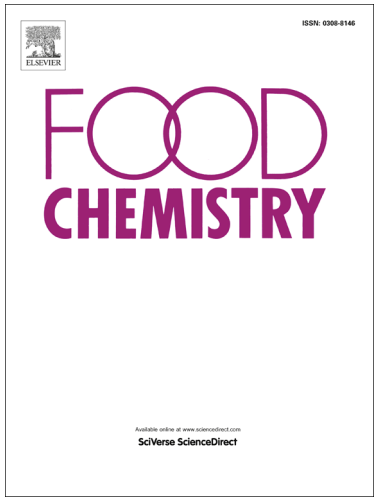



# Consumer acceptance and sensory profiling of reengineered kitoza products

Ana I.E. Pintado, Maria J.P. Monteiro, Régine Talon, Sabine Leroy, Valérie Scislowski, Geneviève Fliedel, Danielle Rakoto, Isabelle Maraval, Ana I.A. Costa, Ana P. Silva, Dominique Pallet, Keith Tomlins, Manuela M.E. Pintado

PII: S0308-8146(15)01337-0
DOI: http://dx.doi.org/10.1016/j.foodchem.2015.08.128
Reference: FOCH 18076

To appear in: *Food Chemistry*

Received Date: 5 May 2015
Revised Date: 12 August 2015
Accepted Date: 17 August 2015

Please cite this article as: Pintado, A.I.E., Monteiro, M.J.P., Talon, R., Leroy, S., Scislowski, V., Fliedel, G., Rakoto, D., Maraval, I., Costa, A.I.A., Silva, A.P., Pallet, D., Tomlins, K., Pintado, M.M.E., Consumer acceptance and sensory profiling of reengineered kitoza products, *Food Chemistry* (2015), doi: http://dx.doi.org/10.1016/j.foodchem.2015.08.128

# CONSUMER ACCEPTANCE AND SENSORY PROFILING OF REENGINEERED KITOZA PRODUCTS

Ana I. E. Pintado[a], Maria J P. Monteiro[a], Régine Talon[b], Sabine Leroy[b], Valérie Scislowski[c], Geneviève Fliedel[d], Danielle Rakoto[e], Isabelle Maraval[d], Ana I. A. Costa[a,f], Ana P. Silva[a], Dominique Pallet[d], Keith Tomlins[g] and Manuela M. E. Pintado[a*]

[a]CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Rua Arquiteto Lobão Vital, Apartado 2511, 4202-Porto

[b]INRA, UR454 Microbiologie, 63122 Saint-Genès Champanelle, France

[c]ADIV, Institut technique Agro-Industriel des filières viandes, 10 Rue Jacqueline Auriol, 63039 Clermont-Ferrand, France

[d]CIRAD, UMR Qualisud, TA B 95-16, 73 Rue Jean-François Breton, 34398 Montpellier Cedex 5, France

[e]UT - Antananarivo University, Madagascar

[f]CUBE - Católica Lisbon School of Business and Economics, Palma de Cima, 1649-023 Lisboa, Portugal.

[g]Natural Resources Institute, University of Greenwich, Central Avenue, Chatham Maritime, Kent, ME7 3RU, United Kingdom

**Running title** –

*To whom correspondence should be addressed

Tel: +351 22 55 80094

Fax: +351 22 50 90351

E-mail address: mpintado@porto.ucp.pt

**Abstract**

Kitoza refers to a traditional way of preparing beef and pork in Madagascar. However, in order to improve some drawbacks previous identified, the product was submitted to a reengineering process. The acceptance and sensory profiling of improved Kitoza products among Portuguese consumers was investigated. A local smoked loin sausage was selected as basis for comparison. Firstly, a Focus Group study was performed to identify sensory descriptors for Kitoza products and explore product perception. Subsequently, a Flash Profile and a consumer sensory acceptance study were conducted. Flash Profile's results showed that beef- and pork-based Kitoza products investigated differed considerably in all sensory dimensions. The Portuguese sausage was characterized as having a more intense and lasting after taste, as well as displaying a higher degree of (meat) doneness. The acceptance study yielded higher overall liking ratings for pork- than for beef-based Kitoza, although the Portuguese sausage remained the most appreciated product.

**Keywords:** Kitoza, smoked/dried meat, beef, pork, Madagascar, sensory profile, consumer test.

## 1. Introduction

Kitoza is a traditional product of Madagascar made from lean beef or pork meat. It was consumed for a long time ago by royalty and the wealthy has been popularized in this country over time. It is nowadays highly appreciated by Malagasy people of different social classes and also by foreigners, being mainly eaten with rice in soups at either breakfast or dinner times.

Kitoza is mainly prepared from meat from the hump of Malagasy zebus or Zebus, although pork meat can be also used. It is locally sold in many different forms: raw in butcheries, cooked in street eateries, dried and smoked in supermarkets.

Kitoza is traditionally prepared by trimming and slicing the meat into approximately 2–4 cm thick and 20 to 50 cm long strips, which are then uniformly salted. Depending on the preference, spices such as garlic, pepper and ginger may also be added to enhance the taste and tenderize the meat. The strips are then threaded onto a cord and hung over fire (a fireplace or barbecue), in order to smoke for at least 24 h. In butcheries, Kitoza is hung on a cord and then air dried at room temperature.

Meat preservation processes are based on slowing down or inhibiting different microbiological, enzymatic and chemical alteration processes (Sciences et Societé, UNESCO, 1986; Touzi & Merzaia-Blama, 2008). Most meat-based products are obtained through a combination of meat preservation processes such as drying, salting, smoking, frying or fermentation which are inexpensive process and widely used in these countries (Kalilou, 1997, Yacouba, 2010).

Applying meat preservation conditions in these countries is a very difficult task, due to a lack of adequate cold storage infrastructure, and especially, owing to climate and environmental conditions that precipitate the rapid degradation of this product. In

Madagascar, due to the highly perishable nature of meat, this type of foodstuff is often dried and/or smoked because the preservation process is easy and economically viable. There are two main advantages related to processing meat through drying:

1) To reduce the water activity in the processed product, thereby inhibiting the development of microorganisms and the rate of enzymatic reactions;

2) To reduce the weight and volume of the final product, thus facilitating its preservation during transport and storage (Yacouba, 2010).

Although being widely consumed in several African countries, traditional Kitoza production does not meet EU food safety requirements and cannot be exported to Europe. However, Kitoza has a high organoleptic potential and its production could be improved to meet international standards.

In the framework of an FP7 project – AFTER "African Food Tradition rEvisited by Research", a reengineering process based on the reorganization of traditional one was conducted to develop Kitoza products adapted to the European market with regard to their safety as well as consumer acceptability. To this end, two studies were done. A consumer study was held to investigate acceptance and drivers of preference and choice among Portuguese consumers in the EU, in which overall liking, intensity of sensory attributes in relation to participants' ideal level, price and placement were evaluated (Gaze et al., 2015). A complementary study on sensory characterization of the products by means of a sensory descriptive study performed with experienced panellists using the Flash Profile method (FP). FP is part of the faster and more flexible novel methodologies for sensory characterization that have been developed in the last years, to overcame some of the constraints of time and resources of conventional descriptive analyses (Cruz et al., 2013; Kim, Jombart, Valentin, & Kim, 2013; Valentin, Chollet, Lelièvre, & Abdi, 2012; Varela & Ares, 2012). Not requiring specific training of

panellists, FP was suggested by Dairou and Sieffermann (2002), for sensory description of food products according to their most salient sensory attributes. Since then it has been applied to describe many different foods including fruit products and beverages, having been proved to be as satisfactory as conventional profiling in many applications, using either trained or semi-trained panellist or consumer panels (Delarue, 2014; Delarue & Sieffermann, 2004; Moussaoui & Varela, 2010; Valentin, Chollet, Lelièvre, & Abdi, 2012; Varela & Ares, 2012). In view of this, the main objective of this study was to investigate the acceptance and sensory profiling of improved Kitoza products among Portuguese consumers.

## 2. Materials and methods

### 2.1. Samples

The Kitoza samples (beef and pork) for sensory and consumer tests were prepared using French meat (due to restrictions to export meat from Madagascar).

These samples were obtained through a reengineering process of the Kitoza products by Institut technique Agro-Industriel des filières viandes (ADIV) platform (CE approved) in France under support of traditional knowledge of Madagascar; according to an improved protocol developed in the framework of an international collaborative FP7 project funded by European Union “African Food Tradition rEvisited by Research” (AFTER).

The optimization approach resulted in the final protocol (Figure 1). At the food processing facilities in CIRAD, Montpellier, France, the meat was cut in strips (2 cm x 30 cm). Then pork meat was seasoned with NaCl (18 g/kg), $NaNO_2$ (0.11g/kg), $KNO_3$ (0.15 g/kg), garlic (4 g/kg), four spices mix (pepper, cloves, nutmeg, cinnamon, 2 g/kg)

and inoculated with the bioprotective cultures (B-LC-77, CHR HANSEN) composed of a mixture of *Pediococcus acidilactici* and *Staphylococcus carnosus*. It is specially developed for application in meat products to secure the formation of curing flavour and stable colour and to inhibit *Listeria monocytogenes.* Our preliminary data showed the interest of the application of these bioprotective cultures on these kinds of products (data not shown). The product was then smoked and dried at 60 °C, 0% of hygrometry during 95 min. Beef meat was seasoned with NaCl (18 g/kg), ginger powder (5 g/kg), sunflower oil (41g/kg) and inoculated with the bioprotective cultures (B-LC-77). The product was then smoked and dried at 60 °C, 0% of hygrometry during 65 min.

The Kitoza meat samples were vacuum packaged and shipped to Portugal under refrigerated (4°C) conditions for the Portuguese sensory and consumer's tests. In parallel microbial analyses were carried out.

Since Kitoza is an unknown product for Portuguese consumers, a local smoked loin sausage was selected as basis for comparison. This sausage loin smoked sausage is a commercial product sold by Primor (Portugal). The product is made from pork and is marketed in vacuum packages (350 g) in refrigerated conditions (0 ºC-5 °C) and a shelf life of 90 days.

The Kitoza meat samples processed and smoked loin sausage are represented in Figure 2: (1) Kitoza beef (KB), (2) Kitoza pork (KP) and (3) Traditional Portuguese smoked loin sausage (PS). The three different samples were used for Portuguese sensory and consumer's tests. Samples were served to the panellists at room temperature in the form of thin slices of approximately 0.5 to 1 cm thickness, without further preparation. Good hygiene practice was followed.

164 **2.2.Microbial analyses**

165

166 Kitoza manufactured samples (beef and pork) were evaluated in terms of food safety
167 and hygiene of the process. Microbiological samples were taken and analysed on
168 selective media according to the Standard methods of microbiological food analysis and
169 the ISO (International Organization for Standardization) Standard (Table 1). The total
170 counts were numerated on Plate Count Agar at 30°C for 72 h; yeasts and moulds on
171 Yeast Glucose Chloramphenicol Agar at 25°C for 48 h; coagulase negative
172 staphylococci on Manitol Salt Agar at 30°C for 48 h; and lactic acid bacteria on Man,
173 Rogosa and Sharpe Agar at 30°C for 48-72 h under anaerobic conditions. The
174 *Enterobacteriaceae* were numerated on Violet Red Bile Glucose Agar at 37°C for 24 h;
175 *Staphylococcus aureus* and coagulase positive staphylococci on Baird-Parker Agar
176 37°C for 24-48 h. *Listeria monocytogenes* and *Salmonella* were detected after
177 enrichment step according the ISO standard (Table 1).

178

179 **2.3. Ethical assessment and consent**

180

181 These studies have been assessed and approved by the Natural Resources Institute
182 (NRI) (Kent, United Kingdom) Ethics Committee. Informed consent was signed by
183 sensory panellists and consumers who participated in this study.
184 Participants were informed prior to the study that their participation was entirely
185 voluntary, that they could stop the interview at any point/time and that their responses
186 would remain anonymous.

187

188

## 2.4. Flash Profile

The sensory profiling study was conducted at the Escola Superior de Biotecnologia – UCP, Porto in Portugal. To this end, samples of the three products were rated by 18 sensory panellists using Flash Profile (FP) (Dairou and Sieffermann, 2002). This is an alternative sensory analysis technique, adapted from free-choice profiling, which is employed to understand the sensory positioning of products (Garruti, Facundo, Lima & Aquino, 2012). This technique combines vocabulary generation through free choice profiling by individual panellists with attribute intensity ranking. FP is usually done in two sessions or steps. In the first session/step panellists are asked to evaluate samples comparatively in order to generate descriptors they consider appropriate to discriminate between the samples. In the second, panellists rank all samples for each selected attribute (Varela & Ares, 2012).

The panellists were recruited and selected in compliance with ISO Standard 8586:2012 (ISO, 2012a) and completed a 3-month training period on sensory evaluation. Training focused on language development, improvement of discriminating ability, memorization and rating intensities of selected attributes. Panel performance was evaluated at the end in compliance with ISO 11132:2012 (ISO, 2012b).

Sessions were conducted in a sensory laboratory with controlled air temperature and lightning. The facilities complied with the requirements of ISO 8589 (ISO, 2007) and comprised a training room, dedicated kitchen and sensory booths with computerized data collection.

In the beginning of the first session, the panellists were briefed about the FP procedure and asked to evaluate the three samples in order to generate sensory descriptors to differentiate among them. The records for attributes definition are represented in Table

2. At the end of the session, descriptors were compiled along with the correspondent anchors, synonyms discarded. The pooled attribute list of 23 descriptors is presented in Table 3. In the second session, panellists were instructed to choose whichever descriptors they would consider more adequate (from the pooled list or others) and to rank the intensities in all samples using a continuous graphical scale (0 to 10). These were allowed and panellists could re-taste the samples as much as they liked (Lawless & Heymann, 2010). Samples in both sessions were presented coded with random three digit codes, water was provided for mouth rinsing.

### 2.5. Focus groups

In order to gain insights on consumer´s perception towards Kitoza meats, one small focus group discussion was performed in Porto (Portugal) with nine recruited volunteers (four men and five women) of different ages. The individuals were invited to taste the two Kitoza products, and to give their impressions about them, main product attributes, possible motivations to buy and to consume, the circumstances and locations for consumption.

The focus group was led by an experienced moderator. A focus group script was developed based on the proposed aims. The themes exploited in focus groups are presented in Table 4.

### 2.6. Consumer acceptance

The study was conducted at Escola Superior de Biotecnologia (ESB) – Universidade Católica Portuguesa (UCP). Participants were non-probabilistically recruited (Porto, n=94) according to their willingness and availability to participate in the study. Their

ages ranged between 18 and 55 years old (average 29), 99% were European residents. 22% of participants consumed different types of charcuterie on a daily basis, 65% of participants consumed these products at least once a week and 9% at least once a month, 4% of participants only consumed these products occasionally.

Questionnaires were administered using Qualtrics (Qualtrics, LLC), an online survey software. Sample acceptability was assessed by overall liking, aspect, texture, flavour ratings provided on a 9-point verbal hedonic scale. (1 = "dislike extremely, 5="neither like nor dislike", 9 = "like extremely") (Jones, Peryam & Thurstone, 1955; Peryam & Girardot, 1952; Peryam & Pilgrim, 1957; Gaze et al., 2015). Hierarchical cluster analysis (Euclidean distances and Ward's agglomeration method) was subsequently performed to identify groups of participants with dissimilar patterns of sample liking.

Sensory attributes – slice size, slice thickness, smoked flavour and condiment, relative to participants' ideal level were measured by attribute ratings provided on a 7-point just-about-right scale [1-3 *too weak* (TW), 4 *just-about-right* (JAR), 5-7 *too strong* (TS)]. The just-about-right (**JAR**) scale combines assessment of attribute intensity and hedonic evaluation, providing information on how consumers feel about a product and how much a sample deviates from an ideal point (just-about-right) (Gacula, Rutenbeck, Pollack, Ressurection, & Moskowitz, 2007; Morais, Morais, Cruz, & Bolini, 2014; Paixão, Rodrigues, Esmerino, Cruz , & Bolini, 2014; Esmerino, Cruz, Pereira, Rodrigues, Faria, & Bolini, 2013; Popper, 2014).

To evaluate the potential impact of the geographic origin of Kitoza on consumer demand, the survey contained a question asking participants how much they were willing to pay for the Kitoza products they had just sampled. Half of the participants were informed about the Malagasy origin of the recipe while the other half were not. The surveys containing the two versions of this question were randomly distributed

among participants. Finally, the survey also included questions about the appropriateness of eating/buying situations for the sampled Kitoza products.

### 2.7 Statistical analysis

XLSTAT software (Addinsoft SARL, France) was used to carry out the statistical analyses. The significance of statistical tests was evaluated at $p<0.05$, unless otherwise mentioned.

The FP results were analysed using General Procrustes Analysis (GPA) a multivariate statistical technique. GPA reduces the scale usage effects by detecting and minimizing individual differences and delivers a consensus configuration and allows the comparison of the proximity between terms that are used by different assessors to describe the test samples (Næs, Brockhoff & Tomic, 2010; Hernández-Carrión, Varela, Hernando, Fiszman, & Quiles, 2014; Rodrigues & Teixeira, 2013; Santos et al., 2013)

Analysis of Variance (ANOVA) was performed on within-clusters' overall liking ratings (aspect, texture and taste) for the three samples, considering participants and samples as sources of variation. Within-cluster mean sample ratings were calculated and significant differences between them tested post-hoc using Tukey's HSD (Honest Significant Difference) tests. Pair-wise Pearson correlations between samples' overall liking ratings were then computed to assess their degree of association.

Hierarchical cluster analysis (Euclidean distances and complete Ward's agglomeration method) was subsequently performed to identify groups of participants with dissimilar patterns of sample liking. The frequency of intensity ratings (TW/TL, JAR, TS/TL) for each of the four sensory attributes evaluated by participants was determined for each sample, and the corresponding proportions calculated.

## 3. Results and discussion

### 3.1 Microbial evaluation

First the results highlighted the absence of pathogenic bacteria such as *Salmonella* and *Listeria monocytogenes* and the count of *Staphylococcus aureus* was below to the detection level in the two Kitoza samples (Table 1). Yeasts and moulds and *Enterobacteriaceae* were enumerated at low level attesting of the hygienic quality of the meat products. The count of the lactic acid bacteria and coagulase negative staphylococci were approximately 7 and 6 log CFU/g, respectively. As expected, these counts are in accordance with the inoculation level of the bioprotective cultures.

### 3.2 Flash profile

Flash profile was chosen as a satisfactory method to describe the sensory profile as an alternative to the use of the Quantitative Descriptive Analysis (QDA), since QDA involves several sessions to generate the descriptors and extensive training with the panel working with the references. Moreover, we had short time between the arrival of samples from France and their shelf life. However, we are aware that this method did not generate data with the same degree of reliability (Cadena, Cruz, Netto, Castro, Faria, & Bolini, 2013), but possess enough discrimination capacity for these samples. The results of GPA performed on the FP evaluation of the three samples are presented in Figure 3. The first two dimensions of the GPA analysis accounted for by 76.5% and 23.5% of the variance respectively.

A good discrimination between the three products was observed. KB was described as having a darker colour tone (doneness) on the outside, but a rawer aspect inside, as well as an intense meat flavour. KB contrasted with PS in terms of the attributes saltiness, moisture, cooking texture, spices, and succulence. These were all relatively stronger for KB and weaker for PS, while aftertaste intensity and duration were stronger for PS than KB. KP main attributes were a more intense smoked odour and flavour, sweet and spiced odour, with a more fibrous and elastic texture, than the other two samples.

### 3.3. Focus groups

The participants observed both Kitoza samples and made some considerations as respect that sensory attributes. The main reactions on Kitoza products by the Portuguese consumers who participated in focus groups were as follows:

- KP was defined as aromatic, sweet taste and similar to a traditional Portuguese smoked loin sausage.
- KB was defined as smoked odor, undercooked meat, poor consistency, very smooth and floury.
- Overall agreed that the samples had different textures. KP much drier and KB with more moisture content and undercooked meat aspect.
- The majority considered the products belonging to the category of smoked meat sausages food and dry meat. With respect to KP, they considered that it had similarities with traditional Portuguese products (like “salpicão”, but without the tripe, or smoked loin sausage), the sweetest and much less salty than similar Portuguese products and with a spicy taste (curry, coconut, cinnamon). Participants considered the KB to be quite different and could not identify in the

national markets similar smoked products; however they indicated some similarities with roast beef.

- Concerning the occasion of consumption, they showed that they would consume only on special occasions, as for example before the dinner with delicacies or how as a snack in a party.
- They consume KP “just like” or probably used in duck rice or mixed with pasta. They probably consume KB only cooked (maybe grilled). For the purchase of these products, KP would be the product they buy most easily because it had a more appealing aspect, while the KB did not have a very attractive appearance. However, the way they are marketed could influence the purchase. The type of market that considered ideal for the sale of these products was the delicatessens, gourmet shops or supermarkets.
- They considered that would it would be useful to have knowledge about the origin of the products; they would buy this product more readily if in the label was written "product manufactured in Europe - according to the traditional recipe of Madagascar".
- Even though they have not considered very attractive products, in short they considered that KP was similar to some traditional Portuguese products, and it was more familiar, tastier and more artificial. They rated “just like” this product. KB was considered different from traditional Portuguese products since the Portuguese’s people do not customarily consume meat products produced from beef meat. They highlighted the unattractive aspect, but nevertheless this product ended up generating more curiosity. They described the product with floury and friable texture and they would consume this type of product cooked.

364 ### 3.4.Consumer study

365

366 #### 3.4.1 Overall liking scores

367

368 The overall acceptability of all samples significantly differed between the three samples
369 at a significant level of $p \leq 0.01$ (one-way ANOVA) (Table 5).
370 On average, all samples were positively appreciated since the mean scores of overall
371 liking were above 5.5. PS was the most preferred product (7.223±0.135) followed by
372 KP (6.319± 0.166) and KB (5.606±0.229), which obtained the lowest mean rating.

373

374 #### 3.4.2 Hierarchical cluster analysis

375

376 The hierarchical cluster analysis (Ward method) identified three groups of consumers
377 with different overall liking patterns as depicted in Figures 4: Cluster 1 (**C1)** - *Kitoza*
378 *beef dislikers* (41%), Cluster 2 (**C2)** - *Overall likers* (43%) and (Cluster 3) **C3** - *Kitoza*
379 *pork dislikers* (16%) (Figure 5). Kitoza pork was liked by 84% of participants (clusters
380 C1 and C2), whereas Kitoza beef was liked by 59% of participants (clusters C2 and C3).
381 Consumer acceptance was positive for all samples, but differed significantly between
382 them ($p < 0.05$). Mean overall liking ratings showed that PS was better appreciated than
383 KP and KB.
384 Positive significant correlations were observed between overall liking and acceptance of
385 sensory attributes, aspect, texture and flavour by consumers (Table 5). Correlations
386 between sensory attributes were also similar for the different clusters.

387

### 3.4.3 Evaluation of intensity of sensory attributes relatively to participants' ideal level

Figure 6 shows the frequencies of intensity ratings, measured on a 5-point JAR scale, for each Kitoza sample and Traditional Portuguese smoked loin sausage and sensory attributes evaluated.

A preponderance of JAR (Just-About-Right) ratings was observed for PS for the four attributes evaluated, with their frequencies ranging from 53.2% to 86.2%. This is well in line with overall liking results, which showed that PS was the preferred sample for Portuguese consumers.

For KP, TW/TL (Too weak/Too little) ratings dominated the smoked flavour and slice size. For condiments and slice thickness the frequencies of JAR ratings were 35.1% and 51.1%, however condiments obtained similar ratings for TW/TL, JAR and TS/TL (Too strong/Too large), with values of 34.0, 35.1 and 30.9%, respectively.

For KB, with TW/TL ratings being preponderant for most attributes except for slice thickness; slices size obtained 67.0% for TW/TL ratings, which shows that most participants preferred larger slices. This result is also in line with the overall taste results, which showed that KB was the least preferred sample.

The results of the JAR highlighted that KB and KP should have larger slices size and stronger smoked flavour.

### 3.4.4. Willingness to pay and product placement

Information about Malagasy traditional origin of Kitoza products had a positive impact on participants' willingness to pay, both for KP and KB (Figure 7). On average,

413 participants stated they were willing to pay a significant higher price pay for KB and KP
414 (respectively 3.3 € and 3.2 € for 100g of product) than when they were not informed
415 about the origin of the products ( 2.2 € for 100g of both products). These results could
416 be related to the unusual and exotic character associated with tradition Malagasy
417 traditional origin.

418 Figure 8, shows the results concerning tasting occasions of KB and KP. The results
419 were similar for both Kitoza products, being the main consumption preference as
420 appetizer for KB (33%) and KP (30%) and as snack, KB (32%) and KP (29%).
421 These results show the trend of consumer's preference in terms of tasting which
422 resembles to the form of consumption of traditional Portuguese charcuterie products.
423 In relation to product placement participants considered the supermarket charcuterie
424 sections the more appropriate place to sell Kitoza products (Kitoza beef (32%) and
425 Kitoza pork (37%)), followed by supermarket gourmet sections (Kitoza beef (22%) and
426 Kitoza pork (21%)). Similar results were obtained for both Kitoza samples (Figure 9).
427 Tasting occasions and product placement for Kitoze products resembles the same trends
428 of traditional Portuguese charcuterie products.
429 These results suggest that because the participants were unfamiliar with this kind of
430 products, they chose market for the sale of Kitoza that were the similar market where
431 similar Portuguese products would be vended, namely supermarkets charcuterie
432 sections. The gourmet shops were other major choices probably because consumers
433 consider these products to be exotic or delicatessen.
434
435
436

## 4. Conclusions

Sensory evaluation resulted in 23 attributes to describe the sensory characteristics of the meat samples. Among the main results we can highlight that the sensory evaluation of meat samples revealed different sensory profiles. The major differences found were that KB was more related to thickness, meat flavour and colour tone aspect attributes and had a more intense meat flavour. KP showed more intense sweet odour, spices and smoked odour. On the other hand, PS was related to after taste duration and intensity sensory attributes.

Between the two Kitoza samples, KP was the most appreciated, although the PS used for comparison in this study was the most appreciated overall, as expected. It is hypothesized that these results are due to the fact that Kitoza products are unknown for most Portuguese consumers and that most of dried and cured meat products are made of pork meat in Portugal.

The appropriateness of spicy flavour, smoked flavour and slice size evaluated showed that most consumers would prefer larger product slices, while in the case of Traditional Portuguese smoked loin sausage although it was presented in small pieces, as it is a more familiar product the slices size was considered JAR by 86.2% of participants.

The impact of Madagascar traditional origin of the recipe evaluated showed a positive effect on product preference, since a significant increase was observed in the average price the consumers stated they were willing to pay, both for Kitoza beef and Kitoza pork, because participants associated with these products exotic products, valuing them.

Moreover, the employment of overall liking assessments and JAR technique and uncovered important drivers for further sensory optimization of the Kitoza samples improved through reengineering processes.

Although the Kitoza products are unfamiliar to most of the Portuguese consumers, the results of this study revealed that improved Kitoza products have the potential to be well accepted and to be promoted and introduced in Portugal and other European markets. This also has the potential to contribute to improved incomes and livelihoods for people living in Madagascar.

## Acknowledgement

This publication is resulting from a research project funded by the European Union (FP7 245–025) called African Food Revisited by Research (AFTER - http://www.after-fp7.eu/), with additional financial support and FCT (Fundação para a Ciência e a Tecnologia) – PEst OE/EQB/LA0016/2013. The views expressed are not necessarily those of the European Union.

## References

Cadena, R. S., Cruz, A. G., Netto, R. R., Castro W. F., Faria, J. A. F, & Bolini, H. M. A (2013). Sensory profile and physicochemical characteristics of mango nectar sweetened with high intensity sweeteners throughout storage time. *Food Research International*, 54, 1670–1679.

Cruz, A. G., Cadena, R. S., Castro, W. F., Esmerino, E. A., Rodrigues, J. B., Gaze, L., & Bolini, H. M. A. (2013). Consumer perception of probiotic yogurt: Performance of check all that apply (CATA), projective mapping, sorting and intensity scale. *Food Research International, 54*, 601-610.

Dairou, V., & Sieffermann, J.M. (2002). A comparison of 14 jams characterized by conventional profile and a quick original method, the flash profile. *Journal of Food Science,* 67, 826-834.

Delarue, J. (2014). Flash Profile *Novel techniques in sensory characterization and consumer profiling* (pp. 175-202). Boca Raton, USA: CRC Press

Delarue, J., & Sieffermann, J. M. (2004). Sensory mapping using Flash profile. Comparison with a conventional descriptive method for the evaluation of the flavour of fruit dairy products. *Food Quality and Preference,* 15, 383-392.

Esmerino, E. A., Cruz, A. G., Pereira, E. P. R, Rodrigues, J. B., Faria, J. A. F., & Bolini, H. M. A. (2013). The influence of sweeteners in probiotic Petit Suisse cheese in concentrations equivalent to that of sucrose. *Journal of dairy science* 96: 5512-5521.

Gacula, M., Rutenbeck, S., Pollack, L., Ressurection, A.V, & Moskowitz. H. R (2007). The just about right intensity scale: Functional analysis and relation to hedonic. Journal of Sensory Studies, 22:194–211.

Gaze, L. V., Oliveira, B. R., Ferrao, L. L, Granato, D., Cavalcanti, R. N., Conte Júnior, C. A., Cruz, A. G., & Freitas, M. Q. (2015). Preference mapping of dulce de leche commercialized in Brazilian markets. *Journal of Dairy Science* 98, 1443-1454.

Garruti, D. S, Facundo, H. V. V., Lima, J. R. & Aquino, A. C (2012). Sensory Evaluation in Fruit Product Development. In: Fabiano A. N. Fernandes; Sueli Rodrigues. (Org.). *Advances in Fruit Processing Technologies*. Boca Raton: CRC, p. 415-440.

Hernández-Carrión, M., Varela, P., Hernando, I., Fiszman, S. M., & Quiles, A. Persimmon milkshakes with enhanced functionality: Understanding consumers' perception of the concept and sensory experience of a functional food. *LWT - Food Science and Technology (in press).* doi: 10.1016/j.lwt.2014.10.063.

ISO (1987). ISO 7954 *Microbiology -- General guidance for enumeration of yeasts and moulds -- Colony count technique at 25 degrees C:* International Organization for Standardization.

ISO (1996). ISO 11290-1 *Microbiology of food and animal feeding stuffs -- Horizontal method for the detection and enumeration of Listeria monocytogenes -- Part 1: Detection method:* International Organization for Standardization.

ISO (1999). ISO 6888-1 *Microbiology of food and animal feeding stuffs - Horizontal method for the enumeration of coagulase-positive staphylococci*

534 *(Staphylococcus aureus and other species) -- Part 1: Technique using Baird-*
535 *Parker Agar Medium:* International Organization for Standardization.

536

537 ISO (2002). ISO 6579 *Microbiology of food and animal feeding stuffs --*
538 *Horizontal method for the detection of Salmonella spp.:* International
539 Organization for Standardization.

540

541 ISO (2003). ISO 4833 *Microbiology of food and animal feeding stuffs --*
542 *Horizontal method for the enumeration of microorganisms -- Colony-count*
543 *technique at 30 degrees C*: International Organization for Standardization.

544

545 ISO (2004). ISO 21528-2 *Microbiology of food and animal feeding stuffs --*
546 *Horizontal methods for the detection and enumeration of Enterobacteriaceae --*
547 *Part 2: Colony-count method*. International Organization for Standardization.

548

549 ISO (2007). ISO 8589 *Sensory analysis. General guidance for the design of test*
550 *rooms*: International Organization for Standardization.

551

552 ISO (2012a). ISO 8586 *Sensory analysis. General guidelines for the selection,*
553 *training and monitoring of selected assessors and expert sensory assessors*:
554 International Organization for Standardization.

555

ISO (2012b). ISO 11132 *Sensory analysis. Methodology. Guidelines for monitoring the performance of a quantitative sensory panel*: International Organization for Standardization.

Jones, L. V., Peryam, D. R., & Thurstone, L. L. (1955). Development of a scale for measuring soldiers' food preferences. *Journal of Food Science, 20*(5), 512-520.

Kalilou, S. (1997). Transformation traditionnelle de la viande en kilichi au Niger, optimisation des procédés, *PhD thesis*, Montpellier, France, 137.

Kim, Y.-K., Jombart, L., Valentin, D., & Kim, K.-O. (2013). A cross-cultural study using Napping®: Do Korean and French consumers perceive various green tea products differently? *Food Research International,* 53, 534-542.

Lawless, H.T., & Heymann, H. (2010). Flash Profiling. In: Sensory Evaluation of Food, (2sd ed.) pp. 252–253. NY, USA: Springer. ISSN 1572-0330; ISBN 978-1-4419-6487-8 e-ISBN 978-1-4419-6488-5.

Molet, L. (1982). Le feu domestique et la cuisine chez les merina (Madagascar), vol IX, pp. 49-66.

Morais, E. C., Morais, A. R., Cruz, A. G., & Bolini, H. M. A. (2014). Development of chocolate dairy dessert with addition of prebiotics and

580 replacement of sucrose with different high-intensity sweeteners. *Journal of*
581 *Dairy Science*, 97, 2600-2609.
582
583 Moussaoui, K. A., & Varela, P. (2010). Exploring consumer product profiling
584 techniques and their linkage to a quantitative descriptive analysis. *Food Quality*
585 *and Preference,* 21, 1088-1099.
586
587 Næs, T., Brockhoff, P. B., & Tomic, O. (2010). Quality Control of Sensory Profile
588 Data *Statistics for Sensory and Consumer Science* (pp. 11-38): John Wiley &
589 Sons, Ltd.
590
591 Paixão, J. A., Rodrigues, J. B., Esmerino, E. A. Cruz , A. G. & Bolini, H. M. A.
592 (2014). Influence of temperature and fat content on ideal sucrose concentration,
593 sweetening power, and sweetness equivalence of different sweeteners in
594 chocolate milk beverage. *Journal of Dairy Science*, 97, 7344-7353.
595
596 Peryam, D. R., & Girardot, N. F. (1952). Advanced taste-test method. *Food*
597 *Engineering*, 24, 58-61.
598
599 Peryam, D. R., & Pilgrim, F. J. (1957). Hedonic scale method of measuring food
600 preferences. *Food Technology,* 11, 9-14.
601

602 Popper, R. (2014). Use of Just-About-Right scales in consumer research. In P.
603 Varela & G. Ares (Eds.), *Novel Techniques in Sensory Characterization and*
604 *Consumer Profiling* (pp. 137-155). Boca Raton: CRC Press
605
606 Raharolahy L. (2004). «Le boeuf dans la societé traditionnelle malgache» [article
607 online]. Makay Nature. [Consulted: October 22nd 2010].
608 file://localhost/<http/::www.makaynature.org:wp-content:uploads:2010:07:le-
609 boeuf-dans-la societetraditionnelle-malgache.pdf>.
610
611 Rodrigues, S., & Teixeira, A. (2013). Use of generalized Procrustes analysis (GPA)
612 to test the effects of sex and carcass weight on sensory quality evaluations of
613 Terrincho lamb meat. *Meat science,* 93, 485-488.
614
615 Santos, B. A, Pollonio, M.A.R, Cruz, A.G, Messias, V.C, Monteiro, R.A, Oliveira,
616 T.L.C, Faria, J.A.F, Freitas, M.Q., Bolini, H.M.A. (2013). Ultra-flash profile and
617 projective mapping for describing sensory attributes of prebiotic mortadellas.
618 *Food Research International,* 54, 1705-1711.
619
620 Sciences et Société (1986). 'La Recherche Scientifique et l'Agriculture de
621 Demain', *UNESCO document*, Impact: Paris, N°142, Vol. 36, N°2.
622
623 Touzi, A. & Merzaia-Blama A. (2008). La conservation des denrées agro
624 alimentaires par séchage dans les régions sahariennes, *Revue des Energies*
625 *Renouvelables SMSTS'08*, Alger.pp. 267–272.
626

Valentin, D., Chollet, S., Lelièvre, M., & Abdi, H. (2012). Quick and dirty but still pretty good: a review of new descriptive methods in food science. *International Journal of Food Science & Technology,* 47, 1563-1578.

Varela, P., & Ares, G. (2012). Sensory profiling, the blurred line between sensory and consumer science. A review of novel methods for product characterization. *Food Research International,* 48, 893-908.

Yacouba, I. (2010). Analyse des techniques traditionnelles de transformation de la viande en Kilichi dans la commune urbaine de Madaoua (Rep. du Niger), pp. 51.

641

642 **Captions for figures:**

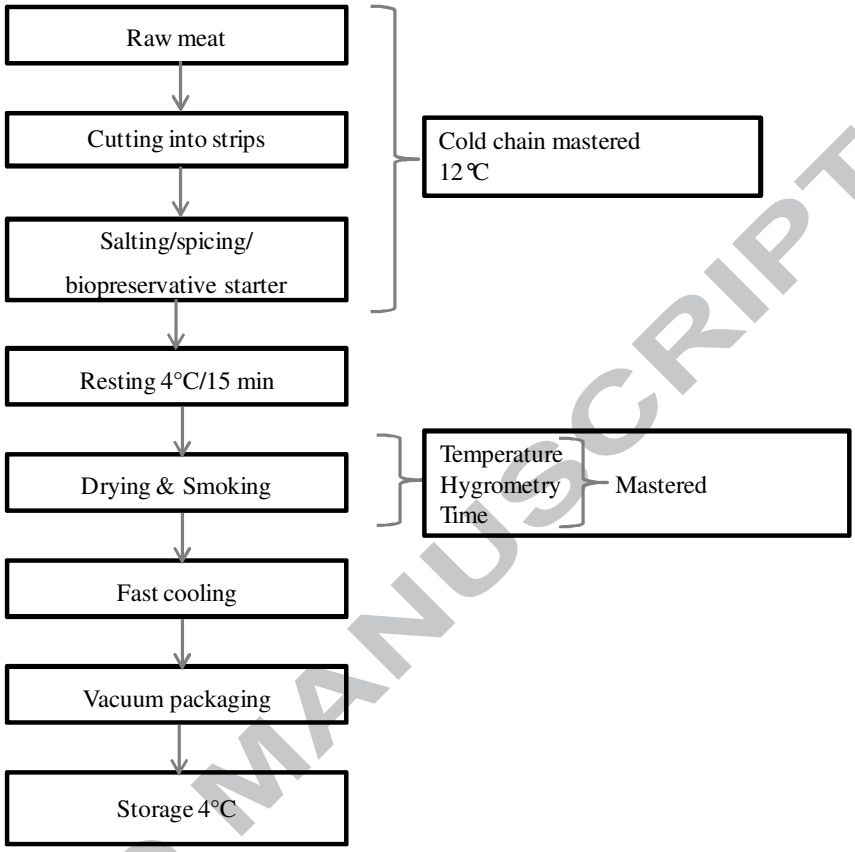
643

644 **Figure 1 –** The diagram of reengineered process of Kitoza in Europe.

645

646 **Figure 2 -** Kitoza samples and traditional Portuguese smoked loin sausage. **A** - Kitoza beef (KB); **B** -
647 Kitoza pork (KP); **C**- Traditional Portuguese smoked loin sausage (PS) used for comparison.
648
649 **Figure 3** – General Procrustes Analysis (GPA) representation of Flash Profile (FP) data (representation of
650 FP sensory attributes of Kitoza samples and Portuguese sausage). **KB** - Kitoza beef; **KP** - Kitoza pork;
651 **PS** - Traditional Portuguese smoked loin sausage.
652
653 **Figure 4** – Hierarchical clustering dendogram that segments participants according to their overall liking
654 patterns of Kitoza samples and Portuguese sausage (n=94).
655
656 **Figure 5** – Mean consumer acceptance of Kitoza samples and Portuguese sausage. Kitoza beef (KB),
657 Kitoza pork (KP) and Traditional Portuguese smoked loin sausage (PS).
658
659 **Figure 6** – JAR evaluations (%) for Kitoza samples and Portuguese sausage. Kitoza beef (KB), Kitoza
660 pork (KP) and Traditional Portuguese smoked loin sausage (PS).
661
662 **Figure 7** – Mean prices that consumers stated they were willing to pay for 100g of Kitoza beef (KB) and
663 Kitoza pork (KP), with and without information about the recipe (Malagasy traditional origin). Error bars
664 represent the confidence interval of the mean (p=0.95).
665
666 **Figure 8** - Preferred ways of consuming Kitoza beef (KB) and Kitoza pork (KP).
667
668 **Figure 9** - Shops that Portuguese consumers considered appropriate for the sale of Kitoza beef (KB) and
669 Kitoza pork (KP).
670
671
672
673
674
675
676
677 **Figure 1:**
678

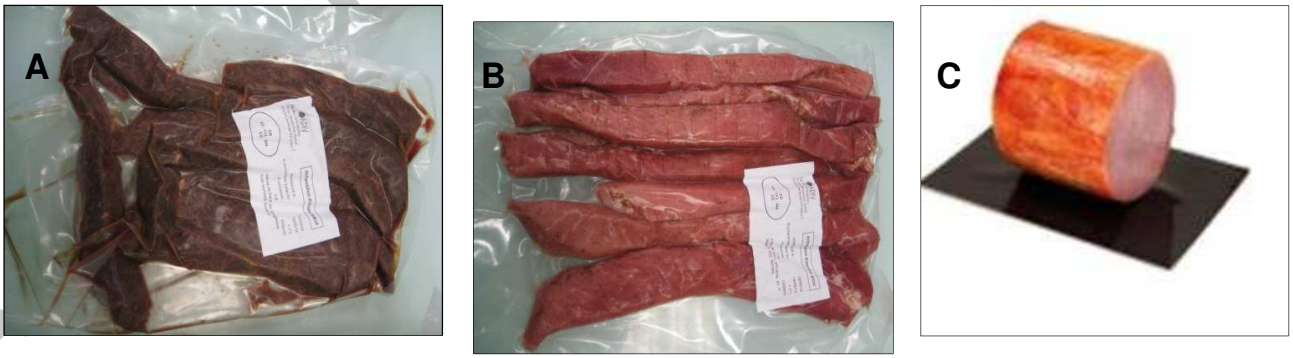
679




680

681

682 **Figure 2:**




683

684

685

686

687

688

689 **Figure 3:**

690

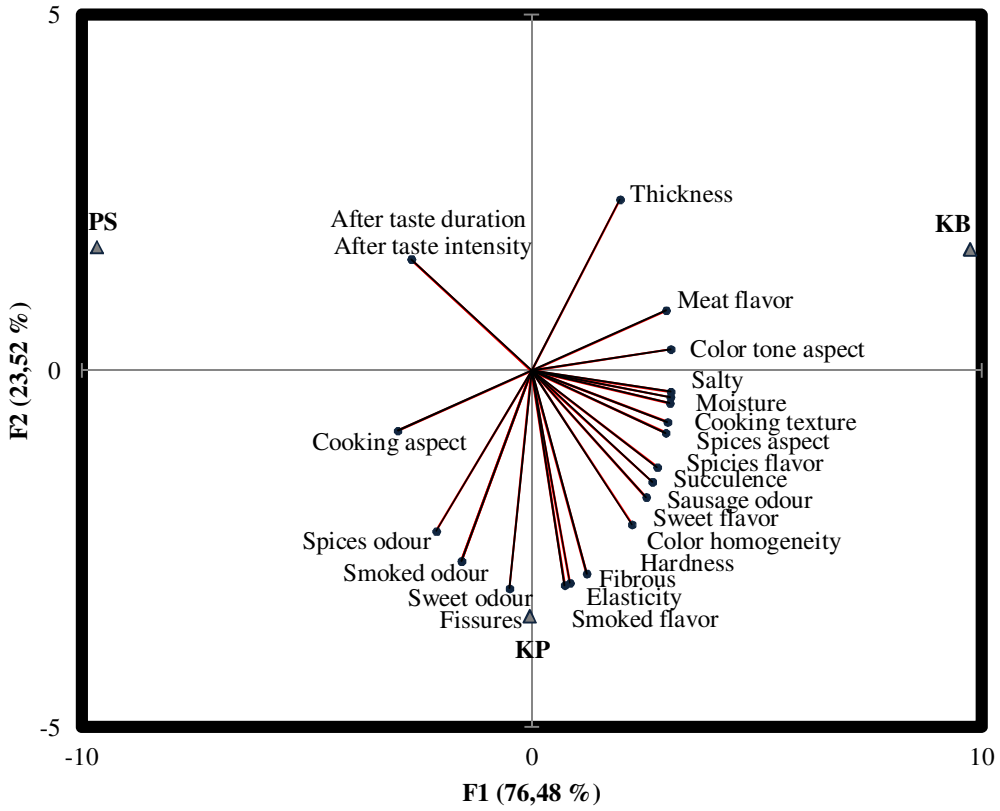



**Figure 4:**

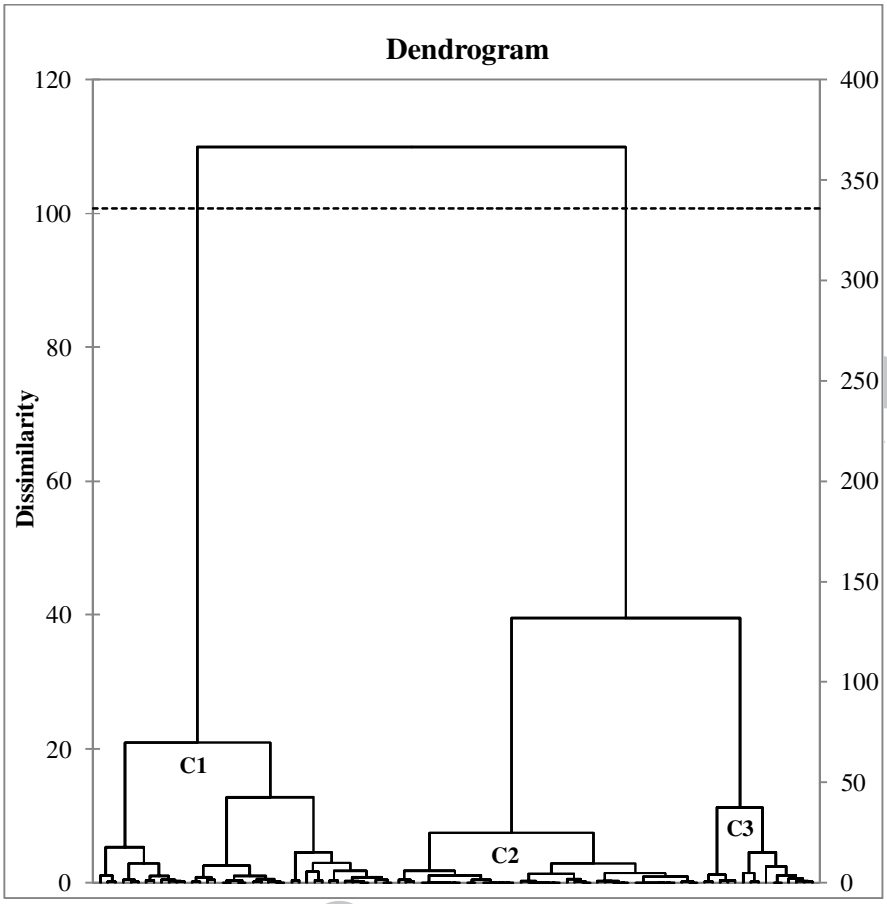
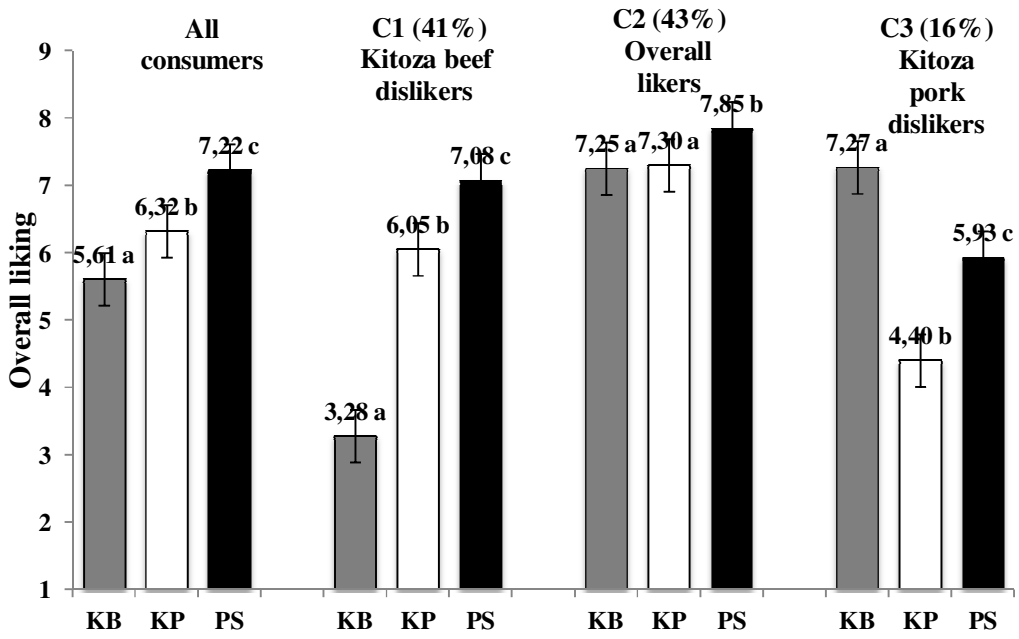



**Figure 5:**




*Error bars represent the confidence interval of the mean (p = 0.95). Different superscripts within a cluster indicate significant differences according Tukey's HSD ($p \leq 0.05$).

**Figure 6:**

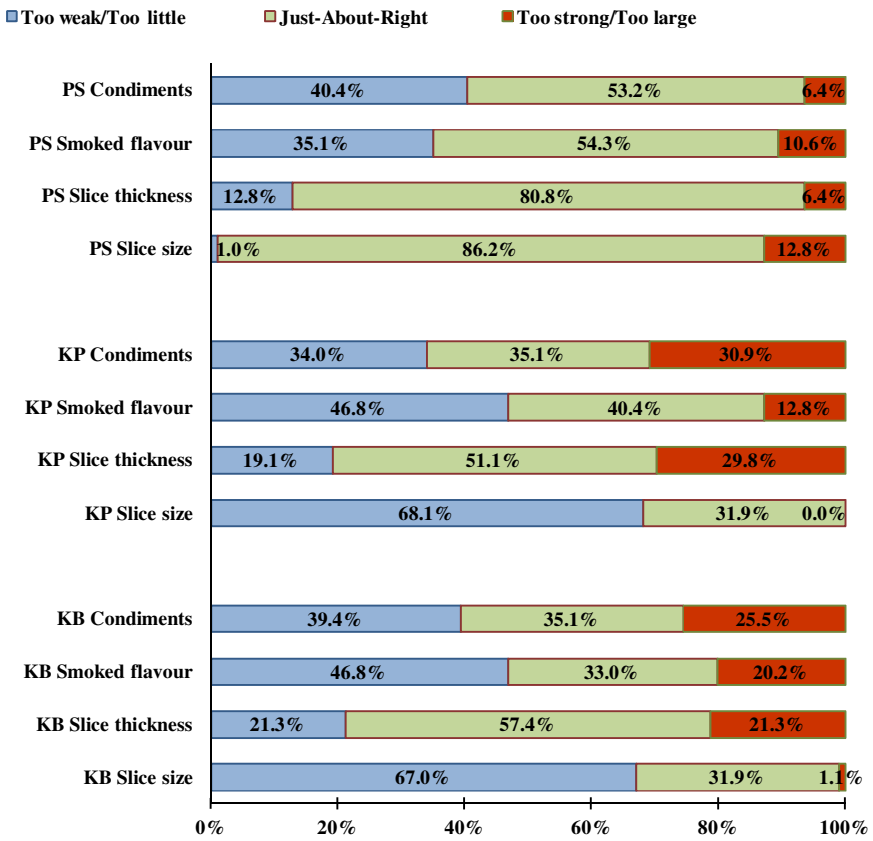



**Figure 7:**

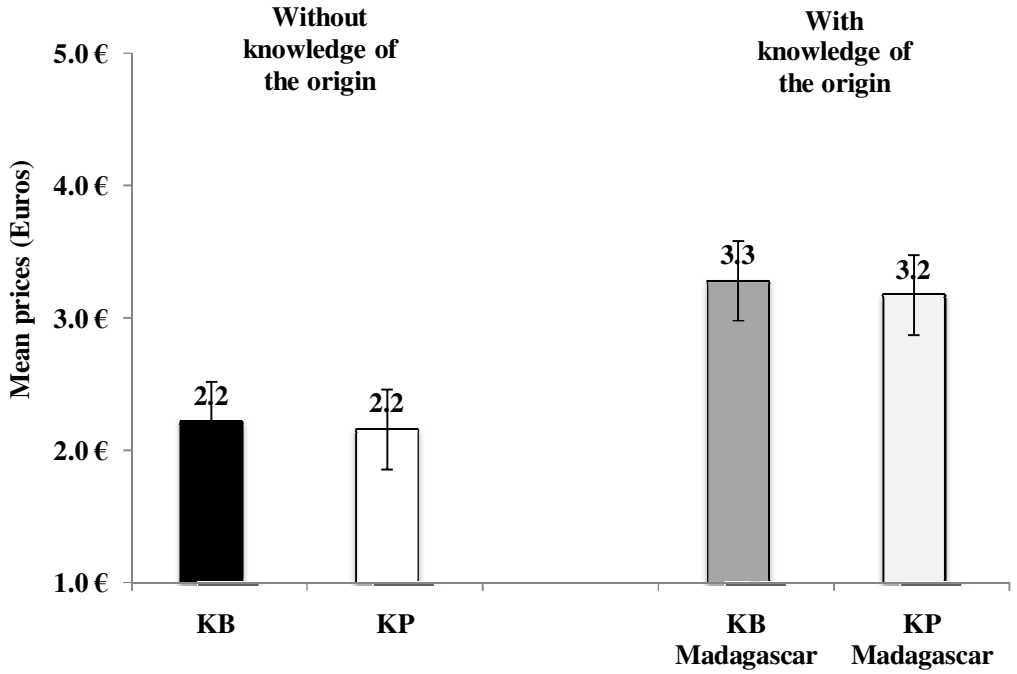
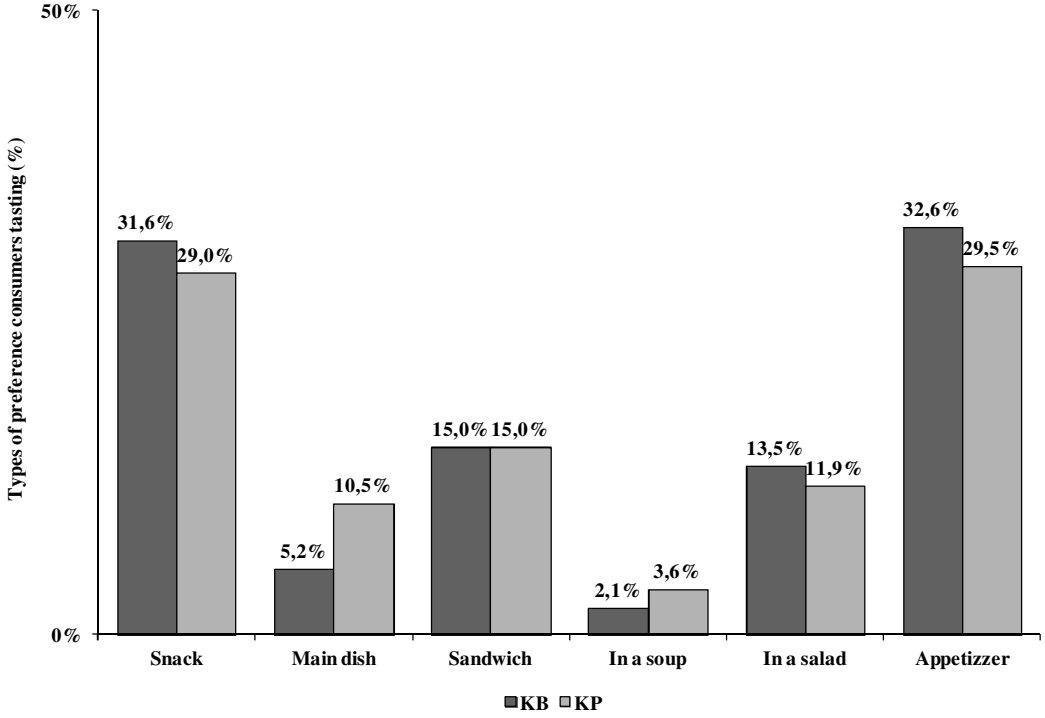
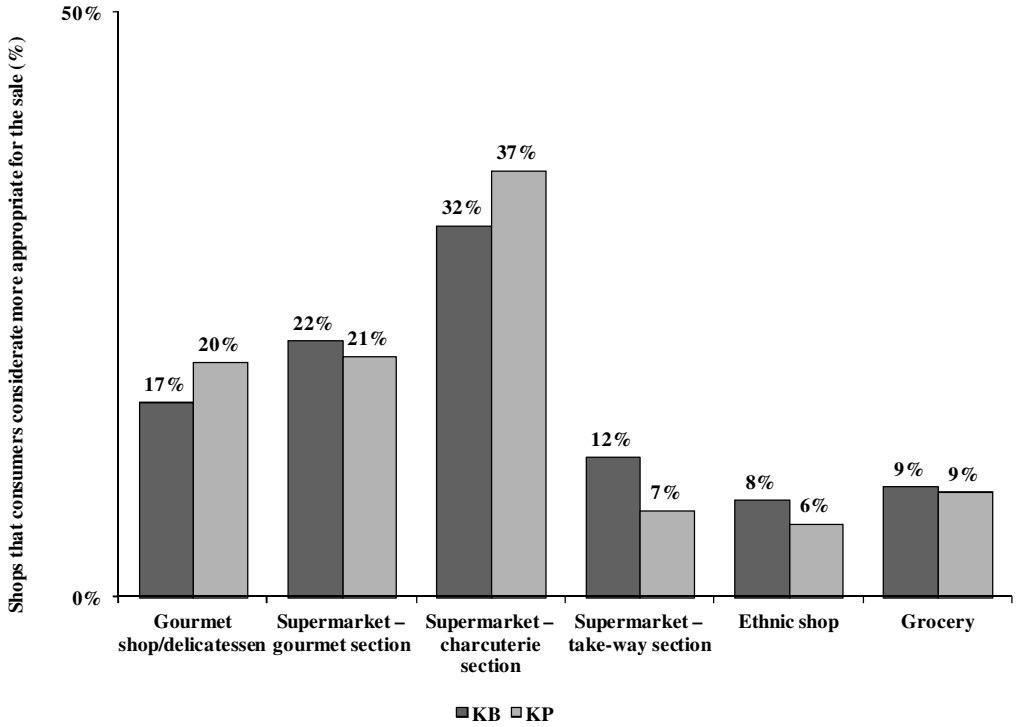

Without knowledge of the origin
With knowledge of the origin
5.0 €
4.0 €
3.0 €
2.0 €
1.0 €
Mean prices (Euros)
2,2
2,2
3,3
3,2
KB
KP
KB Madagascar
KP Madagascar

**Figure 8:**


50%
0%
Types of preference consumers tasting (%)
31,6%
29,0%
5,2%
10,5%
15,0%
15,0%
2,1%
3,6%
13,5%
11,9%
32,6%
29,5%
Snack
Main dish
Sandwich
In a soup
In a salad
Appetizzer
KB
KP

779 **Figure 9:**
780




781
782
783
784
785
786
787
788

**Tables and captions:**

**Table 1** - Microorganisms analysed in the Kitoza manufactured with pork or beef.

| | Method Reference | Pork* log CFU/g | Beef* log CFU/g |
|---|---|---|---|
| **Total count 30 °C** | ISO 4833 | 7.25 ± 0.05 | 7.04 ± 0.03 |
| **Coagulase negative staphylococci** | **-** | 6.63 ± 0.03 | 6.22 ± 0.08 |
| **Lactic acid bacteria** | - | 7.22 ± 0.08 | 7.18 ± 0.07 |
| **Yeast/mold** | ISO 7954 | 2.26 ±0.01 | 2.43 ± 0.03 |
| ***Enterobacteriaceae*** | ISO 21528-2 | 0.69 ± 0.08 | 1.74 ± 0.01 |
| ***Staphylococcus aureus*** | ISO 6888-1 | <2.0 log | <2.0 log |
| ***Listeria monocytogenes*** | ISO 11290-1 | Absence (25g) | Absence (25g) |
| ***Salmonella*** | ISO 6579 | Absence (25g) | Absence (25g) |

* mean value of replicates ± standard deviation

812 **Table 2** - Form used in the 1st session of the Flash Profile to individually generate
813 sensory descriptors for Kitoza samples (Kitoza beef and Kitoza pork) and traditional
814 Portuguese smoked loin sausage.
815

**Sensory evaluation of meat samples**

**Panelist name** _____ **Date** _____

| | **Attribute** | **+Weak** | **+ Strong** |
|---|---|---|---|
| **External aspect** | | | |
| **Internal aspect** | | | |
| **Odour evaluation** | | | |
| **Texture** | | | |
| **Taste/Flavour** | | | |
| **Others sensations** | | | |

816
817
818
819

820 **Table 3** - Attributes form for meat samples used in the 2nd Flash Profile session in
821 order to guide the panellists to individually generate sensory descriptors for Kitoza
822 samples (Kitoza beef and Kitoza pork) and traditional Portuguese smoked loin sausage.
823

**Flash Profile**

It is intended that the **SELECT** descriptors that in your opinion **BEST** differentiate at least two of the samples.
You can use the descriptors of this list or other you want.
The selection and number of descriptors to be used depends solely on **YOUR PERSONAL OPINION**.

| | Attributes | Scale | |
|---|---|---|---|
| **External aspect** | Color tone aspect | Light | Dark |
| | Spices aspect | Without | Many |
| | Color pink - Brown | Pink / salmon | Brown |
| **Internal aspect** | Thickness | Absent | Thick |
| | Cooking aspect | Crude | Baked |
| | Visible fat | Absent | Much |
| | Color homogeneity | Heterogeneous | Homogeneous |
| | Internal fissures | Absent | Many |
| | Moisture | Dry | Moist |
| **Odour evaluation** | Spices odour | Absent | Strong |
| | Smoked odour | Absent | Strong |
| | Fat | Absent | Strong |
| | Sausage odour | Absent | Strong |
| | Dried meet | Absent | Strong |
| | Sweet odour | Absent | Strong |
| **Texture** | Hardness | Soft/tender | Hard |
| | Elasticity | Absent | Very elastic |
| | Succulence | Dry | Very juice |
| | Fibrous | Without fibers | Many fibers |
| | cooking texture | Crude | Well-done |
| | Soft | Rugged | Very soft |
| | Astringent | Absent | Strong |
| | Floury | Absent | Strong |
| | Granularity | Without granules | Many granules |
| **Taste/Flavour** | Spices flavor | Absent | Strong |
| | Salty | Weak | Strong |
| | Smoked flavor | Absent | Strong |
| | Sweet flavor | Absent | Strong |
| | Monoglutamate | Absent | Strong |
| | Sweet | Weak | Strong |
| | Meat flavour | Absent | Strong |
| **After Taste** | After tast intensity | Weak | Strong |
| | After tast duration | Short | Long |

824

**Table 4** – Themes on the focus groups script.

| Exploited topics of focus groups |
| --- |
| **A.** Global sensory characterization |
| **B.** Attitude to buy |
| **C.** Consumption occasion |
| **D.** Consumption Motives |
| **E.** Willingness to pay |
| **F.** Local to buy |
| **G.** Others possible usages of Kitoza |
| **H.** Influence of African Origin on preference |

845

846 **Table 5** - Mean overall acceptability scores for the samples tested: Kitoza beef (KB),
847 Kitoza pork (KP) and Traditional Portuguese smoked loin sausage (PS).

848

| Samples | Average | Groups | | |
|---|---|---|---|---|
| **PS** | **7.223±0.135** | **A** | | |
| **KP** | **6.319±0.166** | | **B** | |
| **KB** | **5.606±0.229** | | | **C** |

849
850 * Means value of replicates ± standard deviation with the same letter are not significantly
851 different Tukey test ($p<0.01$).
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866

867
868

869 **Table 6** – Correlations between sensory attributes (aspect, texture and flavour) and
870 acceptability of Kitoza samples and Traditional Portuguese smoked loin sausage. Kitoza
871 beef (KB), Kitoza pork (KP) and Traditional Portuguese smoked loin sausage (PS).

| Variables | | KB | | | | KP | | | | PS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Overall liking** | **Aspect** | **Texture** | **Flavour** | **Overall liking** | **Aspect** | **Texture** | **Flavour** | **Overall liking** | **Aspect** | **Texture** | **Flavour** |
| **KB** | **Overall liking** | **1** | **0.732** | **0.745** | **0.915** | 0.174 | 0.097 | 0.196 | 0.138 | 0.012 | 0.213 | 0.129 | 0.083 |
| | **Aspect** | **0.732** | **1** | **0.716** | **0.673** | 0.157 | **0.202** | **0.251** | 0.147 | 0.042 | 0.129 | 0.134 | 0.078 |
| | **Texture** | **0.745** | **0.716** | **1** | **0.704** | 0.193 | 0.102 | **0.271** | 0.196 | 0.011 | 0.185 | 0.134 | 0.160 |
| | **Flavour** | **0.915** | **0.673** | **0.704** | **1** | 0.192 | 0.121 | 0.182 | 0.170 | 0.036 | 0.204 | 0.078 | 0.251 |
| **KP** | **Overall liking** | 0.174 | 0.097 | 0.196 | 0.138 | **1** | **0.538** | **0.819** | **0.875** | 0.140 | 0.197 | 0.216 | **0.213** |
| | **Aspect** | 0.157 | **0.202** | **0.251** | 0.147 | **0.538** | **1** | **0.586** | **0.794** | 0.191 | **0.225** | 0.233 | 0.251 |
| | **Texture** | **0.193** | 0.102 | **0.271** | 0.196 | **0.819** | **0.586** | **1** | **0.794** | 0.191 | 0.185 | **0.241** | **0.204** |
| | **Flavour** | 0.192 | 0.121 | 0.182 | 0.170 | **0.875** | **0.794** | **0.794** | **1** | 0.142 | 0.204 | 0.233 | **0.204** |
| **PS** | **Overall liking** | 0.012 | 0.042 | 0.011 | 0.036 | 0.140 | 0.191 | 0.191 | 0.142 | **1** | **0.676** | **0.759** | **0.845** |
| | **Aspect** | **0.213** | 0.129 | 0.185 | **0.204** | 0.197 | **0.225** | 0.185 | **0.204** | **0.676** | **1** | **0.759** | **0.845** |
| | **Texture** | 0.129 | 0.134 | 0.134 | 0.078 | **0.216** | 0.233 | **1** | **0.794** | **0.759** | **0.759** | **1** | **0.759** |
| | **Flavour** | 0.083 | 0.078 | 0.160 | 0.251 | **0.213** | **0.251** | **0.794** | **1** | **0.845** | **0.845** | **0.759** | **1** |

*Values in bold are different from 0 with a significance level alpha=0.05*

872
873
874
875

876

877

878 Highlights
879

880

881 - Sensory profiles showed differences between the two Kitoza samples.

882 - Kitoza beef (KB) showed more intense meat flavour.

883 - Kitoza pork (KP) showed more intense sweet odour, spices and smoked odour.

884 - Between KB and KP samples, KP showed to be more appreciated.

885 - Geographic origin of Kitoza had a positive effect on consumers' willingness to

886 pay.

887
888