RESEARCH ARTICLE Asian Journal of Dairy and Food Research, Volume 42 Issue 3: 286-291 (September 2023)

The Effect of *Saccharomyces cerevisiae* Yeast Enriched with Selenium and Zinc on Some Physiological Traits and Milk Production of Female Shami Goats

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10.18805/ajdfr.DRF-324

ABSTRACT

Background: Milk production is one of the most important goals pursued by breeders of milk-producing farm animals World Wide. Goats are one of the most important of these animals. This study sought to compare the effect of *Saccharomyces cerevisiae* yeast (SCY) with or without selenium and zinc on milk yield and milk nutritional composition and hormones related.

Methods: Twenty four female Shami goats distributed into 4 equal groups (6 goats/group) control group (C) animals fed on standard concentrated diet without adding, T2 (SCY) animal dosed with *S. cerevisiae* at a concentration of 0.2 g/kg of body weight, T3 (Se + Zn) was fed on Selenium and zinc at a concentration of 0.3 and 0.2 g/kg of body weight, respectively, T4 (SCY+Sc+Zn) was represented by dosing their animals with an *S. cerevisiae* 0.2 g/kg body weight with selenium and zinc added to ratio at same as T3.

Result: There was a significant increase (P≤0.05) in the in-milk production, solid-to-fat ratio, milk density and protein level at (SCY+ Sc+Zn) among the transactions, also (SCY+Sc+Zn) highlighted a significant increase (P≤0.05) in prolactin, thyroxine and cortisol hormones accompanied by a significant decrease (P≤0.05) in estrogen and triiodothyronine levels in compared to all treated groups.

Key words: Hormone analysis, Milk production, Mineral, *Saccharomyces cescerevisiae*, Shami goats.

INTRODUCTION

The researchers turned to the formation of dietary supplements, a mixture of two or more substances that have an essential vital effect productively and functionally on the animal, including yeast fortified with selenium and zinc (Tian *et al*., 2022). Yeasts are one of the growth stimulants that help increase metabolism in ruminants because the ration contains a large percentage of fiber, which can only be digested by microbial digestion (Acharya *et al*., 2017). The importance of synergy between yeast, selenium and zinc lies in their physiological role, as yeast improves the stability of rumen fermentation and promotes microbial growth; moreover, complementary yeast provides some nutrients during the digestion process that affect microbial communities and their work, as many studies have shown beneficial effects of yeast on the rumen environment and the number and activity of rumen microbes (Cui *et al*., 2021) as shown in Fig 1. On the other hand, studies using *S. cerevisiae* used in dairy goat feed might vary. When given goats yeast culture, there were improvements in milk output and milk constituents (Cai *et al*., 2021).

High-yield dairy goats need feeding plans that ensure the proper contribution of all essential microelements, including Selenium and zinc. Many studies have proven the vital role of Selenium and zinc in stimulating the secretion of the hormone prolactin and increasing milk production in quantity and quality in dairy farm animals (Enjalbert *et al*., 2006). Although there are few studies (Trinta *et al*., 2020) available on the effect of baking yeast treated with zinc and Selenium and comparing its effect on milk production with the use of yeast alone or of Selenium and zinc separately and independently, there are signs and hints in some studies, although they do not include female goats, that there is such a synergistic effect (Sun *et al*., 2021).

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How to cite this article: Kasim, H.W. (2023). The Effect of *Saccharomyces cerevisiae* Yeast Enriched with Selenium and Zinc on Some Physiological Traits and Milk Production of Female Shami Goats. Asian Journal of Dairy and Food Research. 42(3): 286-291. doi: 10.18805/ajdfr.DRF-324.

Submitted: 20-03-2023 **Accepted:** 10-06-2023 **Online:** 03-07-2023

Aim of the study

This experiment was accompanied to examine the impact of yeast (*Saccharomyces cerevisiae*) supplemented with/ without a mixture of selenium and zinc on milk yield and milk nutritional composition and monitoring of hormones related, which is closely associated with the ability to milk Shami goats females to produce milk.

MATERIALS AND METHODS

This study was conducted in a private field in the Baybukht area North of Mosul during winter season (from November

2022 to February 2023). Twenty-four female Shami goats, aged 1.5 - 2 years and weight averaging 35.5±2.5 were used. During the experiment, the female goats were fed collectively concentrated feed (Table 1) with two morning and evening meals of 2% of the live animal's weight. The amount of focused feed was adjusted during the experiment according to the weight developments of the animals, hay, water and provided metal salt briquettes to the animal's *ad libitum* throughout the investigation.

Experiment design

24 female Shami goats were randomly distributed into four equal groups (6 goats/group). Fed control group (C) animals on the standard concentrated diet without any adding for the second group (SCY) animals were dosed with *S. cerevisiae* at a concentration of 0.2 g/kg of body weight. The third group (Se + Zn) was represented by dosing their animals with an elemental mixture of Selenium and zinc at a concentration of 0.3 and 0.2 g/kg of body weight, respectively. The fourth group (SCY + Sc + Zn) was represented by dosing their animals with an *S. cerevisiae* mixture of 0.2 g/kg body weight with selenium and zinc elements at a concentration of 0.3 and 0.2 g/kg body weight, respectively.

Blood measurements

Blood samples were taken through the jugular vein at the 1st month and end of the 3rd month of the experiment and measured the level of prolactin, estrogen and thyroid hormones. The story of the prolactin, estrogen and thyroid hormones in the blood serum was estimated using a ready-made working kit equipped by the Biotech, Inc. company using the ELISA device technique according to the method of (Uotila *et al*., 1981).

Milk measurements

Milk samples were taken at the end of 1st and 3rd months of the experiment. The goats were milked daily by manual hand milking at seven in the morning at seven in the evening the day before. The amount of production per goat was measured by multiplying the amount of output ×2 to extract the daily milk yield (ICAR, 1995). The concentration of fat, protein and lactose in the milk was measured and the Eko-milk Analyzer estimated the level of non-fat solids and milk density.

The statistical analysis of the experimental data was carried out according to the completely randomized design; the significance of the differences between the coefficients was tested using Duncan's multiple range tests and used the ready-made statistical analysis program (SAS, 2001). Chemical composition based on dry matter mathematically estimated by (Al-Khawaja, 1978).

RESULTS AND DISCUSSION

The results of the statistical analysis of Table 2 and 3 indicated the same results in all measurements of milk components. At the end of the 1st and 3rd months of the experiment, the averages of (SCY + Sc + Zn) recorded the highest increase (P≤0.05) in milk production, solid-to-fat

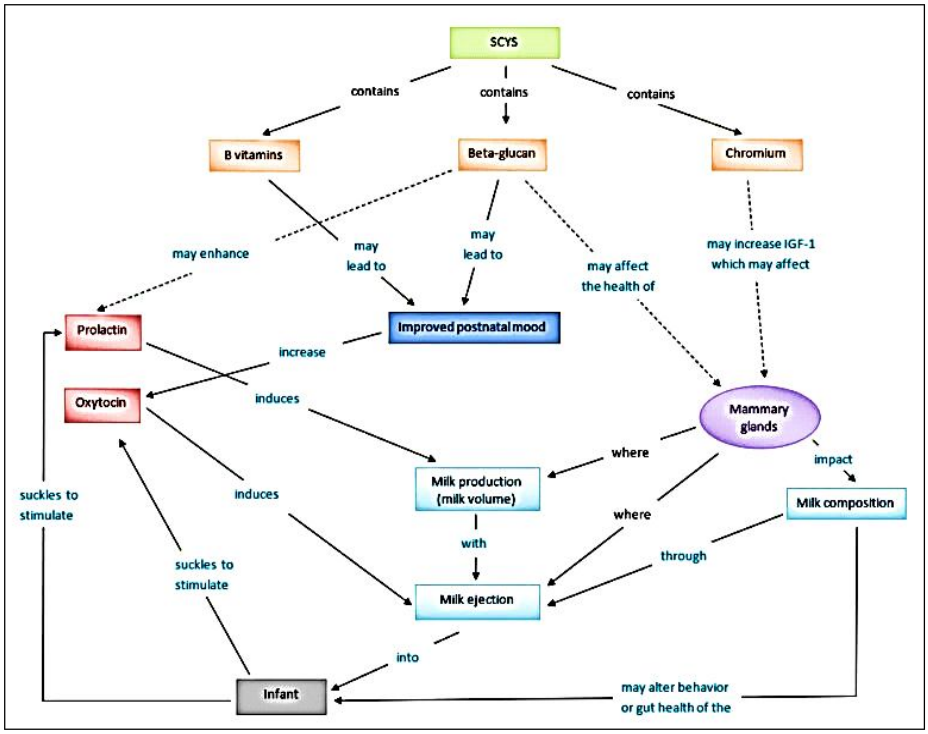


Fig 1: The potential mechanism of *Saccharomyces cerevisiae* yeast-based supplements (SCYSs) on milk production and composition (Jia *et al*., 2021).

ratio, milk density and protein level among all transactions. In turn, (SCY) and (Se + Zn) groups, recorded their significant superiority (P≤0.05) over the control group in milk production, solid-to-fat ratio, milk density and protein level. While in milk fat ratio, also at the end of the 1st and 3rd months, (SCY + Sc + Zn) group gave its lowest rates (P≤0.05) compared to all the experiment transactions, as well as the yeast group (SCY) (P≤0.05) compared to the control, while the decrease was mathematically for the minerals group (Se + Zn) compared to the control. Gomes *et al*. (2012); Ferreira *et al*. (2010) who attributed the improvement in milk production levels, increasing its milk density, the percentage of protein and solid matter in animals that fed on *S. cerevisiae*, to the containment of the outer membrane of yeast cells a high protein concentration and high level of solid matter, concurred with the results of the current study. According to (Dobicki *et al*., 2006), *S. cerevisiae* yeast increased milk production by enhancing microbiota metabolic activity, feed digestibility, energy metabolism and mammary gland health (Milewski and Sobiec, 2009). There is some evidence that *S. cerevisiae* influences the composition of milk in ruminants, in addition to some evidence that it has a favorable impact on milk production (Coleman *et al*., 2023). *S. cerevisiae* supplementation dramatically reduced the amount of milk fat in ruminants (Zaworski *et al*., 2014). Supplementing with *S. cerevisiae* also markedly boosted the amount of total protein in ewe milk (Mustafa, 2022). *S. cerevisiae* altered the protein content of milk as well. After 70 days of supplementation with *S. cerevisiae* at a daily dose of 30 g/animal during lactation, the concentrations of β-casein were significantly decreased, while *k*-casein had a significant rise in ewe milk (Milewski *et al*., 2012). Bioavailable chromium found in *S. cerevisiae* may influence insulin-like growth factor 1 and boost milk output (IGF-1). Chromium was reported to upregulate IGF-1 mRNA and IGF-1 When insulin is present, chromium has been shown to increase the levels of IGF-1 mRNA and IGF-1 receptor in skeletal muscle cells (Jia *et al*., 2018). At the end of the first and third months of the experiment, the goats treated with selenium and zinc produced more milk and milk protein and had less fat, which was consistent with the findings of (Tufarelli and Laudadio, 2011), whose study showed that selenium-fed goats produced the most milk (P≤0.05) and had higher protein concentrations. Additionally, the findings of the group that combined selenium, zinc and *S. cerevisiae* yeast were in line with (Petrera *et al*., 2009) who observed that milk output was equivalent in Saanen dairy goats fed diets containing selenium-yeast. Selenium-supplemented yeast has been found to have a good impact on dairy goat milk production features and the health of the goat mammary gland (Reczyska *et al*., 2019). According to (Salama *et al*., 2003), feeding dairy goats a diet high in zinc improved the levels of

Table 1: Ingredients and chemical composition of the essential diet (NRC, 2007).

Substance	Relative
Crushed barley	47
Wheat bran	42
Soybean	8
Salt	1
Limestone	2
Crude protein	14.57

Table 2: The effect of *S. cerevisiae* dosing with or without minerals on milk production and its components at the end of 1st month.

	Control	*S. cerevisiae* (SCY)	(Se+Zn)	(SCY + Sc + Zn)
Milk production gm/goat/day	271.5±16.27d	492.57±14.71b	347.74±11.67c	675.18±17.62a
Milk fat %	4.22±0.51a	3.75±0.81b	3.62±0.51b	2.85±0.8c
Solid-to-fat ratio%	7.59±0.26c	8.58±0.35b	7.64±0.19c	9.47±0.27a
milk density	26.41±2.18b	28.74±2.31a	26.92±1.23B	29.45±2.09a
Protein level	4.26±0.38c	5.42±0.51b	5.52±0.27b	6.85±0.29a

Data expressed as (Mean ± Stander error).

Different letters in a row indicate significant differences at (P≤0.05).

Table 3: The effect of *S. cerevisiae* dosing with or without minerals on milk production and its components at the end of 3rd month.

	Control	*S. cerevisiae* (SCY)	(Se + Zn)	(SCY + Sc + Zn)
Milk production ml/goat/day	450.41±10.37d	739.04±6.5b	581.22±9.26c	955.73±12.3a
Milk fat %	4.81±0.28a	3.38±0.7b	3.41±0.37b	2.51±0.49c
Solid to fat %	6.19±0.48c	8.07±0.41b	8.33±0.27b	10.51±0.18a
Milk density	26.52±1.22b	28.83±1.75a	26.24±1.67b	29.45±2.68a
Protein level	4.32±0.51b	5.58±0.31c	5.44±0.43c	6.91±0.3a
Lactose %	4.53±0.27a	4.68±0.3a	4.5±0.21a	4.71±0.13a

Data expressed as (Mean±Stander error).

Different letters in a row indicate significant differences at (P≤0.05).

Table 4: The effect of *S. cerevisiae* dosing with or without minerals on prolactin, estrogen, cortisol and thyroid hormones at the end of the study.

	Control	*S. cerevisiae* (SCY)	(Se+Zn)	(SCY + Sc + Zn)
Prolactin H. (ng/ml)	5.21±0.87c	6.7±0.52b	6.24±0.68b	8.69±0.82a
Estrogen H. (ng/ml)	15.07±1.57a	12.2±2.41b	14.84±2.62a	10.57±2.26b
Triiodothyronine (T3) (ng/ml)	2.61±0.52a	1.83±0.74b	1.76±0.81b	1.03±0.84c
Thyroxine (T4) (ng/ml)	72.35±1.39c	83.2±2.28b	85.55±2.19b	94.74±2.37a
Cortisol (ng/ml)	77.33±3.01b	84.05±4.27a	71.22±4.68c	80.61±4.52a

Data expressed as (Mean±Standerd error).

Different letters in a row indicate significant differences at (P≤0.05).

milk production and casein protein, increased the concentration of solid-fatty substances and improved the indicators of milk production recipes and their general specification.

The results of the statistical analysis indicated in Table 4 of the changes in the levels of hormones in the blood serum showed that there is a significant variation (P≤0.05) between the coefficients. The treatment of (SCY + Sc + Zn) recorded the highest concentration (P≤0.05) of the prolactin hormone compared to other groups. In contrast, the estrogen level was decreased (P≤0.05) in the (SCY + Sc + Zn) and (SCY) groups compared to the (Se + Zn) and control groups. While (SCY + Sc + Zn) had recorded the lowest level of T3 hormone, it recorded the highest level of the T4 hormone compared to the rest of the study groups. The (SCY + Sc + Zn) and (SCY) groups also showed higher levels of the hormone cortisol compared to the (Se + Zn) and Control groups. At the same time, one group (Se + Zn) had the lowest cortisol level compared to the other treated groups.

Saccharomyces cerevisiae, which could mobilize nutrients and ensure the supply of chemicals in the body, was given to goats in the current study and these goats had much greater cortisol levels. Strong evidence demonstrates that higher glucocorticoid levels are necessary for increased milk production in order to provide enough energy for galactose synthesis (Mohammed *et al*., 2018). In addition to stimulating the expression of milk protein genes during lactation, cortisol, the main glucocorticoid in galactose production, also plays a critical role in fostering mammary epithelial cell differentiation (Jia *et al*., 2021). These results imply that prolactin and cortisol may increase goat milk production. According to our findings, *Saccharomyces cerevisiae* can make cortisol and prolactin work together in goats to boost production. Here, we discovered that the prolactin level increased together with the cortisol concentration in the treatment group, along with the fact that the combined milk output increased (Du *et al*., 2022). *S. cerevisiae* contained an endogenous ligand for the yeast estrogen-binding protein. Estrogen increases blood flow to the uterus and genital system. The endogenous ligand from S. cerevisiae has recently been demonstrated to have estrogenic action in mammalian systems, which is significant (Feldman *et al*., 1984). Zinc's involvement in enhancing ovarian function and increasing female fertility is thought to be the cause of a large rise in estrogen levels in the (Se + Zn) group compared to yeast-treated groups (Ahmed *et al*., 2001). This could be the case because selenium stops mature follicles and ovarian tissue from oxidizing, which raises the amount of estrogen released by the follicle. The development of follicles, which are responsible for the release of estrogen, may be stimulated by zinc in the tonic immune system (Shareef *et al*., 2021). All domesticated animals' growth, development and metabolism are significantly influenced by thyroid hormones, either directly or indirectly. Thyroxine (T4) must be converted into tri-iodothyronine (T3) in order for the thyroid hormones to operate fully. This process is carried out by a special nuclear receptor protein that may influence the expression of particular regulatory areas of the target genes (Schroede and Privalsky, 2014). After the thyroid hormone receptor was cloned, protein analysis revealed a region that included zinc and selenium ions, which are essential for the receptors' ability to bind to their target genes (Olivieri *et al*., 1996). As a result, it has been suggested that T3's full biological functioning may depend on its zinc and selenium levels (Shahid, 2022). Since the thyroid gland regulates this rate, increased T4 and T3 release increases body heat production and basal metabolic rate in nursing and lactating goats (Aghwan *et al*., 2013). In both animals and humans, low selenium or zinc status decreased the T3/T4 ratio mostly through raising T4 levels rather than by lowering T3 levels (Olivieri *et al*., 1996).

CONCLUSION

According to the results obtained from the study, we concluded that Organic form (*Saccharomyces cerevisiae* yeast supplemented with selenium/ zinc) credited to maximum milk production and the best results for the indicators of milk qualities as measured by the experimental groups for the duration of the study, also measurements of hormones related to the physiological functions of milk production showed their best indicators in the two treatment groups, including on yeast with or without the mixture of mineral elements.

ACKNOWLEDGEMENT

The authors are very grateful to the University of Mosul/ College of Agriculture and Forestry provided facilities,

which helped improve the quality of this work. They also thank Dr. Dheyaa Mohamed for her Assistant Work, College of Veterinary Medicine, University of Mosul.

Conflicts of interest

The researcher declare that there is no conflict of interest of this work.

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