

# Sensory Characterization and Consumer Preference Mapping of Fresh Sausages Manufactured with Goat and Sheep Meat

Kátia Paulos, Sandra Rodrigues, António Filipe Oliveira, Ana Leite, Etelvina Pereira, and Alfredo Teixeira

**Abstract:** The main objective of this study was the sensory characterization, by a taste and a consumers' panel, of fresh sausages from 140 culled goats and 140 culled ewes. Species and type of preparation effects were studied. All data were previously analyzed by analysis of variance. Taste panel data were analyzed by a Generalized Procrustes Analysis (GPA). Consumers' panel data were analyzed by Preference Mapping. The 1st 2 factors explained 88.22% of total variation in GPA. Different sausages samples were perfectly differentiated by assessors. Goat sausages have been considered harder, more fibrous, and less juicy than sheep sausages. The panelists observed that sheep sausages without paprika had greater intensity of flavor, tasted spicy, and had an off-odor, while goat sausages with paprika were considered sweeter. Consumers' panel did not show any preference for the different types of sausages. This means that all types of sausages can have market opportunity.

**Keywords:** fresh sausages, goats, preference mapping, sensory analysis, sheep

**Practical Application:** The present study was a result of a project in co-promotion between 2 breeder associations, an industry unit and a research center. Results indicated that the meat from animals out of quality commercial brands could be useful as processed meat in a product with consumer acceptability. Also these new meat products brought diversity to meat industry to reach new markets and originating 2 new meat brands recorded at INPI (Instituto Nacional da Propriedade Industrial—Natl. Industrial Property Inst.) with the numbers of 489664 and 489662 of National Brands of sheep and goat meat, respectively.

## Introduction

Quality of goats and sheep meat is directly related to its sensory characteristics, such as tenderness, juiciness, taste, and odor (Rodrigues and others 2009; Rodrigues and Teixeira 2009). Meat from young sheep and goats has special sensory characteristics with good market value in contrast to adult animals, particularly the culled ones that have a very low acceptability and market price. This kind of meat is tougher and normally has an unpleasant taste and odor, and usually is transformed by processes as cured with salts or smoked and dried or also as fresh sausages after grinding, mixing with salt, spices, and other ingredients and casing. In the last years, there have been several studies concerning the incorporation of meat from culled sheep and goats in processed products (Nassu and others 2002; Pellegrini and others 2008). These studies have demonstrated the feasibility of using the meat of adult's sheep and goats in the manufacture of sausages and its good acceptance by consumers.

The consumption of sheep and goat meat as well as the consumption of sausages is of great importance and tradition in all

Mediterranean countries. Particularly in North Portugal, there is a long tradition to consume several kinds of sausages. Taking advantage of these 2 factors, and to grant a higher commercial value to a low price product, a project to create a new product, a raw fresh meat sausage from Serrana goats and Churra Galega Bragançana ewes, was developed among a research center (Laboratório de Tecnologia e Qualidade da Carcaça e da Carne da Escola Superior Agrária de Bragança—Carcass and Meat Technology and Quality Laboratory of Agriculture School of Bragança), 2 breeder associations (ANCRAS—Associação Nacional de Criadores da Raça Serrana—Serrana Breed Natl. Assn., and ACOB—Associação de Criadores de Ovinos Bragançanos—Bragançana Breeders Assn.), and a meat manufacturing industry (Bísaro Salsicharia Tradicional). There is an important commercial issue related to this new product since the manufacturing industry is willing to expand their sale to other European Countries where they already have established market. During the process of developing, a new product is imperative to optimize parameters such as shape, color, appearance, odor, taste, texture, consistency, and interaction of all these components in order to achieve a complete balance, leading to an excellent quality and its good acceptability (Penna 1999) once consumers become more exigent with the characteristics of the products they choose and the industry should find the right way to satisfy their requirements. Sensory analysis allows evaluating the consumers' acceptability and quality of products, acting as an inherent part of the plan to create new products. Except for the hearing, all 4 senses as appearance, taste, smell, and texture, are used by meat consumers, which makes this methodology highly representative of human perceptions of food.

MS 20141924 Submitted 11/21/2014, Accepted 5/5/2015. Authors Paulos, Oliveira, Leite, and Teixeira are with Veterinary and Animal Research Centre (CECAV) Univ. Trás-os-Montes e Alto Douro. Author Rodrigues is with Mountain Research Centre (CIMO). Author Pereira is with Escola Superior Agrária/Inst. Politécnico de Bragança, Campus Sta Apolónia Apt 1172 5301-855 Bragança, Portugal. Authors Rodrigues and Teixeira are also with Escola Superior Agrária/Inst. Politécnico de Bragança, Campus Sta Apolónia Apt 1172 5301-855 Bragança, Portugal. Direct inquiries to author Teixeira (E-mail: [teixeira@iph.pt](mailto:teixeira@iph.pt)).

The objective of this study was the sensory characterization of a new product (fresh sausages made from goat and sheep meat) by a taste panel using the Quantitative Descriptive method referred by Meilgaard and others (2007), and the consumers' preference evaluation using the preference mapping procedure.

## Materials and Methods

### Sausages fabrication and sampling

A total of 280 culled females (140 Serrana goats and 140 Churra Galega Bragançana ewes breed) between 5 and 7 years old, with an average of 20 kg carcass weight were used from November 2010 until May 2011. Animals were slaughtered in the official slaughter house of Bragança (Trás-os-Montes region – northeast Portugal). Carcasses were deboned and cleaned from nerves, tendons, and connective tissues to be processed at the manufacturing meat industry. Raw meat (75% to 80% of goat or ewe) was mixed and minced with 15% to 20% of fatty cuts of pork belly of Bísaro (a local pig breed), and then the following ingredients: salt, peppers, bay leaves, water, garlic, rendimix<sup>®</sup>, and flavorex 4000 were added. The mixture was stuffed into 34 to 36 mm pork casings, hung for 24 h, and stabilized in a climate chamber at 13 °C and 80% of relative humidity. And then packaged in a polyamidepolyethylene bag and stored in a freezer until sensory analysis.

### Sensory analysis

For the sensory evaluation of goats and sheep fresh sausages, with or without paprika, a trained taste panel of 9 elements and consumers' panel with 82 elements were constituted, in accordance with the Portuguese Standard (NP-ISO-8586-1, 2001).

A taste panel, with about 10 y of experience that had already participated in previous research of our work team, was used. To form the panel, a recruitment of teachers, students, and staff of the Polytechnic Inst. of Bragança was made. About 40 people were recruited, to select 20, in order to obtain a panel of 9 people, according to the Portuguese Standard NP ISO 8586-1 2001. At recruitment, and before training, a preliminary selection of participants was carried out with the completion of a questionnaire, in order to eliminate the volunteers who were totally unsuitable for sensory analysis. Through selection tests, the following skills of the candidates were investigated: normal acuity to detect the different senses, the ability to discriminate different stimuli in quality and intensity, and recognition memory, verbal expression or descriptive capacity of sensory perception, and the ability in dealing with more complex food (Issanchou and others 1995; Nicod and others 1998; Eguía 2001; NP ISO 8586-1 2001). In the selection step, tests for the recognition of the taste, smell, texture, and vision were made, in which candidates discriminated and described the differences between diverse stimuli. The next step was training, which aimed to familiarize the taster with the procedures to carry out the tests in order to improve their ability to recognize, identify, and quantify the sensory attributes of a particular product. Also to improve its sensitivity and memory to different attributes so that they could provide an accurate answer, consistent and reproducible over time (Cross and others 1978; Costell and Durán 1981; Nicod and others 1998; Eguía 2001). In this step, the assays were based primarily on sensory memory. However, for the experienced taster further aims the ability to identify and recognize the characteristics of a product, the development of a set of descriptors, the identification and establishment of product standards, recognition factors of evolution within the products, and the evaluation of marketing factors (NP ISO 8586-1 2001). To train the assessors in the use of

scales, the concepts of quotation category and scales intervals and proportionality were presented initially classifying series of simple stimuli, although related to the products that were evaluated, odor, taste or texture, as regards the intensity of a specific property (NP ISO 8586-1 2001).

In this study, training consisted of 4 specific sessions to promote panelists adaptation to the product characteristics. In the 1st training session, panelists were asked to describe the product characteristics taking into account the 5 senses. There was an analysis of the attributes referred by the panelists to eliminate synonyms and homogenize terms. In the next training sessions, established attributes were specifically trained. Then, each sample was evaluated for the following sensory attributes: odor intensity (odor associated with raw meat, animal species), off-odor presence (odor that is not natural or up to standard for this type of product), flavor intensity (flavor of raw meat, associated with the animal species), off-flavor (flavor different from the natural for this type of product), hardness (the force needed to chew), juiciness (water perceived during mastication), fibers presence (or stringy—fibers perceived during mastication), spiciness (spicy flavor), and sweetness (flavor of sugar) using Quantitative Descriptive method, in which the tasters identify and quantify the intensity of each attribute present in sausages (NP ISO 8586-1 2001). The products were evaluated by assessors in 8 sessions. In each session, 8 samples were evaluated. A structured but unnumbered scale of 10 cm, with the extremes representing either the minimum (no sensation) or maximum (extremely intense sensation) was used.

The consumers' panel was constituted by teachers, staff, and students from Polytechnic Inst. of Bragança, with no training. Consumers were between 18 and 58 years old, since the consumer analyses were carried out on a higher education institution, as has been said before. The consumers' panel corresponded mainly to young people. Giving the opportunity to study the preferences of this population group, supposedly more reactionary to consume goat and sheep meat or based products. Most consumers who participated in the study are female (62%) and 38% are male. For each sample, the following sensory attributes were evaluated: taste liking, texture liking, spiciness liking, and overall acceptability. In this panel, a scale of 10 cm, unstructured, with intervals (from 0 cm—"do not like" to 10 cm—"like very much") was used for each of the attributes.

The cooking and serving conditions were identical for both panels. Samples were individually wrapped in aluminum foil and cooked in the oven until the internal temperature reached about 75 °C (NP-ISO-8586-1 2001). Once grilled, sausages were divided into pieces of 0.5 cm thick, wrapped in aluminum foil, labeled with random codes of 2 digits and 1 letter, and stored at 60 to 70 °C for maintaining the temperature of the samples for evaluation. Before and between each sample, evaluation panelists must rinse their mouths with mineral water and no salt toasts and/or Golden apple.

### Statistical analysis

In 1st place, an analysis of variance (ANOVA) was made to the taste panel and the consumers' panel data, using 2 species (sheep, goat) and 2 types of formulation (with or without paprika) as fixed factors, with SPSS. The analysis aims basically to check if there is a significant difference between the mean and the factors influence on some dependent variable.

After, the data from the taste panel sensory evaluation were analyzed by Generalized Procrustes Analysis (GPA). GPA is a powerful multivariate technique extensively used in sensory evaluation.

**Table 1—Mean, standard deviation, and significance of the sensory variables evaluated by the taste panel.**

|                  | G/P                        | GP                         | S/P                       | SP                         | Sig. |
|------------------|----------------------------|----------------------------|---------------------------|----------------------------|------|
| Odor intensity   | 3.81 ± 2.00                | 4.00 ± 1.87                | 3.89 ± 2.02               | 3.95 ± 2.12                | NS   |
| Off-odor         | 2.42 ± 1.66                | 2.48 ± 2.25                | 2.49 ± 2.10               | 2.38 ± 1.92                | NS   |
| Flavor intensity | 4.78 ± 2.07                | 4.14 ± 1.82                | 4.90 ± 2.15               | 4.26 ± 2.01                | NS   |
| Off-flavor       | 3.08 ± 2.60                | 2.68 ± 2.32                | 3.19 ± 2.54               | 2.80 ± 2.24                | NS   |
| Hardness         | 4.01 ± 2.51 <sup>a</sup>   | 3.51 ± 2.08 <sup>abc</sup> | 2.54 ± 2.12 <sup>cb</sup> | 2.64 ± 2.24 <sup>bc</sup>  | *    |
| Juiciness        | 4.60 ± 2.30 <sup>cb</sup>  | 5.10 ± 2.06 <sup>bc</sup>  | 6.49 ± 2.40 <sup>a</sup>  | 6.07 ± 2.41 <sup>ab</sup>  | *    |
| Fibers presence  | 4.50 ± 2.14 <sup>ab</sup>  | 4.56 ± 1.99 <sup>a</sup>   | 3.51 ± 2.08 <sup>ab</sup> | 3.36 ± 2.08 <sup>b</sup>   | *    |
| Spiciness        | 4.05 ± 2.11 <sup>abc</sup> | 3.02 ± 2.17 <sup>c</sup>   | 5.13 ± 2.63 <sup>a</sup>  | 3.47 ± 2.41 <sup>bc</sup>  | ***  |
| Sweetness        | 3.80 ± 1.89 <sup>bc</sup>  | 4.67 ± 1.77 <sup>a</sup>   | 3.73 ± 1.91 <sup>c</sup>  | 4.36 ± 1.60 <sup>abc</sup> | *    |

\*  $P \leq 0.05$ ; \*\*\*  $P \leq 0.001$ .

<sup>a</sup> to <sup>c</sup> Means with different superscript letters in the same row are significantly different.

NS, not significant; SP, sheep with paprika; S/P, sheep without paprika; GP, goat with paprika; G/P, goat.

The analysis uses translation, rotation, and isotropic scaling to minimize differences among panelists (Gower 1975; Carlucci and others 1998), identifies agreement between them, and summarizes the sets of 3-dimensional data (samples, characteristics, and assessors). The data matrices of 4 (sausages samples) by 9 (sensory attributes) for the 9 assessors (configurations) were matched to find a consensus using the XLSTAT (Addinsoft 2012) software, an add on of Microsoft Office Excel. Results correspond to the average evaluation established by each panelist for each group of sausages and the respective parameter (sheep with paprika—SP, sheep without paprika—S/P, goat with paprika—GP, and goat without paprika—G/P). To relate consumers' preferences with meat sensory characteristics, external preferences maps (Schlich and McEwan 1992) were established for each of the following variables: taste, texture, spiciness, and overall acceptability. This method requires the use of the previous results from the GPA to describe products as a series of criteria. This 1st step consists in mapping products based on its characteristics, to obtain a sensory map. With a high number of consumers, it was decided to sort them into homogeneous groups in order to have a perceivable result when interpreting the preferences maps. The agglomerative hierarchical clustering was chosen, and the Ward method was used. To determine the number of Clusters relatively to each sensory attribute, we started to truncate the clustering into 4 classes and then evaluate the significance of the same classes and respective  $R^2$  value. After, it was decided to maintain the least number of classes with the higher significance and  $R^2$ , as suggested by McEwan (1998). Aiming consumers' representation in the sensory map, PREFMAP procedure from XLSTAT (Addinsoft 2012) software was finally applied, and products evaluations for each consumer (or group of consumers) were modeled, using products characteristics as explanatory variables.

## Results and Discussion

### Taste panel

In the 1st place, an ANOVA (Table 1) for taste panel data was made. In this analysis, significant differences were found between the 4 products for hardness, fibers presence, spiciness, and sweetness. The higher differences were for spiciness. S/P presented the higher value, and GP the lowest. This may be due to the typical bitter taste of sheep meat, and the camouflage produced by paprika. Although this type of statistical analysis can elucidate about the differences between samples, it was chosen to use the GPA, which is a widespread statistical analysis in sensory evaluation and can provide additional information. GPA was used to minimize the differences between panel assessors, identify the consensus

**Table 2—Residual variance, percentage variation explained by the 1st 3 principal components, and scaling factors for each assessor from the fresh sausages of goats and sheep meat sensory analysis.**

| Assessor | Residual | F1 %   | F2 %   | F3 %   | Scaling factor |
|----------|----------|--------|--------|--------|----------------|
| 1        | 4.089    | 74.375 | 20.022 | 5.603  | 1.119          |
| 2        | 3.472    | 31.456 | 59.478 | 9.066  | 1.067          |
| 3        | 3.145    | 43.379 | 41.184 | 15.438 | 0.866          |
| 4        | 1.161    | 43.350 | 42.355 | 14.295 | 1.066          |
| 5        | 4.901    | 44.911 | 22.274 | 32.816 | 0.961          |
| 6        | 3.753    | 28.619 | 52.442 | 18.939 | 1.166          |
| 7        | 1.083    | 44.118 | 48.004 | 7.878  | 1.845          |
| 8        | 2.908    | 56.630 | 34.190 | 9.180  | 1.097          |
| 9        | 2.741    | 40.882 | 57.839 | 1.280  | 0.673          |

F1 = 1st principal component of Generalized Procrustes Analysis (GPA).

F2 = 2nd principal component of GPA.

F3 = 3rd principal component of GPA.

**Table 3—Residual variance for each sausages group (species/condiment added) from the fresh sausages of goats and sheep meat sensory analysis.**

| Animal group <sup>a</sup> | Residual |
|---------------------------|----------|
| GP                        | 7.935    |
| G/P                       | 8.129    |
| SP                        | 6.227    |
| S/P                       | 4.962    |

<sup>a</sup>SP, sheep with paprika; S/P, sheep without paprika; GP, goat with paprika; G/P, goat without paprika.

between them, and summarize the results in a 3-dimensional representation, thereby making it easier to interpret and identify main conclusions. The assessors profiled 9 terms to describe the differences between products. Their training period promoted similar assessment methods among each other. Indeed, the residual analysis of each tester indicated low levels of variance, confirming the reliability of the panel (Table 2). However, no training could completely eliminate variation among assessors as predicted by Stone and Sidel (2004). The 1st 2 dimensions of GPA explained the greatest percentage of variability for each panelist. The variation may have occurred because some of our panelists used a large part of the scale, whereas others only used a small part of the same scale, as shown by the scaling factors in Table 2. Assessors 1, 2, 4, 6, 7, and 8, tended to use a larger range because scaling factors were higher than 1. Despite of the occurrence of the variation, it is not an issue as the GPA corrected it.

Residuals, by treatment, indicated that the fresh sausages of sheep meat without paprika (S/P) had the lowest values (Table 3) and, therefore, were the most consensual.

**Table 4—Correlation between the sensory attributes of the fresh sausages of goats and sheep meat analysis and the 3 principal components (F1 to F3) of the Generalized Procrustes Analysis (GPA).**

|                  | F1     | F3     | F2     |
|------------------|--------|--------|--------|
| Odor intensity   | -0.067 | -0.989 | -0.134 |
| Off-odor         | 0.660  | 0.337  | -0.672 |
| Flavor intensity | 0.155  | 0.951  | -0.267 |
| Off-flavor       | 0.375  | 0.913  | -0.160 |
| Hardness         | -0.957 | 0.189  | -0.222 |
| Juiciness        | 0.991  | -0.116 | 0.059  |
| Fibers presence  | -0.885 | -0.017 | -0.465 |
| Spiciness        | 0.479  | 0.835  | -0.270 |
| Sweetness        | -0.154 | -0.988 | 0.024  |

F1 = 1st principal component of Generalized Procrustes Analysis (GPA).

F2 = 2nd principal component of GPA.

F3 = 3rd principal component of GPA.

The 1st 2 main axes of the consensus configuration (Figure 1) explained 88.22% of the variability, a quite higher result when comparing with the 68.2% reported by Rodrigues and others (2009), in Terrincho fresh meat of lambs, but lower than the 93% found by Rodrigues and Teixeira (2009), in Serrano fresh meat in young goats.

The correlation between sensory parameters and GPA factors (1 to 3) indicated that hardness, juiciness, and fibers' presence were highly correlated with factor 1 (Table 4). Factor 2 was highly correlated with the odor intensity, flavor intensity, off-flavor, spiciness, and sweetness. As for factor 3, it generally presents very low correlations, except for the off-odor presence, which highly correlates with this factor. However, their correlation with F1 ( $r = 0.660$ ) is proximate to the value found for the correlation with F3 ( $r = -0.672$ ). So, only the 1st 2 factors will be considered in Figure 1, which also shows the coordinates of objects (sausages samples), obtained in the principal components analysis, and the correlation between sensory parameters and the 1st 2 dimensions. In Figure 1, it is possible to notice that there is a perfect distribution of the different types of meat used in the preparation of sausages (sheep and goats) and condiment used in their manufacture (with or without paprika). The fresh sausages of sheep meat are positioned in the

positive part of factor 1, while the fresh sausages of goats' meat are in the negative part of the same factor, indicating that the sausages are separated by sheep tenderness and juiciness compared to goat sausages. On the other hand, the fresh sausages with paprika are on the negative part of factor 2, while fresh sausages without paprika are in the positive, indicating that the condiment influences taste, odor, and flavor attributes.

Species had great influence on the sausage's texture with the hardness and fibrousness associated to goat sausages, while juiciness was more associated with sheep's, according to the panelists. This fact was expected as goat meat is harder and more fibrous than sheep's meat, having less percentage of intramuscular and subcutaneous fat, which increases with age and weight of the animal, improving meat tenderness (Sañudo and others 2000). But Rodrigues (2009), in a study to characterize the carcass and meat quality of Serrano goat kids, observed that heavier animals had higher hardness and fibrousness. Condiment had influence on the presence and intensity of flavor, spiciness, and off-odor. Sausages without paprika presented higher spicy intensity, flavor intensity, and off-flavor than sausages with paprika, which had higher odor intensity and sweetness. Paprika masks the less pleasant sensory characteristics of this type of meat. The masking effect was also found by Nassu and others (2002) in a study on using goat meat in processing of fermented sausage, salami type, in which the incorporation of rosemary minimized goat odor and flavor.

### Consumers' panel

Also for the consumers' panel, an ANOVA (Table 5) was performed. Averages show a median (5 to 6) preference for this type of product, except for spiciness. In this analysis, it was found that the means are very close to each other and only spiciness presented significant differences among sausages. Therefore, we chose to perform a multivariate analysis as Preference Mapping that can extract more information from data. The 1st step to obtain preferences maps correspond to the representation of the sensory map and can be observed in Figure 2. The figure shows the coordinates of the different types of sausages, and the correlation between sensory attributes and the 1st 2 factors obtained in the GPA, which can allow the determination of the sausages characteristics identified

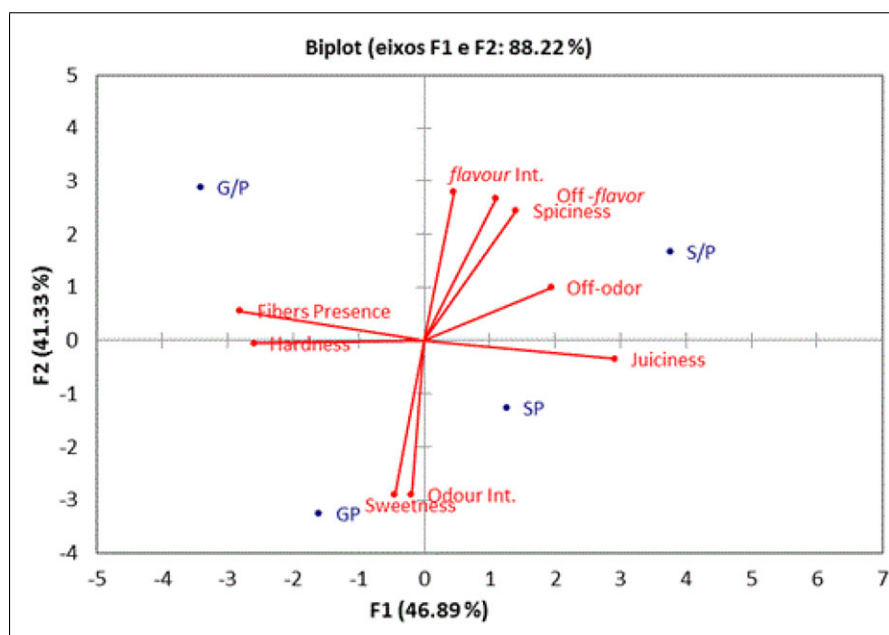


Figure 1—Consensus configuration: joint representation of the correlation between the sensory parameters and their 1st 2 dimensions, and groups of sausages sensory analysis. F1 = 1st principal component of Generalized Procrustes Analysis (GPA); F2 = 2nd principal component of GPA; SP = sheep with paprika, S/P = sheep without paprika, GP = goat with paprika; and G/P = goat without paprika.

**Table 5—Mean, standard deviation, and significance of the sensory variables evaluated by the consumers' panel.**

|                       | G/P                       | GP                       | S/P                      | SP                        | Sig. |
|-----------------------|---------------------------|--------------------------|--------------------------|---------------------------|------|
| Taste liking          | 5.75 ± 2.00               | 5.75 ± 2.22              | 5.98 ± 2.38              | 5.95 ± 2.37               | NS   |
| Spiciness liking      | 3.93 ± 2.90 <sup>ab</sup> | 3.36 ± 2.26 <sup>b</sup> | 4.86 ± 3.33 <sup>a</sup> | 3.75 ± 2.90 <sup>ab</sup> | *    |
| Texture liking        | 5.90 ± 1.96               | 6.02 ± 2.10              | 5.47 ± 2.29              | 5.46 ± 2.30               | NS   |
| Overall acceptability | 5.77 ± 2.08               | 6.02 ± 2.11              | 6.06 ± 2.27              | 6.06 ± 2.43               | NS   |

\**P* ≤ 0.05.

<sup>a, b, ab</sup>Means with different superscript letters in the same row are significantly different.

NS, not significant; SP, sheep with paprika; S/P, sheep without paprika; GP, goat with paprika; G/P, goat.

by the taste panel. Results from the ANOVA for each sensory variable are shown in Table 6 and indicate that none of the established classes was significant, but using more or less classes would not change their significance. Therefore, any conclusion about the classes will be uncertain. Anyway, that fact can be an indication that no preference differences were really detected by consumers, concerning species, or condiment considered in this work.

Even though not significant, an interpretation of the results can be suggested. So, for taste parameter (Figure 2A), consumers' class 1 (39 individuals) prefer tender and juicier sausages, namely the sheep sausages without paprika, as characterized by the taste panel. On the other hand, consumers' class 2 (33 individuals) prefer goat sausages with paprika characterized by being sweeter and with intense odor, but with less flavor intensity and less spicy. And consumer's class 3 (10 individuals) prefers sausages without paprika, which have higher flavor intensity and spicier.

Relatively to spiciness (Figure 2B), goat sausages without paprika, characterized as harder and fibrous, and less juicy, are preferred by class 3 (28 individuals), and less appreciated by class 1 (25 individuals) and 2 (13 individuals). Sheep sausages without paprika, considered less tough and fibrous, spiciest and juiciest, and with a less intense odor, are more appreciated by classes 1 and 2 and less appreciated by class 3.

For the texture parameter (Figure 2C), we can perceive that goat sausages without paprika, with a harder texture, and fibrous and less succulent were preferred by classes 2 (35 individuals) and 3 (14 individuals). On the other hand, class 1 (32 individuals) consumers preferred sausages with paprika, particularly sheep, characterized by low hardness and fibrousness.

Regarding overall acceptability (Figure 2D), classes 1 (23 individuals) and 2 (31 individuals) preferred juicier and spicier sausages. Note that the vectors which represent them are directed to the

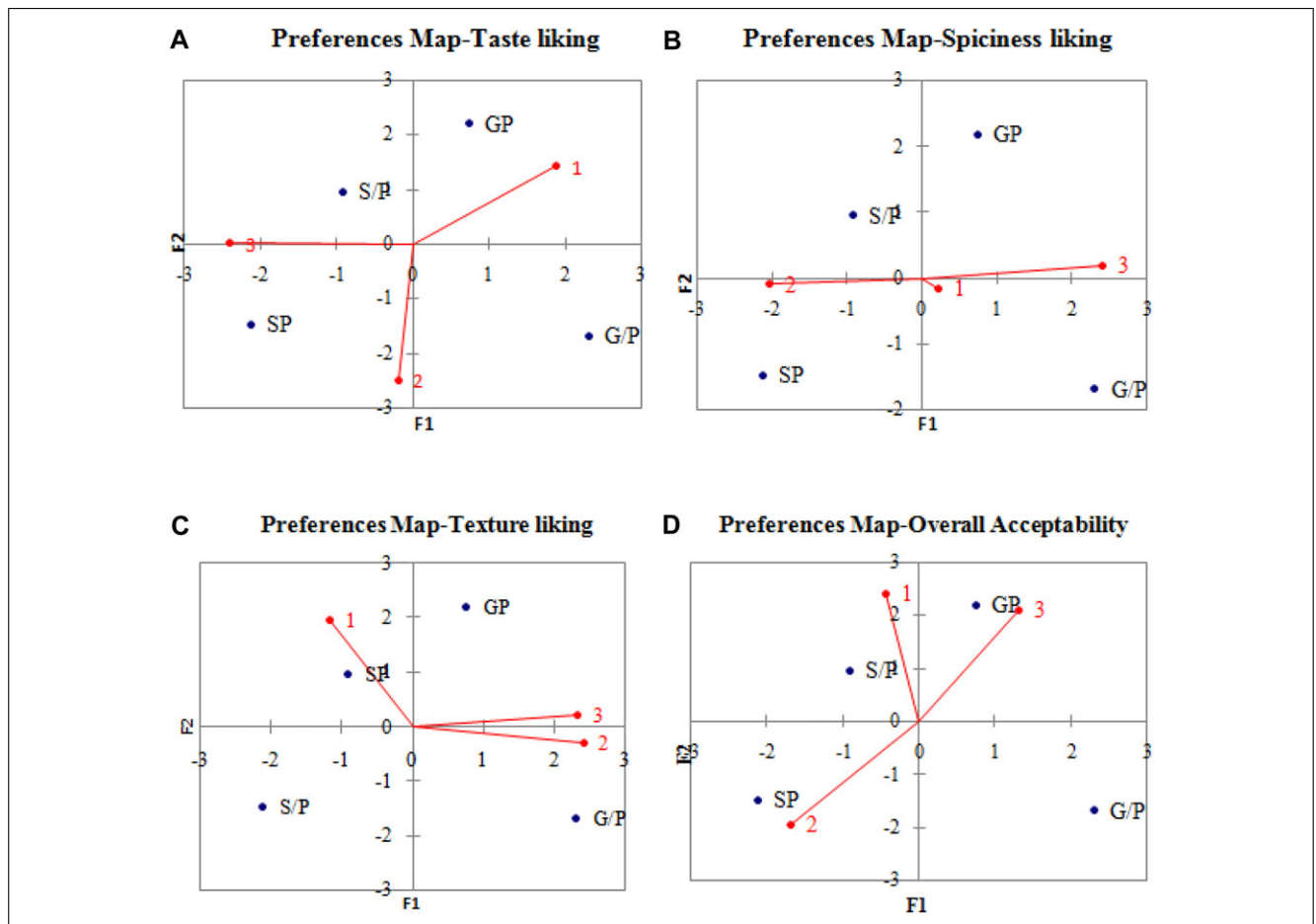


Figure 2—Preferences map for (A) taste, (B) spiciness, (C) texture, and (D) overall acceptability. SP = sheep with paprika, S/P = sheep without paprika, GP = goat with paprika; and G/P = goat without paprika.

**Table 6—Results of analysis of variance for taste liking, spiciness liking, texture liking and overall acceptability, from consumers' panel.**

|                       | Class | DF | Sum of squares | Mean squares | R <sup>2</sup> | F      | Pr > F |
|-----------------------|-------|----|----------------|--------------|----------------|--------|--------|
| Taste liking          | 1     | 2  | 2.924          | 1.462        | 0.975          | 19.338 | 0.159  |
|                       | 2     | 2  | 2.680          | 1.340        | 0.893          | 4.184  | 0.327  |
|                       | 3     | 2  | 1.891          | 0.946        | 0.630          | 0.853  | 0.608  |
| Spiciness liking      | 1     | 2  | 2.611          | 1.306        | 0.870          | 3.358  | 0.360  |
|                       | 2     | 2  | 2.870          | 1.435        | 0.957          | 11.032 | 0.208  |
|                       | 3     | 2  | 2.253          | 1.126        | 0.751          | 1.507  | 0.499  |
| Texture liking        | 1     | 2  | 2.870          | 1.435        | 0.957          | 11.002 | 0.208  |
|                       | 2     | 2  | 2.787          | 1.394        | 0.929          | 6.556  | 0.266  |
|                       | 3     | 2  | 2.581          | 1.290        | 0.860          | 3.077  | 0.374  |
| Overall acceptability | 1     | 2  | 1.064          | 0.532        | 0.355          | 0.275  | 0.803  |
|                       | 2     | 2  | 0.837          | 0.419        | 0.279          | 0.194  | 0.849  |
|                       | 3     | 2  | 1.251          | 0.626        | 0.417          | 0.358  | 0.763  |

coordinates of sheep sausages. Class 3 (27 individuals) shows a marked preference for goat sausages with paprika, considered as having higher odor intensity and sweetness.

In summary, as we have found in many preferences maps obtained by consumers assessments for taste, spiciness, texture, and overall acceptability, there were no significant differences in consumers preferences for sheep and goats fresh sausages, with or without paprika. In other words, there can be market for all types of fresh sausages, as the degree of preference is great for the 4 types (SP, S/P, GP, G/P).

Our results agree with the good acceptance by consumers for similar products studied by other authors (Souza and others 2005; Duarte and others 2007; Francois and others 2009) who used sheep and goat meat for the elaboration of sausages.

## Conclusions

Tasters were able to distinguish the difference between fresh sausages of the 2 species and different formulations. Sheep fresh sausages were juicier, while the goat sausages were defined as harder and more fibrous. Sausages with paprika were evaluated as having a higher odor intensity and sweetness than sausages without paprika. Regarding consumers' panel, it was possible to realize that there is no significant preference for any of the fresh sausages, which means there is market for all types of sausages. This seems to be a product with excellent sensory characteristics, great acceptance by the various types of consumers. This product is an excellent alternative to add value to the sheep and goat meat from culled animals that have very low commercial price. Our study may be useful for producers, since, there is a description of the products, as well as the study of consumer mapping preferences, which will give a feedback acceptance of this new product by consumers, and thus meet the market needs.

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## Author Contributions

S. Rodrigues and A. Teixeira designed the study and interpreted the results. K. Paulos, A.F. Oliveira, A. Leite, and E. Pereira collected test data and K. Paulos drafted the manuscript.

## Conflict of Interest

The authors declare that there are no conflicts of interest.

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