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Studies on development of nutritious cookies by food processing – malting

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Abstract
Cookies serve as a beneficial source of which can be enhanced with protein by substituting some of the refined wheat flour. This study closely examined malted cookies made from ragi, barley, wheat flour, sugar, butter, and baking powder. Finger millet, or ragi, boasts a rich profile of protein, calcium, phosphorus, iron, fiber, and vitamins. Its calcium content surpasses that of all other cereals, and its iodine concentration is the highest among food grains. Ragi is known for its excellent quality protein and contains essential amino acids, vitamin A, vitamin B, and phosphorus.
Malted ragi and barley flour offer remarkable nutritional value, being rich in protein, carbohydrates, calcium, and essential minerals like phosphorus and iron in balanced quantities, which contribute to various health benefits. Evaluated four compositions and compared them with two commercial brands; based on sensory evaluation, compositions C1 and C2 were selected.

Keywords: Nutritious cookies, malting, malted barley flour

Introduction

Cookies are good carrier of nutrients like carbohydrate and fat which can be enriched with protein by partially replacing refined wheat flour. Ragi and barley also content nutrient which lowers blood pressure and maintain cholesterol level, reduces risk of cancer, reduces symptoms of arthritis, promotes healthy bones and teeth. It also promotes cardiovascular health. The cookies content ragi, barley and refined wheat flours are excellent source of amino acids which are high in protein, carbohydrates, iron and calcium. (Kulkarni *et al*, 2018) [1].

The biscuits and cookies industry in India have been growing at a CAGR of 10% for the last three years and is currently valued at INR 145 billion.

Cookies are an excellent source of nutrients such as carbohydrates and fats, which can be enhanced with protein by partially substituting refined wheat flour. Ragi and barley are also nutritious grains that help lower blood pressure and keep cholesterol levels in check. They lower cancer risk, ease arthritis symptoms, and promote healthy bones and teeth. Additionally, they support cardiovascular health. Ragi, barley, and refined wheat flours in cookies provide a rich source of amino acids, along with high levels of protein, carbohydrates, iron, and calcium. (Kulkarni *et al*, 2018) [1].

The biscuit and cookie market in India have experienced a growth rate of 10% annually over the past three years, valued at INR 145 billion. Currently, India ranks as the highest biscuit-consuming country in the world, with expectations for the industry to expand at a rate of 14% until the fiscal year 2019. (Bhoite *et al*, 2018, Dere *et al*, 2018, Dhangare *et al*, 2018)

The malting process transforms raw grains into malt, which is primarily utilized in brewing beer or making whisky but can also be applied in producing malt vinegar or malt extract. Common grains for malting include barley, sorghum, wheat, and rye. “Malting involves the controlled germination of cereal grains or occasionally pulses (peas and beans).” Although sometimes used in its 'green' state (undried), malt is most often employed after it has been dried either in the sun or with warm air currents. Malts serve as key ingredients in various food and drink productions globally, with pulses often being germinated in Asia for culinary uses. (Briggs *et al*, 2018)

Barley, a member of the grass family, is a significant cereal cultivated in temperate climate zones around the world. It has been traditionally used for animal feed, as a source of fermentable material for beer and other alcoholic beverages, and as a key ingredient in various health foods. It features in soups and stews and is also utilized in barley bread across different cultures. Barley grains are typically processed into malt through time-honored techniques. The introduction of health claim regulations recognizing the advantages of β-glucan has now highlighted barley as a valuable crop for "healthy food" production. Both the European Food Safety Authority (EFSA) and the U.S. Food and Drug Administration (FDA) have validated health claims for barley's β-glucan and soluble fiber, stating their effectiveness in lowering blood cholesterol and reducing coronary disease risk. (Viruda *et al*, 2021)

Finger millet, a herbaceous annual plant, is extensively cultivated as a cereal crop in Africa and Asia's arid and semi-arid regions. Originating from the highlands of Ethiopia and Uganda, it is notable for its resilience in high altitudes (over 2000 m), rich micronutrient profile (especially iron and methionine), exceptional drought tolerance, and prolonged shelf life of its grains.

Finger millet boasts the highest calcium content among grains, about ten times that of paddy rice or wheat. Nutritionally enhanced products such as cookies made with ragi flour are formulated to meet the calcium and iron needs of a growing population.

Grains constitute a staple in the Indian diet. Although they offer substantial nutritional benefits, grains also contain several anti-nutritional compounds that can inhibit nutrient absorption, particularly protein. Malting or germination can serve as an effective pre-treatment to enhance the nutritional qualities of native cereal grains. (Baranwal, 2018) [2].

Refined carbohydrates in maida can lead to increased levels of blood triglycerides, elevate blood sugar levels, and induce insulin resistance, all of which are significant risk factors for heart disease and type 2 diabetes. To mitigate these risks, wheat flour is utilized in cookie preparation. (Felson *et al*, 2021) [7].

Objective

To study the development of nutritious cookies by food processing. (Malting)

Materials and Methods

This study discusses the experimental setup, materials utilized, and the methodology applied in the research project titled "Studies on Development of Nutritious Cookies through Indigenous Food Processing - Malting," conducted at the Department of B. Tech Food Technology, MIT ADT University in Pune, Loni Kalbhor.

1. Materials

Malted Barley Flour: This flour, which has a high protein content, is commonly in the food industry, while lower protein variants are mainly used for specific beer styles.

Malted Ragi Flour: Rich in minerals such as iron, calcium, phosphorus, fiber, and vitamins, this flour provides numerous health benefits.

Wheat Flour: Derived from grinding wheat, this powder is essential for human consumption.

Butter: A dairy product created from the fat and proteins found in churned cream, butter is a semi-solid emulsion at room temperature, consisting of roughly 80% butterfat.

Sugar: This term refers to various sweet-tasting, soluble carbohydrates that are widely used in food preparation.

Milk: Enhancing the texture and mouthfeel of baked goods, milk also contributes to creating a robust batter or dough. Its fat and sugar content aids in achieving a crispy crust, desirable color, and flavour.

Baking Powder: This ingredient releases carbon dioxide in the dough, supplying stronger pressure that allows it to expand and rise.

2. Equipment

The processing equipment was sourced from the processing laboratory of MIT School of Food Technology, located in Pune, Loni Kalbhor.

Deck Oven: Utilizing conduction heat, deck ovens bake products through direct heat transfer from a hot stone. They also emit radiant heat, allowing infrared waves to penetrate and warm the dough evenly.

Tray Dryer: This batch process serves to dry materials by circulating hot air.

Muffle Furnace: A specialized jacketed enclosure designed for heating materials.

Hot Air Oven: This equipment is used for dry heat sterilization.

Weighing Balance: Employed for measuring ingredients, this balance has a maximum capacity of 5 kg.

3. Method of preparation of malting

Soaking: Barley and Ragi were selected, Seeds with defects were rejected and only good quality seeds were used for soaking. The Seeds were soaked for 48 hours at room temperature. The care was taken that the utensils were clean and potable water was used. The Soaking utensil was covered until soaking.

Germination: The soaked barley and ragi was germinated by tying it in the muslin cloth. The germination was carried out for 48 hours and care was taking that muslin cloth is not disturb after keeping for germination.

Drying: After the grains have germinated the grains are dried in the hot air oven for 8 hours for 60°c. After drying the grains were milled and sieved and used for the cookie preparation.

Milling: The malted grains were milled and sieved to remove husk and then stored in dry and airtight container until further use.

4. Composition of standardized method of cookies:

Table 1

Sample	Malted Barley Flour	Malted Ragi Flour	Wheat flour	Sugar	Baking Powder	Butter	Milk	Total
C1	100gm	100gm	-	150gm	8gm	120gm	As Required	478gm
C2	150gm	-	50gm	150gm	8gm	120gm	As Required	478gm
C3	-	150gm	50gm	150gm	8gm	120gm	As Required	478gm
C4	75gm	75gm	50gm	150gm	8gm	120gm	As Required	478gm

5. Composition of malted cookies

Fig 1: malted nutritious cookies

6. Flowchart of processing of cookies: (development of multigrain fibrous gluten free millet cookies)

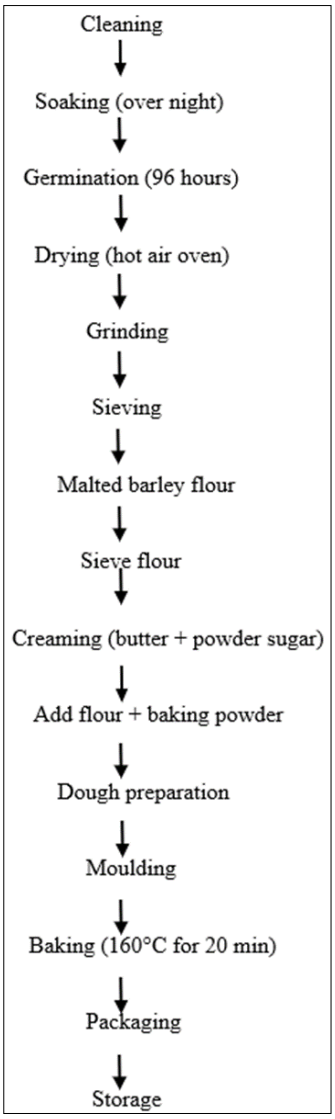

Fig 2: flowchart of processing of cookies

7. Sensory evaluation

The sensory evaluation of different organoleptic properties *viz*, colour, flavor, texture, and taste were carried out by a panel of 10 judges on the basis of Nine Point Hedonic Scale. The average score was calculated for individual organoleptic property. The overall acceptability of the product was taken as the average score of all these organoleptic properties.
(9-point Hedonic Scale)

Table 2

Score	Like
Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither Like nor Dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Result and Discussion

The data obtained in the present investigations was analyzed. The result includes data on preparation of nutritious malted cookies and sensory evaluation of different mean 4 composition of cookies.

1. Preparation of malted ragi, barley flour and cookies

Ragi and Barley flour: First soak the ragi and barley seeds in water for 48 hours at room temperature. Then soaked water was drained and that seeds were tied in muslin cloth for 48 hours at room temperature for germination. After the grains have germinated the grains are dried in the tray dryer for 8 hours at 105 °C. After that the dried seeds grind in fine powder in grinder.

Ragi and Barley cookies: As per the recipe all the ingredients were collected weighted. Then creaming is done by using powdered sugar and butter. After that add flour and baking powder in cream. Then prepare the dough by kneading. The dough is kept for 10 minutes for fermentation. After that make a sheet of dough and make it different shapes or pieces and those pieces kept in moulded trays for baking in deck oven at 160 °C for 20 minutes. After baking cool the cookies at room temperature and packed in appropriate packaging material and store at room temperature.

2. Chemical analysis of malted cookies

The chemical analysis of malted cookies was carried out by evaluation of different parameters such as moisture, total ash, proteins, total fat, carbohydrates, energy value and sugar content.

3. Chemical composition of malted cookies

Table 3

Sr. No.	Test Parameter	C1	C2	C3	C4	Market Brand No. 1	Market Brand No. 2	Unit
1	Moisture	4.83	5.24	4.92	5.16	5.61	6.69	%/100gm
2	Total Ash	1.55	1.55	1.64	1.53	2.19	1.69	%/100gm
3	Protein	12.02	8.12	10.08	11.14	8.00	7.80	gm/100gm
4	Total Fat	20.12	15.51	18.64	19.78	17.64	12.50	gm/100gm
5	Carbohydrates	61.48	69.58	65.67	67.12	59.22	75.00	gm/100gm
6	Energy Value	475.08	450.39	463.04	472.27	540.14	438.00	Kcal/100gm
7	Sugar	8.57	8.23	7.92	8.20	23.73	21.01	gm/100gm

4. Sensory evaluation

The sensory evaluation of different organoleptic properties *viz*., color, flavor, texture and taste. Those three-set compositions rating the panel member by using 9-point hedonic test.
9-point hedonic rating test (like score)

Sample	Score	Remark
C1	9	Like extremely
C2	8	Like very much
C3	6	Like slightly
C4	5	Neither like Not Dislike
MB1	6	Like slightly

Table shows that like score of ibfc with market brand cookies

The score of C1 sample is 9 – Like extremely.
The score of C2 sample is 8 – Like very much.
The score of C3 sample is 6 – Like slightly.
The score of C4 sample is 5– Neither like not dislike.
The score of MB 1 sample is 6 – like slightly.

Conclusion

These chapter deals with the overall summary of the result obtained during the project carried out.
The sensory evaluation of different organoleptic properties *viz*., color, flavor, texture and taste. Those three-set compositions rating the panel member by using 9-point hedonic test
The vivid conclusion was drawn and are presented in this section of report.

1. Summary

Malted cookies are good carrier of nutrients like carbohydrate and fat which can be enriched with protein. During the preparation of malted cookies, chemical properties of malted Ragi and Barley were analyzed *viz*. Also, sensory evaluation of the product was done for color, appearance, flavor, taste and consistency.
Hence the research work was conducted with the following objective.

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