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1 **Consumers' expectations and liking of traditional and innovative pork products**  
2 **from European autochthonous pig breeds**

3

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**27 Highlights:**

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

35

**36 Abstract**

37 The aim of the study was to ascertain the acceptability of Traditional (T) and Innovative (IT) pork  
38 products by European consumers considering also the influence of the sensory properties. The  
39 tests were performed in Barcelona, Bologna, Toulouse and Zagreb, with products from  
40 autochthonous pig breeds Porc Negre Mallorquí (patties), Cinta Senese (dry-fermented sausages),  
41 Gascon-Noir de Bigorre (dry-cured hams) and Turopolje (dry-cured hams), respectively. The  
42 methodological approach relied on the expectancy-disconfirmation model and the assimilation  
43 theory (blind, expected and informed tests). All consumers had a similar behaviour: higher  
44 expectations of T and IT differentiating them significantly from the remaining products, except  
45 in Barcelona test, because consumers in this city were not acquainted with the production system.  
46 Innovation in T products focusing on healthy and process innovation highlighted the need to  
47 provide information about the breed and the production system, but we can conclude that the  
48 sensory quality had a significant role on the preferences of consumers.

**49 Keywords:**

50 Innovative pork products

51 Autochthonous pig breeds

52 Consumer tests

53

## 54 1. **Introduction**

55 Traditional food products are, in general, an important element of regional identity and culture.  
56 The term "traditional" is not always understood in the same way in all countries (Guerrero et al.,  
57 2012), and often, the differences in consumer acceptability between local / traditional and  
58 conventional products are not clear. Several authors have noted that there are also differences in  
59 the perception of Innovative and Traditional concepts according to the context in which they are  
60 used, for example, between rural and urban populations or between the North and the South of  
61 the European continent (Guerrero et al., 2009). In 2006, the European Commission issued the  
62 following definition of "traditional" related to food: "Traditional means that it comes from the use  
63 in a market of a community during a period that has been transmitted from generation to  
64 generation, the period is generally attributed to a human generation, at least 25 years". These types  
65 of products contribute to the development and sustainability of rural areas by protecting them  
66 from depopulation based on the potential differentiation of products and producers. Production of  
67 traditional food products, especially those of animal origin, is often closely related to less  
68 intensive production systems that typically rely on local resources and, as such, play important  
69 roles in the maintenance of the natural environment, including the native breeds of livestock.

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

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

84 The information given to consumers on the impact on health or any other quality dimension may  
85 influence their acceptability of meat products (Carrillo, Varela, & Fiszman, 2012; Schouteten et  
86 al., 2016). The correlation could be positive, but in some cases, the correlation could lead to a  
87 lower or negative expectation of the sensory experience (Norton, Fryer, & Parkinson, 2013). In  
88 this sense, the way in which consumers perceive information, which is strongly affected by  
89 personal attitudes, could turn information into a barrier of negative expectations and reduce the  
90 hedonic value for buyers. The methodology, called *the expectancy-disconfirmation model*  
91 (Oliver, 1980) was followed due to its capacity to analyze the impact of information on  
92 consumers' liking (Kallas, Martínez, Panella-Riera, & Gil, 2016; Napolitano, Caporale, Carlucci,  
93 & Monteleone, 2007). This methodology combines both sensory (intrinsic) and extrinsic food  
94 attributes and is based on the comparison of blind, expected and informed tests of products by  
95 consumers (Deliza & Macfie, 1996). It makes it possible to investigate if and how information  
96 (informed test) about the product (e.g., origin, processing duration, fat content, etc.) potentially  
97 influences consumer liking. The influence of information on the local production of the pig breed  
98 and the production/feeding system on consumer expectations was also reported by Cerjak,  
99 Karolyi, & Kovačić (2011) and Cerjak, Petrčić, & Karolyi (2017) and can be taken as a  
100 differentiation tool in the marketing of traditional pork products.

101 The aim of the study was to ascertain the acceptability of the Traditional (T) and Innovative  
102 Traditional pork products (IT) from four autochthonous pig breeds by consumers, considering the  
103 influence of the sensory properties, the expectations and the information about the product given  
104 to them.

105

106

## 107 2. **Material and methods**

108 In the present study, four consumer sensory tests were performed with four different  
109 autochthonous pork chains: Porc Negre Mallorquí (PNM, Barcelona, Spain), Cinta Senese (CS,  
110 Bologna Italy), Gascon-Noir de Bigorre (NB, Toulouse France), Turopolje (TRP, Zagreb, Croatia).  
111 The studies included traditional pork products or products made from native breeds in a traditional  
112 and innovative way. Consumption tests were conducted in four cities that were identified as  
113 potential new markets / niches for each autochthonous breed and represent three different  
114 European regions: the West (France), the South (Spain and Italy) and the East (Croatia), in the  
115 context of the EU-H2020 project TREASURE. All consumer studies in the different cities were  
116 carried out following the same design and methodology to maximally standardize the conditions  
117 and to achieve the common objective of the TREASURE Project (WP3.3), which is the  
118 determination of consumer acceptability and preference for Traditional pork products (T), and  
119 Innovative Traditional (IT) pork products, in cities that are identified as potential new markets for  
120 three European regions. The products evaluated in each city were different and based on the  
121 autochthonous pig breeds and production systems. The innovations were developed based on  
122 traditional products or products made in a traditional way and originating from each region and  
123 native breed considered. The T and the IT products were also compared with one or two additional  
124 products obtained from commercial types. The first product was with “conventional quality” that  
125 met the minimum production standards. The second product was with “premium quality” with  
126 premium quality production standards.

127 The general details of the sample preparation, serving procedures and instructions for consumers  
128 were:

- 129 • All portions were prepared the same day of the test, separated per lots and stored  
130 according to product characteristics until the time of the test. At least two persons were  
131 responsible to prepare and distribute all the servings during the eating evaluation.

- 132       • It was extremely important to check the shape and size of every portion in order to  
133           homogenize the samples to taste.
- 134       • Several plates with pre-printed stickers with sample codes were prepared for each serving.

135

## 136    **2.1 Products**

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

### 138    2.1.1. *Porc Negre Mallorquí (PNM) patties, Barcelona*

139    Porc Negre Mallorquí-based patties made in a traditional way following a traditional receipt from  
140    a butcher (mixture of fat and meat from shoulder and ham), were evaluated by consumers in  
141    Barcelona as a traditional product. Two innovations to enhance human health were also designed  
142    by incorporating natural ingredients that contribute to an improvement of health: 1) a source of  
143    fibre (porcini mushroom) that contains beta-glucan, which reinforces the immune system  
144    (Cheung, 1998; Rop, Mlcek, & Jurikova, 2009) and 2) a source of antioxidants (berries) may  
145    reduce sucrose digestion and absorption leading to delayed glyceemic response (Ganhão, Estévez,  
146    Kylli, Heinonen, & Morcuende, 2010; Törrönen et al., 2013) .

147    In each test, the equivalent conventional and premium products were included.

148    The formulation of the patties (1000 g basis) for the five groups was composed of 881.2 g of  
149    minced meat, 18 g of salt, 0.3 g of sulphite, 0.5 g of ascorbic acid, 100 ml of pasteurized egg. For  
150    the IT<sub>1</sub>, 10 g of fungi porcini as natural fibre and for IT<sub>2</sub>, 20 g of blue berries as natural  
151    antioxidants, were respectively added, and the amounts of meat were 871.2 g and 861.2 g. The  
152    average fat content was of 16.4% of the total composition. Each individual patty average weight  
153    was 120 g. The patties were prepared a maximum of two days before the trial and kept  
154    refrigerated.

155    The cooking of the patties was performed the day of the test in a kitchen on the premises and just  
156    prior to each consumer session (10-12 consumers/session). Patties were cooked in groups of three

157 on a grill until a core temperature of 78 °C was achieved (approximately 5 min). Each patty was  
158 split in 4 equal pieces, which were given to four consumers.

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

### 162 *2.1.2. Cinta Senese (CS) dry-fermented sausages, Bologna*

163 Cinta Senese dry-fermented sausages are a traditional product for this breed. To improve their  
164 healthiness, the innovation proposed was aimed to replace sodium nitrite with natural  
165 antioxidants. The T and IT were manufactured following the traditional recipe in an industrial  
166 plant. Ingredients consisted of 80% of minced pork lean and 20% of subcutaneous backfat from  
167 Cinta Senese pig breed, salt (2.3%), sucrose (3.5%) and black pepper (2 %). Thirty ppm of sodium  
168 nitrite (E250) were added to the first (T) products, while 10% of natural antioxidants mixture was  
169 used to replace sodium nitrite in (IT) products. Natural antioxidants mixture was made of grape  
170 seed extract, hydroxytyrosol (extracted from defatted olive pomace) and tocopherol. The mixture  
171 had a double antioxidant-antimicrobial action. Fresh sausages, after being weighed, dried at 28°C  
172 and RH 85% for 4 days and then they were ripened for 21 days (T 13°C, RH 70%). Dry-fermented  
173 sausages were stored two days at 4°C before the consumer study. In addition, two other types of  
174 dry-fermented sausages were bought to compare (T) and (IT) to a conventional product and a  
175 premium product. Each sausage was sliced in 0.5cm-thick×2cm-diameter slices and served at  
176 room temperature (20°C). Consumers were in an equipped laboratory with individual cabins and  
177 invited to eat a cracker and drink a glass of water between samples (IBIMET-BIOAGRIFOOD  
178 Department CNR, Bologna).

### 179 *2.1.3. Noir de Bigorre (NB) dry-cured hams, Toulouse*

180 The Noir de Bigorre (NB) Protected Designation of Origin (PDO) dry cured hams, produced in  
181 the south-West of France from pure Gascon pigs (Mercat, Lebret, Lenoir, & Batorek-Lukač,  
182 2019; OJEU, 2017a, 2017b), were considered in the French case study. NB-PDO ham with 24



183 months processing duration, corresponding to the usual processing time for this product, was  
184 considered as (T). Innovation consisted in extending processing time with 12 additional months  
185 during the ripening period, leading to 36 months processing for (IT), with the aim to enhance the  
186 sensory quality (texture, odour, flavour) of the products. T and IT were produced by the Noir de  
187 Bigorre chain according to PDO requirements for pig production and ham processing (OJEU,  
188 2017a, 2017b). Dry-cured hams from Iberian crossbred pigs (50% Iberian, 50% Duroc),  
189 purchased in a fine food shop, were used in the consumer test study as premium quality product  
190 (Table 1). There was no conventional product (Standard Quality) in this consumer study due to  
191 the very high discrepancy in eating quality of Premium and PDO products compared with  
192 conventional, which is related to a different market sector.

193 The study was conducted in Toulouse, with 124 consumers divided in 9 sessions. All products  
194 were prepared in a same manner : 1.3 mm thick ham slices (from 2 to 3 different hams for each  
195 kind of product) were prepared with a slicing machine in the larger part of the ham including both  
196 the *Biceps femoris* and *Semimembranosus* muscles and external fat; then transversal “strips” of  
197 around 3 cm width including both muscles and external fat were cut, settled on a tray and stored  
198 at 4°C under vacuum, 10 days before the sensory tests. According to requirements of NB chain  
199 for T and IT, and of fine food shop for Iberian hams, ham slices packs were placed at serving  
200 temperature (18°C) 1 h (T and IT) or 2 h (Iberian) before start of each sensory session. For eating  
201 tests, ham slices were placed on plastic plates and distributed to consumers following a monadic  
202 distribution and pre-defined random order assigned to each participant, taking care of distributing  
203 trips of similar aspect between consumers, and within each consumer for blind and informed  
204 liking tests. Consumers were asked to rinse their mouths with water between two tastings.

#### 205 2.1.4. Turopolje, (TRP) dry cured hams, Zagreb

206 In study with Croatian consumers the dry-cured hams made from autochthonous Turopolje pig  
207 breed were evaluated. For traditional production (T), cooled raw hams (n=5) were shaped and  
208 manually salted with the mixture of commercial curing salt and spices (black paper, garlic and  
209 red pepper), stacked on piles and left in cold (T=4 °C) for five weeks. After salting, the hams

210 were cold smoked ( $T=18^{\circ}\text{C}$ ,  $\text{RH}=80\%$ ) by beech wood smoke in total eight times, after which  
211 they were placed to the drying and ripening chamber under controlled conditions ( $T=12^{\circ}\text{C}$ ,  
212  $\text{RH}=75\%$ ). For production of (IT) the same processing technology was applied, except that for  
213 less-salted hams ( $n=5$ ) the salting time was shortened from 5 weeks to 3 weeks, while for less-  
214 smoked hams ( $n=5$ ) the difference consisted in 50% reduction of smoke application. Sampling  
215 for sensory tests was performed when dry-cured hams were about 12 months old. To follow a  
216 common experimental design, the T and IT dry-cured hams from Turopolje pig breed were  
217 compared with two conventional types of dry-cured hams (standard and premium quality) from  
218 commercial pork chains. Before tasting, ham slices were equilibrated to room temperature ( $20$   
219  $^{\circ}\text{C}$ ). During the sensory test consumers received 5 samples corresponding to all tested treatments  
220 and were asked to taste them in a pre-defined random order, meaning that the order of tasting was  
221 randomly assigned to each participant according to a common study design. Between two tastings  
222 consumers were asked to rinse their mouths with water and eat a piece of toast.

223

## 224 *2.2 Consumer studies- Experimental design and general aspects.*

### 225 *2.2.1. Consumer recruitment*

226 A total of 487 consumers participated in the four studies, in the range 121 - 124 consumers per  
227 city. Table 2 presents the main socio-demographic traits of the consumers per city. In all the case  
228 studies, the same design was used, and the traditional products and innovations of the region were  
229 analyzed together with the conventional and/or premium conventional product. A quota sampling  
230 procedure was applied in terms of gender and age to ensure representativeness in each city.  
231 Consumers were recruited from a consumers' panel belonging to a market company and  
232 economically compensated for their participation. The sample size correspond to what is  
233 commonly used in the literature of consumers' acceptance studies (Hough et al., 2006).

234 The consumers recruited had to meet some common criteria: i) they were required to eat pork on  
235 a regular basis (in addition, in case of French-case study, they were required to have purchased

236 high quality dry-cured hams in the last 3 months); ii) they were required to be partially or totally  
237 responsible for food purchase at home, and iii) they were required to be between 18 and 75 years  
238 old.

239 The consumers were asked to evaluate the products (T, IT products and conventional-premium)  
240 in a three-step sensory test, (through the methodology of the expectancy-disconfirmation model):

241

242 1) Blind liking (perceived sensory acceptability, P):

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

247

248 2) Expected liking (expected acceptability, E):

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

254

255 3) Informed liking (informed acceptability, I):

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

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

264 is statistically higher than the expected score but can also be negative when the blind acceptability  
265 score is statistically lower than the expected score. The assimilation model occurs when the  
266 evaluation of the product changes in the same direction of the expectation, while the contrast  
267 model occurs when the evaluation of the product changes in the opposite direction to the  
268 expectation, thus increasing the discrepancy between the evaluation of the product and the  
269 expectation. In addition, in the case of assimilation, when the difference between the expected  
270 score and the reported score is significantly different from zero, consumers expectations are not  
271 fully satisfied. Incomplete assimilation can lead to a decrease in the consumer's future expectation  
272 as a result of repeated disconfirmation (Deliza & Macfie, 1996). The sensory properties that can  
273 affect the informed acceptability play an important role in the incomplete assimilation  
274 (Napolitano et al., 2007).

275

### 276 **2.3 Data analysis**

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

287

288

289

290

### 291 3. Results and discussion

#### 292 3.1 Results of the four consumer case studies.

##### 293 3.1.1. Acceptability of Traditional and Innovative products from PNM

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

300 This can explain why the expectations were lower with respect to the blind test; however, in the  
301 informed test (sensory test plus information), the scores reverted to those of the blind test. As  
302 reported in a similar study Cerjak et al. (2011), both sensory properties as well as information  
303 about a native pig breed influenced consumers' preferences. In the case of repeated tasting with  
304 information by consumers, it is foreseeable that consumers move their expectations towards the  
305 informed test. Innovative treatments that incorporate healthy attributes (IT<sub>1</sub> & IT<sub>2</sub>) were evaluated  
306 significantly lower than the remaining products in all phases of the study. The added ingredients  
307 to the traditional treatment led to products that were clearly different in taste and that were scored  
308 lower than Traditional by consumers; the information provided with the description of these  
309 innovative treatments did not change this trend.

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

317

318 *3.1.2. Acceptability of Traditional and Innovative products from Cinta Senese*

319 The results of the consumer test conducted in Bologna (Emilia-Romagna) reflected the impact of  
320 information on consumer expectations, in this case of dry-fermented sausages (Table 5). The  
321 Cinta Senese (CS) dry-fermented sausage is a traditional product from Tuscany, which is a region  
322 not far from Bologna. Cinta Senese pig breed has also a PDO distinction on fresh meat. In the  
323 absence of information on the origin of the meat and the way of raising the pigs, there were no  
324 significant sensory evaluation differences between the different treatments tasted by consumers.  
325 This changed very significantly when consumers were provided with that information: the  
326 expectations of the two products elaborated with CS ,CS dry-fermented sausages (T) and CS dry-  
327 fermented sausages with natural antioxidant (IT), obtained acceptance scores significantly higher  
328 than the control commercial products, and, among them, the premium product had higher scores  
329 than the conventional. In the last phase of the test, which was the combination of the information  
330 and the tasting, two treatments elaborated with CS also obtained the highest acceptance, but no  
331 significant differences were found between the IT and premium. The two treatments elaborated  
332 with CS had a negative disconfirmation because the consumer had higher expectations than  
333 sensory blind acceptance but this disconfirmation was not assimilated because consumers did not  
334 move their informed taste towards their expectations (Table 6).

335

336 *3.1.3. Acceptability of Traditional and Innovative products from the Noir de Bigorre chain –*  
337 *Gascon breed*

338 The three products tasted in this case study and the information provided to consumers are  
339 described in (Table 7). In the first step of the consumer test, the blind hedonic test showed no  
340 significant differences in acceptability scores between the three products, with all having a high  
341 liking score (6.7 to 6.8). In contrast, the description of the product and of the pig breed and  
342 production system strongly influenced the expected liking, with higher acceptability score for IT  
343 than T and the lowest score for IB. Innovation consisting of an additional year of ripening  
344 generated significantly higher expectations by consumers, which is in agreement with a previous

345 study conducted in Norway (Hersleth, Lengard, Verbeke, Guerrero, & Naes, 2011). In the last  
346 step, the hedonic test in the presence of information showed a better acceptability score for the T  
347 and IT hams, which were similar, than for the IB ham.

348 Within the products, differences in the acceptability score between the test phases were also  
349 observed. For both T and IT hams, higher than expected blind acceptability scores were observed,  
350 indicating a negative disconfirmation for these products, whereas the reverse was observed for  
351 the IB ham, which exhibited positive disconfirmation (Table 8). Both NB hams displayed higher  
352 informed than blind acceptability scores: information provided to consumers improved the  
353 product's acceptability, i.e., a significant assimilation occurred for these products. For T, the  
354 informed acceptability score was like the expected acceptability score (complete assimilation),  
355 denoting a complete fulfilment of hedonic expectations for this product. In the case of IT,  
356 assimilation was incomplete (the informed score lower than the expected score), indicating that  
357 consumers' expectations that were aroused by the innovation consisting of an additional year  
358 ripening were not fully satisfied. This can decrease future consumer expectations. Conversely, in  
359 the case of IB ham, the informed acceptability score was lower than the blind score, i.e., a  
360 significant contrast was observed, denoting a negative impact of the information provided in terms  
361 of the consumers' perception of the product (Zakowska-Biemans, Sajdakowska, & Issanchou,  
362 2016).

#### 363 *3.1.4. Acceptability of Traditional and Innovative products from Turopolje pig breed*

364 Consumer sensory tests were carried out in the Zagreb area with three types of dry-cured hams  
365 (typically salted and smoked, less salt or less smoke) from the local Turopolje (TRP) pig breed  
366 using outdoor production system as well as two types of conventional dry-cured hams (standard  
367 and premium quality) from conventional breeds using intensive pig farming. The result showed a  
368 trend like that of the previous countries. In the blind test, in the absence of information about the  
369 breed, production system and product innovation, no significant differences in the acceptability  
370 between the TRP hams and conventional hams were found (Table 9). That means that the  
371 consumers did not appreciate any sensory differences between treatments. On the other hand, in

372 the expectancy test, when consumers had only the information about pig breed/production system  
373 and innovation, the hams made with TRP meat had higher acceptance than conventional hams,  
374 but only typical TRP ham was preferred over the premium ham. Finally, when tasting was  
375 repeated with the information, all TRP hams scored higher than premium ham, while innovative  
376 TRP hams scored like standard ham. In general, the consumers who participated in the study were  
377 acquainted with TRP breed and gave higher scores to its T (i.e., typical TRP ham) than to the  
378 conventional hams for both the expected and informed testing conditions. This result suggests a  
379 preference of typical TRP ham over the conventional hams by local consumers. For IT from the  
380 TRP breed, the advantage was not so clear. However, a good acceptance of health-related  
381 innovations in TRP ham could be noted, as no significant differences were found in the  
382 acceptability between less salted and less smoked and typical TRP dry-cured ham. The effect of  
383 information on health innovations on TRP dry-cured ham acceptance, elucidated by an  
384 assimilation model (Deliza & Macfie, 1996) , showed that in typical TRP dry-cured ham and TRP  
385 dry-cured ham with less salt, the consumers confirmed their expectations. In TRP dry-cured ham  
386 with less smoke, the consumers had a negative disconfirmation, but this higher level of  
387 expectations was not assimilated by the consumers during the informed test. However, it is  
388 interesting that judgement markedly moved toward expectations but without reaching a  
389 statistically significant difference in terms of the I – B scores at the 0.05 level (Table 10).

390

### 391 *3.1.5. Comparison between different information conditions on different product types.*

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

395 On the contrary, consumers expected higher quality in the products from autochthonous pig  
396 breeds. All consumers (except in the test of Barcelona) had a similar behaviour: higher  
397 expectations of T and IT differentiated significantly from the remaining products. These results  
398 agree with those obtained in other similar studies (Cerjak et al., 2011; Iaccarino, Monaco,



399 Mincione, & Cavella, 2006). However, when consumers tasted the products without having the  
400 information, no differences on sensory perception among products were found, except for  
401 Barcelona test. In this case, intrinsic sensory quality influenced positively the liking score.  
402 Consequently, Barcelona can be a new market for PNM products.

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

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

417

#### 418 **4. Conclusions**

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

421 Results showed high expectations for the T and IT products, in the cases where consumers were  
422 familiar with the traditional product and its production system (CS, NB and TRP). In the consumer  
423 test in Barcelona, consumers were not acquainted with the PNM. The combination of the

424 information on products with the tasting sensory properties tended to reduce the differences with  
425 respect to expectations.

426 The information provided, in some cases together with the sensory test, led to an increase in the  
427 acceptability of the Traditional products mainly the PNM patty. Consequently, Barcelona can be  
428 a new market from these products. The consumer study on dry cured ham from the Gascon breed  
429 showed that the inclusion of information resulted also in a higher acceptance compared to blind  
430 tests.

431 This study showed that the information provided to the consumers influenced the acceptability of  
432 the product obtained from autochthonous pig breeds. In the case of the conventional products, the  
433 information provided negatively influenced consumers' perceptions and expectations. On the  
434 other hand, information regarding the premium or traditional products significantly increased the  
435 consumers' expectations, mainly when consumers know the product. This study highlighted the  
436 need to emphasize the breed and the production system in traditional pork products -i.e. by  
437 including information on the label or in specific leaflets, but we can conclude that the sensory  
438 quality had a significant role on the preferences of consumers.

439

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## Tables

558 **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  
 559 traditional product (T) and the innovations (IT1, IT2).

560

City and country	Pig breed / autochthonous pork chain	Conventional product (Standard Quality)	Conventional product (Premium Quality)	T	IT1	IT2
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)

561



562

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

		<b>Barcelona</b>	<b>Bologna</b>	<b>Toulouse</b>	<b>Zagreb</b>
	n Total	121	121	124	121
<b>1. Gender</b>	% Women	48.8	60.3	56.5	49.6
	% Men	51.2	39.7	43.6	50.4
<b>2. Age</b>	% 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

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565

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

	<b>Product</b>	<b>Blind</b>	<b>Expected</b>	<b>Informed</b>
Porc Negre Mallorquí (PNM) patty <sup>1</sup>	T	6.6 $\pm$ 0.15 <sup>a</sup>	6.3 $\pm$ 0.14 <sup>bc</sup>	7.1 $\pm$ 0.10 <sup>a</sup>
PNM patty with natural fibre	IT1	5.2 $\pm$ 0.20 <sup>c</sup>	5.7 $\pm$ 0.15 <sup>d</sup>	5.4 $\pm$ 0.21 <sup>c</sup>
PNM patty with natural antioxidants	IT2	5.6 $\pm$ 0.21 <sup>c</sup>	6.1 $\pm$ 0.16 <sup>cd</sup>	5.7 $\pm$ 0.20 <sup>c</sup>
Mix Pork and Beef patty	Standard	6.0 $\pm$ 0.16 <sup>b</sup>	6.6 $\pm$ 0.15 <sup>b</sup>	6.4 $\pm$ 0.15 <sup>b</sup>
Beef patty	Premium	6.1 $\pm$ 0.15 <sup>b</sup>	7.1 $\pm$ 0.14 <sup>a</sup>	6.4 $\pm$ 0.13 <sup>b</sup>

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

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570

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

<b>Products</b>	<b>E - B<sup>a</sup></b>		<b>I - B<sup>b</sup></b>		<b>I - E<sup>c</sup></b>
Porc Negre Mallorquí (PNM) patty (T)	-0.3	Confirmation	0.5*	Assimilation	0.8* Incomplete
PNM patty with natural fibre (IT1)	0.5*	Negative disconfirmation	0.2		-0.3
PNM patty with natural antioxidants (IT2)	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*

572 <sup>a</sup> Expected minus blind liking scores; <sup>b</sup> Informed minus blind liking scores Informed minus expected liking  
573 scores; \*  $p < 0.05$   
574

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

578

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

	<b>Product</b>	<b>Blind</b>	<b>Expected</b>	<b>Informed</b>
Cinta Senese (CS)				
dry-fermented sausages	T	6.6 $\pm$ 0.16	7.5 $\pm$ 0.09 <sup>a</sup>	6.9 $\pm$ 0.15 <sup>a</sup>
CS dry-fermented				
sausages with natural antioxidants	IT1	6.6 $\pm$ 0.18	7.5 $\pm$ 0.10 <sup>a</sup>	6.8 $\pm$ 0.18 <sup>ab</sup>
Dry-fermented				
sausages	Standard	6.4 $\pm$ 0.16	5.3 $\pm$ 0.15 <sup>c</sup>	6.0 $\pm$ 0.15 <sup>c</sup>
Dry-fermented				
sausages premium	Premium	6.3 $\pm$ 0.15	6.0 $\pm$ 0.14 <sup>b</sup>	6.3 $\pm$ 0.14 <sup>bc</sup>

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

580

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

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<b>Products</b>	<b>E - B<sup>a</sup></b>	<b>I - B<sup>b</sup></b>	<b>I - E<sup>c</sup></b>
Cinta Senese (CS) dry-fermented sausages (T)	0.9* Negative disconfirmation	0.3	-0.6*
CS dry-fermented sausages with natural antioxidant (IT1)	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

<sup>a</sup> Expected minus blind liking scores; <sup>b</sup> Informed minus blind liking scores  
 Informed minus expected liking scores; \*  $p < 0.05$

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584  
 585 **Table 7.** Acceptability scores (least square means  $\pm$  standard error) for the blind, expected and  
 586 informed test and their score differences by treatment (Toulouse).

	<b>Product</b>	<b>Blind</b>	<b>Expected</b>	<b>Informed</b>
Noir de Bigorre PDO ham, 24 months ripening	T	6.7 $\pm$ 0.14	7.2 $\pm$ 0.11 <sup>b</sup>	7.2 $\pm$ 0.10 <sup>a</sup>
Noir de Bigorre PDO ham 36 months ripening	IT1	6.7 $\pm$ 0.14	7.8 $\pm$ 0.11 <sup>a</sup>	7.4 $\pm$ 0.11 <sup>a</sup>
Iberian ham, 50% Iberian pig (IB)	Premium	6.8 $\pm$ 0.15	5.2 $\pm$ 0.15 <sup>c</sup>	5.9 $\pm$ 0.17 <sup>b</sup>

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

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

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	<b>E - B<sup>a</sup></b>	<b>I - B<sup>b</sup></b>	<b>I - E<sup>c</sup></b>
Noir de Bigorre ham, 24 months ripening (T)	0.5* Negative disconfirmation	0.5* Assimilation	0 Complete
Noir de Bigorre ham, 36 months ripening (IT1)	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

<sup>a</sup> Expected minus blind liking scores; <sup>b</sup> Informed minus blind liking scores Informed minus expected liking scores; \*  $p < 0.05$

593

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

	<b>Product</b>	<b>Blind</b>	<b>Expected</b>	<b>Informed</b>
Turopolje (TRP) dry-cured ham	T	6.6 $\pm$ 0.16	7.0 $\pm$ 0.17 <sup>a</sup>	7.0 $\pm$ 0.15 <sup>a</sup>
TRP dry-cured ham less salt	IT1	6.5 $\pm$ 0.17	6.6 $\pm$ 0.18 <sup>ab</sup>	6.6 $\pm$ 0.16 <sup>ab</sup>
TRP dry-cured ham less smoked	IT2	6.1 $\pm$ 0.17	6.7 $\pm$ 0.17 <sup>ab</sup>	6.6 $\pm$ 0.15 <sup>ab</sup>
Standard dry-cured ham	Standard	6.4 $\pm$ 0.17	5.2 $\pm$ 0.16 <sup>c</sup>	6.1 $\pm$ 0.16 <sup>bc</sup>
Premium dry-cured ham	Premium	6.4 $\pm$ 0.19	6.4 $\pm$ 0.15 <sup>b</sup>	5.9 $\pm$ 0.17 <sup>c</sup>

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

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

	<b>E - B<sup>a</sup></b>	<b>I - B<sup>b</sup></b>	<b>I - E<sup>c</sup></b>
Turopolje (TRP)	0.4	0.4	0
dry-cured ham (T)	Confirmation		
TRP dry-cured	0.1	0.1	0
ham less salt (IT1)	Confirmation		
TRP dry-cured	0.6*	0.5	-0.1
ham less smoked (IT2)	Negative disconfirmation		
Standard dry-cured	-1.2*	-0.3	0.9*
ham	Positive disconfirmation		
Premium	0	-0.5	-0.5
dry-cured ham	Confirmation		

<sup>a</sup> Expected minus blind liking scores; <sup>b</sup> Informed minus blind liking scores Informed minus expected liking scores; \*  $p < 0.05$

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