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Preparation of peanut candy with golden flaxseed

Elaboração de paçoquinha com linhaça dourada

Abstract

Introduction: Golden flaxseed has important amounts of α-linolenic acid, soluble fibers and lignans, which can bring benefits to health. *Objective:* To prepare peanut candy added with golden flaxseed flour (GFF) in different proportions and determine its proximate composition and sensory acceptance. *Materials and methods*: Peanut candies were prepared with the addition of 10%, 15% and 20% of GFF. The proximate composition was determined and then acceptance tests (hedonic scale) were applied. Data were analyzed using the Kruskal Wallis test and ANOVA, adopting a significance level of 5%. *Results:* Regular peanut candy and a preparation added with GFF showed no difference in moisture (17.1 to 18.5%) and lipid (30.8 to 34.2%) content. As for ash content, only formulations with 15 and 20% of GFF had the highest percentage, 1.94% and 2.03%, respectively. The protein content was significantly lower (15.4 to 18.5%) and the amount of dietary fiber increased in formulations with GFF. In relation to sensory analysis, the candies added with GFF obtained good acceptability, with no significant differences regarding the attributes evaluated in comparison with the regular peanut candy. *Conclusion*: The data obtained allowed us to see that it is possible to partially replace peanuts with golden flaxseed flour in the preparation of candies, as the new products presented sensory characteristics that pleased consumers in all the evaluated attributes, in addition to superior nutritional value with regard to increased fiber and mineral content.

Keywords: Functional food. Flaxseed. Fatty acids. Sensory analysis

Resumo

Introdução: A linhaça dourada apresenta importantes quantidades de ácido α-linolênico, fibras solúveis e lignanas, podendo trazer benefícios para a saúde. *Objetivo:* Desenvolver paçoquinha adicionada de farinha de linhaça dourada (FLD) em diferentes proporções, bem como determinar sua composição centesimal e aceitação sensorial. *Materiais e métodos*: Foram elaboradas paçoquinhas com adição de 10%, 15% e 20% de FLD. A composição centesimal foi determinada e, após, foram aplicados testes de aceitação (escala hedônica). Os dados foram analisados através de teste de Kruskal Wallis e ANOVA, adotando-se nível de significância de 5%. *Resultados:* As paçoquinhas padrão e adicionadas de FLD não apresentaram diferença no teor de umidade (17,1 a 18,5%) e lipídeos (30,8 a 34,2%). Quanto ao teor de cinzas, apenas as formulações com 15 e 20% de FLD tiveram maior percentual, 1,94% e 2,03%, respectivamente. O teor de proteínas foi significativamente menor nas formulações com adição de linhaça (15,4 a 18,5%) e a quantidade de fibras alimentares aumentou nas formulações com FLD. Em relação à análise sensorial, as paçoquinhas adicionadas

de FLD obtiveram boa aceitabilidade, não sendo observadas diferenças significativas com relação aos atributos avaliados em comparação com a paçoquinha padrão. *Conclusão:* Os dados obtidos permitiram verificar que é possível a substituição parcial do amendoim em paçoquinhas por farinha de linhaça dourada, pois os novos produtos apresentaram características sensoriais que agradaram aos consumidores em todos os atributos avaliados, além de apresentarem valor nutricional superior no que se refere ao incremento de fibras e teor de minerais.

Palavras-chave: Alimento funcional. Linhaça. Ácidos graxos. Análise sensorial

INTRODUCTION

The peanut candy known in Brazil as "Paçoca doce" or "paçoquinha" is a sweet food whose main raw material is peanut. Other ingredients such as cornmeal, sugar, honey and fat may be present in greater or lesser proportions.[1,2]

Peanut candy is highly accepted, especially among children, considering that most of them have a taste for sweeter foods. However, most sweet foods such as jams, marmalades and cocoa paste are not healthy due to the high content of carbohydrates (mainly sugars) and fats, not to mention the low content of proteins and micronutrients.[3]

Many peanut-based sweet foods are already available on the market, but people look more and more for food choices that bring health benefits and advantages over traditional products, taking into account that diet is one of the main determining factors for increased risk of chronic noncommunicable diseases (NCDs), particularly diseases of the circulatory system, diabetes and cancer.[4-6]

The addition of golden flaxseed flour (GFF) has been used to improve the nutritional value of many foods such as bakery products, meat and fish based foods as hamburgers, and also sweet foods. In addition, foods added with flaxseed flour are highly accepted.[3,7-12]

The benefits of golden flaxseed are generally attributed to the presence of high amounts of α-linolenic fatty acid (C18: 3, ω-3), lignans, dietary fiber and vitamin E, which are closely related to reduction of risk of cancer, diabetes, serum total cholesterol and LDL-c levels, as well as decrease of platelet aggregation.[13,14]

Regarding the nutritional composition of golden flaxseed, 100 g provides: 542 kcal distributed into 23.1% of proteins, 33.2% of carbohydrates and 35.6% of lipids, of which 48% are *omega-3* fatty acids, 15.2% omega-6 fatty acids, 26% monounsaturated fatty acids and only 10.7% saturated fatty acids. This profile shows the great potential for the use of golden flaxseed in the development of new products.[7]

In view of the population's growing search for foods with greater nutritional value and the health benefits derived from the consumption of golden flaxseed resulting from the high content of nutrients, this study proposes the preparation of a peanut candy added with golden flaxseed flour and the evaluation its acceptance and proximate composition.

MATERIALS AND METHODS

Raw material

Golden flaxseeds, peanuts, honey, crystal sugar, and iodized salt were used for the preparation of the peanut candy, which were purchased from the "supermarket chain" in the city of Picos-PI.

Elaboration of the peanut candies

Regular peanut candies was prepared, used as a base and having peanuts as the main ingredient (standard formulation), and three other peanut candy formulations were prepared with 10%, 15% and 20% ground golden flaxseed flour in the place of peanut flour. The formulation of the regular peanut candy added with flaxseed is shown in Table 1.

Table 1 Quantity of ingredients present in regular peanut candy formulation and formulation added with golden flaxseed flour (GFF). Picos-PI, Brazil, 2020.

INGREDIENTS (g)	Regular formulation	Formulation 10% of GFF	Formulation 15% of GFF	Formulation 20% of GFF
Peanut	250	225	212.5	200
Golden flaxseed	-	25	37.5	50
Crystal sugar	75	75	75	75
Salt	1.5	1.5	1.5	1.5
Honey	35	35	35	35

GFF: Golden flaxseed flour.

The packaging, preservation and expiration date of all ingredients were checked. The peanut candies were prepared at the Technique and Dietetics Laboratory of the Federal University of Piauí-CSHNB.

According to Ordinance nº 359/2003 under the responsibility of the Ministry of Health, the specific legislation for the Technical Regulation of Portions of Packaged Foods for the purposes of Nutritional Labeling established the standardized portion of 20 g/unit for cereal bars with more than 10% of fats, nougats, "pé de moleque", and peanut candy.[15]

Procedures for preparing peanut candies

After selection of the golden flaxseed grains, they were crushed in an industrial blender (SKYMSEN®, Model: LI-1,5-N), processed and sieved until golden flaxseed flour (GFF) was obtained with fine granulometry (1.40 mm). The flour was stored in a hermetically sealed container, labeled and stored in a dry and ventilated place.

The peanuts were roasted in an aluminum pan over low heat for 10 minutes and then dehulled; then, they went through a grinding process in an industrial blender at speed 3, for two minutes. For the production of peanut candy, crushed peanuts, GFF (10%, 15% and 20%), crystal sugar, honey and iodized salt were crushed for another five minutes in an industrial blender, until obtaining a homogeneous mixture. After all these steps, the food was fit for consumption. A peanut candy unit was portioned in 20-g cubes.

Analysis of the peanut candies

Proximate composition

The moisture, ash, protein and lipid content of regular peanut candies and candies added with GFF was analyzed.[16] The total carbohydrate content was calculated by difference. The values of dietary fiber for 100 g of the product were estimated according to the values obtained by Simbalista et al.[17] All analyzes were performed in triplicate at the Laboratory of Biochemistry and Food Bromatology at the Federal University of Piauí.

The peanut candies had their calorific values estimated through ATWATER conversion factors: 4 kcal/g for proteins, 4 kcal/g for carbohydrates and 9 kcal/g for lipids.[18]

Sensory analysis: acceptance test

The samples, presented in 20-g portions, were evaluated as to the attributes "global impression", "flavor", "appearance" and "texture" through affective methods with a 9-point hedonic scale whose extremes corresponded to "I extremely disliked it (1)" and "I extremely liked it (9)".[19]. Fifty untrained evaluators, all students or civil servants from the Federal University of Piauí - Senador Helvídeo Nunes de Barros Campus (CSHNB)-, applied the scale. After that, the data were organized as follows: 1 to 4 - I disliked it; [5] - indifferent; and 6 to 9 - I liked it. This method is able to simultaneously evaluate one or more samples for a specific attribute, thus determining the existence of difference and the degree of difference between the evaluated products. Sensory tests were performed at the Sensory Analysis Laboratory of the Federal University of Piauí, CSHNB.

After being produced and portioned, the peanut candies were placed separately on an evaluation table, each one coded with three digits. The tasters did not know what ingredients were part of the food composition. Water was offered in the intervals between each tasting session.

Statistical analysis

The data collected in the sensory analysis were analyzed using the Kruskal Wallis test, and ANOVAs and the Tukey's test were used for comparison of the means of the proximate composition data. The level of significance was 5%. The SPSS software, version 19.0, was used for statistical analysis.

Ethical aspects

The research was submitted to the Research Ethics Committee of the UFPI and the study was started after approval (CAAE: 15634313.2.0000.5214). Individuals who agreed to participate in the research were invited to sign the Informed Consent Form, developed according to Resolution 446/2012 of the National Health Council - NHC, after being informed that their participation was not mandatory, their identity would be maintained in secrecy, and they could withdraw from the research at any time.

RESULTS AND DISCUSSION

After preparing the candies, there was a final yield in the mass production of the ingredients of 86.6% (regular peanut candy), 91.7% (peanut candy with 10% GFF), 93.6% (peanut candy with 15% GFF), and 92.9% (peanut candy with 20% GFF). The losses were due to the small portion of the mixture that was adhered to the internal villi of the blender. This type of loss was already expected in the type of processing used.

Analysis of proximate composition

The addition of GFF to the peanut candy can increase the nutritional value of this product, considering that golden flaxseed is an important source of protein, fat and dietary fibers and carbohydrates (including sugars, phenolic acids, lignan and hemicellulose).[20] Table 2 shows the proximate composition found for the regular formulation and the formulations with addition of 10%, 15% and 20% of GFF.

The moisture present in peanuts was 6.4% on average, and in flaxseed, 6.7% on average.[21] It is therefore suggested that as the moisture content of peanuts and of flaxseed was similar and the formulations had an equal addition of honey, the moisture content of the formulations did not differ statistically (Table 2). All samples showed values within the limit of up to 38.0% moisture established by Ordinance nº 90/2006.[22]

Table 2. Proximate composition of regular peanut candy and candy with addition of 10%, 15% and 20% of golden flaxseed flour, on a dry basis. Picos-PI, Brazil, 2020.

	Regular formulation	Formulation 10% of GFF	Formulation 15% of GFF	Formulation 20% of GFF
Moisture	18.5 ± 0.1^{a}	17.7 ± 0.8^{a}	17.7 ± 0.2^{a}	17.1 ± 0.8^{a}
Ash	1.83 ± 0.03^{a}	1.88 ± 0.03^{ab}	1.94± 0.002^{bc}	2.03 ± 0.05^{c}
Protein	21.9 ± 0.8^{a}	18.5 ± 0.9^{b}	17.1 ± 1.8^{b}	15.4 ± 0.5^{b}
Lipid	34.2 ± 0.9^{a}	32.1 ± 2.7^{a}	32.9 ± 0.4^{a}	30.8 ± 0.6^{a}
Carbohydrate	36.57	40.02	39.56	42.37
Fibers*	5.5	7.5	8.5	9.4
Kcal	541.68	522.98	522.74	508.08

*Fiber content indirectly estimated from a study by Simbalista et al.[17]

The ash content of the regular formulation and of the one added with GFF, as shown in Table 2, increased as the percentage of GFF increased. A similar result was found in a study by Hussain et al.[23] which showed an increase in the ash content after the addition of flaxseed flour to cookies, and these differences were attributed to the minerals that are naturally present in flaxseed flour. In a study by Simbalista et al., it[17] was seen that flaxseed contains high ash content, around 4.1%.

In the study by Borges et al.[24] an increase in ash content was observed as flaxseed flour was added to the composition of bread, similar to what was found in the present study, a fact attributed to the good mineral content present in this seed. This same result was seen by Oliveira et al.[25] in breads added with 10% of flaxseed flour, as the authors found higher values of ash content, around 3.4%.

Regarding the protein content, its percentage decreased in formulations that had GFF. The regular formulation presented in its composition a higher content of total proteins (21.9%) than that of formulations with GFF (15.4% to 18.5%). This fact can be explained by the higher protein concentration in peanuts when compared to golden flaxseed. According to the food composition table provided by the USP, peanuts contain 26% of proteins; lower values are present in flaxseeds, ranging from 19% to 21.6%.[21,26]

Despite this, the amino acid profile found in flaxseed protein is similar to that of soy protein, which is known as one of the most nutritious vegetable proteins, as it contains proteins of high biological value. In turn, peanut protein has lysine and sulfur amino acids as limiting agents.[27] Therefore, it is believed despite the percentage reduction in protein, new products have higher nutritional value, due to the possible increase in biological value of the preparation's proteins.

There was no significant difference in the lipid content between the regular formulation and the formulation added with GFF, although the lipid content of roasted peanut is higher than that of the flaxseed, 43.9 g/100 g and 32.3 g/100 g, respectively.[21]

Although there was no difference in total lipid content, it is known that alpha-linolenic acid is the main functional component of flaxseed. Flaxseed oil is rich in polyunsaturated fatty acids (73% of total fatty acid), moderate in monounsaturated fat (18%) and low in saturated fat (9%). It is rich in both essential fatty acids - alpha-linolenic acid (ALA) and linoleic acid (LA);[28,29]peanut oil, on the other hand, is low in ALA and LA, being mainly composed of oleic acid (80 %).[30]

Regarding the carbohydrate content, it was observed that the regular formulation had lowest total carbohydrate content (36.6%), while the formulations with the addition of 10% (40.0%), 15% (39.6%) and 20% (42.4%) of GFF obtained an increase in its percentage. This increase is explained by the fact that the total carbohydrate value found in the peanut composition was less than the values found in the ground grain of golden flaxseed.[21]

The content of dietary fibers present in the products was estimated based on the values obtained by Simbalista et al.[17] According to the technical regulations recommended by Anvisa,[31] solid food is considered a source of dietary fiber if it contains in its composition a minimum of 3 g of fiber /100 g, and food with high fiber content, if it has a minimum of 6 g of fiber/100 g. Based on these values and on the levels of dietary fibers found in formulations with 10% of GFF (7.5 g/100 g), 15% of GFF (8.5 g/100 g), 20% of GFF (9.4 g/100 g),

it can be said that the peanut candies prepared in this research had a high fiber content, thus favoring the proportional replacement of peanuts by GFF.

Oliveira et al.[25] found that the incorporation of flaxseed flour into salt bread increased the total dietary fiber values of the formulation with 10% and 15% by approximately 128% and 124%, respectively, in relation to the control.[32,33]

Sensory analysis

Figure 1 presents the results of the sensory analysis carried out with the peanut candy regarding the attributes “global impression”, “flavor”, “appearance” and “texture”.

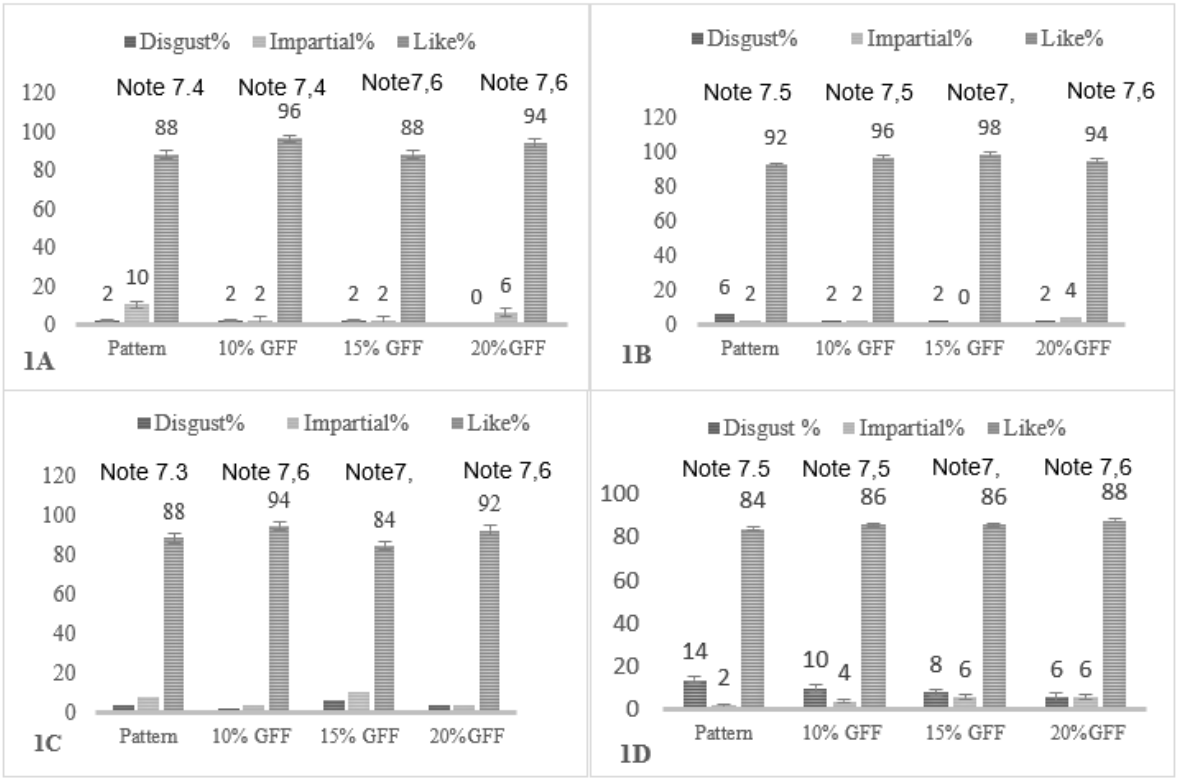
It is observed in Figure 1A that the formulated candies containing 10%, 15% and 20% of GFF and the regular formulation obtained similar global impression scores ($p = 0.589$). Figure 1B presents the results of the sensory analysis concerning the attribute “flavor” (including the residual flavor of the golden flaxseed) of the regular candy and the one prepared with GFF. The results indicate that, despite the increase in the proportions of GFF (10%, 15% and 20%) in the formulated candies, the residual flavor of the golden flaxseed was not perceived among the tasters, with no statistical difference in the average scores between the formulations ($p = 0.661$).

Regarding the “appearance”, the values obtained suggested that the perception of flaxseed flour did not interfere in the acceptance of the attribute evaluated by the tasters ($p = 0.524$), according to Figure 1C. This shows that the flaxseed added nutritional value to the candies without interfering with the acceptance of the new product.

The texture, according to Saydelles et al,[34] is the sensory manifestation of the structure of a product. It can also be defined as all the rheological and structural properties of a food that can be perceived by

mechanical, tactile receptors and, eventually, by visual and auditory receptors. With regard to this attribute, it was again observed that the regular formulation and the one added with GFF did not show a statistically significant difference (p = 0.396), as shown in Figure 1D.

Figure 1. Sensory evaluation of the attributes "global impression","flavor", "appearance" and "texture" of peanut candies prepared with golden flaxseed flour, in different proportions: 1A - Global impression, 1B - Flavor, 1C - Appearance, 1D - Texture



CONCLUSIONS

The data obtained in this work showed that it is possible to partially replace peanuts with GFF in the preparation of candies, obtaining formulations with sensory characteristics that please consumers in all evaluated attributes. The fiber content estimated in the peanut candies added with flaxseed was higher than that of the conventional formulation, and can therefore receive the title of product with high fiber content. The proximate composition showed that the addition of flaxseed in the proportions of 10%, 15% and 20% significantly increased the amount of minerals. Thus, the addition of GFF increased the nutritional value of the product, and its consumption by the population could be stimulated.

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Contributors

Crisóstomo JM and Santos ACCA participated in the conception and design of the study; Rodrigues LARL, Sousa RR and Lavôr LCC participated in the analysis and interpretation of the data; Frota KMG participated in the review and approval of the final version.

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