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Effect of lupin on growth performance, carcass characteristics and meat quality of growing and fattening kids

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Abstract. To determine lupin grain (*Lupinus angustifolius)* effect in kids diet, we analyzed its incorporation effect on growth performances, carcass characteristics and meat quality. Four rations of concentrate (Rm, R2, R3 and R4) respectively with 0%, 12%, 21% and 35% DM of lupin physically treated and completed with barley and faba beans, were distributed to 4 groups of 7 local kids in each one from 90 days until 180 days of age. Results showed no effect of lupin on final weight, ADG (41.30, 47.50, 42.06, 49.76 g/day respectively for Rm, R2, R3 and R4), carcass yield, gastric pouch weight, adipose tissue and bone tissue importance, length of carcass and thigh and compactness index, while its incorporation improved significantly muscle and conformation index (P<0.05). For carcass color, rates higher than 20% increased significantly redness of tail and saddle (P<0.01), and decreased significantly saddle lightness (P<0.05). For the nutritional quality of meat, lupin induced significant reduction of humidity (P<0.01) with 75.76, 77.59, 73.85 and 74.11% respectively for Rm, R2, R3 and R4, while minerals, protein and fat were not affected. Lupin incorporation can reach 35% DM of the concentrate of kids without negatively affecting growth performance, carcass characteristics and meat quality.

Keywords. Lupin – Kids – Growth performances – Carcass characteristics – Meat quality.

Effet du lupin sur les performances de croissance, les caractéristiques de la carcasse et la qualité de la viande des chevreaux en croissance-engraissement.

Résumé. *L'objectif de ce travail est d'analyser l'effet de l'incorporation du lupin dans la ration des chevreaux sur les performances de croissance, les caractéristiques de la carcasse et la qualité de la viande. Quatre rations de concentré (Rm, R2, R3 et R4) iso-énergétiques et iso-azotées composées respectivement de 0%, 12%, 21% et 35% MS de lupin traité physiquement et complétées avec de l'orge et de la féverole, ont été distribuées à quatre lots de 7 chevreaux de 90 à 180 jours d'âge. Les résultats obtenus montrent qu'il n'y a pas d'effet du lupin sur le poids final, le GMQ (41,30, 47,50, 42,06, 49,76 g/jour respectivement pour Rm, R2, R3 et R4), le rendement de la carcasse, le poids du réservoir gastrique, l'importance du tissu adipeux et du tissu osseux*, *la longueur de la carcasse et de la cuisse, et l'indice de compacité. Cependant, le lupin améliore significativement l'indice de muscle et de conformation (P<0,05). Les taux d'incorporation de lupin supérieurs à 20% augmentent significativement l'indice de rouge de la queue et la selle (P<0,01), et diminuent significativement l'indice de luminance de la selle (P<0,05). Concernant la qualité nutritionnelle de la viande, le lupin induit une réduction significative de l'humidité (P<0,01) avec 75,76, 77,59, 73,85 et 74,11% respectivement pour Rm, R2, R3 et R4. Cependant, les cendres, les protéines et la matière grasse ne sont pas affectées. L'incorporation du lupin peut atteindre 35% de MS de la ration de concentré des chevreaux sans affecter négativement les performances de croissance, les caractéristiques de la carcasse et la qualité de la viande.*

Mots-clés. *Lupin – Chevreaux – Performances de croissance – Caractéristiques de la carcasse – Qualité de la viande.*

I – Introduction

In the north west of Morocco, the goat is the dominant livestock species. It represents 41% of ruminant livestock, about 690,000 heads (MAPM, 2008). Herds are concentrated in the

mountainous areas where the diet is based on the use of forest range with forage supply characterized by strong seasonal variability and a deficiency on protein resource (Chentouf *et al.,* 2004). Thus, diversification and improvement of feeding practices are necessary, and lupin can, undoubtedly, improve protein supply in the feeding calendar and can find its place in. However, studies on the introduction of lupin grain in the diet of goats are rare and mainly concern dairy goats (Broqua 2002, Masson 1981; Morales *et al*., 2008). In this context, this study aims to analyze the effect of incorporating physically treated lupin grain in the diet of kids on the performance of growth and fattening, the carcass characteristics and the quality of meat.

II – Materials and methods

Twenty eight kids from the local goat population of Northern Morocco, aged 3 months, were assigned to 4 groups (Rm, R2, R3 and R4) of 7 kids each and were followed from weaning to three months until the age of 6 months. These animals were fed a diet containing oat hay supplemented with 4 iso-energetic and iso-nitrogenous concentrate supplements. These supplements were made of barley, lupin grain, faba bean and a mineral-vitamin supplement. The lupin used was yellow lupin (*Lupinus angustifolius*) due to its availability in the region. Grains naturally exhibit relatively high levels of alkaloids; these are responsible for bitter taste and at high levels of intake can cause poisoning. To reduce their alkaloid content, lupin was subjected to physical treatment (Schoeneberger *et al*., 1982 cited by Mukisira *et al*., 2001) which consists of cooking the lupin in water at a temperature of 100℃ followed by soaking it in cold flowing water for 24 hours and then drying for 24 hours at a temperature of 65℃ in a ventilated oven.

The incorporation of lupin in the concentrate supplement was in the levels of 0, 12, 21 and 35% of DM respectively for lots Rm, R2, R3 and R4. During the test, the weighing of animals was conducted weekly to calculate average daily gain between 90 and 180 days of age (ADG90-180). After slaughter, more weightings and measurement were conducted to evaluate the carcass, yield hot and cold (24 hours *post mortem*), color, importance of adipose tissue, bone and muscle tissue. Compactness index represents ratio of weight on carcass length. While muscle index is thickness relative to length of thigh. The sum of these two indices is Conformation index. The color of the carcass was measured using a portable colorimeter (Chromameter Minolta CR410). Samples were taken on the *Semimembranosus* muscle to determine ash, fat, protein and moisture content. These analyses were carried out according to the AOAC (1979). Statistical analysis was performed by Excel 2007 and software (SAS, 2001).

III – Results and discussion

The final live weight and ADG90-180 are not affected by diet (Table 1). This result is similar to Vicenti *et al.* (2009) who reported that the lupin substitution of soybean had no significant effect on growth performance of bull calves for fattening.

Table 1. Effect of lupin on growth performance of goats

	Initial live weight (kg)	final live weight (kg)	ADG 90-180 (g/day)
Rm	14.1	16.39	41.3
R2	13.93	17.06	47.5
R3	14.04	17.29	42.06
R4	14.06	17.63	49.76
probability	0.99	0.89	0.79
significance	NS	NS	NS

NS: not significant.

Diets had no significant effect on carcass characteristics including yield and hot and cold (24 h *post mortem*) carcass weight (Table 2). Similar results were reported by El Maadoudi (1997) in Timahdite lambs and Vicenti *et al.* (2009) with Podolian bulls.

Table 2. Effect of lupin on carcass weight, yield, pluck and gastric pouch

	Carcass weight (kg)	Cold Carcass yield (%)	Pluck† (kg)	gastric pouch full (kg)	gastric pouch empty (kg)
Rm	7.24	44.12	0.9a	4.21	2.37
R2	7.72	45.08	0.76b	4.24	2.03
R3	8.33	48.77	0.94a	4.73	2.33
R4	7.31	41.34	0.87ab	4.13	1.91
P	0.56	0.09	0.03	0.34	0.06
	NS	NS	*	NS	NS

†Consists of all liver, lung, heart, spleen and trachea.
a, b, ab: in a same column, followed by the letters distinguished values are statistically different than 5%.
P : probability ; NS: not significant; *: P<0.05.

Also, the diet did not affect the weight of perirenal and mesenteric fat, and gastric pouch while the differences observed for the weight of the pluck seem to be more related to the characteristics of animals than to the diet (Table 3). For carcass length, there is no significant difference between lots and the same is also noted for the length of the thigh (Table 3).

Table 3. Effect of lupin on adipose and bone tissue

	Mesenteric fat (kg)	Perirenal fat (kg)	Carcass length (cm)	thigh length(cm)
Rm	0.32	0.08	51.8	21.2
R2	0.3	0.1	53.3	20.0
R3	0.49	0.13	55.3	20.4
R4	0.38	0.09	53.4	20.1
P	0.09	0.23	0.27	0.6
	NS	NS	NS	NS

P : probability ; NS: not significant.

According to the appreciation of the importance of muscle tissue, no differences were found between lots as regards the thigh thickness and the compactness index , while we note that the incorporation of lupin in the diet promoted positively muscle index (P<0.05) and the conformation index (P<0.05) (Table 4).

Concerning carcass color, lupin improved color index. Indeed, it induced a significant reduction of the brightness value of the saddle (P<0.05), an increase of red index of the saddle (P<0.01) and tail (P<0.01). No significant difference was observed for the color indices in the back (Table 5).

Moisture of *Semimembranosus* muscle decreased with increasing rate of lupin in the diet (P<0.05). This result contrasts with that reported by Vicenti *et al.* (2009) who observed no effect of substitution of soybean by lupin in the diet of Podolian bulls on the moisture of this muscle. While fat, protein and ash were not affected by the incorporation of lupin (Table 6).

Table 4. Effect of diet on muscle tissue.

	Thighs thickness (cm)	Compactness Index	Muscle index	Conformation index
Rm	10.62	0.13	0.5b	0.64b
R2	11.13	0.14	0.56a	0.7a
R3	11.19	0.14	0.55a	0.7a
R4	10.53	0.13	0.53ab	0.66ab
P	0.37	0.69	0.02	0.02
	NS	NS	*	*

a, b, ab: in a same column, followed by the letters distinguished values are statistically different than 5%. P : probability ; NS: not significant; *: P<0.05.

Table 5. Effect of diet on carcass color

	L* saddle	a* saddle	b* saddle	L* tail	a* tail	b* tail	L* back	a* back	b* back
Rm	61.09ab	4.38b	9.37	53.91	8.06b	8.31	68	3.53	10.79
R2	63.47 a	3.07b	9.84	54.91	8.20b	8.04	66.37	2.4	8.15
R3	57.40b	6.55 a	9.34	48.62	12.76a	8.83	62.19	3.72	9.94
R4	58.83b	6.31a	9.17	52.89	10.89a	9.41	64.82	4.12	10.51
P	0.013	0.002	0.93	0.13	0.002	0.24	0.06	0.25	0.1
	*	**	NS	NS	**	NS	NS	NS	NS

* Lightness, a * redness; b *yellowness. a, b, ab: in a same column, followed by the letters distinguished values are statistically different than 5%. P : probability ; NS: not significant; *: P<0.05; **:P<0.01.

Table 6. Effect of lupin on moisture, fat, ash and protein of *Semimembranosus*

	Moisture (%)	Fat (%)	Protein (%)	Ash(%)
Rm	75.76a	3.15	20.46	2.17
R2	77.59 a	2.33	20.52	2.15
R3	73.85b	3.38	20.98	2.18
R4	74.11b	3.43	22.15	2.17
P	0.0011	0.054	0.8	0.64
	**	NS	NS	NS

a, b : in a same column, followed by the letters distinguished values are statistically different than 5%. P : probability ; NS: not significant; **:P<0.01.

IV – Conclusions

Lupin can be incorporated in the diet of kids at rates that reach 35% of the concentrate ration and thus improve the carcass quality without adversely affecting fattening performance and meat quality.

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