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NUTRITIONAL ENRICHMENT OF CUPCAKES WITH FLOUR OBTAINED FROM COCONUT MESOCARPO

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ABSTRACT

Coconut palm is one of the most widely distributed fruit trees in the world, occurring in practically all continents, presenting a relevant socioeconomic value. Mesocarp as well as being a source of fiber also has properties that can be used in the food industry as an important food supplement in the human diet, especially because of its fiber, protein, sugar and fat content. The objective was to elaborate enriched cupcakes from the coconut mesocarp and to evaluate the physical-chemical, microbiological and sensorial attributes. The flour was obtained after drying the mesocarp at 70 ° C for 48 h. Cupcakes were prepared in three different formulations (Formulation 1 - 1% flour, Formulation 3% and Formulation 3 - control, without addition of flour). Physical-chemical and microbiological analyzes were performed: water content (%); ash content (%); lipid content (%); total acidity (%); pH; protein content (%); total sugars (%); total fibers (%); *Salmonella* sp / 25 g; *Staphylococcus coagulase positive* (UFC / g); Molds and yeasts (UFC / g), Coliforms at 35 and 45 °C (NMP / g) and *Escherichia coli*; the sensory evaluation of the cupcakes was conducted with 146 untrained tasters, with scores ranging from 1 (I highly disagree) to 9 (I liked it a lot). The sensory tributes adopted were appearance, color, aroma, taste, texture and as the overall acceptance. The evaluators' intention to buy was also evaluated, using a five-point scale, where the tasters assigned scores from 1 to 5, varying from "certainly would buy" to "certainly would not buy." The cupcakes were within the standards required by current legislation. The enriched formulations presented as an interesting proposal for the bakery product market. Among the formulations evaluated by the judges, the one that obtained greater acceptance was the formulation with 3% of the flour.

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INTRODUCTION

The green coconut presents facility for commercialization, for the low cost and availability, for that reason the presence of many street vendors in areas of leisure and recreation.

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But the increase in consumption also increases the possibility of environmental impact in these areas. The accumulation of discarded coconuts, together with the fact that they can not have their volume reduced (due to hardness), bring logistical and environmental difficulties (Silva 2010). Waste disposal is a worldwide concern both in environmental issues and in the waste of food parts with high nutritional content (Menon *et al*., 2014). Therefore, finding a destination for waste other than

discarding has been the focus of study for many researchers, using as main alternative the elaboration of fruit and vegetable flours and the application in food products of several areas, mainly in the food industry (Karovicová and Magala, 2013; Ade *et al*., 2014). It is important to note that partial or total substitution of wheat flour should take place provided that improvements in the sensory and nutritional quality of food products are obtained and that it is economically viable, so that their use by consumers is actually possible, in addition to meeting the need for diversified products (Borges *et al*., 2013). The question of the accumulation of discarded coconuts is still a bottleneck to be solved, which would avoid visual pollution and environmental contamination. The discarded parts of the coccus serve as a source of proteins, enzymes, carbohydrates, lipids, vitamins, minerals, fibers and bioactive compounds, which are important for physiological functions and recoverable and useful (Sousa *et al*., 2011). The evaluation of the quality of the bakery products can be determined by specific physical-chemical, microbiological and sensorial analyzes (Lopes *et al*., 2007). In order to increase the consumption of these nutrients some alternatives have been proposed, among them, the production of new foods with the incorporation of residues in the formulations aiming to add nutritional value to the new products (Padilha and Basso 2015). In this sense, the objective was to elaborate enriched cupcakes from the coconut mesocarp and to evaluate the physical-chemical, microbiological and sensorial attributes.

MATERIAL AND METHODS

The research was carried out at the Laboratory of Microbiology of Food of the Technological Vocational Center (CVT), of the Center of Sciences and Technology Agrifood of the Federal University of Campina Grande (UFCG) Campus of Pombal. The coconut samples used in the research were purchased in the city of Pombal-PB. The samples of the mesocarp were submitted to drying in an air circulation oven at 70 °C for 48h. After drying, the samples were ground in a knife mill and sieved. At the end of the processing, the flour was obtained, it was packed in sterilized plastic polypropylene pots. The raw materials used to prepare the cupcakes were: unleavened wheat flour, eggs, margarine, crystal sugar, vanilla essence, whole milk, dry chemical baking powder and coconut mesocarp flour. The dough of the cupcake was processed manually at the following concentrations: Formulation 1 (99% wheat flour and 1% coconut mesocarp flour); Formulation 2 (97% wheat flour and 3% coconut mesocarp flour); Formulation 3 (100% wheat flour - control). Initially, the margarine and eggs were mixed and the milk and the vanilla essence were added, until a homogeneous mass was obtained. The dough was transferred to aluminum foil bowls, taken to the preheated oven for 25 min. After the cupcake was cooked, it was unmolded and packed in polyethylene trays and covered with pvc film at room temperature. The following physicochemical and microbiological analyzes were performed in triplicate: water content (%) determined in an oven at 105 °C for 24 h until constant weight; the ash content (%) was determined in muffle at 550 °C for 18 h; the lipid content (%) was quantified by the Sohlext direct extraction method; the total acidity (%) was determined by the titration method; pH was determined on bench pH meter; the protein content (%) was determined using the Kjeldahl method, according to the methodology of Brazil (2008); the determination of total sugars (%) was done by the Antrona method described by Yemn and Willis (1954) and the amount of total fibers (%) was determined by the acid-base digestion method described by AOAC (1995), with adaptations of Pontes Júnior (2012); for the identification of *Salmonella* sp / 25 g and *Staphylococcus coagulase positive* (CFU / g) was used the methodology of Silva et al. (2010); (UFC / g), Coliforms at 35 and 45 ° C (NMP / g) and *Escherichia coli* according to the methodology recommended by Brazil (2003).Sensory evaluation of cupcakes was conducted with 146 untrained tasters of both genders using a 9-point verbal hedonic scale according to Stone and Sidel (2004), with scores ranging from 1 (I highly disagree) to 9 (I liked very much). The sensory tributes adopted were appearance, color, aroma, taste, texture and as the overall acceptance. The evaluators' intention to buy the samples was also evaluated using a five-point scale, where the testers assigned scores from 1 to 5, varying from "certainly would buy" to "certainly would not buy." The experiment was conducted in a completely randomized design with three replicates. The comparison of means was done by the Tukey test at 5% of significance and the statistical analysis was done by the Assistat 7.7 program (Silva and Azevedo, 2016).

RESULTS AND DISCUSSION

Table 1 shows the results of the physical-chemical analysis of cupcakes enriched with the coconut mesocarp flour.

Table 1. Results of the physical-chemical analysis of cupcakes enriched with coconut mesocarp flour (*Cocos nucifera* L.)

	Formulations		
Physical-chemical parameters	Formulation 1 (1% flour)	Formulation 2 (3% flour)	Formulation 3 (Control)
Water content (%)	28,44a	28,97a	31,54a
pH	8,29ab	8,20b	8,71a
Total acidity (%)	0,38b	0,37b	0,56a
Ashes (%)	1,02b	1,03b	1,15a
Lipids (%)	4,99a	5,93a	5,43a
Proteins (%),	4,90a	4,11a	3,59a
Total fibers (%)	0,54b	1,13a	0,26b

Means followed by the same letter in the column do not differ significantly from each other by the Tukey test, at 5% probability. The amount of water of a product is linked to the conservation of the food, because the greater the percentage of water, the higher the perishability. No differences were observed between the formulations for the moisture content, but a tendency was observed in the reduction thereof with the addition of the flour. The reduction of humidity guarantees a longer product life, and reduced deterioration of the product by deteriorating microorganisms. Andrade *et al*. (2018) found higher moisture content (38.8 to 42.1%) than that found in this study for whole grain breads produced with different concentrations of green banana flour. Maia (2007) and Bernardino (2011) studied the addition of passion fruit flour and sugarcane bagasse flour in cakes, which showed humidity variations of 33.08 and 15.93%, respectively. It was observed that Formulation 2 presented lower mean for pH followed by formulation 1. It was found that the addition of the flour in the cupcake did not contribute to the increase of the acidity, thus making the product suitable for consumption. Dias *et al*. (2016) when studying the physicochemical characterization of cookies made from oatmeal found pH values ranging from 7.6 to 7.8, values lower than those found in the present study. When studying the characterization of biscuits enriched with açaí flour Azevedo *et al*. (2015) also found lower values (6.62 to 7.11). The data presented above show that there were significant differences for acidity, where Formulation 3

presented higher mean. The acidity values are directly related to the pH, which did not interfere in the acidity of the product, therefore, larger concentrations of the flour can be used. Muniz *et al*. (2014), evaluating the acidity in the addition of the flour of the mesquite sweepings verified the percentage between 6.27 and 6.70%, being superior to that of this study. There was a significant difference for the ash content, where Formulation 3 presented a higher average, it was also observed that the addition of the flour concentrations decreased the ash content of the product. Mariani *et al*. (2015) reported different results in their study, where the ash content in biscuits varied between 1.56 and 4.23%. Maia (2007), when analyzing formulations of cakes with passion fruit flour, also verified a higher value (1.88%) than found in this research. For the lipid content there was no significant difference between the cupcakes analyzed, however, there was a trend in the increase of the lipid content with the increase of the amount of flour. Different from what occurred in the research, Bick *et al*. (2014) demonstrated that the addition of quinoa flour in cookies did not interfere with the lipid content when compared to the standard. Carneiro *et al*. (2015) in a study on the characterization of cakes with partial substitution of wheat flour by oats, quinoa and linseed obtained lipid percentages ranging from 6.21 to 7.54%, being the values higher in relation to the nutritional enrichment study of cupcakes with the addition of coconut mesocarp flour.

cupcakes demonstrated that the use of good manufacturing practices was efficient during the processes, with no contamination by the manipulator or cross contamination. Considering the results obtained after the microbiological analyzes, it was observed that the cupcakes produced with the addition of the coconut mesocarp flour complied with the legislation in force when the number of Coliforms, *Salmonella* sp / 25g. The absence of these microorganisms in the analyzed samples indicate that the raw material and its respective processes were efficient, since the food contaminated by these bacteria is considered as a source of human contamination, representing a great risk to public health. All samples presented counts below the maximum established by current legislation. Therefore, the cupcakes were fit for consumption under the microbiological aspect. Table 3 shows the average results of the scores attributed by the tasters to cupcakes in relation to the appearance, color, aroma, texture, taste and overall acceptance attributes. Means followed by the same letter in the column do not differ significantly from each other by the Tukey test, at 5% probability. It can be observed that the averages of the analyzed attributes do not differ statistically among them at the level, except for the flavor and texture attribute, where Formulation 2 presented the highest average for the texture attribute.

Table 2. Results of microbiological parameters of cupcakes enriched with coconut mesocarp flour (*Cocos nucifera* L.)

	Formulations			
Parameters	Formulation 1 (1% flour)	Formulation 1 (3% flour)	Formulation 3 (Control)	[1]VMPP
Salmonella sp /25g	Absent	Absent	Absent	Absence
Estafilococus coagulase positiva (UFC/g)	Absent	Absent	Absent	-
Molds and yeasts (UFC/g)	Absent	Absent	Absent	-
Coliforms a 35 °C (NMP/g)	<3	<3	<3	-
Coliforms a 45 °C (NMP/g)	<3	<3	<3	$5x10^2$
Escherichia coli	Absent	Absent	Absent	-

[1]VMP: Maximum allowed value, second Brasil (2001).

Table 3. Results of the sensory analysis of the cupcakes elaborated with addition of the coconut mesocarp flour (*Cocos nucifera* L.)

	Formulations		
Attributes	Formulation 1 (1% flour)	Formulation 2 (3% flour)	Formulation 3 (Control)
Appearance	8,04a	7,89a	8,06a
Color	7,89a	7,77a	8,02a
Aroma	7,88a	7,95a	7,64a
Flavor	7,65b	8,11a	7,63b
Texture	7,36ab	7,69a	7,17b
Global acceptance	7,58a	7,94a	7,60a
Buy intention	1,97a	1,74a	2,04a

As for protein levels, the formulations did not differ. Low protein contents were observed in the cupcakes formulations, but a tendency in the protein increase with the addition of the flour to the product can also be observed. Superior results were found by Muniz *et al*. (2014) in their research on cake production with algaroba peel flour, where values ranging from 7.63 to 7.84% were obtained. Freitas *et al*. (2014) also found that the use of pumpkin seeds and bauru flour in celiac biscuit formulations improves nutritional content in relation to protein and lipid contents. For the percentage of fiber in the cupcake, it was noticed that there was a significant increase for Formulation 3, which differed statistically from the others, thus, the higher the concentration of the mesocarp flour, the higher the percentage of fibers in the product. Table 2 shows the microbiological parameters of cupcakes enriched with coconut mesocarp flour. The absence of Staphylococcus coagulase positive, Mold and Yeast and Escherichia coli in

The average attribute values are equivalent to the hedonic terms "extremely disliked" or "extremely liked." Among the formulations, the 3% of the coconut mesocarp meal presented a better acceptance for the aroma, flavor, texture and overall acceptance attributes. According to Carderelli (2006), research into new product developments needs to show not only the degree of overall acceptability, but also what consumers like or dislike about the product, and how those attributes can be modified to increase acceptability. Thus, studies often include questions about product attributes that can determine the overall acceptance level and issues related to food properties, such as flavor, taste and texture.

Conclusion

The elaborate cupcakes were within the microbiological standards required by the current legislation. The enriched

formulations were presented as an interesting proposal for the market of bakery products, like the cupcake. The addition of the coconut mesocarp flour made the product more attractive and with better sensorial characteristics, but among the formulations evaluated by the judges that obtained the highest acceptance was the formulation with 3% of the flour.

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