ARGENTINE "BONDIOLA": SENSORY CHARACTERISTICS AND ACCEPTABILITY BY THE CONSUMERS

GALLINGER, M. M., PICALLO, A. B. AND KHAN, N.*
Instituto Tecnología Alimentos, Centro Agroindustrias, *IMIZA, CCV y A., CNIA - INTA. CC 77 (1708) Morón, Buenos Aires, Argentina.

BACKGROUND The quality of foods is interrelated to the sensory properties of the products. However, there are products with many key attributes determined by a panel descriptive analysis that need to be subjected to a large scale consumer study. Using this approach, descriptive analysis data can be related to the consumer information to determine how variations in the attributes affect consumer acceptance. One important product manufactured in Argentina is a dry-cured product call "bondiola", which is elaborated with neck muscles of pork meat. The sensory attributes used to describe argentine "bondiola" are not defined, consequently it is necessary to develop the terminology that involves the descriptors representing these sensory attributes. This research will allow to identify the significance of the defined attributes in the overall acceptability of the consumers.
OBJECTIVE: The purpose of this study was to assess the sensory descriptors of argentine "bondiola" to predict the acceptance of this product by the consumers.
METHODS: "Bondiola " samples from 5 different commercial brands were labelled A, B, C, D=A, E, F and G=B. Two of them (A and B) were different type of "bondiola" from the same processor. The difference between A and B was the pig breed used to elaborate the product. This samples were vacuum packaged and kept at 2°C until analysis. The samples C, D and E were purchased at the local market and kept under similar condition as A and B. The panel consisted of 7 assessors selected by their ability to recognise basic tastes and performance in sequential triangle tests. Assessors developed the descriptors individually, followed by round-table discussion and consensus was reached by general discussion (M.C.A.S. A., 1999). When it was possible, references samples were provided to help to uniform of panel responses. Samples presented to assessors were coded with 3-digit random numbers. The evaluation procedure used was:

1- observation of the aspects and color on 0.5 cm thick-slices placed on a plate. The attributes evaluated were: uniformity (ASPHET), wetness (ASPW), fat color, distribution and fatness (ASPGC, ASPGD, ASPF), marbling (ASPM), uniformity and dominant colour (ASPCOH, ASPCOD);
2- evaluation of aroma and flavors attributes in judge individual booths on 0.5 cm thick- slice of each "bondiola". The parameters evaluated were: total intensity of typical aroma of "bondiola" (ARB), porky aroma (ARPK), pungency (ARP), "bondiola" flavor (FLB), porky flavor (FLPK), rancidity (FLR), piquantness (FLP), saltiness (FLS), acidity (FLA), off-flavor (FLOFF);
3- evaluation of texture in judge individual booths (oral and manual) on a rolled 0.5 cm slice sample. The attributes evaluated were: difficulty to cut the roll with a knife (MTXC), oral cohesiveness (OTXC), oral firmness (OTXF), oral adhesiveness (OTXA), chewiness (OTXCH) and juiciness (JUI).

As indicated by ASTM (1984), samples were served at room temperature. Assessors used bread and tap water at room temperature to clear their palates. Each descriptor was evaluated by marking a 10cm unstructured scale anchored at each extreme. A balanced incomplete block (BIB) design was used to avoid saturation of chemical senses and carry over effects. A duplicate session was held 1 day after the first with 7 assessors, this meant a total of 8 evaluations per sample.
With 6 samples of "bondiola", A, B, C, D=A, E and G=B, an acceptability test was performed. The consumer panel consisted of 96 persons of different age, location and sex. They received six samples, one after one, coded with 3 digit random numbers and served to the consumers in slices. It was chosen a design in which each consumer receives each of several samples so that the number of sample, the positions of sample in order of presentation and preceding sample are balanced over the whole trial: 6 samples, 96 replicates in 16 balanced blocks of 6 consumers (MacFie, H. 1989). Experimental data were statistically analysed using the SSPS 7.5 for Windows and SAS (1987) statistical softwares.

RESULTS AND DISCUSSION It was determined that five components accounted for 92.88% of the variance in the total set of measurements, but the first three component explained 82.56% of the system variability. Three components could explain as much as the 23 original variables, consequently the remaining components could be ignored without loosing information (Table 1). The component matrix (Table 2) showed the results for the three principal components (PC) computed from the descriptive data. The attributes related to aroma, flavor and texture load highly on the first component (PC1), then it would be labelled as the component of the "palatability". On the second component (PC2) loaded high attributes related to aspect and manual texture then it would be labelled as "aspect and color" component. As the variables ASPGD and ASPM loaded highly and positively on the third component (PC3) this component could be labelled as "fat" component. Figures 1 and 2 display a biplot of the first three PC. Each point is labelled with the sensory attribute name and the products (coded A to G) are plotted with a letter to identify them. The attributes that best described the variability among the samples on the first PC included flavors and aromas that were not characteristics of bondiola on one side. In the opposite side, characteristics bondiola aroma and flavor plus juiciness and firmness were included. In Figure 1 ARB and FLB were attributes strongly positively correlated to one another over the samples. For this reason it would be possible to take in account only one of this attributes in further studies. Other group in the same Figure 1, strongly positively correlated was formed by MTXC and OTXC and another group included FLPK and FLOFF was also highly positively correlated. In the first case only it would be necessary one of the two measurement of texture but in the second case it would not be convenient to take in account only one, because FLPK could be identified between the off-flavors. The attribute FLA was opposite to FLP then the samples that had high FLA had low FLP. The attributes MTXC and OTXC were opposite to OTXF, consequently samples with high MTXC or OTXC had low OTXF. Others attributes such us FLS and FLP and the fat attributes were represented by PC3 (Figure 2). The position of the product points indicates how they fall with respect to each other and with respect to the attributes. Samples B and G were represented by PC1 that explain the 37.5% of total variance, instead samples A and D were represented by PC2 with 26.9% of the variance. Then ARB and FLB were very important for sample B but for samples A and D were more important factors related to the

aspect or color. In the Figure 1 samples B and G are on the left side, where it is placed the FLB and ARB, tenderness and juiciness. On the other side is the sample E, where it is very important the pork flavor and pork aroma between others parameters like rancid flavor and off-flavor. In this case the texture was related to the increase in chewiness and cohesiveness. The position of sample F was better explained by PC3 (18.2% of the total variance). The important attributes for this sample were related to saltiness, acidity, piquantness and factors related to marbling and fat.

According to Muñoz (1997), the results of regressing acceptability of the samples carried out by consumers, against the three factors are summarised in Table 3. The regression model explained 86% of the variability in the consumer acceptability. Factor 1 was the single influential factor ($p<0.097$). The negative sign on its parameter estimate indicated that the products with higher Factor 1 scores tended to be *less* acceptable. Figure 3 shows acceptability plotted against Factor 1. Products E and C had high Factor 1 scores and low product acceptance, whereas products B and F had low Factor 1 and high acceptability. Since ARPK, OTXC, ASPCOH, FLPK, FLR, OTXCH, FLOFF had high positive loading for Factor 1, we could conclude that products with these attributes were less acceptable (samples C and E). By the same reasoning, attributes such as ARB, ARP, FLB, JUG and OTXF which had high negative Factor 1 loadings, were positively associated with product acceptance (A, B, D and F). The three factor model seems to adequately explain the relationship between the product attributes and product acceptance.

CONCLUSIONS The development of sensory descriptors for argentine "bondiola" showed that attributes related to flavor, aroma and texture were more important than attributes related to aspect and color.

Products with attributes such as "bondiola" aroma, "bondiola" flavor and piquantness, responsible for its "palatability", are more acceptable than products with pork flavor or heterogeneity in aspect or color which are negatively associated with product acceptance. However, the regression model might be improved including curvilinear effects for some Factors to better understand the relationships between this Factors and product acceptance.

PERTINENT LITERATURE

ASTM. 1984. Standard practice for establishing conditions for laboratory sensory evaluation of foods and beverages. ASTM Estándar E 480-84, ASTM, Pennsylvania.

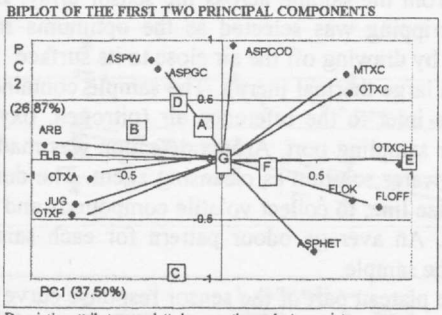
M.C.A.S.A: Manual de conceptos para Análisis Sensorial de los Alimentos, 1999. Temas en Tecnología de Alimentos, Vol III. CYTED, Prog.Iberoamericano de Ciencia y Tecnología para el Desarrollo. Instituto Politécnico Nacional. Editado por Damásio, M.E.

MacFie, H., Bratchell, N., Greenhoff, K. and Vallis, L. (1989). Design to balance the effect of order of presentation and first-order carry-over effects in hall tests. J. of Sensory Studies 4, 129-148.

Muñoz, A. M. 1997. Manual 30. Relating consumer, descriptive and laboratory data to better understand consumer responses. Chap 5. ASTM Publication Code Number (PCN): 28-030097-36.

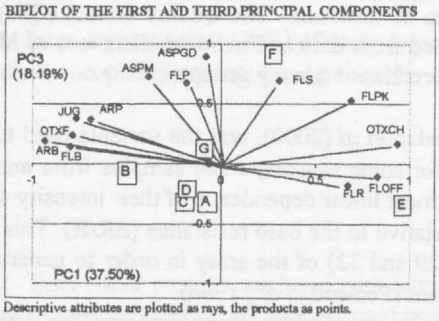
SAS. 1987.SAS-STAT, User's Guide. SAS Inst. Inc., Cary, NC.

FIGURE 1
BIPLOT OF THE FIRST TWO PRINCIPAL COMPONENTS



Descriptive attributes are plotted as rays, the products as points.

FIGURE 2
BIPLOT OF THE FIRST AND THIRD PRINCIPAL COMPONENTS



Descriptive attributes are plotted as rays, the products as points.

FIGURE 3
ACCEPTABILITY PLOTTED AGAINST PRODUCTS SCORES ON THE FIRST FACTOR OF THE PRINCIPAL COMPONENT ANALYSIS

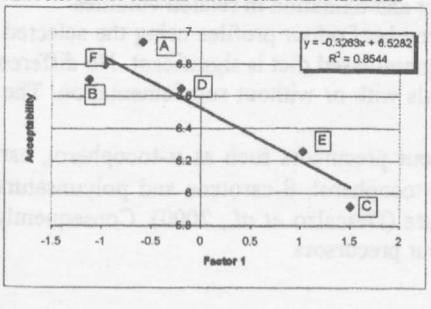


TABLE 1
PRINCIPAL COMPONENTS AND % EXPLAINED VARIANCE

Component	total*	% variance	acumulative%
1	8.62	37.50	37.50
2	6.18	26.87	64.37
3	4.18	18.19	82.56

*: Principal components with eigenvalues higher than 1.

TABLE 2
PRINCIPAL COMPONENT LOADINGS FOR DESCRIPTIVE ATTRIBUTES

Attributes	Components		
	1	2	3
ARB	-0.934	0.126	0.197
ARP	-0.693	-0.157	0.375
ARPK	0.649	-0.019	0.658
ASPCOD	0.058	0.958	0.181
ASPCOH	0.662	-0.588	-0.047
ASPGC	-0.339	0.758	-0.041
ASPGD	-0.083	-0.263	0.896
ASPHET	0.485	-0.760	-0.229
ASPM	-0.386	-0.075	0.732
ASPW	-0.373	0.837	-0.241
FLA	0.362	-0.601	0.641
FLB	-0.801	0.035	0.145
FLOFF	0.827	-0.394	-0.106
FLP	-0.185	0.588	0.679
FLPK	0.688	-0.338	0.531
FLR	0.672	0.560	-0.178
FLS	0.305	0.627	0.695
JUG	-0.769	-0.370	0.384
MTXC	0.653	0.716	0.103
OTXA	-0.580	-0.214	-0.347
OTXC	0.636	0.595	0.149
OTXCH	0.935	-0.094	0.171
OTXF	-0.788	-0.463	0.239

TABLE 3

REGRESSION MODEL RESULTS

Variable	Parameter Estimate	Standard Error	T for Ho	Prob>T
INTERCEP	6.535464	0.1679	38.914	0.0007
Factor 1	-0.323468	0.1088	-2.973	0.097
Factor 2	-0.026301	0.359	-0.073	0.9483
Factor 3	0.016621	0.1497	0.111	0.9218