

## SENSORY PROFILE AND ACCEPTABILITY SCORES OF DIFFERENT RESTRUCTURED STEAKS

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Four types of restructured steaks cooked (AG, AL, PS and STP) were tasted by a trained assessor panel and a consumer panel in order to determine the consumer preference and to relate it to the sensory variation. Preference mapping was the statistical technique used to determine the individual acceptability scores for each product. This technique shows that each product is preferred by a consumer segment and there is no preference consensus. The correlations between profile descriptors and the 3 first preference dimensions reveal that AG is associated with higher ratings for stringy, gristle, heterogeneous. Contrariwise AL sample is associated with higher ratings for saltiness. PS is preferred for its high saltiness. STP is characterised by a medium salty taste, grilled meat aroma and the lack of stringy and fatty odour. This type of steak has the best score of acceptability and perhaps is preferred lightly for its medium sensory characteristics.

When consumers want to know their food product, food manufacturers need two kinds of information: how much people like their products overall and what the sensory characteristics play in their assessment. However all this information cannot be asked of consumers because they have a limited vocabulary with which to describe their perception and they may misunderstand what market researchers mean by product characteristics... (GREENHOFF and MACFIE, 1991). Therefore only the question of preference is often put to consumers; the qualitative and quantitative sensory description is reserved for a trained assessor panel. Preference mapping is a statistical technique which is used to relate the consumer overall liking in terms of the sensory characteristics defined by assessor panel. In our study we chose to study the influence of different textures on acceptability scores. The products were 4 restructured steaks different in the size of flakes, the chopping and the nature of the binder. Descriptive profiling by a sensory panel and a consumer test were carried out to assess the effect of different manufacturing processes on the sensory characteristics and the acceptability scores.

### Materials and methods

Four types of steaks were used in this study: AG, AL, PS and STP. All of them were made with 75% lean meat and 25% flank meat. They were ground, flaked or sliced (Table 1). Secondly, meat was mixed with a binding agent (0.4% alginate plus 0.4% lactate for AG, 1.9% alacem for AL, 0.44% salt for PS and 0.1% salt and 0.1% tripolyphosphate for STP). Then, 1% beef flavouring was added to the taste of binding agents. At the last stage, the steaks were stored at -20°C. The frozen steaks (15 mm thick) were grilled at 290°C for 15 minutes.

Product	Lean meat	Flank meat
AG		
AL	ground through Butcher boy	ground through Butcher boy
PS	flaked through Comitrol 1600 Head	ground through Butcher boy
STP	sliced through Dicer 5mm thickness	ground through Butcher boy
	flaked through Comitrol 1600 Head	ground through Butcher boy

Table 1. Different meat choppings.

Consumer test: A profile of 21 sensory descriptors (*Outside appearance*: moist surface, stringy, scum presence, *Inside appearance*: brown, regular, moist, heterogeneousness of particles size, *Odour*: meat juice, fatty, *Texture*: elastic, dilaceration, gristle, stringy, tender, juicy, *Taste*: salty, sweet, *Aroma*: grilled meat, blood, fatty-greasy) was evaluated four times by 12 trained assessors on non structured

**Consumer test :** 104 voluntary consumers were invited to participate in a full meal. They tasted the 4 types of steaks and gave their evaluation for each product on a scale for overall acceptability.

**Statistical analysis :** 1 - Internal preference mapping : the acceptability rating of the consumers were placed in a 104 row by 4 column matrix. To avoid the different use of absolute scale, or range of use of scale, each column was centred to zero mean and standardised to unit variance. Internal preference mapping (CARROLL and CHANG, 1970; MACFIE and GREENHOFF, 1991) was used to obtain maps of the four samples and indicate the different preference vectors of each consumer. 2 - Screening of significant sensory descriptors and correlations with the preference map : sensory descriptors pointing out differences between products were selected for each assessor by a one-way ANOVA. Then, correlations between the significant attribute scores and products' coordinates in the preference space were calculated. A scatter diagram of these descriptors was plotted using the statistical and graphic programs quoted by SCHLICH and MACEWAN, 1991.

**Results and Discussion**

The first three preference axes (PC1, PC2 and PC3) explain respectively 36 %, 34 % and 30 % of variation. The majority of consumers were strongly fitted either to the first or the second or the third dimension and split either side of preference dimensions. 16 consumers were excluded because they gave the same score to each product. The 4 products are located in 4 different sites of preference map : PS sample is positively correlated with the first axis. AG sample is located in the positive part of the second axis while AL sample is in the negative part of the second axis and STP sample is located on the third preference dimension (Figures 1 and 2). This fact could mean that the 4 products are assessed differently by consumers. The advantage of preference mapping is that individual differences are not averaged but are built into the model. This technique helps us to visualise individual opinions and segment the population into clusters grouped by similarity of preference (NUTE and al, 1988). In order to understand how steaks were assessed, we divided the consumers in 5 groups : 4 groups for each quadrant and one in the middle of the preference map. Each type of steak is preferred to the others by one of the consumer segments.

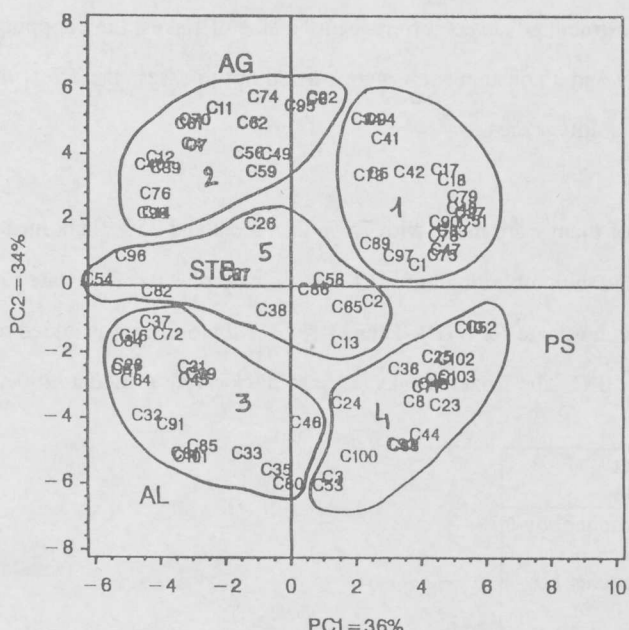


Figure 1: Preference space (PC1, PC2) generated by acceptability data. 'c' : consumer preference vectors with the identifier number.

Group	Count	AG	AL	PS	STP
1	20	57.1	33.6	64.5	47.6
2	19	67.4	40.6	40.6	62
3	19	36.4	64	35.4	53.3
4	18	37.4	54.4	69.2	50.5
5	12	40.1	40.4	39.7	58.4
All the groups	88	48.6	46.9	50.6	54

Table2. Mean acceptability scores by product and consumer group in the preference map (PC1-PC2).

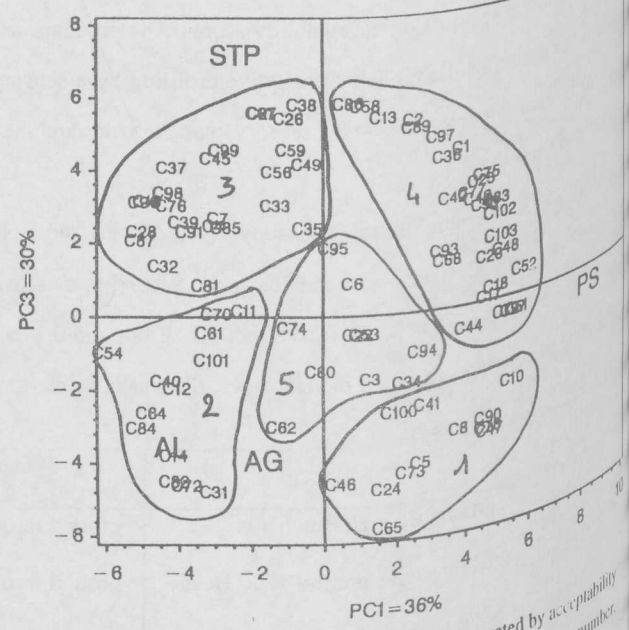


Figure 2: Preference space (PC1, PC3) generated by acceptability data. 'c' : consumer preference vectors with the identifier number.

Group	Count	AG	AL	PS	STP
1	12	55.6	49.2	62.3	33.7
2	13	57.1	57.7	33.3	45.4
3	25	45.1	50.9	36.2	67.2
4	28	41.4	39.3	66.2	57.8
5	10	57.3	41.3	51.4	46.7
All the groups	88	48.6	46.9	50.6	54

Table3. Mean acceptability scores by product and consumer group in the preference map (PC1-PC3)

is preferred by 2 segments of consumers (in the top and bottom right quadrants of PC1-PC2) while AL is preferred by the group in the bottom left quadrant and AG by the group in the top left quadrant (Figure 1, Table 2). STP is preferred by the majority of consumers and is strongly fitted by the third axis (Figure 2, Table 3) or weakly fitted by the first 2 preference dimensions. So its acceptability scores are the best (54) but it is weakly marked against the others (48.6, 46.9 and 50.6 for AG, AL and PS respectively) and not enough to reach a preference consensus.

Sensory descriptors

Assessor	Outside appearance		Inside appearance				Odour		Texture				Taste		Aroma			Total				
	stringy	scummy	brown	granular	moist	heterogeneous	meat juice	fatty	elastic	dilaceration	gristle	stringy	tender	juicy	greasy	salty	sweet		grilled meat	blood	fatty	
1	*	*		*		*	*				*			*			*				11	
2	*	*			*	*			*			*						*			8	
3		*		*		*			*		*		*		*			*		*	8	
4		*					*	*		*	*		*		*			*		*	3	
5		*		*						*	*		*		*		*		*	*	10	
6		*				*		*	*		*		*		*		*		*	*	5	
7		*				*		*	*		*		*		*		*		*	*	7	
8		*				*		*	*		*		*		*		*		*	*	6	
9		*				*		*	*		*		*		*		*		*	*	7	
10		*				*		*	*		*		*		*		*		*	*	7	
11		*				*		*	*		*		*		*		*		*	*	3	
12		*				*		*	*		*		*		*		*		*	*	10	
	2	9	2	2	4	1	5	4	6	5	5	5	3	3	2	6	9	2	5	1	4	85

Screening of significant sensory descriptors according to assessor. \* : significant descriptor for  $p < 0.25$ .

to understand which sensory characteristics are important to distinguish products, we carried out a variance analysis on each product. Table 4 shows the significant sensory descriptors for each assessor. Firstly, stringy appearance and salty taste are the most often selected: 9 times out of 12. Then, some texture descriptors, fatty odour and grilled meat aroma are selected 5 or 6 times. And some other as stringy, juicy, sweet, brown or blood aroma are only kept one or two times. These results could be explained by the manufacturing process: the steaks differed in the nature of the binding agent and the form of meat particles. So steaks were manufactured with binders composed of different concentration in salt: 0.44 % and 0.1 % for PS and STP respectively while both other contained no salt. So a lot of assessors perceived the difference in salt concentration. On the other hand, because lean meat was chopped by different apparatus: ground through Butcher Boy (for AG), flaked through Comitrol (for AL and STP) or sliced through Dicer (for PS), the stringy appearance of steaks was different for the majority of assessors. The texture descriptors, significant for the half of the panel, signify some not very marked differences between the products. This fact could mean that varying process does not lead to great difference in texture. Odour or aroma descriptors are not very discriminant probably because the meat was the same for all the manufacturings and beef flavouring was added to the taste of the binders. And for the descriptors, that are generally non discriminant, there is probably no sensory difference between products.

to explain consumer preference, we related the discriminant sensory characteristics to the preference space. Figures 3 and 4 show the correlations between attribute scores and products coordinates. We can see 2 types of sensory attributes. The first group is composed of good discriminant and good agreement attributes (i.e. located on the same site) as salty taste, stringy appearance, dilaceration, heterogeneous, tender, granular and gristle; while the second group contains good discriminant but bad agreement attributes (i.e. scattered on the map) as fatty odour, meat juice odour, greasy texture, elastic and sweet pointing out the effect of interactions product\*assessor and assessors disagreement about products marking. The first preference axis is explained mainly by salty taste and secondarily by grilled meat aroma. The second axis is explained mainly by texture descriptors. Gristle, dilaceration and stringy are positively correlated with the first axis while tender and granular are negatively correlated. The third axis is positively correlated with salty taste and negatively with stringy, fatty aroma and fatty-greasy odour. AG sample is associated with the higher ratings for stringy, gristle, heterogeneous .



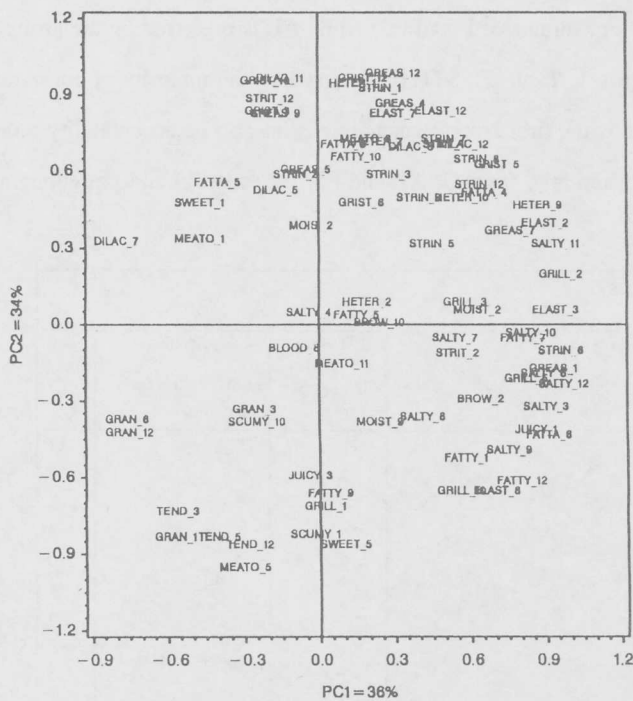


Figure 3 : Correlations between individual significant descriptors and preferred dimensions (PC1, PC2).

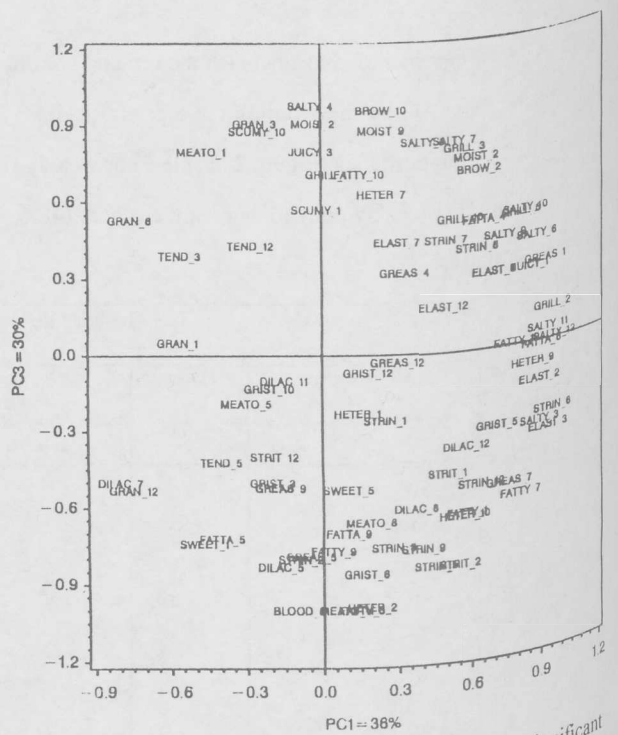


Figure 4 : Correlations between individual significant descriptors and preferred dimensions (PC1, PC3).

MOIST:moist surface, STRIN:stringy, SCUMY:scumy, BROWN:brown, GRAN:granular, MOISI:moist inside, MEATO:meat juice odour, FATTYO:fatty odour, ELAST:elastic, DILAC:dilaceration, GRIST:gristle, STRIT:stringy texture, TEND:tender, JUICY:juicy, GREAS: greasy texture, SALT:salt, SWEET:sweet, GRILL: grilled meat aroma, BLOOD: blood aroma, FATTYA:fatty aroma.

Contrariwise AL sample is associated with the higher ratings for tenderness. PS is preferred for its high saltiness and STP is characterized by a medium salty taste, grilled meat aroma and the lack of stringy texture and fatty odour. Thus there is no preference consensus for the tenderest or the least stringy restructured meat. Perhaps this result means that the majority of consumers do not want a restructured steak that is too tender. Absence of meat structure should be perceived as a fault in texture.

### Conclusion

1) Significant sensory differences in stringy appearance, saltiness, texture descriptors and fatty odour are revealed by the screening of individual discriminant descriptors. 2) Preference mapping shows also differences of acceptability according to appearance, texture and taste descriptors among consumers. Some consumers prefer tenderness and some other consumers prefer stringiness. So it seems there is no overall acceptability consensus for any sensory characteristic.

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