

Development of Sorghum Biscuits Fortified with Water chestnut and Flaxseeds Flour

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ABSTRACT

Now-a-days, people are concerned about their health due to the change and modification in lifestyle. People demand a ready to eat food products that are healthy and safe. Biscuits or cookies are the most consumed snack product that gives feeling of fullness for the hunger between two meals and also liked by the every age group people. Keeping these fact in view, the present investigation is carried out to formulate gluten free, high fibre rich biscuits enriched with jaggery and mulethi powder in three variation of sorghum flour, water chestnut flour and flaxseeds flour that is T₁ (35: 10: 5), T₂ (30: 15: 5) and T₃ (25: 20: 5) from these formulation T₂ is selected according to 10 panelist member by using 9 point hedonic scale. It was found that organoleptic evaluation of variation T₂ had scored highest in colour, flavour, texture, taste, appearance and the overall acceptability also it has maximum or proper nutritional composition such as fibre, protein, iron. As sorghum and water chestnut are good source of fibre and protein and flaxseeds rich in omega3 fatty acids which reducing risk factor for cardiovascular diseases and inflammatory disorder, jaggery is good source of iron. Hence development of consumption of therapeutic bakery product would help to raise nutritional status.

Key Words : Healthy and safe, Gluten free, Mulethi powder, Omega3 fatty acids, Inflammatory, Therapeutic bakery product

INTRODUCTION

The most crucial product in the baking industry is the biscuit. A product that is essentially bread is a biscuit. The Latin words bis and coctus, which indicate “twice cooking,” are the origin of the word biscuit. Typically, biscuits are baked and then dried to eliminate any remaining moisture. Removing the moisture content from the biscuits extends their shelf life. A wide variety of people across all age groups enjoy biscuits and cookies as ready-to-eat snacks because of their accessibility, cost, shelf life, and nutritional value. Biscuits are among the goods prepared with sorghum flour. Because they are readily consumable, inexpensive, nutrient-dense, and accessible in a variety of forms, biscuits are the most widely consumed snack food. All ages, from small children to the elderly, eat various kinds of biscuits. But

the nutritional makeup of the biscuits available on the market is out of balance. The cereal commodity known as sorghum (*Sorghum bicolor* L. Moench) is not particularly well-liked in Indonesia. The nutritional content of sorghum is equal to that of rice, wheat, and corn. One easily cultivated source of carbohydrates is sorghum. There are 73.0 grams of carbohydrates, 332 calories, 3.3 grams of fat, 11 grams of protein, and other nutrients in every 100 grams of sorghum seed. A local white sorghum variety from Bandung that can provide flour that mimics wheat flour is one type of sorghum employed in this study. The general goal of milling is to remove the pericarp, which can give food products a gritty feel. It is possible to turn sorghum seeds into flour, which makes them a valuable flour substitute. As a result, sorghum development is highly promising to meet the demand for local flour. When used as a raw ingredient in cookie

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dough, sorghum flour can be blended with flour made of different materials to create composite flour. Sorghum flour lacks high-quality protein; however, you can make up for this by using another type of flour, like flour made from nuts, which has a high protein content. In Indonesia, nuts are well known for providing two to three times the amount of protein compared to cereals (Wulandari *et al.*, 2017)

Underutilized cereal flour with functional qualities and a nutritional composition that makes it ideal for use in bakeries is sorghum flour. It has a high amylopectin to amylose ratio (70:30 or 80:20), is high in calories, protein, vitamins (B-vitamins), minerals (iron and zinc), fiber, and carbs (Ibrahim and Ani, 2018; Rao *et al.*, 2018). The plant known as Singhara in India is a member of the Trapaceae family and is commonly known as water chestnut (*Eleocharis dulcis*). It is well recognized to improve physical health and is an excellent source of nutrients. Numerous important nutrients, including minerals (potassium, calcium, phosphorus, and magnesium), vitamins E and B complex, essential amino acids (4–7%), sugar (20–32%), carbohydrate (50–60%), dietary fiber (4–10%), and tiny amounts of fats (2–4%). The edible part of the plant, which is primarily the fruit, is prized for being gluten-free (Soni *et al.*, 2018.) and having a variety of medicinal benefits, including the ability to treat bronchitis, anemia, osteoporosis, urine discharges, analgesic activity, anti-inflammatory activity, morpho-physiological activity, astringent, and antileprotic agent (Gupta and Awasthi, 2021). An significant oilseed crop is flaxseed, commonly known as linseed. Flaxseed is known by its botanical name, *Linum usitatissimum*. Flaxseeds are flat, oval, and have a point at one end. The color of the seeds varies from pale to dark reddish brown or yellow according on the variety. Its high shine is caused by a sticky covering (mucilage) that becomes sticky when wet (BeMiller and Whistler, 1993). Rich in Omega-3 and Omega-6 fatty acids, flaxseed has been shown to help decrease blood cholesterol and triglycerides. Moreover, flaxseeds contain over 20% protein and can be added to cereals in the form of nuggets to give them a crunchy feel (Srivastava, 2007).

Since Sorghum, water chestnut and flaxseeds flours are gluten-free and have higher nutritional value and health benefits for those who are nutrient deficient, they can be used in place of wheat flour or refined flour, which is the main ingredient in bakery products like biscuits. Thus, an effort has been made to create nutrient-dense biscuits

based on sorghumwater chestnut and flaxseeds flour and also other ingredients used like jaggery, mulethi powder. Additionally, a sensory and nutritional analysis of these biscuits has been done.

METHODOLOGY

The present research was carried out in the food technology lab of Parul University in Applied Sciences, Vadodara, Gujarat, India.

Materials:

Raw materials and Ingredients:

Sorghum flour, water chestnut flour, flaxseeds, mulethi powder, jaggery, clarified fat, cardamom powder, baking powder, milk. These all were brought from local market.

Chemicals:

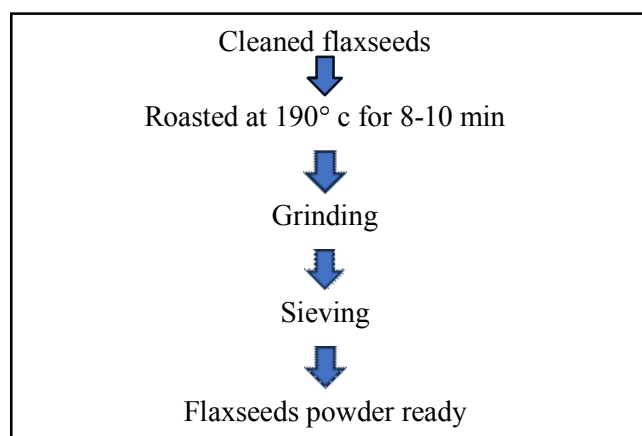
Chemicals of analytical grades were made available in the laboratories of department of analytical lab at industry.

Processing Equipment :

The analytical equipment like hot air oven, muffle furnace, kjeldahl, moisture meter, were made available in the laboratories of department of analytical lab in the industry.

Methods:

Formulation of Flaxseeds Powder:



Formulation of Biscuits :

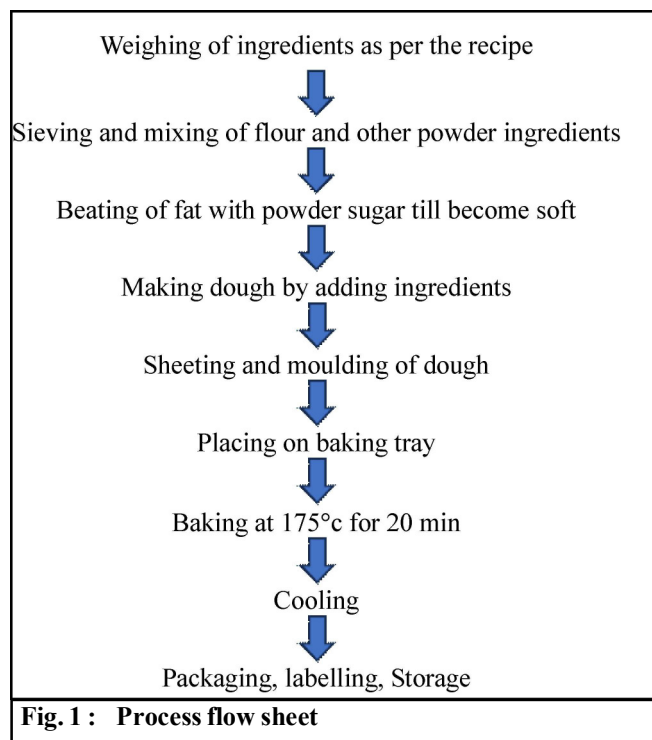
Three different formulation of biscuits are made coded as T₁, T₂, and T₃ prepared according to composition given in Table 1.

Table 1 : Different formulation of biscuits

Sr. No.	Ingredients	Treatments		
		T ₁	T ₂	T ₃
1.	Sorghum flour (g)	35	30	25
2.	Water chestnut flour (g)	10	15	20
3.	Flaxseeds flour (g)	5	5	5
4.	Jaggery (g)	25	25	25
5.	Clarified fat (g)	15	15	15
6.	Mulethi powder (g)	1	1	1
7.	Cardamom powder (g)	2	2	2
8.	Baking powder (g)	1	1	1
9.	Milk (ml)	6	6	6

Preparation of Biscuits:

Sorghum biscuits fortified with water chestnut and flaxseeds flour were prepared as per procedure given in Fig. 1. The roasted flaxseeds are grinded and sieved before using it. The clarified fat/ghee was beaten along with jaggery, then the mixture of Sorghum flour, water chestnut flour, flaxseeds flour, mulethi powder, cardamom powder, baking powder was added and knead the mixture with addition of milk until get the desired consistency dough. The sheet were formed, it was then moulded and place on the baking trays and allow to bake at 175°C for 20 min. after baking the trays were taken out, cooled and biscuits were packed.

**Proximate Analysis of Biscuits:**

Moisture content, protein content, fat content, ash content, total carbohydrate content, total energy was determined using procedures. The moisture content was determine using hot air oven method, Protein content was determine using the kjeldhal method, Fat is estimated by AOAC 950.54, and Ash content is determined by muffle furnace while Carbohydrate was by the difference method. Iron and calcium content was determined using standard method mentioned in Ranganna (2009).

Determination of Moisture content:

A small amount of the crushed prepared cookie sample was kept in a pre-weighed glass petri-dish and dried in hot air oven at 130°C for 4 hours. Then the loss in weight was calculated as the percentage of moisture content (MC) of a sample.

$$MC (\%) = \frac{W_2 - W_1}{2W} \times 100$$

Where, W= weight of the sample, a W_1 = weight of sample along with dish after heating and W_2 = weight of sample along with dish before heating.

Determination of Ash content :

The samples were weighed before and after burning at 600° for 4-6 hours and the loss in weight were calculated as a percentage of the ash content of sample.

$$\text{Ash } (\%) = x = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

Determination of protein content:

Protein estimation was done in kjeldhal digestion flask, with the kjeldhal method given by A.O.A.C. (1980).

Determination of fiber content :

Digest the fat-free sample in the H_2SO_4 and NaOH by 30 minutes washing each and allow the residue to dry at 105°C overnight and final residue was burnt at 600°C for 4 hours, The amount of fiber can be calculated as

$$\text{Crude fiber} = \frac{(W_2 - W_1) - (W_3 - W_1)}{W} \times 100$$

where, W= weight of the sample, the W_1 = weight of empty crucible, W_2 = weight of sample + weight of empty crucible and W_3 = weight of the sample after ignition+ weight of empty crucible.

Determination of Fat content:

Dissolve sample in an organic solvent (petroleum ether) and make the double extraction so that maximum amount of fat can be extracted by removal of organic solvent at 60°C in the oven. The final calculation of fat was done by the help of a formula as:

$$\text{FAT (\%)} = \frac{\text{Weight of extracted fat}}{\text{Weight of sample}} \times 100$$

Determination of Carbohydrate content:

The FDA requires that food manufacturers calculate total carbohydrates in their food with the following formula:

Total Carbohydrates = Total Weight of Food Serving - (Weight of Crude Protein + Weight of Total Fat + Weight of Moisture + Weight of Ash).

Analysis of Iron content:

Sample was weighed and turned into ash. 2.0M HCl, 0.1M KSCN that is potassium thiocyanate was added and sample ash was washed and mixed well. Absorbance was taken at 458nm.

Analysis of Calcium:

Preparation of the standard solution (EDTA, sodium hydroxide, dilute HCl solution and dilute NaOH solution) and reagents (buffer solution, standard calcium solution) were prepared in the fixed proportions.

Sample titration: Sample was taken in the diluted form and add a buffer to maintain pH (approx 10). A pinch of erichrome black T (till red color appeared) and titrated with EDTA (till blue color appeared).

Sensory Evaluation of Biscuits:

The recipe was finalized on the basis of sensory evaluation. Sensory evaluation was carried out by 10 semi trained panellist members by using 9 point hedonic scale as per procedure given by Ranganna (2009).

RESULTS AND DISCUSSION

Proximate Analysis of Prepared Biscuits :

Proximate analysis of selected T₂ formulated biscuits

showed the following result as per the Table 2. The carbohydrate content of biscuits was 65.06% the fat content was 20.20%, the total energy found was 466 kcal/100g, moisture content was 5.2%, total ash content was 2.08%, and total fibre content was 11.15%. total protein content was 7.10% among the minerals iron and calcium content was 8.80 mg and 110 mg per 100 gram of product, respectively. The data shows that formulation of sorghum flour (30g), water chestnut flour (15g), flaxseeds flour (5g) and by using jaggery instead of sugar resulted in increase the fibre content and minerals like calcium and iron.

Sr. No.	Parameter	Results
1.	Carbohydrate	65.06
2.	Fat	20.20
3.	Energy	466kcal
4.	Moisture	2.51
5.	Ash	2.08
6.	Fibre	11.15
7.	Protein	7.10
8.	Iron (mg)	8.80
9.	Calcium (mg)	110

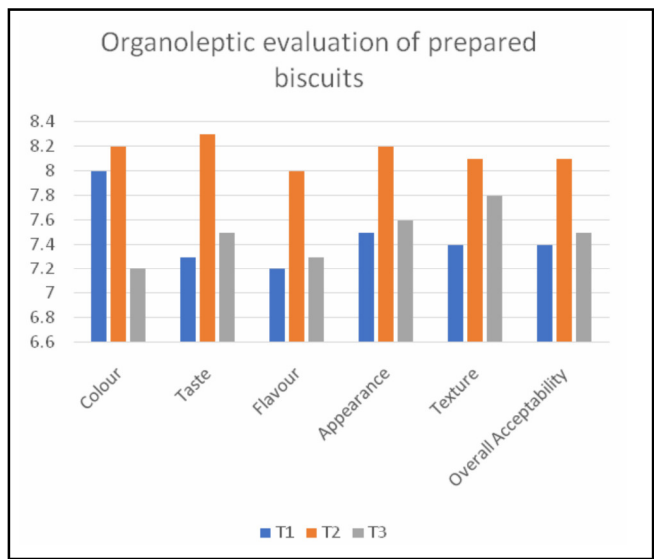


Fig. 2 : Sensory evaluation of prepared biscuits

Sample	Colour	Taste	Flavour	Appearance	Texture	Overall Acceptability
T ₁	8	7.3	7.2	7.5	7.4	7.4
T ₂	8.2	8.3	8	8.2	8.1	8.1
T ₃	7.2	7.5	7.3	7.6	7.8	7.5

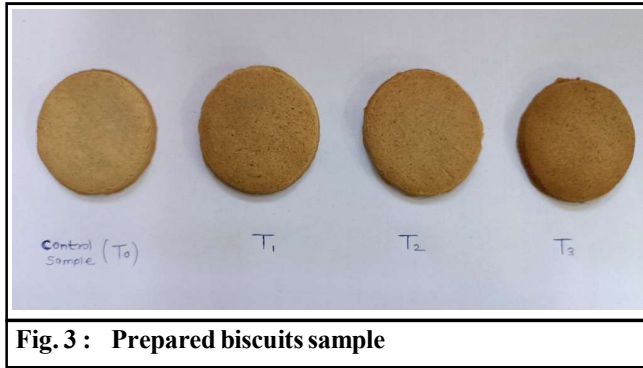


Fig. 3 : Prepared biscuits sample

Sensory Evaluation of Biscuits:

Sensory evaluation of prepared cookies was done by 9 point hedonic scale, 10 semi trained panel members were employed for this sensory evaluation. The product was evaluated on the basis of colour, taste, texture, flavour, appearance and overall acceptability. According to result among three different formulation the maximum overall acceptability score was found in the second variation that is T_2 8.1 where T_1 had 7.4 and T_3 had 7.5 which might be due to proper amount of flour content. Obtained result shows that ratio of 30 % Sorghum flour, 15 % Water chestnut flour and 5 % Flaxseeds flour found to be more acceptable.

Conclusion:

The result of the study indicates that, Biscuits were formulated by combination of sorghum flour, water chestnut and flaxseeds flour in the ratio of 30:15:5 was more acceptable in all format such as in sensory evaluation and in physio chemical properties. It can be conclude that 15% water chestnut flour and 5% flaxseeds flour can be successfully incorporated in sorghum flour. By adding mulethi powder and jaggery to yield biscuits with sensory attributes. As Sorghum is gluten free and rich source of protein. Water chestnut is high in fibre, low in calories. Flaxseeds powder is richest source of omega 3 fatty acids which reducing cardiovascular diseases and inflammatory disorder. And their utilization improves the nutritional status of consumer.

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