Food Structure 6 (2015) 13–20

Contents lists available at ScienceDirect

Food Structure

journal homepage: www.elsevier.com/locate/foostr

Microstructure, texture profile and descriptive analysis of texture for traditional and light mortadella

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ARTICLE INFO

Article history:
Received 25 February 2015
Received in revised form 5 August 2015
Accepted 7 September 2015
Available online 9 September 2015

Keywords:
Descriptive analysis of texture
Texture profile analysis
Mortadella
Low fat

ABSTRACT

The diet is an important modifiable factor that influences the development of chronic diseases. There is a lot of evidence demonstrating the importance of diet modifications on consumer health. However, the consumers demand low fat products without any loss of their texture quality. In this research, descriptive analysis of texture was used to study the influence of two fat level mortadella on sensory texture and to be compared with the texture data given by a texture profile analysis. Two samples of mortadella of a Brazilian commercial brand, traditional and light, were evaluated by 11 trained panelists. The trained sensory panel rated the light mortadella as harder than the traditional mortadella. The texture profile analysis showed that light mortadella was harder than the traditional mortadella too. The increase of the toughness of the light mortadella (low-fat) is explained by a raise at the matrix clutter analyzed by scanning electron microscopy. A correlation analysis showed that the sensory hardness was positively correlated with instrumental springiness. Further, studies should be performed to study consumer's perception of meat products with known differences in their formulation and to compare consumer and trained panelist texture perception of these products.

1. Introduction

In recent years, there have been a number of changes in the lifestyle of the population as a result of industrialization and economic development (WHO, 2003). These changes have caused negative changes in diet and eating patterns, which characterize the "nutrition transition" that includes an increase in the energetic density of the diet and the proportion of saturated fats, increasing the occurrence of chronic non-communicable diet-related diseases such as obesity, cardiovascular disease, hypertension and diabetes (WHO, 2003).

In Brazil, mortadella-type products are some of the most produced meat products, and their consumption has become popular mainly due to its low cost and pleasant flavor. Unfortunately, these products are often negatively perceived by consumers, because they are concerned about the high levels of fat they content. For these reasons, it has been widely studied the reformulation of food products reducing and substituting the fat content in its formulations. However, fat reduction not only modifies their composition and structure, but also the interactions between their components, causing alterations in sensory properties, such as appearance, flavor and especially in the texture (Bayarri, Chuliá, & Costell, 2010).

According to studies published by Dar and Light (2014) and Piqueras-Fiszman and Spence (2012) the texture plays a crucial role in determining food quality, directly affecting its acceptance by consumers, and eventually their preferences. For this reason, it is one of the most important attributes in the success or failure of the food products with low fat content (Stewart-Knox & Mitchell, 2003). However, the development of foods with adequate texture involves the use of multivariate tools, structuring different areas such as culinary arts, food science, materials science, sensory science, and the study of consumer behavior. The perception of food texture is a complex task and is mainly composed by tactile or surface responses skin-related (somesthesis) and by deeper answers related with muscles and tendons (kinesthesis or proprioception) (Kilcast & Kilcast, 2013).

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http://dx.doi.org/10.1016/j.foostr.2015.09.001
2213-3291/

Quantitative descriptive analysis (QDA) is one of the most commonly used methodology (Hildegarde, Ellena, & Helene, 2014) to characterize the sensory properties of food products (Bruzzone, Ares, & Giménez, 2013). Nevertheless, this methodology does not consider the sequential perception during consumption of the food, but rather uses the order of evaluation provided by the panel. Considering this aspect, the QDA was adapted in this research. It was called descriptive analysis of texture (DAT) which evaluate sequentially the intensity of the attributes during the consumption process, in this case mortadella (Dar & Light, 2014).

Texture can be measured objectively (instrumentally) and subjectively (sensorially). Among the instrumental devices, the texturometers imitate chewing conditions and presents significant correlation with sensory texture measures (Szczesniak, 1963). For this reason, this equipment has been widely used to measure texture of different foods. The texture profile analysis (TPA) consists in a double-axial compression of the sample without breaking it, imitating the mechanical behavior of mastication (Bourne, 2002). Correlating instrumental and sensory measures is very important since the quality control of food products and processes are performed by instrumental measurements without neglecting consumer response, predicting consumer acceptance, and thus optimizing the development of new products (Paula & Conti-Silva, 2014).

In this context, the aims of this investigation were to (a) characterize sensorially and instrumentally the texture of mortadella using DAT and TPA, (b) to study the influence of fat content in the microstructure and texture (sensory and instrumental) on mortadella, and (c) to correlate results from DTA with TPA.

2. Materials and methods

2.1. Samples

Two types of Brazilian commercial brand mortadella (São Paulo – Brazil) were used in this study, which had 11% (light) and 18% (traditional) of fat content (according to manufacturer). These types were chosen because according to previous studies, the fat content modifies the perception of texture. Besides, Brazilian legislation also was used as selection criterion, which establish that to be a food considered "light", it has to have a minimum reduction of 25% of the total energy or total sugars or total lipids (Cadena & Bolini, 2011), in our case, the reduction of 18% to 11% of fat represents a reduction of 38.89%. The samples were obtained immediately after industrial process and was stored at 4 ± 1 °C until evaluation. Sample with 11% was prepared with following ingredients: Beef, water, salt, sodium lactate, black pepper, sodium tripolyphosphate, nitrite and nitrate of sodium, glucose, monosodium glutamate and sodium erythorbate. Sample with 18% was formulated by beef, pork back fat, pork meat, water, salt, black pepper, sodium tripolyphosphate, nitrite and nitrate of sodium, glucose, monosodium glutamate and sodium erythorbate. For confidentiality reasons, no further detail concerning samples composition can be provided. Table 1 shows the characteristics of the two selected mortadellas with nutrition information panel as stated on the package to a portion of 50 g.

2.2. DAT

The panelists were composed by graduate students, researchers and professors of the Department of Agro-industry, Food and Nutrition, "Luiz de Queiroz" Agricultural College, University of São Paulo (LAN/ESALQ/USP). DTA was performed in accordance with Stone and Sidel (2004) and Dar and Light (2014).

Table 1
Information displayed on the packages of the two mortadella samples.

	Sample 11% of fat	Sample 18% of fat
Mortadella type as described on the package	Traditional	Light
Caloric value	120 kcal = 504 kJ (6%)	80 kcal = 336 kJ (4%)
Carbohydrate	0%	0%
Protein	10%	12%
Total fat	18%	11%
Saturated fat	18%	9%
Trans fat	0%	0%
Dietary fiber	0%	0%
Sodium	28%	18%

2.2.1. Selection of terms

The sensory panel consisted of eleven trained panelists, aged between 25 and 50 years, male and female and with wide experience in quantitative descriptive analysis and at least 20 h of experience in the evaluation of meat products.

The terms selection was performed in three sessions. In the first session, the samples were presented to the panelists in order to generate the texture descriptors. Panelists were asked to generate their individual descriptors using the Kelly's Repertory Grid Method (Moskowitz, 1983). In an open discussion with the panel leader, panelists agreed on the best descriptors to describe the samples. In the second session were defined the attribute name, the definition, the technique, the scale and the references of the texture descriptors. In the last session, the references were presented to the panelists, indicating the intensity of the reference on an unstructured scale. Because there is a logical sequence of steps in which a food is consumed (e.g. first bite, chewing, chewdown, swallow, etc.), it is appropriate to evaluate the attributes in four different aspects of texture in the following order: surface, first bite, chewdown and residual. The consensus of the definitions of the descriptors generated by the panelists is shown in Table 2.

2.2.2. Panel training

The panelists were trained in the descriptors evaluation using commercial products with different texture characteristics. It was performed six training sessions of 50 min each one. The first session consisted in a meeting where the panel leader explained the use of the 10-cm unstructured scale anchored with the intensity terms at the endings, for example, "low or none" at the left and "very" at the right. In the second session, the intensities of the texture attributes were scored. All samples were evaluated in each session. Sessions missing were conducted until the panel was homogeneous in its assessments and its comprehension of the extremes of the scales. The samples, cut in cylinders of 1.8 cm diameter and 1.5 cm height, were served at 20 °C on plastic containers, labeled with three-digit random numbers. Mineral water was used as rinsing between samples. Evaluations were carried out in the sensory laboratory of LAN/ESALQ/USP, under artificial daylight type illumination, temperature control (20 ± 2 °C) and air circulation. The panelists were selected using four criteria (discrimination, reproducibility, agreement and use of the scale) (Stone & Sidel, 2004) based on the panel performance (Tables 3 and 4).

2.2.3. Final assessment

A balanced complete block experimental design was used in two sessions to evaluate the samples. Nine attributes of texture of the two samples were evaluated in each session. The intensities of the attributes were scored on 10-cm unstructured line scales. The samples were randomly selected from each cooking batch and