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Short Communication

Effects of feeding dried olive (*Olea europaea*) leaves with wheat straw-concentrate rations on feed conversion efficiency in Awassi rams

*Efectos de la alimentación de hojas secas de olivo (*Olea europaea*) con raciones de concentrado de paja de trigo sobre la eficiencia de conversión alimenticia en carneros Awassi*

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Abstract

Three groups of Awassi rams were fed for 6 weeks either a conventional wheat straw-concentrate ration (Control) or 2 experimental rations, where 30 (G1) and 60 % (G2) of the wheat straw was replaced with dried olive leaves following oil extraction. All rations were isocaloric and isonitrogenous. Feed intake (FI), bodyweight gain (BWG) and feed conversion efficiency (FCE) were measured. BWG and FI during the 6-week period were not significantly (P>0.05) different for the different rations, averaging 4.75 and 116 kg/animal, respectively. In addition, there were no significant (P>0.05) differences in FCE values between the Control and experimental groups fed wheat straw + olive leaves, averaging 24.6 kg feed/kg gain. These results suggest that dried olive leaves can replace wheat straw in wheat straw-concentrate rations at levels up to 60 % without affecting performance. Further studies are needed to determine optimal combinations of straw, olive leaves and concentrate to achieve different goals as well as intakes and performance when offered rations ad lib. Economic assessments would determine if including olive leaves would reduce the costs of feeding.

Keywords: Bodyweight gain, feeding, growth performance, tree forage.

Resumen

Tres grupos de carneros Awassi fueron alimentados durante 6 semanas con una ración convencional de concentrado-paja de trigo (control) o 2 raciones experimentales, donde el 30 (G1) y el 60 % (G2) de la paja de trigo se reemplazó con hojas secas de olivo después de la extracción del aceite. Todas las raciones fueron isocalóricas e isonitrogenadas. Se midieron el consumo de alimento (CA), la ganancia de peso (GDP) y la eficiencia de conversión alimenticia (ECA). GDP y CA durante el período de 6 semanas no fueron significativamente diferentes (P>0.05) para las distintas raciones, con un promedio de 4.75 y 116 kg/animal, respectivamente. Además, no hubo diferencias significativas (P>0.05) en los valores de ECA entre los grupos control y experimentales alimentados con paja de trigo + hojas de olivo, con un promedio de 24.6 kg de alimento/kg de ganancia. Estos resultados sugieren que las hojas secas de olivo pueden reemplazar la paja de trigo en las raciones de concentrado-paja de trigo en niveles de hasta el 60 % sin afectar el rendimiento. Se necesitan más estudios para determinar las combinaciones óptimas de paja, hojas de olivo y concentrado para lograr diferentes objetivos, así como consumos y rendimiento cuando se ofrecen raciones *ad libitum*. Las evaluaciones económicas determinarían si la inclusión de hojas de olivo reduciría los costos de alimentación.

Palabras clave: Alimentación, forraje de árboles, ganancia de peso corporal, rendimiento del crecimiento.

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Introduction

Recycling of olive (*Olea europaea* L.) by-products and their utilization in animal nutrition could improve the economics and efficiency of animal production in Mediterranean regions, as well as having environmental benefits (Molina-Alcaide and Nefzaoui 1996). Large quantities of olive leaves are available as by-products of the olive-growing industry in winter in these regions and have potential for alleviating some of the feed shortages and nutritional deficiencies experienced.

Olive leaves represent around 10 % of the total weight of olives retrieved at harvesting (Delgado-Pertíñez et al. 1998). Air-drying for 7 days in the shade at room temperature had no detrimental effects on the nutritive value of olive leaves and could represent a simple and low-cost procedure for their preservation (Martín-García and Molina-Alcaide 2008). However, phenolic components (particularly tannins) in some tree leaves may bind to protein, thus rendering the protein undegradable by rumen microbes.

We considered that performance of rams fed wheat straw-concentrate rations would not be affected by replacing some of the wheat straw with dried olive leaves. Therefore, the objective of the present work was to study effects on feed intake (FI), bodyweight gain (BWG) and feed conversion efficiency (FCE) of partial substitution of dried olive leaves for wheat straw in wheat straw-concentrate rations for Awassi rams plus determine concentrations of total phenols, total tannins and condensed tannins in the leaves.

Materials and Methods

Materials tested, experimental animals and managment

Olive (*Olea europaea*) leaves, as a by-product of olive oil extraction, were collected from 4 factories and dried in the shade for 7 days. The dried leaves were thoroughly mixed to be used later as feed supplement for Awassi rams.

Twelve adult Syrian Awassi rams aged between 2 and 3 years were randomly allocated to 3 similar groups in terms of age and initial body weight: Control group (n = 4; 71.3 ± 9.6 kg); G1 group (n = 4; 71.8 ± 4.7 kg); and G2 group (n = 4; 68.3 ± 6.1 kg). The Control group was fed a conventional wheat straw-concentrate ration (51 % wheat straw and 49 % concentrate), containing 90.1 g/kg crude protein (CP) and 8.37 MJ/kg metabolizable energy (ME). For Groups G1 and G2, portion (30 and 60 %, respectively) of the wheat straw was replaced by dried olive leaves. Level of concentrate in the experimental rations was adjusted, while the level of concentrate was reduced and barley added to make all rations (Control and experimental) isocaloric and isonitrogenous as recommended by Kirchgessner (1982) and Friesecke (1984). Animals were offered the same amounts of CP (166 g) and ME (15.3 MJ) daily. The balanced rations for the 3 groups are shown in Table 1. The concentrate mixture contained (fresh weight basis) 400 g barley/kg, 400 g wheat bran/kg, 180 g cotton cake/kg, 16 g salt/kg and 4 g premix of minerals and vitamins/kg. Nutritional components of the feed ingredients are shown in Table 2.

The present study lasted for 8 weeks (July–August) under natural photoperiod and temperature conditions. Rams were fed on the same rations for 2 weeks to allow them to adapt to the rations before the beginning of the 6-week experimental period. They were individually housed in metal pens with all feeds presented in separate troughs. Rams were weighed at the beginning of the experiment and weekly during the study in the morning before feeding. The different components of each ration were thoroughly mixed prior to feeding. Animals were fed twice daily, at 08:30 and 14:30 h, and all feeds offered were consumed. Water was available ad libitum. FI (kg/animal), BWG (kg/animal) and FCE (kg feed/kg gain) were determined during the 6-week period.

Estimation of nutrient components

Standard methods as described in AOAC (1990) were used for determination of dry matter (DM), ash, ether extract (EE) and crude protein (CP) concentrations. Nitrogen (N) concentration was measured by the Kjeldahl method, and CP concentration was calculated as N% × 6.25. Crude fiber (CF) was determined by the method of Naumann and Bassler (1976) and in vitro digestible organic matter (IVDOM) and metabolizable energy (ME) according to the methods of Menke et al. (1979) using a gas-production technique. Details of methods of incubation and estimation of gas production, IVDOM and ME have been described previously (Al-Masri 2010). Total phenols were quantified by Folin Ciocalteu reagent and total tannins were calculated as the difference between phenolics before and after tannin removal from the extract using insoluble polyvinyl pyrolidone (Makkar et al. 1993). Condensed tannins were determined by the butanol-HCl method (Porter et al. 1986).

Table 1. Daily intake of nutrients and feed ingredients by Awassi rams in Control and experimental groups (G1 and G2).

Feed ingredient	Intake (g/d)			Crude Protein (g/d)			Metabolizable Energy (MJ/d)		
	Control	G1	G2	Control	G1	G2	Control	G1	G2
Wheat straw	1,000	700	400	26.0	18.2	10.4	6.18	4.33	2.47
Olive leaves	-	300	600	-	20.2	40.4	-	1.79	3.58
Concentrate mix	1,000	730	400	139.6	101.9	55.8	9.20	6.71	3.68
Barley	-	220	500	-	25.8	58.7	-	2.47	5.61
Total	2,000	1,950	1,900	165.6	166.1	165.3	15.38	15.30	15.34

G1, G2 = 30 and 60 % of the straw replaced by olive leaves, respectively.

Table 2. Nutritional components (g/kg DM) and metabolizable energy (ME; MJ/kg DM) of the feed ingredients.

	CP	A	CF	EE	IVDOM	ME
Wheat straw	27.7	115	319	11.8	505	6.6
Dried olive leaves	72.9	99.1	163	50	490	6.5
Concentrate	155	53.9	66	36.2	734	10.2
Barley	126	25.0	54	24	816	12.0

CP = crude protein
A = ash
CF = crude fiber
EE = ether extract
IVDOM = in vitro digestible organic matter.

Statistical analyses

Data were subjected to analysis of variance (ANOVA) using a Statview-IV program (Abacus Concepts, Berkeley, CA, USA) to test the effects of ration type on FI, BWG and FCE. Means were separated using Fisher's least significant difference test at the 95 % confidence level.

Results

BWG and FI during the 6-week feeding period were not affected by ration type (P = 0.893 and 0.689, respectively) (Table 2) and averaged 4.75 and 116 kg/animal, respectively. As a result, FCE was not significantly (P = 0.827) affected by ration type fed, averaging 24.6 kg feed/kg gain (Table 3). Average amounts of total phenols, total tannins and condensed tannins in the olive leaves used in this experiment were 77.3, 17.0 and 5.4 g/kg DM, respectively.

Table 3. Effects on BWG, FI and FCE of partial substitution of dried olive leaves (DOL) for wheat straw in straw-concentrate rations for Awassi rams over 6 weeks.

	BWG	FI	FCE
Control	4.35a	119a	27.4a
G1 (30 % DOL)	5.00a	116a	23.2a
G2 (60 % DOL)	4.89a	113a	23.1a
s.e.m.	0.20	1.73	1.42
P-value	0.893	0.689	0.827

Means in the same column followed by different letters are different at P<0.05. BWG= (kg/animal); FI= (kg/animal); FCE= (kg feed/kg gain).

Discussion

The absence of significant differences between the 2 experimental groups and Controls in terms of BWG, FI and FCE indicates that there was no adverse effect of including olive leaves in straw-concentrate rations for Awassi rams during a period of 6 weeks. One would expect similar performance since FI was controlled and rations were adjusted to be isocaloric and isonitrogenous, provided no anti-nutritional components were present.

Since leaves of some shrubs can contain significant amounts of tannins, which can affect utilization of protein in the rumen, it might have been expected that utilization of N from the olive leaves might be lower than that of N in the concentrate. Getachew et al. (2002) reported that plant samples containing total phenols and tannins at concentrations (g tannic acid equivalent/kg DM) up to 40 and 20 g/kg, respectively, are not expected to precipitate protein and, therefore, are unlikely to adversely affect

ruminant production. However, total condensed tannin concentrations exceeding 50 g/kg DM can inhibit ruminal microbial activity, depress dry matter digestibility (Kumar and Vaithiyanathan 1990) and reduce voluntary FI (Waghorn et al.1990). The anti-nutritional components (total phenols, total tannins and condensed tannins) measured in the olive leaves used in this experiment were low (77.3, 17.0 and 5.4 g/kg DM, respectively), which should not depress protein utilization. The levels in our sample of leaves were not abnormal as Delgado-Pertíñez et al. (2000) failed to detect hydrolyzable or condensed tannins in olive leaves, and others (Yáñez-Ruiz et al. 2004; Martín-García and Molina-Alcaide 2008) found low amounts of total condensed tannins in olive leaves (range 9.6–11.1 g/kg DM).

Conclusions

The data suggest that replacing 30 or 60 % of wheat straw in a 50:50 straw-concentrate mixture with dried olive leaves and adjusting the overall rations to be isocaloric and isonitrogenous had no significant effect on performance of rams. Therefore, olive leaves could play an important role as a source of feed in extensive animal production systems in arid and semi-arid zones, making effective use of a by-product of olive production. More studies are needed to determine the optimal combinations of straw, olive leaves and concentrates to achieve different goals as well as others to measure voluntary FI and performance under ad libitum feeding. Economic analyses would determine to what extent including olive leaves in rations would alter costs of feeding rams.

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(Note of the editors: All hyperlinks were verified 7 July 2022).

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