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Research Article

Sensorial Evaluation of a Spreadable Paste based on Orejero Seeds (*Enterolobium cyclocarpum*) and its Physicochemical, Microbiological and Textural Characterization

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Abstract: A degree of acceptance of a paste based on orejero seeds (*Enterolobium cyclocarpum*) was determined with a preference test, for 9 formulations of spreadable pasta, in which was varied the content of pulp, milk and panela. To the formulation with most preferred a categorical scale test by attribute was performed (texture, color, aroma and flavor) with a group of 100 untrained panelists. The results obtained were implemented the corresponding frequency analysis. Furthermore, it was characterized physicochemical, microbiological and textually, determining its ability to be spreadable with a test of retro-extrusion. The formulation that presented better acceptance was F4 (25.6% seed pulp, 69.1% milk, 5.3% panela), which had a high protein content (28.37%), Carbohydrates (30.39%), fiber (13.48) and a good spreadability. Although, was no significant differences in spreadability with the formulation F1 (69% pulp, 2.8% milk) and F3 (28.1% Panela, 79.1% pulp, 2.8% milk, 18.1%).

Keywords: Cohesiveness, legumes, sensory, spreadability, spreadable pasta

INTRODUCTION

The primary use of the orejero seeds (*Enterolobium cyclocarpum*) is the feeding of cattle, thanks to the digestibility of organic material that it presents, the high metabolizable energy it produces; (Oni *et al*., 2008; Babayemi, 2006; Álvarez-Morales *et al*., 2003) and high content of protein and mineral (Zamora *et al*., 2001). Especially in the dry season when few options are available (Cordero and Boshier, 2003).

However, it is also used as part of human food such as cooked, vegetables in soups, toast, ground or mixed with other foods as flour, with different meats in chile sauces (Cano-Herandez and Romero-Guillot, 2012) and in gums used to improve the food texture due to its arabinose and galactose content (León de Pinto *et al*., 1994) as the preparation of ice cream (Rincón *et al*., 2002).

The orejero seeds (*Enterolobium cyclocarpum*) has a good content of minerals, carbohydrates, proteins and limiting amino acids such as lysine, leucine, isoleucine and threonine and by its protein efficiency ratio compared to traditional foods such as corn, wheat, soy and eggs. Is attributed an industrial, medicinal and chemical potential, being a limitation the presence of anti-nutritional factors such as cyanogenic glycosides and trypsin inhibitors. Although, studies have been reported which indicated that enchanted amounts don't represent any risk to human or animal health and recommend that the best way to use the seeds is to cook them previously and can be consumed alone or mixed with other foods (Serratos-Arevalo *et al*., 2008).

Consumers' interest in their health and well-being towards "healthy" or functional foods has allowed a growing interest in the study of legumes. The US Department of Agriculture recommends increasing the consumption of dried beans and peas because they provide nutrients and phytochemical compounds with beneficial effects on health (Leterme, 2002). The World Health Organization recommends its consumption to reduce the risk of diseases associated with food, such as obesity and type 2 diabetes, however, have a low use by the population (Alonso *et al*., 2010; WHO/FAO Expert Consultation, 2003). Although, the nutritional value of legumes and in particular the orejero seeds, it has not been promoted its industrialization due to the little innovation for the development of products that adapt to the current requirements, the low local production and low competitiveness by the low quality of presentation of the products. Also, the consumer

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preference for animal proteins, of higher prestige, more comfortable to prepare and with greater sensorial acceptance (Friedman, 1996). However, in the past last years the consumers are conscious about their health and are highlighted by healthy vegetable diets and balanced, in which legumes play an important role because of their nutritional composition.

Consumption of vegetable margarine have experienced transcendental changes, preferring spreadable products with low-fat over the margarine, these can be effective to help reduce the proportion of fat in the daily diet (Mariscal *et al*., 2006). Thus, it is necessary to offer new alternative products with suitable organoleptic characteristics and good nutritional quality. In this way, Aimaretti *et al*. (2013), reported the development of a spreadable vegetal pasta based on whole grain flour of sorghum and millet and Acevedo *et al*. (2014) of artisanal and technified pastas of oily Sesame (*Sesamum indicum*) grown in Zambrano-Bolívar (Colombia).

Considering the above information, the aim of this study was to determine through sensorial evaluation the degree of acceptance of a spreadable pasta based of orejero seeds (*Enterolobium cyclocarpum*), with different formulations (pulp contents, panela and milk), to choose the best wording and evaluate its physicochemical, microbiological and textural properties.

MATERIALS AND METHODS

Preparation of spreadable paste: The pulp was obtained, with a standardized and selected process, the seeds were cooked with water in a pressure cooker for 2 h, after removing the bark to the seed to obtain the pulp. There were performed nine formulations with paste, milk and panela (Table 1). Initially, the pulp and milk were mixed in a blender until their homogenized, then in a pressure cooker is undergoes with heat treatment, controlling the temperature at 80±1°C, the titrated panela is added and mixed manually for 1 h. Later, it is packaged and stored at 5°C.

Sensory evaluation: Two types of sensory assessments were performed with 4×4 soda crackers, smeared with 2 g of spreadable paste based on orejero. A preference test, where the degree of product acceptability was evaluated by asking 100 voluntary consumers, in a local market in the similar products section, which of the coded samples they preferred, asking them to select one, even if they were not sure (Ramírez-Navas *et al*., 2014). To the most preferred formulation, a categorical scale test by attribute was performed (texture, color, aroma and flavor) with a group of 100 untrained panelists respectively. The obtained results the corresponding frequency analysis was carried out. Once the best formulation was selected, the physicochemical and microbiological analysis were implemented. The textural was evaluated for all Formulations. Statistical analysis was performed using the Minitab® software trial version 16.0.

Table 1: Formulation to produce a spreadable paste of Orejero (*E. cyclocarpum*)

Formulations	Milk (%)	Panela (%)	Pulp (%)
F1	69.1	2.8	28.1
F2	79.1	2.8	18.1
F3	89.1	2.8	8.1
F4	69.1	5.3	25.6
F5	79.1	5.3	15.6
F6	89.1	5.3	5.6
F7	69.1	7.8	23.1
F8	79.1	7.8	13.1

Physicochemical and microbiological analysis: To the spreadable paste was performed moisture analysis (gravimetric method), protein (Microkjeldahl method), ethereal extract (distillation of hexane method), ash content, (gravimetric method), fiber by gravimetric method (AOAC, 1990), aerobic mesophilic count, moulds and yeasts (by plaque count) and Most Probable Number (NMP) of total coliforms (by fermentation in multiple tubes) according to methodology (Blandón-Castaño *et al*., 1999).

Texture measurements: A retro-extrusion test was performed, putting the sample in a cylinder of diameter 50 and 70 mm in height. The vessel was filled with the sample to 75% of its capacity and a uniaxial compression was implemented, with a test tube of 35 mm diameter in a position centered over the vessel, up to 25% of the initial height, then the retro-extrusion is carried out to its initial height. The test was performed on the Texturometer Shimadzu EZ Test ® (Shimadzu Corporation, Tokyo, Japan), using RheoMeter ® Software Version 2.04. The spreadability was determined from the graph applied force vs. distance, taking into account as the main parameter of spreadability: The firmness as the maximum force or substantial resistance to the deformation; the consistency that is the energy needed to penetrate the sample; the cohesiveness that is the maximum force necessary to overcome the attractive effects between the food surface and the test tube surface; and the viscosity index which is the energy involved in the removal of the test tube from the sample.

To determine the incidence of the formulations in the texture of the spreadable paste based of orejero, in term of its spreadability, a completely random design was used, a factorial with a formulations factor in 9 levels or treatments and with 3 replicates for a total of 27 experimental units. The response variables were: cohesiveness, consistency, firmness and viscosity index. The analysis of variance was performed with a significance level of 5%, to the different response variables to determine if there were significant

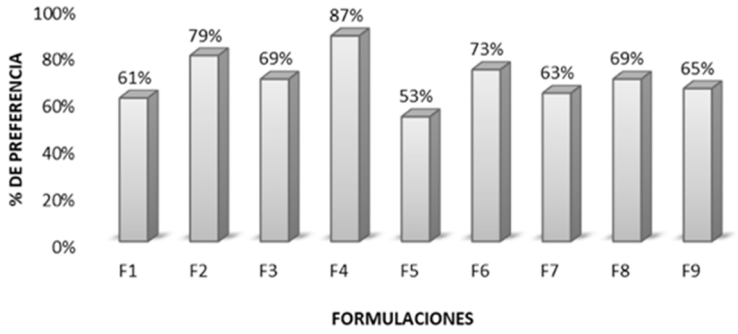

Fig. 1: Preference percentage for the 9 formulations of spreadable paste from *E. cyclocarpum* seed pulp

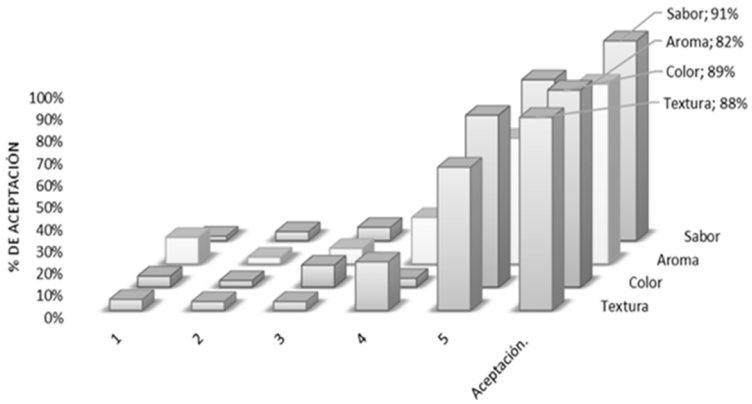

Fig. 2: Results of acceptance degree by attributes expressed in number of people for the F4 formulation of spreadable paste from *E. cyclocarpum* pulp seed

differences between the means of the treatments and was implemented a comparison test of mean to determine the best treatment. Statistical analysis was performed using the Minitab® software trial version 16.0.

RESULTS AND DISCUSSION

Sensory evaluation: Figure 1 the F4 formulation obtained the highest acceptance by preference test (87%). This result is considered as a high degree of approval by the evaluators, which is an essential indication of the acceptance of the product, in addition the formulation is among those with the highest proportion of pulp (25.6%) and an intermediate percentage of panela (5.3%), which allows a higher ratio of protein that is the primary added value in the development of this product. The F2 and F6 formulations were the second and third best in the acceptance percentage (79 and 73% respectively). However, they contain a low percentage of pulp, so the formulation F4 was chosen to continue with other sensory, physicochemical, microbiological and rheological tests.

Figure 2 the texture of the spreadable paste had a 65% of acceptability and a 5% of non-acceptability by the evaluators. The color of the spreadable paste based on orejero had a 78% of acceptability and 5% of non-acceptability by the evaluators, indicating that color was one of the most relevant attributes for the evaluators, the aroma of the spreadable paste based on orejero had a 57% of acceptability and 12% of non-acceptability by the evaluators and the flavor of the spreadable paste based on orejero had a 73% of acceptability and only 2% of non-acceptability by the evaluators, which is a somewhat favorable result for the evaluated product. It can observe the results obtained by the spreadable paste based of orejero for each attribute; these results show the acceptability of the product by the evaluators, which is higher than 85% in each one of the characteristics evaluated, having the flavor the highest acceptability (91%). The results of acceptance by categorical tests for the four attributes evaluated show an acceptability in a percentage higher than 84%, the characteristic of the flavor predominates with an acceptable degree of 90.6% while the aroma shows a similar percentage with a qualifier of 81.6%. The yield of the fruit during the preparation of the paste with the formulation chosen as best was 41.5%.

Physicochemical analysis: Table 2 shows the nutritional chemical composition of the Orejero seed pulp and the spreadable paste based on it, for the formulation F4. Due to the high protein content, the *E. cyclocarpum* seeds may build a significant protein

Table 2: Nutrient chemical composition (dry basis) of mature seeds of *E. cyclocarpum* and spreadable paste (formulation 4) based on pulp of mature seeds of *E. cyclocarpum*

Nutrients (%)	Mature seeds	Spreadable paste F4
Moisture	21.51±0.62	85.16±0.62
Dry mass	78.49	14.84
Carbohydrates	57.02±0.62	28.37±0.42
Protein	28.21±0.51%	30.39±0.36
Ethereal extract	2.03±0.14%	17.92±0.45
Fiber	9.64±0.42%	13.48±0.28
Ash	3.10±0.15%	10.58±0.32

Table 3: Microbiological analysis of the spreadable paste based on *E. cyclocarpum* seed pulp (formulation 4) and reference values according to norm NTC 7557 of 2008

Analysis	Results	Reference values
Mesophilic total count (UFC/g)	<100	<300
Mould and yeast count (UFC/g)	<10	<50
Total coliforms (NMP/g)	<3	<3
Fecal coliforms (NMP/g)	<3	<3

Table 4: Comparison analysis of the consistency and cohesivity measurements of the spreadable paste from *E. cyclocarpum* seed pulp (formulation 4)

Formulations	Consistency (N.s)	Cohesiveness (N)
1	264.38±19.36a*	-8.45±0.69c
2	370.35±7.24b	-8.30±0.94cd
3	572.59±58.22d	-12.31±1.42b
4	342.69±13.60b	-6.53±0.25d
5	531.73±26.36d	-17.44±1.58a
6	444.38±23.02c	-12.17±0.47b
7	543.29±42.94d	-9.12±0.72c
8	540.29±32.08d	-16.67±1.30a
9	732.95±17.78e	-12.91±1.49b

*: Variables with the same superscript letter in the same group did not show significant differences between them ($p<0.05$)

source for the human diet and are similar to other legumes such as beans (Ibrahim *et al*., 2012), chickpea (Conklin-Brittain *et al*., 1999); however, with lower soy protein content (Solano *et al*., 2012). Also, the carbohydrate and ethereal extract contents are like those found in beans and soy (Subuola *et al*., 2012), the fiber content is higher than chickpea and beans (Espitia Orozco *et al*., 2016). The physicochemical results of the Orejero seed pulp were like those published by Espitia Orozco *et al*. (2016), Barrientos-Ramirez *et al*. (2015) and Serratos-Arevalo *et al*. (2008). Regarding the nutritional chemical composition can be observed an increase in the content of protein and ethereal extract, mainly contributed by the milk that is added in the preparation.

Microbiological analysis: Table 3 shows the microbiological analysis of the spreadable paste. As can be seen, all samples satisfy with national and international standards. This evaluation applied to spreadable paste shows satisfactory results, indicating good manufacturing practices used to produce the product (Dias *et al*., 2012).

Texture: In the spreadability test, the most significant variation in all parameters obtained is between the values of the formulations F1, F2 and F4, which has a higher proportion of pulp and a lower proportion of panela than the other formulations. As shown in Table 4 and 5 the values of Consistency, Cohesiveness, Viscosity index and Firmness with minors in formulations F1, F2 and F4, which means that these products have a better spreadability than the other formulations.

Table 5: Comparison analysis of viscosity index and firmness measurements of the spreadable paste from *E. cyclocarpum* seed pulp (formulation 4)

Formulations	Viscosity index (N.s)	Firmness (N)
1	-147.79±8.66e	12.99±0.98a
2	-185.94±12.66d	17.79±0.73b
3	-269.02±13.96a	30.55±2.83e
4	-155.79±10.31e	16.68±0.32b
5	-239.26±19.67c	21.73±1.44c
6	-259.77±29.35ab	21.48±1.29c
7	-170.83±22.72de	24.11±2.77cd
8	-265.03±7.34ab	25.49±2.10d
9	-257.56±6.66ab	35.28±0.95f

*: Variables with the same superscript letter in the same group did not show significant differences between them ($p<0.05$)

Formulation 4 presented the lowest cohesiveness although this did not show significant difference (significance level of 5%) with the F2 formulations (Table 4). The low cohesion is favorable to the extension of the paste in the product to be spread. However, the formulation F4 presented a more moderate viscosity index than the formulation F2, although there were no significant differences with Formulation F1, which had the lowest consistency and firmness (Table 5).

CONCLUSION

Formulation F4 had the highest acceptance by preference test (87%), which is an essential indicator of the approval of the product. Color and flavor were the most accepted sensory attributes, although all were above 82%. The physical-chemical evaluation of the product shows important nutritional characteristics for the consumer, given its high protein content, ethereal extract and fiber, similar to products such as beans and soy. The microbiological parameters kept the requirements of the NTC-3757 of 2008, indicating good manufacturing practices used to produce the product. The formulations with a higher proportion of pulp and a low proportion of panela presented the best parameters of spreadability within which was the formulation F4, that was the one that obtained more acceptance by the panelists.

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