ORIGINAL ARTICLE

Nutritional Valuation of Biscuits from Breadfruit (*Artocarpus altilis*) and Wheat Flours (*Triticum vulgare* L.)

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Abstract

Aim: The elaboration of biscuits was proposed from different percentages of breadfruit flour (*Artocarpus altilis*) and wheat flour (*Triticum vulgare* L). **Materials and Methods:** The samples were processed in a similar way establishing adequate times, optimal temperatures, and good practices of raw material handling. The organoleptic evaluation of the product was carried out through sensory evaluation with 10 untrained tasters, to obtain the best treatment, being this substitution: 40% breadfruit flour + 60% wheat flour, from which the bromatological and microbiological characteristics of the biscuits were determined, with permissible results within the regulations. **Results:** With the analyzes carried out and using the nutritional calculator of the Ecuadorian agency for regulation, control, and health surveillance "for its initials in Spanish," the labeling of the nutritional semaphore of the obtained product was determined by recording: "High" in fat content, "low" in sugar content, and "low" in salt content, which identify biscuits suitable for consumption. **Conclusion:** The results of the microbiological analysis quantified a mesophilic aerobic load of 298 CFU/g. The microbiological tests of molds and yeasts identified values of 18 CFU/g, being within the ranges established by the INEN standards. With respect to *Escherichia coli,* the results showed total absence.

Key words: Biscuits, breadfruit, flour, nutritive

INTRODUCTION

The biscuits are foods of great energetic value due to their high content of carbohydrates and fats. The biscuits provide a media of 450 calories per 100 g, so it is an appropriate complement of breakfast or lunch. The biscuits are currently one of the products of great demand and low cost of production, which, being a food that allows to satisfy hunger, is considered a good vehicle to reach the population with a nutritional proposal of high nutritional value.[1]

Due to the energy contribution of its macronutrients and the high vitamins and minerals content that is present in biscuits, these are a fundamental part of a balanced diet, taking into account that the energy contribution of these foods is easily modulated (Olaoye *et al*., 2007). Nowadays, they are occurring changes in the alimentary habits originated from the social, economic, familiar, and new tendencies related to the image and the health.[2]

The breadfruit (*Artocarpus altilis*) is a product that is also obtained in the subtropics of Ecuador and has been used for a long time as animal feed in cooked or raw state. There are researches that are oriented to the use of vegetable biomass, due to the large size of the folios and their abundance, as well as the breadfruit tree as floury raw material to feed animals (pigs, sheep, and rabbits) of domestic and economic interest.[3] Carbohydrates represent the main source of food energy in the world given that they contribute between 40 and 80% of the total energy consumed, obviously depending on the geographical area, cultural considerations, and economic

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level, in addition to providing easily usable energy for the oxidative metabolism, the carbohydrates contained in food are vehicles of important micronutrients and phytochemicals that maintain glycemic homeostasis and gastrointestinal integrity and functionality.[4]

Celiac disease is a chronic enteropathy that causes poor absorption of food, due to certain proteins (prolamins) that are present in some cereals such as wheat, barley, and rye, which are toxic for these individuals, generating atrophy of the small intestine.[5]

Considering these background, this study intends to deliver a nutritional alternative to this segment of the population faced with a reality in which the supply of products aimed at satisfying their needs is very limited and little varied.

MATERIALS AND METHODS

In this study, a deductive-inductive methodology was developed, where qualitative-quantitative results were obtained. The treatments analysis and the sensory evaluation were prepared as tools a hedonic survey and as a tool a questionnaire. For the hedonic analysis of the biscuits obtained, 10 g per cookie unit were evaluated in triplicate. The combinations for obtaining the biscuits were according to the following experimental scheme [Table 1].

The organoleptic analysis was performed to determine the best treatment and proceed to identify the nutritional value, the organoleptic characteristics analyzed were crunchiness, odor, color, flavor, and acceptability, the organoleptic weighting for each of the characteristics was of 1–5 points. For which, 10 tasters of a total of 25 people were selected, after which the selected people were trained.

Bromatological characteristics

The bromatological characteristics were evaluated and analyzed to the best treatment and these were protein content (AOAC/Kjeldahl), total moisture, dry material, fiber, fat, ash, and organic material, the latter according to the regulations AOAC/gravimetric.

Table 1: Scheme of the experiment

Formulation	Code	Description
0% BFF+100% WF	BFF0	0% breadfruit flour+100% wheat flour
20% BFF+80% WF	BFF1	20% breadfruit flour+80% wheat flour
30% BFF+70% WF	BFF2	30% breadfruit flour+70% wheat flour
40% BFF+60% WF	BFF3	40% breadfruit flour+60% wheat flour

Microbiological characteristics

The microbiological analysis was carried out in the best treatment, and these were aerobic mesophilic CFN/g (Petrifilm AOAC 991), molds and yeasts CFN/g (Petrifilm AOAC 991.02), and *Escherichia coli* CFN/g (Petrifilm AOAC991.07).

Nutritional semaphore analysis

To establish the nutritional semaphore analysis of the best treatment, the following analyzes were carried out: Transfatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, sugars, and sodium chloride (salt).

Statistical analysis

The results obtained in the experiment were developed with the help of statistical tests: (ANOVA) Analysis of variance to determine the significance of the organoleptic tests, separation of means according to the Duncan test at the levels of $P \leq 0.05$, and the sensory analysis of ratting test, for sensory variables. For the microbiological variables, the central tendency (mean) statistics was used.

RESULTS AND DISCUSSION

Organoleptic analysis

In the sensory test for the variables: Crunchiness, odor, color, flavor, and acceptability, statistical difference was observed between the treatments, being the treatment T4 (40% BFF + 60% WF) different from the others. The product had a crunchiness and color characteristic of commercial biscuits. After this analysis, it was determined that the T4 was evaluated as the best among the four treatments under investigation.

Having statistical differences between the treatments, according to the judgment of the untrained tasters, the influence of the raw material under study is determined. In this respect, in similar studies such as the developed by Villarroel *et al*. (2009), who in an investigation of the elaboration of a cookie based on hazelnut flour and quinoa flour for celiac patients showed results that agree with those observed in this work.

Regarding the variable crunchiness between the treatments, it is inferred that the presence of wheat flour in the composition of the biscuits analyzed influenced these results. The biscuits have a characteristic crunchiness. These results are related to what was expressed by Chauvin *et al.* (2008), who reported similar results. These same authors describe crunchiness as the sound produced by highly fracturing of food, which has been called cracking, which decreases depending on moisture content and hydration by salivate effect or storage processes related to the exchange of moisture with the environment.

Odor is the characteristic that can be perceived by the olfactory system.[6] Although there is evidence in the study conducted by Guerrero (2014) that The fruits are fermented for long periods, sometimes for several years, forming a doughy mass called "masi." The seeds are separated and the paste is wrapped in *Heliconia* leaves spread with coconut cream, and the product is baked in the oven for 2 h, acquiring a strong smell like cheese, which is very appreciated by the natives.

In color, the sensory evaluation emanating from the judging process states that biscuits with breadfruit flour generally have a characteristic color. Guerrero (2014) points out that these confectionery products are darkening as the sugar melts not only does caramel brown appear but also a high number of compounds that contribute to the aroma and typical final taste are generated of caramelized sugar.

The sensory evaluation of flavor determined that this is characteristic of this product, to which the level of breadfruit flour with which it was made contributed. A significant difference was reported by the tasters, with the highest concentration exceeding the other treatments.

These results agree with Benítez *et al.* (2008), who in a study of biscuits production with bovine plasma and cassava flour reported higher values for the ratings "I like" and "I like a lot" and interestingly, which is attributed to the levels of sugar that make the product pleasant and well qualified since the sweetener could mask some important unpleasant taste.

Bromatological analysis

The bromatological analysis was performed to the best treatment: T4 (40% BFF + 60% WF) [Table 2].

Through the bromatological analysis of the biscuits, results have been observed with notable values as in the moisture content of 2.15%, being within the normal parameters since in the NTE INEN standards 518 indicates that the requirement must be a maximum of 10%; in dry matter of 97.73%, fiber (1.64%), fat (19.17%), ash (1.39%), organic matter (98.61), and protein (10.72%) being within the normal parameters since in the NTE INEN 519 standards it indicates that the requirement must be a minimum of 3.0% (INEN 2005). However, Mejía (2009), in the preparation of biscuits enriched with carrot foliar protein concentrate, performed the bromatological proximal analysis, establishing values of the protein in 11.33% higher than the value obtained in this investigation.

In relation to the proximal analysis of the biscuits under study, they reported acceptable levels of protein and fiber and high values in fat, but within the parameters established by the nutritional semaphore according to current Ecuadorian regulations, which is an alternative for the consumption of children who require significant levels of fat as an energy source. These results agree with that reported by Benítez *et al*. (2008), who in a study on the elaboration of biscuits based on cassava flour and bovine plasma report high levels of fat from plasma and recommend considering them as an option for children because of their high-energy requirements.

Table 2: Bromathological analyzis in biscuits

Analysis	Content
Moinsture	2.27%
Dry matter	97.73%
Proteins	10.72%
Fiber	1.67%
Fat	19.17%
Ashes	1.39%
Fat ratio - sugar - sodium chloride	19.17% for fat, while sugar content was 5.00% and NaCl (salt) was 0.036%

Determination of labeling of nutritional semaphore

In accordance with the provisions of the health regulation and control agency (ARCSA), the labeling of nutritional semaphore was calculated considering the product as a solid, as it is a baked cookie. The analysis made on the basis of 100 g of biscuits presented the following results with their respective valuation range (semaphore labeling ranges): (33.00 g) Total fat being >3 g of total fats considered a product "high fat;" (5 g) sugars being found in a range equal to 5 and <15 g being a product "low sugar;" and finally with (0.014 g) sodium salt determining a product "low salt."

For the determination of the semaphore labeling, bromatological analysis was performed on saturated fat (12%), transfatty acids (0.13%), monounsaturated fatty acids (5.55%), polyunsaturated fatty acids (2.45%), sugars (5%), salt (sodium chloride) (0.036), and sodium (0.00).

With these results, the calculation was made on the web page of ARCSA that indicated that the cookie is high sugar since the concentration is ≤ to 5 g, high fat since the concentration is ≥20 g and low salt since the concentration is ≤ to 120 mg (ARCSA, 2015).

Microbiological determination of mesophilic aerobes

The results of the microbiological analysis quantified a mesophilic aerobic load of 298 CFU/g. The microbiological tests of molds and yeasts identified values of 18 CFU/g, being within the ranges established by the INEN standards. With respect to *E. coli,* the results showed total absence.

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