Contemporary Engineering Sciences, Vol. 11, 2018, no. 72, 3549 - 3556
HIKARI Ltd, www.m-hikari.com
https://doi.org/10.12988/ces.2018.85237

Mechanical and Sensorial Analysis of Meat Emulsion with Incorporation of Dietary Fibres

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Abstract

Nowadays, the design of food products that are attractive to consumers and that generate some health benefit becomes increasingly relevant. The objective of the present work was to study the mechanical and sensorial properties of a meat-based emulsion (sausage) based on Macabí (*Elops saurus*) with the incorporation of fibre from grapes and vegetable oil from corn. It was found that as the amount of fibre in the matrix increased the values of shear strength, hardness and elasticity, without altering the values of cohesiveness. These results indicate that the grape fibres can interact with both the aqueous phase and the oil phase of the emulsion, making a stable part of the emulsion. On the other hand, all the formulations studied had acceptance percentages higher than 90%.

Keywords: *Elops saurus*, sausages, mechanical properties, sensorial analysis, fibres

Introduction

Currently, one of the priorities worldwide is to eat healthily to increase the quality of life and reduce public spending on health systems. It has been well documented some harmful effects on the health of certain foods so that functional foods regain great interest in society in general [1, 2]

From the nutritional point of view, fish is food with a composition similar to that of meat, although they also have marked differences such as protein content, the quality of their fat and the contribution of certain minerals and vitamins. In the bibliography, work has been reported where they use the meat of the Macabí (*Elops saurus*) to obtain a stable base paste to produce kamacobo, sausages, meatballs and hamburgers [3].

The Macabí is an ichthyological species that has been commercially undervalued due to its morphological characteristics and the disposition of the spines, which makes its consumption difficult. At present, the fishing communities of the Isla de Salamanca National Park area (Colombia) use it to obtain untreated pulp of low quality for their consumption. This one is extracted by mechanical means and put on the market at a low price. In this sense is a suitable option design a product based on Macabí. This work aims to study the mechanical and sensorial properties of sausages based on Macabí as affected by the presence of dietary fibres from grapes.

Materials and Methods

Preparation of Macabí *sausages*

For the preparation of the sausages, a base formulation was followed, as shown in Table 1. The ingredients were homogenised in a cutter for 15-20 min at a temperature of 5-8 °C until an emulsion was obtained. Later the blend was filled into cellulose casings. They were distributed so that each sausage had a length of 14 cm. Then they were cooked with wet steam until reaching 70 °C at the coldest midpoint of the sausage. They were then cooled using an ice bath, packed in high-density polyethene bags and frozen at -18 °C until the corresponding analyses.

Table 1. Standardised formulation for sausages

Ingredient	**Quantity (g)**
Fish Pulp	100
Bread crumb	5.0
Salt	1.5
Garlic	1.0
Seasoning	1.5
White Onion	3.0
Vegetable oil	6.0
Water	3.0
Paprika	2.0
Onion	3.0
Cilantro	3.0

Texture analysis
To determine the mechanical behaviour of the formulations (F1, F2 and F3) three types of tests were performed: cutting, compression and texture profile analysis (TPA). These were done using a TA-XT2i texturometer (Stable Microsystems, Godalming, UK), with a load cell of 50 kg, and the software provided by the manufacturer (Texture Expert Exceed - Stable Micro Systems, version 2.63) to quantify: hardness (kg-f / g), elasticity and cohesiveness (both dimensional).

Sensory analysis
These are used to determine how well consumers can distinguish products from one another. This test was based on giving consumers three samples, two being the same and one different. These tests are commonly used when an ingredient has been substituted in the formulation of the product, and the manufacturer wants to perceive if the consumer distinguishes the difference with the product of the new ingredient and the original product.

Statistical analysis
The effect of the amount of grape fibre about the total weight of the matrix was studied. Four levels of grape fibre 0, 1.5, 2.5 and 3.5 g of fibre / Kg of the matrix were used (F1, F2, F3 and F4 respectively). They were compared with the objective of establishing the main effects of the treatments during the different processing conditions. To do the statistical study, an analysis of variance was applied through the Software SPSS, version 14 for Windows.

Results and Discussion

Texture analysis

Cutting test
Table 2 shows the behaviour of the cutting test performed using a V-shaped blade

(Warner - Bratzler) as an attachment. The sausages were placed on the metal plate. Then the blade was lowered, at a speed of 2 mm / s. The cutting curve was obtained by recording the maximum force that the blade needs to cut the sample completely. Three (three) replicates were applied for each formulation. The results were taken from the maximum peak (maximum force) resulting from the shear stress.

Table 2. Mean values and standard deviation of cutting test of studied formulations

Sample	**Force (MPa)**
F1	$130,4 \pm 0,5^{a}$
F2	$132,3 \pm 0,9^{b}$
F3	$133,2 \pm 0,8^{b}$
F4	$136,5 \pm 0,5^{c}$

Different superscript letter indicates significant differences ($p < 0,05$)

The interaction of grape fibre in sausages in concentrations of 1.5%, 2.5% and 3.5% affect the values of mechanical properties. As the concentration of dietary fibre increases in chorizos, the texture values increase significantly, except for cohesiveness. Brown, et al. (1999) report that the hardness of meat products increases due to the insoluble fibre that forms three-dimensional networks that modify the rheological property of the continuous phase of the emulsion, depending on the amount of fat contained in the product as it traps the fibre. Some authors explain extensively about the effects of fibres on sausages matrices [4].

Profile Texture (TPA)

The texture profile analysis was performed by slicing sausage slices, taking 3 cylinders of 3.0 cm high and 2.0 cm in diameter for each formulation. The test consisted in placing each sample in parallel circular stainless-steel plates of 75 mm diameter (a fixed plate and a mobile one) performing a double cycle compression up to 50% of the initial height (a 50 Kg cell was used whose range was 20 Kg). The probe speed was 2 mm/s, and a waiting time of 2 s between each cycle (2 cycles). The following parameters were quantified: hardness (kg-f /g or N), elasticity and cohesiveness (both dimensional). Table 3 shows the mean values and standard deviations obtained in each assay.

Soluble fibre provides a softer texture than insoluble fibre and can even be used as a fat substitute, according to Piñero *et al.* [5]. Treatment 4 was showed the highest elasticity, unlike 1 with the lowest, although the variation of results was around 7.5%. This result suggests that fibre have a correct distribution into the matrix improving their mechanical properties. This effect could be interesting for consumers because the sausages could be perceived as a turgid product.

Table 3. Mean values and standard deviation of hardness, elasticity and cohesiveness test of studied formulations

Sample	**Hardness (N)**	**Elasticity (MPa)**	**Cohesiveness (MPa)**
F1	3190 ± 18[a]	0.702 ± 0,004[a]	0.249 ± 0,005[a]
F2	3279 ± 14[a]	0.707 ± 0,004[a]	0.255 ± 0,005[a]
F3	3367 ± 3[b]	0.718 ± 0,004[b]	0.252 ± 0,004[a]
F4	3524 ± 12[c]	0.763 ± 0,003[c]	0.261 ± 0,002[a]

Different superscript letter indicates significant differences ($p < 0,05$)

Figure 1 shows a Texture Analyser used for the mechanical test.

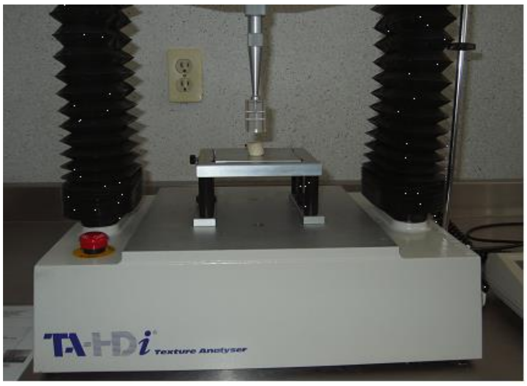

Figure 1. Texture Analyzer during determination

Regarding cohesiveness, the interaction of grape fibre had no significant effect, which indicates that the internal bonds of the emulsion do not change despite adding dietary fibre, at least in quantities from 1.0% to 3.0%. Concerning the hardness, the values are also high, and both characteristics depend on it, because of how hard or soft the sausage is, more strength is required to disintegrate it.

The insoluble fibres of fruits have in addition to physiological advantages, technical properties as high water and fat retention capacity, turning them into optimal ingredients to achieve high yields and low cost. Also, this bipolar affinity ensures its integration into the meat emulsion [6,7]

Sensory analysis
Sensory tests are used to determine the ability of consumers to distinguish one product from another. This test is based on giving consumers three samples being two equal and one different to distinguish the difference between the two types of samples.

This test was carried out to measure the degree of acceptance of the Macabí sausages at different concentrations of grape fibre, with a trained panel of 30 people with a range of ages between 15 and 25 years.

Figures 2 shows the results of the sensory evaluation of the sausages studied with different concentrations of grape fibre, where the highest percentage of acceptance is for the sample that contained 1.5% fibre. For this sample, the acceptance was 97%. This one was followed by the sample with 2.5% and 3.5% with levels of acceptance of 95% and 92% respectively.

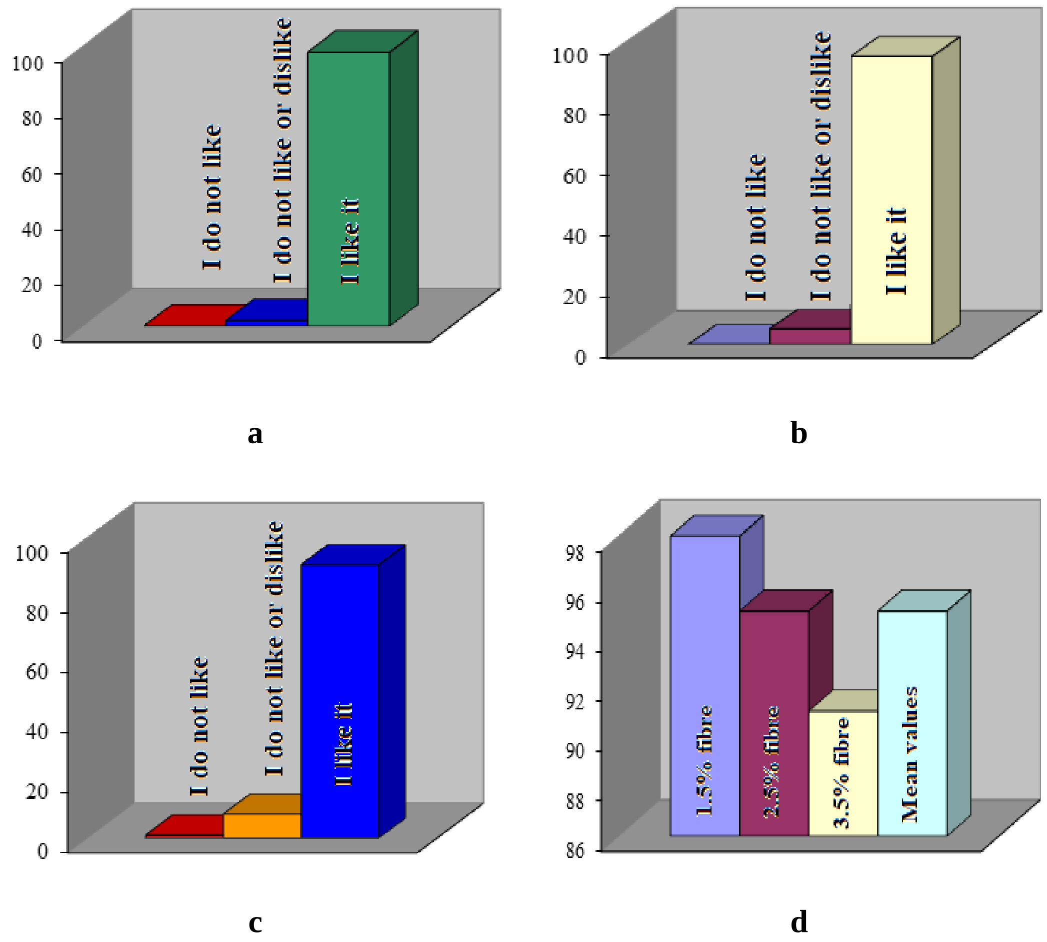

Figure 2. Sensory evaluation for different samples: a) sausages with 1.5% of grape fibres; b) sausages with 2.5% of grape fibres; c) sausages with 1.5% of grape fibres and d) mean values of the favourable sensory evaluation for the different treatments studied

Conclusion

The grape fibre was incorporated up to a percentage of 3.5% to a meat emulsion based on Macabí. A compact, homogeneous and stable structure was observed. As the amount of fibre increased, an increase in the values of shear strength, hardness and elasticity were observed. The cohesiveness values were not affected by the presence of fibre. These results indicate that the fibre can interact with both the phase and the oil phase of the emulsion, making a stable part of the emulsion. On the other side, all the formulations studied had acceptance percentages higher than 90%.

Acknowledgements. The authors thank the University of Cartagena for their support in the development of this work. Ornela Annicharico gives the thanks to Karen Paola María Ortiz for their support and friendship during the development of this work.

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Received: May 30, 2018; Published: September 4, 2018