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Effects of pasture type on tissue composition and sensorial meat quality of lambs raised under the organic livestock system

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Abstract. In organic livestock system, animals should have access to pasture. This study aims to determine the effects of the pasture type (PT) used to fattened lambs according to organic conditions. Fifty four Barbarine lambs with an initial average weight of 24.06±5.01 kg and 8 month-old were divided into two homogeneous groups. Each group received 200 g of organic oat hay and 400 g of organic farmer concentrate (63.7% barley, 18.2% broad bean, 13.6% faba bean, 4.5% mineral vitamin supplement) with access either to natural pasture (NP) or a cultivated green barley pasture (BP) both organic certified. Six lambs from each group were slaughtered at an average weight of 35 kg. Results obtained indicated that NP lambs had higher lean proportions in leg (+3.13%) and lumbar region (+5.88%) than those reread on BP, but no effects of PT were found for fat proportions (P>0.05). As for instrumental meat color parameters, redness (a*) were higher on NP lambs *Longissimus lumborum* (LL) and *Semitendinosus* (ST) muscles. Yellowness (b*) was not affected by PT for both muscles (P>0.05). The meat sensory quality was slightly affected by PT. ST muscle of NP lambs was more tender (7.15 *vs* 5.51; P<0.001) than those produced on BP. Feeding lambs on NP tended to increase meat juiciness and flavor (P < 0.10). However, fat degree was higher in LL muscle of BP lambs (P<0.05). Green barley pasture can be used as an alternative feed resource to fed lambs according to organic system especially in the drought season.

Keywords. Organic livestock system – Pasture type – Tissue composition – Lamb – Sensorial meat quality.

Effets du type de parcours sur la composition tissulaire et la qualité sensorielle de la viande d'agneaux élevés en mode de production biologique

Résumé. *Dans le système de l'élevage en mode biologique, les animaux doivent avoir accès au pâturage. Cette étude vise à déterminer les effets du type de parcours (PT) utilisé pour engraisser les agneaux selon les conditions de l'élevage en mode biologique. Cinquante-quatre agneaux de race Barbarine ayant un poids moyen initial de 24,06±5,01 kg et âgés de 8 mois ont été divisés en deux groupes homogènes. Chaque groupe a reçu 200 g de foin d'avoine biologique et 400 g de concentré (63,7%, orge, 18,2% fève, 13,6 % féverole, 4,5% CMV)avec un accès soit à un parcours naturel (NP) ou à une prairie d'orge cultivée en vert (BP) tous deux certifiés biologiques. Six agneaux de chaque groupe ont été abattus à un poids moyen de 35 kg. Les résultats obtenus indiquent que les agneaux du groupe NP présentent des proportions plus élevées en muscle pour la cuisse (+3,13%) et la région lombaire (+ 5,88%) que ceux élevés sur BP, alors qu'aucun effet de PT n'a été trouvé pour les proportions du gras (P> 0,05). En ce qui concerne les paramètres de couleur de la viande, l'indice de rouge (a *) était plus élevé dans les* muscles Longissimus lumborum *(LL) et* Semitendinosus *(ST) des agneaux NP. L'indice de jaune (b *) n'a pas été affecté par le PT pour les deux muscles (P> 0,05). La qualité sensorielle de la viande était légèrement affectée par le PT. Le muscle ST des agneaux NP est plus tendre (7,15* vs *5,51; p <0,001) par rapport à celui des agneaux élevés sur BP. La conduite des agneaux sur NP tend à augmenter la jutosité et la flaveur de la viande (P <0,10). Cependant, le degré de gras a été plus élevé dans le muscle LL des agneaux BP (P <0,05). Le pâturage en vert sur une prairie d'orge cultivée pourrait être utilisé comme une ressource alimentaire alternative pour engraisser les agneaux selon le mode de production biologique, en particulier pendant la saison de sécheresse.*

Mots-clés. *Système d'élevage biologique – Type de parcours – Composition tissulaire – Agneaux – Qualité sensorielle.*

I – Introduction

In the last decades, following crises that have affected the image of the meat quality such as mad cow and bird flu (Kouba, 2003), consumer has become increasingly demanding in terms of the knowledge of the origin and the production systems of meat products. Thus, the choice is oriented more towards production methods with fewer inputs and chemicals, in other words towards the natural or organic system. Thus, to meet these consumer demands, the quality of red meat had a new challenge (Galgano *et al*., 2016). However, meat produced on grass-fed system has a good nutritional quality (Prache *et al*., 2011, Majdoub-Mathlouthi *et al*., 2015).The regulation of organic animal livestock requires mandatory access to pasture with supplementation of concentrate which must not exceed 40% DM of the ration (JORT, 2005).

In Tunisia, the production and quality of rangeland biomass depends on the climatic conditions which are difficult, especially in the semi-arid and arid regions of the country. The yield of pasture biomass remained low because of the degraded state of rangelands caused by drought and overgrazing (Ben Salem, 2010). Then, it was necessary to find another alternative to guarantee the access to pasture for animals raised under organic livestock system, when conditions do not permit. Barley among cereals seems to provide a solution to a livestock-based production system, as it can be an excellent source of animal feed. It is used in its various forms (grain, forage, straw). This work aims to compare the effect of two pasture types (natural pasture vs. green barley) on tissue composition and sensory meat quality of lamb reared under organic system.

II – Materials and methods

This study was carried out at the Farm of Office des Terres Domaniales (OTD) El Attizez (Sidi Bouzid, Tunisia). All procedures of organic livestock farming practiced in this study (feeding, health, transport and slaughtering) meet the Tunisian legislation law number 2005–57 of organic livestock system (JORT, 2005). Fifty four 8 month-old Barbarine lambs of an average body weight of 24.06±5.01 kg were divided into two homogenous groups (27 lambs per group : 11 females and 16 males) : according to initial body weight and sex, the first group reared under certified organic natural pasture (NP) and the second group on cultivated green barley (*Hordeum vulgare*) pasture (BP). Each group received 200 g of organic oat hay and 400 g of organic farmer concentrate (63.7% barley, 18.2% broad bean, 13.6% faba bean, 4.5% mineral vitamin supplement). Chemical composition of experimental feeds used in this study is shown in Table 1.

Table 1. Chemical composition of experimental feeds (%DM)

	Oat hay	Natural pasture (NP)	Barley pasture (BP)	Concentrate
Dry matter (%)	90.68	45.97	33.5	93.69
Ash	7.22	12.19	9.05	5.50
Crude protein	3.63	10.69	7.28	14.81
NDF	67.85	65.36	62.26	31.66
ADF	37.09	39.43	33.54	7.23
ADL	4.96	5.19	3.78	2.18

DM: Dry matter; NDF: Neutral detergent fiber; ADF: Acid detergent fiber; ADL: Acid detergent lignin.

At the end of the experimental trial which lasted 103 days, six lambs of each group were slaughtered at an average live weight of 35 kg after 16 h of fasting with free access to water. The carcasses were chilled at 4°C for 24 h after which was weighted (cold carcass weight), split along the midline and cut according the method of Fisher and De Boer (1994). Leg and lumbar region were removed from the left side, weighted and dissected to determine their tissue composition. The *Longissimus lumborum*(LL) and *Semitendinosus* (ST) muscles were removed from both sides.

Lightness (L*), redness (a*) and yellowness (b*) color parameters of LL and ST muscles were measured using a Minolta CR-401 chromameter (Osaka, Japan) according to the CIE system (1986). Sensory meat quality of LL and ST muscles were assessed by a taste panel. LL and ST muscles samples were cooked in a preheated oven of 240°C until the core temperature reached 70 °C. Immediately after cooking, muscle was divided in 1.5 × 1.5 cm cubed samples and placed in aluminium foil. Ten tasters participated in this sensory meat evaluation to asses color (0 = very clear, 10 = very dark), tenderness (0 = extremely tough, 10 = extremely tender), juiciness (0 = extremely dry, 10 = extremely juicy), flavour (0 = very low, 10 = very intense), degree of fatty (0 = very lean, 10 = high fat) and acceptability (0 = not acceptable, 10 = extremely acceptable). Bread and water were provided for panellists to refresh their palates between samples.

The data were analyzed by the GLM procedure of the STATISTICA (version 5.5, Stat Soft, Tulsa, Ok, USA). The model included pasture type as a fixed factor and the slaughter weight was used as covariate for analyses of carcass traits and meat quality. The differences between the means were compared by the Duncan test and considered significant when $P \leq 0.05$.

III – Results and discussion

The results of weight and yield carcass and proportions and tissue composition of leg and lumbar region are varied with the pasture type (PT) (Table 2). NP lambs had greater commercial dressing percentage. PT had affected ($P<0.05$) the proportions of leg and lumbar region. Feeding lambs under BP had increased the proportions of leg and lumbar region respectively by +1.40% and +0.72% compared with feeding under BP. For both groups, the average proportions of leg and lumbar region were respectively 33.96%and 7.83% of the total carcass weight. These values were similar to those reported by Karim *et al*. (2007). Regarding the tissue composition of leg and lumbar region, lean proportions in leg and lumbar region were higher respectively by +3.13% and +5.88% for the NP lambs compared with those of BP group. The bone of leg was significantly more developed for the BP lambs. However, the pasture type did not affect ($P>0.05$) fat proportions for both leg and lumbar region. Our results were different to those reported by Mekki *et al*. (2014) who found that the percentage of lean in carcass did not change between lambs reared under herbaceous or woody pastures.

Table 2. Effects of pasture types on carcass traits, proportions (% untailed carcass) and tissue composition of leg and lumbar region (%) of Barbarine lamb

		Natural pasture (NP)	Barley pasture (BP)	SEM	Effect
Weights and yield carcass	Initial weight (kg)	24.11 ± 5.41	24.06 ± 5.01	–	–
	Final weight (kg)	30.35 ± 6.55	31,26 ± 6,42	–	–
	Slaughter weight (kg)	36.90	34.00	0.773	*
	Cold carcass weight (kg)	16.57	16.45	0.174	NS
	Commercial dressing (%)	46.72	46.35	0.729	**
Proportions (%)	Leg	33.26	34.66	0.783	**
	Lumbar region	7.47	8.19	0.342	*
Tissue composition (%)	Leg				
	Lean	69.48	66.35	1.179	***
	Fat	10.48	12.80	1.316	NS
	Bone	18.13	18.38	0.440	***
	Lumbar region				
	Lean	65.72	59.84	1.586	***
	Fat	15.68	18.96	3.030	NS
	Bone	17.21	16.74	1.479	NS

Results of color and sensory quality of meat are shown in Table 3. For both muscles, redness (a*) values were higher in NP lambs than in those reared on BP. This result indicated probably a higher physical activity exercised by lambs reared under NP. Feeding lambs under NP had increased lightness (L*) in LL muscle. These findings indicated that LL muscle of NP lambs is lighter and has a more intense redness. However, pasture type did not affect (P>0.05) yellowness values for both muscles. The meat sensory quality was slightly affected by PT. In fact, for the LL muscle panellists reported no significant effect of PT on the eating quality of lamb meat except the degree of fatty which was higher in LL muscle of BP lambs (P<0.05).The similarity in tenderness and juiciness could have resulted from the similarity of the carcass fatness. Also, panellists found that ST muscle of NP lambs was only more tender (7.15 vs. 5.51; P < 0.001) than those produced on BP. Meat juiciness and flavor in ST muscle tended (P=0.062 and P=0.095, respectively) to increase with feeding lambs on NP that could be related to the floristic composition of NP. In fact, Prache *et al*. (2011) reported that meat flavor vary mainly with the presence of legumes species in pastures.

Table 3. Effects of pasture type on Barbarine lamb meat color and sensory quality of *Longissimus lumborum* and *Semitendinosus* muscles

			Natural pasture (NP)	Barley pasture (BP)	SEM	Effect
Color	*Longissimus lumborum*	L	38.24	36.71	0.717	***
		a*	21.20	20.23	0.438	***
		b*	4.15	3.05	0.338	NS
	Semitendinosus	L	46.88	48.37	1.735	NS
		a*	21.90	19.31	0.219	*
		b	5.48	4.29	0.339	NS
Sensory quality	*Longissimus lumborum*	Color	5.11	4.73	0.348	NS
		Tenderness	6.49	6.74	0.325	NS
		Juiciness	5.74	6.33	0.377	NS
		Flavour	5.26	5.52	0.343	NS
		Degree of fatty	4.29	5.58	0.340	*
		Acceptability	5.46	5.96	0.399	NS
	Semitendinosus	Color	4.27	4.94	0.343	NS
		Tenderness	7.15	5.51	0.289	***
		Juiciness	5.94	5.12	0.282	<0.1
		Flavour	5.55	5.31	0.229	<0.1
		Degree of fatty	4.83	4.59	0.319	NS
		Acceptability	6.16	5.53	0.284	NS

IV – Conclusions

Feeding lambs on natural pasture produced leaner leg and lumbar region.As for the sensorial properties, ST muscle was more tender and meat juiciness and flavour tend to increase with feeding lambs on natural pasture. Green barley pasture can be used as an alternative feed resource to fed lambs according to organic system especially in the drought season.

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