results of this experiment showed a significant ($P<0.05$) high milk production in Group-2, Group-5 and Group-10 (21.3 ± 2.9, 21.3 ± 2.6 and 19.9 ± 2.6 liter/day, respectively) compared to control group (18.7 ± 3.7 liter/day) (Figure 2).

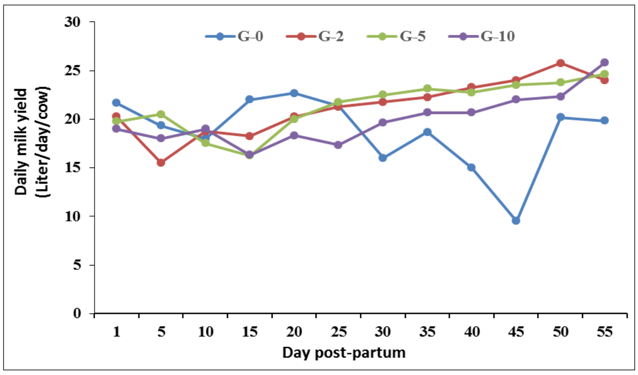

Figure 2. Effect of SC levels (2, 5 and 10%) on daily milk yield (liter/day/cow) and the control group (0%) during the first 60 days post-partum in Algerian dairy cows.

Chemical composition of milk collected in different groups of cows is summarized in Table 1. Milk viscosity was significantly ($P<0.02$) lower in cows supplemented with different SC concentrations than control group. In addition, SC supplemented cows (Group 2%) had a lower somatic cell than group 5% and 10%. There is a significant difference between the control and the cows fed different treatments in somatic cells ($P<0.001$). The cows fed ration containing 10% SC recorded an increased milk acidity in comparison to the control and all other diets treatment.

The milk fat, protein and lactose content according to the concentrations of SC supplemented cows is shown in Table 2. It revealed that higher of milk protein in three treated groups was recorded than in the control group. The milk lactose content seems to be stable in cows supplemented SC and was practically similar to control group. On the other hand, the content milk fat was low in SC supplemented cows during the two months post -partum. The bacterial milk analysis was lower for the cows fed supplemented SC than the control group.

Table 1. Effect of graded levels of SC on chemical composition of milk (pH, viscosity, acidity and somatic cells) in Algerian dairy cows. A significant difference in chemical composition of milk between the control group (0% SC level) and the treated groups (2, 5 and 10% SC level) is indicated by letters (a, b $P < 0.05$).

	Group-0 (n=12)	Group-2 (n=14)	Group-5 (n=16)	Group-10 (n=12)	*P*
pH	6.68±0.18	6.72±0.07	6.71±0.15	6.78±0.15	NS
Viscosity	0.23±0.02^{a}	0.25±0.03^{b}	0.26±0.03^{a,b,}	0.25±0.21	< 0.02
Acidity (°D)	10.7±2.21^{a}	13.0±3.04^{b}	12.75±4.61	15.44±6.69	< 0.02
Somatic cells (10^2 / mm^3)	7.51±0.83^{a}	1.18±0.14^{b}	1.73±0.17^{b}	2.12±0.11^{b}	< 0.001

Table 2. Effect of graded levels of SC on the milk composition and bacterial in Algerian dairy cows. A significant difference in fat (g/L), proteins (g/L), lactose (g/L), lactate bacteria (colony/50µL) and *Staphylococcus aureus* (colony/50µl) between the control group (0% SC level) and the treated groups (2, 5% and 10% SC level) is indicated by letters (a, $P < 0.05$).

	Group-0 (n = 12)	Group-2 (n = 14)	Group-5 (n = 16)	Group-10 (n = 12)
Fat (g/L)	19.5 ± 20.35	14.5 ± 1	13 ± 3.56	20 ± 7.07
Proteins (g/L)	26.73 ± 5.25^{a}	35.8 ± 2.08^{a}	35.18 ± 3.8	33.98 ± 5.84
Lactose (g/L)	55.55 ± 0.35^{a}	54.8 ± 2.82	54.55 ± 0.49	53.25 ± 0.07^{a}
Lactate bacteria (colony/50 µl)	205.000	85.445	7480	5485
Staphylococcus aureus (colony/50 µL)	260.400	89.000	2000	1490

Discussion

The results of the present study shown that supplement of SC in diets of dairy cows increased the milk production (Figure 1), this in agreement with the results previously described (Bruno et al., 2008; Desnoyers et al., 2009; Moallem, et al., 2009). A significant increase in production of milk associated with the yeast supplementation has already been reported in dairy cows (Evans et al., 2012; Bayram et al., 2014; Bakr et al., 2015; Anjum et al., 2018; Rossow et al., 2018). Likewise, Ayad et al. (2013) demonstrated that supplementation with SC had statistically significant effect on milk production over under conditions of field Algerian, which mean daily milk yield was 32.7 ± 1.39 kg/d for the experimental group and 30.7 ± 5.3 kg/d for the control group. On the other hand, Kalmus et al. (2009) reported that cows receiving SC having numerically higher milk yield than the controls, although not statistically significant. In the other hand, Numerous studies have reported an increase in milk yield, but the effects have not been significant (Eramus et al., 1992; Dann et al., 2000; Lima, et al, 2012). Likewise, experiments have noted a response to Saccharomyces cerevisiae (SC) supplementation only in early lactation cows (Wohlt et al., 1991; Robinson & Garret, 1999; Dann et al., 2000). Also, trials annule the effect of yeast on the milk production (Kung et al., 1997; Erasmus et al., 2005). The variation of response of probiotics in previous investigation might be attributed to different reasons such the variability associated with the distributed diets, the types and concentration of SC yeast used and the test animals (Williams et al., 1991). Also, It may be due to the magnitude of improvement of milk production depends on the stage and number of lactation (Majdoub-Mathlouthi et al., 2009). Moreover, the increase in production of milk is in most case associated with increases of dry matter intake (Degirmencioglu et al., 2013). However, This relative increase in milk production is not due to consumption of dry matter intake but related to the complementation of SC in food, reported by Wallace (1994) and Dann et al. (2000). According to Alugongo et al. (2017), the Saccharomyces cerevisiae tended to enhance rumen fermentation by increased butyrate production; and rumen papillae growth. This allows maintenance of the cellulolytic flora and enhances the degradation of plant fibers and therefore the diet digestibility (Wallace 1994). In addition, probiotics increases gastrointestinal absorption of nutrients by the intake of vitamin B1 e.g. thiamine, promotes the colonization of plants by rumen microbes and improves benefit the digestibility of the ration (Erasmus et al., 1992).

Data presented in Table 2 demonstrated that the fat and protein content of milk was different in the treated groups compared to the control group. In this study, the results of fat content in milk were lower in cows receiving graded SC diets than those the control group. This is in accordance with the previously results showed that the use of SC in dairy cows diet would impact on fat content (Putnam et al., 1997; Wohlt et al., 1998; Kalmus et al., 2009; Moallem et al., 2009). Yalçın et al. (2011) have found that the average fat percentage was 6.1% higher in group of the yeast culture than the controls. According to the literature, several authors have not found influence of yeast SC in fat milk (Wohlt et al., 1991; Soder & Holden, 1999, Bayram et al., 2014 and Rossow et al., 2018). This positive effect on fat content may be due to stimulation of cellulolytic bacteria and preferred orientation of fermentation to acetic acid production, especially rich diet on concentrate or contain low degradable forages (Piva et al., 1993). The diversity of results may be due to the chemical composition of the diet, body condition score and lactation field conditions (Masek et al., 2008). Also, many other factors can influence the food characteristics (e.g. the content of starch, net energy, and physically effective fiber), the state physiological (Haimoud-Lekhal et al., 1999), or administrative practices (Beauchemin et al., 2003).

Our results are similar of those obtained by Bruno et al. (2009) who reported that addition of S. cerevisiae induces a significant reduction in the protein content. Also, sevreal studies observed that protein yield from cows fed live yeast culture is higher than the cows control (Kalmus et al., 2009;Yalçın et al., 2011; Bakr et al., 2015; Rossow et al., 2018). However, Szucs et al. (2013) and Lima, et al. (2012) observed that no significant in milk of group SC comparable to the control group. Moreover, Hadjipanayiotou et al. (1997) reported no beneficial effects in milk production, as well as in fat or protein content after feeding yeast to lactating goats in a high concentrate diet. On the other hand Desnoyers et al. (2009) observed that the SC supplementation induced a significant decrease in milk protein. In other investigation, Temim et al. (2009) reported that the protein content of milk from cows of group supplemented with yeast are similar to those measured in controls, except at day 28 of lactation where lower value protein is measured in the group treated compared to control group. Other recent studies have shown that the yeast has no effect on the composition of milk of dairy cows (Degirmencioglu et al., 2013; Aye et al., 2016). This increased of the protein content milk in the experimental group could be the well -known impact of yeast on ruminal fermentation and nutrient digestibility, which improves the absorption of ammonia and enhances the production of microbial protein (Jouany et al., 2007). Note that the supplement of Saccharomyces cerevisiae improved the proportions of casein fractions in total milk (Milewskiet al., 2012).

Lactose reduction rate obtained in milk content with a SC level were similar for all groups, and in agreement with those reported by numerous studies (Lima, et al., 2012; Degirmencioglu et al., 2013; Bayram et al., 2014). However, Bal & Göksu (2013) indicated that the addition of a yeast supplement in a diet 50% concentrate increase the lactose percentages in milk cow. In other investigation, Yalçın et al. (2011) reported a significant improvement in the percentage of lactose in milk of dairy cows when supplemented with yeast culture. The divergency of results could be due to stage of lactation, feeding strategy, the conditions of the environment, the diet composition, type of feed, type and dose yeast incorporated in food (Yalçın et al., 2011). Also, the yeast products could be more effective under stress rather than during normal conditions (Moallem et al., 2009). When compared with the control group, diets supplemented with different levels SC resulted in a remarkable decrease in the number of pathogenic bacteria such as *Staphylococcus aureus* and Lactate bacteria. Several bacterial pathogens can cause mastitis, *Staphylococcus aureusis* one of the most important etiologic agents in mastitis of cows, goats, and sheep (Rich, 2005; Moon et al., 2007; Li & Zhang, 2014; Sağlam et al., 2017).

According to Lapointe-Vignola (2002), the pH of normal milk is ranged from 6.6 to 6.8. On the other hand, pH above 7.0 is due to mastitis milks associated with high cell counts (Marschke & Kitchen, 1985; Rao, 1990). In the present experiment, the pH of cow milk was similar between all groups, and correspond to the pH values physiological. The determination of the pH gives a first idea of the quality of the product and the presence of germs which one can possibly find there (Siousarran, 2003). Our results are in agreement with those of Aye et al. (2016) and Maamouri et al. (2014) that show the complementation in yeast food has no significant difference in pH milk in cow. The feed supplemented with graded SC had effect statistically but slightly on the milk viscosity compared to the control group. The viscosity varies not only with changes in physical (T °C) and also with the hydration of proteins. Moreover, the increased viscosity is observed when the fat globules are broken down by homogenization (Kebchaoui, 2012). Noted that the viscosity of the milk is a complex property that is particularly affected by the emulsified particles and colloids dissolved. In addition, the content of fat and casein has the most important influence on milk viscosity (Ghaoues, 2011).

In this study, the results of titratible acidity of milk were significantly higher in cows receiving graded SC diets than those the control group. This increase in acidity may be due to a raise in lactic milk flora (Kuczaj et al., 2014). Carole (2002) indicated that the acidity of fresh milk can varied between 15 and18 °D. Our results that all mean values of titratable acidity of milk in diets group are similar to that cited previously, which could be explained by increase of acid components in diet supplementation. In the other hand, Hossain et al. (2014) showed that there was no significant ($P>0.05$) variation in acidity of milk between control group and treatment group. The mean of somatic cells count (SCC) recorded was similar in cows group supplemented with 2 and 5 g of SC diet. A significant decrease in somatic cell count in cows receiving different SC level compared to control cows ($P<0.05$). The results of this study correspond to those previously published, which demonstrated that the yeast application has significantly reduced the SCC in milk ($P <0.05$) for SC groups when compared to the control (Degirmencioglu et al., 2013; Kuczaj et al., 2014; Bakr et al, 2015). In 2016, Aye et al. indicated that feeding live SC could significantly reduce the incidence of subclinical mastitis in lactating cows. Otherwise there was no significant treatment effect on acidity (Lima, et al., 2012). The reduction of SCC in yeast-treated cows may be attributed to a better health status of their udder (Albenzio et al., 2015). The CSC determination is used worldwide in dairy practice to describe the hygienic control of milk (Wellnitz et al., 2009), and could be considered as a good indicator of intramammary infection (Petzer et al., 2017). The low somatic cell account is very important and required for a good production of cheese and decrease the milk conservation in the transformation unities. The differences between trials may be due to the other ingredients of the diets (Dawson, 1989), the physiological stage of the lactating (Williams & Newbold, 1990), species, sex and environmental conditions of animals, which can influence the availability of nutrients (Lima, et al., 2012).

Conclusion

The results obtained under the conditions of this experiment showed that the SC from Algeria can improve the milk production in dairy cows. Also, the inclusion of a level (2%) of SC in diets is more effective on the milk yield and protein content. However, supplementation of grade SC at 5% level was found beneficial in ameliorating the milk yield. Thus, dietary inclusion of SC had effect on viscosity, acidity and somatic cell values in dairy cows at the end experiment. Based on the results of this investigation, an effect was found on milk protein and fat production in incorporating the probiotic yeast, Saccharomyces cerevisiae, in the diet of the cows during the postpartum.

References

Albenzio, M., Santillo, A., Kelly, A. L., Caroprese, M., Marino, R., & Sevi, A. (2015). Activities of indigenous proteolytic enzymes in caprine milk of different somatic cell counts. *Journal of dairy science, 98*(11), 7587-7594.

Alugongo, G. M., Xiao, J., Wu, Z., Li, S., Wang, Y., & Cao, Z. (2017). Utilization of yeast of Saccharomyces cerevisiae origin in artificially raised calves. *Journal of Animal Science and Biotechnology, 8*(1), 34.

Anjum, M. I., Javaid, S., Ansar,M. S., & Ghaffar, A. (2018). Effects of yeast (Saccharomyces cerevisiae) supplementation on intake, digestibility, rumen fermentation and milk yield in Nili-Ravi buffaloes. *Iran Journal of Veterinary Research, 19*(2), 96–100.

A.O.A.C. (2003). Official Methods of Analysis of the Association of Official's Analytical Chemists. 17th Ed. Association of Official Analytical Chemists, Arlington, Virginia.

Ayad, M. A., Benallou, B., Saim, M. S., Smadi, M.A., & Meziane, T. (2013). Impact of feeding yeast culture on milk yield, milk components, and blood components in Algerian dairy herds. *Journal of Veterinary Science and Technology,* 4, 135–139.

Aye, Y. N., Myint, H. H., Po, S. P., Kyaw, W. O., & Aung, Y. H. (2016). Effect of dietary supplementation of *Saccharomyces Cerevisiae* on milk composition, milk yield and occurrence of clinical and scub-clinical mastitis in lactating cows. *International Journal of Novel Research in Life Sciences, 3*(4), 18-24.

Bakr, H. A., Hassan, M. S., Giadinis, N. D., Panousis, N., Ostojić-Andrić, D., Abd, E. T. M., & Bojkovski, J. C. (2015). Effect of Saccharomyces cerevisiae supplementation on health and performance of dairy cows during transition and early lactation period. *Biotechnology in Animal Husbandry, 31*(3), 349 -364.

Bal, M. A., & Göksu, S. (2013). Effects of live yeast supplementation on ruminal parameters and lactation performance of dairy cows fed medium or high levels of dietary concentrate. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi, 19*(1), 57-62.

Bayram, B., Aksakal, V., Karaalp, M., & Mazlum, H. (2014). The effect of Saccharomyces cerevisiae on milk yield, milk compositions and body condition score raised organically in dairy cows. *Journal of Animal and Veterinary Advances, 13*(12), 752-756.

Beauchemin, K. A., Yang, W. Z., Morgavi, D. P., Ghorbani, G. R., Kautz, W., & Leedle, J. A. Z. (2003). Effects of bacterial direct-fed microbials and yeast on site and extent of digestion, blood chemistry, and subclinical ruminal acidosis in feedlot cattle. *Journal of Animal Science, 81*(6), 1628-1640.

Bruno, R. G., Rutigliano, H. M., Cerri, R. L., Robinson, P. H., & Santos, J. E. (2009). Effect of performance of dairy cows during summer heat stress. *Animal Feed Science and Technology, 150*(3-4), 175-186.

Budsławski, J. (1973). Badanie mleka i jego przetworów (Milk and milk products analyses) PWRiL, Warsaw (in Polish).

Caric, M., Milanovic, S., & Vucelja, D. (2000). Standard methods for milk and milk products analysis. (in Serbian). Faculty of Technology, Novi Sad

Carole, L. V. (2002). Sciences et technologie du lait, transformation du lait. Fondation de technologue laitière. St Lourent Montréal.

Chandrasekharaiah, M., Sampath, K. T., Prasad, C. S., Samanta, A. K., & Kolte, A. P. (2007). Prebiotics: the rumen modulator for enhancing the productivity of dairy animals. *Indian Dairyman, 59*(8):58-61.

Dann, H. M., Drackley, J. K., McCoy, G. C., Hutjens, M. F., & Garrett, J. E. (2000). Effects of yeast culture (*Saccharomyces cerevisiae*) on prepartum intake and postpartum intake and milk production of Jersey cows. *Journal of Dairy Science*, 83, 123-127.

Dawson, K. A. (1989). Modification of rumen function and animal production using live microbial cultures as feed supplements. In: Proc. California Animal Nutrition Conference, Fresno, USA, 25–43.

Degirmencioglu, T., Ozcan, T., Ozbilgin, S., & Senlurklu, L. (2013). Effects of yeast culture addition (Saccharomyces cerevisiae) to Anatolian water buffalo diets on milk composition and somatic cell count. *Mljekartro,* 63, 42-48.

Desnoyers, M., Giger-Reverdin, S., Bertin, G., Guvaux-Ponter, C., & Sauvant, D. (2009). Meta-analysis of the influence of Saccharomyces cerevisiae supplementation on ruminal parameters and milk production of ruminants. *Journal of Dairy Science*, 92, 1620-1632.

Dobicki, A., Preś, J., Zachwieja, A., Mordak, R., & Jakus, W. (2007). Influence of yeast preparations on chosen biochemical blood parameters and the composition of cow milk. *Medycyna Weterynaryjna, 63*(8), 951-954.

Erasmus, L. J., Botha, P. M., & Kisner, A. (1992). Effect of yeast culture supplement on production, rumen fermentation, and duodenal nitrogen flow in dairy cows. *Journal of Dairy Science,* 75, 3056-3065.

Erasmus, L. J., Robinson, P. H., Ahmadi, A., Hinders, R., & Garrett, J. E. (2005). Influence of prepartum and postpartum supplementation of a yeast culture and monensin, or both, on ruminal fermentation and performance of multiparous dairy cows. *Animal Feed Science and Technology,* 122, 219-239.

Evans, E., Patterson, R. J., & Clark, N. (2012). Case study: effects of a supplemental enhanced yeast product on digestion and milk production in dairy cows. *Professional Animal Scientist,* 28, 682–688.

Frizzo, L. S., Soto, L. P., Zbrun, M. V., Bertozzi, E., Sequeira, G., Armesto, R. R., & Rosmini, M. R. (2010). Lactic acid bacteria to improve growth performance in young calves fed milk replacer and spray-dried whey powder. *Animal Feed Science and Technology, 157*(3-4), 159-167.

Frizzo, L. S., Soto, L. P, Bertozzi, E., Zbrun, M. V., Signorini, M. L., Sequeira, G. R., Rodriguez, A., &Rosmini, M. R. (2011). Intestinal populations of Lactobacilli and coliforms after in vivo Salmonella Dublin challenge and their relationship with microbial translocation in calves supplemented with lactic acid bacteria and lactose. *Animal Feed Science and Technology, 170*(1), 12-20.

Fuchs, B., Rzasa, A., Szuba-Trznadel, A., & Haremza, D. (2007). Preparat drozdzy piwnych podawany lochom prosnym i karmiacym jako czynnik stymulujacy produkcyjnosc i zdrowotnosc prosiat. *Acta Scientiarum Polonorum. Zootechnica, 6*(4), 17-27.

Ghaoues, S. (2011). Magister en Sciences Alimentaires Option: Technologie Alimentaire Université Mentouri, Constantine. Institut de la Nutrition, de l'Alimentation et des Technologies Agro-alimentaires.

Ghazanfar, S., Qubtia, M., Ahmed, I., Hasan, F., Anjum, M. I., & Imran, M. (2018). Effect of indigenously isolated saccharomyces probiotics on milk production, nutrient digestibility, blood chemistry and fecal microbiota in lactating dairy cows. *The Journal of Animal & Plant Sciences, 28*(2).

Ghazanfar. S, Anjum, M. I., Azim, A., & Ahmed, I. (2015). Effects of dietary supplementation of yeast (*saccharomyces cerevisiae*) culture on growth performance, blood parameters, nutrient digestibility and fecal flora of dairy heifers. *The Journal of Animal & Plant Sciences, 25*(1), 53-59.

Glaeser, H. (2002). Determination of the milk fat content of fat mixtures. *Grasas y Aceites,* 53 (3), 357-358.

Hadjipanayiotou, M., Antoniou, I., & Photiou, A. (1997). Effects of the inclusion of yeast culture on the performance of dairy ewes and goats and the degradation of feedstuffs. *Livestock Production Science, 48(*2), 129-134.

Haimoud-Lekhal, D. A., Lescoat, P., Bayourthe, C., & Moncoulon, R. (1999). Effets de Saccharomyces cerevisae et *Aspergillus oryzae* sur les performances zootechniques chez la vache laitière, Étude bibliographique. 6e Rencontres autour des Recherches sur les Ruminants, Paris, France, 157.

Hossain, F. M. A., Islam, M. M., Ara, A., & Iliyas, N. (2014). Supplementing probiotics (Saccharomyces Cerevisiae) in multiparous crossbred cows ration provoke milk yield and composition. *Online Journal of Animal and Feed Research, 4*(2), 18-24.

Jouany, J. P., & Morgavi, D. P. (2007). Use of 'natural'products as alternatives to antibiotic feed additives in ruminant production. *Animal, 1*(10), 1443-1466.

Kalmus, P., Orro, T., Waldmann, A., Lindjärv, R., & Kask, K. (2009). Effect of yeast culture on milk production and metabolic and reproductive performance of early lactation dairy cows. *Acta Veterinaria Scandinavica, 51*(1), 32.

Kawakami, S. I., Yamada, T., Nakanishi, N., & Cai, Y. (2010). Feeding of lactic acid bacteria and yeast on growth and diarrhea of Holstein calves. *Journal of Animal and Veterinary Advances, 9*(7), 1112-1114.

Kebchaoui, J. (2012). Le lait composition et propriétées. Coopérations universitaire 2012-2013, 1-4.

Koneman, E. W, Allen, S. D., Janda, W. M., Schreckenberger, P. C., & Winn, W. C. (1992). Gram-positive cocci part I: Staphylococci and related organisms. In: Color tlas and textbook of diagnostic microbiology, (pp. 405-429).J P Lippincott Company, Philadelphia.

Kuczaj, M., Preś, J., Zachwieja, A., Twardoń, J., Orda, J., & Dobicki, A. (2014). Effect of supplementing dairy cows with live yeasts cells and dried brewer's yeasts on milk chemical composition, somatic cell count and blood biochemical indices. *Veterinary Medicine,* 17 (3), 6.

Kudrna, V., Polakova, K., Lang, P., & Doležal, J. (2007). The effect of different yeast strains on milk yield, fatty acids profile and physiological parameters in dairy cows. *Stočarstvo: Časopis za unapređenje stočarstva, 61*(1), 29-33.

Lapointe-Vignola, C. (2002). Science et technologie du lait: transformation du lait. Presses inter Polytechnique.

Li, L., & Zhang, Z. (2014). Isolation and characterization of a virulent bacteriophage SPW specific for Staphylococcus aureus isolated from bovine mastitis of lactating dairy cattle. *Molecular Biology Reports, 41*(9), 5829-5838.

Lima, L. M., Alcalde, C. R., Freitas, H. S., Molina, B. S. L., Macedo, F. A. F., & Horst, J. A. (2012). Performance of dairy goats fed diets with dry yeast from sugar cane as protein source. *Revista Brasileira de Zootecnia, 41*(1), 232-236.

Maamouri, O., Selmi, H., & Hamdi, N. M. (2014). Effects of yeast (saccharomyces cerevisiae) feed supplement on milk production and its composition in tunisian holstein friesian cows, *Scientia Agriculturae Bohemica, 45*(3), 170–174.

Majdoub-Mathlouthi, L., Kraiem, K., & Larbier, M. (2009). Effects of feeding Saccharomyces cerevisiae Sc 47 to dairy cows on milk yield and milk components, in Tunisian conditions. Livestock Research for Rural Development, 21

Livestock Research for Rural Development, 21 (73).

Marschke, R. J., & Kitchen, B. J. (1985). Detection of bovine mastitis by bromothymol blue pH indicator test. *Journal of Dairy Science, 68*(5), 1263-1269.

Masek, T., Mikulec, Z., Valpotic, H., Kusce, L., Mikulec, N., & Antunac, N. (2008). The influence of live yeast cells (Saccharomyces cerevisiae) on the performance of grazing dairy sheep in late lactation. *Veterinarski arhiv, 78*(2), 95.

Milewski, S., Sobiech, P., Zabek, K., Zarczynska, K., Antoszkiewicz, Z., & Wielgosz-Groth, Z. (2012). Effect of Saccharomyces cerevisiae yeast on milk protein content and composition and serum mineral concentrations in sheep. *Journal of Elementology,* 17 (1).

Milewski, S., & Sobiech, P. (2009). Effect of dietary supplementation with Saccharomyces cerevisiae dried yeast on milk yield, blood biochemical and haematological indices in ewes. *Bulletin of the Veterinary Institute in Pulawy,* 53, 753-758.

Moallem, U., Lehrer, H., Livshitz, L., Zachut, M., & Yakoby, S. (2009). The effects of live yeast supplementation to dairy cows during the hot season on production, feed efficiency, and digestibility. *Journal of Dairy Science, 92*(1), 343-351.

Moon, J. S., Lee, A. R., Kang, H. M., Lee, E. S., Kim, M. N., Paik, Y. H., Parck, Y. H., Joo, Y. S. & Koo, H. C. (2007). Phenotypic and genetic antibiogram of methicillin-resistant staphylococci isolated from bovine mastitis in Korea. *Journal of dairy science, 90*(3), 1176-1185.

Newbold, C. J., Wallace, R. J., & McIntosh, F. M. (1996). Mode of action of the yeast Saccharomyces cerevisiae as a feed additive for ruminants. *British Journal of Nutrition, 76* (2), 249-261.

Petzer, I. M., Karzis, J., Donkin, E. F., Webb, E. C., & Etter, E. (2017). Somatic cell count thresholds in composite and quarter milk samples as indicator of bovine intramammary infection status. *Onderstepoort Journal of Veterinary Research, 84*(1), 1-10.

Phondba, B. T., Kank, V. D., Patil, M. B., Gadegaonkar, G. M., Jagadale, S. D., & Bade, R. N. (2009). Effect of feeding probiotic feed supplement on yield and composition of milk in crossbred cows. *Animal Nutrition and Feed Technology, 9*(2), 245-252.

Piva, G., Belladonna, S., Fusconi, G., & Sicbaldi, F. (1993). Effects of yeast on dairy cow performance, ruminal fermentation, blood components, and milk manufacturing properties. *Journal of Dairy Science, 76*(9), 2717-2722.

Putnam, D. E., Schwab, C. G., Socha, M. T., Whitestone, N. L., Kierstead,N.A., & Gaithwaite, B.D. (1997). Effect of yeast culture in the diets of early lactation dairy cows on ruminal fermentation and passage of nitrogen fractions and amino acids to the small intestine. *Journal of Dairy Science,* 80, 374-384.

Rao, K. R. S. (1990). Milk formation-alteration in mastitis milk composition. *Indian Dairyman, 42* (7), 314-316.

Rich, M. (2005). Staphylococci in animals: prevalence, identification and antimicrobial susceptibility, with an emphasis on methicillin-resistant Staphylococcus aureus. *British journal of Biomedical Science, 62*(2), 98-105.

Roberson, J. R., Fox, L. K., Hancock, D. D., & Besser, T. E. (1992). Evaluation of methods for differentiation of coagulase-positive staphylococci. *Journal of Clinical Microbiology, 30*(12), 3217-3219.

Robinson, P. H., & Garret, J. E. (1999). Effect of yeast culture (*Saccaromyces cerevisiae*) on adaptation of cows to postpartum diets and on lactatational perfomance. *Journal of Animal Science,* 77, 988-999.

Rossow, H. A., Riordan, T., & Riordan, A. (2018). Effects of addition of a live yeast product on dairy cattle performance. *Journal of Applied Animal Research, 46*(1), 159-163.

Sağlam, A. G., Şahin, M., Çelik, E., Çelebi, Ö., Akça, D., & Otlu, S. (2017). The role of staphylococci in subclinical mastitis of cows and lytic phage isolation against to

Veterinary World, 10(12), 1481-1485.

Siousarran, V. (2003). L'hygiène du lait cru en zone urbaine et périurbaine de Niamey, Niger.

Soder, K. J., & Holden, L. (1999). Dry matter intake and milk yield and composition of cows fed yeast prepartum and postpartum. *Journal of Dairy Science,* 82, 605-610.

Stone, C. W. (2002). The subtleties of yeast. Feed Mix, 10 (6), 32-33.

Szucs, J. P., Suli, A., Halasz, T., Arany, A., & Bodor, Z. (2013). Effect of live yeast culture Saccharomyces cerevisiae on milk production and some blood parameters. *Scientific Papers Animal Science and Biotechnologies, 46*(1), 40-44.

Temim, S., Boudjenah, A., Djellout, B., Bouzerd, S., Atif, M. E., Hafsi, F.,Ghozlane, F., & Baziz, H. A. (2009). Effet de la complémentation alimentaire en levure Saccharomyces cerevisiae sur les performances zootechniques et les paramètres sanguins de la vache laitière en peripartum. *Livestock Research for Rural Development, 21*(11).

Vibhute, V. M., Shelke, R. R., Chavan, S. D., & Nage, S. P. (2011). Effect of probiotics supplementation on the performance of lactating crossbred cows. *Veterinary World,* 4 (12), 557.

Wallace, R. J. (1994). Ruminal microbiology, biotechnology, and ruminant nutrition: progress and problems. *Journal of Animal Science, 72*(11), 2992-3003.

Wellnitz, O., Doherr, M. G., Woloszyn, M., & Bruckmaier, R. M. (2009). Prediction of total quarter milk somatic cell counts based on foremilk sampling. *Journal of dairy research, 76*(3), 326-330.

Williams, P. E. V., & Newbold, C. J. (1990). Rumen probiosis: the effects of novel microorganisms on rumen fermentation and ruminant productivity. In: Cole, D.J.A., & Haresign, W. (eds.): Recent advances in animal nutrition. Butterworths, London, 211–227.

Williams, P. E. V., Tait, C. A. G., Innes, G. M., & Newbold, C. J. (1991). Effects of the inclusion of yeast culture (Saccharomyces cerevisiae plus growth medium) in the diet of dairy cows on milk yield and forage degradation and fermentation patterns in the rumen of steers. *Journal of Animal Science,69*(7), 3016-3026.

Wohlt, J. E., Corcione, T. T., & Zajac, P. K. (1998). Effect of yeast on feed intake and performance of cows fed diets based on corn silage during early lactation. *Journal of Dairy Science, 81*(5), 1345-1352.

Wohlt, J. E., Finkelstein, A. D., & Chung, C. H. (1991). Yeast culture to improve intake, nutrient digestibility, and performance by dairy cattle during early lactation. *Journal of Dairy Science,* 74, 1395-1400.

Yalçın, S., Yalçın, S., Can, P., Gurdal, A. O., Bagci, C., & Eltan, O. (2011). The nutritive value of live yeast culture (Saccharomyces cerevisiae) and its effect on milk yield, milk composition and some blood parameters of dairy cows. *Asian-Australasian Journal of Animal Sciences, 24*(10), 1377-1385.