RESEARCH ARTICLE

SENSORY ASSESSMENT OF COOKIE TYPE BISCUITS PRODUCED WITH EGGPLANT FLOUR (*SOLANUM MELONGENA*, L.)

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ABSTRACT

Eggplant flour (*Solanum melongena*, L.), rich in fiber, minerals, and vitamins, is a viable alternative for food enrichment, since its processing allows the maintenance of important nutritional characteristics, leading to benefits to consumers of its products. This study's objective was to evaluate the sensory acceptance of cookie type biscuits manufactured with eggplant flour in different concentrations. Eggplant flour was produced in laboratory and incorporated in cookies dough, in substitution of oat flour, in the percentages of 5, 10 and 15%; a control formulation was also made, without addition of eggplant flour. The cookie type biscuits were evaluated through sensory assessment by affective acceptance test, for aroma, color, taste, and appearance attributes. The results were statistically evaluated by the linear regression method at 5% of probability and demonstrate, by the analysis of variance, that the biscuits differed significantly, however, the color and aroma did not have mathematic models adjusted, showing consistency between the formulations produced. For taste, quadratic model was adjusted, with higher scores for the biscuit with a portion of 15% of eggplant flour in substitution of oat flour. The appearance presented a cubic model, with interference of non-standardization of the biscuits. The use of eggplant flour in food products with the purpose of formulations enriching was shown to be viable from a sensorial perspective, and should be an alternative to increase daily intake of dietary fiber.

INTRODUCTION

Eggplant (*Solanum melongena*, L.) belonging to the family Solanaceae, originates in Southeast Asia, arriving in Brazil in the 16th century through Portuguese expeditions. It is widely produced in the Brazilian territory mainly in the states of São Paulo, Minas Gerais, and in the southern region of the country, however small producers cultivate this species throughout Brazil (Finco *et al.,* 2009). Rich in fiber, minerals, and vitamins, the eggplant has been identified in several studies as a functional food, capable of playing important health benefits since it is constituted by several phytochemical compounds (Scorsatto *et al.,* 2017). This solanaceae representative is characterized by its high antioxidant potential and by controlling blood cholesterol levels, due to its absorption in the intestine and the bond of some of its components to the bile salts, exerting a hypocholesterolemic effect (Carvalho & Lino, 2014).

Eggplant flour is a viable alternative for food enrichment, since its processing allows the maintenance of important nutritional characteristics to promote correct functioning of gastrointestinal tract, as well as the prevention of chronic degenerative diseases, being its high content of dietary fibers responsible for its functionality in human organism. The usage of this flour in bakery products, such as breads, cakes, and biscuits, in partial substitution to wheat flour have been applied by food industry in order to increase the supply of dietary fiber in some products (Soares *et al.,* 2012). Cookie-type biscuits production with the use of mixed flours is an alternative for enrichment and technological development of functional foods, since this product has wide commercial and sensorial acceptance, reaching different age groups, and also, their diversity meets the flour analysis concerned to their chemical, physical, and sensorial properties (Dias *et al.,* 2016). In this regard, the development of a new food product requires the assessment of its acceptability among consumers, as well as its

behavior in the market, through a sensorial affective test, capable of reveal their performance regarding the consumers (Silva *et al.,* 2018). In order to enrich the nutritional composition of the cookies, a product widely accepted among consumers, making it a food product with high fiber content, capable of acting in prevention of chronic degenerative diseases, this study's objective was to assess the sensory acceptance of cookie type biscuits incorporated with eggplant flour.

MATERIALS AND METHODS

It is a study of quantitative approach that will use statistical software for data analysis. The objectives characterize the research as descriptive and the data collection will be carried out experimentally. It was carried out in the city of Vitória da Conquista, Bahia, and the production of Eggplant flour and cookies as well as their sensorial analysis were performed at the Health Laboratories of the Northeast Independent College - FAINOR. The inclusion criterion for the tasters who performed the sensorial evaluation of the cookie type biscuits produced were university students, employees, and professors of the Northeast Independent College - FAINOR, who were eighteen years old or older and that were in agreement with the criteria of the research described in the informed consent term (TCLE). While the exclusion criteria were subjects not belonging to FAINOR's students, staff and teachers, those who were under the age of eighteen, and who did not accept the criteria of the research or refused to sign the informed consent form. Those who present some food restriction to any ingredient contained in the preparations were also excluded.

Obtaining Eggplant Flour: The eggplants used for the flour production were purchased from CEASA in the city of Vitória da Conquista, Bahia, packed in polyethylene bags and stored under refrigeration until processing. The Eggplant Flour (EF) was produced according to the flowchart shown in Figure 1, and the methodology proposed by Scorssato and colleagues (2017). The eggplants were sliced and dehydrated in a circulation oven and refurbished air at a temperature set at $62 \pm 5\ °C$ for about 12 hours and cooled in a desiccator for 1 hour. Later, the dehydrated samples were triturated in a processor, classified in 60 mesh (Figure 2), and packed in plastic bags.

Obtaining biscuits with eggplant flour: A standard formulation produced by the author with percentages of 5, 10 and 15% eggplant flour in substitution of oat flour was used for cookies processing. The biscuits were identified with numerical codes I (5%), II (10%) and III (15%). A control formulation, without the eggplant flour, named Control was elaborated. The ingredients and their respective amounts are set as shown in Table 1 and the sum of the flour masses totals 100% while the other ingredients were determined according to the total amount of oat flour employed in the formulation. The biscuits were processed in a blender, and the cookie type biscuits were after molded. The cookies were baked in a conventional oven at 180 ° C for 15 to 20 minutes, cooled to room temperature, and packed in plastic containers.

Microbiological Analysis: The presence of total coliforms and *Escherichia coli* were determined according to the methodology described in AOAC 991.14 (2012), while coagulase positive *Staphylococci* were determined according to ISO 6888-1 (2016), and the presence of *Salmonella* spp. by ISO 6579-1 (2017) methodology.
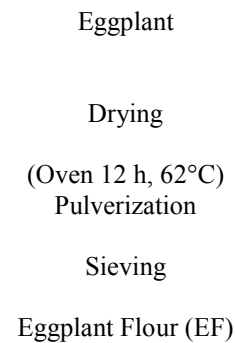
Eggplant

Drying

(Oven 12 h, 62°C)
Pulverization

Sieving

Eggplant Flour (EF)

Figure 1. Flowchart for obtaining eggplant flour

Figure 2. Eggplant flour

Sensory Analysis: Cookies acceptability was assessed by affective acceptance test using a hedonic scale of nine points, ranging from extreme one (extremely displeased) and nine (extremely enjoyed) (IAL, 2008) by a team of 40 untrained tasters, who were between 18 and 45 years old, composed of students, professors, and employees of FAINOR. The sensorial analysis was carried out in the laboratory in individual compartments, adapting the conditions for its objective, and the samples were coded with random three digit numbers and evaluated for the appearance, color, flavor, and aroma characteristics through the sensory assessment sheet. The tasters were initially recruited and conducted to sign an Informed Consent Term (TCLE) approved by the Ethics Committee of the Northeast Independent College, with approval protocol No. 3.254.948 for the collection of research data, thus preserving privacy and the confidentiality of the data obtained from the research participants. The cookies to be evaluated were arranged in plastic dishes and served with water. The evaluation sheets were handed in and the tasters were advised to fill them. The results from the sensory assessment were submitted to regression analysis at the 5% probability level, using SAEG software version 9.1.

RESULTS AND DISCUSSION

The biscuits were evaluated for their microbiological safety so that they could be submitted to sensorial acceptance analysis. The biscuits microbiological analyzes are presented in Table 2. It was observed that the products obtained are within the standards required by the legislation, obeying the provisions of the National Health Surveillance Agency (ANVISA) - Ministry of Health, according to RDC No. 12/2001 (Brasil, 2019). Given the results achieved, cookies were considered safe for consumption from the microbiological perspective. The results from the sensory assessment, carried out to evaluate the acceptance of the cookies incorporated with

Table 1. Formulation of cookie type biscuits with eggplant flour in partial substitution to oat flour

Ingredients		Biscuits		
	Control	I (5%)	II (10%)	III (15%)
Oat flour	100 g	95 g	90 g	85 g
Eggplant flour	0	5 g	10 g	15 g
Muscovado	120 g	120 g	120 g	120 g
Cocoa powder	120 g	120 g	120 g	120 g
Baking soda	15 g	15 g	15 g	15 g
Vanilla essence	15 mL	15 mL	15 mL	15 mL
Coconut oil	120 mL	120 mL	120 mL	120 mL
Egg	1 unit	1 unit	1 unit	1 unit
Source: The author				

Table 2. Microbiological analyzes of cookie type biscuits produced with different percentages of eggplant flour

Microorganisms	Reference value[1]	Control 0%	Biscuit 5%	Biscuit 10%	Biscuit 15%
Total Coliforms (CFU/g)*	Max. 1×10^1 CFU/g	$< 1 \times 10^1$	$< 1 \times 10^1$	$< 1 \times 10^1$	$< 1 \times 10^1$
Escherichia coli CFU /g)*	Max. 1×10^1 CFU/g	$< 1 \times 10^1$	$< 1 \times 10^1$	$< 1 \times 10^1$	$< 1 \times 10^1$
Staphylococcus coagulase positiva (CFU /g)*	Max. 5×10^2 CFU/g	Ausence	Ausence	Ausence	Ausence
Salmonella spp./25g	Ausent/25g	Ausence	Ausence	Ausence	Ausence

*CFU – Colony Forming Unit [1]Reference value according to the Resolution No. 12, January 02, 2001 - ANVISA - item 10 - Flour, pasta, bakery products (industrialized and packaged) and similar products, wafers and biscuits, without filling, with or without a covering, including gingerbread, cookies, and similars (BRASIL, 2019).

Eggplant flour, in a hedonic scale of 9 points, for the variables appearance, color, aroma, and taste, are arranged in the graphs from 1 to 4. In Figure 3, it was observed for the aroma feature that, no significant regression model was found, among the evaluated, for the study of eggplant flour concentrations added to cookies type biscuits. The biscuit aroma presented average scores ranging from 6.57 to 7.42, which corresponds to slightly and moderately approval scores for the concentrations of eggplant flour used in the cookies production. Silva and Silva (2015) evaluated the biscuits produced with flour of mango agroindustrial residue and did not obtain significant difference for the flavor attribute, with scores varying between 6.9 and 7.5. The color attribute assessed in the biscuits did not present a significant regression model for the study of eggplant flour concentrations (Figure 4).

The average scores fluctuated between 6.81 and 7.52, showing an evaluation result between slightly enjoyed and moderately enjoyed, respectively, evidencing a good acceptance of the cookies concerned to these attributes. The constancy exhibited by these features, due to the non-adjustment of the significant model, indicates that the ingredients used in the biscuit formulation may have influenced its aroma and color, masking possible variations caused by the increased concentration of eggplant flour. Finco and collaborators (2009) when adding eggplant flour in the concentrations of 5, 10 and 15%, in substitution of wheat flour, in the biscuits production, did not observe statistically significant difference through the analysis of variance. It was observed a significant difference for the taste attribute ($p < 0.05$) in the sensory assessment of the eggplant flour biscuits, with a positive quadratic effect of eggplant flour concentrations on the taste of cookies, with higher acceptance (7,84) when the cookies were added with 15% of eggplant flour, replacing oat flour (Figure 5). The addition of a greater concentration of eggplant flour to cookies can lead to superior benefits to consumers' health, due to the different functionalities presented by this flour, making it a widely accepted commercial product in a functional food without causing damages to its taste. The high fiber content present in eggplant flour gives it a good water absorption capacity, which is an important characteristic in the bakery

products production such as breads, cakes, and biscuits, showing itself as a viable alternative for partial substitution to wheat flour, allowing that this product act in daily dietary fiber supplementation (Scorssato *et al.,* 2017). The biscuit presentation differed significantly ($p < 0.05$) according to analysis of variance. In Figure 6, it was observed that there was a cubic effect of eggplant flour concentrations on the cookies appearance. Possibly due to the artisanal form of biscuit production, the presentation was not standardized, as there was no use of a cylinder to cut and mold them, resulting in an uneven appearance and variations in sensory assessment due to the addition of eggplant flour.
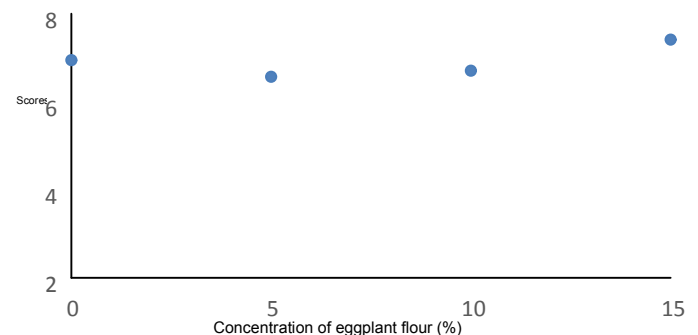
Figure 3. Sensory assessment for the feature aroma of cookie type biscuits with different concentrations of Eggplant flour. Vitória da Conquista, 2019
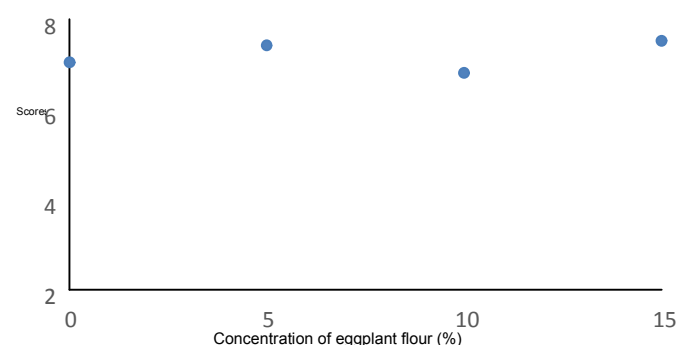
Figure 4. Sensory assessment for the feature color of the cookie type biscuits with different concentrations of Eggplant flour. Vitória da Conquista, 2019
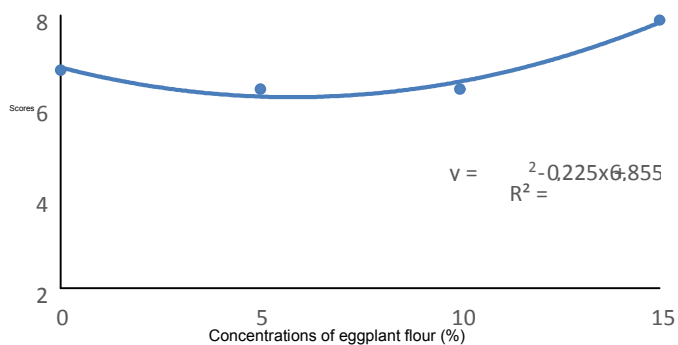
Figure 5. Sensory assessment for the feature taste of the cookie type biscuits with different concentrations of Eggplant flour. Vitória da Conquista, 2019
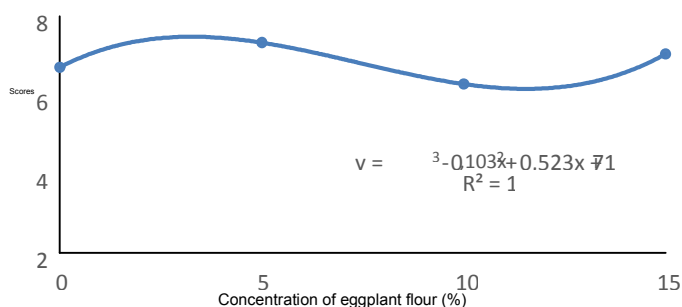

Figure 6. Sensory assessment for the feature appearance of the cookie type biscuits with different concentrations of Eggplant flour. Vitória da Conquista, 2019

Researches carried out with biscuits incorporated with flour of mango agroindustrial residue, the appearance exhibited a decrescent linear effect in relation to the increase of this flour concentrations, observing that the biscuits standardization and form may have influenced the results (Silva & Silva, 2015).

Final remarks: Sensorial acceptance assessment for appearance and color sensorial attributes did not have models adjusted by statistical analysis of regression, showing constancy in the exhibited scores for these characteristics, thus indicating that the increase in concentration of eggplant flour did not affect the consumer's perception on the cookies. The biscuits produced with a higher percentage of eggplant flour, 15%, attained higher scores, demonstrating that the flavor was improved with the addition of eggplant flour. Appearance presented a cubic effect for the detected scores, being able to be improved by greater uniformity in biscuits production. The use of eggplant flour in food products with the purpose of enriching the formulations was shown to be viable from the sensorial perspective, and could be an alternative to increase daily supply of dietary fiber for the consumers, from a widely accepted food in several age groups like the cookie type biscuit.

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