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# Frozen Pancake Cubes with Water Chestnut Powder: Development and Quality Evaluation

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## Abstract

The study aimed to develop frozen millet pancake cubes using water chestnut powder, perceived as tasty and nutritious by consumers. The pancake batter consisted of sorghum and water chestnut flour, jaggery, milk, oil, baking powder, soda, and vanilla essence. Various formulations were prepared with different proportions of sorghum and water chestnut flour. Quality evaluation was conducted on these pancake cubes. Nutritional analysis per 100 grams showed energy values of 338.6 Kcal for the control and 111.5 Kcal for Treatment 3, with moisture content at 24.7% and 71% respectively. Treatment 3 exhibited higher protein, fat, fiber, and mineral content compared to the control. Antioxidant activity measured by DPPH scavenging showed a range of 73%, with a total phenol content of 64.20. Shelf-life assessment over 30 days indicated a gradual increase in Total Bacterial Count, while yeast and mold growth remained negligible. From the results protein, fiber, and minerals of T3, were higher than in the control sample. These innovative methods satisfy the demands of contemporary customers. These findings demonstrate the potential of incorporating water chestnut powder into frozen millet pancake cubes to meet the preferences of modern consumers.

***Key words*:** Ready-made frozen food, Frozen pancake batter cubes, Sorghum flour, Water chestnut powder, Conventional food

People's lifestyles have largely changed dramatically. The concept of food has undergone constant change. People used to be accustomed to eating homemade food in the past. Eating at the restaurant had started as soon as this pattern had shifted. After that, it changed again. People have started bringing food from home, but it's usually ready-made frozen food (RMFF) from supermarkets or markets. It happened as a result of Westernization. In addition, as globalization has accelerated, the workloads of average people have grown significantly [15]. Frozen foods are becoming increasingly popular because the cold chain works more efficiently in developed markets. Additionally, this market now serves a variety of consumer preferences, including those for organic and vegan foods. Additionally, because functional flours—like rice and maize flours—as well as pre-cooked and fortified flours are being used more frequently, flour is a key component of many frozen food products [10].

A prepackaged, fresh, or frozen snack just needs to be warmed up before it is served. Ready-made frozen food is defined by American dictionary publisher Merriam-Webster as specialty food that can be swiftly prepared and served. These forms of nutrition pay little attention to quality or significance and are instead made to be readily available, used, or consumed. Foods of this kind are kept in cold storage [15]. Pancakes are a widely consumed breakfast food made from wheat known by different regional names worldwide. Conventional wheat pancake processing conditions have been thoroughly researched to enhance texture and flavor. Composite flours are used in the creation of substitute foods due to the trend toward gluten-free, functional foods for various health reasons [17]. The most significant meal of the day for us is breakfast. Everyone skips the most significant portion of their daily diet in this rising urbanization. Due to their hectic schedules, people are neglecting their first meal of the day, but they are not aware of the adverse consequences associated with it. The practice of missing breakfast has been linked to the emergence of metabolic conditions such as obesity, cardiovascular disease, diabetes mellitus, and so forth. An effort was made to make quick and healthful pancakes [13]. Similar to other cereals like wheat, rice, and maize, sorghum and millets are farmed flowering plant species of the Poaceae (also known as Gramineae) family of grasses, whose seeds are used for both human and animal nutrition. The Roman goddess of grain, Ceres, is the source of the word "cereal"[16].

Around the world, sorghum is eaten in a variety of foods and beverages, including roasted bread, breakfast cereal, tortillas, couscous, gruel, steam-cooked goods, and alcoholic and non-alcoholic drinks. Sorghum's possible uses in food and industry have been documented. It is used to make a variety of industrial products and can be processed into starch, flour, grits, and flakes. Additionally, it can be processed into malted foods, drinks, and beer. Due to its high nutritional value, ease of adaptation to a variety of growing environments, and low need for water, sorghum can be included in the diets of people

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everywhere, especially those who are intolerant of wheat [9]. Water chestnuts have a mild flavor and are sweet and crunchy. Water chestnuts are a great way to increase salivation and reduce thirst. It is a food for leading a healthy lifestyle and reduces loose motion. Water chestnuts have few calories and a high nutritional content. Its detoxifying qualities make it advantageous for those with jaundice. When consumed in raw or juice form, it helps both adults and children with the issue of poor appetite. In addition to being delicious to eat, water chestnut kernels are rich in important minerals. Water chestnuts can be used as coolants, astringents, and appetizers. Water chestnut flour was eaten during fasts in many Indian religious customs. The protein, carbohydrate, flavonoid, and antioxidant contents of water chestnuts were all high. As a result, water chestnut fruit acetone extract has more phenolic and antioxidant qualities. After steaming, when the water chestnut's kernel is cooked and the outer layer softens, it is eaten. The current study was designed to optimize a process for water chestnut flour preparation, assess its nutritional and biochemical qualities, and prepare dosas using water chestnut flour [6].

Due to its low GI, water chestnut flour (WCF) can be a useful raw ingredient when creating baked goods for people with diabetes. However, since WCF doesn't contain gluten, it can't completely replace wheat flour in baked goods. Gluten-free baked goods do not have the same textural or sensory qualities as their gluten-containing counterparts. Barley contains 5–8% gluten and is regarded as a functional food due to its low GI value and β-glucan content [5]. The Main Objective of this study are:

- To formulate Frozen millet pancake batter cubes incorporated using water chestnut powder.
- To examine the Organoleptic Evaluation, Physicochemical properties, and Nutrient analysis of the formulated product.
- To analyze the Microbial and shelf life of the developed product.

## MATERIALS AND METHODS

*Procurement of raw materials*

The Raw Ingredients like Sorghum, Water chestnut flour, Jaggery, Milk, Baking soda, Baking Powder, Refined Oil, and Vanilla Essence were purchased from the Provisional store in Chennai, Tamil Nadu, India.

*Formulation of frozen pancake batter cubes*

Combine sorghum flour, water chestnut flour, and jaggery in a mixing bowl. Add milk, oil, and vanilla essence to the dry ingredients. Mix well until smooth. Sprinkle baking powder and baking soda, and mix until combined. Pour the batter into ice cube trays and freeze until solid. When ready to use, thaw the desired number of cubes in the refrigerator overnight or at room temperature for a few hours [3], [17].

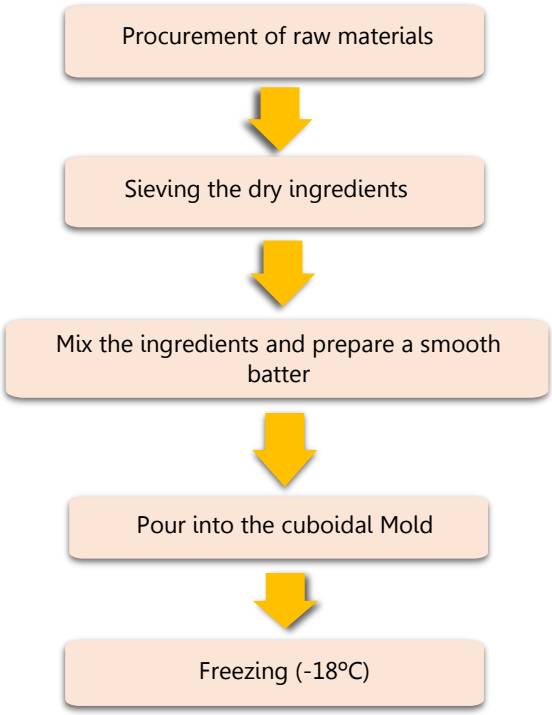


Fig 1 Flow chart of formulation of frozen millet pancake cubes incorporated with water chestnut (*Trapa natans*) powder

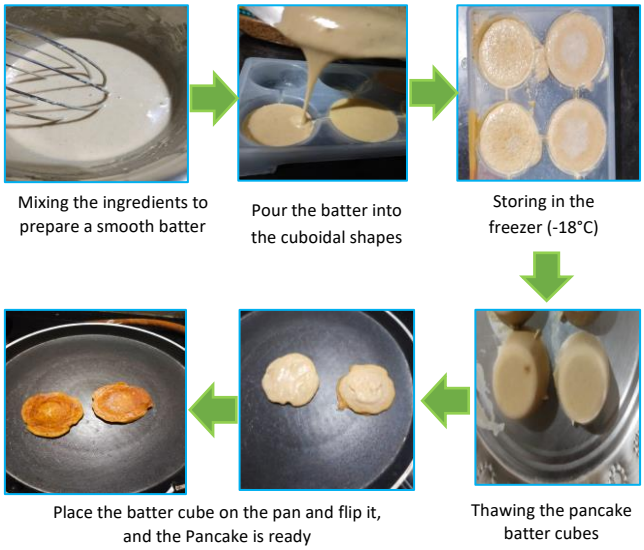


Fig 2 Formulation of the pancake from the frozen pancake batter cubes incorporated with water chestnut powder

Table 1 Variation table

| Ingredients | C1 gm/ml | T1 gm/ml | T2 gm/ml | T3 gm/ ml |
|---|---|---|---|---|
| Sorghum flour | 45 | 40 | 35 | 30 |
| Water chestnut flour | - | 5 | 10 | 15 |
| Jaggery powder | 25 | 25 | 25 | 25 |
| Milk | 20 | 20 | 20 | 20 |
| Baking powder | 1 | 1 | 1 | 1 |
| Baking soda | 1 | 1 | 1 | 1 |
| Oil | 10 | 10 | 10 | 10 |
| Vanilla essence | 2 | 2 | 2 | 2 |

Data in (Table 1) Variation table shows the control and treatment proportions taken for the formulation of the product.

*Organoleptic analysis*

A nine-point hedonic scale was used to evaluate the acceptability (Color, Texture, Appearance, Taste, Flavor, and Overall Acceptability) of the Pancake developed from frozen pancake batter cubes incorporated with water chestnut powder.

A paired comparison test was also carried out, in which the Sorghum Pancake and the Sorghum Pancake incorporated with Water Chestnut Powder were contrasted.

*Physicochemical properties of sorghum*

Assessment of physicochemical analysis of sorghum involved thousand-grain weight, thousand-grain volume, bulk density, hydration capacity, hydration index, and swelling capacity.

*Nutrient analysis*

Energy, protein, moisture content, fat, carbohydrates, fiber, and ash are the nutrients evaluated in the proximate composition of sorghum pancake and sorghum pancake incorporated with water chestnut powder. Potassium mineral content, DPPH, and total phenol content are also examined.

*Microbial analysis*

Assessment of total bacterial count and total yeast and mold count were evaluated for the frozen sorghum pancake batter cubes incorporated with water chestnut powder.

*Shelf-life analysis*

The shelf-life analysis of Frozen Sorghum Pancake Batter cubes incorporated with Water chestnut Powder was examined on the 5$^{th}$, 15$^{th}$, and 30$^{th}$ day of storing it in the freezer (-18ºC).

## RESULTS AND DISCUSSION

*Organoleptic evaluation*

The formulated pancake cubes were used to prepare the pancake in three different ratios. 20 untrained panelists performed an organoleptic evaluation on the control and treatment groups, using a "9-point Hedonic Scale". The different sensory attributes: Colour, texture, appearance, taste, flavour, and overall acceptability were assessed. Significantly**,** treatment 3 exhibited the highest mean scores of the other samples. The mean scores: color (8.38±0.46), Texture (8.45±0.43), Appearance (8.48±0.38), Taste (8.35±0.40), Flavour (8.28±0.34), and Overall Acceptability (8.6±0.26).

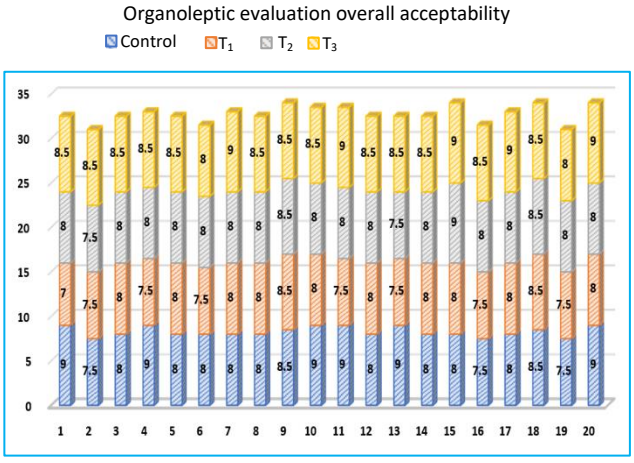


Fig 3 Mean scores of overall acceptability

*Physicochemical properties of sorghum*

The (Table 2), depicts the values of the physicochemical properties of sorghum.

*Thousand-grain weight*

The results showed that the thousand-grain weight was 33g. A study [14] reported that the thousand-grain weight was 36.94 g. The difference between the values in these two studies is 3.94 g.

Table 2 Values of physicochemical properties

| Parameters | Value |
|---|---|
| Thousand Grain weight | 33g |
| Thousand Grain volume | 29ml |
| Bulk density | 1.13 g/ml |
| Hydration capacity | 4 g |
| Hydration index | 12.12% |
| Swelling capacity | 2 ml |

*Thousand-grain volume*

The thousand-grain volume of the sorghum was evaluated. The results showed that the grain sorghum volume was 39.3 ml. [14] reported that the thousand-grain volume was 42.69 ml. The difference between the two values is 3.39ml.

*Bulk density*

The sorghum grain's bulk density was assessed. A bulk density of 1.13 g/ml was obtained. similarly, in a study by [4], the grain sorghum had a value of 1.16g/ml. There is a 0.03g/ml difference in the values between these two studies.

*Hydration capacity*

The hydration capacity of the grain sorghum was 10.3 g. [14] in this study reported that the hydration capacity was 12.6 g/1000 grains. The difference between the two values is 2.3g. Hence, similar results have been obtained.

*Hydration index*

The sorghum grain's hydration index was calculated. The hydration index of grain sorghum was found to be 34.2 based on the results. [14] reported similar results, stating that the 1000-grain sorghum's hydration index was 35.59. There is a tiny 1.39 difference in the values between the two studies.

*Nutrient analysis*

Data in (Table 3) depicts the mean score values of the Control and Treatment 3 sample.

Table 3 Value of Nutrient Analysis

| Proximate parameters | Control %/ 100 gm | Treatment %/100gm |
|---|---|---|
| Energy value (Kcal/100g) | 338.6±1 | 111.5±1.0 |
| Protein % | 5.2±0.1 | 12.8±1.0 |
| Moisture% | 24.7±1.0 | 71±1 |
| Fat% | 10.8±1 | 9.3±1 |
| Carbohydrates% | 57.23±1.0 | 23.5±1.0 |
| Crude fiber% | 0.77±0.1 | 5.8±1.0 |
| Ash | 1.17±1 | 3.45±1 |
| Potassium | 48.4±1.0 | 56.3±1.0 |

From the assessment of nutrient analysis, the energy of the treatment 3 sample was calculated to be 111.5±1.0Kcal/100g. The energy of the control group was found to be 338.6±1 Kcal/100g**.** A study by [12] showed that the energy of gluten-free rice pancakes was up to 315.38 Kcal/100g. The energy content of Treatment 3 was nearly 111.5 kcal, which is less than the control group. The protein content of the Treatment 3 was found to be 12.8±1.0 g/100g. The Control group's protein content was 5.2±0.1g/100g. The Protein content of the treatment group was higher than the control group. A study by [8] showed that the protein content of gluten-free pancakes was found to be 8.62 g/100g. The mean value of the moisture content of the Treatment 3 sample was found to be 24.7±1.0. The control group's moisture content was

measured to be 71±1. The moisture content of the treatment group was found to be higher than the control group. A study by [17] showed that the moisture content of pancakes made from an instant mix containing peanut flour was found to be 23.3±1.0. The fat content of the control group was found to be 10.8±1 g/100g, which was higher when compared to Treatment 3. The Fat content of Treatment 3 was measured to be 9.3±1 g/100g. A study by [12] revealed that rice pancakes contain about 11.8 g/100g of fat.

The carbohydrate content of Treatment 3 was found to be 23.50±1.0 g/100g which was lesser than the control group. The Control group's carbohydrate content was found to be 57.23±1 g/100g. A study by [12] stated that Rice pancakes contain up to 46.39 g/100g of carbohydrates. The fiber content of the control group and Treatment 3 was 0.77±0.1 g/100g and 5.8±1.0 g/100g respectively. The fiber content was higher in Treatment 3 when compared with the control group. This was due to the addition of the Water chestnut powder. A study by [12] stated that the low GI Rice pancakes contained about 0.93 g/100g of fiber content. The ash content of Treatment 3 was higher than the control group. The ash content of Treatment 3 was found to be 3.45±1 %/100g whereas the ash content of the control group was measured to be 1.17±1 %/100g. A study by [11] stated that the pancake mix enriched with dehydrated squash pulp was found to be 3.53±0.07%100g. The mineral analysis- Potassium of the control group and Treatment 3, which shows Treatment 3 is higher than the control group. A study by [2] reported that the level of potassium in the pancake was 6%.

Table 4 Antioxidant activity by DPPH

| Antioxidant | Initial OD | Final OD | Scavenging % |
|---|---|---|---|
| Sample (Treatment 3) | 0.942 | 0.254 | 73 |

*DPPH activity and total phenols*

The Functional properties such as Antioxidant properties and total phenol of the formulated product were examined. the Antioxidant Analysis of the Highly Accepted Experimental Sample (Treatment 3) The results are discussed below in (Table 4). The antioxidant content of the treatment 3 was 73%. A study by [7] states that the Antioxidant activity of pancakes was 56%. Treatment 3 was analyzed for its Total Phenol content which was found to be 64.20 mg/g s shown in (Table 5). The total phenolic content was 18.65 mg/g for the pancake which was reported by [7].

*Microbial analysis*

In this research study, the microbial analysis includes the total bacterial count and total yeast and mold count of the control and Treatment-3. The Total Bacterial Count of the Treatment 3 was measured to be 100000 CFU/g or 10 $x10^4$ CFU/g. A study by [11] detected 8500 UFC/g mL-1), when the maximum permitted is 200,000 to 300,000 UFC/g mL1 according to NTC 267 (NTC 2007). TYMC, or total yeast and mold count, is the number of colony-forming units present per gram of product (CFU/g). A colony-forming is the scientific means of counting and reporting the population of live bacteria or yeast and mold in a product. There was no growth of mold recorded in Treatment 3, Yeast- $14x10^4$/ml.

Table 5 Total Phenol Content

| Parameters | OD | Concentration mg/100g |
|---|---|---|
| Sample (Treatment 3) | 0.565 | 64.20 |

*Shelf-life analysis*

Every product has a shelf life (SL), a crucial characteristic. All parties involved in the supply chain should be conscious that each food has a specific shelf life. According to theory, shelf life is the amount of time after production (or, in some cases, after maturation or aging) during which the food product maintains the necessary level of quality under clearly outlined storage conditions [1]. The data in (Table 6) depicts the shelf life of Treatment 3 which is stored on the $5^{th}$ day is $27x10^4$, on the $15^{th}$ is 32 $x10^4$ 32 days, and on the $30^{th}$ is 40 $x10^4$ days. There is no growth of yeast mold on the $5^{th}$, $15^{th,}$ and $30^{th}$ day. A study by [11] showed significant changes during storage, increasing by 6.57% during storage in the mixtures of the pancake.

Table 6 Shelf-life of the frozen Pancake Batter Cubes

| Intervals | Total bacterial count$x10^4$ cfu/gm | Yeast and Mold$10^4$ cfu/gm |
|---|---|---|
| $5^{th}$ | 27 | Nil |
| $15^{th}$ | 32 | Nil |
| $30^{th}$ | 40 | Nil |

## CONCLUSION

In conclusion, the formulation of frozen pancake batter cubes is an important milestone in the ease of use and adaptability of ready-made frozen food. We have determined the ideal ingredient ratio that guarantees both outstanding taste and general acceptability through careful formulation and sensory analysis. These frozen pancake batter cubes provide a beneficial and healthy choice for customers looking for quick and delightful breakfast options, provided that more research is done on the packaging techniques and health advantages of these products.

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