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Effect of the protein level in maize silage-based diets on performance of early weaned lambs' fattening and carcass characteristics

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Abstract. The aim of this study was to evaluate effects of different protein levels in maize silage-based diets on weaned lambs performance and carcass characteristics. Sixty Moroccan (local breed) early weaned lambs (14.7±0.45 kg initial body weight and 80±6.3 days were divided into three treatments, 20 males each. They received a diet containing maize silage (21%), wheat straw (19%) and concentrate supplement (60% as dry matter basis) with different protein levels, 18 (T1), 16 (T2) and 14 (T3) g crude protein/ 100 g dry matter of the supplement. The trial lasted for 105 days after 14-day of adaptation period. Feed offered and orts were daily registered and feed intake calculated. Lambs were weighed at the beginning and at the end of the trial, and fortnightly in order to determine the average daily gain and feed conversion. At the end of the trial, 3 lambs per each treatment were slaughtered. The carcass dressing percentage, fatness (1-5 scale) and conformation (SEUROP system) were determined. Results revealed that the protein level did not affect either lamb fattening performance or carcass characteristics for the whole period. The ADG was 223.3, 193.9 and 205.4 g/ day for T1, T2 and T3, respectively. Feed conversion ratio was 4.7, 5.6 and 5.5 kg dry matter intake/ kg ADG for T1, T2 and T3, respectively. The dressing percentage and fatness were 56.5, 54.1 and 55.1% and 2.8, 2.3 and 2.5 for T1, T2 and T3, respectively. In conclusion, lambs may be fed maize silage-based diets containing 20 % of maize silage and concentrate feed supplement containing 14% CP during the fattening period without negative effects on lambs performance and carcass characteristics.

Keywords. Protein level – Lamb – Maize silage – Fattening – Carcass.

Effet du niveau protéique des rations à base d'ensilage de mais sur les performances d'engraissement des agneaux sevrés précocement et les caractéristiques de la carcasse

Résumé. *L'objectif ce travail était d'évaluer l'effet du niveau protéique des rations à base d'ensilage de maïs sur les performances d'engraissement des agneaux sevrés précocement et les caractéristiques de leur carcasse. Soixante agneaux sevrés précocement (14,7 ± 0,45 kg de poids vif initial et 85 ± 6,3 jours d'âge) ont été répartis aléatoirement en trois traitements de 20 mâles chacun. Ils ont reçu un régime contenant de l'ensilage de maïs (21%), de la paille de blé (19%) et un supplément de concentré (60% en MS) avec différents niveaux de matières azotées totales (MAT): 18 (T1), 16 (T2) et 14 (T3) g MAT/100 g MS. L'essai a duré 105 jours précédé d'une période d'adaptation de 14 jours. Les quantités distribuées et les refus ont été enregistrés chaque jour pour calculer les quantités ingérées. Les agneaux ont été pesés au début et à la fin de l'essai et tous les quinze jours afin de déterminer le gain moyen quotidien et l'indice de consommation. À la fin de l'essai, 3 agneaux de chaque traitement ont été abattus et le rendement de carcasse, l'état d'engraissement (échelle de 1 à 5) et la conformation (SEUROP) ont été déterminés. Le niveau protéique du régime alimentaire n'a affecté ni les performances d'engraissement ni les caractéristiques de la carcasse. Le gain quotidien moyen (GMQ) a été de 223,3, 193,9 et 205,4, respectivement, pour T1, T2 et T3. L'indice de consommation a été de 4,7, 5,6 et 5,5kg MSI / kg GMQ, respectivement, pour T1, T2 et T3. Le rendement de carcasse et l'état d'engraissement ont été de 56,5, 54,1, 55,1% et 2,8, 2,3 et 2,5, respectivement, pour T1, T2 et T3. En conclusion, les agneaux peuvent être nourris avec des régimes contenant 20% de l'ensilage de maïs et un concentré contenant 14% de MAT pendant la période d'engraissement, sans affecter négativement les performances et les caractéristiques de la carcasse des agneaux.*

Mots-clés. *Niveau protéique – Agneaux – Ensilage de mais – Engraissement – Carcasse.*

I – Introduction

In Morocco, small ruminant production is considered the main source of income for farmers living in arid and semi-arid areas in which they are raised mainly on the available natural rangelands. However, the irregular rainfall (drought season), rangeland degradation (limited forage availability) and high price of supplementary feeding affect negatively the animal productivity and therefore the farmers' income. This situation leads to switch from a traditional feeding system based on the rangelands (extensive production system) to a semi-intensive production system based on concentrate supplementation to maintain a certain level of production's performance. In this production system, the lamb fattening is the most common practice to mitigate the effects of drought. In such situation, silage can be successfully fed to fattening lambs to improve animal performance and pasture utilization (Marley *et al*., 2007; Stanley, 2003). However, the most important factor affecting the forage quality and its utilization is the protein content which can improve the utilization of low-quality forage (Poppi and McClennan, 1995). The use of a low-cost diet through the incorporation of alternative forage resources such as maize silage and protein supplement feeds may constitute a good feeding practice to improve lambs' fattening performance. The objective of this work was to evaluate the effects of the protein level in maize silage-based diets on the fattening performance of early weaned lambs and carcass characteristics.

II – Material and methods

Sixty Moroccan, local breed, early weaned lambs (entire males) with an average initial live weight of 14.7±0.45 kg and age of 80±6.3 days, were randomly assigned to three treatments, (20 animals per treatment). Lambs received a basal diet of maize silage (21%), wheat straw (19%) and concentrate feed (60% as dry matter basis). The concentrate supplement consisted of three crude protein level, 18 (T1), 16 (T2), and 14 (T3) g crude protein/ 100 g dry matter. All used diets were isoenergetic. The chemical composition of diet's ingredient is presented in Table 1. The experiment was lasted for 105 days after a 14-day adaptation period to the experimental diets. Lambs were fed twice daily, and feed offered and orts daily registered. Free clean water and mineral block were available all the time. In addition, Lambs were weighed before morning feeding, at the beginning and the end of the trial, and fortnightly.

Table 1. Chemical composition (% DM) of different experimental diets' ingredients

	Maize silage	Concentrate feed18% CP	Concentrate feed 16% CP	Concentrate feed 14% CP	Wheat straw
Dry matter (DM)	35.12	88.45	88.75	87.37	89.88
Organic matter (OM)	96.31	90.3	90.79	89.03	93.8
Crude protein (CP)	7.91	18.41	16.46	14.36	3.26
Neutral detergent fiber (NDF)	42.66	26.27	26.44	29.04	76.53
Acid detergent fiber (ADF)	25.64	17.46	18.86	21.00	62.06
Lignin	4.42	2.45	3.12	2.43	12.11

At the end of the experiment, and after a 24h period, 3 lambs per each treatment were weighed (slaughter live weight, SLW) and slaughtered, while carcass weight was recorded immediately (Hot Carcass Weight, HCW) to determine the dressing percentage (HCW*100/SLW), the fatness degree (1 to 5 scale) and carcass conformation according to the SEUROP system (Cañeque and Sañudo, 2005).

The effect of protein supplement level on fattening performance (initial fattening weight is used as covariate) and carcass characteristics was analyzed by means of a one-way analysis of variance

according to the model: $Y_{ij} = \mu + Ti + \varepsilon_{ij}$ where *Ti* represents the treatment effect and ε_{ij} the experimental error. The PROC GLM procedure of the SAS statistical package (version 8.01) was used for the analysis. Comparisons among mean values were tested using the LSD test.

III – Results and discussion

1. Fattening performance of early weaned lambs

Initial and final live weights as well as average daily gain (ADG) and feed conversion ratio (FCR) are presented in Table 2. Animals feeding a high protein level (T1) had greater final weights than those in T2 and T3 groups (P=0.0023).The body weight changed between lambs in T1 and T2 was 4 kg (Table 2). However, the protein level did not affect the ADG for the whole period. The feed conversion ratio of lambs varied between 4.7 for T1 and 5.6 for T2. The improved FCR for T1 may be associated with a better feed efficiency of the supplement containing 18% CP that is not significantly reflected in the ADG. Our results agreed with several studies that didn't find any effects of protein level on ADG and FCR (Ríos-Rincón *et al*., 2014; Beauchemin *et al*., 1995) indicating that dietary effects on growth performance were due mainly to energy concentration rather than protein level or degradability of the protein source when finishing diets contained more than 14% of crude protein. This fact may be explained that when the protein supply exceeds the requirement, energy becomes limiting for growth, and the animals no longer respond to additional intakes of protein (Titgemeyer, 2003).

In our experiment, the percentage of inclusion of maize silage was about 20% which may affect the ADG and FCR. In this regard, Van de Vyver *et al*., (2013) found that the inclusion of 50% silage in diets had the best ADG and FCR to other levels of silage maize incorporations.

Table 2. Fattening performance of early weaned lambs fed concentrate feed with different level of crude protein

	Treatment			SEM	P-Value
	T1	T2	T3		
Live weight (LW, kg)					
Initial	14.34	14.50	15.37	–	–
105 days	38.4[a]	34.4[b]	35.7[b]	0.93	0.0023
Average daily gain (ADG, g/d)					
0-30 days	210.5[a]	156.4[b]	142.6[b]	9.39	<.0001
30-60 days	258.6	223.4	268.0	14.42	0.0906
60-105 days	234.5[a]	208.5[ab]	176.1[b]	12.34	0.0069
0-105 days	223.3	193.9	205.4	8.67	0.0607
Feed conversion (kg DMI/ kg ADG)	4.7	5.6	5.5	–	–

T1: Concentrate feed containing 18% CP; T2: Concentratefeed containing 16% CP; T3: Concentratefeed containing 14% CP ; SEM: standard error of the mean; P: probability of the differences;
[a. b] Means with different superscripts are significantly different (P<0.05).

2. Carcass characteristics

Carcass characteristics are given in Table 3. The analysis of variance revealed no significant effect of the crude protein level of the used supplement on dressing percentage and fatness. Similar results were obtained by Beauchemin *et al*., (1995) where the protein level, in high-energy finishing diets, only had small effects on dressing percentage.

Table 3. Carcass characteristics ofearly weaned lambs fed concentrate feed with different level of crude protein

	Treatment			SEM	P-Value
	T1	T2	T3		
WCDP (%)	56.5	54.1	55.1	1.42	0.5302
Fatness	2.8	2.3	2.5	0.12	0.0580
Conformation	R	R	R	–	–

T1: Concentratefeed containing 18% CP; T2: Concentratefeed containing 16% CP; T3: Concentratefeed containing 14% CP; SEM: standard error of the mean; P: probability of the differences; SEM: standard error of the mean; P: probability of the differences; WCDP: Warm Carcass Dressing Percentage.

IV – Conclusions

The results of this experiment showed that lambs may be fed maize silage-based diets containing 20 % of maize silage and concentrate feed supplement containing 14% CP during the fattening period without negative effects on lambs performance and carcass characteristics. However, further trials should be carried out increasing the proportion of maize silage inclusion in the diet and involving aspects related to meat quality (chemical, physical and sensory parameters) in order to complete the concept of the obtained results in the current study.

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