Effect of addition Thymol to the diet on growth Performance and Digestibility Coefficient and some blood Biochemical parameters in Arabi lambs

Abbas Nasser.Al-Dabisi[1] Hanaa Ali Al-Galbi[2] and Murtda Faraj Al-Hellou[3]

[1]Animal Production Department, College of Agriculture, University of Basrah, Iraq

[2,3]Department of Biology, College of Education, Qurna, University of Basrah, Iraq

Corresponding author email: abasnaser89@gmail.com, hanaa.jabar@uobasrah.edu.iq,

murtadha.abdulhussian@uobasrah.edu.iq

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Abstract

This study was conducted to ascertain the influence of addition thymol powder to the diet on growth performance, nutrient digestibility and some blood biochemical parameters of lambs fed a diet consisting of 60% concentrated and 40% alfalfa hay. Sixteen Arabi male lambs were randomly distributed into four groups; the first group lambs were received diet without any addition and served as control group, while the second, third, and fourth groups lambs were received 200, 300 and 400 mg thymol.kg^{-1} dry matter, respectively, for 105 days. The results showed that the supplement groups had a significantly higher (P≤0.05) in total and daily weight gain, feed conversion ratio, and feed intake than in control group. Lambs received 300 mg thymol.kg^{-1} significantly improved (P≤0.05) digestibility coefficient of dry matter and nitrogen free extract as compared with control lambs. Lambs received 300 mg thymol.kg^{-1} feed) were higher (P>0.05) than those received 200 mg thymol.kg^{-1} feed in terms of organic matter, crude fiber, cellulose, and hemicellulose digestibility coefficient. Blood urea concentration was significantly lower (P≤0.05) in the second group (200 mg thymol.kg^{-1}) than control group. While other blood parameters such as glucose, total protein, albumin, globulin, cholesterol, triglycerides, phosphorus, and calcium concentrations were not affected by thymol addition. It can be concluded that addition thymol at 300 mg.kg^{-1} enhanced growth performance and nutrient digestibility in Arabi lambs without adverse effect on blood biochemical parameters.

Keywords: Arabi lambs, thymol, growth performance, digestibility coefficient, blood parameters.

Introduction

Growth traits, such as body weight gain in lambs, are among the most vital economic aspects of animal husbandry (5). In animal nutrition, antibiotics previously serve the most popular choice for feed additives due to their significant advantages for productivity and health (8). However, the regular use of these chemical cause's bacterial resistance as well as accumulation of antibiotic residues in animal products, several natural products have been proposed as alternatives to antibiotics (29). Plant-derived natural feed supplements such as saponins and essential oils (3) were investigated as alternatives to antibiotic to improve growth performance and quality characteristics of animal products (18), due to presence the bioactive components in these plants (17, 27). Among these natural alternatives was thyme oil, as the common thyme plant contains thymol as a major compound (2, 17). Thymol-2 (isopropyl-5-methylphenol) is a monoterpenoid found in thyme oil and other plant extracts, and is an aromatic substance that is extracted from the thyme plant, *Thymus vulgaris* (15). Thymol-containing essential oils have been used medically for a variety of conditions, including the treatment of respiratory and digestive system diseases and as an antitussive, expectorant, carminative, and antispasmodic (19, 26), antioxidant, anti-inflammatory (23, 24), antifungal and antimicrobial activities (16, 25). Several studies also indicated the use of thymol as a preservative for foodstuffs and medical preparations (22). However, thymol applications are not only at the pharmacological level, as it was included in the list of generally recognized as safe for use as food additives with minimum toxicity (12), by increasing gastrointestinal secretion and triggering the shape and function of the gastrointestinal system, it is utilized to improve growth, production, and feeding efficiency (20).

Therefore, the aim of this study was to ascertain the effect of different doses of thymol powder addition to the diet on growth performance, digestibility coefficient and some blood biochemical parameters in Arabi lambs.

Materials and Methods

This study was carried out in the college of agriculture's animal field at Basrah University in Iraq. Thymol powder (purity 99%) was imported from Heowns Biochemical Technology Co., Ltd. (Tianjin, China).

Treatments, feeds and Animals

Sixteen Arabi male lambs with 4-5 months of age and average body weights 22.50±0.25 kg were randomly distributed into four groups (4 animal each) in a group feeding. The study continued 105 days, including the adaptation period of 14 days. Lambs were placed in semi-closed pens of equal size, where each treatment was allocated an

appropriate area of 3 ×3 m for each treatment, and the feeding was collective for each group, at a rate of 3% of the mean live weight of the animal group, diet was offered twice daily (at 8:00 AM and 4:00 PM), and consisted of 60% concentrate and 40% alfalfa hay 40% (Table 1). Thymol powder was added at a rate of 0, 200, 300 and 400 $mg.kg^{-1}$ dry matter of feed to the four groups, respectively. Throughout the duration of the trial, the animals continued to receive veterinarian medical treatment, including doses against liver and intestinal worms. with UNLRAFO mectin JECT 1 ml. $animal^{-1}$, as well as the animals were given Booster injection in the thigh at 5 ml. $animal^{-1}$, which is a group of vitamins (A, B, E and D3).

Table 1. Chemical composition of concentrate diet and alfalfa hay used in the current study (on dry matter basis)

Items (%)	Concentrate*	Alfalfa hay
Dry matter (DM)	89.71	91.11
Organic matter (OM)	96.51	93.25
Crude protein (CP)	12.68	16.4
Ether extract (EE)	3.41	1.28
Crude fiber (CF)	7.61	32.28
Nitrogen Free Extract (NFE)	71.77	34.40

*The concentrate feed consisted of 50% barley, 35% wheat bran, 10% yellow corn, 4% soybean meal, 1% vitamins and minerals.

Feed intake and weight gain

The amount of feed offered daily and the amount of feed remain on the next day were recorded to determine the amount of feed intake on a daily basis. The initial weights of the lambs were recorded after they were given two weeks to become used to the research environment before having their weights measured every two weeks in the morning before a meal until the end of the study. The average daily weight gain was calculated by dividing the total weight gain by the number of study days, and the feed conversion ratio was calculated by dividing the amount of feed intake (kg) by the total weight gain (kg).

Digestion trail

At the last week of the experiment, the lambs were located into an individual pens. Feces of each lamb were collected using special collection bags in the morning before feeding, weighed and a 10% sample was obtained, and stored in nylon bags in the freezer until chemical analysis such as dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), and Nitrogen free extract (NFE) were carried out in accordance with the A.O.A.C. (1). The cellulose and hemicellulose contents were calculated according to the method of Van Soest method (30).

Blood collection and Analysis

Blood samples were withdrawn from all lambs using 10 ml syringes via the jugular vein before morning feeding. The blood samples were placed in sterile glass tube with gel and centrifuge at 3000 rpm for 20 minutes to harvest serum. The biochemical parameters were made spectrophotometry methods using commercial kits provided by Biolabo (French) following the instruction of each kit for determined the glucose, total protein, albumin, urea nitrogen, and cholesterol concentrations. The globulin concentration was calculated by subtraction albumin from total protein (10). Triglycerides were estimated according to the method of Fossti and Prencipe (13). Calcium and phosphorus concentration were determined Using a ready-made analytical kit provided by the (Agappe) firm.

Statistical Analysis

The data were analyzed statistically using the SPSS statistical program (28). Completely Randomized Design (CRD) was used using the following model, $Y_{ij} = \mu + T_i + eij$, where Y_{ij} Observation, μ is the overall mean, T_i is the effect of i treatment, e_{ij} is the random error. Means compared using the same statistical program's Duncan Multiple Test at the 0.05 level of significance.

Results and Discussion

Growth performance and feed intake

In Table 2. the results showed that the addition of 300 or 400 mg.thymol.kg^{-1} led to a significant increased ($P \leq 0.05$) in the final body weight of lambs as compared with the control group. No significant differences in final body weight were obtained between lambs second group who received 200 mg thymol.kg^{-1} and control one. Furthermore, results also showed that the addition of 200, 300 or 400 mg thymol.kg^{-1} was significant increased ($P \leq 0.05$) in daily and total weight gain of lambs as compared with control group (0 mg thymol.kg^{-1}), although the statistical analyses were not done for feed intake and feed conversion ratio due to group feeding of lambs in feeding trial, lambs received 300 mg thymol.kg^{-1} feed were higher in total feed intake (80.70 kg) than those control who received 0 mg thymol.kg^{-1} feed (72.78 kg). Results also showed mathematical improved in feed conversion ratio 4.10 and 4.24 kg feed intake.kg weight gain^{-1} for lambs received 300 and 400 mg thymol.kg^{-1} feed, respectively as compared with control one (5.84 kg feed intake.kg weight gain^{-1}). This may be due to thymol, which has been shown to have several beneficial properties, including: immunomodulatory, antioxidant, antibacterial and antitumor properties (21). Thymol supplementation has been shown to improve the growth performance of lambs, including their total and daily weight gain, rumen microbial balance, improved digestive secretion, activation of the digestive system's structure and function, feed conversion effectiveness, and feed intake (11). Increasing feed intake by adding thymol may be related to its ability to

stimulate saliva secretion. Another possible explanation for enhanced feeding and nutrient intake is improved forage digestibility, which should reduce the amount of time the digester spends in the digestive tract (17). In addition, lambs in the third group received 300 mg thymol.kg^{-1} showed the better feed conversion ratio (4.10 kg feed intake.kg weight gain^{-1}). may be due to increasing feed acceptability and intake due to the pleasant smell and flavor of thymol. These results are consistent with Alsaht *et al.* (6) who confirmed that the addition of thymol cinnamaldehyde mixture at 100 and 200 mg.kg^{-1} to the diets of Rahmani lambs led to an improvement in weight gain, feed conversion efficiency and improved feed intake. However, Biricik *et al.* (9) showed that the adding of thymol to the diet of Merino sheep at doses of 100 to 300 mg.kg^{-1} did not change weight gain, feed conversion ratio, or feed intake.

Table 2. Effect of addition thymol on feed intake and growth performance of Arabi lambs (means ± Standard deviation)

Items	Levels of thymol addition				Significant level
	Control	**200 mg thymol**	**300 mg thymol**	**400 mg thymol**	
Initial body weight (kg)	22.25±0.35	22.30±0.33	22.50±0.54	22.52±0.52	NS
Final body weight (kg)	35.70±1.01^{b}	39.92±1.37^{ab}	43.20±0.52^{a}	42.15±2.12^{a}	P≤0.05
Total weight gain (kg)	13.45±0.68^{b}	17.62±1.39^{a}	20.70±0.86^{a}	19.62±1.88^{a}	P≤0.05
Daily weight gain(kg)	0.149±0.70^{b}	0.195±0.01^{a}	0.229±0.09^{a}	0.217±0.02^{a}	P≤0.05
Total feed intake (kg)	72.78	79.80	80.80	79.08	-
Feed conversion ratio (kg feed intake.kg weight gain^{-1})	5.84	4.80	4.10	4.24	-

^{a,b} different letters horizontally mean that there are significant differences (P≤0.05). NS= non-significant. Feed intake and feed conversion ratio were not done in statistical analysis due to group feeding.

Nutrient digestibility coefficient

Lambs fed 300 mg thymol.kg^{-1} showed superiority higher (P≤0.05) in digestibility coefficient of dry matter, and nitrogen free extract than those fed control diet 0 thymol.kg^{-1} (Table.3). Both dry matter and nitrogen-free extract digestibility coefficient were not significant among treatment groups (0, 200, and 400 mg thymol.kg^{-1}). The digestion coefficient of nitrogen free extract exceeded 80% (83.22 and 82.76%, respectively when lambs fed 300 and 400 mg thymol.kg^{-1}). Significant increased (P≤0.05) in digestibility coefficient of organic matter in lambs fed 300 mg thymol.kg^{-1} (77.25%) as compared with those fed 200 mg thymol.kg^{-1} (72.42%). No significant differences were observed among lambs who received 0, 300 and 400 mg

thymol.kg^{-1}. Thymol is crucial for enhancing the bioavailability of nutrients, livestock productivity, public health, and immunity, as well as lowering the issues associated with many animal diseases like cancer and some other diseases (24), may be the cause of the significant superiority of the digestibility coefficients in the current study. These functions can be attributed to thymol's capacity to act as an antispasmodic by preventing free radicals and other potentially harmful substances from interacting with cellular biological components, as well as to its capacity to alter the microbial balance and promote the growth of gut villi, which improves nutrient absorption (4).

Table 3. Effect of addition thymol on nutrient digestibility coefficient in Arabi lambs (% ± Standard deviation)

Digestion coefficient (%)	Levels of thymol addition				Significant level
	Control	200 mg thymol	300 mg thymol	400 mg thymol	
Dry matter	69.56±3.30^{b}	70.54±1.10^{ab}	76.22±1.15^{a}	73.96±0.75^{ab}	P≤0.05
Organic matter	73.06±1.88^{ab}	72.42±0.76^{b}	77.25±1.29^{a}	76.50±1.09^{ab}	P≤0.05
Crude protein	73.95±5.78	73.56±5.26	85.20±2.31	74.09±6.70	NS
Ether Extract	84.54±1.44	85.00±0.68	87.87±0.67	87.02±1.12	NS
Crude fiber	70.41±3.00	66.71±3.24	71.18±1.93	70.51±0.52	NS
Cellulose	55.39±7.39	60.31±3.00	60.65±3.71	64.67±2.09	NS
Hemicellulose	61.81±8.08	58.13±3.82	61.36±2.77	66.68±5.28	NS
Nitrogen free extract	75.74±3.27^{b}	77.56±0.79^{ab}	83.22±1.95^{a}	82.76±1.61^{ab}	P≤0.05

^{a,b} different letters horizontally mean that there are significant differences (P≤0.05). NS= non-significant.

These findings were in line with those reported by Abd El Tawab *et al.* (2) who added thyme powder to the diet of Barki ewes at a rate of 20 g.ewe^{-1}, and they found that the digestibility coefficients were significantly higher (P≤0.05) in ewes fed thyme powder than ewes fed control diet. Also, Ghoneem and Mahmoud (14) reported significant improvement (P≤0.05) in dry matter and organic matter digestibility when thyme leaf powder and thyme oil were added to the diets of Damascus female goats as compared with those in control group. However, these results disagreed with the findings of Alsaht *et al.* (6) who reported no significant difference on nutrient digestibility when added a mixture of thymol cinnamaldehyde at 100 and 200 mg.kg^{-1} to the diets of Rahmani lambs.

Blood biochemical parameters

According to Table 4. The blood urea nitrogen concentrations in lambs fed 200 mg thymol. kg^{-1} (20.70 mg.100 ml^{-1}) were lower significantly (P≤ 0.05) than those in control group (33 mg.100 ml^{-1}). Thymol addition which changed the microbial activity in the rumen, reduced the amount of protein breakdown, and stimulated nitrogen escape from the rumen in its form. As a

result, the animal benefited and the low concentration of urea in the treatment was produced. Inhibiting the ammonia-producing bacteria slows down the rate at which the amine group is removed in the rumen (14). Results in Table 4. also showed that thymol addition did not affect serum total protein, albumin, globulin, glucose, triglyceride and cholesterol concentrations. Calcium and phosphorus concentrations are also not affected by thymol addition.

Table 4. Effect of addition thymol on some blood parameters in Arabi lambs (means ± Standard deviation)

Items	Levels of thymol addition				Significant level
	Control	200 mg thymol	300 mg thymol	400 mg thymol	
Total protein (g.100 ml^{-1})	7.24±0.30	7.10±0.55	7.70±0.48	7.65±0.10	NS
Albumin (g.100 ml^{-1})	3.64±0.11	4.10±0.73	3.36±0.18	3.18±0.82	NS
Globulin (g.100 ml^{-1})	3.60±0.36	3.00±0.73	4.43±0.63	4.46±0.16	NS
Glucose (mg.100 ml^{-1})	70.60±5.79	77.30±6.81	72.15±3.56	78.97±2.63	NS
Urea nitrogen (mg.100 ml^{-1})	33.00±4.76^{a}	20.70±1.14^{b}	28.02±1.75^{ab}	24.35±2.08^{ab}	P≤0.05
Cholesterol (mg.100 ml^{-1})	37.10±3.55	38.35±1.44	48.40±4.60	36.20±5.40	NS
Triglyceride (mg.100 ml^{-1})	19.40±2.47	17.62±0.35	24.40±4.13	20.37±3.13	NS
Calcium (mg.100 ml^{-1})	10.18±1.01	9.39±0.94	10.28±0.97	10.82±1.02	NS
Phosphorous(mg.100 ml^{-1})	5.73±0.63	5.82±0.43	5.92±0.67	6.03±0.45	NS

^{a,b} different letters horizontally mean that there are significant differences (P≤0.05). NS= non-significant.

The decrease in concentration of urea nitrogen in this study was consistent with the results obtained by Baraz *et al.* (7), who reported significant decrease (P≤0.05) in the urea concentration when thyme oil was added at a rate of 9 $ml.day^{-1}$ to the diet of Holstein cows as compared with control group. Similar results reported by Ghoneem and Mahmoud (14), who noticed significant decrease (P≤0.05) in urea nitrogen concentration when added thyme oil at 10$g.kg^{-1}$ dry matter to the diets of Damascus female goats. In contrast, Biricik *et al.* (9) found that the addition of thymol at 100 and 300 $mg.kg^{-1}$ to the diet of Merino sheep did not affect the blood urea nitrogen, glucose, protein, and albumin concentrations.

Conclusion

From the results obtained in this study it can be concluded that addition thymol at 300 $mg.kg^{-1}$ feed enhanced growth performance of Arabi lambs in terms final body weight,

daily and total weight gain, and improved dry matter and nitrogen-free extract digestibility coefficient. Thymol addition did not alert biochemical parameters such as glucose, protein, albumin, globulin, triglycerides, cholesterol, calcium and phosphorus concentration.

Conflict of interest

The authors declare no conflict of interest.

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