

SHORT COMMUNICATION: Quality of ewe and goat meat cured product *mantas*. An approach to provide value added to culled animals

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Oliveira, A. F., Rodrigues, S., Leite, A., Paulos, K., Pereira, E. and Teixeira, A. 2014. **SHORT COMMUNICATION: Quality of ewe and goat meat cured product *mantas*. An approach to provide value added to culled animals.** Can. J. Anim. Sci. **94**: 459–462. The effect of species on quality of a cured meat product (*mantas*) was analyzed in eight culled ewes and eight culled goats. Carcasses were aged at 4°C for 4 d, deboned, salted for 96 h and dried for 48 h. Samples (in triplicate) from the longissimus dorsi (LD) were analyzed for pH and water activity (a_w). Samples of cured LD were subjected to chemical analyses. It was possible to conclude that cured goat meat had higher moisture content ($P < 0.001$) than cured ewe meat, 44 and 51%, respectively. Directly related to the moisture content, a higher total, saturated, mono- and polyunsaturated fat content ($P < 0.001$) was found in ewes. The others chemical determinations did not present differences ($P > 0.05$) for the species effect.

Key words: Goat, ewe, meat, processed product

Oliveira, A. F., Rodrigues, S., Leite, A., Paulos, K., Pereira, E. et Teixeira, A. 2014. **COMMUNICATION BRÈVE: La qualité du *mantas*, un produit de charcuterie-salaison de brebis et de chèvre. Une approche pour offrir une valeur ajoutée aux animaux de réforme.** Can. J. Anim. Sci. **94**: 459–462. L'effet de l'espèce sur la qualité d'un produit de charcuterie-salaison (*mantas*) a été analysé chez huit brebis de réforme et 8 chèvres de réforme. Les carcasses ont été vieilles à 4° C pendant 4 jours, désossées, salées pendant 96 h, puis séchées pendant 48 h. Les échantillons (en triplicats) du muscle longissimus dorsi (LD) ont été analysés pour le pH et l'activité de l'eau (a_w – « water activity »). L'analyse chimique a été effectuée dans des échantillons de LD saumuré. Il a été possible de conclure que la viande de chèvre saumurée avait une teneur plus élevée en eau ($P < 0,001$) que la viande de brebis (44 % et 51 % d'eau respectivement). Directement liée à la teneur en eau rapportée, une teneur plus élevée ($P < 0,001$) en matières grasses totales, saturées, mono-insaturées et polyinsaturées a été observée chez les brebis. Les autres analyses chimiques ne présentaient pas de différences ($P > 0,05$) entre les espèces.

Mots clés: Chèvre, brebis, viande, produits transformés

In Portugal, as well as in other Mediterranean countries, quality sheep and goat products are available. However, carcasses from culled animals of breeds from certified quality label products have a lower price and poor consumer acceptability. Meat from such animals is more suitable to process as dried, cured or smoked products (Webb et al. 2005). In several countries, culled animals are slaughtered and their meat is processed, for example, the Spanish *cecina de castron* (Hierro et al. 2004), the Italian *violin di capra* (Fратиanni et al. 2008) or the Brazilian *charqui* and *manta* (Madruga and Bresan 2011).

The objective of this study was to recover value from aged sheep and goats from flocks in the northeast of Portugal by creating a distinct product. At the same time, the effect of species (sheep vs. goat) on the quality of physicochemical characteristics of a processed meat product, *manta*, was evaluated.

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Carcasses were acquired directly from the *Serrana* and *Bragançana* National Associations of Breed Producers (Mirandela and Bragança, Portugal); experiments were not conducted on live animals. The research project was approved by the Agro Program of the INIAP from Portuguese Agricultural Ministry. The authors certify that animals were cared for under guidelines comparable to those laid down by the Canadian Council on Animal Care.

Animal Sampling, Carcass Manipulation and Meat Processing

Sixteen culled animals, eight *Bragançana* ewes and eight *Serrana* goats, between 8 and 12 yr old, with an average of 45 ± 5 kg liveweight, were randomly selected from

Abbreviations: IMF, intramuscular fat; LD, longissimus dorsi; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; SFA, saturated fatty acid; TBARS, 2-thiobarbituric acid reactive substances

several flocks by two breeder associations. All animals were raised under the same production system, based on daily natural grassland and ad libitum wheat or rye straw. Animals were slaughtered in the official slaughterhouse of Bragança (Trás-os-Montes, northeast Portugal). The average carcass weight was 20 ± 1.9 kg. After ageing, carcasses were divided into quarters by a straight cut from the point close to the lower edge of the backbone at the 13th rib, and then deboned separating only the long bones and vertebral column, retaining the ribs in the anterior quarter and preventing muscles from being separated, which resembled a blanket (*manta*) of meat. The *mantas* (eight per species) were then salted and placed on top of each other, in piles, separated by 5 cm of coarse marine salt, for 96 h in a cooler with a constant temperature of 4°C and relative humidity of 75%. Every 12 h the piles were rearranged, moving down the upper *mantas* and redistributing the pressure. *Mantas* were then washed, removing excess salt, and air-dried in a room with a temperature of 8–10°C and relative humidity of 60–70% for 48 h. Finally, samples were taken from the LD muscle for physicochemical analysis and *mantas* were vacuum packed and refrigerated.

pH and a_w Measurements

One hour post mortem pH values were recorded from the LD muscle between the 12th and 13th ribs of the left side of carcass. Carcasses were then cooled at $4 \pm 1^\circ\text{C}$ for an ageing period of 4 d. Twenty-four hours after slaughter, pH was measured again. Water activity (a_w) in raw fresh meat and at the end of the fabrication process of *mantas* was measured with a probe measuring over the range of 0–1, with room temperature control.

Chemical Composition Analysis

Meat samples were previously minced. Moisture and ash contents were determined according to Portuguese Standards (NP) [NP 1614 (2002) and NP 1615 (2002) respectively]. Crude protein content was measured according to NP 1612 (1979). Lipid oxidation was monitored by measuring 2-thiobarbituric acid reactive substances (TBARS) at the end of the drying process. Total fat was determined by gas chromatography according to AOAC standards [Association of Official Analytical Chemists (AOAC) 1997] with BÜCHI instruments. All analyses were performed in triplicate.

Fatty Acid Quantification

Fatty acid determination was performed using the BÜCHI Fat Determination System (AOAC International), which consists of the Extraction Unit B-815 for simultaneous extraction/saponification of the fatty acids, and the Fat Determination B-820, which determines the fat content based on the isolated fatty acids by means of gas chromatography (Teixeira and Rodrigues 2013).

Statistical Analysis

A one-way analysis of variance (ANOVA) was carried out to analyze the species effect. Statistical analysis was performed using the statistical package JMP Pro 10 (2012 SAS© Institute, Inc.)

Means (\pm SD) of pH and a_w values are presented in Table 1. No significant differences ($P > 0.05$) between species were found except for pH value assessed at 24 h after slaughter, which was significantly ($P < 0.01$) higher in goat than ewe *mantas*. Both pH and a_w values dropped from 1 to 24 h after slaughter in accordance with the results found and described previously by Teixeira et al. (2010, 2011). pH and a_w are also in agreement with the values found by Rubio et al. (2007) in a similar product, beef *cecina* (pH = 5.85–6.03 and a_w = 0.878–0.923).

No significant differences ($P > 0.05$) were found for TBARS, protein and ash contents between ewe and goat *mantas*, but the latter showed a significantly higher moisture content of 6.5% ($P < 0.001$) (Table 1). Both *mantas* had high protein content (23.9%), as observed for similar products such as jerked beef, with ~25% protein, according to Cristian (2006). However, a recent study by Costa et al. (2011) has found lower protein content than in the present study in salted lamb and goat meat. The relatively low ash content of the meat is in agreement with the results of Madruga et al. (2008), and the majority of the minerals found in this kind of meat are in the form of chlorides directly associated with the addition of salt during the *manta* manufacture. TBARS values, a measure of lipid oxidation recorded, were lower than the values found in salted sheep meat by Sobrinho et al. (2004). These results suggest that we can develop a similar product, but with better fat quality, namely in polyunsaturated fatty acid (PUFA) values, that are so important in several diets.

The goat *manta* had a higher moisture content ($P < 0.001$) than the sheep *manta*, which was expected and was related to fat content, since sheep meat had higher intramuscular fat (IMF) content than goat meat, as was also found by Babiker et al. (2003) and Sobrinho et al. (2004) working with salted sheep and goat meats, respectively.

Table 1. Physic and chemical determinations of ewe and goat *mantas* (mean \pm SD)

N = 48	Ewe	Goat	Significance
pH _{1h}	6.37 \pm 0.11	6.43 \pm 0.15	NS
pH _{24h}	5.75 \pm 0.03	5.88 \pm 0.04	**
a_w initial	0.96 \pm 0.00	0.96 \pm 0.01	NS
a_w 48h ^z	0.86 \pm 0.01	0.86 \pm 0.01	NS
% protein	23.93 \pm 1.80	23.99 \pm 1.67	NS
% moisture	44.49 \pm 0.70	50.95 \pm 1.09	***
% ash	1.01 \pm 0.20	0.64 \pm 0.28	NS
TBARS ^y	2.16 \pm 0.23	1.87 \pm 0.33	NS

^zAir drying.

^ymg MA eq. kg⁻¹ sample.

** , *** $P < 0.01$ and $P < 0.001$, respectively; NS, not significant ($P > 0.05$).

Significant differences between *mantas* were found in the IMF content ($P < 0.001$) and fatty acid profile in the LD (Table 2). Ewe *mantas* had a considerably higher ($P < 0.001$) IMF content than goat *mantas*, 14.89 and 8.97 g 100 g⁻¹ of muscle content, respectively. The extensive fat content of ewe *mantas* was as saturated fatty acids (SFA), while in goats it was verified as mono-unsaturated fatty acid (MUFA), taking into account that ewe *mantas* had higher MUFA content ($P < 0.001$). The differences in fat content and fat partition found between these two sheep and goat processed meat products have also been recorded in fresh meat.

The most important saturated fatty acids in both *mantas* were C16 (palmitic), C18:0 (stearic) and the contents of these fatty acids were significantly higher in ewe than in goat *mantas*. The saturated fat in ewe and goat *mantas*, particularly the greater presence of C16 and C18, was similar to the values found by Facco (2009) for *charque*, but less than the quantities recorded in *charque* and jerked beef by Correia et al. (2003).

The most abundant unsaturated fatty acids were the C 18:1, the C 18:2 and the ratios UFA/SFA MUFA/SFA PUFA/SFA although favorable to health in both products were higher in goat *mantas*. This confirms the tendency reported by Pearce et al. (2010) for goats to deposit a healthier fatty acid composition, and the studies by Lee et al. (2008), who observed higher levels of unsaturated fat in the meat of goats compared with lambs fed the same diet.

Table 2. Fatty acid profile (g 100 g⁻¹ of longissimus dorsi muscle and total percentage of the three fats) of ewe and goat *mantas* (mean ± SD)

N = 48	Ewe	Goat	Significance
<i>Saturated</i>			
C ₄	0.03 ± 0.02 (0.25)	0.06 ± 0.02 (0.64)	NS
C ₈	0.13 ± 0.01 (0.98)	0.14 ± 0.01 (1.75)	NS
C ₁₀	0.06 ± 0.02 (0.46)	0.06 ± 0.02 (0.7)	NS
C ₁₂	0.05 ± 0.01 (0.37)	0.05 ± 0.03 (0.6)	NS
C ₁₄	0.51 ± 0.04 (3.69)	0.43 ± 0.05 (4.83)	NS
C ₁₆	2.89 ± 0.21 (19.34)	1.80 ± 0.30 (19.51)	**
C ₁₈	2.49 ± 0.19 (16.22)	1.02 ± 0.27 (11.15)	***
<i>Unsaturated</i>			
C _{16:1}	0.39 ± 0.04 (2.66)	0.39 ± 0.06 (4.14)	NS
C _{18:1}	5.46 ± 0.40 (36.53)	3.21 ± 0.56 (34.74)	***
C _{18:2}	0.87 ± 0.06 (5.82)	0.44 ± 0.09 (5.07)	***
C _{18:3}	0.17 ± 0.02 (1)	0.03 ± 0.03 (0.26)	*
C _{20:4}	0.02 ± 0.01 (0.15)	0.04 ± 0.01 (0.61)	NS
IM Fat	14.89 ± 1.02	8.97 ± 1.45	***
Σ SFA ^z	6.17 ± 0.39 (41.34)	2.53 ± 0.55 (28.43)	***
Σ MUFA ^z	5.85 ± 0.43 (39.20)	3.60 ± 0.61 (38.88)	***
Σ PUFA ^z	1.05 ± 0.08 (6.96)	0.52 ± 0.11 (5.93)	***
UFA/SFA	1.12 ± 0.08	1.60 ± 0.19	***
MUFA/SFA	0.95 ± 0.07	1.38 ± 0.18	***
PUFA/SFA	0.17 ± 0.02	0.21 ± 0.04	***

^zSFA, saturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids.

*, **, *** $P < 0.05$, $P < 0.01$, and $P < 0.001$, respectively; NS, not significant ($P > 0.05$).

Our results show that both processed meats designated as ewe and goat *mantas* have high protein content, a balanced fat content and a resistance to oxidative processes, indicating that this process could be a strategy to differentiate meat from animals with very low commercial value. More research is required to assess the food safety, sensorial quality and commercial acceptance of these processed products.

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