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Goat meat quality. Effects of salting, air-drying and ageing processes

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Introduction

Goat meat is one of the most consumed meats in the World and according to Teixeira (2003) Portugal traditionally consume specially kid meat in Easter and Christmas. Goat meat is also an important part of food consumption and the main product of several traditional dishes in Mediterranean diet. As referred by Teixeira et al. (1995), consumers value low-fat, high-quality products and therefore, there is an increasing potential development of the goat meat market since the demand for *cabrito transmontano* is so high that *Serrana* breed producers cannot keep up. Nevertheless, meat from heavier animals and particularly the older ones as well as culled goats are not very well appreciated. Such meat is more suitable for making processed products as drying, curing with salts or smoking meat (Webb et al., 2005). Particularly in Spain, as well as in other European countries as Italy, the draught animals as well as the culled goats were slaughtered, salted, smoked and air dried following a recipe for cured ham laid down 2000 years ago (Sterling and Jones, 2000). This product was called *cecina*, after the Latin *siccina* that means cured meat, and nowadays is being made with top quality beef also designated popularly as "beef ham". This product also comes as *cecina de cabra* and *cecina de castro*n, made from the legs of goat meat called as "goat ham". Also in Brazil, particularly in north eastern the manufacture of fermented sausages containing goat meat is an alternative use of meat from old animals (Nassu et al., 2003) and to increase the value of dry salting goat and sheep meats (Madruga et al., 2005). So, the use of processes as salted, smoked and air dried to preserve meat products was a practice before the global usage of refrigeration but nowadays becomes more and more important as a way to recover old recipes for upgrading meat products. In this sense, the objective of the present work was to study a strategy which gives value-added to meat from culled goats, with a very low commercial price, and to create a new goat meat product.

Material and methods

Animals and fabrication

Ten culled goats from *Serrana* breed, between 5 and 9 years old were used. Animals were slaughtered in the Bragança commercial abattoir, with an average carcass weight between 16.6 kg and 24.4 kg. After slaughter carcasses were cooled at 4 ºC, for two ageing

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treatments, five for 72 hours (ageing 1) and the other five for 120 hours (ageing 2). Carcasses were divided into quarters by a straight cut from a point close to the lower edge of the backbone at the 13rd rib and then deboned. Fresh meat characteristics such as pH, color, water activity, water-holding capacity (WHC), texture and determination of heminic pigments were assessed in the *longissimus thoracis et lumborum* muscle (MTL). The boneless meat was then submitted to a salting process for 60 hours followed by 48 hours air-dried at 8-10° C. The fabrication process involve the following stages: 1 - deboning; 2 - salting and staking meat pieces into piles, separating each one from the other by a 5 cm of coarse marine salt during 60 hours; 3 - stumbling each 12 hours throwing down the upper-most piles; 4 - washing to remove the excess of salt; 5 - air-drying at 8-10° C during 48 h and finally 6 - vacuum packaging. During salting, stumbling and air drying meat samples were collected for analysis.

Instrumental measurements

According to the definition of processing/fabrication method the effects of ageing, salting and drying on physical characteristics of meat such as color and water activity (a_W) were assessed in *subscapularis* and *semimembranosus* muscles. Also physical color parameters were assessed in salting and air-dried samples meat.

The pH was measured immediately before cutting carcasses in MTL using the equipment Crison, pH-metro 507 and a 52-32 spear electrode. Meat color was obtained in fresh meat samples in MTL and as well as in salting and air-dried samples in *subscapularis* and *semimembranosus* muscle, using a chromameter Minolta CR 300 and the coordinates lightness (L*), redness (a*) and yellowness (b*) according (CIE, 1986). The Hue (H*) and Croma (C*) coordinates were calculated using the color parameters. The WHC was measured according to Honikel (1998). Meat samples were placed inside a bag in a water bath heated to 70°C. After cooled, the muscle was cut (the cut line parallel to the muscle fibres direction) in pieces of about 2 cm long and 1 cm2 section, and measured (8 repetitions for sample) the maximum shear force (SF) in kgf with an *Instron* press equipped with a Warner-Bratzler cell (WBSF). Water activity (a_W) was analyzed by the AOAC (1990) procedures as a measure of water content and was assessed using the *HygroPalm* a_W1 with a probe measuring over the range 0 to 1 a_W or 0 to 100% relative humidity, with a temperature control of measurements. Haem pigments were obtained using the reflectance of the exposed surface by spectroscopy by a *Spectronic Unicam 20 Genesys e mode l4001/4*. The method is based on the muscle pigment content by Hornsey (1956). The spectrophotometer was adjusted to 512 nm as isobestic point (Stewart, 1965) and the reflectance data of the meat surface were used to obtain the deoxymyoglobin (Mb), oxymyoglobin (MbO2) and metmyoglobin (MMb). Results were expressed in total pigments as OD*(mg of myoglobin/g of muscle).

Statistical analyses

The experimental design was completely random. Parameters such as pH, water-holding capacity, texture, pigments, water activity and color, in fresh meat, during salting and air-drying, were analyzed. The effect of ageing was studied.

Fresh meat pH, color, and aw as well as pigment determination, water-holding capacity and texture, and color and aw during salting and air-drying data were submitted to an analysis of

variance, with ageing as only treatment with two levels (72 e 120 h). One-way ANOVA procedure from SPSS software for Windows, version 17.0, was used.

Results and discussion

The fresh meat characteristics according to ageing are shown in Table 1. The pH, WHC and pigments were not affected by meat ageing process which significantly influenced the a* and b* meat color parameters and as a result the Chroma (C*) value of ageing 2 was lower than ageing 1 (140.4 *vs* 89.7). Nevertheless, Dzudie et al. (2000) studying the effect of curing time on quality of goat ham found that pH and WHC were significantly affected.

Table 1: Means ± standard deviation of fresh meat color and physical parameters. Effect of ageing.

Color parameters	Effect of ageing		Significance
	Ageing 1	Ageing 2	
L*	33.0±3.82	32.3±3.06	**NS**
a*	$17.4\pm2.26_a$	$14.4\pm2.87_b$	**
b*	$8.0\pm1.89_a$	$6.0\pm1.55_b$	**
H*	24.5±4.46	22.3±2.69	**NS**
C*	$140.4\pm43.85_a$	$89.7\pm37.73_b$	**
Physical parameters			
pH	5.8±0.23	5.8±0.21	NS
a_w	$0.98\pm0.009_a$	$0.97\pm0.002_b$	**
WHC	28.6±5.82	22.1±3.59	NS
DO*	5.3±1.18	5.8±0.86	NS
SF (kgf/cm^2)	$9.9\pm2.04_a$	$6.7\pm1.29_b$	**

Means in the same column with different superscripts differ significantly: * P<0.05; ** P<0.01; NS – not significant

Ageing was a significant positive effect in reducing the a_w and meat shear force. The most affected meat quality parameter by ageing process was texture, 6.7 and 9.0 kgf for ageing 2 or 1, respectively. Dzudie and Okubanjo (1999) observed a reduction of shear force with tumbling time processing of goat hams. Also Dzudie et al. (2000) found that shear force was the main characteristic affected by cured process of goat loins.

On Table 2 is shown the effects of salting and air-drying processes in the physic meat color. The C* parameter of ageing 2 was significantly lower than ageing 1 during salting process while the H* was higher, 64.6 *vs* 76.9 and 39.2 *vs* 35.2, respectively. Also during the air-drying process the C* values were higher for ageing 1 than ageing 2 (30.7 *vs* 20.7) making the meat darker.

During salting as well as air-drying the values of meat water activity (a_W) dropped from 0.97 to 0.77and from 0.87 to 0.84, respectively. The same effect was found by Nassu et al. (2003) in fermented goat meat sausages as well as Paleari et al. (2003) studying several animal species but particularly when comparing between raw and cured goat meat (a_W between 0.94 and 0.88).

Table 2: Means ± standard deviation of meat color parameters. Effects of salting and air-drying.

Color parameters	Effect of salting		Significance
	Ageing 1	Ageing 2	
L*	33.8±0.17	34.2±0.17	**NS**
a*	$10.9\pm0.17_a$	$9.3\pm0.15_b$	***
b*	6.6±0.09	6.6±0.09	**NS**
H*	$35.2\pm0.52_a$	$39.2\pm0.52_b$	***
C*	$76.9\pm1.60_a$	$64.6\pm1.60_b$	***
	Effect of air-drying		
L*	32.2±0.25	32.0±0.25	**NS**
a*	4.5±0.12	4.3±0.12	**NS**
b*	6.5±0.16	5.9±0.16	**NS**
H*	54.8±0.67	53.5±0.67	**NS**
C*	$30.7\pm1.40_a$	$26.7\pm1.40_b$	*

Means in the same column with different superscripts differ significantly: * P<0.05; ** P<0.01; *** P<0.001; NS – not significant.

Conclusion

Salting and air-drying affect the C* and H* parameters making the meat darker and reducing the water activity which was extremely important for final product preservation. The ageing process is important in terms of meat texture, since it makes the meat tender and reduces the toughness.

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