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Effect of preservative addition on sensory and dynamic profile of Lucanian dry-sausages as assessed by quantitative descriptive analysis and temporal dominance of sensations

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ABSTRACT

The quantitative descriptive analysis (QDA) was combined with temporal dominance of sensations (TDS) to assess the sensory properties of Lucanian dry-sausages either added with nitrate, nitrite and L-ascorbic acid (NS), or not (NNS). Both QDA and TDS differentiated the two groups of sausages. NNS products were perceived with higher intensity of hardness ($P < 0.05$) and tended to be perceived with higher intensities of flavor ($P < 0.10$), pepper ($P < 0.20$), and oiliness ($P < 0.20$), while resulting lower in chewiness ($P < 0.20$). TDS showed that in all the sausages hardness was the first dominant attribute; then, in NNS products flavor remained dominant until the end of tasting, whereas in NS products oiliness prevailed. In conclusion, TDS showed that the perception of some textural parameters, such as oiliness, during mastication was more dominant in NS products, whereas using conventional QDA this attribute appeared higher in sausages manufactured without preservatives. Therefore, TDS provided additional information for the description and differentiation of Lucanian sausages.

1. Introduction

Sensory profiling, namely quantitative descriptive analysis (QDA), is a method for qualifying the type and quantifying the intensity of the sensory properties immediately after sensory stimulation (Stone & Sidel, 2004). Although QDA can give insights into a higher number of attributes, perception is a dynamic process (Piggott, 1994), involving oral activities affecting flavor and texture attributes (Foster et al., 2011). Thus, temporal dominance of sensations (TDS) has been developed (Pineau, Cordelle, Imbert, Rogeaux, and Schlich, 2003): the product perception is depicted by curves indicating the frequency by which a sensation is considered as dominant by a trained panel during the taste of the product (Pineau et al., 2009). Therefore, QDA and TDS methodologies are designed for providing complementary information (Lenfant, Loret, Pineau, Hartmann, and Martin, 2009). Temporal dominance of sensations has been used for different products, including yoghurt (Bouteille et al., 2013), fish sticks (Albert, Salvador, Schlich, and Fiszman, 2012), mozzarella cheese (Rodrigues, Gonçalves, Pereira, Carneiro, and Pinheiro, 2014), and sausages (Devezeaux de Lavergne, Derks, Ketel, de Wijk, R. A., & Stieger, 2015). Dry sausages are typically cured by addition of sodium/potassium nitrite or nitrate, spices, phosphates, sodium chloride and other preservatives as bacteriostatic, bacteriocidal, antioxidant and color stabilizer agents (Sebranek and Bacus, 2007). There are raising concerns about the safety of using nitrate and nitrite for cured meat (Sebranek and Bacus, 2007). In a previous study about consumer liking and choice determinants of Lucanian dry cured sausages, taste and addition of preservatives were identified among the most influential aspects affecting consumer choice (Braghieri, Piazzolla, Carlucci, Bragaglio, and Napolitano, 2016). Thus, in this study the effect of preservative addition on sensory properties of Lucanian dry sausage was assessed, using both the TDS method and the conventional QDA.

2. Materials and methods

2.1. Products

Dry-sausages were produced in 8 different manufacturing plants in Basilicata region, southern Italy. These 8 plants were recruited on the basis of their process characteristics, as they all used the following traditional procedure. Pork cuts (shoulder, belly and trimmings of ham) were ground in a meat grinder using a plate of 12–18 mm of hole diameter; then salt and spices (ground sweet red pepper and wild fennel seeds) were added to the mixture. Four plants did not add their products (P3, P5, P7, P8) with any preservatives (no nitrate/nitrite sausages, NNS), whereas other 4 plants added their products (P1, P2, P4, P6) with nitrate, nitrite and L-ascorbic acid (nitrate/nitrite sausages, NS). This

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preservative mix (nitrate up to 150 mg/kg, nitrite up to 150 mg/kg, L-ascorbic up to 500 mg/kg) was chosen because it is the most commonly used for dry-sausage manufacturing. The sausage mixture was stuffed in natural casings (36–42 mm of diameter), brought to dry (2–7 days) into dedicated places (15 °C, 65% of relative humidity, RH) and seasoned (13–18 °C, 75–85% RH) for a month. After ripening, the sausages were vacuum packaged (80 mbar) using bell-shaped machines (Mixer Duo, Euromatic Tecnology Srl, Italy) in plastic bags (oxygen transmission rate at 23 °C and 0% R.H. of ≤50 cm^3/m^2/bar/24 h, DIN 53380; water vapor transmission rate at 23 °C and 85% R.H. of ≤3 g/m^2/24 h, DIN 53122) and refrigerated at 4 °C.

2.2. Chemical composition

Moisture, protein, and ash contents in homogenized sausage samples were determined according to AOAC (1995) methods. Total lipids were extracted from 5 g of minced sausage according to Folch, Lees, and Stanley (1957), using chloroform:methanol (2:1) as solvent. Analyses for all samples were carried out in duplicate.

2.3. Key-attribute sensory profiling (KASP)

A QDA approach (Murray, Delahunty, and Baxter, 2001) was followed to select key-attributes (i.e. the most effective attributes in discriminating products) to be used for the following TDS analysis. A 9-member trained sensory panel (5 males and 4 females, aging 26–35 years) with three years of experience in the descriptive analysis of sausages was used. Panelists were selected according to ISO recommendations (ISO 3972:, 2011; ISO 8586:, 2012). For this purpose the four basic tastes were used: three levels of sucrose (Carlo Erba, Milan, Italy), sodium chloride (Carlo Erba, Milan, Italy), citric acid (Carlo Erba, Milan, Italy) and quinine hydrochloride (Sigma-Aldrich, USA) were diluted in filtered, deionized water at room temperature (Braghieri et al., 2016). The panelists were informed about the taste of each basic concentration. Then, they tasted a 10 mL quantity of high and low concentration for each taste solution in blind. De-ionized water was used to prepare two blanks. All taste solutions and blanks (totaling 10 samples) were presented in random order. Between each sample, the panelists rinsed their mouths with filtered, de-ionized water. The panelists had to identify the intensity (low and high) of each taste solution. The ability to recognize eight out of the 10 taste solutions was used as cut-off point for selection purposes (arbitrary threshold set on the basis of previous studies, e.g. Albenzio et al., 2013). Then, panelists were trained for the scale use (Stone & Sidel, 2004). Based on results of a previous study on sensory profiling of Lucanian dry-sausages (Braghieri et al., 2016), an already reduced vocabulary represented by 10 key attributes was used and the panelists were trained with a specific reference frame in two two-hour sessions (Table 1). Under the guidance of the panel leader, the assessors determined which of the proposed references were most suitable to represent the previously identified sensory attributes. Two points of the scale were anchored to the reference material for training purposes. Then, for each assessment session, four samples were presented; each product was evaluated in triplicate. Samples were coded with three-digit randomized numbers and served in randomized order according to product, replication and assessor. Each subset of 4 products was identical in the 3 replications and among the 9 panelists. Six assessment sessions were needed to complete the KASP. For each sample, two 4.5 mm slices were cut using a commercial slicing machine and immediately served to the panelists. Both the slices and the plates were at room temperature (20–23 °C). Tests were performed at about 10.00 a.m. in a controlled sensory analysis laboratory (ISO 8589, 2007), equipped with individual booths and under red lighting to mask color differences in the samples. The interval between samples was approximately 10 min. Panelists were asked to drink a sip of still water at the beginning of the sensory evaluation and to eat unsalted crackers between samples to try to make the palate conditions similar for each sample. All attributes were rated on unstructured line scales of 100 mm, anchored at the extremities (0 = absent, 100 = very strong).

2.4. Temporal dominance of sensations

The same nine panelists performing KASP were used. The panel had no experience in TDS and therefore attended four two-hour training sessions. Panelists were introduced to the notion of temporality of sensations with dark chocolate. Dark chocolate was chosen in order to facilitate the perception and explain the notion of temporality of sensations as it is characterized by a well-defined dynamic profile (Jager et al., 2014); subsequently, panelists tasted commercial sausages in order to refine these notions and relate them to the object of the experiment. According to Pineau et al. (2009), a dominant sensation was defined as the sensation that triggers most of the attention at a point of time, which may not be the most intense. Then, the panelists were trained to use the computerized TDS data capture system (FIZZ, Biosystemes, Courteno, France) and to evaluate the products following the protocol described below. Pineau et al. (2012) indicated that a maximum of 10 attributes could be evaluated using TDS; however, in this study only 5 out of 10 key attributes (overall flavor, hardness, oiliness, chewiness and pepper flavor) were selected, based on KASP results. Six evaluating sessions were performed. Each product was evaluated in triplicate. For each daily session, four samples (5 mm slice) were presented. Each

Table 1
List of sensory attributes of dry sausages and reference frame used by a 9-member trained sensory panel for Key attribute sensory profiling.

Attributes	Definition	Low	High
Taste			
Saltiness	Fundamental taste associated with sodium chloride	2 g/L sodium chloride	8 g/L sodium chloride
Bitterness	Fundamental taste associated with quinine hydrochloride	0.27 g/L quinine hydrochloride	1.08 g/L quinine hydrochloride
Flavor			
Overall flavor	Level of overall flavor	Fifteen-day seasoned commercial Lucanian sausage	"Napoli" salami
Fennel flavor	Flavor accociated with fennel seed	Cacciatore salami	Commercial Lucanian sausage
Sweet pepper flavor	Flavor accociated with sweet red pepper powder	Cacciatore salami	Commercial Lucanian sausage with sweet pepper
Pepper flavor	Flavor accociated with aromatic spices added to sausage	Commercial Lucanian sausage	"Napoli" salami
Texture			
Hardness	Force required to compress the sample with the molars	Cubed Hungarian salami	Two-month seasoned cubed Sausage
Adhesiveness	Force required to remove the sample from the palate	Two-month seasoned cubed commercial Lucanian sausage	Cubed Ham
Chewiness	Number of chews required to prepare the sample for swallowing	Cubed Hungarian salami	Two-month seasoned cubed commercial Lucanian sausage
Oiliness	Perception of the amount of fat released by the product during mastication	Cubed dry cured ham	Cubed pancetta