

SENSORIALY EVALUATION OF LAMB MEAT PRODUCED UNDER DIFFERENT PRODUCTION SYSTEMS OF URUGUAY

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Introduction

Marketing and promotion strategies for meat products in most of the current export markets, mainly in those with high competitiveness, have demonstrated the advantage of being based on solid scientific and technique knowledge in order to certify and assure the nourishing innocuousness, animal welfare, human health and product quality. In spite of this world tendency, in Uruguay, there is a recent concern about this matter, so there is a need of positioning Uruguayan meat products in an international context based on this modern approach.

There are many different sheep production systems in the world, with very specialized lamb meat products oriented to certain niche markets. This reality is very clear in Europe, where in the Mediterranean area, young animals are produced almost at the foot of the ewe (“lechales”) with a short period of fattening under very intensive production conditions, whereas in the North Europe, lambs are produced on intensive grazing systems with strategic use of concentrates, but remarkably heavier than those coming from the South. In this sense, the average carcass weight in 2001 was 11.1, 20.1 and 21.7 kg for Spain, UK and Germany, respectively.

These differences in lamb types and production systems are also associated with a high variation in both cooking and consumption habits, determining a wide range of preferences for certain type of meats and, therefore, generating some constraints in the commercial exchange (Hernando *et al.*, 1996 and Sañudo *et al.*, 1998).

These difficulties are greater in sheep than in bovine species, given that lamb meat is more aromatic, so, it has more probability of being rejected by the most sensible consumers.

There are some reasons to believe that significant differences may exist in lamb palatability attributes of different geographical sources due to variations in genetics, nutrition, slaughter weight and age, chilling rates, processing, and extent of postmortem ageing (Jeremiah, 1988).

As a result, the better knowledge gathering in relation to those factors influencing the preferences of the end consumers around the world will generate more information for the future design of marketing and promoting campaigns of the Uruguayan lamb.

Objective

To characterize and to analyze comparatively the sensorial quality of two Uruguayan lamb products in relation to European products coming from three different countries.

Material and methods

Animals of Uruguay

In Uruguay, 60 animals coming from two types of products were analyzed: light lambs (11.1±1.4 kg of cold carcass weight and 3-4 months of age) and heavy lambs (19.4±2.2 kg of cold carcass weight and 12-13 months of age). All the animals were castrated males of the Corriedale breed (the majority breed of Uruguay) raised under grazing conditions on rangelands and finished between two to three months on improved pastures at the Research Unit "Glencoe" of INIA Tacuarembó. The lambs were slaughtered at commercial conditions.

Animals of Europe

In Europe, in order to compare with the two Uruguayan products, one representative type of commercial lamb was used in each country (Germany, Spain and the United Kingdom) with two ageing times (7 and 20 days), using 20 animals by country. The Table 1 shows the comparisons in carcass and meat quality of the Uruguayan and European lambs.

In Germany, the animals were males of Suffolk breed or Schwarzköpfe Fleischschaf x Merino Landschaf crossbreed with a CCW of 23.2±3.65 kg. The animals were finished in pastures dominated by clover, with a strategic use of concentrates, mainly a mixture of wheat, pea and beans. The age at slaughter was on average 4 to 6 months. Spanish animals were entire males of the Rasa Aragonesa breed, weaned around 55 days of age and reared under confinement from birth under intensive feeding system, using concentrate and cereal straw *ad libitum*. The age at slaughter was under 3 months and CCW average was 10.2±0.6 kg.

In the United Kingdom, the lambs were castrated males from commercial crossbreeding type with a 22.8±1.7 kg CCW, bred mainly on grass, with a strategic use of concentrates.

General sampling

The muscle *Longissimus dorsi* (LD) was taken of all the animals for each country and lamb type at 48 hours after slaughtering. It was divided into pieces that were vacuum packaged and aged for 20 days for the Uruguayan lamb types, which is the regular aging period of the lamb meat exported to Europe.

In Europe, the meat was aged 7 days (most common in Europe) or 20 days (similar of the Uruguayan ageing time).

Sensorial evaluation

The sensorial analysis was performed by a trained panel of 8 people, in individual cabins with red light. Each one of the panelists valued, in a non-structured 1-100 line scale, the following variables: lamb odor intensity, strange odors intensity, tenderness, juiciness, lamb flavor intensity, fatty flavors, strange flavors, quality of the flavor and global appreciation.

The meat was previously defrosted in water until reaching an internal temperature of 16-18 °C. This meat was later cut into slices of 2 cm thickness, which were then cooked in a double plate grill, preheated to 200 °C, until reaching an internal temperature of 70 °C. Finally, each piece was cut into prisms of 2 cm side, and maintained warm until the tasting time.

The analysis was made with plates serving four samples at each time, where were compared the 8 types of lamb meats, resulting of the following possible combinations: 2 Uruguayan products and the lamb meat of Germany, Spain and United Kingdom, aged for 7 or 20 days.

Statistical analysis

For the statistical analysis it was used the GLM procedure (General Linear Model) of the SAS.

The applied model used for evaluations of the results of the sensorial analysis determined differences between type of samples, considering the plate within each session, and the panelist as fixed effects. Also, the interaction panelist by animal type was introduced into the model. The statistical differences ($P < 0,05$) between types of samples of the least square means of each attribute were obtained by the Tukey test.

Results and Discussion

Characterization of Uruguayan products

In Table 2, the results obtained in carcass and meat quality traits (tenderness, WB Warner Bratzler, pH and meat color) for both Uruguayan products are summarized in table 2, in relation to the average of the European carcass and meat samples.

It was observed that the Uruguayan carcasses have a similar morphology and composition to those coming from the European lambs. The linear measures and the percentage of different tissues from the Uruguayan light lamb carcass were within the expected ranks observed for the European light lamb carcass. The composition of the Uruguayan heavy lamb carcasses was also located within the expectable ranks for this type of product under European conditions, but much closer to the lowest values reported.

The pH of the Uruguayan lamb meat was slightly high, and its texture and meat color (as much for the light lambs as for the heavy ones) fell down within the expected values. The explanation of higher red intensity of Uruguayan meat could be associated with the grass fed production system.

Sensorial evaluation

The results of the sensorial panel evaluation are presented in Tables 3 and 4 and in Figure 1. In Table 3, can be seen the importance of the different main effects as well as those related to the interaction occurred between lamb type and panelist. In Table 4, are shown the corrected averages of the different sensorial attributes for the eight lamb types analyzed. The results of the analysis of main components are represented in the Figure 1.

The results presented in Table 3 highlighted that the effect of the lamb type was significant, or at least showed a tendency, for all the attributes of the sensorial profile, with the exception for the intensity of lamb flavor.

From the information gathered by the panel (Table 4), can be appreciated that, the greater lamb odor intensity occurred in the Spanish lamb aged by 7 days, because this product is familiar for the Spanish panel, which is associated to the "natural" lamb aroma. Nevertheless, this intensity of lamb odor was significantly higher ($P < 0,05$) than the Uruguayan light lamb. Within the European lambs, the greater notes for the strange odors were associated with the longer ageing period. This could be related to the normal effect caused by ageing, which results in the development of some aromas derived from rancidity and microbial contaminations, modifying the normal odor of meat. This increase in strange odors is especially remarkable in the meat of younger animals of Spain and Germany which, by their peculiar structure and muscular physiology, are more sensitive to longer ageing periods. This effect did not occur for the lamb meat of the Uruguayan animals.

The highest values of tenderness were obtained in the meat of the youngest animals aged by 20 days, followed by the rest of the lamb meats aged by 20 days and finally the meat provided by the olderer lambs with 7 days of ageing. These results give an idea about the importance of the ageing, over other productive, industrial or processing aspects, in the attainment of tender meats. Possibly, because of its greater intra muscular fat content and, to a certain extent, for its high pH values, the meat of the Uruguayan heavy lambs was juicier than the meat of the German animals aged by 7 days.

Lamb flavor was not significantly different ($P > 0.05$) between the different types of meats evaluated. On the other hand, the greater greasy flavor was obtained in the meat of Spanish and the heavy Uruguayan lambs, although the differences were significant only between the Spanish and German lamb meat aged by 7 days. The fat of the Spanish animals was presumably more unsaturated, with lower temperature of fusion, and the greater fat cover of the Uruguayan heavy lamb, can help to explain these results. Greater strange flavors were detected, within each country, particularly in the meat with greater ageing times. In general, the German meat, mainly aged for 7 days, was the one that presented the lowest notes of strange flavors.

For the group of panelists, the Spanish meat, especially the most aged, and the one of heavy Uruguayan lambs, were those that obtained the lowest acceptability notes. This result can be related to the greater presence of abnormal and greasy flavors, not well accepted by panelists, and to the excessive ageing period of the local meat.

In Figure 1, it can be shown the way that the different types of lambs are grouped according to the principal component analysis performed. The panel separates by the vertical axis the youngest, Spanish and German animals, from the older animals of less intensive production system. This axis is mainly associated to lamb odor and flavor. The horizontal axis, which is associated to descriptors of acceptability and tenderness as well

as greasy and strange flavors and odors, separate basically the lambs of Germany and Spain, leaving grass animals in an intermediate situation.

Conclusions

The carcass of the Uruguayan light lambs presented, despite of the differences in size, very similar characteristics to those of the heavy lambs. In general, the Uruguayan products could be penalized for an excessive degree of fatness, but just in the case of the countries of the Mediterranean area.

The Uruguayan meat gives values of pH slightly elevated, which could be indicated that some pre-slaughter management techniques might be improved.

The Uruguayan lamb meat has aromatic and textural characteristics not very different from those of the European lamb types compared, especially to the German and British types aged by 20 days.

Meat of the youngest animals aged for 20 days was the tenderest, highlighting the importance of the ageing period to obtain good tender values for the lamb meat.

Long ageing periods (20 days) of the lamb meat, on the other hand, tend to develop especial aromas (abnormal and greasy flavors) that modify the normal odor of meat, which were not well accepted by the tasting panelists.

It does not appear a clear relationship between morphology, carcass weight and acceptability of the Uruguayan lamb types, there was a slight tendency from the experts to reject the meat coming from a carcass with more fat content.

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Tables and Figures

Table 1. Comparisons of carcass and meat quality of the Uruguayan and European lamb types analyzed.

	CCW (kg)	Conformation (1-5)	Fat cover (1-5)	pH
Uruguayan Light	11.1	2.5 (O+)	2.3	5.78
Uruguayan Heavy	19.4	2.8 (R)	2.9	5.80
German	23.2	2.6 (R-)	2.8	-
Spanish	10.2	1.0 (P)	1.8	-
British	22.8	3.6 (O-)	3.0	-

Note: CCW = cold carcass weight.

The conformation and fat cover scores were determined according to the European Union standards (SEUROP) (CEE (1991)).

Table 2. Carcass and meat quality traits compared between Uruguayan and European products. European information was obtained from Sañudo (personal communication).

Products	Uruguayan Light lamb	Uruguayan Heavy lamb	Variability in Europe	
			Light intensive lamb (local breed)	Grass lamb (meat breed)
Carcass quality				
Carcass length (cm)	55.8	63.1	50-55	60-65
Leg length (cm)	34.3	26.0	35-37	33-36
Fat (%)	10.3	11.6	9-11	10-14
Muscle (%)	60.9	61.5	59-61	60-63
Bone (%)	25.0	22.4	24-27	22-25
Other (%)	3.8	4.5	2-4	2-4
Meat quality				
pH	5.77	5.85	5.5-5.6	5.6-5.7
Tenderness (7 days)	3.41	2.85	3-4	2-3
Tenderness (20 days)		2.47	1.5-2.0	
L *	41.5	40.2	40-45	35-40
a *	18.5	20.0	10-15	15-20
b *	9.3	10.0	5-7	6.0-8.0

Table 3. Statistical significance of the different main effects and their interactions on diverse sensorial attributes of lamb meat.

	Lamb odor intensity	Strange odor intensity	Tenderness	Juiciness	Lamb flavor intensity	Fat flavor intensity	Strange flavor Intensity	Flavor quality	Global acceptability
Lamb type (T)	+	***	***	+	NS	**	***	***	***
Panelist (P)	***	***	***	***	***	***	***	***	***
Plate (Session)	***	*	***	***	***	***	***	***	***
T*P	+	*	NS	NS	***	***	**	***	***
Root MSE	1.24	1.63	1.24	1.53	1.15	1.35	1.87	1.35	1.41

Note: NS= not significant differences; + = P<0.10; * = P< 0.05; * * = P<0.01; * * * = P< 0.001.

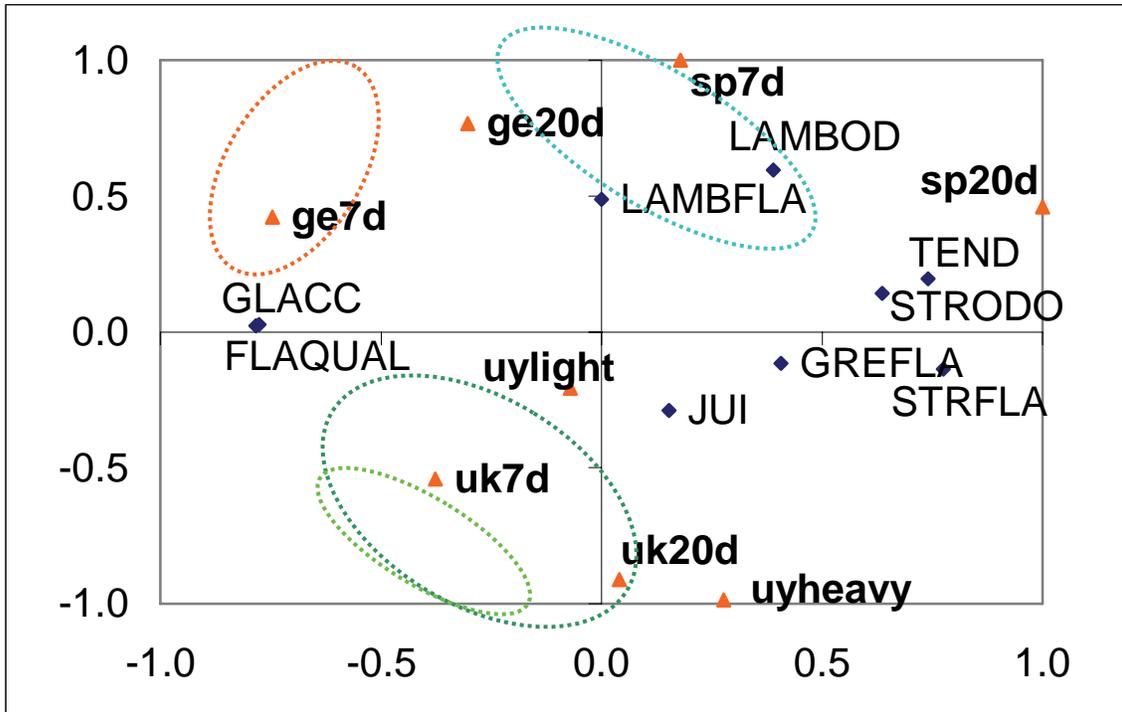
RMSE: Residual Mean Square Error

Table 4. Comparison of different sensorial quality traits between Uruguayan and European lamb types.

	Lamb odor intensity	Strange odor intensity	Tenderness	Juiciness	Lamb flavor intensity	Fat flavor intensity	Strange flavor Intensity	Flavor quality	Global acceptability
Uruguayan Light	4.51 b	2,80 c	6,96 bc	4,94 ab	5,91	4,55 ab	4.29 cd	4,08 ab	3,94 ab
Uruguayan heavy	4,71 ab	3,02 c	7.23 b	5,19 a	5,80	4,74 ab	4.78 b	3.96 b	3.87 b
Spain 7 days	5,03 a	3,12 c	7,38 a	5,07 ab	6,11	4,83 a	4.76 b	3.87 b	3.78 b
Spain 20 days	4,87 ab	3,35 a	7,73 a	4,89 ab	5,95	4,57 ab	5,58 a	3,25 c	3,14 c
Germany 7 days	4,82 ab	2,59 c	6,53 c	4.64 b	5,83	4.28 b	3.69 d	4,62 a	4,43 a
Germany 20 days	4,84 ab	3,35 a	7,31 a	4,82 ab	6,01	4,47 ab	3.90 cd	4,41 ab	4,29 ab
UK 7 days	4,77 ab	2,74 c	6,65 c	4,81 ab	5,76	4,29 ab	4.39 cd	4,25 ab	4,06 ab
UK 20 days	4,80 ab	3.13 b	7.15 b	4,96 ab	5,75	4,43 ab	4,55 bc	4,09 ab	3,97 ab

Note: a, b, c, d: different letters between the lamb type indicate significant differences (P<0.05).

Figure 1. Analysis of main components between variables and lamb types (ge: German; sp: Spanish; uk: British; 7d and 20d: meat aged 7 and 20 days; uylight: Uruguayan light; uyheavy: Uruguayan heavy).



Note: LAMBOD: lamb odor intensity; LAMBFLA: lamb flavor intensity; STRODO: strange odor intensity; TEND: tenderness; JUI: juiciness; GLAPP: global acceptability; FLAQUAL: flavor quality; GREFLA: greasy flavor intensity and STRFLA: strange flavor intensity.