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RELATIONSHIP BETWEEN SENSORY EVALUATION AND INSTRUMENTAL MEASUREMENTS OF TEXTURE OF RABBIT MEAT

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ABSTRACT

The objective of this study was to evaluate the relationship between sensory texture traits and two instrumental texture assessment methods, Warner-Bratzler shear test (WB) and Texture Profile Analysis (TPA). Animals from three synthetic lines A, V and R were used in this experiment. Sensory analysis was performed in forty animals per line. A quantitative descriptive analysis was performed by six trained tasters of rabbit meat. The parameters evaluated were: hardness (H), juiciness (J), fibrousness (F) and flouriness (Fl). Sensory analysis was carried out on samples of the *Longissimus dorsi* muscle, randomizing sex and muscle location. Texture analyses were performed in twenty animals per line. Three parameters were measured for WB: maximum shear force (WB SF), shear firmness (WB FI) and total work performed to cut the sample or the area under the curve obtained (WB W). Four traits were measured for TPA: hardness (TPA H), cohesiveness (TPA CO), springiness (TPA SP) and chewiness (TPA CH). Sensory data were standardized dividing them by the standard deviation of each taster. Sensory and texture data were analysed using model including taster, line and session for sensory data and line and sex for texture. Correlations between the estimated residuals of both models were computed. Sensory hardness was negatively correlated with juiciness (-0.41) and positively with fibrousness (0.58) and it was not correlated with flouriness. A low negative correlation was found between juiciness and fibrousness. High correlations were found among WB measurements. All correlations between WB measurements and sensory analysis traits were low. Correlation between WB SF and sensory hardness was positive (0.26) and WB FI was negatively correlated with J and F. No correlation was found between WBW and sensory traits. Residual correlation coefficients between sensory analysis traits and TPA parameters were also low. Sensory hardness was only correlated with TPA CO (0.26). Negative correlations were found between juiciness and TPA H (-0.32) and TPA CH (-0.30) and no correlations were found for F. Sensory flouriness was positively correlated with TPA H (0.36), TPA SP (0.29) and TPA CH (0.34), this sensory trait was not predicted by WB. Low correlations were found between WB and TPA parameters.

The results from this study show that instrumental and sensory evaluations are both required for evaluating rabbit meat tenderness, since correlations between measurements are low.

Key words: Texture, residual correlations, warner-bratzler, TPA, sensory evaluation.

INTRODUCTION

Texture is one of the main parameters that determine meat quality. Texture is a very complex parameter that it is influenced by several factors such as genetic, muscle metabolism, muscle composition (fat and collagen) and *post mortem* changes (pH and proteolytic enzyme activity) (Warriss, 2010). Among texture attributes, hardness is the most important to consumers. In the sensory map made by Rødbotten *et al*. (2004) comparing meat from 15 commercial animal species, rabbit meat was ranked among the tenderest, with scarce coarseness and medium-low juiciness.

Meat tenderness can be evaluated by sensory analysis or instrumental methods. One of the most widespread instrumental methods used for measuring hardness is Warner Bratzler (WB) shear test (Shackelford *et al*., 1995). Warner Bratzler shear measurements have been taken in rabbit meat by several authors (Ariño *et al*., 2006; Bianchi *et al*., 2007; Carrilho *et al*., 2009; Combes *et al*., 2008). Texture profile analysis (TPA) is a compression method widely used for evaluating food texture, although its use has been limited in meat. Recently, some authors have used TPA in rabbit meat (Ariño *et al*., 2006; Dalle Zotte *et al*., 2008; Pla, 2008; Ramírez *et al*., 2004).

The objective of this study was to evaluate the relationship between sensory texture traits and two instrumental texture assessment methods, WB and TPA.

MATERIALS AND METHODS

Animals

Animals from three synthetic lines A, V and R were used in this experiment. Lines A and V were selected for litter size at weaning and line R for growth rate between weaning and slaughter (9 weeks). Animals were reared at the experimental farm of the Universitat Politècnica de València (Spain) and were slaughtered by electrical stunning and exsanguination at 9 weeks of age. At 24 hours *post mortem*, *Longissimus dorsi* muscles were dissected. Muscles from the left side of the carcasses were used for texture analysis and muscles for the right side of the carcass were used for sensory evaluation. After sampling, muscles were vacuum-packed in plastic bags and kept at -20 ºC until analysis.

Sensory evaluation

The sensory analysis was performed in forty animals per line (n=120). A quantitative descriptive analysis was performed by six trained tasters of rabbit meat in 20 sessions. The parameters evaluated were: hardness (H), juiciness (J), fibrousness (F) and flouriness (Fl). The sensory analysis was carried out on samples of the *Longissimus dorsi* muscle following a complete block design. Muscle samples were thawed at 4 ºC/24 h in their vacuum-packed plastic bag, cooked at 80 ºC for 1h by immersion in a water bath with automatic temperature control. Samples were cut into four pieces and randomized to tasters in order to avoid location effects.

Texture analysis

Texture analysis were performed in twenty animals per line (n= 60). Muscle samples were thawed at 4ºC/24 h in their vacuum-packed plastic bag; they were cooked as in the sensory analysis and then cooled at room temperature (20±2 ºC) before the analysis. Samples for Warner-Bratzler shear test (WB) were obtained by cutting at least two prisms measuring 2 cm length x 1 cm^2 base, with the muscle fibres parallel to longitudinal axis (Guerrero & Guàrdia, 1999). They were completely cut using a WB shear blade with a triangular slot cutting edge and three parameters were measured: maximum shear force (WB SF) (kg), shear firmness (WB FI) (kg/s) and total work performed to cut the sample or the area under the curve obtained (WB W) (kg x s). Samples for Texture Profile Analysis (TPA) (Bourne, 1978) were obtained by cutting cubes of 1 cm each side parallel to the muscle fibre direction and then compressing to 75%. In this test the following traits were measured: hardness (TPA H) (kg), cohesiveness (TPA CO), springiness (TPA SP) and chewiness (TPA CH) (kg). The Texture Analyser Mod. TA-XT2 (Stable Micro Systems, UK) was used for both tests and all the samples were cut or compressed perpendicular to the muscle fibre direction at a crosshead speed of 5 mm/s. The average value for each *Longissimus dorsi* sample was recorded (mean of two to four replicates).

Statistical analysis

Sensory data were standardized dividing them by the standard deviation of each taster, in order to avoid a scale effect of the taster scoring. Sensory data were analyzed by least squares method using a model with line (with three levels, A, V and R), sex (with two levels), taster (six levels) and session (20 levels) effects. Texture data were analyzed by least squares method using a model with line (with three levels, A, V and R) and sex (with two levels) effects. Correlations between the estimated residuals of both models were computed applying the CORR procedure of SAS (SAS Institute Inc. Cary, USA, 2002).

RESULTS AND DISCUSSION

Descriptive statistics of the analyzed variables is in Ariño *et al*. (2006 and 2007). Residual correlation coefficients between traits of sensory analysis and WB texture parameters are given in Table 1. Sensory hardness was negatively correlated with juiciness and positively with fibrousness and it was not correlated with flouriness. A low negative correlation was found between juiciness and fibrousness. Similar results were found by Carrilho *et al*. (2009). High correlations were found among WB measurements (r ranged from 0.77 to 0.91). All correlations between WB measurements and sensory analysis traits were low. Correlation between WB SF and sensory hardness was positive and WB FI was negatively correlated with J and F. No correlation was found between WBW and sensory traits. Several works in rabbit meat have shown poor relationships between WB measurements and tenderness; Bianchi *et al*. (2007) and Dalle Zotte *et al*. (2008) found a negative correlation between WB SF and tenderness (-0.43 and -0.37, respectively), and Carrilho *et al*. (2009) found a correlation of -0.265 between maximum load and sensory tenderness.

Table 1. Residual correlation coefficients between traits of sensory analysis (H, J, F, FL) and Warner-Bratzler texture parameters (WB SF, WB, FI, WB W).

	H	J	F	FL	WB SF	WB FI	WB W
H	1	-0.41***	0.58***	-0.03	0.26*	0.11	0.19
J		1	-0.24***	-0.20***	-0.21	-0.23†	-0.15
F			1	-0.05	-0.03	-0.14*	0.04
FL				1	0.11	0.22	0.14
WB SH					1	0.91***	0.90***
WB FI						1	0.77***
WB W							1

Sensory traits: Sensory hardness (H), Juiciness (J), Fibrousness (F) and Flouriness (Fl). Warner Bratzler parameters: Maximum shear force (WB SF) (kg), shear firmness (WB FI) (kg/s) and total work performed to cut the sample or the area under the curve obtained (WB W) (kg x s); ****P*<0.001; **P*<0.05; †*P*<0.10.

Residual correlation coefficients between sensory analysis traits and TPA parameters were also low (Table 2). Sensory hardness was only correlated with TPA CO (0.26). Negative correlations were found between juiciness and TPA H (-0.32) and TPA CH (-0.30) and no correlations were found for F. Sensory flouriness was positively correlated with TPA H (0.36), TPA SP (0.29) and TPA CH (0.34), this sensory trait was not predicted by WB device. Dalle Zotte *et al*. (2008) also studied correlations between sensory tenderness and TPA parameters, and found a negative correlation with TPA H (-0.37) and TPA CH (-0.38) but they did not study correlations with other texture sensory traits.

Table 2. Residual correlation coefficients between traits of sensory analysis (H, J, F, FL) and Texture Profile Analysis parameters (TPA H, TPA CO,TPA SP and TPA CH).

	TPA H	TPA CO	TPA SP	TPA CH
H	0.08	0.26*	-0.09	0.07
J	-0.32*	-0.18	-0.18	-0.30*
F	0.10	0.22	-0.12	0.07
FL	0.36**	0.06	0.29*	0.34**
TPA H	1	0.58***	0.52***	0.92***
TPA CO		1	0.30*	0.68***
TPA SP			1	0.77***
TPA CH				1

Sensory traits: Sensory hardness (H), Juiciness (J), Fibrousness (F) and Flouriness (Fl). TPA parameters: hardness (TPA H) (kg), cohesiveness (TPA CO), springiness (TPA SP) and chewiness (TPA CH) (kg). ****P*<0.001; ***P*<0.01; **P*<0.05.

Low correlations were found between WB and TPA parameters (Table 3). WB SF was positively correlated with TPA H, TPA CO and TPA CH (r ranged from 0.21 to 0.24). WB FI was positively correlated with TPA H, TPA CO and TPA CH (r ranged from 0.23 to 0.28). A correlation of 0.29 was found between WB W and TPA CO.

Table 3. Residual correlation coefficients between Warner-Bratzler texture parameters (WB SF, WB, FI, WB W) and Texture Profile Analysis parameters (TPA H, TPA CO, TPA SP and TPA CH).

	TPA H	TPA CO	TPA SP	TPA CH
WB SF	0.24†	0.29*	0.03	0.21
WB FI	0.26*	0.23†	0.21	0.28*
WB W	0.17	0.29*	-0.02	0.15

Warner Bratzler parameters: Maximum shear force (WB SF), shear firmness (WB FI) and total work performed to cut the sample or the area under the curve obtained (WB W). TPA parameters: hardness (TPA H), cohesiveness (TPA CO), springiness (TPA SP) and chewiness (TPA CH). *$P<0.05$; †$P<0.10$.

CONCLUSIONS

The results from this study show that instrumental and sensory evaluations are both required for evaluating rabbit meat tenderness, since correlations between measurements are low. It is necessary a more detailed study of the precision of the instrumental and sensory methods used for rabbit meat evaluation because it is convenient to approach sensory and instrumental results.

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