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EFFECT OF ENSILING RESIDUES PRUNING OLIVE TREES, TWIGS AND LEAVES ON THE PERFORMANCE OF AWASSI LAMBS

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Abstract

The experiment was conducted to investigate the possibility of improving palatability and nutritive value of residues pruning Olive trees, twigs, and leaves by ensiling. Fifteen Awassi male lambs were used with 3-3.5 months of age and a mean initial weight of 19.60 kg. Lambs were randomly distributed into 3 groups in individual pens with 5 lambs per each. Roughages (silage and barley straw) were offered ad libitum, whereas, three levels of silage were used 0, 25 and 50%, the concentrate was offered at a rate of 3% of the body weight. The experiment was lasted for 8 weeks, following a preliminary period for 15 days. The results of the experiment recorded significant differences at the level ($p < 0.01$) of all nutrients consumed, as the third and second treatment outperformed the first treatment that was fed to hay. Whereas, Silage showed a significant increase at the level of ($p < 0.01$) in the rate of total and daily weight gain for the first, second and third treatment and it amounted to 8.85, 11.45 and 11.70 kg 147.48, 184.12 and 194.98 g / day, respectively, the results of the experiment showed a significant increase in the digestibility factor of ether extract ($P<0.01$) for the three treatments, it reached 79.71, 75.12 and 91.02, respectively. The results of the experiment showed a significant increase in the digestibility coefficient of ether extract ($P<0.01$) for the 3 treatments, 79.71, 75.12, and 91.02 respectively. While lignin increased significantly ($P<0.05$) it reached 68.87 compered with the first and second treatments. No differences with the pH between treatments, ammonia nitrogen, were significant differences ($P<0.05$) at 3 and 6 hours after the morning feeding 11.90, 11.30, 21.01 and 11.67, 18.67, 22.47 mg / 100 ml, respectively. Volatile fatty acids after 3 and 6 hours of morning feeding increased significantly ($p<0.01$) 4.20, 9.10 8.80; 5.33, 8.83, and 11.33 mmol / 100 ml for the first, second and third treatment respectively. The second treatment outperformed of volatile fatty acids after 3 hours the morning feeding 9.10 mmol / 100 compared to the first and third treatment and were 4.20 and 8.80 mmol / 100 ml, respectively.

Key words: olive, tree pruning residues (twigs and leaves), silage intake, Rumen fermentation, live weight gain, Awassi lambs

Introduction

The use of non-traditional forage products, such as low-cost agricultural residues, will reduce the costs of production. One such non-traditional feeds the olive waste (Taheri, *et al.*, 2012). The Olea europaeal tree of permanent evergreen trees belongs to the Oleacea family, which is capable of withstanding hot climates and has reached an area of 9.5 million hectares 2010 (FAO, 2012). Olive trees by-products are branch and leaf residue pruning, residue after removing the nucleus, and aqueous solution (peat water) known as molasses (Martín-García and Molina-Alcaide, 2008). The recycling and use of these wastes are economically significant because they have been deposited, as well as reducing the environmental pollution. In the insufficient fodder seasons, it can be used as fodder replacements in ruminant feeding, which then decreases the cost of fodder which animal products (Fayed *et al.* 2009). In addition to providing nutrients and low prices, it takes a lot of chemical, biological, and physical transactions to make animal feeding more efficient to improve its palatability and animal consumption (Hassan *et al.*, 2011). A major constraint in sheep raising (Awawdeh 2011) is the limited feed material and the lack of natural pastures in most Middle East countries. One of the main constraints in sheep breeding (Awawdeh 2011) is its limited time of year availability (Awawdeh and Obeidat, 2011), (Alomar *et al.,* 2015) have suggested the possibility of feeding Awassi rams on olive leaves as

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feed supplements and this feeding may boost the animal production's economic performance Chemical treatments of these residues have been used to improve their nutritional value, such as urea (Karkutli *et al.*, 2011), sodium hydroxide (Hassan *et al.*, 2011), and fungi and yeasts (Fayed *et al.*, 2009). Silage is one of the ways in which feed is kept apart from the air and supplied to animals in the lack of forage and pasture (Wilkinson and Davies, 2012). Moreover, the silage cycle was popular in cooler Europe and America and is now widespread in Asian countries (Wilkins and Wilkinson 2015). The goal of this study is therefore to investigate the possibility of improving the nutritional value of the olive tree pruning residues (twigs and leaves) through the silage process to increase the degree of palatability and digestion due to the high residue of fibers needed for ruminant feeding. Use different levels of feeding 0, 25, 50% of olive trees (twigs and leaves) silage and providing them with free hay and concentrated feed given at 3% of body weight and its effect on intake, weight gain, rumen fermentation, and nutrient digestibility factor.

Material and Method

Animals and Management

The study was conducted in the animal field of the College of Engineering Sciences, Agriculture, University of Baghdad / Abu Ghraib for the period (25D 9-25D 11D 2019) to investigate the effect of using silage residues of pruning olive trees (leaves and twigs) on the amount of feed intake, total and daily weight gain, digestion coefficient, and rumen fermentation. Ingredient composition of the concentrated diet, chemical composition of concentrated diets and silage and pruning olive trees (leaves and twigs) and wheat hay are presented in (Tables 1 and 2), respectively.

Table 1: Formulation and chemical composition of the treatment diet used in this experiment (DM %).

Ingredients	Barley	Yellow corn	Soybean meal	Wheat bran	Minerals & Vitamins
(%)	32	36	10	20	2

Table 2: Chemical composition of all ingredients, concentrate, Barley straw and silage (DM %)

Ingredient (%)	Concentrate	Barley straw	Silage olive twice and leaves	Leaves olive tree
DM	96.18	95.50	90.16	94.80
OM	90.26	85.95	83.55	84.80
CP	13.66	3.12	9.98	7.42
EE	6.41	3.69	6.33	6.26
CF	11.05	35.99	36.18	31.11
NFE	59.14	43.15	31.06	40.01
NDF	37.59	69.48	39.01	33.88
ADF	9.27	57.10	29.93	26.92
Cellulose	5.22	21.93	5.25	10.57
Hemicellulose	28.32	12.38	9.08	6.96
ADL	4.05	35.17	24.68	16.35
ME*MJ/kgDM	12.45	9.35	9.31	10.71

Metabolizable energy (ME) values are estimated according to the following equation of0.012×CP+0.031×EE+0.005×CF+0.014×NFE MAFF (1975): *

Preparation Silage of olive tree (twigs and leaves)

The olive branches and leaves were cut, as the lengths of the branches ranged between 2-3 cm. The process of preparing the silage was done by collecting the young twigs and then cutting them into small pieces (throats). After completing the chilling process, the molasses were added at a rate of 8% gradually using a water spray with continuous stirring to ensure the homogeneity process and secure a dry matter of up to 30% and after the mixing process, The continuous mixture was filled in 30 kg plastic drums and pressed well to eliminate air gaps, avoid mold and provide anaerobic conditions for the mixture. Then the drums were sealed with plastic caps and toroidal metal locks tightly to prevent air ingress and keeping for 60 days ensuring fermentation. After the completion of the fencing process, the barrels were opened and samples were taken from different locations for carrying out chemical analyzes and taking sensory measurements of the fence.

1. Feeding trails.

Fifteen lambs were used, divided into three groups, each group consisting of five lambs, then the lambs were placed in individual pens, as a preliminary period that lasted two weeks, The concentrated diet was given to animals gradually for two weeks (preliminary period) before the beginning of the experiment. Roughages and concentrated diet were given at the same time at 8.00 am. Concentrated diets were given to the animals at a rate of 3% of body weight. Wheat straw and silage were given ad libitium. The residual of both diets was collected and weighed before the given of ration on the next day. The number of concentrated diets was given for each

lamb then adjusted according to the bodyweight change every two weeks in order to ensure that the intake would be about 3% of the recorded body weight. The given roughages were adjusted according to the intake of the previous day. Recording of daily intake and the live-weight gain were maintained for 8 weeks throughout the whole feeding trial. Lambs were weighed every two weeks before feeding. Feed intake was daily recorded and feed conversion ratio was estimated according to lambs.

2. Chemical analysis.

All chemical analyses were conducted in the Central Laboratory of graduate students and nutrition laboratory of the College of Engineering Sciences Agriculture D University of Baghdad. Dry matter was established by drying the samples to constant weight in the oven at 105°C overnight as method ID 930.15(AOAC, 2005). Ash was established by igniting the dried sample in the muffle furnace at 550°C for 5 hr as a method ID. 942.05 (AOAC, 2005). Organic matter was established as the difference between 100 and the percentage of ash. Crude Protein (CP) (N × 6.25) was established by Kjeldahl method according to AOAC (2005) (method ID.2001.11). Neutral detergent fiber (NDF) was established according to the method of Van Soest *et al.* (1991). Acid detergent fiber (ADF) and acid detergent lignin (ADL) were established as described by Goering and Van Soest (1970) using fiber refluxing apparatus with NDF, ADF, and 72% H2SO4 solutions respectively. Hemicelluloses were estimated as the difference between NDF and ADF. Cellulose was estimated as the difference between ADF and ADL.

3. Rumen Fermentation Characteristics Sampling of rumen liquor.

Rumen liquor samples were collected from lambs during the last day of the experiment. They were withdrawn at 3 hr and 6 hr post morning feeding to study rumen fermentation characteristics through the determination of the ruminal pH, NH3-N and TVFA concentrations. Samples were withdrawn from the same animals in all sampling time by using a smooth rubber stomach tube, which connected to Hand Operated Siphon Pump and inserted into the rumen via the esophagus as described by Saeed (2011) with some modifications. Rumen liquor was strained through four layers cheesecloth to discard the solid unfermented particles and immediately measured for pH using Portable digital pH meter (ph-80) after adjusting with standard pH buffer solutions (pH=7). After that, approximately 10 ml of the rumen liquor was preserved with 2-3 drops of HCL acid to prevent fermentation. The samples stored at -20 °C until analysis (Filípek and Dvoøák, 2009) Total volatile fatty acids (TVFAs) in the rumen liquor were estimated according to the steam distillation method (Warner,1964).The NH3-N concentrations were calculated according (AOAC,2005).

4. Statistically analysis

Data were statistically analyzed using the Completely Randomized Design Model (CRD) procedure (SAS 2012). Duncan's multiple range tests were used to Analysis of variance was carried out on all data determine the significance of differences between treatments means (Duncan, 1955).

Results and discussion

The effect of feeding olive tree pruning residues (twigs and leaves) on the performance of Awassi lambs

1. Daily Intake

The main effect off feeding concentrate and different levels of residues of silage pruning olive trees (twigs and leaves) at 0, 25 and 50% with barley straw in daily nutrients intake of DM, OM, CP, CF, EE, NFE, NDF, ADF, ADL cellulose, hemicelluloses and ME are shown in table3. Overall daily nutrients intake of DM, OM, CP, CF, EE, NEF,NDF, ADF, ADL, cellulose,hemi celluloses and ME were significantly ($P<0.01$) increased with increasing level of feeding silage olive tree pruning (twigs and leaves) that offered with barley straw ad libitum . The increase in the intake of the nutrients consumed with the silage may be a guide for the palatability of the manufactured silage because it contains mineral elements, proteins, and antioxidant compounds contained in olive residues, leaves, and twigs. Also during the ensiling process, molasses were added, encouraging the fermentation, which led to increased palatability to the second and the third compared to the first treatment. This is consistent with (Molina-Alcaide Yanez-Ruiz,2008). In another study, it was observed to increase the dry and organic material intake (Taheri, *et al.*, 2012; San Pedro, *et al.*, 2015). Helal and Hassan(2013) found that feeding lambs five sources of fodder, including remnants of pruning olive trees with grains significant increase the amount of dry matter intake.

The results of the experiment also showed an increase in the intake of fiber, cellulose, and hemicellulose with residues of pruning olive trees, possibly due to organic acids and lactic acid that were produced by microorganisms during fermentation of silage, which helped to break down the phenolic bonds associated with plant cell parts in addition to increasing the activity of bacteria digesting cellulose Which increased the amount

of fiber neutral, acidic, cellulose, hemicelluloses, and lignin, and this is what the current experiment has reached.The addition of molasses to the waste of olive trees showed a significant increase for fiber consumed (Krkutle, *et al.* 2011) due to increasing the activity of microorganisms in the rumen animal. On the other hand, silage of olive trees include flavonoids that improve digestion, raise the feed conversion ratio, and protect the protein from degradation (Durmic and Blache, 2012). Hussein (2016) also showed that there were no significant differences in the metabolic energy MJ/kg dry matter when feeding lambs on reed silage and reed hay .

2. Weight gain

The main effect of feeding concentrate and different levels of residues of silage pruning olive trees (twigs and leaves) at 0, 25, and 50% with barley straw and the rate of a daily weight gain are shown in table 4. Lambs fed 25 and 50% of silage grew faster (P<0.01) than those fed only barely straw. Increased growth rates in lamb fed a high level of silage may be attributed to increasing the palatability of silage as a result of containing some additives such as molasses whose quality has led to an increase in the amount of intake, in addition to the mineral elements (Barrajón-Catalán *et al.*, 2015) and the protein Abbas (2016) found in the waste of olive trees, and phenolic compounds (Europeans) (Apak *et al.*, 2007) that reduce protein breakdown in the rumen and cross into and its transport to the stomach and intestines in the form of amino acids as well as the breakdown of carbohydrate sources for the fermentation process and increase the digestibility factor of some nutrients, perhaps one of these reasons is the supporter of the final weight of the animal. Al-taif (2017) indicated that olive leaves can increase enzymatic activity by increasing the GOT activation process which plays an important role for body organs such as the liver and pancreas, Za Za (2008) found that feeding Awassi lambs on three types of silage significantly increased the final weight increase rate with silage and improved performance when the hay ratio decreased. This is consistent with the results of the studied experiment. Another study between Fayde *et al.* (2009), feeding lambs on the waste of olive trees, leaves, and twigs with yeast or urea showed a significant increase in the rate of weight gain (Karkoutli, *et al.*, 2011) explained that adding molasses to olive tree pruning residues did not affect the daily weight increase rate g / day. Feeding three levels of silage (olive waste) to replace barley grains (10, 20, or 30% on a dry matter basis) the results of the experiment showed an increase in the average daily weight gain of lambs at the level of 30% silage of olive waste instead of barley (Thair *et al.*, 2012). While, Hagos et al (2015) the use of progressive proportions of olive and acacia leaves residue 0: 100, 0: 100, 35:65, 65: 35 significantly in the final weight kg and daily weight g / day and feed conversion efficiency.

Table 3: Effect of different levels of feeding silage olive pulp twigs and leaves on total daily nutrients intake g/ h/ day of Awassi male lambs

Items	% silage olive pulp twigs and leaves			Significant
	T1 CON+STRAW + (0)% silage	T2 CON+STRAW (25)% silage	T3 CON+STRAW (50)% silage	
DM	940. 63 ±24.00 b	1.1518± 0.018 b	1.428± 0.030 a	**
OM	837.65±21.69C	977.58± 26.21 b	1.248± 27.82 a	**
CP	101.61±3.47C	126.71± 1.48 b	152.37± 4.25a	**
NFE	515.75±14.39C	584.58±9.07b	679.38± 18.3 a	**
EE	5.58± 2.28 C	7.28± 3.93 b	9.26±1.61a	**
NDF	432.71± 9.14 c	501.20± 11.77 b	620.07± 11.60 a	**
ADF	206.90±4.55 C	251.41± 9.33 b	340.82±3.59 b	**
Cellulose	90.08±1.80b	94.34±3.59b	114.78± 1.82 a	**
Hemicelluloses	226.03± 7.07 c	250.17±3.62 b	278.77±8.83a	**
ADL	115.65± 2.76 c	206.62±5.73b	327.87± 3.76 a	**
ME/MJ	2.26±7.07 c	2.50±3.62b	2.78±8.83a	**

a, b and c: Means in the same column for each item with different superscripts different significantly (P<0.01) **

Table 4: Effect of different levels of feeding silage olive pulp twigs and leaves on live weight gain of Awassi male lambs

Items	% silage olive pulp twigs and leaves			Significant
	T1 CON+STRAW + (0)% silage	T2 CON+STRAW + (25)% silage	T3 CON+STRAW + (50)% silage	
Final live weight (Kg)	19.60±0.67	19.80±0.20	19.60±0.92	NS
(Total live weight gain Kg	28.45±0.80	30.85±0.31	31.30±1.36	NS
(Daily Live gain(g/day)	8.85±0.44b	11.45±0.55a	11.70±0.59a	**
Feed conversion ratio (g DM/ LWG)	147.48±7.39b	184.12±3.81a	194.98±9.97a	**

a, b and c: Means in the same column for each item with different superscripts different significantly. NS: No significant (P<0.01) **

3. Rumen fermentation

The main effect of different levels of feeding concentrate and residues of silage pruning olive trees (twigs and leaves) at 0, 25 and 50% with barley straw on rumen fermentation characteristics are shown in table 5.TVFA concentrations were greater (P<0.01) for those lambs fed high level of pruning olive trees silage than those fed low and barely straw only, The second treatment increased the concentration of total volatile fatty acids after 3 hrs of morning feeding 9.10 mmol / 100ml compared to the first and third treatment were 4.20 and 8.80 mmol / 100 ml respectively, while the results showed

an increase in total volatile fatty acids with the third treatment after an 6 hrs of morning feeding Perhaps this is due to the silage containing molasses as a source of rapidly decomposing carbohydrates in addition to the nitrogenous source, fermentation that occurs during fencing leads to a rise in organic acids in addition to lactic acid (Kung, *et al.*, 2018), which reduced the pH and the rise of volatile fatty acids While the third treatment after 6 hrs from the morning of nutrition was increased 11.33 mmol / 100 ml, the reason for this may be the concentration of TVFA between the contents of the rumen and epithelial cells and their concentration in the blood. Within the epithelial cells in the rumen, TVFA (Dijkstra, *et al.*, 1993) increased absorption processes decreased.

Hussein (2016) recorded when feeding the Awassi lambs on reed silage and reed hay with three levels of urea 0, 1 and 2% reduced volatile fatty acids after 3 hours of feeding. Fayed *et al.* (2009) feeding lambs on olive leaves with and without urea and yeast resulted in significant differences in the concentration of volatile fatty acids. While Helal and Hassan (2013) found feeding goats on roughage feed, a significant t increase in the concentration of volatile fatty acids reached its peak after 3 hours of feeding.

As for ammonia nitrogen, the results of the experiment showed significant differences (P <0.05) at 3 and 6 hours after morning feeding between the three treatments. And improve the growth of fiber-degrading cellulolytic bacteria Instead of soluble carbohydrates (Van Soest, 1994). The feeding on the fence led to an increase in ammonia nitrogen after 3 hours and a decrease after 6 hours Perhaps it is due to the provided diet, its decrease with the center and its height when introducing silage and hay due to the high fiber ratio in addition to the molasses added to the silage.

This result corresponds to Baytok, *et al.*, (2005) the increase of ammonia nitrogen with molasses, then returned to decline after 6 hours after feeding. This may be a reflection of the high energy and organic matter in the feed provided to the lambs that led to an increase in the rate of metabolism in the rumen (Bonsi *et al.*, 1995). Olive trees (twigs and leaves), and ammonia nitrogen concentration was observed to decrease after 3 hours of morning feeding, and it reached 21.10 mg / 100 ml. This may be due to energy and protein balance due to the high flavonoids (Oleuropein, which is an antioxidant, free radical inhibitor, and a good oxidizer of low fatty proteins. Density (Apak, *et al.*, 2007) in addition to the mineral elements present in olive residues (Mahdi, 2011) that increase the activity of microorganisms and increase the absorption of ammonia nitrogen through the rumen wall by increasing the proportion of silage. In an experiment conducted by Seok *et al.* (2016) an increase in the concentration of ammonia nitrogen with a sheep feed composed of the center and silage compared to the control treatment. Hussain (2016) recorded highly significant differences in ammonia nitrogen for the rumen liquid withdrawn after 3 hours of feeding, to return and decrease after 6 hours of feeding. This corresponds to Silva, *et al.*, (2018) when feeding sheep on leguminous silage by a ratio of (50:50) increased concentration of NH3-N four and six hours after eating legume silage without a concentrate. The results of the statistically analyzed experiment showed that there were no significant differences in the pH between the three treatments of the samples drawn at 3 and 6 hours after morning feeding from the animal rumen liquid the results of the experiment are consistent with Seok *et al.* (2016). There were no significant differences in the pH of the rumen when feeding the sheep on the feed of the concentrate, silage, and hay. Hussein (2016) indicated that silage reed showed a significant effect on pH of 6.91 compared to reed hay 6.71. (2009) reported feeding lambs on various sources of coarse clover feed and olive leaves with and without urea and yeast resulted in non-significant differences in the concentration of volatile fatty acids. Between Helal and Hassan (2013) feeding goats on five types of coarse feed. Significant increase in the concentration of volatile fatty acids reached their peak after 3 hours of feeding, and this corresponds to Fayed (2009, 2011).

Table 5: Effect of different levels of feeding silage olive pulp (twigs and leaves) on rumen fermentation of Awassi male lambs

Items	Time	% silage olive pulp twigs and leaves			Significant
		T1 CON I STRAW I (0)% silage	T2 CON I STRAW I (25)% silage	T3 CON I STRAW I (50)% silage	
TVFA (mmoI/I)	3hr	4.20±0.47 b	9.1000± 0.17a	8.80±0.60 a	**
	6hr	5.33±0.44 c	8.83±0.16 b	11.3±0.663a	**
NH3-N (mg/100ml)	3hr	11.90±1.40 ab	30.11±9.50 a	21.01± 2.02 b	*
	6hr	11.67±2.33 c	18.67± 2.33 b	22.47± 3.05 a	*
PH	3hr	5.84±0.18	6.06±0.20	6.02±0.19	NS
	6hr	6.43±0.18	6.73±0.06	6.43±0.12	NS

a,b, c Means in same Colum with different superscripts are significantly different* (P<0.05) ** (P<0.01) NS: No. significant

Conclusion

1. Silage can be made from pruning olive trees (twigs and leaves) that are of good quality and acceptable to the animal, and this was observed through the

reach, value, and value of the nutritional value estimated during the experiment.

2. An improvement was observed in the amount of nutrients eaten by increasing the percentage of silage intake.
3. There is a significant increase in the rate of weight gain and this indicates that it can be used instead of hay because of its high nutritional value, as it contains active substances and as an antioxidant.
4. Increased coefficient of digestion of fats and alkene, and these characteristics are required as they affect the effectiveness of microorganisms in rumen.
5. The rumen environment improves by increasing volatile fatty acids. The 25 and 50% ratios can be used without any harm to animal health.

Recommendation

1. Other types of olive residue can be used as nuclei and peat after the afternoon.
2. Silage was very good quality as indicated by the results of the research.
3. Its effect on rumen gases, methane and total gas measurements, and measurement of volatile single fatty acid, propionic and butyric fatty acid ratios can be studied.
4. Improve silage by adding other substances such as urea, yeast and enzymes.
5. Using olive tree pruning waste as a substitute for some other waste such as wheat and barley straw.
6. Conducting more experiments and different percentages so that we can confirm the results obtained.
7. Conducting more experiments and applying them to cows, calves and goats.

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