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Effect of intramuscular fat content and serving temperature on temporal sensory perception of sliced and vacuum packaged dry-cured ham

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ABSTRACT

The present study aimed to evaluate the influence of three serving temperatures (7 °C, 16 °C and 20 °C) and two different ham sections varying in the intramuscular fat (IMF) content on the sensory characteristics of sliced and vacuum-packaged Iberian dry-cured hams using the time-intensity (TI) method. Preceding the TI study, appearance and odour of dry-cured hams were evaluated using a descriptive profile. Fluidity and brightness of the external fat, brightness of lean and all odour attributes increased as serving temperature increased whereas the hardness of external fat decreased with temperature. Oral temperature would have disguised the effect of serving temperature over time as a consequence of a possible balance between both temperatures during samples' consumption. TI revealed that the effect of serving temperature on flavour and texture perception was more noticeable along the first seconds of chewing. Odour intensities increased with the IMF content and temporal perception of hardness, saltiness and rancid flavour were also significantly influenced by the IMF content.

1. Introduction

Sensory characteristics are of a great importance for consumer preferences and satisfaction with foods (Tuorila & Monteleone, 2009). In fact, flavour and texture have a clear relationship to meat palatability (Behrends et al., 2005; Calkins & Hodgen, 2007).

The serving temperature influences the ratings of sensory attributes (Engelen et al., 2003) being an important factor affecting both acceptability and intensity of odour and flavour attributes. The effect of serving temperature on flavour perception depends on the food and the sensory attribute evaluated (Ventanas, Mustonen, Puolanne, & Tuorila, 2010). Moreover, product temperature could influence the viscosity of the product and the ratio of solid and melted fat and thereby affects the quality and the thickness of the oral coating formed during product consumption (Engelen et al., 2003).

Iberian dry-cured ham is one of the most valuable derived meat products of Spain, with a first-rate consumer acceptance. This high consumer preference is mainly sustained on its unique and much appreciated sensory features, being the juiciness and flavour the most important properties in determining Iberian dry-cured ham acceptability (Ruiz, García, Muriel, Andrés, & Ventanas, 2002). Traditionally, Iberian dry-cured hams have been sold as the whole leg including the hoof whereas current purchasing trends involve portioning such as in sliced and vacuum-packaged dry-cured hams.

Dry-cured ham is generally recommended to be consumed at room temperature in order to improve the perception of its particular sensory properties. However, sliced and vacuum packaged dry-cured ham is commonly stored under chilled conditions in both domestic refrigerators and in display cabinets in the market and thus, in most occasions, people consume this product just after it was taken out from the fridge. The "room temperature" is considerably variable throughout the year, particularly in Mediterranean countries where this product is mostly consumed. Taking into consideration the variety of temperatures of dry-cured ham consumption and the likely influence of this parameter on the sensory features and hence, acceptability of dry-cured hams, it is of great interest to investigate the impact of serving temperature on the sensory perception of this product. Additionally, most studies have investigated the effect of temperature of consumption on sensory properties of solutions (Bartoshuk, Rennert, Rodin, & Stevens, 1982; Calvino, 1986; Green & Frankmann, 1987), model system (Ventanas, Mustonen, et al., 2010), semi-solid products (Engelen et al., 2003), meals (Ryynänen, Tuorila, & Hyvönen, 2001) or pork patties (Reinbach, Tøft, & Møller, 2009) but no scientific studies have been carried out in dry-cured products.

Several authors have reported the influence of different factors such as the length of the ripening process (Ruiz, Ventanas, Cava, Andrés, & García, 1999), the pig feeding system (Ventanas, Ventanas, Tovar, García, & Estévez, 2007) or the fat content and composition (Ruiz, Ventanas, Cava, Andrés, & García, 2000) on Iberian dry-cured ham sensory properties using the descriptive profile analysis. However, temporal aspects of sensory perception affected by the temperature of consumption have not been studied before in dry-cured meat products

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and particularly in Iberian dry-cured hams. The time-intensity (TI) method allows monitoring the intensity over time and thus provides more real and valid information compared to static techniques (Dijksterhuis & Piggott, 2001). The objective of the present study was to investigate the effect of serving temperature (7 °C, 16 °C and 20 °C) on the dynamic perception of flavour and texture in Iberian dry-cured ham using TI methodology. Moreover, to evaluate the effect of the IMF content and the possible interactions with the temperature of consumption, two different sections of the Iberian dry-cured hams were considered.

2. Materials and methods

2.1. Dry-cured ham samples

Eight dry-cured hams (7.5 kg average) were obtained from free-range reared Iberian pigs fed on grass and commercial concentrates during the fattening period (60 days prior to slaughter) and slaughtered at 160 kg live weight and 12 months of age. Green hams were processed traditionally, including two defined steps: salting/post-salting and ripening (Estévez, Morcuende, Ventanas, & Ventanas, 2008). During the first period (4–6 months), low temperatures (0–7 °C) were combined with high relative humidity (80–90%) to reduce the risk of bacterial spoilage. Then, the hams were ripened for 15 months in a cellar at temperatures ranging from 10 to 27 °C and relative humidity 58–80%. In order to evaluate the effect of the IMF content on sensory characteristics, once the ripening process was finished (~30% weight loss), the hams were deboned and two different sections varying in the IMF content were extracted (*Quadriceps femoris* (QF) containing lower IMF content compared to *Biceps femoris* (BF)). Afterwards, muscles were sliced (1 mm thickness) and vacuum-packaged (polyamide and polyethylene in the upper film with 34.0 cm^3/m^2 permeability to O_2 at 23 °C and 85% HR, polyamide and polyethylene in the lower film with 18.0 cm^3/m^2 permeability to O_2 at 23 °C and 85% HR) (Mobepack Company, Salamanca, Spain). A total of 244 packages of slices (100 g each one) were obtained (89 packages of QF batch and 155 packages of BF batch). Subsequently, both batches (QF and BF) were stored at chilled conditions (5 °C) for one month.

2.2. Chemical composition

Moisture content and chloride content (ISO 1443) were determined using official methods (AOAC, 2000). Folch method (Folch, Lees, & Sloane Stanley, 1957) was employed for determining the intramuscular fat content (IMF). Protein content was determined by Kjeldahl method (ISO 937, 1978). Ten repetitions per batch were performed.

2.3. Sensory evaluations

Descriptive sensory analysis and TI evaluations were performed in all dry-cured ham batches at different serving temperatures (7 °C, 16 °C and 20 °C). These temperatures were selected based on: (i) 7 °C simulated chilled conditions in domestic refrigerators, (ii) 20 °C simulated samples' consumption at room temperature and (iii) 16 °C is an intermediate temperature between the others and similar to the temperature reached in the last stage of dry-cured hams' ripening.

All the glass plates using for presenting the samples to the panellist were conditioned at the different serving temperatures for at least 45 min. Afterwards, dry-cured ham slices were placed on different glass plates and conditioned at the different serving temperatures for at least 30 min. This preconditioning protocol of glass plates and samples was carried out in heat cabinets (VELP Scientific, mod. FTC 90E and Aqua Lytic, mod. FKS 3600). Samples were taken out from the heat cabinet and served to the panellists immediately before samples' testing.

2.3.1. Panellist

Ten panellists (five males and five females) with previous experience in sensory evaluation participated in the study (training and evaluation sessions). All of them were staff of the University of Extremadura.

During training sessions (2 h), assessors (n = 10) were getting familiar with the appearance, odour, texture and flavour attributes and the intensity rating procedure with the FIZZ software system used for the evaluations. The attributes were selected after panel discussion and were in agreement with those previously reported by Fuentes, Estévez, Grébol, Ventanas, and Ventanas (submitted for publication). All panellists have previous experience with the TI technique.

2.3.2. Organization of the sessions

For practical reasons, the samples were presented in blocks representing one group (QF with a lower IMF content and BF with a higher IMF content) per day. In each daily session three samples at two different serving temperatures were presented to the panel. Assessors participated in a total of sixteen sessions consisted of eight sensory profiling sessions and eight TI sessions. Each sample (QF and BF) at each temperature (7 °C, 16 °C and 20 °C) was evaluated four times.

In each session, three samples with random three digit codes were presented to the assessors. Samples were allowed to equilibrate for at least 30 min at the selected temperature in heat cabinets. Evaluations were conducted in individual booths. The presentation order of samples for each assessor was randomized following a William Latin Square design.

Prior to TI, descriptive sensory analysis was carried out over eight consecutive days. To generate and set up the list of attributes characterizing the dry-cured ham samples, all batches at different serving temperatures were evaluated. Samples were presented on glass plates with a list of potential attributes according to Fuentes et al. (submitted for publication). Panellists rated the intensity of the selected attributes using an unstructured scale (10 cm). After discussion the panel reached an agreement. The selected attributes were for appearance of external fat: colour intensity, colour homogeneity and brightness; for tactile texture of external fat: fluidity, hardness and sandy; for appearance of lean: red colour intensity, marbling and brightness; and for odour of lean: overall, rancid and cured. Their verbal anchors were from “less” to “more” for all attributes, except for fat colour intensity that anchors were from “white” to “yellow”. Panellist were instructed to evaluate first the attributes of the external fat of the dry-cured ham slice, and then those related to the lean (Fuentes et al., submitted for publication).

Dynamic sensory properties of flavour and texture in dry-cured ham affected by IMF content and serving temperature were studied using TI methodology. Sample size was standardised at half slice and the protocol was established as follows: panellists should keep the sample in their mouths, chew for 10 s and then swallow. After swallowing panellists should continue the evaluation until they did not perceive anything. Panellists were instructed to move the cursor along the scale according to the intensity of their perception. The time of the evaluation was fixed in 120 s, but panellists could stop before by moving the mouse completely towards “less” extreme. During the data collection, specific messages were displayed in the computer screen showing commands as “indicate the intensity during chewing the sample by moving the cursor along the scale”, “swallow the sample” and “move the cursor completely toward less if you do not perceived anything more”. The final rinsing protocol between samples was tap water and a piece of unsalted crackers. This standardised protocol was used in all TI evaluations. Panellists rated one attribute at a time and all attributes were evaluated four times, thus a total of 40 TI-curves of each attribute were obtained for each sample at each serving temperature.

All sensory data were collected using the FIZZ software (Sensory Analysis and Computer Test Management) (Biosystemes, France, 2002).