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RESEARCH*ARTICLE*
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Effect of yeast supplemented with selenium or zinc on some antioxidant indices and liver and kidney functions in local Iraqi goats.

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ABSTRACT

The purpose of the research was to investigate the effect of yeast supplemented with selenium or zinc on the antioxidant profile of local Iraqi goats. The study utilized seventeen female goats with an average body weight (BW) of 37.5 ± 2.5 kg and an average age of 2-2.5 years. The animals were randomly assigned to three groups: group I contained five goats, while groups II and III contained six goats. The control group (Group I) was not treated, while Group II was given a dose of selenium-supplemented yeast (*Saccharomyces cerevisiae*-selenium) at 0.03 g/kg/BW. Group III was offered a dose of zinc-supplemented yeast (*Saccharomyces cerevisiae*-zinc) at 0.2 g/kg/BW. The samples were administered orally to the animals for 45 days after being dissolved in 30 ml of distilled water. The changes in the level of liver and antioxidant enzymes were determined by collecting blood samples from the jugular vein on the first day and the 45th day. The result showed the Y+Se and Y+Zn treatments significantly reduced malondialdehyde, AST, and ALT in comparison to the control treatment ($P < 0.05$). However, the GPx levels of the animals that received the treatment diets increased. In both treatment treatments, there was a significant decrease in Creatinine and Urea. The treatments exhibited decreased indications of globulin and albumin in comparison to the control treatment. In conclusion, the results suggest that the serum antioxidant activity of goats was not only improved but also the lipid peroxidation was reduced by dietary yeast supplemented with selenium (*Saccharomyces cerevisiae*-selenium).

***Keywords*:** *Saccharomyces cerevisiae*, Zinc, Selenium, liver enzymes, goats.

INTRODUCTION

Feed shortages, environmental pressures, parasites, and diseases are the primary factors contributing to diminished feed efficiency and economic viability in global sheep production. Reactive oxygen species (ROS) levels rise during oxidative stress, while antioxidant capacity falls. This leads to lipid peroxidation, which can damage DNA and cause proteins to be expressed in the wrong way. Selenium (Se) is a vital trace element for both animals and humans. A lack of Se in female mammals has been linked to a number of health problems, such as infertility, abortion, placenta retention, and weakened immune systems [1]. Selenium, a trace element, is essential for normal animal function within an appropriate dosage range for all species. It can inhibit ROS from harming cells and diminish inflammation. These actions have prompted suspicion that they may also safeguard animals against chronic illnesses arising from cellular damage and inflammation [2]. In this case, increasing the Se level in the goats' food to 4 mg/kg had no harmful or toxic effects and increased the blood antioxidant capacity of the goats [3]. Selenium yeast (Se-yeast) is abundant in Se and can be utilized as feed supplementation for ruminants. It is applicable in the treatment of some cardiovascular disorders, liver diseases, and tumour-associated conditions resulting from Se deficiency [4]. These days, additives like zinc-supported yeast and organic Se are being used more and more to improve animal health and production, which helps with some of the problems [5, 6]. Bread yeast (SC) was utilized to enhance rumen fermentation, stimulate microbial proliferation, and augment the stability of rumen fermentation. Consequently, the utilization of Se-enriched animal feed is a secure and efficacious method to enhance the existing condition of the Se deficit. Recent investigations of the impact of dietary Se supplementation on animal physiological regulation have highlighted the significance of Se bioavailability [7, 8]. Organic Se is preferred because of its reduced toxicity, enhanced bioavailability, and diminished environmental pollution. [9] found that a Se level of 0.6 mg/kg from SeY can improve goats' growth, carcass characteristics, and meat quality. Consequently, maternal Se insufficiency during gestation is likely to result in aberrant physiological function and adverse health outcomes. Blood serves as a crucial and dependable indicator of the health status of individual animals. The blood parameters of animals can be significantly influenced by various factors, including nutrition, sickness, stress, parturition, and climate. The biochemical blood tests provided fundamental data for animal health support. The aims of our study are to investigate the effects of yeast fortified with Se or Zn on antioxidant activity in sheep and to offer innovative solutions for addressing Se or Zn deficiencies in ruminants.

Materials and methods

2.1. The experimental Animals

The animal farm affiliated to the College of Veterinary Medicine at the University of Fallujah operated from June 15, 2019, to August 2, 2019. Seventeen goats, with an average age of 2 to 2.5 years and a weight of 37.5 ± 2.5 kg, which had previously parturited, were marked with plastic ear tags. All animals received an equivalent concentrated meal constituting 3% of their body weight. The composition ratio consists of 35% wheat bran, 50% barley, 8% soybean meal, 6% chopped straw, 0.5% salt, and 0.5% vitamins and minerals. Straw, water, non-blooming alfalfa, and minerals were supplied ad libitum. All goats received 10 ml of albendazole orally and 2 ml of ivermectin subcutaneously during the acclimatization phase.

2.2. Experimental design

The animals were randomly divided into three groups: Group I consists of 5 goats, whilst Groups II and III each comprise 6 goats. The female goats had ingested the same ration. Group I functioned as a control group, getting no treatment (con). In contrast, Group II was provided selenium-fortified yeast (Saccharomyces cerevisiae-selenium) at a dosage of 0.03 g/kg body weight (Y+Se), obtained from https://www.made-in-china.com/products-search/hot-china-products/Yeast.html. Group (III) was administered zinc-enriched yeast (Saccharomyces cerevisiae - zinc) at a dosage of 0.2 g/kg body weight (Y+Zn), in accordance with guidelines of [10]. The animals received treatment for 45 days by dissolving the samples in 30 ml of distilled water and administering them orally. The animals underwent treatment for 45 days by dissolving the samples in 30 ml of distilled water and delivering them orally. Pregnancy was confirmed with an ALOKA-5000 MH ultrasound (USA). The pregnancy rates for Groups I, II, and III were 60%, 83.5%, and 83.5%, respectively.

2.3. Blood sample collection

Blood samples were collected from the jugular vein on the first day and the 45th day after the experiment to evaluate alterations in antioxidant enzyme levels (monoaldehyde (MDA), Glutathione peroxidase (GPX), Alanine Transaminase (ALT), Aspartate Transaminase (AST), Glucose, Total protein (TP), Creatinine, Urea, Globulin, and Albumin). Agappe kits, a product manufactured in India, and the Mindray BA-88A semi-automatic chemistry analyzer from Switzerland were employed to analyze all samples.

2.4. Statistical analysis

The statistical analysis (ANOVA) was conducted using two-way analysis of variance, with the data presented as Mean and Standard Error (Mean± SE). Additionally, a post-hoc test was implemented to ascertain the minimum Duncan [11]. A significant difference between the means was observed ($p < 0.05$) in multiple range and F tests. The Statistical Software for the Social Sciences Program (SPSS) version 25 application has been used to achieve this objective.

Results

Table 1 shows the biochemical characteristics of the experimental subjects. The Malondialdehyde index was considerably reduced in the Y+Se and Y+Zn treatments compared to the control treatment ($P < 0.05$), while Glutathione peroxidase levels elevated compared with the control treatment ($P < 0.05$). These biomarkers remained at normal levels across all groups throughout the study duration.

Table 1. Effects of Se and Zn on Malondialdehyde (nmol/g) and Glutathione peroxidase (U/I) in Iraqi local goats.

Treatments	MDA Period			GPX Period		
	1 day	45th day	mean	1 day	45th day	mean
Con	0.52 ±0.02	0.80 ±0.02	0.66±0.03 A	35.00±0.64	30.64±0.64	32.82±0.45 B
Y+Se	0.57±0.04	0.42±0.04	0.50±0.01 B	35.10±0.58	38.17±0.58	36.64±0.41 A
Y+Zn	0.47±0.04	0.46±0.04	0.46±0.01 B	34.83±0.58	37.65±0.58	36.24±0.41 A
mean	0.53±0.02	0.56 ±0.02		34.98±0.34	35.49±0.34	

Means with different capital letters in the same column a significantly different at ($P<0.05$)

AST and ALT markers of goats employed as experimental animals are presented in (Table 2). The AST and ALT levels were reduced in the Y+Se and Y+Zn treatments compared to the control treatment ($P < 0.05$). However, the ALT grew progressively over time, showing a gradual increase in the mean for all groups, although the AST was not significantly affected by the duration of the study.

Table 2. Effects of Se and Zn on Alanine Transaminase (IU/ml) and Aspartate Transaminase (IU/ml) in Iraqi local goats.

Treatments	ALT Period			AST Period		
	1 day	45th day	mean	1 day	45th day	mean
Con	14.69±0.47	21.34±0.47	18.01±0.25 A	89.57±1.38	100.13±1.38	94.85±0.97 A

Y+Se	15.05±0.43	14.80±0.43	14.93±0.54 B	89.33±1.26	82.05±1.26	85.69±0.89 B
Y+Zn	14.73±0.437	15.40±0.43	15.06±0.52 B	89.00±1.26	86.85±1.26	87.92±0.89 B
Mean	14.82±0.26 b	17.18±0.26 a		89.30±0.75	89.67±0.75	

Means with different small letters in the same row a significantly different at (P<0.05)

The blood indicators for goats, including total protein and glucose are presented in Table 3. The total protein was reduced in the Y+Se and Y+Zn treatments compared to the control treatment (P < 0.05). However, total protein exhibited a progressive increase over time across all groups, although glucose levels were not significantly affected by treatments or the duration of the study.

Table 3. Effects of Se and Zn on Glucose (ml/dl) and Total protein (g/dl) in Iraqi local goats.

Treatments	Glucose Period			Total protein Period		
	1 day	45th day	mean	1 day	45th day	mean
Con	70.97±0.87	71.39±0.87	71.18±0.62	4.90±0.43	6.78±0.25	5.84±0.05 A
Y+Se	70.51±0.80	70.79±0.80	70.65±0.56	5.13±0.38	4.99±0.43	5.06±0.09 B
Y+Zn	69.92±0.80	70.83±0.80	70.38±0.56	5.06±0.36	4.92±0.24	4.99±0.03 B
Mean	70.47±0.47	71.01±0.47		5.03±0.08 b	5.57±0.08 a	

Means with different capital letters in the same column a significantly different at (P<0.05)
Means with different small letters in the same row a significantly different at (P<0.05)

The serum biomarker values for creatinine and urea in goats shown significant variations among the animal groups (Table 4). Animals subjected to Y+Se and Y+Zn treatments exhibited a significant reduction in both serum markers (Creatinine and Urea) compared to the control treatment (P < 0.05). Furthermore, the duration of creatinine reduced over time, resulting in a progressive increase in the mean for all groups, but urea was not significantly affected throughout the study period.

Table 4. Effects of Se and Zn on Creatinine (mg/dl) and Urea (mg/dl) in Iraqi local goats

Treatments	Creatinine Period			Urea Period		
	1 day	45th day	mean	1 day	45th day	mean
Con	1.40±0.09	1.08±0.09	1.24±0.04 A	17.06±0.71	22.65±0.71	19.86±0.50 A
Y+Se	1.01±0.08	0.94±0.08	0.98±0.03 B	19.52±0.64	15.97±0.64	17.75±0.45 B
Y+Zn	1.04±0.08	0.92±0.08	0.98±0.06 B	19.14±0.64	17.02±0.64	18.08±0.45 B
Mean	1.15±0.05 a	0.98±0.05 b		18.57±0.38	18.55 ±0.38	

Means with different capital letters in the same column a significantly different at (P<0.05)
Means with different small letters in the same row a significantly different at (P<0.05)

The blood biomarker data for globulin and albumin in goats shown significant variance among the animal groups (Table 5). Animals that received Y+Se and Y+Zn treatments revealed a significant reduction in serum levels of globulin and albumin compared to the control group (P < 0.05). Furthermore, the duration of globulin and albumin reduced over time, but the mean values gradually increased across all groups.

Table 5. Effects of se and Zn on Globulin (g/dl) and Albumin(g/dl) in Iraqi local goats.

Treatments	Globulin Period			Albumin Period		
	1 day	45th day	mean	1 day	45th day	mean
Con	1.91±0.06	2.64±0.06	2.28±0.08 A	2.94±0.08	4.07±0.08	3.50±0.05 A
Y+Se	2.00±0.05	1.94±0.05	1.97±0.02 B	3.07±0.08	2.99±0.02	3.03±0.03 B
Y+Zn	1.97±0.05	1.92±0.05	1.94±0.05 B	3.03±0.08	2.95±0.06	2.99±0.09 B
mean	1.96±0.03	2.17±0.03		3.01±0.04	3.34±0.04	

Means with different capital letters in the same column a significantly different at (P<0.05)

Discussion

The MDA considered a stable end-product of fatty acid peroxidation, can be employed as an essential indicator for assessing the extent of lipid peroxidation. The lower MDA content in the Y+Se and Y+Zn treatments in comparison to the control treatment also implies that excessive Se can result in a reduction in ROS production and lipid peroxidation. The MDA content in the Y+Se and Y+Zn treatments was significantly lower (P < 0.05) than that in the control, indicating that

lipid peroxidation may be more readily induced by Se deficiency. The Se has the ability to resist lipid peroxidation and reduce the free radicals by means of biochemical along with non-enzymatic mechanisms of antioxidant defense [12]. After selenium and zinc supplementation with yeast, the activity of this selenium-dependent enzyme significantly increased, as evidenced by the comparison of GPx activity in blood. Perhaps this clarifies the reason for the decreased MDA levels in the blood of the treatment groups. The results are consistent with [13, 14].

The activities of AST and ALT in the affected treated goats were significantly lower than

those in the control animals ($P < 0.05$). Liver necrosis or disease is frequently indicated by significantly elevated serum levels of ALT and AST [15]. In other words, hepatic tissue damage and elevated serum AST activities may result from an excess of metals [16]. The Y+Se and Y+Zn treatments exhibited elevated ALT and AST activity in the current study over time, which was consistent with the typical physiological range of goats.

The maternal Y+Se and Y+Zn interventions influenced the serum total protein in this study. Previous research has also indicated that yeast enriched through Se or Zn supplementation may affect serum total protein [17, 18]. The inclusion of yeast in the diets of the goats is a critical indicator of improved health and physiological status, as their serum total protein concentrations decrease when protein is deficient in the diets. This could be the reason for the reduction in total protein in the experimental diets.

Compared to the other groups, the concentrations of creatinine and urea were significantly reduced by the Y+Se and Y+Zn regimens ($P < 0.05$). These modifications in the biochemistry of goat serum may be associated with the fact that zinc is a component of Zn metalloenzymes, which are responsible for preserving protein structural integrity [19]. The activity of glutathione S-transferase and total sulfhydryl groups, essential components of the enzyme glutathione peroxidase, can be enhanced by selenium, which reduces the formation of thiobarbituric acid-reactive substances. This, in turn, restricts lipid and protein oxidation, enabling blood globulin to evaluate systemic immune function during heightened metabolic demands. In contrast, blood urea may more precisely reflect short-term dietary effects on rumen ammonia (NH_3) production and hepatic nitrogen turnover [20].

It is important to note that the serum albumin and globulin levels of all goats in our experiment were lower than the normal physiological ranges recorded by [21]. In the same study, Alimohamady, Aliarabi, Bruckmaier and Christensen [22] observed substantial variations in the concentrations of total protein between the first and 45th days of animals that received Y+Se and Y+Zn treatments. S. cerevisiae supplementation to dairy calves resulted in elevated plasma total protein and globulin concentrations, as reported by [23].

Conclusion

The current study's results indicate that dietary yeast supplemented with selenium (Saccharomyces cerevisiae-selenium) not only enhanced the serum antioxidant activity but also decreased the lipid peroxidation of goats. Additional research is necessary to elucidate the impact of (Saccharomyces cerevisiae-selenium) on the conjugated PUFA concentrations in the meat of goats, as determined by metagenomics.

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تأثير الخميرة المعززة بالسيلينيوم أو الزنك في بعض مؤشرات مضادات الأكسدة ووظائف الكبد والكلى في الماعز المحلي العراقي.

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الخلاصة
هدفت هذه الدراسة إلى معرفة تأثير الخميرة المكملة بالسيلينيوم أو الزنك في مضادات للأكسدة لدى الماعز المحلي العراقي. شملت الدراسة سبعة عشر أنثى ماعز بمعدل وزن بلغ 37.5 ± 2.5 كغم، ومتوسط العمر يتراوح بين 2-2.5 سنة. وزعت الحيوانات عشوائيًا إلى ثلاث مجموعات: شملت المجموعة الأولى (مجموعة السيطرة) خمسة ماعز، في حين كانت المجموعتان الثانية والثالثة على ستة ماعز لكل منهما. لم تخضع المجموعة السيطرة لأي معاملة، بينما تم إعطاء المجموعة الثانية جرعة من الخميرة المكملة بالسيلينيوم ***(Saccharomyces cerevisiae-selenium)*** بتركيز 0.03 غ/كغم من وزن الجسم. أما المجموعة الثالثة، فقد تلقت جرعة من الخميرة المكملة بالزنك ***(Saccharomyces cerevisiae-zinc)*** بتركيز 0.2 غ/كغم من وزن الجسم. جرعت الحيوانات لمدة 45 يومًا بعد إذابتها في 30 مل من الماء المقطر. قيمت التغيرات في مستويات إنزيمات الكبد والمضادة للأكسدة من خلال جمع عينات الدم من الوريد الوداجي في اليوم الأول واليوم الخامس والأربعين. أظهرت النتائج أن المعاملتين ***Y+Se*** و ***Y+Zn*** أدت إلى انخفاض معنوي في مستويات ***MDA***، وإنزيمي ***AST*** و ***ALT*** مقارنة بالمجموعة السيطرة ***(P < 0.05)*** ومع ذلك، لوحظت زيادة في مستويات إنزيم ***GPx*** لدى الحيوانات التي تلقت المكملات الغذائية. كما سجلت المعاملات انخفاضًا معنويًا في مستويات الكرياتينين واليوريا. بالإضافة إلى ذلك، أظهرت المعاملات انخفاضًا في مستويات الكلوبيولين والألبومين مقارنة بالمجموعة السيطرة. ويمكن ان نستنتج، إلى أن نشاط مضادات الأكسدة في مصل دم الماعز قد تحسن، كما انخفضت عمليات اكسدة الدهون عند استخدام الخميرة الغذائية المكملة بالسيلينيوم (***Saccharomyces cerevisiae-selenium***).

الكلمات المفتاحية: *خميرة الخبز*، الزنك، السيلينيوم، انزيمات الكبد، الماعز.