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DEVELOPMENT OF SNACK USING CASSAVA (*Manihot esculenta*) AND WHEAT (*Triticum aestivum*) FLOUR MIXTURE

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ABSTRACT

This research work aimed to assess the suitability of incorporating cassava flour as a supplementary ingredient alongside wheat flour for snacks. In addition, this investigation explored the advantages combining cassava and wheat flours, considered the unique flavor and mixture characteristics imparted by cassava flour. Five different treatments were tested based on the ratios of cassava to wheat flour by dry weight. The aroma, taste, appearance, color, mouthfeel, and overall acceptability of developed snacks were evaluated using sensory tests. The 50 trained panelists trained in 5 -point hedonic scale of 1 (dislike very much) to 5 (like very much). The best snacks preparation composition identified by sensory tests were evaluated for its moisture, ash, color, and texture. Results revealed that the mixture containing a ratio of cassava flour to wheat flour; 25:75 was the most favorable sample across all sensory attributes. Selected best snakes contain moisture content 7.84%, total ash 3.37%. Colour values (L, a* and b*) were 51.61, 6.80 and 28.78 respectively. Hence, it can be recommended that the snack mixture of 25% cassava flour with 75% wheat flour can be selected as the best snack mixture. The findings may lead to the development of a snack while expanding the understanding of cassava flour's versatility in food production.*

Keywords: *Cassava, Manihot esculenta, Snack, Triticum aestivum, Wheat flour*

INTRODUCTION

Snack products become popular in Sri Lanka and wheat used as the major ingredient to of snack product industry. Substitution of wheat flour by different kinds of flour in snack making is economically essential in Sri Lanka as wheat is imported by other countries. There is novel trend of using mixture of flour for snack products producing industry to be economical and viable.

Cassava (*Manihot esculenta*) is the perennial woody plant cultivated mostly as an annual crop. This drought tolerant crop is an important source of energy for people in the tropical and sub-tropical regions (Cockand Howeler, 2012). Cassava is a valuable food crop emerging as a staple food for most of the African countries. The roots and leaves are good sources of nutrients such as carbohydrates, protein, and vitamins (Bayata, 2019). The majority of production is used for human consumption while less amount is used for animal feed. The crop has a high yield potential under good conditions and compared to other crops it stands well in the marginal land (Montero, 2003). Therefore, this is one of the potential crops to fulfill the food demand of increasing population (Hidayat *et al*., 2023).

The mass production of cassava flour represents a significant in the agricultural and food processing sectors. However, despite the abundance of cassava flour, its full potential remains largely untapped in the food industry. Currently, cassava flour is predominantly relegated to the role of a thickening agent or additive, mainly finding its place in the baking process, where it contributes texture and consistency (Abidinand Devi, 2013). Unfortunately, its utilization as a primary or leading ingredient in food products remains limited. To identify the full potential of cassava flour in the food industry, it is imperative to study its compatibility with other ingredients, particularly wheat flour, which is a staple in many food preparations worldwide. Therefore, this study was conducted with the aim of evaluating the applicability of cassava flour as an alternative to wheat flour for the development of snacks.

METHODOLOGY

Selection of Raw materials

Well-matured cassava (variety: kirikawadi) tubers were collected from cassava cultivation in Dambadeniya, Kurunegala District in Sri Lanka located at 7.3697° N, 80.1512° in low country intermediate zone with an average maximum temperature range from 22 to 30 °C and with average annual precipitation 20000 mm.

Preparation of snack

This study was performed on a laboratory scale. The collected cassava tubers were peeled and thoroughly washed. After that the cleaned tubers were cut into small pieces (2mm size). These small pieces were then subjected to oven drying at a temperature of 55°C for a duration of 16-18 hours until the moisture content reduced up to 8%, and they were subsequently ground using an electric grinder. The resulting cassava flour was sifted through a mesh with a pore size of 250 µm. A combination of wheat flour and cassava flour was prepared according to treatment specifications. In accordance with existing literature, ingredients such as turmeric powder, curry powder, salt, pepper, garlic, ginger, water, and vegetable oil (in equal proportions across all treatments) were added to the mixtures of cassava and wheat flour in appropriate quantities. Preliminary investigations were carried out to determine the appropriate ratios of other raw materials to incorporate into the snack. Five distinct treatments were employed based on the cassava-to-wheat flour ratios by dry weight: T1 (100% cassava, 0% wheat), T2 (75% cassava, 25% wheat), T3 (50% cassava, 50% wheat), T4 (25% cassava, 75% wheat), and T5 (0% cassava, 100% wheat, serving as the control)

Sensory Evaluation of the snack

Sensory evaluation was carried out to determine the suitable ratio of cassava flour and wheat flour to develop the snack. The acceptability of the five treatments was tested by using sensory analysis (appearance, smell, taste, mouthfeel, and overall acceptability) of a five-point hedonic scale of 1 (dislike very much) to 5 (like very much) and a sensory panel consisting of 50 trained panelists (Head *et al*., 1977).

Physiochemical characterization of the snack

The best mixture was selected according to the sensory characteristics and physiochemical properties such as moisture, ash, color, and texture of selected best snacks were evaluated by following methods.

Moisture content

The moisture content was determined by drying at 105°C to constant weight using the AOAC (1990) method.

Texture and colour of the snack

The Instron, TA, XT2 texture analyzer has been adapted to perform a texture analysis of the snacks. A compression test was carried out to measure snack texture and force at rupture was considered as the texture of the snacks (Gunathilake, 2018).

The process of determining color involved measuring three parameters specified by the CIELAB system. These color-related parameters, namely L*, a*, and b*, were determined using a colorimeter that was equipped with a diffuse reflectance setup known as the Color Quest II Sphere. These measurements were conducted through reflection, utilizing an observation angle of 10 degrees, the standard D65 illuminant, and the exclusion of specular reflection (abbreviated as RSEN). The L* value corresponds to the perception of lightness, where L* = 0 represents black and L* = 100 signifies white. In contrast, a* and b* are indicators of chromaticity, with +a* representing the color red and -a* indicating green. Similarly, +b* signifies yellow, and -b* represents blue.

Total Ash

Total ash content was performed by gravimetry after incineration in a muffle at 550°C using the AOAC (1990) method.

Statistical Analysis

Data gathered from the sensory evaluation was analyzed according to Friedman non-parametric test at 95 % level of significance using Mini tab statistical software.

RESULTS AND DISCUSSION

Sensory characteristics of the snack

The results of the sensory analysis of treatments show that there was a significant ($P \leq 0.05$) difference between the five treatments with respect to appearance, smell, taste, mouthfeel, and overall acceptability. Among the five treatments, treatment 04, that combination of cassava and wheat flour with the ratio of 25: 75 has shown the highest median values of 4.7, 4.8, 5.0, 4.9, 5.0 for appearance, smell, taste, mouthfeel, and overall acceptability respectively. In addition, the highest sum of ranks was recorded as 233.0, 233.5, 232.5, 234.0, 232.5 for appearance, smell, taste, mouthfeel, and overall acceptability respectively. Accordingly, treatment 04 was the most preferred snack mixture in comparison to the other 4 snack mixtures for its sensory qualities (Table 1, Figure 1). Indeed, previous research conducted by other scientists has identified an important factor in achieving desirable snack structure, namely, the presence of gluten. Gluten, a protein found in wheat, plays a crucial role in providing elasticity and structure to many baked goods, including snacks. Consequently, to attain optimal snack texture and quality when combining wheat and cassava flours, it is typically necessary to incorporate a substantial amount of wheat flour into the mixture. (Abidinand Devi, 2013) snacks (Maziya-Dixon *et al*., 2017), bread (Udofia *et al*., 2013), biscuits (Oluwamukomi *et al*., 2011) etc shown acceptance in different combinations.

Physiochemical characteristics of the snack

Selected best treatment (treatment 04) that used cassava and wheat flour with the ratio of 25: 75 was

Table 1. Friedman test results for sensory evaluation

Variable	Cassava and Wheat flour 100:0	Cassava and Wheat flour 75:25	Cassava and Wheat flour 50:50	Cassava and Wheat flour 25:75	Cassava and Wheat flour 0:100	Highest Sum of Rank	P – value
Appearance	1.00	4.20	2.10	4.70	1.00	233.0	0.000*
Smell	2.00	4.40	1.60	4.80	1.20	233.5	0.000*
Taste	1.80	4.80	1.80	5.00	1.60	232.5	0.000*
Mouth feel	1.10	4.40	2.00	4.90	1.10	234.0	0.000*
Overall acceptability	2.00	5.00	2.00	5.00	2.00	232.5	0.000*

*Value are medians of each response *value are significantly differs at 0.05 significance level according to the Friedman test*

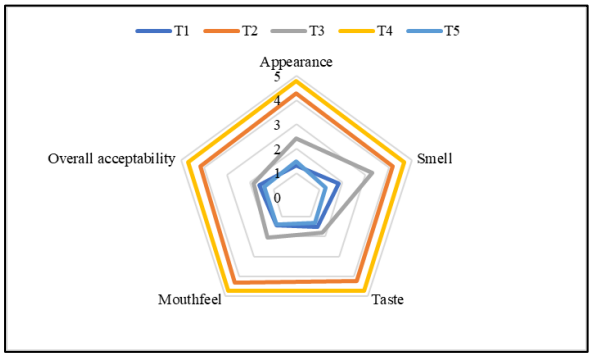

Figure 01. Radar plot of hedonic sensory rating of developed snacks

tested for its physiochemical characteristics such as moisture content, ash, color, and texture. The results revealed that, the moisture content of 7.48 g/100g. This moisture level indicates that the snack maintains a desirable crispiness while retaining a sufficient amount of moisture to enhance palatability. According to Awolu *et al*., (2015) the mixture of rice flour (58g/100g), cassava flour (33g/100g) and groundnut flour (9g/100g) give 20g/100g as the optimum moisture content for the extraction snack production process.

The total ash content, indicative of mineral composition, was found to be 3.37 g/100g. This measurement underscores the potential nutritional value of the snack, with its contribution to dietary minerals such as calcium, magnesium, and phosphorus. According to Obadina *et al.*, (2013) ash content of extruded cassava-based snacks ranged from 2.00 ± 0.35 to 2.90 ± 0.00. while moisture content ranged from 2.90 ± 0.14 to 8.60 ± 0.00.

Texture and colour of the snack

Texture analysis was used to determine a textural parameter of snacks. Snack hardness was taken as its texture value that can be defined as maximum tolerable force snack can withstand without breaking (force at rupture). Maximum hardness value of the selected best snack was 7.50 N. According to the previous studies, this value implies that the snack product offers a satisfying textural experience, combining a pleasing crunchiness with a balance that enhances consumer enjoyment (Luo *et al*., 2020).

Color properties were assessed through L*, a*, and b* values, which respectively represent lightness, red-green color, and yellow-blue color. The best snack selected by sensory test exhibited color values of L* = 51.61, a* = 48.47 and b* = 46.61 suggesting a visually appealing product with a vibrant and inviting appearance. Previous literatures are also proved it (Han e*t al*., 2010)

CONCLUSIONS

It can be concluded that according to the sensory test, snack made from the mixture of cassava flour with wheat flour; 25: 75 (T4) showed higher significant acceptance values. Further this treatment snacks were tested for moisture, ash, color, and texture. They showed acceptable values, the mixture of cassava flour can be used as an supplementary for wheat flour to produce good quality snacks.

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