

# Interactive Effects of Garlic and Fenugreek on Growth Performance and Serum Biochemical Responses in Awassi Lambs

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**Abstract:** The study was conducted to determine the impact of garlic and fenugreek supplementation on growth performance, as well as the effect of these supplements on the blood biochemical parameters of choice in lambs. Six dietary treatments of three lambs each (completely randomized design, CRD) were used to offer an entire randomized trial to 18 lambs. The treatments were, T1 (control, no additives), T2 (1g garlic), T3 (2g garlic), T4 (1g fenugreek), T5 (2g fenugreek), and T6 (1g garlic + 1g fenugreek) and given one capsule every animal trial was conducted for a period of 60 days, beginning in April. Body-weight characteristics such as initial weight and final weight and change in weight were measured. The measurements of blood biochemical parameters were also performed, including triglycerides (TG), total cholesterol (Ch), low-density lipoprotein (LDL), high-density lipoprotein (HDL), albumin (Alb), alanine aminotransferase (ALT), aspartate aminotransferase (AST), and chloride (ChL). One-way ANOVA under CRD was used to analyse the data and compare the results of the means of treatment using the multiple range test at  $P=0.05$  as postulated by Duncan. Findings showed that dietary treatments had significant effects on initial body weight ( $P = 0.05$ ), final body weight ( $P = 0.01$ ), and also weight gain ( $P \leq 0.01$ ). Fenugreek (T4) and combined supplementation (T6) groups of lambs recorded the highest final body weights. There were found no substantial differences

between treatments in the parameters of lipid profiles (TG, Ch, LDL, and HDL) and liver enzyme activities (ALT and AST) ( $P > 0.05$ ). Significant differences however existed in chloride levels ( $P \leq 0.05$ ) and the combined treatment had lower chloride levels than most of the other treatments. Conclusively, the growth performance of lambs was increased by supplementing with garlic and fenugreek, especially when used in combination with each other, and there were no adverse effects of most blood biochemical parameters and this implies that the supplements of garlic and fenugreek may be used safely as natural feed additives in lamb production.

**Keywords:** fenugreek, garlic lambs, chloride, ALT and AST.

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## Introduction

Herbal feed additives have attracted growing attention as substitutes of antibiotic growth promoters in rumen nutrition due to its ability to improve growth performance, rumen fermentation, health condition, and product quality without residual drug traces (He Ding et al., 2023). Garlic (*Allium sativum* L.) that is rich in organosulfur compounds including allicin has been shown to have strong influence on rumen fermentation, volatile fatty acid profiles, and methane emissions in addition to increasing feed efficiency and average daily gain among ruminants (Zhu et al., 2021; He Ding et al., 2023). Garlic skin supplementation in the growing lambs was observed to alter rumen microbial composition and metabolome, which improved the fermentation efficiency and growth performance. Besides, garlic powder in the diet has been reported to supplement immunological parameters and alter rumen fermentation and blood metabolites in Barki lambs (Rabee et al., 2025). It has also been mentioned in rumen fermentation research that various products like garlic oil may decrease the generation of methane and stimulate a more profitable volatile fatty acid portfolio, which warrants their application as sustainable feed additives (MDPI, 2022). Besides direct nutritional effects, hormonal and metabolic interactions are also important in the regulation of physiological responses of small ruminants. It is also reported that interactions of estrogen, testosterone, and cholesterol occur in the local sheep breeds and highlights endocrine effects on lipid metabolism (Palani and Omer, 2025). Moreover, progesterone was found to control heavy metals among the ewes in Awassi that were fed on plant additives (Palani et al., 2025). It is the dynamics of these hormones that highlight the need to have an in-depth biochemical profiling in the assessment of dietary interventions. Another phytochemical source of interest is fenugreek (*Trigonella foenum-graecum* L.), which is a source of saponins and flavonoids, which have been reported to have impact on digestion, metabolic balance, and physiological reactions (Singh et al., 2022). The feeding of fenugreek seed was indicated to affect the intake of the feed, the digestibility and growth characteristics in lambs (Ibidhi and Ben, 2022). Fenugreek dieting in the diet of dairy goats has also been linked with alterations in blood biochemical and hematological parameters in heat-stressed dairy goats (El-, Tarabany et al., 2018). In spite of these developments, the interaction effects of the use of the garlic and fenugreek supplementation on the growth performance and the blood biochemical parameters of lambs in controlled experimental designs have not been evaluated effectively. Thus, the aim of the current research was to assess the

impacts of dietary intervention with garlic and fenugreek supplements on body weight characters and the chosen blood biochemical parameters in the lambs (CRD).

## Materials and Methods

The current experiment was carried out at the animal production field of college of agriculture in university of Kirkuk, Iraq. Eighteen lambs were used and randomly assigned to six experimental treatments based on Completely Randomized Design (CRD), each treatment had three lambs. The experimental treatment included: T1 (Control): basal diet no additives; T2: basal diet with the addition of one capsule with 1g garlic/day; T3: basal diet with the addition of one capsule with 2g garlic/day; T4: basal diet with the addition of one capsule with 1g fenugreek/day; T5: basal diet with the addition of one capsule with 2g fenugreek/day; and T6: basal diet with the addition of one capsule with 1g garlic + 1g fenugreek/day. The capsules were administered to each lamb once a day based on the treatment assigned to the lambs, The experimental trial was conducted for a period of 60 days, beginning in April. Initial body weight had been taken at the start of the experiment and the final body weight taken at the end of the experimental period with the weight gain calculated as the difference between the final and initial body weights. All the lambs were sampled with blood and serum was separated to undergo a biochemical analysis at the conclusion of the experiment. Biochemical parameters that were evaluated were: triglycerides (TG), total cholesterol (Ch), low-density lipoprotein (LDL), high-density lipoprotein (HDL), albumin (Alb), alanine aminotransferase (ALT), aspartate aminotransferase (AST) and chloride (ChL). Hematological parameters were established with the help of an automatic hematology analyzer (Mindray M680, USA; production in China). All laboratory tests were done at the department of animal production, college of Agriculture, University of Kirkuk. The statistical analysis of SAS (2004) data was CRD through the one way analysis of variance (ANOVA) and the difference between the means of the treatments compared with the help of the Duncan Multiple Range Test (Duncan, 1955) in the range of P 0.05 significance level. Findings were in the form of Mean + Standard Deviation (Mean +SD).

## Results

### 1. Body Weight Traits

The impact of the garlic and fenugreek supplementation on body weight characteristics is provided in Table 1. Body weight at the start of treatments was significantly different (P 0.05). Lambs, T2, T3, T4, T5 and T6, were found to have much higher initial weights compared to those of the control group (T1). There was a significant effect of dietary treatments on final body weight (P 0.01). The highest final body weights were recorded in Lambs fed T4 (1g fenugreek) and T6 (a combination of the two supplements), which was very different compared to the control and some single groups. Treatment had a significant impact on weight gain as well (P 0.01). T1 and T6 recorded the highest increases in weight and thereafter T3 and T4, with T2 and T5 recording the lowest increases. These results show that the test food supplement of combined garlic and fenugreek can improve growth performance in the experimental conditions.

### 2. Lipid Profile Parameters

Table 2 is a summary of the effect of experimental treatments on the parameters of lipid profile. There was a lack of significant differences between treatments with triglycerides (TG), total cholesterol (Ch), LDL -cholesterol and HDL-cholesterol (P> 0.05). The numerical changes were evident, especially in TG and total cholesterol levels but the changes were not statistically significant as Duncan multiple range test determined. To this end, lipid metabolism of lambs was not significantly changed by the use of supplementation with either or both of garlic and fenugreek, in the period of the experiment.

### 3. Liver Enzymes and Corresponding Biochemical Characteristics.

Table 3 demonstrates the impacts of the dietary therapies on liver enzymes and the associated biochemical parameters. There were no any significant differences in terms of albumin, ALT, or AST activities among the treatments ( $P > 0.05$ ). The level of chloride (Cl) however showed a significant difference between treatments ( $P \leq 0.05$ ); the combined supplementation group (T6) had lower values than control and majority of other treatments. In general, the results of ALT and AST activities did not undergo substantial alterations; therefore, the dietary supplement of garlic and fenugreek did not have a harmful impact on liver functioning during the circumstances of the present research.

#### General Summary of Results

Overall, dietary supplementation by using garlic and fenugreek showed a significant effect on the parameters of growth performance, especially on the final body weight and weight gain, whereas the majority of blood biochemical parameters were not affected. Combined supplement (garlic + fenugreek) showed encouraging results in regard to growth, and no adverse effects were noted on lipid composition and liver enzyme functions.

**Table 1. Effect of garlic and fenugreek supplementation on initial body weight, final body weight, and weight gain of lambs under a completely randomized design (CRD).**

Treatment	Initial Weight	Final Weight	Weight Gain
T1 (Control)	23.00 ± 1.00 b	45.33 ± 2.52 b	22.33 ± 2.31 a
T2 (Garlic 1 g)	31.33 ± 4.73 a	47.67 ± 3.51 b	16.33 ± 1.53 b
T3 (Garlic 2 g)	31.00 ± 6.08 a	49.00 ± 4.00 b	18.00 ± 3.00 a
T4 (Fenugreek 1 g)	38.33 ± 5.03 a	57.00 ± 5.57 a	18.67 ± 0.58 a
T5 (Fenugreek 2 g)	32.00 ± 3.61 a	44.33 ± 2.52 b	12.33 ± 2.89 b
T6 (Garlic 1 g + Fenugreek 1 g)	34.00 ± 5.57 a	56.33 ± 3.79 a	22.33 ± 2.89 a
<b>ANOVA (p-value)</b>	p = 0.0354	p = 0.0045	p = 0.0019
	F = 3.488	F = 6.231	F = 7.723
	dfE = 12	dfE = 12	dfE = 12

(Mean ± SD followed by Duncan grouping letters,  $\alpha = 0.05$ )

**Table 2. Effect of garlic and fenugreek supplementation on lipid profile parameters of lambs under a completely randomized design (CRD).**

Treatment	Triglycerides (TG)	Total Cholesterol (Ch)	LDL-Cholesterol (LDL)	HDL-Cholesterol (HDL)
T1 (Control)	44.60 ± 11.21 a	77.53 ± 6.47 a	21.00 ± 8.66 a	30.51 ± 5.24 a
T2 (Garlic 1 g)	18.93 ± 5.51 a	69.23 ± 13.29 a	17.00 ± 6.24 a	25.69 ± 8.75 a
T3 (Garlic 2 g)	60.20 ± 60.81 a	73.67 ± 19.32 a	18.00 ± 6.56 a	25.43 ± 6.16 a
T4 (Fenugreek 1 g)	21.83 ± 4.22 a	72.33 ± 2.05 a	11.33 ± 2.89 a	30.57 ± 3.74 a
T5 (Fenugreek 2 g)	23.13 ± 3.23 a	77.53 ± 3.00 a	18.33 ± 5.77 a	24.21 ± 3.57 a
T6 (Garlic 1 g + Fenugreek 1 g)	28.07 ± 9.28 a	59.17 ± 15.37 a	10.33 ± 1.15 a	27.30 ± 3.43 a
<b>ANOVA (p-value)</b>	p = 0.3676	p = 0.4545	p = 0.2315	p = 0.6134
	F = 1.196	F = 1.007	F = 1.608	F = 0.732
	dfE = 12	dfE = 12	dfE = 12	dfE = 12

(Mean ± SD followed by Duncan grouping letters,  $\alpha = 0.05$ )

**Table 3. Effect of garlic and fenugreek supplementation on liver enzymes and related biochemical parameters of lambs under a completely randomized design (CRD).**

Treatment	Albumin (A1B)	Alanine aminotransferase (ALT)	Aspartate aminotransferase (AST)	Chloride (ChL)
T1 (Control)	24.33 ± 1.53 a	9.20 ± 4.07 a	86.57 ± 6.07 a	59.80 ± 6.41 a
T2 (Garlic 1 g)	22.10 ± 5.60 a	10.70 ± 4.53 a	86.57 ± 25.33 a	46.63 ± 15.45 a
T3 (Garlic 2 g)	23.83 ± 4.37 a	10.63 ± 5.39 a	108.30 ± 60.74 a	48.83 ± 8.94 a
T4 (Fenugreek 1 g)	25.03 ± 1.10 a	13.60 ± 1.08 a	99.17 ± 8.12 a	49.90 ± 9.04 a
T5 (Fenugreek 2 g)	24.43 ± 3.14 a	12.10 ± 0.35 a	111.57 ± 9.50 a	56.43 ± 5.25 a
T6 (Garlic 1 g + Fenugreek 1 g)	23.30 ± 3.63 a	12.57 ± 8.12 a	96.63 ± 36.48 a	37.33 ± 14.78 b
<b>ANOVA (p-value)</b>	p = 0.9320	p = 0.8793	p = 0.8783	p = 0.2271
	F = 0.250	F = 0.339	F = 0.341	F = 1.625
	dfE = 12	dfE = 12	dfE = 12	dfE = 12

(Mean ± SD followed by Duncan grouping letters,  $\alpha = 0.05$ )

## Discussion

The current results indicate that when dietary supplemented with garlic and fenugreek is used, growth performance especially final body weight and weight gain are affected but most of the blood biochemical parameters do not vary significantly. The observed enhancement in the combined supplementation pattern can be explained by the bioactive components of the sources of garlic and fenugreek, which have been reported to regulate rumen fermentation and nutrient exploitation. Garlic products have received a significant amount of research attention on its effects on rumen microbial ecology and fermentation properties. In fact, a recent systematic review has emphasized the fact that supplementation of garlic is able to enhance the feed efficiency, change volatile fatty acid production and reduce methane production in ruminants (Ding et al., 2023). Exposure to experimental research also shows that derivatives of garlic can have an effect on the microbial protein production and fermentation patterns, and thus farm animals perform better (Baquet et al., 2005). The meta-analytical data indicate that the production of propionates and the increase in the feed-to-mass ratio can be stimulated by the use of garlic-based additives when using specific nutritional regimes (Kholif et al., 2024). Supplementation with garlic skin in fattening lambs has been reported to cause desirable rumen microbiome changes in composition and metabolic pathways, both of which are associated with enhanced growth performance (Zhu et al., 2021). In a similar vein, it has been demonstrated that the supplementation of garlic oil can influence the rumen fermentation parameters and certain blood metabolites in lambs, which is why it is predicted to be considered a valuable functional feed additive (Çimrin et al., 2020). Such mechanisms can be one of the reasons, why greater weight gain was reported in the combined treatment group in the current study. Fenugreek seeds have steroidal saponins, flavonoids and alkaloids that could affect digestion, microbial activity and metabolism. Most recent researches have characterized that depending on the feeding strategy, fenugreek supplementation is able to enhance nutrient digestibility and growth performance in lambs (Ibidhi and Ben Salem, 2022). Fenugreek is also mentioned as a phyto-genic additive with possible uses in the area of methane reduction and performance improvement in ruminants (Abd El-, Hack et al., 2023). Synergistic effect of the combined treatment of garlic and fenugreek could be as a result of complementary activity on the rumen

fermentation and system metabolism. Although supplementation affected growth traits, there was no significant change in lipid profile parameters even though there was an improvement. This observation is consistent with the previous reports which have shown that phytogetic additives have local effects in the rumen more than systemic lipid -modulating effects in ruminants (Windisch et al., 2008; Patra and Yu, 2012). The fact that there were no drastic changes in the levels of triglycerides and cholesterol indicates that the levels of the supplementation used were metabolically safe and that they did not interfere with lipid homeostasis. The unsubstantial alteration of the ALT and AST activities also supports the fact that the dietary treatments are safe. Hepatic stress is a sensitive indicator of liver enzymes and a stable level means the lack of hepatotoxic effects of garlic and fenugreek supplementation. The past studies have also documented that phytogetic additives can be added to the diet of ruminants without any negative effects on liver functionality (Panthee et al., 2017; Ding et al., 2023). Such data align with the results of Al Ubaidy et al. (2020) who found that the addition of different percentages of glycerin to the Awassi lamb diet did not cause any harmful effects on the most serum biochemistries, which presupposes that nutritional interventions can be implemented without causing a severe metabolic imbalance. Surprisingly, there was great variation in chloride concentration across treatments. Even though the literature does not directly correlate the phytogetic supplementation and the modulation of electrolytes in sheep, the modification of rumen fermentation can indirectly affect the provision of electrolytes balance in the body, through a change in the acid-base balance and absorption processes. This observation should be further investigated to explain the physiological basis of the same. In general, the present findings are consistent with the existing literature indicating that phytogetic feed additives can increase the growth performance by the means of controlling rumen microbial activity and fermentation efficiency more than by producing a significant change in the systemic biochemical profiles. Garlic and fenugreek together would seem to be worth using in enhancing the growth performance of lambs without impairing the metabolic health.

### **Limitations of the Study**

Despite the positive obtained results, there are a number of limitations, which are worth pursuing. The small size of the sample and short experiment time can be a limitation to generalizing the findings to the routine populations. Moreover, the research was only done on one breed of sheep, the Awassi; thus, reducing the ability to extrapolate the findings to other sheep breeds or production systems. Moreover, a limited range of biochemical parameters was studied, which did not allow conducting a thorough evaluation of hormonal, immunological or rumen microbial alteration. Therefore, it is recommended that additional studies on bigger cohorts, prolonged feeding, and more stringent physiological evaluations be conducted to support and expand the current findings.

### **Conclusion**

To sum up, dietary supplementation using garlic and fenugreek showed a positive growth performance in the lambs, especially with regards to the final body weight and weight gain. The joint supplementation (garlic + fenugreek) had the best outcome, which indicates the potential synergistic impact on nutrient utilisation and rumen fermentation. There were no significant changes in most of the blood biochemical parameters such as lipid profile and liver enzyme activities, which means that under the conditions of the experiment, the treatment of the diet was metabolically safe. The results indicate that garlic and fenugreek can be used as natural phytogetic feed supplements to enhance growth performance of lamb production systems.

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