Effects of *Prosopis laevigata* pods on carcass characteristics, non-carcass components, meat quality, fatty acid profile and sensory attributes

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Abstract

It was hypothesized that feeding mesquite pods to male Rambouillet lambs would have no negative effects on carcass characteristics, meat chemical composition and fatty acid composition of *Longissimus thoracis et lumborum* (LTL). Twenty-one male lambs (2.5 months old and 21 ± 1.44 kg bodyweight) were randomly assigned to one of three experimental diets, two of which replaced maize grain and stover with mesquite pods (*Prosopis laevigata*) (PL): 0 g PL/kg feed (PL0), 250 g PL/kg feed (PL250) and 500 g PL/kg feed (dry matter basis). The feeding trial lasted 72 days. Carcass traits, chemical composition, fatty acid profile, and sensory characteristics of meat were measured. Carcass linear dimensions, non-carcass components, digestive tract and offal, compression value, and chemical composition of meat were similar in all treatments. Dietary inclusion of PL decreased carcass shrinkage loss. Lambs fed PL500 had better muscle conformation and degree of fat. Meat produced by PL-fed lambs was well accepted by panellists who judged meat appearance, colour, flavour, juiciness, toughness, and stringiness. In lambs fed PL0, the LTL muscle was lighter and yellower than that of animals fed PL250 and PL500 diets. Fatty acid composition was altered. The PL0 diet resulted in lower percentages of total trans fatty acids (TFA) and saturated fatty acids (SFA) and higher percentages of most unsaturated fatty acids (UFA) and polyunsaturated fatty acids (PUFA) n-6 compared with PL250 and PL500 diets. Mesquite diets of up to 500 g/kg dry matter (DM) for growing lambs improved carcass quality and nutritional parameters of the meat.

Keywords: Mesquite, muscle conformation, rumen content
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Introduction

The major strategy for developing livestock industries in which production of grain is limited and cost is high should be to increase the use of low-cost indigenous feed resources to reduce the requirements for imported feed. Mesquite (*Prosopis* spp.) is a leguminous tree that grows in several arid and semi-arid regions of the world and provides feed biomass when grains and pasture reserves are low (Sawal *et al*., 2004). Mesquite pods contain 220 g free sugars, 78 g crude protein, 21 g fat, and a potential degradation of 163 g/kg DM (Peña-Avelino *et al*., 2014) and can therefore be used to balance diets that are based on grain. Mesquite pods have been evaluated as a potential feed ingredient for livestock in many species, including sheep (Mahgoub *et al*., 2005a; Mahgoub *et al*., 2005b; Obeidat *et al*., 2008; Obeidat *et al*., 2011). Most of these studies have shown that mesquite pods could replace conventional feeds without causing health problems or affecting growth performance in lambs. In a preliminary study, mesquite (*P. laevigata*) pods replaced a third of conventional ingredients (grain, by-products or forage) in finishing lamb diets with no effect on growth performance (Negrete *et al*., 2016). On the contrary, the addition of 300 g pods/kg DM reduced feed costs by 21%, and improved carcass yield and proportion of UFA in subcutaneous fat. The inclusion of a high proportion of mesquite pods (500 g/kg DM) in lamb fattening diets improved average daily gain, feed intake and feed conversion, because this feedstuff provided a good source of soluble carbohydrates and was of adequate particle size to improve rumen nitrogen (N) metabolism (Peña-Avelino *et al*., 2016). High proportions of mesquite pods are safe for finishing lambs, but it is necessary to evaluate whether the effects of mesquite pods on performance and carcass characteristics affect meat characteristics

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such as nutritional value, fatty acid profile and sensory attributes. Therefore, the objective of this study was to evaluate the effects of replacing maize grain with high levels of mesquite pods on carcass and chemical characteristics, fatty acid and sensory evaluation of meat from finishing lambs.

Materials and methods

The experiment was approved by the Academic Committee of the Centro de Biociencias (Animal Ethics Certificate Number Abr15/004) of the Universidad Autónoma de San Luis Potosí, and was carried out in compliance with the regulations established by the Animal Protection Law enacted by the State of San Luis Potosi, Mexico. A comprehensive description of the design for this study and details of the lambs, experimental diets and feeding procedures are given in Peña-Avelino *et al*. (2016). Briefly, 21 non-castrated male Rambouillet lambs weaned at 2.5 months of age with 21 ± 1.44 kg average initial bodyweight were used in the study. The animals were confined in individual pens (1.2 m x 0.8 m) equipped with feeders and water troughs and randomly assigned to one of the three experimental treatments, consisting of three proportions of mesquite pods. Lambs were subjected to 12 days of adaptation to the experimental diets before the 72-day trial. Experimental diets included maize grain, soybean meal and corn stover (PL0) and PL-based diets consisting of 250 g (PL250) and 500 g (PL500) mesquite pods/kg dry matter to replace equal amounts of maize. Diets averaged (per kg DM basis) 146 g crude protein, 226 g neutral detergent neutral, 34 g fat and 12 MJ metabolizable energy (Peña- Avelino *et al*., 2016). Lambs had free access to feed and water, which were served twice a day (at 8:00 and 14:00 hours). The amount of feed offered and orts were recorded daily.

On day 73, after a 16-hour fasting period, all lambs were stunned with the captive bolt method and were slaughtered using standard procedures in a commercial slaughterhouse regulated by Mexican animal health law (NOM-033-SAG/ZOO-2014). Live weight was obtained before slaughter, and non-carcass components (heart, liver, spleen, kidney, testes, lungs, trachea, digestive tract and offal) were weighed immediately after slaughter. Carcass weight was recorded to determine hot carcass weight. The carcasses were refrigerated for 24 hours at 4 °C to obtain cold carcass weight, and refrigeration losses were calculated as carcass shrinkage loss. Hot carcass dressing and cold carcass dressing percentages were calculated by dividing hot carcass weight and cold carcass weight by final bodyweight and multiplying each result by 100, as described by Zimerman *et al*. (2008). The carcasses were classified for conformation and fat using the EU scale (EEC Regulation 1278/94): E: excellent; U: very good; R: good; O: fair; P: poor. Following Colomer-Rocher *et al*. (1988) and Ruiz de Huidobro *et al*. (2005), the conformation scale was divided into three subclasses to produce a scale from 1 to 15. Degree of fat cover was taken into account using a classification range from 1 to 5 (1: low, 2: slight, 3: average, 4: high, 5: very high). Kidney fat cover content was assessed with a scoring system that considers pelvic-renal fat as a whole (1: low, 2: average, 3: high). Subcutaneous fat thickness was measured using a digital calibrator (Mitutoyo, UK) 4 cm from the spinal column and at the level of the 13th rib. Carcass linear dimensions, as described by Ruiz de Huidobro *et al*. (2005), were taken as follows: L: internal carcass length (length from cranial edge of the symphysis pelvis to the cranial edge of the first rib), F: hind limb length (length from perineum to distal edge of the tarsus), B: buttock perimeter (maximum perimeter at G), G: buttock width (widest buttock measurement on a horizontal plane on the hanging carcass), Th: thorax depth (maximum distance between the sternum and the back of the carcass at the sixth thoracic vertebra), and Wr: thorax width (widest carcass measurement at the ribs). Carcass compactness indices were calculated from these carcass conformation measurements: L/G, G/F, Wr/Th, Th/L and Th/G.

A day after slaughter (after 24 hours' refrigeration), the LTLs of the left and right sides from T10 to L6 were sampled, refrigerated at 2 °C and transported for less than one hour to the laboratory. The left side of LTL was used for physical and chemical analysis, while the right side was used for sensory analysis. In the laboratory, pH_{24} was immediately measured (~24 hours post mortem). For that, 3 g refrigerated LTL was homogenized with deionized water (20 ml) using a blender (Waring 51BL32 700, Torrington, CT, USA). The pH_{24} of LTL samples was measured with a pH meter (Thermo-Orion 410Aplus, Torrington, CT, USA). The left and right sides of LTL were vacuum packed and frozen at -20 °C until analysis.

Meat quality parameters (compression, colour and chemical composition) were measured on LTL muscle dissected from the left half of the carcass, which had been left to age for 48 h at 4 °C. Three determinations were performed on each sample. Six parallelepipeds of approximately 1 × 1 × 2 cm (height × width × length) from each sample were cut parallel to the long axis of the muscle fibres. A compression test was carried out at room temperature (20 ± 2 °C), applying up to 20% strain at a speed of 50 mm/min, with a computer-controlled Instron universal texturometer model 3365 (Instron Engineering Corp., High Wycombe, UK), equipped with a modified compression cell that prevents transverse elongation of raw meat. Meat colour was read in the lab colour space with a colorimeter (Konica Minolta On Colour CM-2500d Online, Osaka, Japan): luminosity (Hunter L* value), redness (Hunter a* value), and yellowness (Hunter b* value).

Subsamples of LTL were placed in a 100-mL beaker and freeze-dried using a Labconco freeze dryer (Model 4.5, Labconco Corp., Kansas City, MO, USA) until the total weight of the beaker and sample did not decrease by more than 0.1 g in 12 hours. Moisture percentage was calculated by loss in weight owing to freeze-drying. After moisture had been determined, the samples were mixed and powdered using a ceramic mortar. Samples were placed in jars and sealed to prevent them from regaining moisture. Fat percentages were determined with a fat extractor (Labconco Corp., Kansas City, MO, USA) using the method described by Camfield *et al.* (1997). Crude protein and ash content were determined following AOAC procedures (2006). To assess fatty acid composition, subsamples of LTL were homogenized according to Folch *et al*. (1957). The esterified samples were analysed using an Agilent Technologies gas chromatograph with flame ionization detection, following Gómez-Brandón *et al*. (2008).

For sensory analysis, the right side of frozen LTL was thawed and aged for 72 hours at a temperature of 4 °C. After thawing, the LTL was trimmed for any external connective and fat tissue. Meat subsamples (150 g) were wrapped in aluminium foil and cooked at 200 ºC until an internal temperature of 85 °C was reached (Komprda *et al*., 2012). Cooked meat was cut into cubes (approx. 1 cm^3), which were put on plates and allocated individually to a single glass. The panel consisted of 84 untrained consumers. Each panellist evaluated three meat samples, corresponding to each treatment. Thus, the total samples corresponding to 21 lambs were evaluated four times each. Cooked subsamples were presented in random order to each panellist. The LTL samples were evaluated for appearance (the consumer's first impression), colour (associated with consumer evaluation of meat quality), flavour, juiciness (liquid perceived during mastication), toughness (force needed to chew), and stringiness (fibre perceived during mastication) on a scale of 1 to 9 (AMSA, 2015).

Data of carcass weight, dressing, linear dimensions and compactness indices, meat characteristics, chemical composition and fatty acid profile were analysed in a completely random design using GLM procedure (SAS, 2002). The Tukey's multiple comparison of means test was used. Additionally, orthogonal polynomial coefficients were used to test the linear or quadratic effects of feeding PL on measured parameters. Categorical data such as conformation, fat degree, kidney fat cover and sensory evaluation were analysed with the nonparametric Kruskal-Wallis test. A probability of less than or equal to 0.05 (P <0.05) was considered significant.

Results

Carcass shrinkage loss decreased linearly as PL inclusion level increased in the diet (P <0.01). In contrast, conformation and fat score increased linearly (P <0.05) as dietary inclusion of PL in the diet increased (Table 1). Neither carcass linear measurements nor carcass compactness indices were affected by diets. Only buttock perimeter was larger in lambs fed PL500 and PL250 diets (P<0.05), compared with lambs fed PL0. Non-carcass components, offal, and digestive tract were similar in all treatments (Table 2).

Meat chemical composition was similar among treatments for moisture, ash, crude protein and ether extract (Table 3). No differences were observed among treatments in compression value. However, pH value increased linearly (P <0.01) as the proportion of mesquite pods increased in the diet. In terms of colour, PL0 fed lamb LTL muscle was lighter and yellower than that of animals fed PL250 and PL500 diets (P <0.01). Redness did not differ among meat samples from animals of the three treatments. No differences were noted in sensorial characteristics (Table 3). Overall, the sensory analysis data showed no adverse effect on the organoleptic properties of meat samples.

The major fatty acids in LTL lipids (Table 4) were the SFA palmitic (16:0; 28% of total FAME) and stearic (18:0; 17%), MUFA oleic acid (18:1c9; 40%) and PUFA linoleic acid (18:2n-6; 4%). The PL0 diet increased (P <0.05) the percentages of certain SF's (C15:0; C17:0), MUFA (C16:1:C17:1) and PUFA (C18:2n 6c), as well as total UFA, total PUFA n-6 and UFA/SFA and PUFA/SFA ratios. Meat of lambs fed PL250 had higher (P <0.05) percentages of stearic (C18:0, SFA) and elaidic acid (C18:1n9c, MUFA), total SFA and total TFA, while PL500 produced more oleic acid (C18:1n9c, MUFA).

Discussion

In a previous study using mesquite pods, Mahgoub *et al*. (2005a; 2006b) reported lower values for carcass weight and dressing than those of the current results. Recently, Negrete *et al*. (2016) observed in finishing lambs that addition of 300 g PL pods per kg DM improved carcass yield and classification and shrinkage loss. The reduction of shrinkage loss by mesquite pods could be related with the improvement of fat score. Savell *et al.* (2005) indicated that increased fatness might decrease shrinkage by serving as a barrier against moisture loss, or it might act to minimize the total moisture content in the carcass. These results strongly suggest that diets with PL pods have potential value in ruminant nutrition, since the quality of the resulting carcasses is comparable with that of carcasses of lambs fed conventional diets.

Table 1 Means of carcass characteristics of Rambouillet lambs fed diets containing mesquite pods

	PL, g/kg DM[1]				*p*-values	
	PLP0	**PLP250**	**PLP500**	**SEM[2]**	**Linear**	**Quadratic**
Growth performance						
Initial bodyweight, kg	23.3	21.6	22.8	4.16	0.79	0.44
Final bodyweight, kg	37.7	39.1	41.1	6.34	0.33	0.93
Hot carcass weight, kg	18.1	18.4	19.1	3.58	0.97	0.77
Cold carcass weight (CCW), kg	17.0	17.7	18.3	3.33	0.84	0.91
Hot carcass dressing, %	48.0	47.0	46.5	2.42	0.11	0.09
Cold carcass dressing, %	45.0	45.5	44.5	2.60	0.14	0.78
Carcass shrinkage loss, %	6.3[a]	5.3[b]	4.3[c]	0.71	0.04	0.01
Conformation, EUROP[3]	7.0[c]	8.4[b]	11.1[a]	1.20	0.003	0.04
Fat score, EUROP[4]	1.8[c]	2.7[b]	3.3[a]	0.18	0.002	0.70
Kidney fat cover[5]	2.2	2.1	2.0	0.59	0.15	0.89
Carcass linear dimensions						
Subcutaneous fat thickness, mm	0.41	0.40	0.37	0.21	0.62	0.48
Buttock perimeter (B), cm	41.0[b]	42.6[a]	43.1[a]	3.02	0.02	0.29
Internal carcass length (L), cm	65.3	65.3	63.4	4.88	0.99	0.98
Hind limb length (F), cm	29.8	32.2	31.0	3.76	0.58	0.32
Buttock width (G), cm	26.8	30.9	28.0	4.37	0.63	0.10
Thorax depth (Th), cm	20.1	21.3	21.1	1.45	0.17	0.31
Thorax width (Wr), cm	27.4	28.5	28.0	5.19	0.83	0.72
Carcass compactness indices[5]						
L/G	1.5	1.4	1.6	0.25	0.38	0.23
Th/G	0.76	0.69	0.78	0.12	0.75	0.20
CCW/L, g/cm	0.44	0.40	0.41	0.08	0.45	0.53
G/F	0.92	0.96	0.91	0.19	0.88	0.62
Wr/Th	1.4	1.3	1.3	0.31	0.75	0.93
Th/L	0.51	0.50	0.49	0.05	0.38	0.88

[1]PL: *Prosopis laevigata* pods
[2]SEM: standard error of mean
[3]Conformation score on a 15-point scale where 1 = poor and 15 = excellent
[4]Fat score on a 5-point scale where 1 = very lean and 5 = very fatty
[5]Kidney fat cover on a scale 3-point scale where 1 = poor and 3 = abundant
[5]Internal carcass length (L), hind limb length (F), buttock perimeter (B), buttock width (G), thorax depth (Th) and thorax width (Wr), cold carcass weight (CCW)
[a-b] Row means with different superscripts differ at $P < 0.05$

Conformation and fat scores were influenced by treatments with PLP. Similarly, Negrete *et al*. (2016) found that lambs fed 300 g PLP/kg had better conformation than lambs not fed PLP. Mesquite in diets decreased the acetate : propionate ratio in the rumen, owing to increases in propionate (Peña-Avelino *et al*., 2016), which is a precursor of glucose, the main carbon source for deposition of fat tissue. This change may have promoted the higher degree of fat on carcasses of lambs fed mesquite diets.

The only difference in carcass linear dimensions was buttock perimeter (B), which was larger in lambs fed mesquite diets than in PL0 fed lambs. This can be correlated with fat and conformation scores, which were also higher in mesquite-fed animals. Non-carcass components did not differ among treatments. These results were within the range of acceptable values (Obeidat et al., 2008). Dietary treatments were formulated with the same content of neutral detergent fibre, but there were more non-structural carbohydrates in PL

diets, and that may have influenced the palatability of the PL500 diet, promoting higher intake, although it did not influence the weight of the digestive tract.

Table 2 Means of non-carcass components of Rambouillet lambs fed diets containing mesquite pods

	PL, g/kg DM[1]				*p*-values	
	PL0	PL250	PL500	SEM[2]	Linear	Quadratic
Non-carcass components						
Heart weight, kg	0.25	0.22	0.25	0.07	0.97	0.35
Liver weight, kg	0.78	0.72	0.75	0.15	0.71	0.44
Spleen weight, kg	0.06	0.04	0.05	0.02	0.72	0.17
Kidney weight, kg	0.31	0.24	0.25	0.10	0.21	0.34
Testes weight, kg	0.16	0.16	0.26	0.10	0.99	0.17
Lungs and trachea, kg	0.71	0.68	0.73	0.19	0.86	0.63
Digestive tract						
Rumen, empty, kg	1.5	1.6	1.7	0.22	0.06	0.09
Rumen content, kg	4.6	5.3	5.5	0.94	0.13	0.57
Small intestine, empty, kg	0.79	0.77	0.84	0.16	0.59	0.56
Small intestine content, kg	0.38	0.57	0.52	0.20	0.27	0.26
Large intestine, empty, kg	0.98	0.95	0.93	0.19	0.59	0.95
Large intestine content, kg	0.61	0.52	0.82	0.11	0.33	0.30
Offal						
Skin, kg	4.5	4.2	4.7	0.84	0.70	0.27
Blood, kg	1.6	1.6	1.6	0.23	0.99	0.35
Horned head, kg	2.0	2.0	1.9	0.26	0.78	0.72
Feet, kg	1.2	1.2	1.1	0.17	0.39	0.89

[1]PL: *Prosopis laevigata* pods
[2]SEM: standard error of the mean
[a-b] Row means with different superscripts differ at $P < 0.05$

Chemical composition in LTL was in agreement with Komprda *et al*. (2012), who studied growing lambs. The pH observed in meat was similar to that reported by Obeidat *et al*. (2011) using mesquite diets. The normal pH range in lamb meat is about 5.4 to 5.6 (Young *et al*., 2004), and even 5.8 (Safari *et al*., 2011). This result shows that pH is within standard reference values. The indicators of colour values (L, a and b) in lambs fed PL were different from those reported by Obeidat *et al*. (2008) in sheep fed a 200 g/kg *Prosopis juliflora* diet. This may be related to low levels of secondary compounds such as tannins, which produce lighter-coloured meat, as found by Negrete *et al*. (2016). The differences in coloration between the control diet and PL treatments can be associated with ultimate pH. In other species, when pH is low, the meat is pale (Gajana *et al*., 2013). The results indicated that the *L* value of meat from PL0-fed lambs was higher than that from lambs fed mesquite diets, while *b* was higher in meat from PL0-fed animals.

Meat sensory attributes are important because they reflect meat quality and consumer preferences (Rodrigues & Teixeira, 2009). Little is known about the sensorial changes produced by mesquite diets. In the current study, the authors found no significant effect on sensorial characteristics. The meat produced by mesquite had good acceptance by panellists, indicating no adverse effects on attributes of sensory meat quality. Factors such as feed ingredients, animal handling, and slaughtering procedures have important effects on the attribute texture that involves juiciness, tenderness, pastiness, adhesion to teeth and stringiness. Flavour can be associated with the reserves of fat and fatty acid profile (Jeremiah *et al*., 1998), but the authors found no differences in lamb flavour among samples in the current study, in agreement with Miranda-de la Lama *et al*. (2012).

Table 3 Means of chemical composition and sensory characteristics of *Longissimus thoracis et lumborum* muscle from lambs fed finishing diets containing mesquite pods

	PL, g/kg DM[1]				*p*-values	
	PL0	**PL250**	**PL500**	**SEM[2]**	**Linear**	**Quadratic**
Chemical composition						
Moisture, g/100g meat	70.7	72.1	71.1	1.18	0.56	0.04
Ash, g/100g meat	1.1	1.0	1.1	0.11	0.23	0.19
Crude protein, g/100g meat	21.9	21.8	21.6	1.40	0.09	0.03
Ether extract, g/100 g meat	4.1	3.6	3.8	0.87	0.58	0.35
pH (24 h *post mortem*)	5.5[b]	5.7[a]	5.8[a]	0.12	0.001	0.50
Compression, kg	1.4	1.6	1.6	0.41	0.09	0.62
Meat colour						
L (lightness)	45.8[a]	42.4[b]	42.5[b]	3.11	0.002	0.19
a (redness)	9.2	9.9	9.7	1.20	0.07	0.79
b (yellowness)	14.7[a]	13.4[b]	13.5[b]	1.21	0.06	0.007
Sensory analysis[3]						
Appearance[4]	5.4	6.0	5.8	0.28	0.54	0.25
Colour[5]	6.5	6.8	6.6	0.25	0.70	0.07
Flavour[6]	6.7	7.0	6.6	0.19	0.39	0.59
Juiciness[7]	6.4	6.4	6.0	0.24	0.94	0.12
Toughness[7]	6.8	6.5	6.5	0.18	0.36	0.23
Stringiness[8]	6.8	7.1	7.1	0.23	0.22	0.11

[1]PL: *Prosopis laevigata* pods
[2]SEM: standard error of the mean
[3]Sensory analysis on a 9-point scale
[4]Appearance ranging from 1 = dislike very much to 9 = like very much
[5]Colour ranging from 1 = very dark, to 9 = very light
[6]Flavour, ranging from 1 = extremely intense to 9 = not perceptible
[7]Juiciness and toughness ranging from 1 = very dry, 9 = extremely juicy
[8]Stringiness ranging from 1 = very high to 9 = very low
[a-b] Row means with different superscripts differ at $P < 0.05$

The results showed that the PL0 diet resulted in higher concentrations of most SFA, UFA and PUFA n-6 compared with PL250 and PL500 diets. It may be explained by the fatty acid profile of mesquite pods. Indeed, Negrete *et al*. (2016) indicated that C16:0, C18:0, C18:1 and C18:2 account for more than 90% of total FA, indicating that mesquite pods have 1.6-fold more C16:0, 4.3-fold more C18:0, 0.3-fold less C18:1 and 0.4-fold less C18:2 than maize grain, which was the conventional grain that was replaced in greater proportion when mesquite pods were included in the experimental diets. The ratio PUFA n6/n3 did not differ among treatments. Regardless of treatment, the n6/n3 ratio in meat surpassed the recommended value, but PL500 had the lowest value. Luciano *et al*. (2013) observed an n6/n3 ratio of 3.47 with pasture diet, intermediate values of 5.30-10.85 with pro-oxidants, and 11.72 with feed concentrates.

Table 4 Fatty acid composition (g/100 g total fatty acid) of *Longissimus thoracis et lumborum* from lambs fed finishing diets containing mesquite pods

	PL, g/kg DM[1]				*p*-values	
	PL0	**PL250**	**PL500**	**SEM[2]**	**Linear**	**Quadratic**
C10:0	0.21	0.24	0.22	0.04	0.48	0.77
C12:0	0.23	0.24	0.23	0.06	0.91	0.49
C14:0	3.8	3.7	3.6	0.49	0.35	0.84
C15:0	0.52[a]	0.48[a]	0.34[b]	0.09	0.002	0.28
C16:0	27.9	28.0	28.2	1.3	0.50	0.96
C16:1	2.8[a]	2.6[b]	2.6[b]	0.21	0.03	0.12
C17:0	1.5[a]	1.4[ab]	1.2[b]	0.20	0.003	0.44
C17:1 c9	1.02[a]	0.74[b]	0.66[b]	0.14	0.007	0.27
C18:0	14.5[b]	17.1[a]	16.5[a]	1.35	0.02	0.02
C18:1 t9	2.5[ab]	2.9[a]	1.7[b]	0.64	0.04	0.02
C18:1 c9	39.0[ab]	37.9[b]	40.9[a]	1.8	0.07	0.03
C18:2 n-6 (LA)	4.5[a]	3.4[ab]	2.5b	1.3	0.009	0.85
C18:3 n-3 (ALA)	0.51	0.34	0.31	0.15	0.15	0.16
C18:2 CLA cis9-trans11	0.51	0.48	0.50	0.10	0.95	0.55
C20:4 n-6 (AA)	0.50	0.48	0.54	0.11	0.52	0.41
Total SFA[3]	48.7[b]	51.2[a]	50.3[ab]	1.7	0.10	0.04
Total UFA[4]	51.3[a]	48.8[b]	49.7[ab]	1.6	0.09	0.03
Total MUFA[5]	45.3	44.1	45.9	1.4	0.49	0.04
Total PUFA-n6[6]	5.0[a]	3.9[ab]	3.0[b]	1.3	0.01	0.79
Total trans[7]	3.0[ab]	3.4[a]	2.2[b]	0.66	0.04	0.02
n6/n3 ratio	9.8	11.4	9.8	3.8	0.36	0.08
UFA/SFA	1.1[a]	0.95[ab]	0.99[b]	0.07	0.09	0.05
PUFA/SFA	0.11[a]	0.08[ab]	0.07[b]	0.03	0.02	0.55

[1]PL: *Prosopis laevigata* pods
[2]SEM: standard error of mean
[3]SFA (saturated fatty acid): ∑(C10:0; C12:0; C14:0; C15:0; C16:0; C17:0; C18:0)
[4]UFA (unsaturated fatty acid): ∑(C16:1; C17:1; C18:1t9, C18:1c9, C18:2 n-6, C18:3 n-3, C18, C18 :2 CLA cis9-trans11), C20:4 n-6
[5]MUFA (monounsaturated fatty acid) : ∑(C16:1; C17:1; C18:1n9t; C18:1n9c)
[6]PUFA (polyunsaturated fatty acid)
[6]PUFA-n6: ∑(C18:2n6c C20:4 n-6) TFA: ∑(C18:1n9t; CLA cis9-trans11).
[a-b] Row means with different superscripts differ at $P<0.05$

Conclusion

This study showed that high levels of mesquite pods do not have an adverse effect on carcass dressing and weight, carcass linear dimensions, carcass compactness indices and non-carcass components. Neither compression value nor chemical of meat was affected by mesquite pods. Even more, mesquite pods reduced carcass shrinkage loss, and improved muscle conformation and degree of fat. Mesquite pods increased percentages of total TFA and SFA, and therefore reduced percentages of most unsaturated and polyunsaturated fatty acid n-6 in meat lamb. The consumer panel could not differentiate between meat appearance, colour, flavour, juiciness, toughness and stringiness from lambs fed mesquite diets and those produced with the control diet. Mesquite pods are a non-conventional ingredient with potential value as a cheap alternative for livestock feedstuff in arid and semi-arid areas.

Authors' Contributions

LPA: doctoral student who conducted the experiment; JPR: mentor, conception and design; JCGL & JV; carcass evaluation; AGL: meat analysis; and LYE: fatty acid and sensory analysis.

Conflict of Interest Declaration

The authors have declared that no competing interests exist.

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