SENSORY CHARACTERISTICS AND VOLATILE COMPOUNDS IN BEEF FROM YOUNG BULLS AND HEIFERS OF PIRENAICA AND FRIESIAN BREEDS

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BACKGROUND

Meat is a highly appreciated food not only by its sensory characteristics but also by its nutritional value, being cooked meat flavor one of the most important quality attributes to consumers (Shahidi *et al.*, 1986; Rhee, 1989). Characteristic flavor of cooked meat originates from heat induced reactions, mainly Maillard reactions and lipid degradation, that involve complex mechanisms producing a wide variety of volatile compounds (Mottram, 1998). This study was carried out on beef from animals produced in the Mediterranean area, with light and low fat carcasses, unlike those carcasses produced in countries from northern Europe and the USA. Animals from Pirenaica, a local native beef breed from the north of Spain, and Friesian breed, were used being both of them representatives of the beef produced in this region.

OBJETIVES

The aim of the present work was to study the relationship among the sensory variables of aroma and flavor assessed at the sensory evaluation and the volatile compounds detected instrumentally, both studied in cooked beef from Pirenaica and Friesian breeds.

METHODS

30 animals of Pirenacia breed (15 bulls and 15 heifers) and 28 animals of Friesian breed (15 bulls and 13 heifers) aged 12-13 months were sampled. The *longissimus dorsi* muscle was sliced into 1.5 cm thick steaks that were individually packed under vacuum and kept in a cooler (2ºC) until 7 days *postmortem*. Intramuscular fat content, between 1-3 %, was low in the sudied samples. Meat samples were thawed at 4ºC for 24h and cooked on a double plate grill at 200ºC until they reached an internal temperature of 70ºC (AMSA, 1978).

Volatile compounds analysis. Approximately 10 g of cooked ground beef were placed in the headspace vial. The vial was attached to a purge-and-trap sample concentrator (OI Analytical 4460A, Texas). The sample was heated at 70ºC and purged with a 40 mL/min helium flow for 10 min. Headspace volatiles were collected on a Tenax GC trap (60/80 mesh) at 30ºC and thermally desorbed at 180ºC for 4 min with a 40 mL/min helium flow. A Hewlett-Packard model HP-5890 gas chromatograph equipped with a DB-5 capillary column (5 % phenilmethylsilicone; 50 m x 320 µm i.d. x 1.05 µm film thickness) and flame ionization detector were used. Identification of volatile compounds was performed on a HP-6890 gas chromatograph coupled to a HP-5973 quadrupole mass spectrometer. The obtained spectra were compared with those from the Wiley 275 library.

Sensory analysis. Aroma and flavor of beef samples were evaluated by a 13 members descriptive panel selected and trained as described previously (Gorraiz *et al.*, 2000). The cooked steaks were cut immediately into 2 x 1.5 x 1.5 cm cubes. Panelists evaluated the following beef aroma and flavor attributes: characteristic aroma, livery aroma, characteristic flavor, livery flavor, bloody flavor, fatty flavor and aftertaste, using a 150 mm unstructured line scale.

Statistical analysis. Factor analysis and multiple regression were applied to the instrumental and sensory data. The SPSS 8.0 (1998) statistical package was used for all the analyses.

RESULTS AND DISCUSSIONS

Factor analysis showed high correlation among 2-propanone, butanodione and dimethylsulfide volatile compounds in factor 1 (Table 1), that were responsible for the separation of bulls and heifers (Figure 1). Hexane, octane and 2,2,4,6,6-pentamethylheptane were related in factor 2 (Table 1), differentiating meat from both breeds (Figure 1). Concerning intramuscular fat content, it correlated positively with aftertaste, and negatively with bloody flavor, in factor 4 (Table 1). This fact corroborated the influence of this fat depot in the formation of cooked meat flavor, even if no volatile compounds, directly related to the intramuscular fat, were observed, since it showed very low correlation with all the detected volatile compounds. Fatty and livery flavor correlated positively in factor 5 with ethanal (Table 1), which decreased during aging and it is likely involved in the appearance of off-flavors (Shahidi *et al.*, 1986). Linear significant relationships between the sensory variables and some volatile compounds of beef were identified by means of the multiple regression analysis by the stepwise method (Table 2). This was the case of the 2-propanone, that showed positive correlation with livery aroma and flavor and bloody flavor. So, this compound may contribute significantly to the perception of these aromatic notes. The ethanal showed a positive correlation with livery flavor (Table 2), as at the factorial analysis (Table 2), and a correlation with the characteristic aroma, which may let us presume that this compound may be associated to the perception of strange aromas, probably decreasing the acceptability of these meats by consumers (Shahidi *et al.*, 1986). The hexane produced by lipid oxidation, showed linear significant correlation with fatty flavor (Table 2). Finally, there was found a positive relation between 2,2,4,6,6-pentamethylheptane and characteristic flavor (Table 2). These results could be the reflection of the contribution of these compounds to complex aromas.

PERTINENT LITERATURE

American Meat Science Association. ASTM: Chicago, Il. 1978.
Gorraiz, C.; Beriain, M.J.; Chasco, J.; Iraizoz, M. *J. Sen. Stud.* **2000** (in press).
Mottram, D.S. *Food Chem.* **1998**, *62*(4), 415-424.
Shahidi, F.; Rubin, L.J.; D'Souza, L.A. *CRC Crit. Rev. Food Sci. Nutr.*, **1986**, *24*(2), 141-150.
SPSS. *User's guide*. SPSS Inc., Chicago, 1998.

Table 1. Factorial analysis of the sensory variables of aroma and flavor, volatile compounds and intramuscular fat.

	Factor 1 24.2 %	Factor 2 15.3 %	Factor 3 12.4 %	Factor 4 9.5 %	Factor 5 8.6 %	Factor 6 7.0 %
characteristic aroma	-0.07479	-0.08389	0.77973	0.15349	-0.13256	-0.09507
livery aroma	0.11266	0.00773	-0.13529	0.03890	0.13156	0.86532
characteristic flavor	-0.15006	0.29860	0.84307	0.04450	-0.00488	-0.05088
fatty flavor	-0.14350	0.18129	0.46783	0.27665	0.67611	0.09465
livery flavor	0.10739	-0.06325	-0.23769	-0.01167	0.61242	0.35822
bloody flavor	0.11205	-0.14031	0.39135	-0.72096	0.06394	0.44959
aftertaste	0.00734	-0.02109	0.30946	0.70137	0.09517	0.41748
hexane	0.27628	0.67020	-0.00681	-0.21669	0.37344	-0.27076
octane	-0.10852	0.87996	0.03204	0.14546	0.03315	0.02743
2,2,4,6,6-pentamethylheptane	-0.35491	0.72558	0.20762	-0.00317	-0.20027	0.07206
2-propanone	0.75556	0.31982	-0.09975	-0.29652	0.10049	0.17559
butanedione	0.82596	-0.28700	-0.02753	0.00215	0.08319	-0.01698
ethanal	0.14504	-0.00743	-0.11079	-0.26672	0.75209	-0.02387
dimethylsulfide	0.87253	-0.14038	-0.14318	-0.07241	0.02329	0.08482
intramuscular fat	-0.19097	-0.00260	0.23845	0.79679	-0.19285	0.1630

Table 2. Multiple regression equations of the aroma and flavor variables as a function of the volatile compounds

		R
characteristic aroma	$y = 73.35 - 2.77 \cdot 10^{-4} \cdot$ ethanal	0.2549
livery aroma	$y = 27.61 + 6.14 \cdot 10^{-6} \cdot$ 2-propanone	0.3426
characteristic flavor	$y = 63.89 + 3.46 \cdot 10^{-4} \cdot$ 2,2,4,6,6-pentamethylheptane	0.3103
fatty flavor	$y = 34.07 + 5.24 \cdot 10^{-5} \cdot$ hexane	0.2829
livery flavor	$y = 21.95 + 3.57 \cdot 10^{-6} \cdot$ 2-propanone $+ 1.69 \cdot 10^{-4} \cdot$ ethanal	0.3782
bloody flavor	$y = 43.27 + 4.92 \cdot 10^{-6} \cdot$ 2-propanone	0.2313
aftertaste	No independent variable was significant ($p \geq 0.05$)	

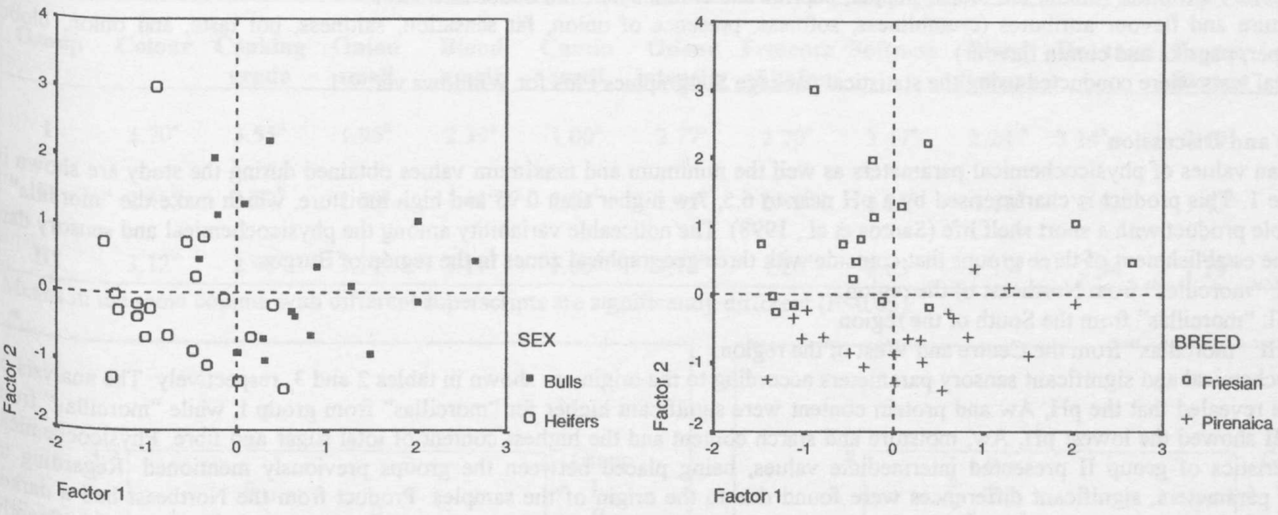

Figure 1. Plot of the samples grouped by sex and breed in the bidimensional space delimited by rotated factors 1 and 2