

Consumers' expectations and liking of traditional and innovative pork products from European local pig breeds

Mauro Vitale ^{a1}, Zein Kallas ^b, Evelyn Rivera-Toapanta. ^a, Daniel Karolyi. ^c, Marija Cerjak ^c, Bénédicte Lebret ^d, Herveline Lenoir ^e, Carolina Pugliese ^f, Chiara Aquilani. ^f, Meta Čandek-Potokar ^g, Marta Gil ^a, Maria Àngels Oliver ^{a*}

^a *IRTA, Food Industries, Granja Camps i Armet, 17121 Monells, Spain.*

^b *CREDA-UPC-IRTA, Centre de Recerca en Economia i Desenvolupament Agroalimentari, 08860 Castelldefels, Spain.*

^c *UNIZG, University of Zagreb Faculty of Agriculture, Svetošimunska cesta 25, 10000 Zagreb, Croatia.*

^d *PEGASE, INRAE, Agrocampus Ouest, 16 Le Clos, 35590 Saint-Gilles, France*

^e *IFIP – Institut du Porc, La Motte au Vicomte, BP 35104, 35651 Le Rheu, France*

^f *UNIFI, Università degli Studi di Firenze, Department of Agriculture, Food, Environment and Forestry (DAGRI), Section of Animal Sciences, Via delle Cascine, 5 – 50144 Firenze, Italy*

^g *KIS, Kmetijski Inštitut Slovenije, Agricultural Institute of Slovenia, Hacquetova ulica 17, 1000 Ljubljana, Slovenia*

*** Corresponding author:**

Maria Àngels Oliver

Granja Camps i Armet, 17121 Monells, Spain

E-mail address: mariaangels.oliver@irta.cat (M.A. Oliver)

Tel.: +34 972630052.

^{a1} *Present address: Metalquimia, Font de l'Abat, 21, 17007 Girona, Spain*

Highlights:

- The acceptability of different traditional pork products from four local pig breeds of four European regions was evaluated following a standardized common protocol.
- Expectations on traditional and innovative pork products with respect to standard and premium controls were higher when consumers were acquainted with the local production system.
- Sensory quality had a relevant role on the preferences of consumers

Abstract

The aim of the study was to ascertain the acceptability of local pork products by European consumers (blind, expected and informed tests) considering the influence of the sensory properties, the expectations and the information about the product given to them. The consumer tests were performed in four cities following an agreed protocol, with products from local breeds (Negre Mallorquí, Cinta Senese, Gascon-Noir de Bigorre and Turopolje) and included traditional (TPP) and innovative products (ITPP). The methodological approach relied on the expectancy-disconfirmation model and the assimilation theory. All consumers had a similar behaviour: higher expectations of TPP and ITPP differentiated significantly from the remaining products, except in Barcelona test, because consumers in this city were not acquainted with the production system. ITPP focusing on healthy and process innovation highlighted the need to emphasize the breed and the production system in traditional pork products, but we can conclude that the sensory quality had a significant role on the preferences of consumers.

Keywords:

Innovative meat products

Local pig breeds

Consumer tests

1. Introduction

Traditional food products are, in general, an important element of regional identity and culture. The term "traditional" is not always understood in the same way in all countries (Guerrero et al., 2012) , and often, the differences in consumer acceptability between local / traditional and conventional products are not clear . Several authors have noted that there are also differences in the perception of innovation and traditional concepts according to the context in which they are used, for example, between rural and urban populations or between the North and the South of the European continent (Guerrero et al., 2009). In 2006, the European Commission issued the following definition of "traditional" related to food: "Traditional means that it comes from the use in a market of a community during a period that has been transmitted from generation to generation, the period is generally attributed to a human generation, at least 25 years". These types of products contribute to the development and sustainability of rural areas by protecting them from depopulation based on the potential differentiation of products and producers. Production of traditional food products, especially those of animal origin, is often closely related to less intensive production systems that typically rely on local resources and, as such, play important roles in the maintenance of the natural environment, including the local breeds of livestock.

Typically, traditional meat products often have high fat and salt contents in comparison with conventional products (Garbowska, Radzymińska, & Jakubowska, 2013; Halagarda, Kędzior, Pyrzyńska, & Kudelka, 2018). In addition, smoking has been used for centuries for the preservation of meat in some European regions. In traditional meat processing, which is generally carried out by small and medium low-tech artisanal enterprises, old-fashioned smoking procedures (i.e., products are exposed to smoke in the same chamber where smoke is generated by pyrolysis of wood) are still largely used. Hence, traditional meat products may additionally be associated with greater exposure to potentially unhealthy substances from the smoke (Andrés, Barat, Grau, & Fito, 2008; Phillips, 1999). In fact, a recent study with Croatian consumers indicated controlled smoking conditions as best accepted health related innovation of traditional meat products with the least negative impact on perceived traditional character of product

(Karolyi & Cerjak, 2015). Innovations in traditional pork products aiming at improving their healthy or sensory quality properties could contribute maintain or expand their market share and availability.

The information given to consumers on the impact on health or any other quality dimension may influence their acceptability of meat products (Carrillo, Varela, & Fiszman, 2012; Schouteten et al., 2016). The correlation could be positive, but in some cases, the correlation could lead to a lower or negative expectation of the sensory experience (Norton, Fryer, & Parkinson, 2013). In this sense, the way in which consumers perceive information, which is strongly affected by personal attitudes, could turn information into a barrier of negative expectations and reduce the hedonic value for buyers (Lähteenmäki, 2013; Verbeke, Pérez-Cueto, Barcellos, Krystallis, & Grunert, 2010).

In sensory research, there is methodology that combines both sensory (intrinsic) and extrinsic food attributes and is based on the comparison of blind, expected and informed tests of products by consumers (Deliza & Macfie, 1996). This methodology makes it possible to investigate if and how information (informed test) about the product (e.g., origin, processing duration, fat content, etc.) potentially influences consumer liking. The influence of information on the local production of the pig breed and the production/feeding system on consumer expectations was also reported by (Cerjak, Karolyi, & Kovačić, 2011) and (Cerjak, Petrčić, & Karolyi, 2017) and can be taken as a differentiation tool in the marketing of traditional pork products.

In the present study, four consumer sensory tests were performed with four different breed-local pork chains (Negre Mallorquí (Spain), Cinta Senese (Italy), Gascon-Noir de Bigorre (France), Turopolje (Croatia)). The studies included traditional pork products or products made from local breeds in a traditional way (TPP) and innovative TPP (ITPP). Consumption tests were conducted in four cities that were identified as potential new markets / niches for each local breed and represent three different European regions: the West (France), the South (Spain and Italy) and the East (Croatia), in the context of the EU-H2020 project TREASURE. The aim of the study was to

ascertain the acceptability of these pork products by consumers considering the influence of the sensory properties, the expectations and the information about the product given to them.

2. Material and methods

All consumer studies in the different cities were carried out following the same design and methodology to maximally standardize the conditions and to achieve the common objective of the TREASURE Project. The products evaluated in each city were different and according to the local pig breeds and production systems. The innovations were developed based on traditional products or products made in a traditional way and originating from each region and local breed considered. The TPPs and the ITPPs were also compared with one or two additional products obtained from commercial types. The first product was with “conventional quality” that met the minimum production standards. The second product was with “premium quality” with premium quality production standards.

2.1 Products

The products evaluated for the four local breeds are summarized on Table 1.

2.1.1. PNM patties

Negre Mallorquí-based patties made in a traditional way following a traditional receipt from a butcher (mixture of fat and meat from shoulder and ham), were evaluated by consumers in Barcelona as a traditional product. Two innovations to enhance human health were also designed by incorporating natural ingredients that contribute to an improvement of health: 1) a source of fibre that reinforces the immune system and 2) a source of antioxidants that help to prevent cardiovascular diseases. In each test, the equivalent conventional and premium products were included.

The formulation of the patties (1000 g basis) for the five groups was composed of 881.2 g of minced meat, 18 g of salt, 0.3 g of sulphite, 0.5 g of ascorbic acid, 100 ml of pasteurized egg. For

the ITTP1, 10 g of fungi porcini as natural fibre and for ITTP2, 20 g of blue berries as natural antioxidants, were respectively added, and the amounts of meat were 871.2 g and 861.2 g. The average fat content was of 16.4% of the total composition. Each individual patty average weight was 120 g. The patties were prepared a maximum of two days before the trial and kept refrigerated.

The cooking of the patties was performed the day of the test in a kitchen on the premises and just prior to each consumer session (10-12 consumers/session). Patties were cooked in groups of three on a grill until a core temperature of 78 °C was achieved (approximately 5 min). Each patty was split in 4 equal pieces, which were given to four consumers.

Consumers were in individual sensory booths and received the coded samples in a monadic way following a pre-established design. They were asked to rinse their mouths with water and eat non-salted toast before each sample.

2.1.2. *CS dry-fermented sausages*

Cinta Senese dry-fermented sausages are a traditional product for this breed. To improve their healthiness, the innovation proposed was aimed to replace sodium nitrite with natural antioxidants. The TPP and ITTP were manufactured following the traditional recipe in an industrial plant. Ingredients consisted of 80% of minced pork lean and 20% of subcutaneous backfat from Cinta Senese pig breed, salt (2.3%), sucrose (3.5%) and black pepper (2 %). Thirty ppm of sodium nitrite (E250) were added to the first TPP products, while 10% of natural antioxidants mixture was used to replace sodium nitrite in ITTP products. Natural antioxidants mixture was made of grape seed extract, hydroxytyrosol (extracted from defatted olive pomace) and tocopherol. The mixture had a double antioxidant-antimicrobial action. Fresh sausages, after being weighed, dried at 28°C and RH 85% for 4 days and then they were ripened for 21 days (T 13°C, RH 70%). Dry-fermented sausages were stored two days at 4°C before the consumer study. In addition, two other types of dry-fermented sausages were bought to compare TPP and ITTP to a conventional product and a premium product. Each sausage was sliced in 0.5cm-thick×2cm-

diameter slices and served at room temperature (20°C). Consumers were in an equipped laboratory with individual cabins and invited to eat a cracker and drink a glass of water between samples (IBIMET-BIOAGRIFOOD Department CNR, Bologna).

2.1.3. NB dry-cured hams

The Noir de Bigorre (NB) Protected Designation of Origin (PDO) dry cured hams, produced in the south-West of France from pure Gascon pigs (Mercat, Lebret, Lenoir, & Batorek-Lukač, 2019; OJEU, 2017a, 2017b), were considered in the French case study. NB-PDO ham with 24 months processing duration, corresponding to the usual processing time for this product, was considered as TPP. Innovation consisted in extending processing time with 12 additional months during the ripening period, leading to 36 months processing for ITPP, with the aim to enhance the sensory quality (texture, odour, flavour) of the products. TPP and ITPP were produced by the Noir de Bigorre chain according to PDO requirements for pig production and ham processing (OJEU, 2017a, 2017b). Dry-cured hams from Iberian crossbred pigs (50% Iberian, 50% Duroc), purchased in a fine food shop, were used in the consumer test study as premium quality product (Table 1). There was no conventional product (Standard Quality) in this consumer study due to the very high discrepancy in eating quality of Premium and PDO products compared with conventional, which is related to a different market sector.

The study was conducted in Toulouse, South-West of France, with 124 consumers divided in 9 sessions. All products were prepared in a same manner : 1.3 mm thick ham slices (from 2 to 3 different hams for each kind of product) were prepared with a slicing machine in the larger part of the ham including both the *Biceps femoris* and *Semimembranosus* muscles and external fat; then transversal “strips” of around 3 cm width including both muscles and external fat were cut, settled on a tray and stored at 4°C under vacuum, 10 days before the sensory tests. According to requirements of NB chain for TPP and ITPP, and of fine food shop for Iberian hams, ham slices packs were placed at serving temperature (18°C) 1 h (TPP and ITPP) or 2 h (Iberian) before start of each sensory session. For eating tests, ham slices were placed on plastic plates and distributed to consumers following a monadic distribution and pre-defined random order assigned to each

participant, taking care of distributing trips of similar aspect between consumers, and within each consumer for blind and informed liking tests. Consumers were asked to rinse their mouths with water between two tastings.

2.1.4. TRP dry cured hams

In study with Croatian consumers the dry-cured hams made from local Turopolje pig breed were evaluated. For traditional production (TPP), cooled raw hams were shaped and manually salted with the mixture of commercial curing salt and spices (black paper, garlic and red pepper), stacked on piles and left in cold ($T=4^{\circ}\text{C}$) for five weeks. After salting, the hams were cold smoked ($T=18^{\circ}\text{C}$, $\text{RH}=80\%$) by beech wood smoke in total eight times, after which they were placed to the drying and ripening chamber under controlled conditions ($T=12^{\circ}\text{C}$, $\text{RH}=75\%$). For production of ITPP the same processing technology was applied, except that for less-salted hams the salting time was shortened from 5 weeks to 3 weeks, while for less-smoked hams the difference consisted in 50% reduction of smoke application. Sampling for sensory tests was performed when dry-cured hams were about 12 months old. To follow a common experimental design, the TPP and ITPP dry-cured hams from Turopolje pig breed were compared with two conventional types of dry-cured hams (standard and premium quality) from commercial pork chains. Before tasting, ham slices were equilibrated to room temperature (20°C). During the sensory test consumers received 5 samples and were asked to taste them in a pre-defined order. The order of tasting was randomly assigned to each participant. Between two tastings consumers were asked to rinse their mouths with water and eat a piece of toast.

2.2 Consumer studies- Experimental design and general aspects.

2.2.1. Consumer recruitment

A total of 487 consumers participated in the four studies, in the range 121 - 124 consumers per city. Table 2. presents the main socio-demographic traits of the consumers per city. In all the case studies, the same design was used, and the traditional products and innovations of the region were analyzed together with the conventional and/or premium conventional product.

The consumers recruited had to meet some common criteria: i) they were required to eat pork on a regular basis (in addition, in case of French-case study, they were required to have purchased high quality dry-cured hams in the last 3 months); ii) they were required to be partially or totally responsible for food purchase at home, and iii) they were required to be between 18 and 75 years old.

The consumers were asked to evaluate the products (TPP, ITPP and conventional-premium) in a three-step sensory test:

1) Blind liking (perceived sensory acceptability):

In the first test, the participants had to test and evaluate a portion of each of the products, without having any information about them. A hedonic 9 points scale (from 1= dislike extremely to 9= like extremely) was used to measure the general acceptability of the coded samples according to their taste (perceived taste).

2) Expected liking (expected acceptability):

In the second test, consumers received only a sheet with information about the pig breed or the local pork chain, the production system or the ripening duration, and/or the nutritional properties of the products or their potential effects on human health. They were asked to read the information carefully and to express their acceptability of the products on the same scale as in the previous test, based solely on information.

3) Informed liking (informed acceptability):

Finally, the consumers were provided with additional samples of each of the products along with a sheet with the description of the pig breed, the production system or the ripening duration, and/or the nutritional properties or their potential effects on human health. The consumers were asked to read the information before testing the sample and were invited to score each sample on the same scale as the previous two tests.

This methodological approach relies on the expectancy-disconfirmation model (Oliver, 1980) and the assimilation theory. Accordingly, the difference between the expected and blind liking is defined as a "disconfirmation". Disconfirmation can be positive when the blind acceptability score is statistically higher than the expected score but can also be negative when the blind acceptability

score is statistically lower than the expected score. The assimilation model occurs when the evaluation of the product changes in the same direction of the expectation, while the contrast model occurs when the evaluation of the product changes in the opposite direction to the expectation, thus increasing the discrepancy between the evaluation of the product and the expectation. In addition, in the case of assimilation, when the difference between the expected score and the reported score is significantly different from zero, consumers expectations are not fully satisfied. Incomplete assimilation can lead to a decrease in the consumer's future expectation as a result of repeated disconfirmation (Deliza & Macfie, 1996). The sensory properties that can affect the informed acceptability play an important role in the incomplete assimilation (Napolitano, Caporale, Carlucci, & Monteleone, 2007).

2.3 Data analysis

Data analyses were performed using the SAS 9.4 software (SAS Institute Inc., Cary, NC, USA) for each case study separately but based on the same model. The model included the treatment (product), the test phase and its interaction as fixed effects and the session as a blocking effect. Repeated measures were considered because each consumer evaluated all the treatments three times (three tests). Significant ($p < 0.05$) mean differences were determined after applying the Tukey test. To evaluate the effect of information and sensory experience on the consumer acceptability, the difference between the expected and perceived liking scores (E-P) as well as the differences between the informed and perceived liking scores (I-P) and between the informed and expected liking scores (I-E) were calculated. Paired t-tests were then performed to establish if those differences were significantly different from zero.

3. Results and discussion

3.1 Results of the four consumer case studies.

3.1.1. Acceptability of Traditional and Innovative products from PNM

The analysis of the results from the study with the Porc Negre Mallorquí (PNM) patties made in a traditional way, showed the treatment without any innovation had the highest sensory acceptance. These results were significantly differentiated from the other studies (see blind and informed columns) (Table 3). The PNM is a pig breed reared only on the island of Mallorca, which is approximately 200 km in a straight line from Barcelona. The consumers of Barcelona test were not acquainted with the PNM system and their products.

This can explain why the expectations were lower with respect to the blind test; however, in the informed test (sensory test plus information), the scores reverted to those of the blind test. As reported in a similar study (Cerjak et al., 2011), both sensory properties as well as information about a local pig breed influenced consumers' preferences. In the case of repeated tasting with information by consumers, it is foreseeable that consumers move their expectations towards the informed test. Innovative treatments that incorporate healthy attributes (ITPP1 & ITPP2) were evaluated significantly lower than the remaining products in all phases of the study. The added ingredients to the traditional treatment led to products that were clearly different in taste and that were scored lower than TPP by consumers; the information provided with the description of these innovative treatments did not change this trend.

(Fernández-Ginés, Fernández-López, Sayas-Barberá, & Pérez-Alvarez, 2005) reported that in some cases, the use of ingredients considered beneficial for health results in products may introduce lower sensory and physicochemical quality. In both treatments, a negative disconfirmation occurred but was not assimilated by the consumers from Barcelona (Table 4). One potential alternative to improve consumer acceptability could be to report exactly what natural ingredient was added to the product since this would likely reduce the uncertainty about the product.

3.1.2. Acceptability of Traditional and Innovative products from Cinta Senese

The results of the consumer test conducted in Bologna (Emilia-Romagna) reflected the impact of information on consumer expectations, in this case of dry-fermented sausages (Table 5). The Cinta Senese (CS) dry-fermented sausage is a traditional product from Tuscany, which is a region

not far from Bologna. Cinta Senese pig breed has also a PDO distinction on fresh meat. In the absence of information on the origin of the meat and the way of raising the pigs, there were no significant sensory evaluation differences between the different treatments tasted by consumers. This changed very significantly when consumers were provided with that information: the expectations of the two products elaborated with CS (CS dry-fermented sausages [TPP] and CS dry-fermented sausages with natural antioxidant [ITPP]) obtained acceptance scores significantly higher than the control commercial products, and, among them, the premium product had higher scores than the conventional. In the last phase of the test, which was the combination of the information and the tasting, two treatments elaborated with CS also obtained the highest acceptance, but no significant differences were found between the ITPP and premium. The two treatments elaborated with CS had a negative disconfirmation because the consumer had higher expectations than sensory blind acceptance but this disconfirmation was not assimilated because consumers did not move their informed taste towards their expectations (Table 6).

3.1.3. Acceptability of Traditional and Innovative products from the Noir de Bigorre chain – Gascon breed

The three products tasted in this case study and the information provided to consumers are described in (Table 7). In the first step of the consumer test, the blind hedonic test showed no significant differences in acceptability scores between the three products, with all having a high liking score (6.7 to 6.8). In contrast, the description of the product and of the pig breed and production system strongly influenced the expected liking, with higher acceptability score for NB36 than NB24 and the lowest score for IB. Innovation consisting of an additional year of ripening generated significantly higher expectations by consumers, which is in agreement with a previous study conducted in Norway (Hersleth, Lengard, Verbeke, Guerrero, & Naes, 2011). In the last step, the hedonic test in the presence of information showed a better acceptability score for the NB24 and NB36 hams, which were similar, than for the IB ham.

Within the products, differences in the acceptability score between the test phases were also observed. For both NB24 and NB36 hams, higher than expected blind acceptability scores were

observed, indicating a negative disconfirmation for these products, whereas the reverse was observed for the IB ham, which exhibited positive disconfirmation (Table 8). Both NB hams displayed higher informed than blind acceptability scores: information provided to consumers improved the product's acceptability, i.e., a significant assimilation occurred for these products. For NB24, the informed acceptability score was like the expected acceptability score (complete assimilation), denoting a complete fulfilment of hedonic expectations for this product. In the case of NB36, assimilation was incomplete (the informed score lower than the expected score), indicating that consumers' expectations that were aroused by the innovation consisting of an additional year ripening were not fully satisfied. This can decrease future consumer expectations. Conversely, in the case of IB ham, the informed acceptability score was lower than the blind score, i.e., a significant contrast was observed, denoting a negative impact of the information provided in terms of the consumers' perception of the product (Zakowska-Biemans, Sajdakowska, & Issanchou, 2016).

3.1.4. Acceptability of Traditional and Innovative dry-cured hams from Turopolje pig breed

Consumer sensory tests were carried out in the Zagreb area with three types of dry-cured hams (typically salted and smoked, less salt or less smoke) from the local Turopolje (TRP) pig breed using outdoor production system as well as two types of conventional dry-cured hams (standard and premium quality) from conventional breeds using intensive pig farming. The result showed a trend like that of the previous countries. In the blind test, in the absence of information about the breed, production system and product innovation, no significant differences in the acceptability between the TRP hams and conventional hams were found (Table 9). That means that the consumers did not appreciate any sensory differences between treatments. On the other hand, in the expectancy test, when consumers had only the information about pig breed/production system and innovation, the hams made with TRP meat had higher acceptance than conventional hams, but only typical TRP ham was preferred over the premium ham. Finally, when tasting was repeated with the information, all TRP hams scored higher than premium ham, while innovative TRP hams scored like standard ham. In general, the consumers who participated in the study were

acquainted with TRP breed and gave higher scores to its TPP (i.e., typical TRP ham) than to the conventional hams for both the expected and informed testing conditions. This result suggests a preference of typical TRP ham over the conventional hams by local consumers. For ITPP from the TRP breed, the advantage was not so clear. However, a good acceptance of health-related innovations in TRP ham could be noted, as no significant differences were found in the acceptability between less salted and less smoked and typical TRP dry-cured ham. The effect of information on health innovations on TRP dry-cured ham acceptance, elucidated by an assimilation model (Deliza & Macfie, 1996), showed that in typical TRP dry-cured ham and TRP dry-cured ham with less salt, the consumers confirmed their expectations. In TRP dry-cured ham with less smoke, the consumers had a negative disconfirmation, but this higher level of expectations was not assimilated by the consumers during the informed test. However, it is interesting that judgement markedly moved toward expectations but without reaching a statistically significant difference in terms of the I – B scores at the 0.05 level (Table 10).

3.1.5. Comparison between different information conditions on different product types.

In all consumer tests (except in Barcelona), the conventional products evaluated (standard quality) were positively disconfirmed: Consumers tended to expect lower sensory quality from these products.

On the contrary, consumers expected higher quality in the products from autochthonous pig breeds. All consumers (except in the test of Barcelona) had a similar behaviour: higher expectations of TPP and ITPP differentiated significantly from the remaining products. These results agree with those obtained in other similar studies (Cerjak et al., 2011; Iaccarino, Monaco, Mincione, & Cavella, 2006). However, when consumers tasted the products without having the information, no differences on sensory perception among products were found, except for Barcelona test. In this case, intrinsic sensory quality influenced positively the liking score. Consequently, Barcelona can be a new market for PNM products.

Sensory quality is relevant regarding how a consumer judges a product (Iaccarino et al., 2006). Although sensory properties play an important role in the determination of actual liking, if the meat is acceptable in terms of sensory properties, information about the production system, processing or the meat nutritional characteristics allows the consumers to gain a more positive perception of the product and increase their acceptability (Napolitano et al., 2007). Hence, information about a traditional pig breed can be used as an influential marketing tool to differentiate meat products (Cerjak et al., 2011), but marketing should take into consideration the two most important variables: health reasons and taste preferences (Marino et al., 2017).

In all cases of this present study, acceptability improved when consumers had information but only in a few products this information was assimilated by the consumers. This was the case for the study in Toulouse where knowledge of the ham quality label (PDO) and of the pig breed and production system had a significant influence on expectations and sensory acceptability. It is important to keep in mind that information provided by producers could deeply influence the buying decisions of this group of consumers (Marino et al., 2017).

4. Conclusions

Innovative products focusing on healthy and process innovation must consider the information provided to the consumers and the sensory quality of the products.

Results showed high expectations for the TPP and ITPP, in the cases where consumers were familiar with the traditional product and its production system (CS, NB and TRP). In the consumer test in Barcelona, consumers were not acquainted with the PNM. The combination of the information on products with the tasting sensory properties tended to reduce the differences with respect to expectations.

The information provided, in some cases together with the sensory test, led to an increase in the acceptability of the Traditional products mainly the PNM patty. Consequently, Barcelona can be a new market from these products. The consumer study on dry cured ham from the Gascon breed

showed that the inclusion of information resulted also in a higher acceptance compared to blind tests.

This study showed that the information provided to the consumers influenced the acceptability of the product obtained from local pig breeds. In the case of the conventional products, the information provided negatively influenced consumers' perceptions and expectations. On the other hand, information regarding the premium or traditional products significantly increased the consumers' expectations, mainly when consumers know the product. This study highlighted the need to emphasize the breed and the production system in traditional pork products, but we can conclude that the sensory quality had a significant role on the preferences of consumers.

Acknowledgements

This study received funding from the European Union's Horizon 2020 Research and Innovation programme under grant agreement No 634476 (Project acronym: TREASURE). IRTA thanks CERTA funding. The authors thank M^a José Bautista, Jaume Dilme and Agustí Quintana for their technical assistance. E. A. Rivera-Toapanta is a recipient of a doctoral fellowship awarded by the INIA (Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria).

The content of this paper reflects only the author's view and the European Union Agency is not responsible for any use that may be made of the information it contains.

References

- Andrés, A., Barat, J. M., Grau, R., & Fito, P. (2008). Principles of Drying and Smoking. In *Handbook of Fermented Meat and Poultry* (pp. 37–48).
<https://doi.org/10.1002/9780470376430.ch5>
- Carrillo, E., Varela, P., & Fiszman, S. (2012). Effects of food package information and sensory characteristics on the perception of healthiness and the acceptability of enriched biscuits. *Food Research International*, 48(1), 209–216.
<https://doi.org/10.1016/j.foodres.2012.03.016>
- Cerjak, M., Karolyi, D., & Kovačić, D. (2011). Effect of information about pig breed on consumers' acceptability of dry sausage. *Journal of Sensory Studies*, 26(2), 128–134.
<https://doi.org/10.1111/j.1745-459X.2011.00329.x>
- Cerjak, M., Petrčić, M., & Karolyi, D. (2017). Effect of Information about Animal Feeding on Consumer Acceptability of Sausages from Turopolje Pig Breed. *Agriculturae Conspectus Scientificus*, 82(2), 151–154.
- Deliza, R., & Macfie, H. J. H. (1996). The generation of sensory expectation by external cues and its effect on sensory perception and hedonic ratings: A review. *Journal of Sensory Studies*, 11(2), 103–128. <https://doi.org/10.1111/j.1745-459X.1996.tb00036.x>
- Fernández-Ginés, J. M., Fernández-López, J., Sayas-Barberá, E., & Pérez-Alvarez, J. A. (2005). Meat Products as Functional Foods: A Review. *Journal of Food Science*, 70(2), R37–R43.
<https://doi.org/10.1111/j.1365-2621.2005.tb07110.x>
- Garbowska, B., Radzymińska, M., & Jakubowska, D. (2013). Influence of the origin on selected determinants of the quality of pork meat products. *Czech Journal of Food Sciences*, 31(6), 547–552. <https://doi.org/10.17221/479/2012-cjfs>
- Guerrero, L., Claret, A., Verbeke, W., Vanhonacker, F., Enderli, G., Sulmont-Rossé, C., Guàrdia,

- M. D. (2012). Cross-cultural conceptualization of the words Traditional and Innovation in a food context by means of sorting task and hedonic evaluation. *Food Quality and Preference*, 25(1), 69–78. <https://doi.org/10.1016/j.foodqual.2012.01.008>
- Guerrero, L., Guàrdia, M. D., Xicola, J., Verbeke, W., Vanhonacker, F., Zakowska-Biemans, S., Hersleth, M. (2009). Consumer-driven definition of traditional food products and innovation in traditional foods. A qualitative cross-cultural study. *Appetite*, 52(2), 345–354. <https://doi.org/10.1016/j.appet.2008.11.008>
- Halagarda, M., Kędzior, W., Pyrzyńska, E., & Kudelka, W. (2018). Fatty acid compositions of selected Polish pork hams and sausages as influenced by their traditionality. *Sustainability (Switzerland)*, 10(11). <https://doi.org/10.3390/su10113885>
- Hersleth, M., Lengard, V., Verbeke, W., Guerrero, L., & Naes, T. (2011). Consumers' acceptance of innovations in dry-cured ham: Impact of reduced salt content, prolonged aging time and new origin. *Food Quality and Preference*, 22(1), 31–41. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0950329310001205>
- Iaccarino, T., Monaco, R. Di, Mincione, A., & Cavella, S. (2006). Influence of information on origin and technology on the consumer response: The case of soppressata salami. *Food Quality and Preference*, 17(1), 76–84. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0950329305001357>
- Karolyi, D., & Cerjak, M. (2015). The acceptance of health related innovations in traditional meat products by Croatian consumers. *Poljoprivreda*, 21(1), 228–231. <https://doi.org/10.18047/poljo.21.1.sup.54>
- Lähteenmäki, L. (2013). Claiming health in food products. *Food Quality and Preference*, 27(2), 196–201. <https://doi.org/10.1016/j.foodqual.2012.03.006>
- Marino, R., della Malva, A., Seccia, A., Caroprese, M., Sevi, A., & Albenzio, M. (2017).

- Consumers' expectations and acceptability for low saturated fat 'salami': healthiness or taste? *Journal of the Science of Food and Agriculture*, 97(11), 3515–3521.
<https://doi.org/10.1002/jsfa.8205>
- Mercat, M. J., Lebret, B., Lenoir, H., & Batorek-Lukač, N. (2019). *Gascon Pig*. In « *European Local Pig Breeds – Diversity and Performance. A study of project TREASURE* », Eds M Čandek-Potokar & R. Nieto (Eds). Retrieved from <http://dx.doi.org/10.5772/intechopen.83764>, 14 p.
- Napolitano, F., Caporale, G., Carlucci, A., & Monteleone, E. (2007). Effect of information about animal welfare and product nutritional properties on acceptability of meat from Podolian cattle. *Food Quality and Preference*, 18(2), 305–312.
<https://doi.org/10.1016/j.foodqual.2006.02.002>
- Norton, J. E., Fryer, P. J., & Parkinson, J. A. (2013). The effect of reduced-fat labelling on chocolate expectations. *Food Quality and Preference*, 28(1), 101–105.
<https://doi.org/10.1016/J.FOODQUAL.2012.08.004>
- OJEU. (2017a). Commission Implementing Regulation (EU) 2017/1552 of 5 September 2017 entering a name in the register of protected designations of origin and protected geographical indications (Porc noir de Bigorre (PDO)). Retrieved January 9, 2020, from Official Journal of the European Union website: https://eur-lex.europa.eu/eli/reg_impl/2017/1552/oj
- OJEU. (2017b). Commission Implementing Regulation (EU) 2017/1554 of 5 September 2017 entering a name in the register of protected designations of origin and protected geographical indications (Jambon noir de Bigorre (PDO)). Retrieved January 9, 2020, from Official Journal of the European Union website: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017R1554>
- Phillips, D. H. (1999). Polycyclic aromatic hydrocarbons in the diet. *Mutation Research - Genetic Toxicology and Environmental Mutagenesis*, 443(1–2), 139–147.

[https://doi.org/10.1016/S1383-5742\(99\)00016-2](https://doi.org/10.1016/S1383-5742(99)00016-2)

Schouteten, J. J., De Steur, H., De Pelsmaeker, S., Lagast, S., Juvinal, J. G., De Bourdeaudhuij, I., ... Gellynck, X. (2016). Emotional and sensory profiling of insect-, plant- and meat-based burgers under blind, expected and informed conditions. *Food Quality and Preference*, 52, 27–31. <https://doi.org/10.1016/j.foodqual.2016.03.011>

Verbeke, W., Pérez-Cueto, F. J. A., Barcellos, M. D. d., Krystallis, A., & Grunert, K. G. (2010, February). European citizen and consumer attitudes and preferences regarding beef and pork. *Meat Science*, Vol. 84, pp. 284–292. <https://doi.org/10.1016/j.meatsci.2009.05.001>

Zakowska-Biemans, S., Sajdakowska, M., & Issanchou, S. (2016). Impact of Innovation on Consumers Liking and Willingness to Pay for Traditional Sausages. *Polish Journal of Food and Nutrition Sciences*, 66(2), 119–127. <https://doi.org/10.1515/pjfn-2016-0004>

1

2

Tables

3 **Table 1.** Products included in the sensory consumer test per country, as well as the type of product, the conventional and/or premium products used, the
4 traditional product (TPP) and the innovations (ITTP1, ITTP2).

5

City and country	Pig breed / local pork chain	Conventional product (Standard Quality)	Conventional product (Premium Quality)	TPP	ITPP1	ITPP2
Barcelona, Spain	Negre Mallorquí (PNM)	Patty conventional	Patty Premium	Patty	Patty Natural Fibre	Patty Natural antioxidant
Bologna, Italy	Cinta Senese (CS)	Dry-fermented sausages conventional	Dry-fermented sausages Premium	Dry-fermented sausages	Dry-fermented sausages Natural antioxidants	
Toulouse, France	Gascon / Noir de Bigorre (NB) chain		Dry-cured ham Premium (Iberico ham – 50% Iberian Pigs)	PDO Noir de Bigorre Dry-cured ham 24 months	PDO Noir de Bigorre Dry-cured ham 36 months	
Zagreb, Croatia	Turopolje (TRP)	Dry-cured ham conventional	Dry-cured ham Premium	Dry-cured ham	Dry-cured ham (Less salting time)	Dry-cured ham (Less smoking time)

6

7

8 **Table 2.** Socio-demographic characteristics of consumers (gender, age).

		Barcelona	Bologna	Toulouse	Zagreb
	n Total	121	121	124	121
1. Gender	%Women	48.8	60.3	56.5	49.6
	% Men	51.2	39.7	43.6	50.4
2. Age	% 18-29 years	12.4	38.7	11.3	17.4
	% 30-39 years	21.5	26.1	14.5	24.0
	% 40-49 years	26.5	16.8	30.7	28.1
	% 50-59 years	22.3	10.9	21.0	14.9
	% > 60 years	17.4	7.6	22.6	15.7

9

10

11 **Table 3.** Acceptability scores (least square means \pm standard error) for the blind, expected and
 12 informed test and their score differences by treatment (Barcelona).

Product		Blind	Expected	Informed
Porc Negre Mallorquí (PNM) patty ¹	TPP	6.6 \pm 0.15 ^a	6.3 \pm 0.14 ^{bc}	7.1 \pm 0.10 ^a
PNM patty with natural fibre	ITTP1	5.2 \pm 0.20 ^c	5.7 \pm 0.15 ^d	5.4 \pm 0.21 ^c
PNM patty with natural antioxidants	ITTP2	5.6 \pm 0.21 ^c	6.1 \pm 0.16 ^{cd}	5.7 \pm 0.20 ^c
Mix Pork and Beef patty	Standard	6.0 \pm 0.16 ^b	6.6 \pm 0.15 ^b	6.4 \pm 0.15 ^b
Beef patty	Premium	6.1 \pm 0.15 ^b	7.1 \pm 0.14 ^a	6.4 \pm 0.13 ^b

13 Different letters (a, b, c, d) in the same column indicate significant differences ($p < 0.05$) between groups

14

15

16 **Table 4.** Effect of expectation on acceptability of different pork products (Barcelona)

Products	E - B^a	I - B^b	I - E^c
Porc Negre Mallorquí (PNM) patty	-0.3 Confirmation	0.5* Assimilation	0.8* Incomplete
PNM patty with natural fibre	0.5* Negative disconfirmation	0.2	-0.3
PNM patty with natural antioxidants	0.5* Negative disconfirmation	0.1	-0.4
Mix Pork and Beef patty	0.6* Negative disconfirmation	0.4	-0.2
Beef patty	1* Negative disconfirmation	0.3	-0.7*

17 ^a Expected minus blind liking scores; ^b Informed minus blind liking scores Informed minus expected liking
 18 scores; * $p < 0.05$
 19

20

21

22 **Table 5.** Acceptability scores (least square means \pm standard error) for the blind, expected and

23 informed test and their score differences by treatment (Bologna).

	Product	Blind	Expected	Informed
Cinta Senese (CS)				
dry-fermented sausages	TPP	6.6 \pm 0.16	7.5 \pm 0.09 ^a	6.9 \pm 0.15 ^a
CS dry-fermented sausages with natural antioxidants				
	ITPP1	6.6 \pm 0.18	7.5 \pm 0.10 ^a	6.8 \pm 0.18 ^{ab}
Dry-fermented sausages	Standard	6.4 \pm 0.16	5.3 \pm 0.15 ^c	6.0 \pm 0.15 ^c
Dry-fermented sausages premium	Premium	6.3 \pm 0.15	6.0 \pm 0.14 ^b	6.3 \pm 0.14 ^{bc}

24 Different letters (a, b, c, d) in the same column indicate significant differences ($p < 0.05$) between groups

25

26 **Table 6.** Effect of expectation on the acceptability of different pork products (Bologna)

27

Products	E - B^a	I - B^b	I - E^c
Cinta Senese (CS) dry-fermented sausages	0.9* Negative disconfirmation	0.3	-0.6*
CS dry-fermented sausages with natural antioxidant	0.9* Negative disconfirmation	0.2	-0.7*
Dry-fermented sausages	-1.1* Positive disconfirmation	-0.4	0.7*
Dry-fermented sausages premium	-0.3 Confirmation	0	0.3

^a Expected minus blind liking scores; ^b Informed minus blind liking scores
Informed minus expected liking scores; * $p < 0.05$

28

29

30 **Table 7.** Acceptability scores (least square means \pm standard error) for the blind, expected and

31 informed test and their score differences by treatment (Toulouse).

	Product	Blind	Expected	Informed
Noir de Bigorre PDO ham, 24 months ripening (NB24)	TPP	6.7 \pm 0.14	7.2 \pm 0.11 ^b	7.2 \pm 0.10 ^a
Noir de Bigorre PDO ham 36 months ripening (NB36)	ITPP1	6.7 \pm 0.14	7.8 \pm 0.11 ^a	7.4 \pm 0.11 ^a
Iberian ham, 50% Iberian pig (IB)	Premium	6.8 \pm 0.15	5.2 \pm 0.15 ^c	5.9 \pm 0.17 ^b

32 Different letters (a, b, c, d) in the same column indicate significant differences ($p < 0.05$) between groups

33

34

35

36 **Table 8.** Effect of expectation on the acceptability of different pork products (Toulouse).

37

	E - B^a	I - B^b	I - E^c
Noir de Bigorre ham, 24 months ripening (NB24)	0.5* Negative disconfirmation	0.5* Assimilation	0 Complete
Noir de Bigorre ham, 36 months ripening (NB36)	1.1* Negative disconfirmation	0.7* Assimilation	-0.4* Incomplete
Iberian ham, 50% Iberian pig (IB)	- 1.6* Positive disconfirmation	-0.9* Contrast	0.7* Incomplete

^a Expected minus blind liking scores; ^b Informed minus blind liking scores Informed minus expected liking scores; * $p < 0.05$

38

39 **Table 9.** Acceptability scores (least square means \pm standard error) for the blind, expected and
 40 informed test and their score differences by treatment (Zagreb).

	Product	Blind	Expected	Informed
Turopolje (TRP)				
dry-cured ham	TPP	6.6 \pm 0.16	7.0 \pm 0.17 ^a	7.0 \pm 0.15 ^a
TRP				
dry-cured ham less salt	ITPP1	6.5 \pm 0.17	6.6 \pm 0.18 ^{ab}	6.6 \pm 0.16 ^{ab}
TRP				
dry-cured ham less smoked	ITPP2	6.1 \pm 0.17	6.7 \pm 0.17 ^{ab}	6.6 \pm 0.15 ^{ab}
Standard				
dry-cured ham	Standard	6.4 \pm 0.17	5.2 \pm 0.16 ^c	6.1 \pm 0.16 ^{bc}
Premium				
dry-cured ham	Premium	6.4 \pm 0.19	6.4 \pm 0.15 ^b	5.9 \pm 0.17 ^c

41 Different letters (a, b, c, d) in the same column indicate significant differences ($p < 0.05$) between groups

42

43

44 **Table 10.** Effect of expectation on the acceptability of different pork products (Zagreb).

	E - B^a	I - B^b	I - E^c
Turopolje (TRP) dry-cured ham	0.4 Confirmation	0.4	0
TRP dry-cured ham less salt	0.1 Confirmation	0.1	0
TRP dry-cured ham less smoked	0.6* Negative disconfirmation	0.5	-0.1
Standard dry-cured ham	-1.2* Positive disconfirmation	-0.3	0.9*
Premium dry-cured ham	0 Confirmation	-0.5	-0.5

^a Expected minus blind liking scores; ^b Informed minus blind liking scores Informed minus expected liking scores; * $p < 0.05$

45

46