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Preparation and quality evaluation of sweet potato (*Ipomoea Batatas*) flour biscuits

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Abstract
Sweet potato is one of the most edible winter snacks, boiled or usually roasted and eaten. Sweet potatoes are nutritional, packing a good quantum of vitamin A, vitamin C, and manganese into each serving. This research study aims to investigate the preparation, quality evaluation, and standardization of flour and biscuits derived from sweet potato (Ipomoea Batatas). The nutritional composition, including proximate analysis, was also determined. Furthermore, the sensory attributes were evaluated by a panel of trained experts with a 5-point hedonic scale rating. In this trial, sweet potato flour was incorporated with wheat flour in a ratio of 20%, 30%, and 50% Along with other elements from which three samples were made. Statistical analysis of the sensory data showed Sample C received higher scores and the nutritional analysis of the biscuits revealed that Moisture content was found (14.0%), Total ash content was (2.94%), Carbohydrate content was (57.0%), Fat content was (18.0%), Protein (8.10%), Dietary fibre was (1.92%), Total sugars (15.4%) and Total Starch was (39.4%). Overall, this study provides valuable insights into the preparation, quality evaluation, and standardization of flour and biscuit derived from sweet potatoes. The findings contribute to the implementation of this nutritious tuber in food processing industries and encourage the development of innovative and health-promoting food products.

Keywords: Sweet potato flour, sweet potato biscuits, physiochemical analysis, standardization, nutritional composition, sensory evaluation, quality evaluation and microbial load

Introduction
The sweet potato (*Ipomoea batatas* (L.) Lam.) is a stiff, sweet-tasting root vegetable that belongs to the Convolvulaceae family. The statistical data of the United Nations Food and Agriculture Organization (FAO) shows that sweet potato is the fifth and the seventh most important food crop in developing countries and the world. Further than 130 million tons of sweet potato are produced annually of which over 95% of the crop is produced in Asia developing countries. The sweet potato has come well established with a large eventuality for, and to be used as a staple food in developing nations due to its short maturity time, capability to grow under different climatic conditions, and fairly poor soils (Nguyen Van Toan 2018) [2].

The flour can be stored for 6 months or further in sealed holders. It can be used as a cover for wheat flour in the following quantities: 100% in white gravies, 25-50% in eyefuls, galettes, and flatbreads, and 15- 20% in viands. SP flour would be retailed as a low-cost volition to imported wheat flour, especially for snack food and pate directors. Small flour product and use trials were made using original kinds. Important specialized exploration on SP flour carried out in developing country institutions has concentrated on product expression using SP flour rather than on effective, low-cost, small-scale processes to produce the flour. Sweet potato-grounded products are of high quality and could contend with being products in the request (Srivastava S *et al*., 2012) [1].

Sweet potato is a member of the Convolvulaceae family, and it is a dicotyledonous root vegetable plant with large starchy, sweet-tasting, tuberous roots. Besides the tubers, the young leaves and shoot are also consumed sometimes as greens. Sweet potato (Ipomoea batatas) is the only member of the over 1,000 species of the Convolvulaceae family and the approximately 50 genera that is of significant importance, some others are used locally, but many are actually poisonous. Potato is the world's most widely grown tuber crop and the fourth largest food crop in terms of fresh produce after rice, wheat, and maize the potato has

capabilities for a salutary role in world food product, owing to its status as a cheap and generous crop, which can be raised in a wide variety of climates and locales sweet potato contain complex carbohydrates, beta-carotene (a provitamin A carotenoid), manganese, vitamin C, vitamin B6, dietary fibre and potassium. Pink, yellow and green varieties are also high in beta-carotene (Onabanjo O.O, Ighere Dickson A, 2014) [3].

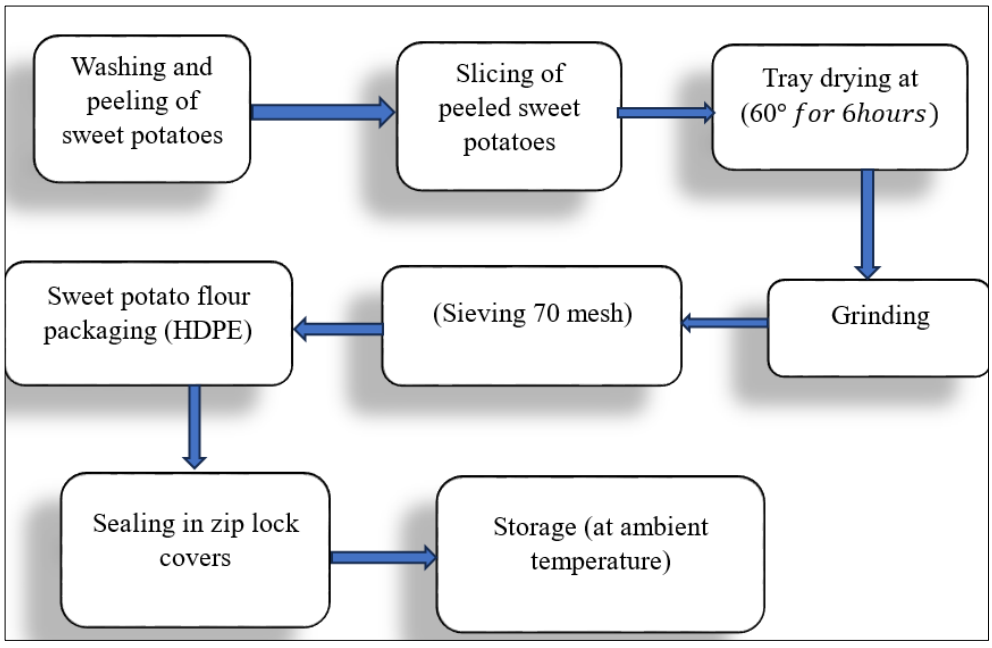
The processing of sweet potato into starch generates by products which is currently very limited in use. The solid residue produced from the bounce birth process contains the rich of fibre, which can be recovered by several processes including a milling and sieving process to produce salutary fibre. therefore, the end this exploration was to study the effect of rate of orange fleshed sweet potato (OFSP) flour, bounce, and residual flour on the organoleptic characteristics and physicochemical of biscuits (E S Harahap *et al*, 2020) [5].

Materials and Methods

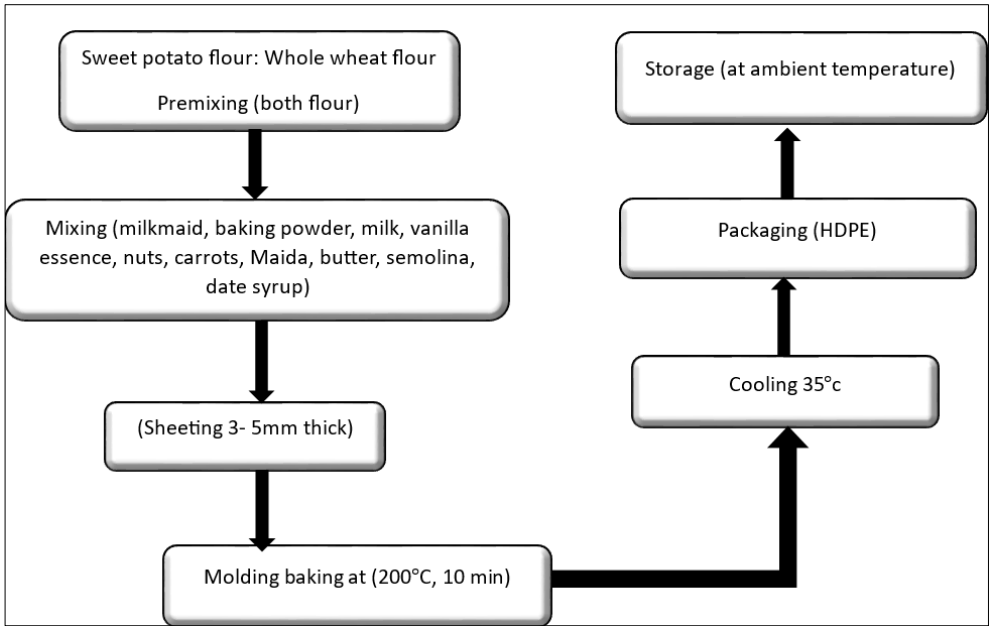
Materials

Slightly red-pink sweet potatoes of a variety without any abrasion were reaped from the local market in Hyderabad city Telangana state India. The sample was stored in a zip lock cover on the shelves of the lab at ambient temperature until its use. Below are the other ingredients purchased from local supermarkets in Hyderabad which are used for baking biscuits: Wheat flour, baking powder, Butter, Milkmaid (sweetener), Semolina, Date syrup, Milk, Carrots, Dry fruits (almonds, cashew, raisins), Vanilla essence, less quantity of all-purpose flour.

Fig 1: pink-red sweet potato took for study



Flow chart 1: Creating flour from sweet potatoes



Flowchart 2: Making biscuits with wheat and sweet potatoes (composite flour)

Sweet potato flour biscuits formulation

Three differences in formulations percentage will be changed with the following items used in making cookies as well as a variety of quantities used to develop standard recipes. Replicated trials were done, and one sample is concluded based on taste, texture, colour, appearance, aroma, flavor, and overall acceptability.

Table 1: Ingredients used for formulation of biscuits (gms/ml)

S. No	Ingredients	Sample - 1	Sample - 2	Sample -3
1	Sweet potato flour	50gms	50gms	50gms
2	Wheat flour	20gms	30gms	50gms
3	Semolina	0gms	5gms	0gms
4	All-purpose flour	5gms	5gms	5gms
5	Baking powder	2gms	2gms	2gms
6	Milk maid[sweetener]	10ml	10ml	10ml
7	Vanilla essence	1tsp	1tsp	1tsp
8	Carrots	0gms	0gms	5gms
9	Milk	0ml	5ml	0ml
10	Date syrup	0ml	3ml	0ml
11	Nuts [cashew, raisins, almonds]	0gms	0gms	5gms
12	Butter	15gms	15gms	15gms

Sensory evaluation

The consumer acceptance of three different samples of biscuits was evaluated by twenty judges. The biscuits were served on white disposable plastic plates and tissue papers were provided for cleaning. Samples were coded with different colour and the sample order was randomized. The panel was asked to evaluate the biscuits. Colour, taste, flavor, texture, aroma, appearance and overall acceptability of the biscuits using a 5-point hedonic scale.

Statistical Analysis

Data gained from sensory evaluation were subjected to analysis of variance. Results were presented as means ± standard deviations of triplicate experiments. It was statistically calculated by ANOVA by establishing a significant difference at $p \leq 0.05$.

Nutritional Evaluation

The Nutritional evaluation of the premier-selected sample was analysed as follows

Table 2: Nutritive value of developed sweet potato flour biscuits

S.no.	Parameters	Methods
1	Moisture	IS 12711: 1989 (RA.2020)
2	Total ash	
3	Carbohydrates (by difference)	CTL/SOP/FOOD/262- 2014
4	Total fat	AOAC 20th Edn. 2016, 920.39
5	Protein (N×6.25)	AOAC 20th Edn. 2016, 986.25
6	Dietary fiber	AOAC 20th Edn. 2016, 985.29
7	Total sugars	FSSAI Manual 2015- Beverages, Sugars and Confectionaries.
8	Reducing sugar	
9	Non-reducing sugar such as (sucrose)	
10	Total starch	Is 4706(p-2): 1978 (RA.2020)

Microbial analysis

Microbial analysis such as shelf life and total plate count was carried out for 30 days of the study by the procedure followed by the Indian Standard method.

Result and Discussion

Sensory evaluation

Table 3 shows the mean and standard deviation of the sensory scores for different parameters in terms of colour, taste, acceptance, texture, flavor, aroma, and overall acceptability. In terms of colour, sample 1 has a mean value of 2.85 while sample 2 has a mean value of 3.1, and sample 3 has a mean value of 4.02. Regarding texture, sample 1 has a mean value of 3.07 while sample 2 has a mean value of 2.9, and sample 3 has a mean value of 4.15.

Further aroma, sample 1 has a mean value of 2.95 while sample 2 has a mean value of 2.85, and sample 3 has a mean value of 4.1. In terms of taste, sample 1 has a mean value of 2.75 while sample 2 has a mean value of 2.97, and sample 3 has a mean value of 3.95. For appearance, sample 1 has a mean value of 2.77, while sample 2 has a mean value of 2.62, and sample 3 has a mean value of 4.12. Regarding flavor, sample 1 has a mean value of 3.77 with a standard

deviation value of 0.4 while sample 2 has a mean value of 2.82 with a standard deviation value of 0.4, and sample 3 has a mean value of 3.97 with a standard deviation value of 0.6.

Finally, in terms of overall acceptability, sample 1 has a mean value of 3.22 while sample 2 has a mean value of 2.95, and sample 3 has a mean value of 4.17. These measurements provide an assessment of sensory attributes for three samples 1, 2, 3. Sample 3 generally tends to have great mean values across all attributes, indicating a potentially better sensory experience compare to samples 2 and 1. Biscuits with varying amounts of sweet potato flour substitution were sensory assessed and compared to control biscuits made just with whole wheat flour.

Table 3: Sensory evaluation of sweet potato biscuits

Parameter	Colour	Texture	Aroma	Taste	Appearance	Flavour	Overall Acceptability
Sample 1	2.85±0.3	3.07±0.24	2.95±0.35	2.75±0.5	2.77±0.41	3.17±0.49	3.22±0.34
Sample 2	3.1±0.3	2.9±0.52	2.85±0.4	2.94±0.4	2.62±0.5	2.82±0.4	2.95±0.5
Sample 3	4.02±0.5	4.15±0.6	4.1±0.6	3.95±0.6	4.12±0.65	3.97±0.6	4.17±0.7

When compared to the other ratios that were similar to the control sample, the colour ratings of biscuits made with 50% sweet potato flour were at their highest. As a result, adding sweet potato flour at a level of 50% increased the sensory qualities, specifically the texture, flavor, colour, appearance, aroma, taste, and general acceptability Sweet potato flour was added to the developed biscuits, improving their nutritional value. As a result, Table 8 contains standard deviation of sensory evaluation.

Nutritional Analysis of sweet potato flour biscuits

The nutrition analysis of selected samples has a carbohydrate of 57.0 g/100g, 8.10g/100g of protein,14.0g/100g of moisture, 2.94 g/100g of ash, 18.0 g/100g of fat content, 1.92g/100g of dietary fiber, Total sugars 15.4g/100g, Reducing sugars 7.30g/100g, non-reducing 7.70 g/100 g, total starch content 39.4 g/100g (Table 4).

Table 4: shows the nutritive value of developed biscuits.

S. No.	Parameters	Results	Units
1	Moisture	14.0	g/100g
2	Total ash	2.94	g/100g
3	Carbohydrates (by difference)	57.0	g/100g
4	Total fat	18.0	g/100g
5	Protein (N×6.25)	8.10	g/100g
6	Dietary fibre	1.92	g/100g
7	Total sugars	15.4	g/100g
8	Reducing sugar	7.30	g/100g
9	Non-reducing sugar such as (sucrose)	7.70	g/100g
10	Total starch	39.4	g/100g

Microbiological parameters of sweet potato flour biscuits after 30 days of storage

As shown below in Table 5, the parameter listed is the total viable count, which is measured in Colony forming units per gram (cfu/ml). According to the IS (Indian Standard) methods, the acceptable limit for the total plate count is Max 50 cfu/ml. Along with microorganisms like coliform, E. coli, Salmonella, Staphylococcus aureus, Yeast, and Mold. Using a thorough chemical, physical, microbiological, and physical investigation, shelf-life research evaluates the food product's quality and hygienic standards and provides food producers and manufacturers with confidence in the product's shelf life. Safeguard their brand and customers. The other studies which were taken for comparison do not show any shelf-life analysis or microbiological parameters.

Table 5: Microbiological parameters of sweet potato flour biscuits

S. No	Parameters	Units	16.06.2023	03.07.2023	15.07.2023	Specified Limits
1	Total viable count	Cfu/ml	0.1×10	0.42×10	0.51×10	Max 50
2	Coliform	Cfu/ml	0.1×10	0.35×10	0.49×10	<10
3	E. coli	Cfu/ml	Absent	Absent	Absent	Absent
4	Salmonella	Cfu/ml	Absent	Absent	Absent	Absent
5	Staphylococcus aureus	Cfu/ml	absent	Absent	Absent	Absent
6	Yeast	Cfu/ml	0.1×10	0.1×10	0.1×10	Max 2
7	Mold	Cfu/ml	0.1×10	0.1×10	0.1×10	Max 2

Table 6: Chemical parameters pH values of sweet potato biscuits

S. No	Parameters	16.06.2023	03.07.2023	15.07.2023	Specified limits
1	pH	7.0	7.23	7.37	Not specified

Table 7: Organoleptic parameters after shelf life

S. No	Parameters	16.06.2023	03.07.2023	15.07.2023	Specified limits
1	Appearance in terms of colour	4.5	4.5	3	3 to 5
2	Odour	4.5	4.5	3	3 to 5

3	Taste	4.5	4.5	3	3 to 5
4	Texture	4.5	4.5	3	3 to 5

Conclusion

In this study, the replacement potential of wheat flour with sweet potato flour in biscuits to improve nutritional values and the development of new recipes to make good quality biscuits from sweet potato were successfully and thoroughly investigated. According to the sensory evaluation scores, the results of biscuits produced from sweet potato flour were significantly good sensory score. The selected sweet potato biscuits were found to be highly nutritional, and the selected sample was also found to be absent in microbiological parameters after one-month study. It was found that sweet potato contains a limited amount of protein, although rich in dietary fiber content and carbohydrate, so a successful combination with wheat flour for biscuit production would be nutritionally advantageous.

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