

Original Research Article

Development of Gluten Free Flour & Gluten Free Cookies and their Sensory evaluation

Priyanka Yadav¹ & Ritu Mathur²

Department of Food Science and Nutrition

Maharshi Dayanand Saraswati University, Ajmer

Abstract

Gluten free option was chosen with the objective to develop gluten free products and its acceptability as a new food product for celiac patients and its comparison with standardized recipes.

Gluten free flour was developed by different millets, pseudo-cereals that were very good in nutrients like protein, fibre, calcium, iron and low content of calories as compare to wheat and rice. The process includes forming a mixture of different flours of millets like ragi (finger millet), rajgira (amaranth), little millet, foxtail millet, kodo millet and a pseudo-cereal quinoa in equal proportion.

A popular snack cookies was chosen for product development. Gluten free cookies were made by combining developed gluten free flour and gram flour. Homemade maida cookies were made for comparison with gluten free cookies.

The products were sensory evaluated by 30 panel members. A 9-point Hedonic scale was used to rate the acceptance or rejection of the snack cookies.

Gluten-free cookies got highest score in all characteristics appearance (79%), taste (76%), colour (86%), texture (83%), overall acceptability (87%) except odour (76%) which was equal to maida cookies (76%).

Hence, in conclusion it can be said that gluten-free cookies were acceptable and liked by panelists. With this as these are nutritionally good, so it can prove a healthy addition in diet variety for celiac patients.

Introduction

Gluten free diet is the solution of not only celiac disease but also other conditions like wheat allergy or gluten ataxia, etc.

- Celiac disease is a very common upcoming problem nowadays. It is a problem that cannot be controlled or treated by medicines but can be controlled by restriction of gluten in diet. In celiac disease, gluten found in many cereals triggers an immune system that damages the inner membrane of the small intestine. It is an autoimmune disorder in which absorption capacity of the small intestine is largely hampered
- Some people may feel symptoms of abdominal pain, bloating, diarrhea, constipation, “foggy brain”, rash or headache after consumption of gluten. It's cause is unknown but it's non celiac gluten sensitivity
- In the condition of an autoimmune disorder named gluten ataxia, muscle control and movement is affected due to nerve disorders
- Wheat allergy can also be seen in some patients where the body's immune system generates antibodies to the wheat protein, resulting in symptoms like congestion or breathing difficulties

Symptoms

A wide range of signs and symptoms can be observed in these types of patients. Common digestive signs are diarrhea, weight loss, bloating and gas, abdominal pain, nausea, vomiting & constipation.

Non digestive signs and symptoms are also seen in many patients like anemia, bone problems, skin problems, oral ulcers, headaches and fatigue, impaired spleen function etc.

Impaired absorption of nutrients can lead to decay of weight loss, anemia, irritability, short stature, delay puberty, tooth decay in children as well as failure to thrive in infants.

Sometimes neuromuscular signs like seizures or impaired coordination may be observed.
<https://www.mayoclinic.org/diseases-conditions/celiac-disease/symptoms-causes/syc->

Gluten is a wheat protein that is composed of gliadin (prolamin) and glutenin (glutelin) that is also found in rye, barley and oats. Gluten-free diet is not only beneficial for celiac patients but also in other problems like herpetiformis, gluten ataxia, and wheat allergy. With these benefits, the market for gluten-free products is growing very fast. A lot of research work has been done on this direction.

Gluten-Free Products

Sale of gluten free products has been forecasted to increase as per global market data. Increasing clinical application and demand of gluten free products is directly influencing the food market and labeling of gluten free products. As per The Food and Drug Administration a product is labeled as gluten free only when it's gluten content is < 20 PPM. It helps consumers decide the right choice of products.

Natural gluten free food groups include fruits, vegetables, meat, poultry, legumes, nuts and dairy products. However, some recipes prepared from these products may have “hidden” gluten. Hence, it's very important to review product labeling and ingredient list carefully. Traditional bakery products are more likely to contain gluten. Some cereals and pseudo-cereals like rice, corn, quinoa, pearl millet, kuttu, arrowroot, flaxseeds, gluten free flours made from rice, corn, soy, potato and beans flour, tapioca, sorghum and amaranth are naturally gluten free. Therefore these can be used as a base ingredient for making bakery products or any other recipe.

<https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/in-depth/gluten-free-diet/art-20048530>

As per increasing consumer demand, various manufacturing companies are focusing on increasing the production of more gluten-free packaged recipes. In this direction the bakery sector has its important role. There is an increasing demand for gluten-free crackers, bread and biscuits nationally in the past few decades.

Millets have important role in this direction.

Different flours in Gluten-free flour development and there plant description was done. In these, Ragi, Rajgira, Quinoa, Bajra, Littel millet, Foxtail millet, Kodo millet are of much importance.

1. Finger millet



Classification of plants:

Kingdom	Plantae
Order	Poales
Family	Poaceae
Genus	Eleusine
Botanical name	Eleusine coracana
Common name	Ragi, Nachani etc

Finger millet originated from the East Africa (Ethiopian and Uganda highlands) ranking sixth in India after production of wheat, rice, maize, sorghum and bajra. Ragi is most commonly grown and consumed in Karnataka and to some extent in Andhra Pradesh, Tamil Nadu, Odisha, Maharashtra, Uttarakhand and Goa.

https://en.wikipedia.org/wiki/Eleusine_coracana

Nutritive value of Finger millet:

Finger millet is considered one of the most nutritious cereals. Finger millet contains about 5-8% protein, 65-75% carbohydrates, 15-20% dietary fibre and 2.5-3.5% minerals. Of all the cereals and millets, finger millet has the highest amount of calcium (344 mg%) and potassium (408 mg %). The cereal has low fat content (1.3%) and contains mainly unsaturated fat. 100 grams of Finger millet has roughly on an average of 336 Kcal of energy in them (Devi et al., 2014).

2. Amaranth

Classification of plant:

Kingdom	Plantae
Order	Caryophytes
Family	Amaranthaceae
Genus	Amaranthoideae
Botanical name	Amaranthus cruentus L.
Common name	Chulai, rajgira

Amaranth is native to North and Central America, where Native American Hunting and Gathering tribes once gathered wild species of the plant. Amaranth is classified as a pseudocereal. Amaranth is consumed as both a vegetable and a grain. Amaranth leaves are usually picked fresh for use as greens in salads or blanched, steamed, boiled, fried in oil, and mixed with meat, fish, cucurbit seeds, groundnut or palm oil, many more. Amaranth grain is a popular snack sold in Mexico, and its use has spread to Europe and part of North America.

<https://en.wikipedia.org/wiki/Amaranth>

Nutritive value of Amaranth:

Amaranth (cooked) contain nutritional value per 100 g

Energy	371 kcal
Carbohydrates	65g
Dietary fibre	7g
Fat	7g
Protein	14g
Iron	7.6mg
calcium	159mg

https://en.wikipedia.org/wiki/Amaranth_grain

3. Little millet



Classification of plant

Kingdom	Plantae
Order	Poales
Family	Poaceae
Genus	Panicum
Botanical name	Panicum sumatrense
Common name	Kutki

The little plant or kutki is originated in the Andes and cultivated in low fertile soils. In India, its annual production is 102 thousand tones only, which is quite less than other crops (Anonymous, 2011). It is mainly grown in Gujarat, Odisha, Andhra Pradesh, Chhattisgarh, Jharkhand, Madhya Pradesh and Tamil Nadu in India.

https://en.wikipedia.org/wiki/Panicum_sumatrens

Nutritive value of little millet

Little millet provides the following nutrients per 100 grams:

Calories	329 kcal
Protein	9.7 gm
Fat	5.2 gm
Fibre	7.6 gm
Carbohydrate	60.9 gm
Calcium	17 mg
iron	9.3 mg

<https://bnborganics.com/products/little-millet>

4. Foxtail millet



Classification of plant:

Kingdom	plantae
Order	Cyperales
Family	Poaceae
Genus	Setaria
Botanical name	Setaria italica
Common name	Kangni

Foxtail millet was first domesticated in China and then became a cereal cultivated throughout Eurasia. It remains a major crop in arid and semi-arid regions of China and India to this day. Currently, it is widely grown in Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Uttar Pradesh and Bihar states.

https://en.wikipedia.org/wiki/Foxtail_millet

Nutritive value of Foxtail millet:

Carbohydrates	60.1 gm
Protein	12.3 gm
Fat	4.30 gm
Energy	331 kcal
Fibre	6.7 gm

Calcium	31 mg
Iron	2.8 mg

<https://bnborganics.com/blogs/news/foxtail-millet-guid>

5. Kodo millet



Classification of plant:

Kingdom	Plantae
Order	Poales
Family	Poaceae
Genus	Paspalum
Botanical name	P.scrobiculatum
Common name	Koden, Kodra

Kodo millet originated in tropical Africa and domesticated in India before 3000 years. Although it is grown in many states of India but Jhum field of Arunachal Pradesh are major cultivating area of this crop

https://en.wikipedia.org/wiki/Paspalum_scrobiculatum

Nutritive value of kodo millet per 100 gm:

Protein	9.8 gm
Fat	3.6 gm

Fibre	5.2 gm
Carbohydrate	66.6 gm
Calcium	35 mg
Iron	1.7 mg
Carbohydrate	353 kcal

<https://healthyday.net/kodo-millet-varagu-health-benefits-and-nutrition-facts/>

6. Quinoa



Classification of plant:

Kingdom	Plantae
Order	Caryophyllales
Family	Amaranthaceae
Genus	Chenopodium
Botanical name	C. quinoa
Common name	kinwa

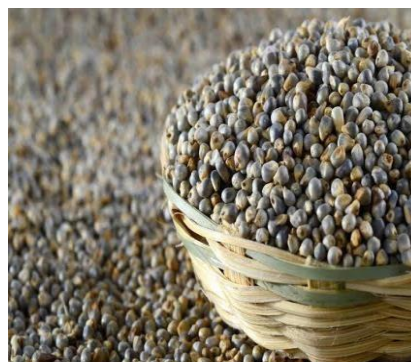
<https://en.wikipedia.org/wiki/Quinoa>

It is a super food due to its high nutritional content. It is considered a pseudo cereal because of similarity in nutritive value. Widely grown types of quinoa are red, black, white, tri-colour.

Nutritional value of quinoa per 100 gm

Energy	374 kcal
Carbohydrates	68.9 gm
Fiber	5.9 gm
Fat	5.8 gm
Protein	13.1 gm
Calcium	60 mg
Iron	9.25 g

7. Pearl millet



Classification of plant

Kingdom	Plantae
Order	Poales
Family	Poaceae
Genus	Cenchrus
Botanical name	C. Americanus
Common name	Bajra

https://en.wikipedia.org/wiki/Pearl_millet

Rajasthan is the largest producer of Pearl millet in India that is grown in semiarid to arid climates (Clotault et al, 2012).

Nutritional value of pearl millet

Nutrient per 100 gm of pearl millet:

Energy	363 kcal
Carbohydrates	67 gm
Fiber	2.3 gm
Fat	4.8 gm
Protein	11.8 gm
Calcium	42 mg
Iron	11 mg

<https://healthyday.net/pearl-millet-health-benefits-and-nutritional-value>

Research Methodology

It involves development of gluten-free flour, gluten-free cookies and for the sensory evaluation of the cookies and their comparison with standard homemade maida cookies.

Similar types of products were made by Yadav and Mathur (2012) using Moth beans. Likewise, product development using Pigeonpea was also done by Choudhary & Verma (2022).

The methodology is described under following section:

Phase 1: Material collection, procurement and processing of raw ingredients

Phase 2: Development of gluten-free flour or formulation of Gluten Free-Flour mixture

Phase 3: Product development from gluten-free flour

Phase 4: Acceptability evaluation of developed product

Phase 5: Statistical analysis

The detailed methodology is as follows -

Phase 1: Material collection, procurement and processing of raw ingredients:

The present research work was carried out with sample collection. This phase is very important for this research.

Collection of fresh raw materials namely:

- Ragi
- Bajra
- Amaranth
- Little millet

- Foxtail millet
- Kodo millet
- Quinoa
- Gram dhal
- Sugar
- Ghee
- Milk

Ragi, bajra, amaranth, gram dhal were procured in bulk from the local market of Ajmer, Rajasthan, India. Little millet, foxtail millet, kodo millet, quinoa were ordered by an online shopping app. Sugar, ghee and milk were procured from a nearby market in Ghooghara, Ajmer, Rajasthan, India.

Pre-preparation

The procured materials were prepared before the preparation of cookies.

Processing of raw ingredients

Ragi, bajra, amaranth, little millet, foxtail millet, kodo millet, quinoa, gram dhal were cleaned and then ground to make flour and then packed in an airtight container and stored.

Sugar and ghee are also packed in an airtight container and stored.

Phase 2: Development of Gluten-free flour or formulation of Gluten Free-Flour mixture:

For the selection of mixture of flours, formulation of gluten free flour mix for the preparation of gluten free cookies:

2.1: Preparation of Composite Flour for chapatti, for trial purpose

This was a trial method to observe the differences can occurs or not in texture, taste, appearance or any other with change in different ingredients.

Ingredients Sample	Ragi	Quinoa	Amaranth	Little millet	Foxtail millet	Kodo millet	Bajra
S1	25	25	-	25	25	-	-
S2	25	-	25	-	25	-	25
S3	20	20	20	20	20	-	-
S4	14.3	14.3	14.3	14.3	14.3	14.3	14.3

Table 1: Formulation of GFFM by using different ratios for trial purpose

Sample 1: was prepared by 4 ingredients ragi, quinoa, little millet, foxtail millet in equal proportion

Sample 2: was prepared by 4 ingredients ragi, amaranth, foxtail millet, bajra all are in equal proportion

Sample 3: In this ragi, quinoa, amaranth, little millet, foxtail millet 4 ingredients was used in equal proportion

Sample 4: It was prepared by 7 ingredients in equal proportion



Image 1: Formation of chapattis by using different ratios for trial

2.2: Standardization of Gluten-Free Flour mix for further preparation

Batches of 100g of GFFM chapatti was prepared by using different ratio of ragi, quinoa, amaranth, little millet, foxtail millet, kodo millet, bajra shown in images. As chapati is a staple food, so focus was on developing Gluten free flour that can be used to make chapaties as well as cookies.

Reasons for selection of sample 4 for cookies development

Different samples show approx some similar characteristic like texture, color, taste. So Then finally a mixture (S4) of all ragi, quinoa, amaranth, little millet, foxtail millet, kodo millet, bajra was selected for further GF cookies because it is a mixture of more variety of flours with good nutrient quality.

Phase 3: Product development from Gluten-free flour:

- 3.1 Standardization of basic Recipe
- 3.2 Product Development from Gluten-free flour mixture
- 3.3 Standard recipe product for comparison with developed product

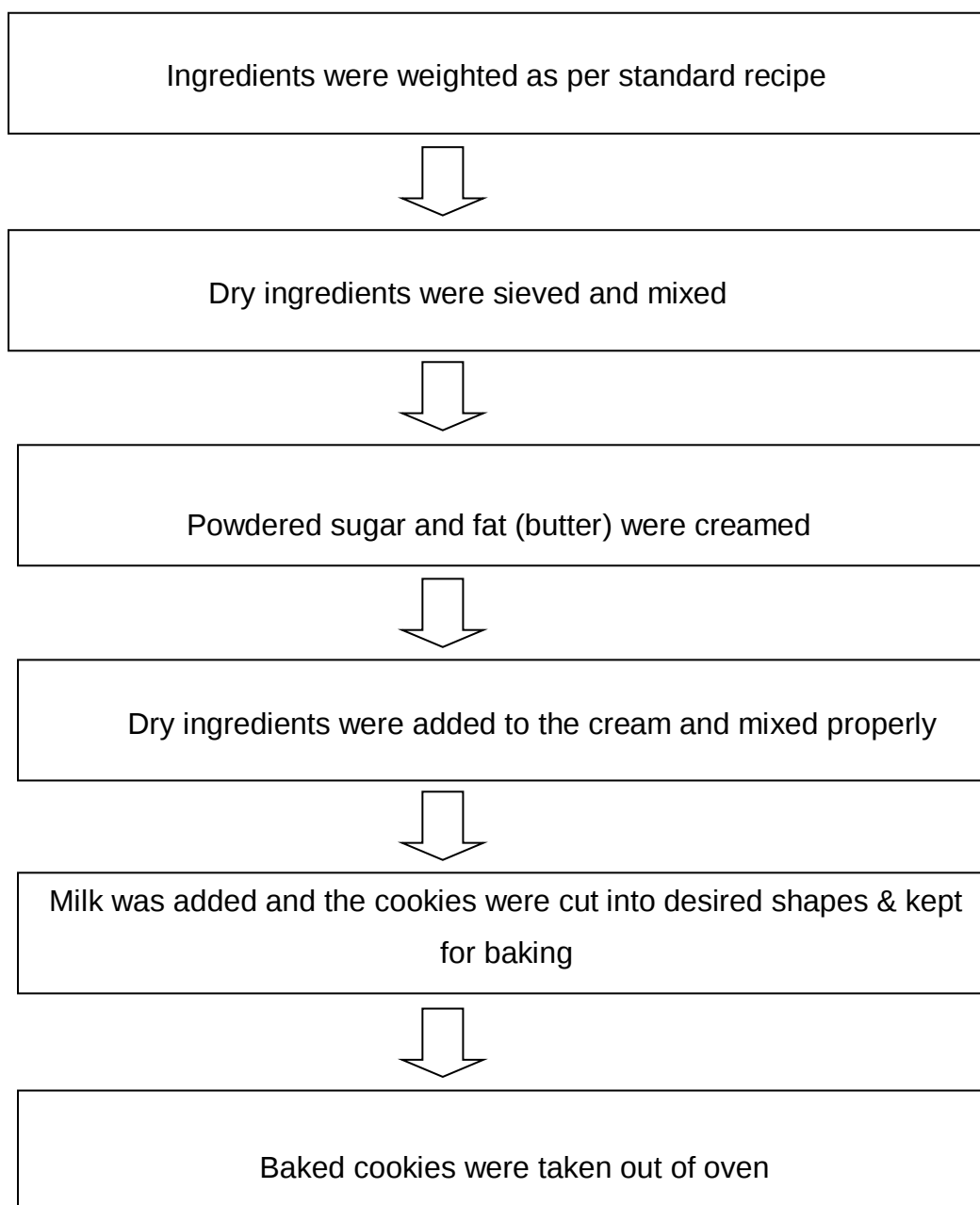
3.1: Standardization of basic recipe:

Standardized recipes are one that “has been tried, adopted, and retired several times for use by given food service operation and has been found to produce the same good result and yield every time when the exact procedures are used with the same type of equipment and the same quantity of ingredients” in the manual. (Standardized recipe >> BNG Hotel Management Kolkata).

Standardization is also required to calculate food cost and selling price accurately.

3.2: Product Development from Gluten-free flour mixture:

In development of the recipe, Gluten Free Cookies were prepared by substituting maida with gluten-free developed flour.

Method of preparation:

Flow chart 1: Flow chart for the preparation of gluten free cookies

Procedure:

- a) Take a developed gluten-free flour mixture in a bowl and add gram flour in it
- b) Add small amount of cardamom about 5 gm, almond powder about 10- 15gm, add pinch of salt and baking soda in mixture
- c) Make a creamy mixture of ghee and sugar
- d) Add prepared dry mixture into creamy mixture of ghee and sugar and mix all thoroughly
- e) Add milk and knead into hard dough
- f) Make small size balls and flatten them slightly and placed them on a baking tray
- g) Baking was done in kadhai at medium to high flame for 12-13 minutes. Flip them and leave for 3-4 minutes and cookies were ready for serve

Kadhai method for baking:

- a) Take a kadhai place on gas flame
- b) Kadhai was filled with 1 kg of salt and place a ring in the center of kadhai
- c) Place a baking tray on the ring
- d) And cover the baking tray by another plate or tray

**Baking process of cookies**

Total serving:

Total serving cookies were 16 pieces with 200gm.

Cooking time:

Dough preparation about 15 minutes

Cookies preparation about 7-8 minutes

Baking time about 16-17 minutes

Total time: 40 minutes



Step 1



Step 2



Step 3



Step 4



Step 5

Steps of gluten free cookies preparation

3.3: Standard recipe product for comparison with developed product

For the comparison of acceptability of developed product we need a standard recipe to comparison with that we can easily analysis of product acceptability in market by people.

Homemade maida cookies were prepared for comparison with gluten free cookies.

Procedure

- a) Take a refined wheat flour maida in a bowl and add gram flour in it
- b) Add small amount of cardamom about 5 gm, almond powder about 10-15gm, add pinch of salt and baking soda in mixture
- c) Make a creamy mixture of ghee and sugar
- d) Add prepared dry mixture of refined wheat flour into the creamy mixture of ghee and sugar and mix all thoroughly
- e) Add milk and knead into hard dough
- f) Make small size balls and flatten them slightly and placed them on a baking tray
- g) Baking was done in kadhai at low to medium flame for 12-13 minutes. Flip them and leave for 3 minutes and cookies were ready for serve

Total serving

Total serving cookies were 20 pieces with 200 gm.

Cooking time

Dough preparation about 15 minutes

Cookies preparation about 7-8 minutes

Baking time about 16-17 minutes

Total time: 40 minutes.



Product: Gluten-Free cookies



Product: Slandered maida cookies

Phase 4: Acceptability Evaluation of developed product

Sensory evaluation of a product means assessment of product acceptability through senses. It is also called subjective or organoleptic evaluation.

Sensory test is very essential in new product development as it helps to know consumer preference after different types of variations in the new products.

4.1 Selection of panel members

4.2 Sensory evaluation by hedonic scale

4.1 Selection of panel members

Panel members may be trained, semi trained or consumer panels. Panelists should be able to discriminate easily between samples and they should be able to identify any minute change in the product.

For present research a panel consisting of 30 untrained member was selected which included Graduate or Postgraduates of Maharshi Dayanand Saraswati University campus.

4.2 Sensory Evaluation by hedonic scale

It's a 9-points rating scale, ranging from 'like extremely' to 'dislike extremely'. Score of 9 was given to 'like extremely' and rating of 1 was given to 'dislike extremely'.

Formulation of score card

Following sensory characteristics were taken in the score card for evaluation of acceptability -

- Color
- Appearance
- Odour
- Texture
- Taste
- Overall acceptability

Phase 5: Statistical Analysis

Data obtained in the present study was interpreted and analyzed by calculating mean, standard deviation and percentile.

Results and Discussion

Acceptability comparison between standard and products developed from gluten free flour mixture.

Acceptability comparison between gluten free cookies and standard maida cookies:

The acceptability evaluation of the gluten free cookies during the study was done using **9-point Hedonic Scale** to judge and grade the various organoleptic qualities of the samples like color, appearance, odor, texture, taste and overall acceptability and while the latter was used for assessing the general acceptability of the products hence developed.

Characteristics	Maximum score	Score Obtained	
		A	B
Appearance	9	7.1	6.9
Odour	9	6.8	6.9
Taste	9	7.7	6.8
Colour	9	7	6.6
Texture	9	7.5	7.3
Overall Acceptability	9	7.8	7.4

Table 2: Scores obtained for Appearance, Odour, Taste, Colour, Texture and Overall acceptability in Gluten-free cookies and maida cookies

Maximum score = 9

A = Gluten-Free Cookies

B = Maida Cookies

Sample		Appearance	Odour	Taste	Colour	Texture	Overall Acceptability
A	$\bar{x} \pm \sigma$ score	7.1 $\pm$ 1.22	6.8 $\pm$ 1.1 9	7.7 $\pm$ 1.1 9	7 $\pm$ 1.45	7.5 $\pm$ 1.05	7.8 $\pm$ 0.86
	% score	79	76	86	78	83	87
B	$\bar{x} \pm \sigma$ score	6.9 $\pm$ 1.23	6.9 $\pm$ 1.2 7	6.8 $\pm$ 1.2 2	6.6 $\pm$ 1.2 8	7.3 $\pm$ 1.00	7.4 $\pm$ 0.90
	% score	77	77	76	73	81	82

Table 3: Mean Acceptability and percent scores (% score) of Appearance, Odour, Taste, Colour, Texture and Overall Acceptability in Gluten-free cookies and Maida cookies

$\bar{x}$ = Mean

Σ = Standard Deviation

% = Percent score

A = Gluten-Free Cookies

B = Maida Cookies

% Score for Gluten-free cookies and maida cookies

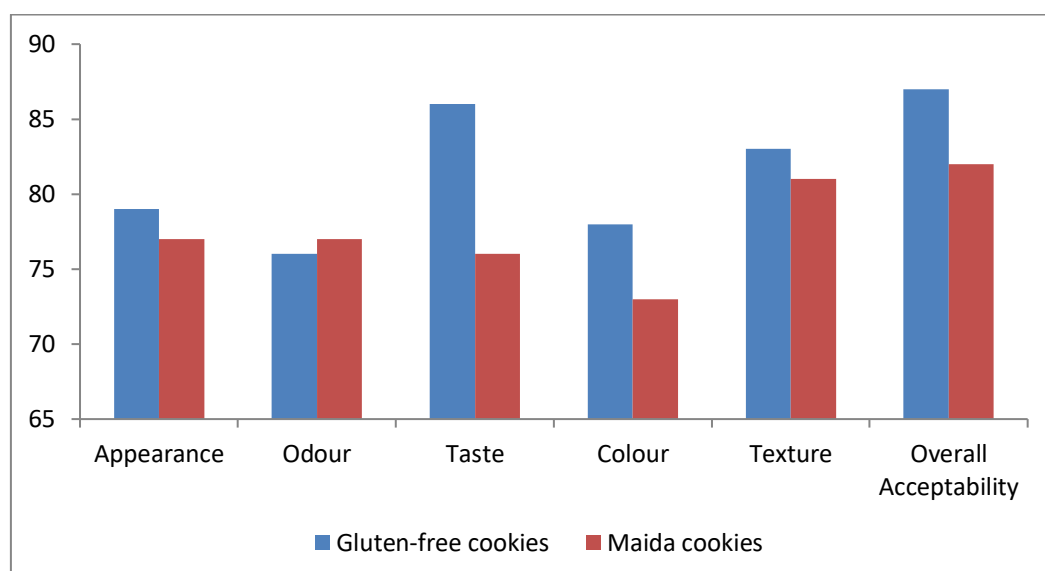


Figure 1: % Score of Appearance, Odour, Taste, Colour, Texture, Overall Acceptability in Gluten-free cookies and maida cookies

In the present study the percent score of appearance for gluten-free cookies and maida cookies shows that gluten free cookies sample A obtained highest scores i.e, 79% then sample B 77% maida cookies, so obtained score indicated slight difference about 2% between sample A and sample B.

When percent score of odour were compared between two samples that were sample A and sample B, the scores show that sample A obtained 76% score and sample B obtained 77% scores. These score show about only 1% difference between sample A and sample B.

When % score of taste were compared between two samples i.e sample A and sample B. The compared score show that sample A obtain highest score i.e 86% and sample B obtain lowest score i.e 76%. The comparison shows little difference in highest score and lowest score.

When % score of colour shows that sample A obtained high score with 78% and the sample B obtained lowest score with 73%. These score of colour also indicate 5% difference in colour of sample A and sample B.

Percent score texture were compared between sample A and sample B, and sample A show high score i.e 83% then sample B i.e 81%. These score of sample A and sample B indicate minor difference in gluten free cookies (sample A) and maida cookies (sample B).

The % score of overall acceptability shows sample A with 87% score and sample B with 82% score. Gluten-free cookies show high acceptability score and maida cookies show lowest acceptability score. This indicates that there were slight difference of 5% in between sample A and sample B.

All above percent score for all aspects like appearance, taste, colour, texture and overall acceptability except odour were indicate that panelists liked gluten free cookies slight more then maida cookies. In case of odour, percent score indicate panelists like maida cookies slight more than gluten-free cookies.

Appearance	Odour	Taste	Colour	Texture	Overall acceptability
A > B	A < B	A > B	A > B	A > B	A > B

Table 4: show more or less likeability in between sample A and sample B.

A < B: Maida cookies more likeable then gluten-free cookies

A > B: gluten-free more likeable then maida cookies

A = B: both were equally liked

Table no. 4 indicate that appearance, taste, colour, texture, overall acceptability of gluten-free cookies are slightly more accepted then maida cookies except odour of GF cookies slightly less acceptable.

According to product acceptability, gluten-free cookies are accepted by panellists due to their small differences in maida cookies and gluten-free cookies.

Conclusion

The present study was undertaken to developed gluten-free cookies snack with incorporate developed gluten-free flour which was developed under this dissertation work and conduct organoleptic evaluation of these gluten-free cookies with another one home made maida cookies.

Organoleptic studies were conducted to test the acceptability of product by 30 panelists or judges.

Both basic recipes i.e gluten-free and maida cookies were standardized and developed under controlled conditions.

Score card were made for products according to the various characteristics of each recipe. The characteristics were judged by marks allotted for appearance, odour, taste, colour, texture, and overall acceptability. Panel member given a 9-point Hedonic scale to

rate the different products which range from “**Liked extremely**” to “**Dislike extremely**”. Maximum points given to each characteristic, multiplied by the weight of the characteristics helped to obtain the final scores.

Incorporation of gluten-free flour in cookies means that standard maida cookies were substituted by gluten-free flour. It was a very significant step towards the addition of a healthy diet option for celiac patients or other gluten insensitivity cases.

Hence, from the above Organoleptic studies results concluded that gluten-free cookies were liked in the range of “like moderately” to “like very much” by the panel members with overall acceptability of 75%-88%. And in case of maida cookies the overall acceptability was 75%-82%. Thus, there was very little difference in overall acceptability, but in comparison gluten-free cookies slightly more acceptable than standard homemade maida cookies.

References

Anonymous (2011). Coordinator Review paper presented in annual workshop of AICRP on small millets. held at OUAT, Bhubaneswar (Orissa) on April 23- 25

Choudhary, M. & Verma, P. (2022). Nutritional evaluation of pigeon pea and development of food product incorporating it. International J Nutrition & Lifestyle, 2(2), 106 - 120

Clotault, J., Thuillet, A. C., Buiron, M., De Mita, S., Couderc, M., Haussmann, I.G., Mariac, C. & Vigouroux, Y. (2012). Evolutionary History of Pearl Millet (*Pennisetum glaucum* [L.] R. Br.) and Selection on Flowering Genes since Its Domestication. Molecular Biology & Evolution, 29(4), 1199 - 1212

Devi, P.B., Viajayabharathi, R., Satyabama, S., Malleshi, N.G. & Priyadarsini, V.B. (2014). Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: a review. J Food Sci Technol, 5(6), 1021 - 1040

<https://www.mayoclinic.org/diseases-conditions/celiac-disease/symptoms-causes/syc->

<https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/in-depth/gluten-free-diet/art-20048530>

https://en.wikipedia.org/wiki/Eleusine_coracana

<https://en.wikipedia.org/wiki/Amaranth>

https://en.wikipedia.org/wiki/Amaranth_grain

https://en.wikipedia.org/wiki/Panicum_sumatrens

<https://bnborganics.com/products/little-millet>

https://en.wikipedia.org/wiki/Foxtail_millet

<https://bnborganics.com/blogs/news/foxtail-millet-guid>

https://en.wikipedia.org/wiki/Paspalum_scrobiculatum

<https://healthyday.net/kodo-millet-varagu-health-benefits-and-nutrition-facts/>

<https://en.wikipedia.org/wiki/Quinoa>

https://en.wikipedia.org/wiki/Pearl_millet

<https://healthyday.net/pearl-millet-health-benefits-and-nutritional-value>

Yadav, P. & Mathur, R. (2012). Organoleptic Studies on Utilization of Moth Beans (*Phaseolus aconitifolius*, Jacq.) In Some Indian Snacks Mathri, Ladoo, Kachori, Department of Food Science and Nutrition, Maharshi Dayanand Saraswati University, Ajmer (unpublished)