PERFORMANCE ASSESSMENT OF A BEEF SENSORY PANEL

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I. INTRODUCTION

Appearance, tenderness, juiciness and overall acceptability are the main organoleptic characteristics by which consumers judge meat quality. These characteristics are affected by several intrinsic and extrinsic factors and, for this reason, it is important to control every aspect of the production chain in order to obtain meat with good sensory properties. When the animals are reared under the same conditions, the breed is one of the most important factor affecting meat sensory characteristics. These properties are perceived by the human senses and sensory analysis is the one which provides a direct quantification of the human perception of meat characteristics. Analytical sensory tests, used to detect differences or to describe the meat characteristics, are usually conducted by trained panels. Although the training of the judges allows to standardize the evaluation methodology, no training can eliminate all variations among panelists [1]. Therefore the aim of this study was to assess the performance of a trained panel in the sensory evaluation of beef from different breeds. The study is part of a larger project.

II. MATERIALS AND METHODS

Thirty six young bulls belonging to 6 European beef and dairy breeds (6 Hypertrophied Piemontese, HP; 6 Charolais, C; 6 Limousin, L; 6 Hypertrophied Piemontese x Friesian crosses, HPxF; 6 Italian Fresian, F; 6 Italian Brown; B), were reared under the same environmental conditions in the experimental farm of the DISAFA. The animals were slaughtered at an EU-licensed abattoir when they reached the optimal finishing status according to the Italian market. Eight days after slaughter, from the right side of the carcass a portion of *longissimus thoracis* muscle between the 10^{th} and 13^{th} thoracic vertebra was taken. Each sample was cut into two 1.9 cm thick steaks which were cooked on a double plate grill at 250°C until the internal temperature reached 70°C. A 7-member trained panel screened, selected, and trained according to protocols described by AMSA [2] was used to perform the sensory analysis. The sensory evaluation consisted of two steps: visual evaluation of raw meat and assessment of the eating qualities of cooked meat. Appearance of raw meat (Ap), initial ease of penetration of the meat by the teeth (Tp), ease with which the meat breaks into fragments (Tf), amount of residue remaining after chewing (Tr), juiciness (Ju) and overall acceptability (Oa) were scored on 8-point scale, where 1 and 8 were respectively the minimum and the maximum score. Analysis of variance was used to evaluate the differences between the beef samples and the performance of the judges. Judges were assessed using analysis of variance performed on the results of each judge (source of variation: beef sample). Analysis of variance was also used to evaluate the results of the sensory analysis via the assessment of the F values for the beef, the judge, and the beef x judge interaction. Finally a General Procrustes Analysis (GPA), which minimizes differences among judges and identifies agreement between them, was performed. Data matrices of 6 meat samples by 6 sensory characteristics for the 7 judges were matched to find a consensus using the Microsoft Office Excel add-in software, XLSTAT [Addinsoft, Paris, France].

III. RESULTS AND DISCUSSION

Table 1 shows the least squares means of the sensory characteristics. The beef from HP showed the higest scores for Ap,Tp, Tf, Tr and Oa, wheras beef from HPxF and dairy breeds displayed the lowest scores for all the organoleptic characteristics. Ju was significantly higher in meat from beef breeds in comparison with the others. Meats from HPxF tended to be slightly better than that of dairy breeds but all were inferior to those obtained from the beef breeds. Among beef breeds, beef from HP constantly obtained the best evaluations, while the judgments on meat supplied by the others two beef breeds were very similar. These results largely agree with previous studies.

The performance of each judge was also evaluated. All the judges exhibited good discriminative power (P beef sample $\leq$ 0.05). The analysis of variance had a significant (P$\leq$0.05) F value for the beef sample, indicating that the judges identified differences between at least two of the beef samples tested. The F value of the judge was not significant. This means that they all made beef judgments in a similar way. Also the interaction between the beef sample and the judge was not significant for any of the analyzed characteristics, demonstrating that there was consensus among the judges to evaluate each beef sample. Therefore, we can conclude that the judges were in agreement.

The GPA is a powerful multivariate technique extensively used in sensory analysis to evaluate the performance of the panel and of individual judges. In fact, GPA is able to take account of differences in the use of the scales and it usefull for monitoring judges performances because it allows individual differences between judges to be evaluated. The Procrustes analysis of variance (PANOVA) is helpful in finding out which step of the statistical analysis affects the consensus space solution. Table 2 illustrates that rotation and translation had no effect on the original configuration of data, whereas the scaling of each judge configuration to a common origin was highly significant in reducing the variability of settings.

The scaling factors for each judge configuration are a measure of the scoring range the judges used. Four judges used a wider part of the scale, while the others used a narrower part as their scaling factors were higher and lower than 1, respectively.

Overall, residuals by object (beef) were of a similar magnitude and suggest relatively good agreement among the panelists. Nevertheless, beef from L and F showed the higher and the lower residual (2.38; 0.46) and therefore were the least and the most consensual among the judges, respectively. On the other end, the residuals by configuration (judges) showed that two judges had the higher values (2.60; 2.30) which means that they gave rates that do not match the consensus. However, on the whole, the results indicate good panel performance.

Table 1 Sensory scores (least square means) for beef sensory analysis (ANOVA)

	Beef breeds			Crosses	Dairy breeds	
	Hypertrophied Piemontese	Charolais	Limousin	Hypertrophied Piemontese x Friesian	Italian Friesian	Italian Brown
Appearance; Ap	7.9^{A}	7.2^{B}	7.0^{B}	6.0^{C}	5.9^{C}	5.9^{C}
Ease of penetration; Tp	6.7^{A}	5.9^{B}	6.0^{B}	5.1^{C}	4.7^{C}	4.6^{C}
Ease of fragmentation; Tf	6.8^{A}	6.0^{B}	6.1^{B}	5.1^{C}	5.0^{C}	4.7^{C}
Residue after chewing; Tr	6.6^{A}	5.8^{B}	5.8^{B}	4.9^{C}	4.7^{C}	4.6^{C}
Juiciness; Ju	6.3^{A}	5.8^{A}	5.8^{A}	5.1^{B}	4.9^{B}	4.9^{B}
Overall acceptability; Oa	6.7^{A}	5.9^{B}	5.8^{B}	4.6^{C}	4.7^{C}	4.7^{C}

^{A,B,C} Different letters in the same raw indicate significant differences (P$\leq$0.01)

Table 2 Procrustes analysis of variance for beef sensory analysis (PANOVA)

Source	Degrees of Freedom	Sum of Squares	Mean Sum of Squares	*F*-statistic	*P*-value
Scaling	6	2.181	0.363	3.293	0.006
Rotation	90	5.908	0.066	0.595	0.992
Translation	36	4.944	0.137	2.244	0.206
Corrected total	216	22.305	0.183		

IV. CONCLUSION

Judges were able to distinguish the different meats and were generally very consensual for all sensory characteristics.

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