

## Galletas integrales tipo cookie con fibra de brotes de bambú: propiedades tecnológicas

### Whole cookies with bamboo shoots: technological properties

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#### ABSTRACT

Brazilians consume about 8.5kg of cookies per capita/year, and cookies with a health claim are available in the Brazilian market, so the use of wholemeal flour and bamboo shoots can meet this demand for new products. The objective of this work was the elaboration of whole cookies without and with chocolate (GC) and commercial bamboo shoots fibre (FBB). Formulations were: standard (C0) without addition of FBB and GC; C1, with the addition of 15% GC; C2, with 10% FBB; C3 with 15% GC and 10% FBB and C4, with 15% GC, 10% FBB and 25% fat reduction. Ingredients were mixed, rolled, cut ( $h = 5\text{mm}$  and  $\varnothing = 5\text{cm}$ ), provided at  $160^{\circ}\text{C}$  for 8 minutes and evaluated after cooling. The addition of FBB with GC and the reduction of fat content reduced the mass spreading. The mass loss (%) was higher in formulations C1 and C4. Biscuits with fibres (C1 to C4) had a lighter color ( $L = 60.31 \pm 1.99$ ) and a higher hardness than the standard ( $27.00 \pm 2.29$ ). Bamboo shoot fibres showed potential for use in cookies, and it can even be used for fat reduction, improving its nutritional characteristics and consumer demand for healthier products.

**Keywords:** Bamboo shoot, Fibres, Health.

#### RESUMEN

Considerando el aumento de la variedad de galletas con propiedades saludables, el uso de harina y fibra de brotes de bambú puede satisfacer la demanda de nuevos productos. El objetivo de este trabajo fue elaborar y evaluar las características tecnológicas de galletas tipo *Cookie* con y sin chocolate (GC), con fibras de brotes de bambú (FBB). Fueron elaboradas cinco formulaciones: un control (C0) sin adición de FBB y GC; C1, (15% GC); C2, (10% FBB), C3, (15% GC, 10% FBB); y C4, (15% GC, 10% FBB y 25% reducción de grasa). Los ingredientes fueron mezclados, la masa laminada, cortada ( $h=5\text{ mm}$  y  $\varnothing=5\text{ cm}$ ), y horneada a  $160^{\circ}\text{C}$  durante 8 minutos. La adición de FBB con GC, así como la reducción del contenido de grasa, disminuyeron la difusión de la masa durante el horneado. Las galletas con fibras (C1 y C4) presentaron una coloración más clara ( $L=60.31\pm 1.99$ ) y mayor dureza en comparación al control

(27.00±2.29). Las fibras de brotes de bambú demostraron tener potencial para ser utilizadas en formulación de galletas, permitiendo reducir el % de grasa, mejorando sus características nutricionales a la vez que satisface la demanda de productos más saludables.

**Palabras Clave:** Brote de bambú, Fibras, Salud.

## 1. INTRODUCTION

Brazil is among the largest producers of biscuits, with a production of 1.3 million tons in 2015, with consumption per capita/year of 8.5kg, being surpassed only by Argentina, the United Kingdom, Italy, and the United States. This per capita consumption puts Brazil in 5th place as a consumer (Abimapi, 2015). Of these, cookies are very present in the trade, with a wide variety of sizes, flavors, and ingredients.

Cookies can be defined as baked cereal products that have high levels of sugar and fat, with a moisture content of 2 to 8% and a water activity ranging from 0.1 to 0.3, where the quality of the ingredients used in its formulation has a direct influence on the characteristics of the final product (Gökmen et al., 2008; Pareyt et al., 2009).

This type of biscuit is highly consumed by different audiences, due to its long stability and ease of consumption, especially by children, due to the sweet taste and crunchy texture (Chevallier et al., 2000; Fasolin et al., 2007; Jacob and Leelavathi, 2007, Moraes et al., 2010, Feddern et al., 2011, Simabesp, 2012).

There are classic chocolate chip cookie biscuits made with refined wheat flour, but there are cookies with health claims, and can be added with various whole grains and fibers, including bamboo shoots (*Bambuseae* spp.), Whose use in biscuits was reported by Farris and Piergiovanni (2008) and Farris et al. (2008)

Some crops like the Asian ones consume the bamboo in the form of sprout. Its nutritional potential has already been studied, being rich in vitamins, minerals, amino acids and fibers (Chongtham et al., 2011). Brazil has 89% of all bamboo genera and 65% of all known species in America. It also houses one of the largest native bamboo reserves in the world (180,000 km<sup>2</sup>), which is located in the southwest of the Amazon, constituting a solid economic possibility still unexploited (Judziewicz et al., 1999).

In the international market, there are several companies that market bamboo shoots fiber. However, Brazil does not produce this type of fiber and imports the CreaFibe® product at an average cost of R \$ 6.00 / kg. In other countries, bamboo shoot fibers are produced under the trade names Jelucel®BF (Jelu-Werk, 2016) and Nutriloid® Bamboo Fiber (Tic-Gums, 2016) and with specifications and percentages of use in the preparation of several types of food products.

Coupled with the greater demand of consumers for healthy products and contributing to the prevention of certain diseases, product formulations added with bamboo shoots fibers have been very successful since, in addition to increasing the supply of fibers, they reduce the energy value and the fat and sugar content present at high levels in bakery products, especially in cookie-type biscuits. The present work had as objective the elaboration, technological evaluation and the total alimentary fiber content and tasting of cookie type biscuits without and with the addition of drops of chocolate (GC) and of commercial bamboo shoot fiber (FBB).

## 2. MATERIAL AND METHODS

### 2.1. MATERIAL

The bamboo shoots fibre used was supplied by *Nutrassim Indústria, Comércio Importação e Exportação LTDA* (Extrema, MG), and the other ingredients were purchased from the city of Campinas (SP).

## 2.2. PRODUCTION OF COOKIES

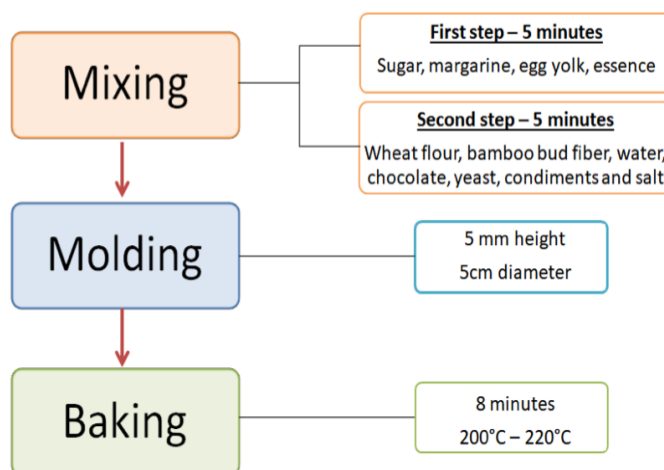
Whole cookies were prepared following formulations shown in Table 1, where formulation C0 is the control formulation, ie, it had no addition of commercial bamboo shoot fiber (FBB) or chocolate drops (GC).

**Table 1.**

Formulations of cookies with bamboo shoots fibre and reduction of fat content.

Ingredients	C0	C1	C2	C3	C4
Whole wheat flour (%)	100	100	100	100	100
Sugar (%)	54.6	54.6	54.6	54.6	54.6
Margarine (%)	38	38	38	38	28.5
Chocolate Drops - GC (%)	-	15	-	15	15
Bamboo shoot fiber - FBB (%)	-	-	10	10	10
Egg yolk (%)	9.4	9.4	9.4	9.4	9.4
Water (%)	12	12	24	24	30
Bicarbonate ammonia (%)	2.50	2.50	2.50	2.50	2.50
Salt (%)	0.61	0.61	0.61	0.61	0.61
Spice (%)	0.36	0.36	0.36	0.36	0.36
Vanilla essence (%)	0.15	0.15	0.15	0.15	0.15

Figure 1 shows the flowchart of cookies processing: in the mixing step, two phases were followed. In the first phase, the cream formation, sugar, margarine, egg yolk and vanilla essence were added in a mixer and beaten for five minutes at high speed. In the second step, for the mass formation, the other ingredients were added and the beating was performed for approximately five minutes, adjusting the amount of water to be added, according to the characteristics and appearance of the standard sample (C0). Afterwards, the dough was rolled in the thickness of 5 millimetres, cut into a cylindrical cutter with a diameter of 50 millimetres and transferred to baking sheets. The whole cookies were baked for approximately 8 minutes in an oven with temperatures close to 200 ° C in the ballast and 220 ° C in the ceiling. At the end of the delivery, the cookies were cooled for 30 minutes, packed in a vacuum and stored in a controlled temperature room, protected from light.



**Figure 1.** Flowchart of whole cookies processing steps.

## 2.3. Technological Analysis

Ten whole cookies, before and after baking, had their diameter and height measurements determined using pachymeter, to be evaluated for horizontal (CH) and vertical (CV) growth, it was also determined in the 10 biscuits the weight, using a semi-analytical balance, to calculate the mass loss in the delivery (PM).

The cookies were analyzed for specific volume (VE) by displacement of the millet seed and the measure of the proportion of growth of the cookies was calculated by dividing the diameter of the samples by the thickness of the same.

The hardness was determined in a Stable Micro Systems Texture Analyzer TAXT2 (Surrey, England) with probe 3-point bending rig (HDP / 3PB) and colour (parameters L\*, a\* and b\*) using a colorimeter (CR 400 Konica Minolta, JAPAN), by the CIE-Lab system.

The theoretical calculation of the total dietary fibre content was carried out taking into account the specifications provided by the suppliers of whole wheat flour and also of the bamboo shoot fibre.

### 3. RESULTS AND DISCUSSIONS

Table 2 shows the results of the technological analyses carried out on the cookies. It was found that all the formulations enabled the formation and cutting of the cookies mass. There was no significant difference between the samples in relation to the specific volume. With respect to growth, we observed an antagonistic behaviour, where the C3 and C4 cookies, which presented the highest vertical growth, also presented the lowest horizontal growth. That is, the addition of the FBB with GC as well as the reduction of the fat content had the effect of reducing the spreading of the mass during the baking.

Kaur, Singh and Kaur (2017) evaluated the effect of partial substitution of wheat flour on the production of cookies by different concentrations of flax meal and the impact of this substitution on the physical-chemical, antioxidant and sensorial characteristics of the cookies. The authors observed that the growth of cookies was higher in the greater percentages of substitution of wheat flour, a behaviour justified by them in the strength of the wheat flour used, which may have stopped the growth of cookies.

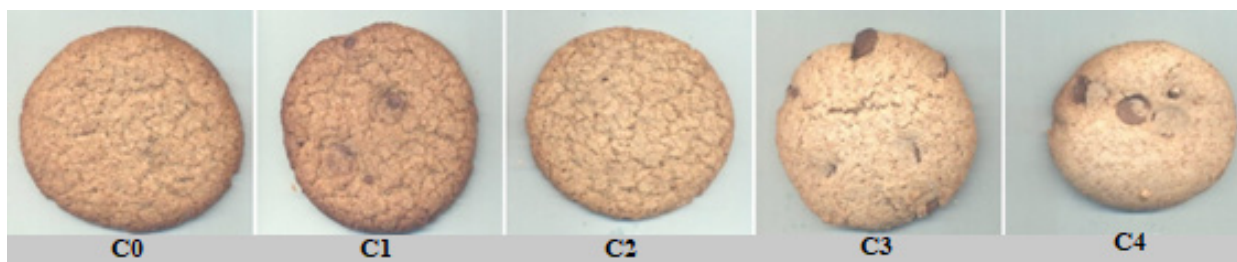
The hardness of the biscuits was higher for the whole cookies C3 and C4, which contained FBB and GC, and C4 was elaborated with the least amount of fat in its formulation in relation to the others and with a greater amount of added water. This may justify its high hardness value since fat is an important ingredient for maintaining the texture of biscuits (Manley, 2000).

**Table 2.**  
Technological characteristics of whole cookies<sup>1</sup>

Parameters evaluated	Formulations				
	C1	C2	C3	C4	C5
Vertical growth (mm)	1.9±1.1 <sup>b</sup>	1.1±0.9 <sup>c</sup>	2.7±0.95 <sup>b</sup>	5.5±1.2 <sup>a</sup>	5.9±0.9 <sup>a</sup>
Horizontal growth (mm)	2.0±0.2 <sup>a</sup>	1.58±0.2 <sup>b</sup>	2.04 ±0.3 <sup>a</sup>	0.84±0.2 <sup>c</sup>	0.63±0.2 <sup>c</sup>
Weight loss (%)	15.61±0.93 <sup>b</sup>	16.86±2.95 <sup>a</sup>	14.96±0.36 <sup>b</sup>	15.95±0.79 <sup>b</sup>	16.66±0.64 <sup>a</sup>
Specific volume (mL / g)	2.32±0.23 <sup>ns</sup>	2.26±0.24 <sup>ns</sup>	2.31±0.20 <sup>ns</sup>	2.16±0.21 <sup>ns</sup>	2.33±0.22 <sup>ns</sup>
Hardness (N)	27.00±2.29 <sup>c</sup>	41.43±4.07 <sup>c</sup>	39.48±3.82 <sup>c</sup>	73.41±5.83 <sup>b</sup>	86.57±7.41 <sup>a</sup>
Colour Parameters					
L*	52.33±0.60 <sup>b</sup>	48.25±2.05 <sup>c</sup>	53.76±0.67 <sup>b</sup>	60.31±1.99 <sup>a</sup>	58.98±1.79 <sup>a</sup>
a*	10.72±0.39 <sup>b</sup>	11.78±0.59 <sup>a</sup>	9.89±0.92 <sup>b</sup>	8.32±0.53 <sup>c</sup>	9.13±0.49 <sup>c</sup>
b*	28.63±0.69 <sup>a</sup>	28.50±0.74 <sup>a</sup>	28.49±1.15 <sup>a</sup>	26.11±0.28 <sup>b</sup>	27.08±0.60 <sup>b</sup>
Dietary fibre (%)	2.34	2.19	6.43	5.74	5.82

<sup>1</sup> Data expressed as mean ± standard deviation. Different letters on the same line differ from one another by the Scott-Knott test (p <0.05); ns: non-significant. C1 (Standard): 0% commercial bamboo shoot fibre (FBB) and 0% chocolate droplets (GC), C2: 0% FBB and 15% GC, C3: 10% FBB and 15% GC and C4: 10% FBB, 15% GC and 25% fat reduction.

There was a significant difference in the colour parameters  $L^*$ ,  $a^*$  and  $b^*$ . For the parameter  $L^*$ , the highest means were from samples C3 and C4, which contained FBB in their formulation, indicating clearer cookies than the others, as can be observed in Figure 1. For parameter  $b^*$ , which indicates variations of colour between blue and yellow, all averages were positive, indicating products with yellowish colour, being the highest averages in formulations C0, C1 and C2. Kaur, Singh and Kaur (2017) studied the partial replacement of wheat flour with linseed flour in cookies and observed that the higher percentages of linseed flour incorporation resulted in a lower luminosity ( $L^*$  parameter) of the cookies. The data observed in the present study (higher  $L^*$  values) for cookies with FBB presence can be justified because of the colour characteristics of the FBB itself, which is visually white with high  $L^*$  values.



**Figure 2.** Image of whole cookie made with commercial bamboo shoot fibre (FBB) and chocolate drops (GC). C0 (standard): 0% FBB and 0% GC, C1: 0% FBB and 15% GC, C2: 10% FBB and 0% GC, C3: 10% FBB and 15% GC C4: 10% FBB, 15% GC and 25% fat reduction.

The whole wheat flour used in the study had a fibre content of 5.1g / 100g of flour and the bamboo shoot fibre 95.44g of fibre / 100g of fibre isolated according to the specifications provided by the suppliers. The theoretical calculation of the total dietary fibre content of whole cookies showed that for C0 and C1, without the addition of FBB, the theoretical content of dietary fibre was 5.1 g of fibres / 100 g of product. For samples C2, C3 and C4, this content was approximately three times higher, 14.64%, indicating that FBB can be used to increase fibre content and promote the consequent known benefits of human dietary fibre intake, such as increase of the faecal cake, regulation of the intestinal transit among others (Prosky, 2000; Brownlee, 2001).

Consumer demand for healthier products contributes to a change in the ingredients of products with an established market, such as cookies. Therefore, the search for new natural ingredients has been stimulated, aiming to insert the development of new food products in the concepts of health and well-being, sustainability and ethics, reliability and quality, sensoriality and pleasure as presented in Brazil Food Trends 2020 (2010). Ingestion of dietary fibre has been studied for decades and studies relate the low intake of this nutrient with diseases such as diabetes, coronary heart disease and some cancers. In the food industry the ingredient commonly added to bakery products for increasing fibre content is the wheat bran itself. However, studies relate the presence of bran and whole flours in food products with negative consumer perception (Kruger; Matsuo; Dick, 1998).

In Brazil, the National Agency of Sanitary Surveillance (ANVISA) allows the use of functional claims in the packaging of foods related to the amount of fibre in the portions. For “fibre source” claims the food must have at least 2.5 g of fibre per serving and to be considered as having “high fibre content” it must have at least 5 g of fibre per serving of product ( Page 2 In the case of Europe, the specifications are somewhat more stringent, requiring 3 g per 100 g portion of product to be considered a source of fibres and 6 g per 100 g of product to be considered as rich in fibres (European Commission, 2012) .

Therefore, cookie type C3 and C4 biscuits meet the specifications of Brazilian legislation and fit as a source of fibre. In the case of formulation C2, added with FBB and without chocolate drops, the fibre levels were even higher and met the requirements of the European Commission, presenting 6.43 g of fibre in 100 grams of product.

The reduction of fat in formulation I5 and the incorporation of fibres in the formulations C1, C2, C3 and C4 also resulted in a caloric reduction of the product. A portion of 25g of cookie-type biscuits corresponds on average to 16% of the Recommended Daily Value of fat intake, and 6% of the RV of carbohydrates, considering a diet of 20000 kcal / day. The proposed formulations could increase the intake of non-digestible carbohydrates, which would reduce the energy value of the product, and cookies, which are foods rich in fats and carbohydrates, could present a healthier and therefore less harmful health profile.

#### 4. CONCLUSION

The results indicate that it is possible to incorporate bamboo shoot fibre into whole cookies with adequate technological characteristics and without consumer rejection. The fibre content of the cookies was higher for the samples that contained bamboo shoot fibre, contributing to improve the nutritional characteristics of cookies and present a new product with bamboo derivatives what led us to take advantage of the productive chain of bamboo, and in a sustainable manner, its insertion in Brazilian food habits, providing the inclusion.

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