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CORRELATION BETWEEN SENSORY AND PHYSICO-CHEMICAL PARAMETERS USED IN EVALUATION OF SUCKLING LAMB MEAT QUALITY

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Introduction

Meat is a complex product and its quality evaluation is not always easy. Many studies on meat and meat products have been designed to develop instrumental methods to replace the sensory tests, mainly because sensory methodologies have been seen as subjective and expensive (Risvik, 1994). However, although instrumental methods have the advantages of being objective and cheaper, they only provide partial explanations of the complex set of interactions that occur when cooked meat is consumed. Karlsson (1992) proposed that when a large number of measures were used to assess meat quality and they were correlated, they could be replaced by fewer measures without a significant loss of information. This technique has been already used to assess relationships between carcass characteristics (Hernández *et al.*, 2000, Sarti *et al.*, 1992), between meat characteristics (Karlson, 1992) and between carcass and meat characteristics (Okeudo and Moss, 2005) however comprehensive reports on correlations between sensory and physico-chemical parameters in sheep are relatively scarce (Cañeque *et al.*, 2004) and the sensory parameters can differ from one panel test to the other. Such information is important because it provides a broad picture on the probable effects of a change in one quality factor on the vast range of other quality factors, including consumer acceptance. The aim of this work was to study the relationship between several meat quality traits (physico-chemical measurements) and sensory parameters used to asses the quality of suckling lambs.

Materials and Methods

Nineteen suckling lambs (animals that were raised exclusively on maternal milk from birth to slaughter at one month of age), from three breeds: 30 Churra lambs, 30 Castellana lambs and 30 Assaf lambs were slaughtered according to standard commercial procedures in Magnus abattoir (Arcenillas, Zamora, Spain). At 72h post-mortem, carcasses were cut into two halves and the *M. Longissimus dorsi* from the left half of carcasses was taken to the laboratory. pH measurements were recorded up to 24hrs and the rest of physico-chemical parameters up to 72 hours post-mortem. Meat colour was measured on fat free surface of the *M. Longissimus thoracis* (between 8th and 9th ribs) after 1 h blooming at 4ºC and fat colour was determined on fat-cover of the left loin. Lightness (L*), redness (a*) and yellowness (b*) were recorded with a D65 illuminant at a 10ºC standard observer in the CIELab space. Other physico-chemical parameters included fat, moisture (IR method, Lurueña *et al.*, 2004) and expressible juice (Grau and Ham, 1953). Warner-Bratzler shear force was determined on *M. Longissimus thoracis* (9th-12th rib level). The muscle was wrapped in aluminium foil and cooked on a pre-heated double hot plat grill at 200ºC until the internal temperature reached 70ºC. Then six rectangular parallelepipeds, 1 x 1 cm-thick and 2-3 cm long, were cut parallel to the muscle fibres using a TX-T2i*plus* (Stable Micro Systems, Surrey, England).

Sensory analysis was developed by a fifteen member trained panel using a quantitative descriptive analysis on 2 cm-thick slices of *M. Longissimus lumborum* wrapped in aluminium foil and cooked on a pre-heated double hot plat grill at 200ºC until the internal temperature reached 70ºC. Then, they were cut into portions, each one uniform and free from obvious connective tissue and fat streaks. The sub-samples were immediately wrapped in aluminium foil, codified and kept at 60ºC. Meat was served following a randomised design for order and carry over effects. Each attribute was rated on a nine-point structured scale with score 1 equivalent to the lowest intensity and score 9 to the highest intensity of the attribute.

Statistical analysis was performed using the Statgraphic Plus program for Windows (Manugistics Inc. 1995). Outliers were detected by means of Box and Wisker plot afterwards, multivariate analysis was used to construct a linear correlation matrix and significance of the correlation coefficient (r) was established using the *t* test.

Results and Discussion

Results (Table 1) showed there were several significant correlations between sensory and instrumental parameters differing from other studies where few significant correlations were found (Cañeque *et al.*, 2004). Regarding colour parameters there was significant negative correlation between brown (external meat colour after cooking) and L* but this correlation was positive with yellow (b*) showing that raw darker meats (lower value of L*) were also perceived as darker by the panellists. This parameter was also correlated with fat content, because the higher the slaughtering weight of lambs was, the higher the fat content was and this fat have more intense yellow colour (b* value). It was possible to observe a positive correlation between pink (internal meat colour after cooking) and L* (both of meat and fat) and this sensory parameters was positively correlated with the red colour of meat. This indicated that pale pink raw meat kept this colour after cooking inside the meat.

Regarding texture parameters, hardness did not showed significant correlation with WBSF revealing this instrumental method was not a good predictor for sensory hardness. On the other hand, significant correlation between red colour and hardness was observed and also a negative correlation between moisture and hardness. This negative correlation was also observed for fibrous sensation revealing that a low moisture content produce that muscular fibres were less hydrated and were more difficult to cut (hardness) and to chew (fibrous sensation).

The juiciness was positively correlated with intramuscular fat but not with moisture or expressible juice. These results pointed out that fat content is more important than moisture for juiciness because it produces a sustained juiciness in the mouth. A positive correlation between % fat and a* have been previously observed (Okeudo and Moss, 2005) that may explain the positive correlation observed between juiciness and a*. Expressible juice was significant correlated with springiness and fat because the higher de water holding capacity, the fibres were more turgent and recovered easily the initial form.

Finally regarding flavour and odour determinations, the most important correlation founded was the positive correlation between odour intensity and fat percentage, because fatty acids are important precursors of aroma compounds in meat and meat products. This correlation was not found for taste intensity, revealing these two parameters were independents.

Table 1: Correlation coefficients between sensory parameters and meat quality parameters.

	Brown	Pink	Hardness	Juiciness	Fibrous	Spring	Taste int.	Odour int.	Liver odour
WBSF								-0.250	
L^*_{meat}	-0.392**	0.263	0.259						
a^*_{meat}		0.401**	0.208	0.363*		0.286*			
b^*_{meat}	0.221								
L^*_{fat}		0.490**							
a^*_{fat}		-0.328**	-0.282*				-0.246	0.221	-0.291*
b^*_{fat}	-0.200		-0.213			0.249			
Expr. juice						0.280*			
Moisture%			-0.272*		-0.384				
Fat%	0.297*			0.200		0.204		0.345**	
pH									

* Significant correlation at α=0.1 level; ** Significant correlation at α=0.05 level.

Conclusions

Results revealed that an increase in moisture and fat produced that suckling lamb meat was more tender and juicy, with higher odour intensity and lower fibrous sensation. However, pH was not correlated with any sensory parameter and WBSF opposite as expected did not showed correlation with hardness. Finally, CIELab parameters were shown to be good predictors of sensory colour.

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