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Incorporation of faba bean in barley-based concentrate in feed of Sicilo-Sarde dairy ewes: effects on milk yield and lamb growth

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Abstract

This study was designed to find the effect of incorporation of faba bean in barley-based concentrate diet on milk yield and lamb growth. Thirty Sicilo-Sarde dairy ewes belonging to the flock of the National Land Office in Ghézala- Mateur (Tunisia) were divided into two homogeneous groups of fifteen animals of matching lambing body weight, lactation number and litter size, and were offered two different concentrates associated to the same basal diet. Ewes were lodged in the same conditions and received oat hay *ad libitum*. Concentrate given to the experimental group (F) contained 17.5% of faba bean (*Vicia faba* L.) 7% of soya, 4% of vitamin and mineral supplement (VMS) and 71.5% of barley. The control group (C) concentrate contained 13.5 of soya, 4% of VMS and 82.5% of barley. Each concentrate was given at the rate of 500g/ewe/day in two equal meals. The two concentrates had comparable contents of energy and crude protein. Total milk yield during the feeding trial (11 weeks) and lamb growth for different periods evaluated were insignificantly ($P>0.05$). The study concluded that faba bean, as a local resource, can substitute some concentrate imported, such as soya, in the diet of dairy ewes raised in a low input production system.

Keywords: Dairy Ewes, Faba Bean, Lamb Growth, Milk Yield

Introduction

In Tunisia, dairy sheep population is estimated at approximately 8000 female units raised mainly in state farms and in some private flocks (ESAE, 2005). The Sicilo-Sarde is almost the only autochthonous dairy sheep breed, localized in sub-humid area in northern Tunisia (Bizerte and Béja). It is characterized by a long suckling (3-4 months) and an extended lambing period from August to October, with the consequent low milk production level varying from 60 to 120 kg/year (Moujahed et al., 2009). Sicilo-Sarde dairy sheep feeding is based on grass grazing and forage, as a basal diet and concentrate complementation all the year (Rouissi et al., 2008). Performances of dairy ewes depend mainly on a balanced diet (Bocquier and Caja, 2001) with the required concentrate complementation during critical periods such as gestation and suckling period. However, during the last years, the worldwide overall economic situation resulted in an increase in the price of raw materials used in the formulation of livestock concentrate (corn and soya). In this way, the search for other alternatives such as their entire or partial replacement by local feed resources (barley, faba bean) is imperative. The annual production of faba bean in Tunisia is approximately 35,000 tons. This annual legume is used in the formulation of feed concentrated for animals as it is also used in the human food (Selmi et al., 2009).

The objective of this study was to evaluate the partial substitution of faba bean for soya in concentrate formulation and its impact on milk production of Sicilo-Sarde dairy ewes and the growth of their lambs during the suckling period.

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Materials and Methods

The experiment was carried out on the dairy flock of the National Land Office (OTD) in Ghézala-Mateur, Tunisia. Thirty Sicilo-Sarde ewes were divided into two equal groups of matching lambing weight (51.9 ± 4.9 and 52 ± 5.4 kg), lactation (third) and litter size (1.4 ± 0.5 and 1.5 ± 0.5 lambs/ewe). It is proper to indicate that body weights of ewes and their distribution within both groups were made by the end of the gestation period (at lambing).

From the last third of gestation and during the eleven weeks postpartum, all ewes received a daily diet containing oat hay *ad libitum* and a concentrate, each group of animals received a different concentrate. The feed composition of the control and experimental groups is given in Tables 1 and 2. Each concentrate was given on the basis of 500g/ewe/day distributed in two equal meals a day. The two concentrates had comparable values of energy and nitrogen.

Table 1: Centesimal composition (%) of concentrates of the experimental (F) and control (C) groups

Ingredients	Concentrate (C)	Concentrate (F)
Barley	82.5	71.5
Soya	13.5	07
Faba bean	00	17.5
VMS	04	04

VMS: Vitamin and mineral supplement

It is important to indicate that lambs in each group received a creep feeding in the form of hay and concentrate (150 g/head/day) during the period between the age of 30 days and the end of the experiment. All animals were offered fresh water renewed twice a day. Each group of animals was housed in a separate compartment containing two parts: one covered part of 20 m^2 and another identical non covered part for exercise. Each compartment was fitted out with two racks of 2.5 m for forage, a manger for concentrate distribution and a collective drinking trough.

Animals of each group were given adaptation period (4 weeks) followed by experimental period (8 weeks). Concentrate was offered twice a day. Oat hay was provided in two equal meals at 08:00 and 16:00, with the quantities being adjusted in order to have around 15% as refused feeds. Daily feed intake was measured during the experimental period for each group. Distributed and refused feeds were weighed daily, and one sample from each feed was taken, twice a week, for analyses.

The chemical composition of forage and concentrate samples were determined. Dry matter of hay samples (distributed feed and refusals) was determined twice a week by drying them in a forced-air oven at 105°C for 24 h. Mineral matter, crude protein and crude cellulose of hay and concentrates were determined using samples dried at 50°C and ground through a 1-mm screen according to the AOAC techniques (AOAC, 1990). The nutritive values (UFL, PDIE and PDIN) of all experimental feeds were determined using the Sauvant formulae (Sauvant, 1981) as follows:

UFL/Kg DM = [1.218*(–organic matter) + 0.11 CP - 1.81 CC + 1.26 fats]/100.

PDIE = [5.14 CP - (4.8*CP*0.4) - 0.8 CC + 68.8 organic matter]/100.

PDIN = [7.44 CP - (2*CP*0.4) + 1.2 organic matter]/100.

All chemical analyses were carried out in the Animal Nutrition Laboratory of the Agricultural High School in Mateur, Tunisia.

Individual ewes' milk yield was recorded once a week on one milking during the whole suckling period (11 weeks). Prior to each milking, the lambs were separated from their mothers for 4 h before the milking (14.00 h) to provide the appropriate period for milk secretion. Before separation from the lambs, the ewes were milked to remove residual milk. This method was similar to that used after weaning and permitted the milk yield in the suckling period to be known. The estimated daily milk yield was obtained by multiplying the recorded milk yield by six. Ewes were always hand-milked.

At birth, lambs were ear tagged and then daily weighed during the experimental period. This allows, for each lamb, the recording of birth weight, weight at typical ages of 10 (W_{10}), 30 (W_{30}), 50 (W_{50}) and 70 days (W_{70}) as well as average daily gain between 10 and 30 (ADG_{10-30}), between 30 and 50 (ADG_{30-50}) and between 30 and 70 days of age (ADG_{30-70}).

Statistical Analysis

Data were collected according to the two levels of diets, the other main environmental variables that were thought to affect milk yield and lamb growth being identical for both animal groups. There were two diet groups (F and C). The analysed traits (dependent variables) were feed intake, daily and total milk yields, birth weight, typical age weights (W_{10}, W_{30}, W_{50} and W_{70}) and average daily gains (ADG_{10-30}, ADG_{30-50} and ADG_{30-70}).

Data were analysed using General Linear Model (GLM) of Statistical for windows (SAS, 1989). Means of dietary treatments were compared using the Duncan range test.

$Y_{ij} = \mu + D_i + A_j + e_{ij}$

Where: Y_{ij} = dependent variable;

μ = mean;

D_i = fixed effect of diet, i;

A_j = effect of individual animal, j;

e_{ij} = random residual

Table 2: Chemical composition and nutritive value of forage and concentrate ingredients

	DM, %	CP, %	CC, %	MM, %	OM, %	PDIN (g)	PDIE (g)	UFL
Soya bean	90.5	46.8	8.4	15.9	84.1	322	237	1.02
Faba bean	90.9	24.8	10.6	13	87	166	113	0.98
Barley	89.2	10.2	6.4	13.8	86.2	71.3	91.6	1.01
Concentrate (C)	89	16.8	9.4	11.1	88.9	99	103	0.96
Concentrate (F)	89	16.2	7.6	7.3	92.7	96	95	0.96
Oat hay	84	5.2	39.7	7.8	92.2	36	54	0.54

DM: Dry matter, CP: Crude protein, CC: Crude cellulose, MM: Mineral matter, OM: Organic matter, PDIN: Protein supplied when nitrogen is limited in the rumen, PDIE: Protein supplied when energy is limited in the rumen, UFL: Net energy value per kg DM for lactation.

Results and Discussion

Daily forage intake was similar for the two diet treatments with average values of 1.66 and 1.70 kg DM/ewe/day for F and C groups, respectively. Such values were considered acceptable compared with those usually reported for dairy ewes, perhaps because of the relatively good quality of the hay (0.54 UFL) and concentrates. In fact, the concentrates were quantified so that the fermentation conditions in rumen had to be favourable to the bacterial proliferation which leads to a maximum forage intake (Chermiti, 1994). Figure 1 showed that the hay intake had the same tendency for both animal groups with a little superiority for the control group (C). This may be explained by the high crude protein levels in concentrates. In this context, Journet et al. (1983) showed a strong relationship between the increase of crude protein levels in diets and feed intake. They attributed such an effect to a ruminal digestion enhancement. The degradable protein allows an increase in rumen cellulolytic activity, a decrease in length of retention time of feed and an enhancement of digestive transit which stimulates feed intake (Chénost, 1987).

Means total and daily milk yield for ewes of the control and experimental groups (C and F) are presented in Table 3.

Table 3: Mean milk yield of ewes fed the experimental diets

	Group (C)	Group (F)	SEM
Total milk yield/ewe (l)	67.16	75.21	10.8
Test-day milk yield/ewe (ml)	987	1115	0.72

Results indicated that total and test-day milk yields for group F were numerically higher than those for group C though the differences were not significant (P>0.05). These results disagreed with those reported by Maâmouri and Rouissi (2008) in a study comparing milking performances of two ewe groups from the same breed fed soya and faba bean. The slightly higher milk yield observed for group F could be due to the fact that whole faba bean contains methionine and lysine that are essential amino acids which stimulate milk secretion (Baldwin et al., 1993; Sevi et al., 2002). As shown in figure 2, test-day milk yield reached its maximum value at week 9 for group F and at week 10 for group C. For both groups, lactation curves during the experimental period had a similar tendency.

Lamb growth, from birth to day 70 postpartum, was identical for the control and the experimental groups (Table 4). No significant difference in lamb weights between the two groups was observed.

Table 4: Body weight and growth traits of lambs of control and experimental groups

Traits	Group C (n=16)	Group F (n=17)	Diet effect	SEM
weight (Kg) at ages:				
at birth	3.2	3.4	NS	0.14
W_{10}	5.4	5.8	NS	0.24
W_{30}	8.9	9.4	NS	0.36
W_{50}	12	12.7	NS	0.50
W_{70}	14.4	14.9	NS	0.62
Average Daily Gains (g/d)				
ADG_{10-30}	177	181	NS	10.5
ADG_{30-50}	154	165	NS	9.82
ADG_{30-70}	137	138	NS	7.95

SEM: Standard error of means; NS: treatment effect is not significant (P>0.05)

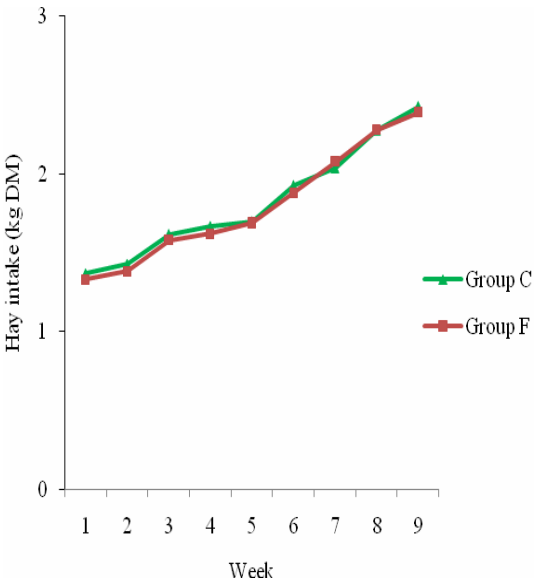

Fig. 1: Hay DM intake during the experimental period

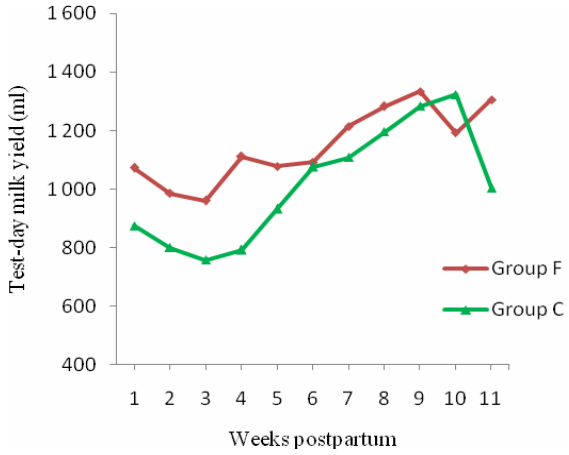

Fig. 2: Test day milk yield during the experimental period

However, the average daily gain between days 10 and 30 for lambs from group F (181g/d) seemed slightly higher than that for group C (177g/d). Such a tendency would be attributed to the higher milk yield of their mothers mentioned above. The same occurred for ADG_{30-50} (Table 4).

On the other hand, the observed values of ADG_{30-50} and ADG_{30-70} showed that lambs receiving concentrate with faba bean (group F) had the same growth rate as lambs fed concentrate containing soya (group C). Such an observation indicated that the partial substitution of faba bean for soya in the concentrate did not limit milk production of Sicilo-Sarde ewes during the suckling period and the growth performances of their lambs.

Conclusions

The findings of the present study suggest that concentrates containing faba bean is comparable to the commercial grain (soya) concentrates. Faba bean, as a local resource, can be used effectively as a substitute for some concentrate, such as imported soya, in the diet of dairy ewes raised in a low input production system.

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