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QUALITY ATTRIBUTES AND HARMFUL COMPONENTS OF CURED MEATS: EXPLORING THE ATTITUDES OF ITALIAN CONSUMERS TOWARDS HEALTHIER COOKED HAM

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Abstract

In recent decades, processed meat consumers have drastically revised their consumption patterns and have gained an increasing awareness of related health concerns. Although several studies have examined the role of meat products in the human diet, we observed a certain scarcity in the multi-perspective approach to the health implications of cocked ham. Therefore, we decided to verify different sources of potentially unhealthy constituents by simultaneously analysing the role that saturated fats, salt and nitrites play in consumer perception. The purpose of this paper was to investigate consumer preferences for healthier processed meat, in particular the specific objective of this study was to evaluate the balance between intrinsic and extrinsic characteristics and the components or additives that could pose a risk to the health of consumers, by considering the sensory and marketing characteristics involved in the choice of cooked ham. With these aims, two different analyses on stated preferences were carried out: firstly, a principal component analysis was performed to identify the main consumer attitudes towards meat products; subsequently, a conjoint analysis was carried out in order to identify the descriptive attributes. The results show that the presence of high salt content and nitrites discourage the intention to purchase, as the presence of a high fat content also does, however at the same time, consumers attach importance to taste, colour and juiciness that are strongly influenced by the above mentioned potentially unhealthy compounds. The overall results are strongly consistent with previous studies but evidence a certain dichotomy between sensory properties and health attributes.

Keywords: *conjoint analysis, food additives, principal component analysis, processed meats*

Introduction

In recent decades, the increasing awareness of health concerns linked to meat have led consumers to drastically revise their consumption patterns, causing a modification of the global meat demand (Font-i-Furnol and Guerrero, 2014). Furthermore, growing concerns about the adverse effects on health deriving from inappropriate food consumption have emerged and existing literature has highlighted the importance of health issues related to processed meats (Grasso et al. 2014).

In particular, the presence of additives, such as nitrites and sodium chloride, in processed meat and their prolonged consumption might cause serious health implications for consumers (Sebranek and Bakus, 2007). In a similar manner, the addition of optional ingredients, such as glutamate and lactose may be an underlying cause of intolerances (Zhang et al., 2010; Cenci-Goga et al., 2012). Likewise, a particular emphasis has focused on fat content, indeed the literature on fat reduction in meat products is well documented, with many studies arguing that a prolonged high consumption of red and processed meat is associated with an increased risk of cancer in the distal portion of the large intestine (Chao et al., 2005; Larsson and Wolk, 2006; Micha et al., 2010; Pan et al., 2011).

Within this context, the meat industry faces the need to reduce these potentially harmful compounds by ensuring that their presence does not represent a safety issue. To this effect, European stakeholders and policy makers strongly believe that enhancing the healthy image of meat products is a priority (Hung et al., 2016b).

Although several studies have examined the nutritional role of meat products in the human diet (Sharma et al., 2013; Bohrer, 2017), we observed a certain scarcity in the multi-perspective approach to the health implications linked to the potentially harmful components. Various researches have explored the attitudes of consumers towards many meat products (Resurreccion, 2004; Hersleth et al., 2011; Balogh et al., 2016) but cooked ham, that is perhaps the most popular product in the processed meat market, has undergone limited scrutiny. In particular, no specific study was carried out on cooked ham.

Since the daily consumption of cooked ham is quite common throughout all European countries, cooked ham represents a rather interesting case study, given that it is one of most widespread meat products in Italy and is perceived as one of the healthiest products among processed meats (Di Vita et al., 2016a). For this reason, we decided to verify if consumers are effectively aware of the importance of not over consuming nitrite, fat, salt and other additives, and are thus potentially forgoing the consumption of meat or accepting a drastic reduction of their content.

The cooked ham we have analysed refers to a standard product, marketed on the whole national territory, and meets the standards for cooked cured ham reported in the Codex Alimentarius (2015).

It consists of essential ingredients, such as uncured ham and brine (a mixture of water and food-grade sodium or potassium nitrite) and optional ingredients, such as sucrose, inverted sugar, dextrose, lactose, maltose, honey, spices, water soluble aromatic hydrolysed protein and food-grade gelatine. Its quality depends on several factors that can be attributable to: meat cut type, processing technology, composition and quantity of brine, "rate and extent of tumbling or massaging", cooking time and temperature (Válková et al., 2007).

In the light of the current research regarding the role that experience and credence quality attributes have on consumer decision making, the aim of this paper is to assess the attitudes of Italian consumers towards cooked ham by simultaneously analysing their role in the consumer perception of cooked ham. Since this point remains largely unaddressed by the literature, more in detail, the specific objective of this study was to evaluate the balance between intrinsic and extrinsic characteristics and the different sources of potentially unhealthy constituents for consumer health such as saturated fats, salt, nitrites and additional additives, by considering the sensory and marketing characteristics when choosing cooked ham.

The balance between quality attributes and health in processed meat consumption: a literature review

The reasons underlying consumer preferences and the perception of quality of meat products are heterogeneous and they depend on sensory properties; however, they also depend on psychological and marketing aspects (Caracciolo et al., 2010; Font-i-Furnol and Guerrero, 2014).

In particular, the sensory properties appear to be closely related to the presence of compounds and additives, that besides having a conservative action may have potential adverse effects on the health of the consumer. The presence of fat improves the texture of meat and how the salt and nitrites exert a direct effect on flavour and taste (de Almeida et al., 2017).

Sensory analyses of cured and processed meats have been carried out in relative depth and several approach perspectives have been used to evaluate its quality parameters (Resurreccion, 2004; Di Vita et al., 2017). Sensory properties of meat products depend on several factors, related to the animal species, genotype, feeding, age, slaughter, ante and post mortem treatment, storage conditions and ageing period (Font-i-Furnol and Guerrero, 2014).

Concerning the sensory attributes of cured meat, the prominent role of taste in food choices of consumers is well established and it represents the most important sensory attribute (de Almeida et al., 2017). The texture of processed meat is a multi-parameter that involves tenderness and juiciness (Ruiz et al., 2002; Font-i-Furnol and Guerrero, 2014). These are both positively correlated to intramuscular fat content, although tenderness is directly related to fat content, which is not always

perceived as a positive attribute (Resureccion, 2004), whereas juiciness seems to be the most important characteristic in dry-cured ham acceptability (Ruiz et al., 2002). These two parameters, in addition to the appearance, are mainly influenced by intramuscular fat content and fatty acid composition, as reported by Ruiz-Carrascalet al. (2000) for dry cured ham. Additionally, other studies focusing on the sensory analysis of meat products, have highlighted the importance of flavour intensity and saltiness (Ruiz et al., 2002; Font-i-Furnol and Guerrero, 2014).

Despite the widespread scientific contribution on consumer acceptance based on sensory evaluation, for many processed meat products, such as, dry-cured ham, salami and sausages (Solheim, 1992; Ruiz, et al., 2002; Guardia et al., 2006; Sugimoto et al., 2016), consumer evaluation of sensory characteristics for cooked ham has been scarcely investigated.

Few studies have taken into account the chemical and sensory parameters together with consumer attitudes; in this direction a study based on the sensory aspects of cooked pork ham highlighted the importance of juiciness, tenderness and the absence of off-flavour (Bryhni et al., 2003). Finally, concerning consumer attitudes, another study was addressed to evaluate purchase intention, perceived healthiness and taste expectations towards sliced ham (Shan et al., 2017). For this reason, any sensory attributes discussed in this paragraph and stressed in the statistical analysis have been developed from analogous pork products in terms of organoleptic characteristics.

Among the extrinsic attributes ("non-sensory factors") the packaging, the freshness and national origin of product were considered, since they affect consumer perception of the product by creating "expectations, as they represent the first contact between an individual and a product" (de Almeida et al., 2017). Previous studies have also argued that information concerning the country of origin has to be taken into account, given it represents an important factor during the purchasing process for many traditional meat products (Balogh et al., 2016). Finally, to the knowledge of the authors, no recent research about the credence attributes of cooked ham has been identified, consequently, several aspects still require further in-depth examination.

On the other hand, several studies have argued the harmful effects that many compounds of processed meat may have. In particular, the high levels of fat, sodium and nitrites in processed meat have been deemed as potentially harmful for the human metabolism.

Sodium overconsumption has been associated to hypertension and to an increased risk of stroke and cardiovascular diseases (Kameník et al., 2017). For this reason, the World Health Organization (WHO) has published precise recommendations to reduce sodium overconsumption for adults and children (WHO, 2012), and an overall consensus in the need for a drastic reduction of salt content has been observed (Ruusunen and Puolanne, 2005; Inguglia et al., 2017). The risk deriving from salt overconsumption is relatively high when consuming meat products, since they represent one of

the main sources of sodium among processed foods (Desmond, 2006). Guàrdia et al. (2006) in assessing the acceptability of reduced-salt meat products, demonstrated that the replacement of sodium chloride by potassium chloride and a subsequent 50% reduction of salt contents, motivates consumers, especially women, to gain a positive attitude towards fermented sausages with a reduced sodium content. Mendoza et al., (2014) pointed out that males and respondents with a low level of education are the least engaged in health issues linked to salt reduction for salty cold cuts such as; ham, salami, bacon and smoked meats. In any case, a recent study showed that labels indicating a salt reduced product have little influence on the acceptance of processed meat (de Almeida et al. 2017). Nevertheless, recent literature argues that salt content can be reduced without altering the sensorial properties, since the salty taste intensity is not dependent on the sodium content (Kameník et al., 2017).

Recent strategies to reduce the content of sodium in meat products have taken into account the use of flavour enhancers such as monosodium glutamate (Inguglia et al., 2017); however, glutamate can pose a potential risk for consumers affected by food intolerances (Patriarca et al., 2009).

The role of sodium is often interrelated with the action of nitrites, since the use of nitrites and nitrite as the preservation method for the processing of meat products dates back to ancient times and is currently firmly established (Honikel, 2008). Sodium and potassium salts of nitrites and nitrates, are commonly used in curing mixtures to increase and fixate the meat colour, to prevent microbial activity and to enhance characteristic flavours (Sindelar and Milkowski, 2012; Mortensen et al., 2017). Nevertheless, recent studies argue that their intake can contribute to cancer in consumers since they modify the acidic environment of the stomach; nitrite may form carcinogenic nitrosamines (Honikel, 2008; Merino et al., 2016). The issue surrounding processed meat consumer attitudes towards nitrites and nitrite has not been fully addressed and the empirical evidence on this matter is limited. An initial survey investigates purchase intention towards processed meat products with a reduced level of nitrite (Hung et al., 2016b). Nitrites have a negative health image for consumers, who on the contrary perceive the natural compounds from fruits and vegetables, added as chemical additives, to be natural and healthy (Hung et al., 2016a). Although consumers have scarce knowledge about the nitrites added to meat products, they are positively inclined to replace nitrites in processed meat by products containing phytochemicals, for example celery or red beet (Hung et al., 2016b). Similarly, the results obtained by Sindelar et al. (2007),indicate that powdered vegetable juice can replace the role of nitrites in the manufacture of cured ham, providing similar quality and sensory attributes as traditionally cured hams.

With reference to other additives, such as lactose and glutamate, no previous studies have been performed to verify their role in consumer choices of processed meats, however the presence of this

compound is very interesting from the perspective of health consequences as it may induce intolerances(Zhang et al., 2010; Cenci-Goga et al., 2012).

Conversely, the role of fat in consumer preference for cured meats has been taken into account by several studies. Many authors highlighted the negative role of fat overconsumption, and a particular emphasis has been placed on the fat content of processed meat on human health (Kähkönen and Tuorila, 1998; Michaud et al., 2003; Nöthlings et al., 2005). The fat content in cured meat products varies significantly from product to product, and the different production methods adopted (Grasso et al., 2014), in addition, fat in cured meat is normally perceived negatively by consumers (Grunert, 1997). It usually has a detrimental effect on the willingness to eat and to purchase these products; in particular, high intramuscular fat in cooked ham does not influence any sensory properties other than marbling (Resurreccion, 2004). In a study carried out on fat-reduced sausages, it was shown that when texture and saltiness are similar to the standard, the hedonic responses of consumer are not affected (Solheim, 1992). Finally, many studies showed how consumer purchase intentions for processed meat are strongly affected by price (Shan et al., 2017; Resurreccion, 2004).

Methods

Data collection

The survey was conducted in 2016, in the metropolitan area of Catania, located in Sicily, to evaluate the influence of quality attributes on consumer attitudes. Data was collected by administering a face-to-face questionnaire, containing closed-ended questions, to 499 regular consumers who usually purchase and consume processed meats. Respondents were randomly selected to achieve a balanced sample, in terms of socio-demographic characteristics, of Italian consumers from metropolitan areas. Consumers were intercepted and interviewed at large retail stores in order to capture a random population of consumers in a real shopping environment (Panzone et al., 2016; Di Vita et al., 2016b).

The interviews were directed to habitual consumers of processed meats in order to identify the importance of the main attributes as argued in recent literature. Before being administered, the questionnaire was pre-tested and partially adjusted by performing minor changes and revisions required as a result of the pre-test.

Table 1-The socio-demographic characteristics of the sample

Category	Variable	N.	%
Gender	Male	263	52.7
	Female	236	47.3

Age	18-30	214	42.9
	31-45	168	33.7
	46-60	82	16.4
	>60	35	7.0
Education	Primary	137	27.5
	Secondary	180	36.1
	Graduate/Post graduate	182	36.5
Monthly family Income	<1,500 €	353	70.7
	1,500-3,000 €	56	11.2
	3,001-4,000 €	6	1.2
	>4,000 €	0	0.0
	N/A	84	16.8

Two different analyses on stated preferences were carried out: firstly, a principal component analysis was performed to identify the main attitudes of consumers of meat products; subsequently a conjoint analysis was carried out in order to identify any descriptive attributes.

Principal Component Analysis

The principal Component Analysis (PCA) was performed in order to identify the main attributes influencing the attitudes of Italian consumers towards processed meat and to identify different consumer categories.

PCA enables the exploration of a set of interrelated variables, without imposing any fixed structure of the outcome and it is widely employed where quantitative result measurements produce results useful in making critical decisions (Vlontzos et al. 2018). In addition, this methodology reduces the number of initial variables and summarises them in a limited number of components, enabling the interpretation of complex multivariate data (Asioli et al., 2014).

Initially, the correlation between all the variables was analysed using a correlation matrix and considering the minimum correlation value of 0.3, to define a variable suitable to initiate the process of factor reduction. The suitability of the sample was analysed using the KMO index, whereas the Bartlett sphericity test was performed in order to verify the hypothesis that the correlation matrix coincided with the identity matrix. Finally, the extraction of the factors was based on the Varimax rotation, in order to maximise the sum of the variance of the squared loadings. A correlation value between the coefficients, identified by the KMO index, above 0.5 indicated suitable data for PCA and greater than 0.8 is considered "very good". Whereas, the hypothesis of the Bartlett's sphericity test is that the correlation matrix is an identity matrix, and when p-value <

0.05, this indicates that a factor analysis may be performed. In order to determine how many components to retain, the eigein value-one criterion method and the scree plot test were chosen, following the criterion that the components must explain at least 60% of the total variance. The analysis was carried out using the SPSS 25.0 software package for Windows.

Concerning the PCA, the identification of the variables has been deduced from the main scientific contributions regarding sensorial analysis and consumption of processed meat. In particular, the attributes we employed for the multivariate analysis were mainly derived from previous studies on processed meat, as reported in Table 2.

Among the other attributes, we analysed the most important sensory traits, such as colour, spiciness and odour (Bryhni et al. 2003), together with ham freshness (Kerry et al. 2006). Finally, since salt reduction, fat content (Gaviglio and Pirani 2015) and nitrites (Honikel 2008; Sebranek and Bacus 2007) affect texture, flavour and colour (Inguglia et al., 2017), we decided to verify if these potentially harmful characteristics were still important for respondents.

Tab. 2 –Variables employed in the PCA from survey data

Glutamate	Zhang et al., 2010
Lactose	Cenci-Goga et al., 2012
Nitrites	Honikel, 2008; Arihara, 2006
Fat	Kähkönen and Tuorila,1998; Arihara, 2006
Spiciness	Tomović et al., 2017
Taste	Kameník et al., 2017; Inguglia et al., 2017
Colour	Bryhni et al., 2003; Kameník et al., 2017
Odour	Bryhni et al., 2003; Font-i-Furnol and Guerrero, 2014
Tenderness	Bryhni et al., 2003, Ruiz et al., 2002
Flavour intensity	Ruiz et al., 2002; Inguglia et al., 2017
Juiciness	Bryhni et al.,2003; Font-i-Furnol and Guerrero, 2014; Kameník et al., 2017
Packaging	Resurreccion, 2003; Chen et al., 2013
National (Italian) origin	Balogh et al., 2016
Freshness	Kerry et al., 2006
Saltiness	Ruiz et al., 2002

Conjoint analysis design

Conjoint analysis (CA) is widely considered a worthwhile methodological approach to test and assess the consumer acceptance of novel products, that as such, are not yet widely available on the market (Cardello et al., 2007; Annunziata and Vecchio, 2013). Furthermore, it has also been employed in studies concerning consumer acceptance of healthier processed meat (Shan et al., 2017). For this reason, CA was deemed as a useful method to assess the health concerns of

consumers towards meat products, thus also evaluating consumer acceptance of cooked ham with a reduction and/or absence of potentially harmful components.

Regarding the conjoint design, bundles of attributes derived from existing literature were considered before selecting and including them in the conjoint experiment. These attributes included in the CA were obtained by taking into account the perception that consumers have towards the potentially harmful compounds of processed meat, in order to verify if consumers are effectively aware of the implications of these products for their own health. In particular, the choice of attribute and level was supported by previous studies highlighting the increased potential risk deriving from a high intake of salt, fat and nitrites (Arihara, 2006). These were combined with the outcomes derived from specific focus groups. The final conjoint card was definitively structured by results and information obtained from previous focus groups. Two focus groups were established in order to verify the most significant items to include in the final conjoint card. The first focus group was conducted by discussing the health issues surrounding processed meat products, with the following experts: technical consultants, food technologists and agri-food economists. Subsequently, a second focus group was held by interviewing a group of selected consumers. They were asked to express their opinion with regard to the attributes they take into consideration when purchasing processed meat and cooked ham, with the aim of representing the complex and multiple views of respondents (Marvulli, 2008; Zarbà et al., 2013). Finally, the conjoint card was checked through a pre-test in order to identify any misleading questions (Lingua et al., 2018).

The interviews were full-profile and were elaborated using SPSS 15.0 software for Windows, which helped to categorise the combinations of attributes capable of maximising the utility for the consumer; consequently, the rule of additive linear composition was applied. The initial subset consisted of a high number of combinations, due to different attributes and levels; consequently, we used an unbalanced fractional factorial design to reduce the number of profiles that consumers had to evaluate.

Respondents were presented with nine different cooked ham profiles, differing in terms of price (1.10€; 2.70€; 3.30€), salt content (normal or reduced), nitrites (present/absent) and fat content (low/medium/normal). Consumers were requested to state their preferences by ranking the different alternatives, based on their personal level of acceptance (Annunziata and Vecchio, 2013).

The final set of combinations that enabled the estimation of the part-worth utility is shown in Table 3, reporting the cooked-ham profile obtained by the algorithm based on four different attributes and levels.

Tab. 3 –The profiles of nine ham typologies derived from orthogonal design

Option	Price (€)	Low-salt content	Presence of nitrites	Fat content
1	1.10	No	yes	low
2	1.10	Yes	yes	low
3	2.70	Yes	yes	medium
4	2.70	Yes	no	low
5	2.70	No	yes	high
6	3.30	Yes	yes	high
7	3.30	Yes	yes	low
8	1.10	Yes	no	high
9	3.30	No	no	high

Results

a) Results of PCA

This section reports the results of the PCA, which are displayed in Table 4. As the correlation matrix showed that all the variables have a correlation higher than 0.3, they were all included in the processing of the factor reduction. In addition, the results of the KMO tests (0.80) and the Bartlett test (Approx. Chi-Square 6146.264, df 190, Sig. 0.000) indicate the adequacy of the sample. The application of the factor reduction method allowed the 20 original variables to be reduced to 4 components, based on the results of the application of the eigein the value-one criterion method. Therefore, the strength of the choice has been confirmed by the scree plot test. The final four components allow a reflection of 63.6% of total variance, explaining respectively 30.2%, 19.0%, 8.2%, and 6.1% of the variance.

The first component extracted (C1) identifies the factor related to "**misinformed and unhealthy consumption**" of cooked ham. This component is positively correlated to sensory parameters such as the presence of fat in the slice (+0,828), the presence of spices (+0,786) and the taste as a whole (+0,669). This last outcome partially confirms what was also stated by Martinez (2010), whereby the sensory characteristic is considered as the main driver of food products. Surprisingly, this component also includes a positive correlation with those variables reported in the label considered as allergenic, such as glutamate (+0,958) and lactose (+0,936), or not completely healthy, such as nitrites (+0,925). It is likely that this outcome implies a scarce knowledge of said components by these respondents and consequently indicates a low level of information of what constitutes a balanced diet, together with a low level of interest towards the real provenance and composition of cooked ham.

This hypothesis seems to be confirmed by the fact that people with a high educational level are attentive to the absence of additives in processed meat, as indicated by the negative correlation with the level of education (-0,506) and by the negative correlation with an interest in the origin of the

product (-0,463). This first component proves that some of the most important constituents, such as fat and nitrites, which are deemed to be potentially harmful by current medical literature, are not considered to be so unhealthy by these respondents.

The second component (C2) is related to the "**sensory-based processed meat consumption"** given the positive correlation with many sensory properties, such as the colour of ham (+0.839), the odour (+0.825) and the texture related to tenderness (+0.818), together with flavour intensity (+0.784). This component is characterised by the high prevalence of intrinsic attributes, it represents the consumer who also prefers the freshly sliced product (+0.375), local origins (+0.377) and appreciates a normal salt content in cooked ham (+0.432). Additionally, the consumers included in this component do not display a particular awareness for potentially harmful components, but make their choices based on the sensorial and pleasurable attributes of ham, as they are more focused on the hedonic sensory experience.

The third component (C3) identifies "**fast cooked ham consumption**". This component is characterised by young consumers (-0,652), mainly male and frequently single (-0,537), who choose the sliced and packaged ham (+0,631) and who have no interest in the intrinsic characteristics of the product, except for the origin, which they prefer to be Italian (+0,361).

The fourth component (C4) categorises the "**price-sensitive consumption**", showing a positive correlation with low income (-0,582) and, consequently, it identifies an extremely price-sensitive consumer (+0,684), who prefers the fresh option (+0,378) but has no interest in the sensory elements, with the exception of saltiness (-0,483), a variable to which this consumer assigns negative importance.

Table 4 –PCA Results (Rotated Component Matrix) from survey data.

	Rotated Component Coefficients			
Items	1	2	3	4
Glutamate	**0.958**	-0.060	0.036	-0.079
Lactose	**0.936**	-0.067	0.029	-0.103
Nitrites	**0.925**	-0.060	0.061	-0.173
Fat	**0.828**	-0.030	0.151	-0.157
Spices	**0.786**	-0.091	0.058	-0.274
Taste	**0.669**	**0.445**	0.032	0.045
Education level	**-0.506**	0.306	0.305	0.041
National (Italian) origin	**-0.463**	**0.377**	**0.361**	0.342
Colour	0.002	**0.839**	-0.099	0.140
Odour	-0.259	**0.825**	0.161	0.127

Juiciness	-0.239	**0.818**	0.180	0.142
Fragrance	-0.042	**0.784**	-0.050	-0.153
Texture	0.222	**0.771**	-0.192	0.010
Age of consumers	0.121	-0.070	**-0.652**	0.230
Packaging	0.299	-0.279	**0.631**	0.099
Gender	-0.085	-0.029	**-0.537**	-0.068
Price	-0.197	0.055	0.044	**0.684**
Individual income	0.119	-0.158	0.344	**-0.582**
Saltiness	0.112	**0.432**	-0.098	**-0.483**
Freshness	-0.294	**0.375**	0.208	**0.378**

Note: major loadings for each item are in bold

b) Results of CA

The results of the conjoint analysis are reported in Table 4. Part-worth utilities of attribute levels show that the high health implication awareness of the sample to fat content and only subsequently, to the presence of nitrites, gives cause for concern. The high values of Pearson's R and Kendall's tau show that the conjoint analysis fits the data well. Consumers assigned the highest mean importance to low fat content (44.4%). This first result is consistent with previous research (Shan et al., 2017) and it can be considered as an encouraging signal for retailers and producers, who maintain that fat content reduction is easier to achieve than nitrite reduction (Hung et al., 2016b).

The second most important attribute was the level of nitrites (22.25%). This last outcome corroborates the results deriving from earlier experiments, addressing stakeholder and consumer reactions towards processed meat products with nitrite reduction, thus confirming the strong consumer interest in innovative meat products having potential health benefits (Hung et al., 2016b). It must however be emphasised as both producers and processers have argued, that the reduction of nitrites is more difficult to achieve when compared to other additives, given their multiple functionalities (Hung et al., 2016b).

At the same time, this outcome reveals that consumer attitudes and purchases are negatively influenced by presence of chemical additives, verifying the "perceived harmfulness" of these additives (Hung et al., 2016b), thus confirming a certain consumer awareness of health risks linked to nitrite additives in food.

Quite relevant, though to a slightly lesser extent than the two previous attributes, is the mean importance of low salt content (19.49%). This result is supported by previous studies on salt reduction. In this respect, some authors provided evidence that a 40% reduction of salt enables a

healthier product to be obtained, with a good texture, ensuring high acceptance for this sensory quality by consumers (Pires et al., 2017).

On the contrary, some respondents seem to be strongly price-sensitive, since they prefer ham with the lowest price. This last outcome seems to lead to an inconsistent indication, considering that a nitrite-free product and with a limited amount of salt and fat certainly implies a cost increase for producers and therefore a product with a higher price than traditional cooked-ham. However, this result aligns to a recent study showing that consumer purchase intention for processed meat is strongly affected by price (Shan et al., 2017).

The ideal profile of cooked-ham is a product with a low salt content, without nitrites and with a low-fat content but at the lowest average price (1.10 €/hg). Again, this outcome evidences a high awareness by consumers for their health, whereas, at the same time, it shows a relatively limited propensity to pay, as consumers are not inclined to purchase at the higher prices for healthier processed meat products.

A certain caution must be exercised when interpreting these results. In fact, whether it is true or not that the consumer negatively perceives the presence of the three compounds, recent studies have established that a healthier reformulation of processed meat has a relatively low impact on taste expectations and as a consequence, preference towards reformulated meat products are not homogenous among consumers (Shan et al., 2017).

Table 5 – Conjoint analysis results

Average Importance	Factor	Level	Utility
13.86%	**Price (€/hg)**	1.10	.5751
		2.70	-.2849
		3.30	-.2902
19.49%	**Low-salt content**	No	-.6087
		Yes	.6087
22.25%	**Presence of nitrites**	Yes	-.6947
		No	.6947
44.41%	**Fat content**	High	-1.2889
		Medium	-.1956
		Low	1.4844

Pearson's R =0.977

Kendall's tau=0.944

Discussion

In this section we present the main findings and debate them according to the results of the different methodological approaches: PCA and CA.

The overall results of both approaches are strongly consistent with previous studies (Hung et al., 2016b) but present some new elements in the balance between the sensory and healthy characteristics of cured meats. The results deriving from the PCA corroborate previous findings, arguing that the characteristic taste is the main driver of processed meat consumer preferences (de Almeida et al., 2017; Verbeke, 2006; Hersleth et al. 2011); only "hasty ham consumers" or those who are price-sensitive do not place importance on this attribute.

In addition, it emerges that tenderness, fragrance and texture are equally important sensory attributes. Our results are consistent with a previous study on consumers liking for cooked pork, whereby juiciness and tenderness are considered as the most important attributes (Bryhni et al., 2003), they also confirm the findings of Válková et al., (2007) showing that the most important parameters that influence consumer perception of ham quality are texture and colour. The findings are also confirmed by Cornforth and Jayasingh (2004), who found that the effect of colour in cured meats was crucial for consumers during retail purchases.

Furthermore, since the present study corroborates the fact that consumers are increasingly oriented towards healthier and more sustainable meat products (Jiménez-Colmenero et al., 2001), our findings indicate a scarce correlation between sensory parameters and health issues, reinforcing the low propensity of consumers to compromise between flavour and healthiness, as stated by Verbeke (2006). In addition, since biotechnological literature has identified the anti-oxidative effect of some functional and natural ingredients, such as vegetable proteins, dietary fibres, herbs and spices in meat products (Fernández-Ginés et al., 2005; Zhang et al., 2010; Tomovic et al., 2017), the appreciation for spiciness, shown by one of the components examined, seems to be one of the strategies that could potentially be adopted by meat producers.

Moreover, our results confirm, as revealed in other studies (Ni Mhurchu et al. 2010), the importance of the educational level of processed meat consumers, which is directly correlated with the level of knowledge of the products (see component 1).

Concerning the gender of consumers, our results shows that the consumer profile identified by component 3, as young and male, is quite consistent with a previous study that highlights that male and elderly people express the highest appreciation for cooked pork (Bryhni et al., 2003).

As stated by other authors (Kuhne et al. 2010), traditional foods, such as cooked ham, are among the main products involved in innovation processes to meet consumer acceptance. In particular, a high acceptance rate is attributed to packaging and labelling that guarantees the origin (Iaccarino et

al. 2006). Although consumers generally perceive packaged meat products as easy to handle and store and packaging of meat products is performed for the consumer's convenience (Resurreccion, 2004), our study evidences that only one component attaches importance to packaged cooked ham, whereas two components prefer freshly sliced cooked ham. Consequently, freshness can be considered a very important attribute for Italian consumers of cooked ham. Furthermore, our work shows that the consumer who pays attention to sensory aspects is not interested in the Italian origin of the product; this negative correlation is quite evident, both for the traditional consumers and especially for the 'hasty' component.

The results of the CA prove that consumers are conscious of the health risks associated with processed meat consumption, thus confirming the awareness to buy healthier processed meat products as evidenced in similar studies (Hung et al., 2016a; Xazela et al., 2017). In addition, the results evidence that a high salt and fat content and the presence of nitrites discourage the intention to purchase, however at the same time, consumers attach importance to taste, colour and juiciness that are strongly influenced by the above mentioned potentially harmful compounds.

Thus, the reduction of the salt content represents one of the major issues for the processed meat sector (Desmond, 2006), especially for those with consumers oriented towards healthier lifestyles. In this direction, the results of the conjoint analysis evidence the high awareness of consumers in relation to these chemical additives and therefore, the ideal profile of cooked ham is a product with a low salt and fat content and without nitrites.

As demonstrated by Andrade et al. (2017), the wholesomeness of the product, especially linked to factors such as the low presence of salt, is an element highly considered by consumers in the choice of a meat product.

Behaviours and attitudes towards salt reduced products were studied by Mendoza et al. (2014), illustrating that males and respondents with a low level of education are the least interested in health concerns linked to salt reduction, in salty cold cuts such as ham, salami, bacon and smoked meats.

Conclusion

In view of the paucity of studies regarding cooked ham consumer attitudes, this paper aimed to fill the gap in the literature by presenting the results of a study on cooked ham consumers. The objective of this research was to gain an insight of consumer perception towards cooked ham attributes, linking their importance to the potentially harmful compounds commonly included in these products (fat, salt and nitrites).

Results derived from both methodological approaches support that the reduction of salt, fat and additives, in addition to the substitution of glutamate and the enhancement of traceability for meat products were the priorities.

Nevertheless, some aspects of the preference and decision-making processes are not univocally interpretable, since there is a certain dichotomy between sensory properties and health attributes.

Consumers do not make a direct correlation between sensory properties and the ingredients of cooked ham that are potentially harmful to their health. The respondents show a scarce awareness of the aspects related to healthy consumption and demonstrate a very limited knowledge of the main risk factors for their health, especially when the elements associated to hedonic (sensory) pleasure take over.

The question is totally different when the healthier characteristics are analysed separately from the sensory attributes, as in the conjoint analysis. In this case, respondents would be more willing to purchase ham with reduced or absent salt, fat and nitrite contents, but only when paying a relatively low price.

These apparently contradictory results certainly merit further investigation given that they represent a limitation of this work. For this reason, there are still several aspects that deserve a more in-depth examination for each specific product and further research should address the investigation of the preference of consumers for cooked ham enriched with other compounds, able to reduce the health risks for habitual consumers of processed meat.

Finally, our results have important managerial implications for the processed meat industry, which is called to gradually test and introduce innovative forms of cooked ham, characterised by healthier characteristics and with less additional ingredients and additives.

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