Mitigation of The Diet Using Dried Olive Pulp and Its Effect on Growth and Food Utilization Efficiency in Awassi Lambs

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Abstract

Fifteen 5-6 months old Awassi lambs ages, weighing an average of 31.5 kg, were evaluated for their growth and blood parameters in relation to the level of their olive pulp they consumption. The lambs were divided into three groups. Each group received 3% of its body weight of concentrate feed manufactured by Erbil Feed in pellet form. The first group received was the control fed with concentrate feed without olive pulp, the second and third treatments were also fed the concentrate feed, but contained 5% and 10% air-dried olive pulp respectively. The results indicated that there were no significant differences in average weight but noticed non- significant increase in the treatments fed olive pulp compared to the control, also, it was more economical. Blood parameters showed that feeding 5% olive pulp to the lambs led to significant decreases in total protein, globulin, and urea concentrations compared to the other two treatments. Triglyceride and low-density cholesterol concentrations decreased significantly in the two olive pulp treatments compared to the control. However, the concentrations of cholesterol and high-density cholesterol decreased significantly in the 10% olive pulp treatment compared to the other two treatments. In conclusion, olive pulp feeding had no adverse effect on lambs growth and it increased economic inputs.

Keywords: olive pulp, growth, economic feasibility, sheep.

Introduction

Most feed manufacturers use agricultural by-products in certain proportions, which may range from 5-10% of the feed ingredients, depending on their energy and protein content and cost. This increases the diversity of raw materials in the feed and reduces production costs. It can also enhance productivity due to its content of

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metabolically active compounds, such as flavonoids, gallic acid, and tyrosol. Additionally, it raises the antioxidant capacity of animals due to its content of free phenols and other compounds **[4] [27]**. Over the past two decades, competition among breeders to obtain agricultural manufacturing residues has become intense. This has led to a significant increase in the residues' marketing value due to the decline in agricultural areas for strategic crops **[18]**, such as cereals and oil crops, as a result of global warming, lack of rainfall, and demographic changes caused by the migration of peasant laborers to cities to increase their income, these changes reflect inflation in the global economy. Olive industry residues are among these agricultural products. Olive trees are among the most widespread fruit trees in Iraq **[23]**. According to the Ministry of Agriculture statistics, local production reached about 35,000 tons in 2021. Nineveh Governorate's production constituted about 20% of the total production in Iraq **[29]**, or 7,000 tons. Olive juice residues constitute an estimated 35-40% **[16]**. Failure to exploit large quantities of waste may result in environmental issues, especially since modern methods of exploitation are lacking. Using the waste in animal nutrition may be the best solution. Olive kernel waste contains a high percentage of fiber and ether extract, while the protein percentage is low. Fiber is associated with a high percentage of lignin **[17] [9] [21]**. Studies have also indicated that using olive juice residues in sheep feed improves the quality and flavor of the meat due to its high content of unsaturated fatty acids. Additionally, studies have observed increased antioxidant capacity in animals fed olive pulp due to the increased intake of free phenolic compounds in the pomace **[14]**. An important observation in animal fattening projects is that increasing the level of nutrient concentrates and their fermentation by rumen microorganisms leads to a marked increase in volatile fatty acids and a decrease in rumen pH value. When this exceeds the absorption capacity of the rumen, it may lead to rumen acidity and damage to the rumen epithelium, ultimately impairing animal performance **[20]**. The Purpose of this study was to investigate the effect of different proportion of olive pulp on growth performance and Biochemical blood parameters in Awassi Lambs.

Materials and Methods

The study was conducted from April 24 to June 24, 2024, in the animal field of the Department of

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Animal Production at the College of Agriculture and Forestry at the University of Mosul. Fifteen Awassi lambs, aged 5-6 months and weighing an average of 31.5 kg, were subjected to a preventive health program under the supervision of a veterinarian to ensure their safety from diseases during the study period. The lambs were divided into three groups. Each group was fed 3% of its body weight of a concentrate feed manufactured by Erbil Feed in pellet form, as shown in Table 1. The first group was fed the concentrate feed without olive pulp, and was considered the control treatment. The second and third treatments were fed with concentrate feed manufactured to obtained, 5% and 10%, respectively, of air-dried olive pulp. Table 2 shows the chemical composition of olive pulp. The lambs were weighed every two weeks during the 60-day study period. At the end of the study, blood samples were drawn from the jugular vein using 10-ml plastic syringes. The samples were placed in glass tubes without anticoagulants. The serum was separated and kept for the estimation of blood chemistry characteristics, including lipid profile, urea, glucose, and total protein, using a spectrophotometer from the British company EMC. A randomized complete design (CRD) with one-way ANOVA was used to conduct the statistical analysis of the data. Duncan's polynomial test **[15]** was used to compare the means, and the significance level of the studied traits was determined at a 5% probability level.

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Table 1. Ingredients of concentrate feed

Chemical composition according matter as it is

Ingredients	%	Chemical composition	%
Soya bean meal	17	Dry matter	90.34
Sunflower meal	5	Crude protein	17.85
Crushed chickpea	7	Crude fiber	6.82
Soya bean hulls	4	Ether extract	1.92
Yellow corn	20	Crude Ash	5.15
Wheat bran	10.475	Nitrogen Free Extract	58.59
Wheat flour	6.5	Metabolic energy Kcal/kg	2799
Barley	23		
Molasses	4		
Limestone	1		
Ruminant premix	0.5		
Salt	1		
Appetite	0.025		
Sodium bicarbonate	0.5		
Total	100		

Table 2. chemical composition and fatty acids content of olive pulp.

Chemical compositon	%	Fatty acids content	%
Dry matter	86.7	Palmitic acid	**0.92**
Crud protein	8.9	Palmitoleic acid	**0.09**
Ether extract	5	Stearic acid	**0.25**
ash	6.8	Oleic acid	**6.46**
Lignin	26.7	Linoleic acid	**1.01**
Natural detergent fiber	68	Linolenic acid	**0.08**
Acid detergent fiber	52.8	Arachidic acid	**0.04**

Chemical composition determined according to **[6]** in Erbil Feed Company laboratory. Fatty acids content analyzed using gas chromatograph interfaced to a mass spectrometer (GC-MS).

Results and Discussion

diagram 3, showed the results of the mitigation of the diet using dried olive pulp. There were no significant differences in final body weight or total weight gained. The values reached 44.4, 45.30, and 44.60 kg in

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the first, second, and third treatments, respectively. There were also no significant differences in total weight gained. The values reached 12.9, 13.6, and 13.1 kg in the first, second, and third treatments, respectively. Adding olive pulp to feeds at 5% and 10% improved growth performance but not significant in lambs compared to the control group, this may be due to olive pulp lack of negative effects on digestion or rumen fermentation patterns, despite its low digestibility and high fiber content. Lignin and nitrogen are bound to the acid-detergent fiber, lignin, and tannins. Therefore, Possible explanation for the improved growth performance of lambs in this study that olive pulp serves as a dilution of concentrated feed, leading to microbial activity on the nutritional compounds of other feed sources. Additionally, **[19]** showed that high proportions of oleic acid have a minimal impact on rumen bacteria. Additionally, the proportions used in the study were within the ideal proportion of olive pomace in sheep feed, which should not exceed 12% **[7]**. Most studies on this topic agree with the current study's results that using olive pulp has no negative effect on weight gain or final marketing weight. **[10]** showed that using different percentages of olive pulp in Moroccan lamb feed did not lead to significant differences in final weight or total or daily weight gain. There was a tendency toward increased weight gain when olive pulp was used in feed. **[22]** used 12% olive pulp in the diets of Najdi lambs and reported that the results did not indicate significant differences in final weight; however, this was accompanied by a significant increase in daily weight gain compared to the control group. **[2]** confirmed that replacing jute meal with olive pulp in different proportions did not cause significant differences in final weight or weight gain. These results align with those of **[26]**, who demonstrated that using olive pulp at 0%, 10%, or 20% in concentrated feed for Merino-Kivircik lambs did not result in decreased weights, and there were no significant differences between treatments. **[17]** found comparable results in final weight and weight gain of lambs when using olive pulp at 10% and 20%, compared to the control. Similar results were found in the work of **[13]** used two feeds to feed lambs: the first was a control feed, and the second contained 8% olive pulp, 18% corn fermentation residues, and 18% citrus pomace. Likewise, **[21]** found un significant increase in the final weight and weight gain in kids fed with 20% olive pulp in diet content. The results showed no significant differences in

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final weight or daily weight gain between lambs that consumed both feeds. In another study, **[3]** reported that Barbary sheep fed 30% olive pulp had the greatest weight gain compared to other proportions of 0%, 10%, 15%, and 25%.**[28]** used olive pulp with concentrate feed in ratios of 3:1, 1:1, and 1:3, in addition to a control group that was fed 2% of its body weight and did not receive olive pulp. Their results indicated that using olive pulp at a ratio of 1:3 with concentrate feed significantly increased the final weight of goat calves. The 1:3 ratio of olive pulp to concentrate feed significantly increased the final weight of goat calves compared to the other treatments. Unlike previous studies, **[8]** found that feeding sheep giblets with 20% olive pulp resulted in a significant decrease in final weight. This decrease in weight was due to the negative effect of olive pulp on the digestion of food compounds. Similar results were obtained in calf studies. For example, **[12]** showed that including olive pulp in calf feed at 7.5% or 15% resulted in significant increases in weight gain and final weight compared to the control group. However, **[11]** showed that final weight reduction in calves fed different levels of olive pulp was 10% and 15%, respectively, compared to the control group.

The results of the statistical analysis, shown in diagram 4, revealed that there were no significant differences in concentrated feed intake among the three treatments. The intake was 45, 42.75, and 40.5 kg, respectively. However, there were arithmetic differences in feed efficiency among the diets of the second treatment. It reached 0.322 kg, compared to 0.291 and 0.318 kg for the first and third treatments, respectively. These results are consistent with those of **[22]**, who found that feed utilization efficiency significantly improved when 12% of the feed ingredients were replaced with olive pulp. However, **[13]** showed that differences in food conversion efficiency were not significant when sheep were fed a mixture of agricultural residues containing 8% olive pulp. Studies have confirmed that adding olive pulp to feed improves its economic cost because of its low cost and lack of negative impact on lamb productivity **[2] [28] [21].**

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When the results of this study were compared with those of other studies on Awassi lambs, **[25] [18]** it was noted that the rate of weight gain was significantly higher. This may be due to the diversity and balance of the components in the commercial feed manufactured by Arbil Feed, as opposed to the traditional feeds used in previous studies. Furthermore, diluting the feed with olive pomace resulted in a slight increase in weight compared to the control group. This may be due to the antioxidant and polyphenol content of olive pomace, which reduces oxidative stress and promotes digestive health, thereby improving feed utilization.

The economic feasibility in diagram 5, the third treatment was the most feasible. It consumed a total of 49.5 kg of feed at a price of 18.35 USD. This is compared to the first and second treatments, which consumed 54 and 51.7 kg of feed at prices of 20.28 and 19.32 USD, respectively.

figar (3) the effect of Mitigation of the diet using dried olive pulp on Final weight and Total gain

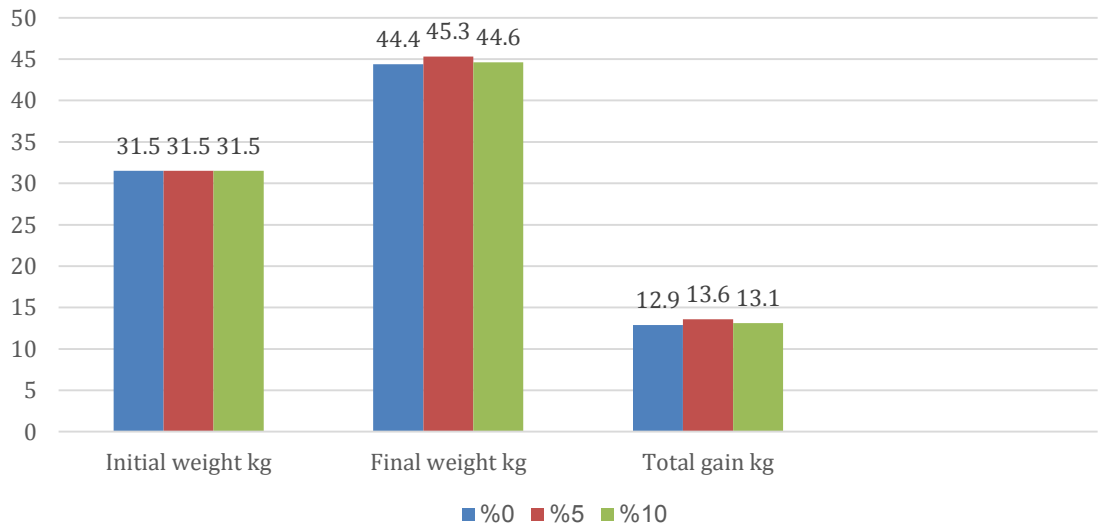

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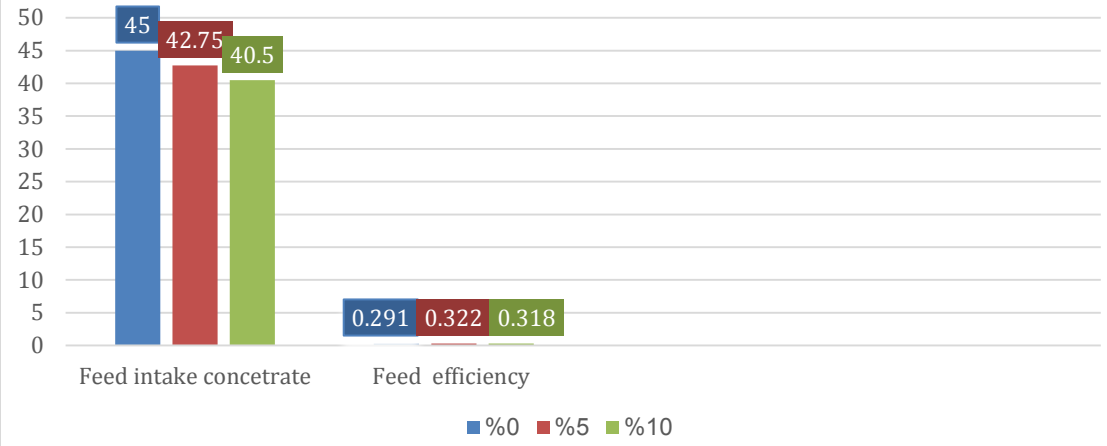
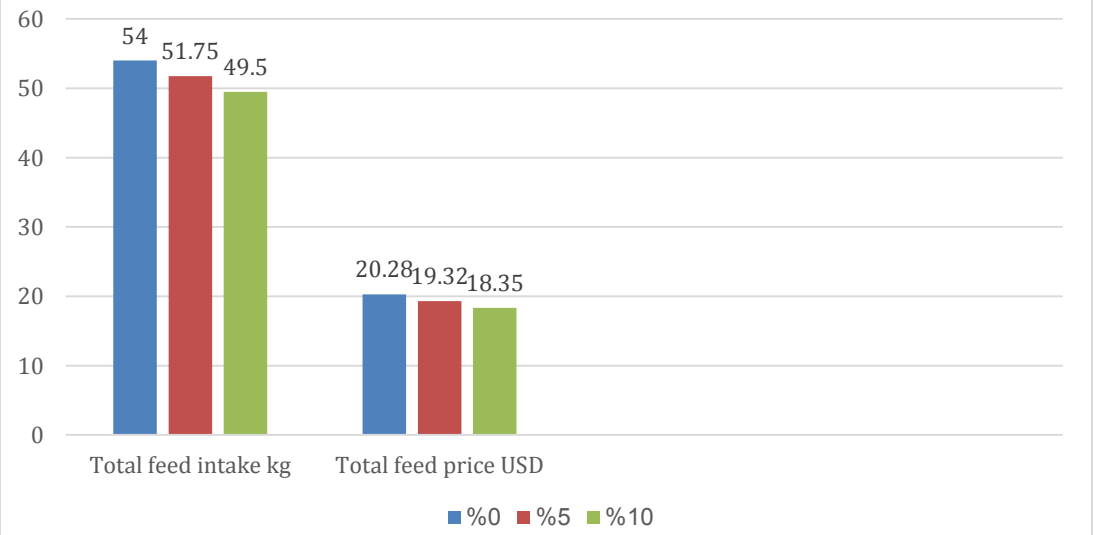
diagram (4) the effect of Mitigation of the diet using dried olive pulp onFeed intake and Feed efficiency



figar (5) the effect of mitigation of the diet using dried olive pulp on Total feed intake and Total feed price



The effect of olive pulp on biochemical blood characteristics in Table (4) shows that the statistical analysis revealed significant differences in the increase of blood total protein in favor of the third

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treatment. The value reached 7.98, compared to 7.03 g/dl for the second treatment. No significant differences were observed in albumin among the three treatments. The significant increase in globulin and blood urea was observed in the first and third treatments. The globulin values reached 3.52 and 3.65 g/dl, respectively, and the urea values reached 60.3 and 57.35 mg/dl, respectively, compared to the second treatment where the globulin value reached 3.12 g/dl and the urea 52.17 mg/dl. No significant differences were observed in the glucose content of the olive pulp. A significant increase in triglyceride levels was observed in the first treatment, reaching a value of 22.73 mg/dl, compared to values of 10.06 and 9.62 mg/dl for the second and third treatments, respectively. As for cholesterol and high-density fats, the significant increase was in the first and third treatments. The values reached 69.7 and 68.01 mg/dl for cholesterol and 28.98 and 28.53 mg/dl for high-density lipoproteins, respectively, compared to 51.61 and 19.90 mg/dl for the third treatment. A significant increase in low-density lipids was observed in favor of the first treatment, reaching a value of 32.52 mg/dl, compared to 22.86 and 19.69 mg/dl for the second and third treatments respectively. **[13]** showed that differences in blood urea, total protein, and cholesterol measurements were not significant when lambs were fed a diet containing agricultural residues. **[24]** confirmed this finding in sheep, showing that the inclusion of 30% olive pulp in feed ingredients did not cause significant differences in total protein, triglycerides, cholesterol, or urea levels in sheep's blood. However, **[5]** observed an increase in blood protein and HDL cholesterol with a decrease in cholesterol, LDL and glucose concentrations as the percentage of olive pulp increased from 5% to 10%. **[1]** found that brown Swiss calves fed 15% olive pulp had lower cholesterol and triglyceride and LDL cholesterol, but HDL increased than values in the control group. However, **[11]** showed that increasing the amount of olive pulp in feed ingredients to 15% did not lead to significant differences in cholesterol and triglyceride levels.

The results of the current study are consistent with previous studies showing that increasing the amount of olive pulp by less than 10% lowers blood lipid concentrations.

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Traits	Olive pulp level		
	0%	5%	10%
Total protein g/dl	7.30 ± 0.24 ab	7.03 ± 0.47 b	7.89 ± 0.21 a
Albumin g/dl	3.78 ± 0.11	3.74 ± 0.20	4.24 ± 0.18
Globulin g/dl	3.52 ± 0.14 a	3.12 ± 0.04 b	3.65 ± 1.34 a
Urea mg/dl	60.30 ± 1.17 a	52.17 ± 1.54 b	57.35 ± 1.78 a
Glucose mg/dl	59.22 ± 2.43	59.71 ± 2.93	61.28 ± 2.55
Triglyceride mg/dl	22.73 ± 2.97 a	10.06 ± 0.54 b	9.62 ± 0.15 b
Cholesterol mg/dl	69.70 ± 2.75 a	68.01 ± 2.96 a	51.61 ± 1.98 b
HDL cholesterol mg/dl	28.98 ± 1.77 a	28.53 ± 2.01 a	19.90 ± 0.69 b
LDL cholesterol mg/dl	32.52 ± 0.86 a	22.86 ± 2.71 b	19.69 ± 0.68 b

Table 3. Effect of olive pulp levels on blood biochemical parameters.

Different letters that appear horizontally indicate significant differences ($p \leq 0.05$)

Conclusion

The results of the current study align with previous findings that feeding olive pulp up to 10% in fattening lambs has no negative impact on growth or weight gain. Thus, In the face of mounting global feed costs, this is a crucial step to take in order to reduce expenses. However, there is also a need for further studies on this topic, as they contribute to the sustainability of animal feed.

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