



# DEVELOPMENT OF MULTIGRAIN FIBROUS GLUTEN FREE MILLET COOKIES

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## Abstract

Bakery sector is among the top in the food industry. Cereal flour particularly refined wheat flour is the basic ingredient for this sector as it is only wheat flour that forms viscoelastic dough when mixed with water. The viscoelasticity appears because the gluten proteins are water compatible and thus will swell and interact. However, there are two limiting factors for using wheat flour for human consumption. First is that a part of human population (Gluten intolerance persons) is allergic to gliadin part of wheat protein which causes Celiac disease (CD). Secondly, cereal proteins are low in several essential amino acids potentially causing protein malnutrition. A cookie made from refined wheat flour only may not be able to provide all the nutrition. Thus, there is a need to develop products for celiac persons and a product which is nutritious too. Apart from this, today world's population is exploding, so there is also an urgent need to utilize under utilized crop not only because they are cheap but also are nutritionally superior to wheat.

A study was conducted to standardize an innovative nutritious cookies for all age groups especially gluten allergic people. Oats (*Avena sativa*), Ragi or Finger millet (*Eleusinecoracana*), and Jowar (*Sorghum vulgare*) being gluten free, are suitable for individuals suffering from celiac disease so were selected for developing this product. Apart from being gluten free these are rich source of several phytochemicals, possesses cholesterol lowering, blood glucose lowering, and anti-ulcerative, wound healing properties as indicated by *in vitro* and *in vivo* studies. Different trials were conducted to standardize the recipe using various proportions of flours & honey. The developed product provides good amounts of proteins, fibre, vitamins and minerals. The product was evaluated on the basis of sensory attributes and overall acceptability of the product by nine point hedonic scoring method. It was found to be far better and appealing than one made with all refined flour recipe. Shelf life study result showed that the product had good shelf life and was widely accepted even after 30 days.

**Key words :** Multigrain gluten free cookies, millet cookies, celiac disease, ragi, sorghum, oats.

## Introduction

The demand of bakery products is increasing at the rate of 10.07% per annum. India is a developing country with large segment of population depending on wheat as staple foods and 25% of wheat is used in the preparation of baked foods. Baked products are considered as an excellent vehicle for fortification, value addition and feeding at mass scale. Baked products can be made a good source of dietary fiber in the total food consumption as they are consumed and relished by all age groups.

In developing countries cereal staples provide two-thirds of the total protein and calorie intake. Among the cereal flours, only wheat flour forms viscoelastic dough when mixed with water. The viscoelasticity appears to be because the gluten proteins are water compatible and

thus will swell and interact. Wheat flour dough is unique in its ability to retain gas. This property appears to result from a slow rate of gas diffusion in the dough. The third major unique property of wheat flour dough is its ability to set in the oven during baking, and thereby to produce a rigid loaf of bread or product with honeycomb like porous structure. Although not clearly understood, this appears to be a heat- induced cross-linking of the gluten proteins.

Majorly, wheat flour is used by bakery industry for making various products like biscuit, bread, cakes etc. A cookie made from refined wheat flour only may not be able to provide all the nutrition. Therefore, it is important to develop nutritionally enhanced products which can meet the nutritional requirement of special segment (persons with gluten intolerance) by utilizing under utilized crops. This not only enhances the nutritional value (table

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1), but also provides avenue to develop product at low cost. Development of good gluten network is a requirement for production of bakery products. Thus, Gluten-free bakery foodstuffs are a challenge for technologists and nutritionists since alternative ingredients used in their formulations have poor functional and nutritional properties.

Celiac disease (CD) is an immune-mediated enteropathy, characterized by lifelong intolerance to gluten in genetically susceptible individuals. This study aims to develop hypoallergenic cookies using blends of Oats, Sorghum, Ragi flour and honey. Formulated cookie samples were evaluated for product quality characteristics and shelf life analysis. Hedonic scaling was used to evaluate the product.

### Materials and Methods

Multigrain gluten free biscuits were made with different flour combination of oats, sorghum & ragi flour and honey as sweetener. Following methodology was followed for developing Multigrain gluten free biscuits:

#### Raw material procurement

The raw material used such as Ragi, Sorghum, Oats, Sugar, Honey, Butter, dark chocolate, baking soda and Baking Powder were procured from local delhi market. Sieved through appropriate mesh sieve and were used for the study. All ingredients were stored at room temperature (33-37°C) and used as per recommended storage condition.

#### Preparation of multigrain gluten free cookies

- a. Control cookies were prepared following the standard recipe used by Sharma and Bakshi (2017). Each cookie sample were prepared from 500g of flour blend. Dough temperature is maintained at 32-34°C (preferred 32°C). The dough was formed as per standard methodology. Resting time of 15- 20 min was given. The dough was rolled manually into 1 cm thickness. Cookies were cut in round shape with a diameter of 4.0 cm across. Cookies were baked in a commercial baking oven maintaining temperature of 150-180°C for 15-20 minutes and cooled at a room temperature, evaluated for physical and sensory characteristics. The cooled cookies were sealed in a plastic bag until measurements were taken. Random samples were taken from each trial and the average values were reported.
- b. Various flour blends of Ragi, Sorghum and Oats were prepared in the varying ratios and used for making cookies as per the recipe given in table 2

and following same method used for making control recipe with some modification.

#### Physical property measurements

Average thickness of cookies was measured by stacking six cookies and measuring the height to the nearest mm and width of cookies was measured by laying six cookies to edge, measuring nearest mm using vernier calipers. Average weight of six cookies was recorded in grams using electronic balance. Expansion in the thickness and width was observed.

#### Sensory analysis

Sensory analysis of developed cookies was done after 24 hours by trained panelist on hedonic scale. Total possible score for the evaluation was maximum 50 and acceptability index was calculated on per cent basis.

### Results

#### Screening of trials and development of selected cookies

A combination of 25:25:50 was found most suitable and product was made using this combination. The cookies were brownish in color, evenly baked, attractive, well spread with pleasant baked and honey flavor. The incorporation of millet flour and honey altered the baking, sensory, textural properties of the cookies which were opined to be coarse textured because of the presence of oats. As observed in table 3, trial cookies although have better sensory properties as compared to control cookies made using refined wheat flour.

Honey has the effect on all the parameters, but the effect was more prominent on cookies aroma. The incorporation of oats has resulted in coarse texture which was liked by panelist and slight bitter taste of ragi was masked by chocolate added in the recipe. Cookies developed using coarse cereals is definitely with enhanced nutritive value.

#### Physical characteristics of cookies

Millet incorporation affected physical characteristics which resulted in dull brown coloured compact cookies with slight coarse mouth feel but acceptable taste and flavour. The results of the evaluation of physical characteristics of value added cookies in comparison with control cookies are presented in table 4. It was observed that the control cookies exhibited excellent product profile with golden brown, attractive, pleasant aroma, flavor and smooth mouth feel. The control cookies recorded weight of 10.02g with an increase in thickness of 0.42 cm and a diameter of 1.05 cm. The cookies have a good spread as compared to the trial sample. As compared to control

**Table 1 :** Table showing the nutrient content in flours used.

Nutrient → Cereal & Millet ↓	Protein (g)	Total Dietary Fibre (g)	Soluble fibre (g)	Energy (KJ)	Total folates (µg)	Total Carotenoids (µg)	Calcium (mg)	Iron (mg)	TPUFA polyphenols	Total (mg)
Sorghum	9.97	10.22	1.73	1398	39.42	212	27.60	3.95	524	23.25
Finger millet	7.16	11.18	1.67	1342	34.66	154	364	4.62	431	135
Oats	14.2*	10.2*	4.4*	397*	21.84* <sup>1</sup>	Nil* <sup>1</sup>	21.06* <sup>1</sup>	4.4	2.9	323ppm* <sup>2</sup>
Refined wheat flour	10.36	2.76	0.62	1472	16.25	270	20.40	1.77	50.64	5.17

\* Data taken from Oats, bagrry's packet

\*1 <http://www.whfoods.com/genpage.php?tname=nutrientprofile&dbid=109> accessed on 23.04.2018

\*2 Amount of Avenanthramides <https://www.sciencedirect.com/science/article/pii/S0733521015000272> accessed on 23.04.2018

**Table 2 :** Table showing the ingredients of cookies.

Ingredients	
Ragi	25g
Sorghum	25g
Oats	50g
Dark Chocolate	40g
Butter	75g
Sugar	50g
Honey	12.5g
Baking powder	1/2tsp
Baking soda	1/4tsp
Vanilla essence	10drops

cookies, the trial cookies have slightly more expansion in thickness (0.47cm) and less increase in diameter (0.71cm) with a recorded average weight of 11.81g.

### Texture (hardness of cookie)

The trail cookies were crunchy, fractured easily and have short bite in comparison to control cookies.

### Sensory evaluation of cookies

The result of sensory analysis as given in table 3 shows that the trial sample was liked most by the panelist on all sensory aspects as compared to control cookies. The total score of the control cookies was 33.98 out of 50 however Trial sample recorded a sensory score of 42.53 out of 50 *i.e.* above the control cookies.

### Nutritional Analysis of control and enriched cookies

The nutrient composition of trial cookies is presented in table 5 in comparison with control cookies. From the nutritional analysis, it was found that trial enriched cookies were nutritionally superior to control cookies. Apart from calcium, iron and protein the developed millet and oats cookies also contain soluble fibre of 3.05g, total dietary fibre of 10.45g, total folate 29.44g, total carotenoids 91.50 µg, total PUFA 240.20 mg and total polyphenols 201.06 mg.

### Yield and cost of preparation of trial cookies

All the recipes yielded ten to twelve cookies. The yield in terms of weight per recipe varied. Per kilo basis the maximum number about 78 cookies was recorded in control cookies followed by about 83 in Trial cookies. The cost of preparation of cookies was highest in trial because of the high cost of ingredients which includes oats, ragi, sorghum, honey and chocolate in comparison to refined wheat flour control cookies.

### Storage quality evaluation

Shelf life is an important parameter of marketability, consumer acceptance of any food by a consumer. Over a period of 60 days storage study, the total score of control cookies decreased from 33.98 (0<sup>th</sup> day) to 29.41 (60<sup>th</sup> day). The score remained constant for a more than a month then it started declining gradually. The same trend was also observed in case of Trial cookies, the score declined from 42.53 (0<sup>th</sup> day) to 39.25 (60<sup>th</sup> day). The score of enriched cookie was still better than control cookie due to better aroma retention and texture. Packaging may be responsible for reduction in sensory score.

### Discussion

The highly accepted coarse cereal and oats cookies were derived at 25% ragi, 25% sorghum and 50% oats, the recipe, which yielded dull brown cookies in comparison to 100% refined wheat flour cookies, which were baked golden brown. The dull appearance of the cookies is attributed to inherent characteristics of the flours used for making cookies.

The cookies were crunchier and soft to break in comparison to all refined flour control cookies, which were in comparison more compact and harder to break in texture. The difference in the texture may be attributed to the lack of gluten and extra fiber and protein in the

**Table 3 :** Summary of sensory evaluation.

Trial No.	Appearance & color (10)	Aroma (10)	Texture (10)	Flavor & Taste (10)	Overall acceptability (10)	Av mean score (10)	Total Score (50)
Control	8.98	6.46	6.32	6.15	6.07	6.79	33.98
Trial	8.67	8.65	7.87	8.37	8.97	8.5	42.53

**Table 4 :** Physical dimensions of control and trial cookies.

Sample code	Av. Thickness (cm)			Av. Diameter (cm)			Weight (g)
	Before baking	After baking	Expansion in thickness	Before baking	After baking	Expansion in diameter	
Control	0.45	0.87	0.42	3.69	4.74	1.05	10.02
Trial	0.44	0.91	0.47	4.04	4.75	0.71	11.81

**Table 5 :** Table showing the nutritional value of cookies.

Nutrients	Energy (Kcal)	Protein (g)	Iron (mg)	Calcium (mg)	Total Dietary Fibre (g)
Control	1021.155	10.435	1.88625	20.4	2.76
Trial	1384.15	14.015	4.3769	93	6.4

coarse cereal flour and oats cookies.

A major portion of millet flour comprised of coarser particles which possibly affected the spreading capacity of cookies, besides yielding gritty mouth feel and crunchier texture as compared to control. The millet flour and oats incorporation affected baking performance, but it enhanced nutritional values in terms of fiber, iron, calcium and protein content over conventional cookies. Partial replacement of sugar with honey resulted in decreased requirement of fat (%) during making cookies apart from contributing rich aroma. This is important because fats are implicated in deleterious health effects and now the food industry is moving towards reducing fat percentage in food.

In the present study, substitution of refined wheat flour with pearl millet in cookies resulted in increased protein, iron, calcium and dietary fiber content over control cookies. In the present investigation, the carbohydrates especially the starch content per se get reduced due to the inclusion of these ingredients affecting compactness of cookies. Resistant starch (RS) represents the part of starch escaping digestion and not absorbed in the small intestine of healthy humans. Millet are higher in RS compared to wheat flours and the other cereal whole grains. RS is 2.0% in millet, while it is <1.0% in the remainder of cereal whole grains and flours. So, millet incorporation increases the nutraceutical value of the cookies.

The flavour was highly appreciated and texture was improved due to addition of honey. The incorporation of

**Table 6 :** Cost and yield analysis of cookies produced in conventional oven.

Parameters	Control	Trial
Cost Rs./Kg cookies	78.7	560
Cost Rs./cookie	0.94	6.74
Cost Rs./serving	1.89	13.48

1 serving = 2 cookies

The cost per serving of trial cookies is Rs. 13.48 and of control is Rs. 1.89.

honey in cookies greatly influenced the nutrient composition, there is also a significant increase in the essential amino acids in comparison to control cookies.

The subjective data reflected that the overall acceptability of the Trial cookies (8.97) was the highest among all samples including the control with the overall acceptability value of 6.07.

The production cost of millet-jaggery cookies was more compared to the control cookies due to the use of coarse millet flour, oats and honey.

## Conclusion

Nutri dense, underutilized, coarse grains and honey could be effectively used in bakery goods to enhance iron, calcium, fibre and other nutraceutical constituents of product efficiently.

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