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Growth performances and carcass composition of Barbarine lambs: Effect of the substitution rate of soya bean cake by faba beans (*Vicia faba*)

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Abstract. The objective of this study was to examine the effect of faba beans level in the diet on lamb growth performance and carcass composition. Thirty male lambs of the fat tail Barbary breed were divided into three groups of ten on the basis of live weight (33.4±2.56 kg). Three different iso-nitrogen and iso-energetic concentrates, where soya beans cake was partially substituted by faba beans were compared (concentrates comprising 0, 100 g/kg and 200 g/kg faba beans). Lambs underwent an adaptation period of 15 days. Five lambs from each group were slaughtered after a 30 days-finishing period. The other lambs were slaughtered after a 60 days-finishing period. Lambs carcasses were dissected. Average daily gain during the first 30 days-finishing period (125 g/day) and during all the trial (75 days) (137 g/day) was similar for all dietary treatments. Faba bean levels in diets had no significant effect on the carcass quality. However, lambs fed by concentrates comprising 100 g/kg faba bean had the lowest proportion of fat in the carcass. It be concluded that carcass lambs which received faba beans were less fatty.

Keywords. Barbary lamb – Growth – Carcass quality – Faba bean – Soya bean cake.

Performances de croissance et composition de la carcasse des agneaux de race Barbarine : Effet du taux de substitution du tourteau de soja par la féverole (*Vicia faba*)

Résumé. *L'objectif de cette expérience est d'étudier l'impact de la substitution partielle du tourteau de soja par de la féverole durant différentes périodes de finition sur les performances zootechniques, le rendement à la découpe et la composition de carcasse d'agneaux. Trois groupes de 10 agneaux ont reçu différents types de concentré iso-énergétiques et iso-azotés. Un groupe (SBM) a reçu un concentré à base de tourteau de soja. Les groupes FB1 et FB2 ont reçu un concentré contenant 100 g/kg et 200g/kg de féverole respectivement. La durée d'adaptation au régime a été de 15 jours. La moitié des agneaux de chaque groupe ont été abattus après une période de finition de 30 jours, qui suivait la période d'adaptation à l'alimentation expérimentale. Les autres agneaux ont été abattus après une durée de finition de 60 jours. L'incorporation de la féverole dans la ration n'a pas affecté la vitesse de croissance des agneaux (137g/ jour en moyenne). Les agneaux qui ont reçu le concentré contenant 200g/kg de féverole durant toute la période de finition ont le rendement vrai le plus élevé (59,17%), tandis que les agneaux du FB1 ayant été abattus après 30 jours seulement ont la carcasse la plus maigre et le rendement à la découpe au niveau du gigot le plus élevé.*

Mots-clés. *Barbarine – Croissance – Qualité de la carcasse – Féverole – Tourteau de soja.*

I – Introduction

The feeding of sheep in Tunisia is often provided by natural vegetation and fallow resources. These resources vary considerably depending on climatic conditions particularly rainfall. Moreover, nearly two thirds of lambings takes place in autumn so that the lambs and their mothers can take advantage of the surge of grass. In good years, lambs are marketed in

spring at a live weight of 20 to 25 kg, without being fattened indoors. However, in dry years, the growth rate of lambs may be very low and their live weight at weaning (5 months) may not exceed 16 to 17 kg (Abderrabba, 1989). In recent years, in arid and semi-arid areas, the energy and protein requirements of fast growing, intensively fattened lambs have been met using soyabean and maize, which are the major ingredients in concentrates and largely imported at high costs (Lanza *et al.*, 2003). Therefore, the use of legume grains such as faba beans (*Vicia faba*), in animal nutrition, is expected to increase further in the near future. In lambs' feeding, the substitution of soya bean meal by faba beans does not affect growth performance (Surra *et al.*, 1992; Purroy *et al.*, 1993; Atti and Mahouchi, 2009). The objective of this study was to evaluate the effects of partial substitution of soya bean by faba beans and finishing period duration on lamb growth rate and the carcass quality.

II – Materials and methods

1. Measurements

The experiment was conducted on a farm in North West of Tunisia. The feeding trial was carried out with a total of 30 fat-tailed Barbarine male lambs. Before the experiment period, lambs received wheat straw and concentrate where soybean meal was the main protein source. At 180 days of age, the lambs were divided into 3 groups balanced according to live weights (33.4±2.56 kg), with 10 animals per treatment. Treatments included: Lambs fed with concentrate where soybean meal was the main protein source (SBM group); lambs fed with concentrate where comprising 100 g/kg faba bean, faba beans being the main protein source (FB1 group) and lambs fed with concentrate comprising 200 g/kg faba bean, faba beans being the main protein source (FB2 group). The duration of the experiment was 75 days (with 15 days-adaptation period the experimental diets). The lambs were raised in stalls and fed a diet based on the experimental concentrates and wheat straw. The wheat straw was offered *ad libitum*. In detail, SBM lambs received a concentrate that comprised mainly barley and soybean meal, FB1 and FB2 lambs received a concentrate in which part of soybean meal and maize were replaced by faba beans (the concentrate comprising 100 g/kg and 200 g/kg faba beans respectively) (Table 1). Moreover, the concentrate fed to the SBM group contained small quantities of bran, to obtain iso-proteic and iso-energetic diets. Animals of all groups had free access to water. They were weighed weekly just prior to feed distribution. Five lambs per group were slaughtered 30 days after the beginning of the experimental treatments at an average body weight of 36 ±1.03 kg. At the end of the experiment (75 days), all remaining lambs were slaughtered at an average body weight of 40 ± 1.6 kg. The left half-carcasses were cut according to Colomer Rocher *et al.*, (1972) into six joints (leg, lumbar region, flank, thoracic region, neck and shoulder). All regions were dissected into fat, muscle and bones.

The Net dressing percentage was calculated within this equation= (Hot carcass weight / (liveweight – Digestive contents))*100.

The yield of different carcass pieces was calculated by the ratio of piece weight to cold carcass weight.

The chemical composition of the experimental diets is reported in Table 1. Mineral content was determined by ashing at 550°C for 8h. Nitrogen was determined by the Kjeldahl method (CP=N x 6.25). The NDF (Neutral detergent fiber), ADF (Acid detergent fiber), ADL (Acid detergent lignin) were determined using the Van Soest method.

2. Statistical analysis

All statistical analyses were performed using SAS 9.1. Data were analysed using the GLM procedure to determine the effects of the experimental factors (faba bean level and duration of the finishing period) and their interaction on final live weight, daily gain, hot carcass, net

dressing, cutting yields and carcass. Duncan's test was used for pairwise comparison. Differences were considered significant at the p≤ 0.05 level.

Table1. Chemical composition and constituents of experimental foods

	Wheat straw	Concentrate		
		SBM	FB1	FB2
Composition				
Dry matter (%)	93.62	88.29	88.55	88.84
Crude protein (%DM)	2.74	15.77	15.71	16.33
NDF (%DM)	81.22	0.16	0.16	0.21
ADF (%DM)	47.21	0.38	3.4	4.6
ADL (%DM)	7.22	1.1	1.4	2.1
Energy (UF/kg DM)	0.31	0.96	0.97	0.96
MM (%DM)	7.56	6.61	6.32	6.53
Ingredients (%)				
Barley		29	42.5	48.5
Maize		42	32	18
Bran		10	-	-
Soya bean meal		14	10.5	8.5
Faba bean		-	10	20
MVS[b]		5	5	5

NDF: Neutral detergent fiber; ADF: Acid detergent fiber; ADL: Acid detergent lignin; UF: Feed unit = French Feed Unit System for ruminants; MM: Mineral matter; MVS: Mineral- vitamin-supplement.

III – Results and discussion

Lambs performances are presented in Table 2. Except for the net dressing percentage, the level of faba bean incorporation within concentrates did not affect lamb performances (p>0.05). Consequently, there was not a significant effect of the level of incorporation of faba beans within concentrates on final liveweights. This result is line with those previously reported by Atti et Mahouchi (2009), Lanza *et al.* (1999) and Caballero *et al*. (1992). This legume seed leads to a similar daily gain than soya bean (Surra *et al.*, 1992) and a higher daily gain than that observed with other legume seeds like lupins and lentils (Purroy *et al.,* 1993). These results can be explained by the amino acids profile of faba beans, which generally completes that of cereal grains (Popova, 2007). Moreover, the introduction of barley in the SBM concentrate should optimize the use of the faba beans' rapidly degradable protein fraction (about 90%, Jarrige, 1988) and improve the microbial protein synthesis in the rumen. The FB2 and SBM lambs had the highest net dressing percentage compared to FB1 lambs (57.75, 56.14 and 55.29 for FB2, SBM and FB1 respectively). This result can be explained by the weight of digestive tube of different groups.

Daily gain and net dressing percentage were affected by the duration of the finishing period. The lambs that had the longer finishing period had a higher liveweight and hot carcass weight than the lambs that had the shorter finishing period. The daily gain during the last four weeks increased comparatively to the first four weeks of the finishing period. Consequently, feed conversion ratio was more favourable for FB1 and FB2 lambs during the long than for the short finishing period. Therefore, the FB2 lambs having the long finishing period had the highest net dressing percentage than SBM lambs and FB1 lambs. The interaction between faba beans level and duration of the finishing period affected final weight lambs, hat carcass weight and net

dressing percentage. The incorporation of faba bean in concentrates improved net dressing percentage with 3% to 4% if the duration of the finishing period is extended to 60 days. The duration of the finishing period has the global effect on hot carcass weight and net dressing percentage also.

Table 2. Lamb performances

Duration of finishing period	30 days			60 days			P		
	SBM	FB1	FB2	SBM	FB1	FB2	FBL	DFP	I
Initial weight (kg)	33.33	33.35	33.55	33.33	33.35	33.55	ns	ns	ns
Final weight (kg)	37.32^{b}	36.28^{b}	36.36^{b}	39.86^{a}	41.03^{a}	40.91^{a}	ns	****	**
Daily gain (g/day)	123	113	119	140	135	135	ns	ns	ns
Hot carcass weight (kg)	17.44^{b}	16.86^{b}	17.66^{b}	19.72^{a}	20.52^{a}	21.12^{a}	ns	****	***
Net dressing (%)	55.91^{b}	53.98^{b}	56.33^{ab}	56.38^{ab}	56.61^{ab}	59.17^{a}	ns	*	*

SBM: Lambs fed with concentrate where soybean meal was the main protein source; FB1: Lambs fed with concentrate where comprising 100g/kg faba bean; FB2: Lambs fed with concentrate comprising 200 g/kg faba bean; FBL: faba bean level; DFP: duration of the finishing period ; I: Interaction (Faba beans level* duration of the finishing period).
ns = Not significant ; (*): p<0.05 ; (**): p< 0.01 ; (***): p< 0.001; (****): p<0.0001; a, b: within a column, means without a common superscript letter differ (p<0.05)

The yield of different carcass pieces is presented in the Table 3. The ratio of hind leg weight to cold carcass weight was only affected by faba beans level. The ratio of hind leg weight to cold carcass for the FB1 was the highest compared to those for SBM and FB2 groups (31.93, 33.66 and 32.88 respectively to SBM, FB1 and FB2). Indeed, the FB1 lambs slaughtered after 30 days had the highest leg percentage (34.59%).

Table 3. Lambs cutting yields

Duration of the finishing period	30 days			60 days			P		
	SBM	FB1	FB2	SBM	FB1	FB2	FBL	DFP	I
Leg (%)	31.96^{b}	34.59^{a}	32.96^{b}	32.26^{b}	32.74^{b}	32.61^{b}	*	ns	ns
Lumbar region (%)	10.22^{a}	10.03^{a}	10.16^{a}	9.27^{ab}	8.70^{b}	9.20^{ab}	ns	***	**
Flank (%)	4.39^{b}	4.27^{b}	4.42^{b}	6.06^{a}	5.78^{a}	5.53^{a}	ns	****	***
Thoracic region (%)	25.24	24.76	23.27	23.42	24.08	23.97	ns	ns	ns
Neck (%)	8.91^{ab}	9.43^{ab}	9.32^{ab}	8.87^{ab}	8.31^{b}	10.43^{a}	ns	ns	ns
Shoulder (%)	18.9	18.32	18.7	18.6	18.89	18.31	ns	ns	ns

SBM: Lambs fed with concentrate where soybean meal was the main protein source; FB1: Lambs fed with concentrate where comprising 100g/kg faba bean; FB2: Lambs fed with concentrate comprising 200 g/kg faba bean; FBL: faba bean level; DFP: duration of the finishing period; I: Interaction (Faba beans level* duration of the finishing period).
a, b: within a column, means without a common superscript letter differ(p<0.05)

The duration of the finishing period affected the lumbar region percentage (p<0.001) and the flank percentage (p<0.0001). The lumbar region percentage decreased while the flank percentage increased with the duration of the finishing period. The interaction between faba beans level and duration of the finishing period affected lumbar region yield and flank yield. The extension of duration of the finishing period to 60days promotes the abdominal region development (flank). The duration of the finishing period has the global effect.

Carcass composition is presented in Table 4. Faba beans level did not affect the muscle

percentage neither fat or bone percentage (p>0.05). Fat and bone carcass percentage were affected by finishing period and interaction between faba beans level and duration of the finishing period. The FB1 lambs having the shorter duration of finishing period had the less fat percentage and the highest muscle percentage (Table 4).

Table 4. Carcass composition

Duration of finishing period	30 days			60 days			P		
	SBM	FB1	FB2	SBM	FB1	FB2	FBL	DFP	I
Muscle (%)	55.13^{b}	60.04^{a}	55.94^{b}	55.34^{b}	56.10^{b}	57.37^{b}	ns	ns	ns
Fat (%)	22.35^{a}	16.94^{b}	21.23^{a}	24.06^{a}	22.98^{a}	22.64^{a}	ns	*	*
Bone (%)	20.24^{a}	20.6^{a}	20.61^{a}	18.41^{ab}	18.35^{ab}	17.78^{b}	ns	****	**

SBM: Lambs fed with concentrate where soybean meal was the main protein source; FB1: Lambs fed with concentrate where comprising 100 g/kg faba bean; FB2: Lambs fed with concentrate comprising 200 g/kg faba bean; FBL: faba bean level; DFP: duration of the finishing period ; I: Interaction (Faba beans level* duration of the finishing period).
a, b: within a column, means without a common superscript letter differ(p<0.05).

Most studies have reported no effect of different nitrogen sources on carcass composition. Thus, Purroy *et al.* (1992) and Lanza *et al.* (1999) were reported that lambs fed faba beans had the lowest proportion of fat in the carcass than those fed soybean meal or lentils.

IV– Conclusion

This study was designed to examine the effects of using faba beans as an alternative protein source in the diet growth performances and carcass composition of Barbarine lambs. Partially replacing concentrates based on soya bean meal as protein source by concentrates comprising 100 g/kg or 200 g/kg faba beans did not affect lamb daily gain. Lambs fed by concentrates comprising 200 g/kg faba beans slaughtered on the end of experiment (75 days) had the highest net dressing percentage. However, the FB1 lambs had the highest ratio of hind leg weight to cold carcass weight. Lambs from the FB1 group had the lowest proportion of fat in the carcass. In conclusion, the use of concentrates comprising 100 g/kg faba beans in the diet of Barbarine lambs for 30 days is feasible and has a little positive effect on growth performances and on carcass quality.

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