



EFFECT OF CURCUMIN SUPPLEMENTATION ON PRODUCTION PERFORMANCE AND BLOOD METABOLITE PARAMETERS OF SHEEP

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Article info	Abstract
Received: 2023-10-04 Accepted: 2023-11-06 Published: 2023-12-31	The objective of the study was to evaluate the impact of curcumin supplementation on animal performance and health. Fifteen local dairy sheep assigned randomly into three equal groups: control (C) without supplement, T1 (50 mg curcumin /head/day), and T2 (100 mg curcumin /head/day). The results were demonstrated that ewe's milk in curcumin group treatments on day 20 and 40 had significantly lower content of milk fat and higher in protein compared to control group. In both T1 and T2, a marginal drop in the total amount of protein in the serum was observed. It appears that triglycerides was significantly decreased in T2 on day 20 and 40 compared to the other groups. It seems that lymphocytes in curcumin treatment groups were reduced on day 20 and 40. Also, it was noticed the inclusion of curcumin in the diet of dairy sheep has the potential to enhance animal health and production due to its anti-inflammatory properties.
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Keywords: Feed supplement, Local sheep, Milk composition, Blood hematology, Anti-inflammatory effects.

تأثير إضافة الكركم على الأداء الإنتاجي وبعض صفات الدم في الأغنام

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الخلاصة

الهدف من الدراسة هو تقييم تأثير إضافة الكركم على أداء الانتاجي وحالاته الصحية للحيوانات التجربة. تم توزيع خمسة عشر من أغنام المحلية المنتجة للحليب بشكل عشوائي إلى ثلاث مجاميع متساوية: مجموعة السيطرة (C) بدون اضافات، T1 (50 مغم كركم/رأس/يوم)، و T2 (100 مغم كركم/رأس/يوم). أظهرت النتائج أن حليب النعاج في مجاميع المعاملة بالكركم في اليوم 20 و 40 يحتوي على كمية أقل بكثير من دهون وكمية عالية من البروتين مقارنة بالمجموعة السيطرة. في كل من T1 و T2، لوحظ انخفاض هامشي في كمية البروتين الكلي في المصل. كما لوحظ مستوى الكليسيريدات الثلاثية اقل معنوياً في T2 في اليوم 20 و 40 مقارنة بالمجموعات الأخرى. كما اتضح تخفيض الخلايا الليمفاوية في مجاميع المعاملة بالكركم في اليوم 20 و 40. كما وجد بان إضافة الكركم في النظام الغذائي للأغنام المنتجة للحليب لديه القدرة على تعزيز صحة الحيوان وإنتاجه بسبب خصائصه المضادة للالتهابات.

كلمات مفتاحية: المضافات الغذائية، الأغنام المحلية، مكونات الحليب، امراض الدم، التأثيرات المضادة للالتهابات.

Introduction

One important source of income for the sheep business is the production of sheep milk and its products (10). Sheep milk is a desirable source for making yogurt and cheese as well as for short-and medium-chain fatty acids, which are crucial for a balanced diet (20). Breed, nutrition, season, lactation stage, and health state are some of the variables that affect milk composition (3).

The use of phytotherapeutics in animal production has been documented in the literature as an advantage for animal health and performance because they can enhance barrier function and nutrient transport in the gastrointestinal tract, which contributes towards increasing productivity, modulating the immune and oxidant systems, and reducing the activity of microbial pathogens that are harmful to animals (17). *Curcuma longa L.*, a member of the Zingiberaceae family of plants, is used to produce curcumin. Curcumin, a natural sources bioactive substance produced from *Curcuma longa*, is utilized for its antibacterial properties, anti-parasitic, and

antioxidant properties (7, 12 and 21). The hydrophobic polyphenol diphenylmethane, which has aromatic properties and the ability to give color, is considered to be the active ingredient of curcumin (8).

According to (14), adding curcumin to breastfeeding lambs' diets caused weight gain while also providing anti-inflammatory and antioxidant properties, both of which are favorable biological advantages that improve productivity. Curcumin's antibacterial properties are also advantageous. For instance, curcumin was administered to nursing sheep with chronic subclinical mastitis by (10), who concluded that the majority of the time the condition was treated. Oxidative stress in nursing animals is normal, and it causes metabolic alterations in the animal and its products (18). Therefore, research on feed additives aims to enhance milk's qualities in order to increase product value and nutritional characteristics.

However, there is a dearth of research examining the effects of curcumin supplementation on the health and productivity of ruminants. Hence, our research hypothesis posited that the inclusion of curcumin in sheep feed would yield beneficial outcomes in terms of health and productivity. This study aimed to investigate the potential effects of incorporating curcumin into the daily diet of sheep on various aspects, including performance, milk production and composition, health, as well as potential changes in blood parameters.

Materials and Methods

Animals and experimental design: Fifteen local sheep (2.5-3 years) raised in the Tel-leban village-Ninawa in Iraq. After an adaptation period for 20 days, sheep randomly divided equally into three groups (5 sheep for each) (control, T1= 50mg curcumin/head/day, and T2=100mg curcumin /head/day). All animals were fed *ad libitum* on the same feed formulation (15) (Table 1) during entire experiment. Free access to clean water was made available to the animal. Curcumin was purchased from local markets, derived from dried extract of *Curcuma longa* (turmeric). Curcumin was accurately measured using a digital scale for each treatment administered to the sheep. It was then thoroughly mixed with wheat bran and slightly moistened to ensure the designated amount was received. The curcumin-wheat bran mixture was manually fed to the sheep in two separate feedings, once in the morning and once in the evening. The experiment period was 40 days and samples (milk and blood) were taken on day 0, 20 and 40.

Table 1 Rations used in the experiment.

Ration composition %		Chemical analysis of basal ration %	
Sunflower shell	25.00	Dry matter	88.00
Cracked wheat	10.00	Crude protein	16.00
Corn	10.00	Ash	6.50
Barley	10.00	Cellulose	18.50
Molasses	5.00	Phosphate	1.00
Soybean	25.00	Ether Extract	3.50
Hazelnut meal	9.00	Aflatoxin	1mg/ton
Salt	1.00		
Marble dust	2.00		
Calcium carbonate	0.50		
Sodium chloride	1.00		
Vitamins and Minerals	1.50		
Total	100		

Sample collections and analysis: Milk samples were collected from each animal in the morning and evening for chemical analysis, at room temperature (1 mL) of milk taken from each sample and tested in the laboratory for milk composition analysis. All milk samples were analyzed by eco-milk analyzer.

Blood was collected from the jugular vein on days 0, 20 and 40 of the experiment. Total blood was collected in two tubes: without anticoagulant to obtain serum, and with EDTA as anticoagulant for hemogram. The blood collected without anticoagulant was centrifuged at 3500 rpm for 10 min, and the serum was stored at – 20 °C until analyses. Blood parameters hemoglobin Hb, White blood cells WBC, Lymphocytes, Monocytes, and MCHC were analyzed used Vet Animal Blood Counter (MCL 3800, China). Serum parameters (Total Protein, Triglyceride, Cholesterol, Creatine, and Glucose) were analyzed in Med-Line laboratory for disease diagnosis, Erbil, Iraq, commercial laboratory by Cobas analyzer (Roche Cobas®6000 analyzer series -Roche-Diagnostics, Japan).

Statistical analysis: Data was analyzed using Graphpad Prism version 8.0.1 (Graph Pad Software Inc. San Diego, CA, United states) in two-way ANOVA (Tukey's multiple comparisons test).

Results and Discussion

Effect of curcumin on milk compositions: The result of effect of curcumin supplement on the milk composition is presented in (Table 2), fat percentage at the beginning of experiment trial was not differed significantly. While, as ewes were continuously fed on the curcumin supplement, its results showed a significant decrease in milk fat content. In both time 20 and 40 days, fat content were lower in added curcumin treatments compared to the control group. Milk protein content increased and was significantly differ compared to the control group. Treatment one had higher content of protein 5.20 and 5.18 in day 20 and 40 respectively. Regarding to the lactose content in the added treatment groups, data showed that (50

mg/head/day) could rise milk lactose compared to the both control and treatment two (100 mg/head/ day). The highest content of SNF and milk density were in T1 in day 20 and 40, it was different significantly compared to control and T2 at the same day.

(1) discovered that feeding awasi ewes with medicinal herbs had an effect on milk protein and non-fatty solids when compared to the control group. (2) found a considerable increase in the amount of milk protein in awasi ewes fed 200 g of medicinal herbs per head per day. This rise is due to a shift in acetate and propionate concentrations caused by variations in DM and NDF digestion (10). Turmeric powder may improve milk production in sheep, according to (1 and 5). This is owing to the anti-inflammatory and antibacterial properties of curcumin, which has resulted in improved digestion and nutritional absorption (6). Saponins in turmeric powder can also alter the balance of bacteria in the gut and offer more nutrients, particularly protein, in the small intestine (16).

Table 2 Effect of curcumin on milk composition.

Parameters%	days 0			days 20			days 40		
	C	T1	T2	C	T1	T2	C	T1	T2
Fat	9.24 ±0.19a	9.17 ±0.10a	9.22 ±0.03 a	9.54 ±0.23a	6.98 ±0.20b	7.05 ±0.22 b	9.64 ±0.23 a	7.06 ±0.16 c	7.08 ±0.17b
Protein	5.15 ±0.08 c	5.22 ±0.09 b	5.30 ±0.03a	4.91 ±0.16 c	5.20 ±0.17a	5.11 ±0.15b	4.89 ±0.16 c	5.18 ±0.17 a	5.08 ±0.13b
Lactose	4.90 ±0.08a	4.93 ±0.08 a	4.95 ±0.02a	4.79 ±0.15 c	5.11 ±0.17a	4.84 ±0.14b	4.81 ±0.15c	5.03 ±0.17 a	4.89 ±0.18 b
SNF	10.77 ±0.18 c	10.97 ±0.17 b	11.14 ±0.06 a	10.82 ±0.32c	11.38 ±0.23a	10.88 ±0.23 b	10.89 ±0.33 c	11.28 ±0.37a	10.91 ± 0.33b
Density	35.22 ±0.54c	35.41 ±0.60b	35.64 ±0.21 a	35.31 ±1.11 c	36.60 ±1.33a	36.24 ±1.10b	35.41 ±1.10 c	36.68 ±1.13a	36.29 ±1.11 b

C: control, T1: 50mg curcumin/head/day, T2:100mg curcumin/head/day, SNF: solid non-fat content. Means with different letters within each row differ significantly (P<0.05).

Effect of curcumin on blood serum parameters: The blood serum parameters of each group are presented in (Table 3). The total protein in the blood serum of T1 and control at day 20 day 40 was not significantly differ. At day 20 and 40 triglyceride in the blood serum of T1 showed to be high and significantly different (P<0.05). According to the blood serum cholesterol control had lower value during entire period of experiment, while by daily feeding curcumin supplement at different level the cholesterol in the serum blood of T1 and T2 increased. Blood glucose and creatine were significantly difference between treatment groups during experiment period.

(9) found that different doses of curcumin had varying impacts on the serum biochemistry of nursing lambs. The results of this study agreed with (11), they reported decreasing serum levels of total protein and globulin when sheep fed on 100mg curcumin, while level of cholesterol increased on days 20 and 40. Because globulins are proteins linked with the innate immune response, a decrease in serum total protein and globulin seen in nursing lambs given 200 mg/kg curcumin can be

regarded a detrimental impact of the treatment on the immune response (14 and 22), showed curcumin can lower blood lipid levels. Curcumin use was associated with positive effects due to its hypocholesterolemic effects, as measured by a decrease in total cholesterol and LDL levels and an increase HDL, with these findings linked to the inhibition of the enzyme 3-hydroxi-3-methyl-glutaril-CoA reductase (HMG-CoA reductase) activity (19). (8) noticed that the administration of curcumin in rats with renal impairment reduced urea and creatinine levels.

Table 3 Effect of curcumin on blood serum parameters.

Parameters	days 0			days 20			days 40		
	C	T1	T2	C	T1	T2	C	T1	T2
Total Protein(g/dL)	7.40 ±0.33 a	7.38 ±0.13a	7.35 ±0.14 a	7.52 ±0.35 a	7.55± 0.21a	7.20 ±0.20 b	7.42 ±0.11 a	7.39 ±0.13 a	7.10 ±0.17 b
Triglyceride (mg/dL)	13.62 ±0.53a	13.15 ±0.31 c	13.31 ±0.30 b	21.70 ±0.43 b	22.98 ± 0.45a	19.86 ±0.44c	21.82 ±0.53 b	22.77 ±0.56 a	19.93 ±0.50c
Cholesterol (mg/dL)	52.03 ±0.73 b	50.65 ±0.49 c	55.56 ±0.46 a	50.79 ±0.47 c	53.34 ± 0.49b	56.39 ±0.44a	51.71 ±0.18 c	52.64 ±0.35 b	56.69 ±0.18 a
Creatinine (mg/dL)	0.68 ±0.01 a	0.64 ±0.02a	0.56 ±0.02 b	0.64 ±0.04 a	0.54± 0.03c	0.52 ±0.01b	0.70 ±0.03 a	0.56 ±0.02 b	0.54 ±0.03 b
Glucose (mg/dL)	38.94 ±0.65 a	35.73 ±0.27 c	36.89 ±0.23 b	41.53 ±0.45 a	39.90 ± 0.49b	37.09 ±0.40 c	40.57 ±0.16a	38.68 ±0.34 b	35.97 ±0.22c

C: control, T1: 50mg curcumin/head/day, T2:100mg curcumin/head/day. Means with different letters within each row differ significantly (P<0.05).

Effect of curcumin on the blood hematology: Effect of added curcumin on the blood hematology of ewes is presented in the table 4. Hemoglobin found to be different significantly between groups at various time of experiment. Table 4 showed high value of hemoglobin (Hb) in the middle of experiment, and was significantly differ compared to the other group at same time of experiment. While there was no significant differences between T1 and T2 at the end of experiment. WBC tend to be higher in T1 at day 20 and there was no differences at day 40 between T1 and T2. Lymphocytes percentages were reduced in curcumin treated group on 20 and 40. Curcumin added group T1 did not showed any significant differences according to the monocyte and MCHC at day 40.

(10) observed that curcumin had no influence on the quantity of red cells or hemoglobin content in sheep fed a curcumin-enriched diet. In this study, leukocytes decreased by adding curcumin into the diet. Also, several studies resulted that curcumin supplement had an effect on leukocytes percentages. (8) detected a decrease in the number of leukocytes as a result of reduced lymphocytes in calves fed curcumin concentrate. The anti-inflammatory impact of dietary curcumin was obvious in non-nursing calves due to a decrease in lymphocytes. Curcumin's anti-inflammatory activity is due to its capacity to inhibit nuclear factor kappa B (NF-Kb) and diminish granuloma formation in response to diverse inflammatory stimuli without causing harm to the organism (4). The anti-inflammatory effect of curcumin in the diet was also validated in dairy sheep and lambs by suppression of pro-

inflammatory cytokines and rise of anti-inflammatory cytokines (8). However, (13) explained that reduction of leukocytes and lymphocytes which are known as inflammatory cells is not desirable in the farm animal at high level. As active inflammatory processes take a considerable quantity of ATP, which is thus no longer available for weight growth or production.

Table 4 Effect of curcumin on the blood hematology.

parameters	days 0			days 20			days 40		
	C	T1	T2	C	T1	T2	C	T1	T2
Hemoglobin g/dL	10.80 ±0.86 b	9.87 ±0.79c	11.32 ±0.87 a	10.87 ±0.91b	10.95 ±0.88b	11.15 ±0.89 a	10.53 ±0.84 b	10.95 ±0.88a	11.02 ±0.88a
WBC 10 ³ /mm ³	10.24 ±0.72a	9.76 ±0.68b	10.43 ±0.73a	10.00 ±0.70c	10.78 ±0.75 a	10.20 ±0.73b	9.89 ±0.70 b	10.78 ±0.69 a	10.76 ±0.73a
Lymphocytes %	48.75 ±2.44 b	53.88 ±2.61a	52.24 ±2.69 a	49.87 ±2.49 a	49.90 ±2.50a	48.17 ±2.48b	47.53 ±2.38c	50.02 ±2.45 a	49.81± 2.49b
Monocytes %	2.53 ±0.15a	2.48 ±0.15a	2.38 ±0.14 a	2.53 ±0.16 b	2.85 ±0.14 a	2.49 ±0.17 b	2.53 ±0.15 a	2.48 ±0.14a	2.38 ±0.17b
MCHC g/dL	31.57 ±2.52 a	31.62 ±2.50a	31.34 ±2.51b	32.43 ±2.63b	32.85 ±2.58 a	32.29 ±2.60 b	32.87 ±2.63a	32.69 ±2.62b	32.86 ±2.63 a

C: control, T1: 50mg curcumin/head/day, T2:100mg curcumin/head/day. Means with different letters within each row differ significantly (P<0.05)

Conclusion: Overall, following 40 days of treatment, the addition of curcumin to the sheep diet improved the milk composition, hematological and biochemical variables of serum. Curcumin supplement can be feed local sheep at high dosage, because its affection had significant differences on the production and animal health.

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