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Factors affecting dry-cured ham consumer acceptability

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ABSTRACT

The objectives of the present study were (1) to compare the relative importance of price, processing time, texture and intramuscular fat in purchase intention of dry-cured ham through conjoint analysis, (2) to evaluate the effect of dry-cured ham appearance on consumer expectations, and (3) to describe the consumer sensory preferences of dry-cured ham using external preference mapping. Texture and processing time influenced the consumer preferences in conjoint analysis. Red colour intensity, colour uniformity, external fat and white film presence/absence influenced consumer expectations. The consumer disliked hams with bitter and metallic flavour and with excessive saltiness and piquantness. Differences between expected and experienced acceptability were found, which indicates that the visual preference of consumers does not allow them to select a dry-cured ham that satisfies their sensory preferences of flavour and texture.

1. Introduction

Food perception and selection is a multifactor process where our five senses, physiological, psychological aspects and extrinsic factors participate. All these factors may influence consumer preferences and lead to the acceptance or rejection of a food (Axelson & Brinberg, 1989; Stafleu, Graaf, Staveren, & Schroots, 1991/2).

Dry-cured ham is an important food product in the Mediterranean area. Visual impressions based on perceived intrinsic and extrinsic cues are important inputs that may generate quality expectations in meat products (Bello Acebrón & Calvo Dopico, 2000). In dry-cured ham, Resano, Sanjuán, Cilla, Roncalés, and Albisu (2010) found in Spanish and French dry-cured hams that consumer and trained panellist gave high values for crumbliness, softness, flavour and sweetness whereas high mould odour, high saltiness and crust were valued as negative by both panels. In addition, they found a certain degree of heterogeneity in consumers' preferences, highlighting clusters with opposite liking trends. On the other hand, Norwegian consumers preferred lower salt level and longer ageing of hams than a higher salt level and shorter ageing time (Hersleth, Lengard, Verbeke, Guerrero, & Næs, 2011) whereas the Spanish consumers paid special attention to appearance, especially, colour and fat content of the dry-cured ham (Guàrdia, Aguiar, Claret, Arnau, & Guerrero, 2010). In a survey study on butchers and consumers Morales, Guerrero, Claret, Guàrdia, and Gou (2008), found that butchers considered salty taste and their experience as the factors most important that affect the consumer's decision to purchase, whereas the consumers consider sensory attributes (aged flavour, smell, intramuscular fat, texture colour and salty taste) more important than extrinsic characteristics when purchasing dry-cured ham (Morales et al., 2008). However, little information has focused on how sensory properties may affect dry-cured ham preference.

The objectives of the present study were (1) to compare the relative importance of price, processing time, texture and intramuscular fat in purchase intention of dry-cured ham through conjoint analysis, (2) to evaluate the effect of dry-cured ham appearance on consumer expectations, and (3) to describe the consumer sensory preferences of dry-cured ham using external preference mapping.

2. Materials and methods

2.1. Ham selection and sample preparation

Six raw hams with different pH levels (ranging from 5.5 to 6.2) were selected from a batch of 68 hams. The pH was measured on the *semimembranosus* muscle at 24 h post-mortem in abattoir. They were salted for different periods of time (6 d or 14 d) in order to achieve different salt contents and subsequently were processed in traditional way (approximately 12 months of process), i.e., all the hams were salted at 36 h post-mortem with a mixture (per kg of raw ham): 0.5 g KNO_3, 0.3 g $NaNO_2$ and 10 g NaCl, and subsequently were covered with dry salt and piled up at 3 °C ± 2 °C for 6 d or 14 d depending on the salting treatment. In order to increase the differences in salt content among the different salting treatments, the heaviest hams within each pH group (12.5 kg to 14 kg) were assigned to the 6-day-salting treatment whereas the lightest ones (9.5 kg to 11 kg) to the 14-day-salting treatment. After salting, the hams were washed with cold water and hung in a post-salting room at 2 °C ± 2 °C and 78% ± 2% RH for 62 d (resting period).

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Subsequently, the hams were dried: 34 d at 11 °C ± 2 °C and 70%–80% RH; 10 d at 12 °C ± 2 °C and 60%–75% RH; 106 d at 14 °C ± 2 °C and 50%–65% RH; 126 d at 18 °C ± 2 °C and 40%–55% RH; and 10 d at 18 °C ± 2 °C and 40%–55% RH. The lean surface of the first hams that reached a weight loss of 28.5% was covered with a layer of melted fat to slow down the drying rate. Ham weight losses were monitored until achieving a final weight loss of 33%.

The combination of different pH and salt content was selected in order to obtain clearly different samples regarding sensory characteristics (Arnau, Guerrero, & Gou, 1997; Guerrero, Arnau, Maneja, & Gou, 1993). The pH values and NaCl contents of hams used in the present study are shown in Table 1.

At the end of the drying process, the hams were boned, faced level with the head of femur and sliced (1-mm-thick) perpendicularly to the femur axis from the distal part. The first 14 slices were used for descriptive sensory analysis (trained assessors) and the rest of them (80 slices) were individually vacuum-packed in skin trays for expectations and preference mapping. The sequence of slicing was standardized to avoid the influence of slice position in the consumer perception. i.e., the first consumer evaluated the first slice in all hams, and so forth.

The remains of each ham were minced, vacuum-packed and kept at −18 °C ± 2 °C for NaCl content analysis. The NaCl content was measured using a Technicon™ AutoAnalyzer™ II (Bran+Luebbe GmbH, Norderstedt, Germany) based on the photometric method described by Zall, Fisher, and Garner (1956).

2.2. Sensory descriptive analysis

A seven-member trained panel performed the sensory analysis in one session. The assessors were selected and generically trained following ASTM (1981) and ISO standards and all of them had more than eight years of experience in quantitative descriptive analysis of dry-cured ham. Each assessor received two slices and evaluated visual appearance. Afterwards, they assessed flavour of the first slice and texture of the second one. The descriptors of visual appearance (Red colour intensity, colour Uniformity, external fat, marbling and scoring of white film), flavour (metallic, sweetness, saltiness, piquantness, bitterness, matured and aged) and texture (hardness, pastiness, crumbliness, adhesiveness and fibrousness) were quantified using a non-structured scale ranging from 0 (absence) to 10 (maximum intensity; Guerrero, Guàrdia, & Arnau, 2005). The sensory laboratory was designed according to ISO standards with separate booths, and the samples were evaluated blocking the order of presentation and the first-order carry-over effect (MacFie, Bratchell, Greenhoff, & Vallis, 1989). The average scores of the panel for each sample were calculated.

2.3. Consumer test

Eighty consumers were recruited in Barcelona and Girona provinces (Catalonia-Spain) in terms of age, gender and education level in accordance with social-demographic characteristics of Catalonia through quota sampling (IDESCAT, 2006). Social-demographic characteristics of consumers are shown in Table 2. The study was carried out between October and November 2006.

Table 1
pH and NaCl content of dry-cured ham used.

	Hams salted for 6 d			Hams salted for 14 d		
	A	B	C	D	E	F
pH[a]	5.59	5.82	6.18	5.65	5.72	5.92
NaCl content (%)	4.66	4.50	4.01	6.45	5.83	5.77

[a] pH measured on the *semimembranosus* (SM) muscle at 24 h post-mortem.

Table 2
Socio-demographic characteristics of consumer participants.

	(*n* = 80) %
Age	
<30	20.0
30–65	61.3
>65	18.7
Gender	
Male	48.8
Female	51.2
Education level	
Primary education	47.5
High school/professional training	32.5
University graduate	20.0

2.3.1. Conjoint analysis

The different attributes and levels were selected: processing time (9 months, 12 months and 18 months), intramuscular fat (high, intermediate and low), texture ("soft", "not soft nor hard" and "hard") and price (12 €/kg, 25 €/kg and 44 €/kg). By combining four attributes and three levels per attribute, 81 different profiles were obtained, which was considered an elevated number of products for consumer testing. Therefore, an incomplete factorial design was used thus reducing the number of combinations to nine. Additionally one different card was created. Thus, a set of ten cards with hypothetical dry-cured ham product was designed (Table 3). Examples of cards used in the present study are shown in Fig. 1. Consumers were individually interviewed at their homes where they received these cards and were asked to sort them according to their preference: from the most appreciated one (score 1) to the least appreciated one (score 10). This test was also carried out following a balanced block design for position and carry over effects (MacFie et al., 1989).

2.3.2. Expected acceptability

Each consumer was interviewed at home by one of the authors of the present study. The consumer received a vacuum-packed slice from each ham (n= 6), one by one, in a skin tray codified with random three-digit number. Then, he/she was encouraged to evaluate the expected acceptability for each sample without opening the tray. The expected acceptability is the result of visual impressions based on perceived sensory attributes.

The expected acceptability of consumers was quantified using a nine-point hedonic scale from "I expect to dislike extremely" (score 1) to "I expect to like extremely" (score 9).

2.3.3. Experienced acceptability

Another set of the six samples was provided with random codes different to the previous evaluation so that the consumer could not recognize or memorize the codes of the samples between the two

Table 3
Attribute levels included in the cards presented to the consumers in the conjoint analysis.

Cards	Price (€/kg)	Texture	Intramuscular fat content	Processing time (months)
1	44	Medium	High	9
2	44	Hard	Low	12
3	25	Soft	High	12
4	25	Hard	Intermediate	9
5	25	Medium	Low	18
6	12	Hard	High	18
7	12	Soft	Low	9
8	44	Soft	Intermediate	18
9	12	Medium	Intermediate	12
10	44	Medium	Intermediate	18