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Halophytes and grass pea as alternative fodder resources for rearing lambs on saline area. The case of Kerkennah archipelago

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Abstract. Mediterranean saline soils can be valuable sources of nutrients for livestock. In Kerkennah, the Tunisian archipelago, characterized by high soil salinity, halophytic vegetation could partially substitute cultivated roughages. Moreover, some autochthonous legumes, such as *Lathyrus sativus* could be used as a protein source instead of soybean meal. In this context, we studied the effects of feeding lambs on rangeland rich in halophytes on growth performances and carcass quality. Forty weaned female Queue Fine de l'Ouest lambs aged 153±32 days and with an average weight of 25.45±4.33 kg were assigned into two homogeneous groups (n=20). The first group was fed in feedlot with straw *ad libitum* (S). The second was reared on rangeland rich in halophytes (R) (*Suaeda mollis*, *Salsola longifolia*, *Medicago littoralis*, *Gasul nodiflorum*) with a stocking rate of 3.33 lambs/ha. R group and S group received respectively 300 and 500 g/head/day of concentrate containing 12% of the grass pea. After 3 months, lambs were slaughtered at 33 kg. The average daily gain (ADG) was similar between groups ($P > 0.05$) (92 vs. 96 g/day for R and S groups, respectively). The cold carcass weight averaged 14.4 kg and was not affected by feeding system (FS) ($P > 0.05$). Dressing percentage and commercial dressing percentage were higher for the R group ($P = 0.05$). FS had also an effect on the fattening state. In fact, the lambs in the R group had lower perirenal fat weight than that of the S group (208.15 vs. 369.01 g; $P < 0.01$). Whereas, the subcutaneous fat thickness was similar between groups. In conclusion, the results show that feeding sheep on saline rangeland with a moderate supply of concentrate allows similar growth with less fatty carcass and a lower feed cost than those fattened indoor.

Keywords. Lamb – Rangeland – Halophytes – Grass pea – Growth – Carcass quality.

Halophytes et gesse commune comme ressource fourragère pour l'élevage d'agneaux en zone saline : Cas de l'archipel de Kerkennah

Résumé. Les sols salins méditerranéens peuvent constituer une source précieuse d'éléments nutritifs pour le bétail. Dans l'archipel tunisien Kerkennah, caractérisé par une forte salinité du sol, la végétation halophyte pourrait remplacer partiellement le fourrage. En outre, certaines légumineuses autochtones, telles que *Lathyrus sativus*, pourrait être utilisée comme source de protéines au lieu du tourteau de soja. Dans ce contexte, nous avons étudié les effets de l'engraissement des agnelles sur un parcours riche en plantes halophytes sur les performances de croissance et la qualité de la carcasse. Quarante agnelles sevrées de race Queue Fine de l'Ouest âgées de 153±32 jours et ayant un poids vif moyen de 25,45±4,33 kg, ont été réparties en deux groupes homogènes (n=20). Le premier groupe a été élevé en bergerie avec de la paille à volonté (LB). Le deuxième a été élevé sur un parcours riche en plantes halophytes (LP) (*Suaeda mollis*, *Salsola longifolia*, *Medicago littoralis*, *Gasul nodiflorum*) avec un chargement de 3,33 agnelles/ha. LP et LB ont reçu respectivement une moyenne de 300 et 500 g/j d'aliment concentré contenant 12% de la gesse commune. Après 3 mois, les agnelles ont été abattues à 33 kg. Le GMQ moyen était identique entre les deux groupes ($P > 0,05$) (92 vs. 96 g/j, respectivement pour LP et LB). Le poids de la carcasse froide était en moyenne de 14,4 kg et n'était pas affecté par le mode de conduite (MC) ($P > 0,05$). Les rendements vrai et commercial étaient plus élevés pour le groupe LP ($P = 0,05$). Le MC a eu un effet sur l'état d'engraissement. Les agnelles du groupe LP avaient un poids du gras péri-rénal inférieur à celui du groupe LB (208,15 vs. 369,01 g; $P < 0,01$). Cependant, l'épaisseur du gras de couverture était similaire entre les groupes. En conclusion, l'engraissement des ovins sur un parcours salin avec un apport modéré d'aliment concentré permet une croissance similaire et d'avoir une carcasse moins grasse et une charge alimentaire plus faible que l'engraissement en bergerie.

Mots-clés. Agneaux – parcours – Halophytes – Gesse commune – Croissance – Qualité carcasse.

I – Introduction

In the Mediterranean basin, the lamb's fattening ration is generally based on hay or straw with supplementation of concentrate, or on natural resources like rangelands. Several studies have shown that lamb reared on pasture could be a simple feeding strategy to naturally manipulate dietetic characteristics of sheep products. So, Jiménez *et al.* (2019) reported that finishing lambs on high-quality pasture can produce satisfactory growth rates without compromising characteristics of the carcass. Furthermore, Atti *et al.* (2015) found that carcass of lamb grazing grasslands, being leaner, will be demanded by consumers and recommended by nutritionists.

Pastoral resources depended mainly on weather conditions. Climate change, drought and salinity are among the dominant environmental problems in Tunisia that caused major challenges like the extension of the *sabkha*, with a progression of the adapted halophytic plants. Masters *et al.* (2007) suggested that many of these salt-tolerant forages are also capable of being converted into various livestock products. Ben Salem *et al.* (2004) also reported that halophytes could be alternative feeds to replace common roughages, especially for sustaining grazing livestock when common feeds are scarce. Therefore, some of these plants are palatable and can be well valued and provide a valuable source of nutrients for lambs. Nevertheless, fattening lambs on saline pasture is not sufficient to meet their needs, so supplementation with concentrate is necessary. In Tunisian conditions, soybean meal is the most used and expensive source of nitrogen in the concentrate. In a context of sustainability, it would be more interesting to value locally produced legumes such as grass pea (*Lathyrus sativus*).

The aim of this work was to characterize growth performances and carcass quality of female Queue Fine de l'Ouest lambs reared on natural saline pasture and to compare them to indoor lambs. All lambs were supplemented with concentrate containing grass pea.

II – Materials and methods

The trial was conducted in a farm of Kerkennah archipelago located in the governorate of Sfax, (arid region of Tunisia with an average annual rainfall of 246 mm), during spring season. Forty female weaned Queue Fine de l'Ouest lambs aged 153 ± 32 days and with an initial body weight of 25.45 ± 4.33 kg were divided into two homogeneous groups ($n = 20$) according to body weight and age. The first groups were housed indoor and received oat straw *ad libitum* (S). The second was reared on 6 ha of natural rangeland rich in halophytes of a coverage rate of 66.1 % for 6h daily (R). To satisfy nutrient needs, besides to the basal diet each group received the same concentrate (15% maize, 30% barley, 15% wheat bran, 9% soybean meal, 12% grass pea, 15% alfalfa plug and 4% CMV) with 300 and 500 g/head/day respectively for lambs reared on rangeland and those fed indoor. The animals were individually weighed before receiving the meal of the morning, at the beginning of the trial and every 21 days to calculate the average daily gain (ADG).

The floristic inventory was taken during April and May. The natural rangeland was composed of halophytic fodder shrubs and herbaceous species. The most frequent fodder shrubs were halophytes (61.53%): *Suaeda mollis* (30.84 %), *Salsola longifolia* (15.55%), *Reaumuria vermiculata* (12.23%), *Atriplex lindleyi* (1.14%), *Zygophyllum album* (1.10%) and *Arthrocnemum macrostachyum* (0.67%). For the herb species, rangeland was composed mainly of *Medicago littoralis* (22.79%), *Cynodon dactylon* (14.22%), *Gasoul nodiflorum* (3.16%), *Trigonella maritime* (2.42%) and *Erodium laciniatum* (1.34%).

At the end of the fattening period, lambs reached approximately an average final bodyweight (BW) of 33 kg. They were weighed before slaughtering on the farm. Then, they were transported to a commercial slaughterhouse, where they were re-weighed just before slaughtering (slaughter weight: SW). Lambs were slaughtered according to the Muslim practice and under veterinarian control. Also, the hot carcasses were weighed one hour after slaughter (hot carcass weight (HCW)), chilled at 4°C for 24h and re-weighed (cold carcass weight: CCW).

Dressing percentage ($DP = HCW/(SW - \text{digestive tract content: DTC}) \times 100$) and Commercial dressing percentage ($CDP = CCW/SW \times 100$) were calculated.

The carcass fatness was evaluated by the measurement of kidney fat weight and subcutaneous fat thickness. Kidney fat was removed and weighed. Subcutaneous fat thickness was measured using an Electronic Digital Calibrator after an incision between the 10th and the 11th ribs and about 4 cm to the right of the spinal column (Fisher and De Boer, 1994).

Data on the effects of diet on the various parameters (lamb growth and carcass quality) were treated with the GLM procedure (general linear model) using statistical analysis software (STATISTICA, version 5.5, USA). The model included one main factor: feeding system (saline pasture vs. indoor). Differences among means were considered to be significant when $P \leq 0.05$.

III – Results and discussion

The feeding system did not affect ($P > 0.05$) the ADG, final body weight, slaughter weight, hot and cold carcass weights (Table 1). Results of growth performances were similar, despite that concentrate supplementation was higher for the S group. As a result, saline pasture is more balanced in terms of energy and nitrogen compared to the straw. In addition, dressing percentage and commercial dressing percentage were higher for the R group. These results confirm the findings of other previous studies that reported a better efficiency of grazing system with low concentrate supply (Smeti *et al.*, 2014; Atti *et al.*, 2015).

Table 1. Effect of feeding system on growth and slaughter performances of female Queue Fine de l'Ouest lambs

	Feeding system		SEM	P-value
	Saline pasture	Indoor		
Weaning age (d)	152.10	154.55	5.079	0.813
Weaning weight(kg)	25.60	25.30	0.684	0.829
Final weight (kg)	32.90	32.95	0.749	0.974
Slaughter weight (kg)	30.98	31.83	0.550	0.463
Average daily gain (g)	92	96	3.945	0.859
Hot carcass weight (kg)	14.93	14.67	0.295	0.673
Cold carcass weight (kg)	14.53	14.36	0.298	0.781
Dressing percentage (%)	52.72	50.75	0.521	0.054
Commercial dressing percentage (%)	46.87	45.11	0.440	0.039

SEM: Standard error of mean; P: Probability.

Table 2. Effect of feeding system on carcass fatness of female Queue Fine de l'Ouest lambs

	Feeding system		SEM	P-value
	Saline pasture	Indoor		
Kidney fat weight (g)	208.15	369.01	30.144	0.003
Subcutaneous fat thickness (mm)	2.45	2.74	0.356	0.698

SEM: Standard error of mean; P: Probability.

Lambs in the R group had lower perirenal fat weight than that of the S group (208.15 vs. 369.01 g; $P < 0.05$). Arieli *et al.* (1989) reported that the consumption of a high-salt diet requires higher energy requirements to process the high salt load, which would decrease the availability of energy for lipogenesis and reduce fat deposition. Nevertheless, the subcutaneous fat thickness was sim-

ilar between groups ($P>0.05$). This result is different from that reported by Majdoub-Mathlouthi *et al.* (2015), Hamdi *et al.* (2016) and Hajji *et al.* (2019). In fact, they explain the lower carcass fat of lamb grazing by the greater energy expenditure for physical activity.

IV – Conclusions

During the favorable season, grazing saline pasture, with a moderate concentrate supplementation offers the same lamb's growth and less fatty carcass than the indoor group fed on oat straw and higher amount of concentrate. Therefore, this management system could be recommended to alleviate the feeding cost and, consequently to increase farmer's income with the potential to improve the sustainability of sheep production in marginal areas.

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