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## Standardization and formulation of gluten free biscuit using rice as base ingredient suitable for celiac disease

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### Abstract

The present investigation was undertaken with an aim to standardize and formulate rice based biscuit suitable for celiac patient. All grains were processed into flours by using traditional household method. Standardization of rice based biscuit was done with various trials. First trial was done by preparing biscuit with 100 per cent waxy rice with binding agent gum and egg separately but biscuits were found very compact and hard in texture. Second trial was done by preparing biscuit by using 100 per cent non-waxy rice guar gum and egg served as binding agent in two different trials but biscuits were not found acceptable in texture. Another trial was done and biscuit was prepared by using 50 per cent non-waxy rice and 50 per cent waxy rice using 5 per cent gum and egg as binding agent separately. Both the variations were found to be acceptable in every aspects but biscuit prepared by using egg was selected for further study because egg is more nutritious and also act as both binding and emulsifying agent. Moreover, egg is also easily available in local markets. The standardized products were evaluated for their acceptability through sensory evaluation by a set of 10 trained and semi-trained panels. All six rice based standardized products were found acceptable but out of all, C<sub>2</sub> exhibits highest scores for all sensory attributes. Therefore, biscuit was formulated from flour mix prepared by mixing two varieties of rice flours, buckwheat flour, soya flour at different ratio. For preparing of gluten free biscuit the flour mix was prepared in four different ratios 60:10:20:10, 50:20:20:10, 40:30:20:10, 30:40:20:10 respectively and were used to prepare 100gm flour mix for biscuit.

**Keywords:** Gluten free biscuit, celiac disease, processing, standardization

### 1. Introduction

Food baskets of Indian consumers are emerging to be more diverse and include more processed and value added food products. Among all processed foods, biscuit is one of the oldest bakery items consumed regularly by all age groups of population. Biscuits represents a fast growing segment of food because of consumer demands for convenient and nutritious food products. The consumers demand has increased for the quality food products with taste, safety, convenience and nutrition (Masoodi *et al.*, 2012) [5]. Nowadays foods are not intended to only satisfy hunger and to provide necessary nutrients for humans but also to prevent and manage many nutrition-related disease. Celiac is one of the nutrition related disease commonly prevalent among 1.4 percent of the total population based on serological tests and 0.7 per cent based on biopsy results (Singh *et al.*, 2018) [7]. Celiac disease is a chronic disorder of the small intestine caused by exposure to gluten in the genetically predisposed individuals. It is characterized by a strong immune response to certain amino acid sequences found in the prolamin fractions of wheat, barley and rye (Hussein *et al.*, 2012) [4]. When people with celiac disease eat foods containing gluten, their immune system responds by damaging the intestinal villi leading to the malabsorption of nutrients (Feighery, 1999; Hussein *et al.*, 2012) [4]. Rice is a major staple food for about 65 per cent of the country's population. Rice is naturally gluten-free and contains proteins that are known to be reasonably nutritious. Rice protein is valuable because it has ranks high in nutritive quality (rich in the essential amino acid lysine) among the cereal proteins. Apart from carbohydrate and protein, it provides reasonable amount of other nutrients viz., minerals and vitamins such as phosphorus, calcium, magnesium, potassium, iron, zinc, copper, manganese, thiamin, niacin and riboflavin. Rice is characterized by low prolamin, hypoallergenic activity, insipid taste, low sodium and high digestible carbohydrate contents, which is suitable to be incorporated into celiac diets (Mona *et al.*, 2015) [6].

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Early bone disease is common in both men and women with celiac disease due to malabsorption. Vitamin D deficiency, which is common in celiac disease, needs to be treated to maintain serum 1-25 dihydroxy vitamin D levels (Cranney *et al.*, 2006). Calcium absorption from soybeans has been shown to be similar with milk (Heaney *et al.*, 1991). Thus, soybean can prove beneficial to people for celiac disease.

Beside these, buckwheat is one of the most valuable pseudocereals in terms of its nutritional composition and it is suitable for celiac patients because of its gluten-free characteristics. Buckwheat is a rich source of starch and contains many valuable compounds such as proteins, antioxidant substances, trace elements and dietary fibre. Due to its excellent nutritional value, buckwheat can be included in the gluten free diet for celiac patients. Therefore, the present study aims to standardize and formulate gluten free biscuit using rice as a base ingredient suitable for celiac disease.

## 2. Methodology

### 2.1 Processing of raw materials

All the raw materials were processed to make them ready for developing the product. Ingredients i.e. two varieties of rice

and buckwheat were processed into flour in order to use them as base ingredient for development of rice based biscuits.

#### 2.1.1 Procurement of raw materials

Rice, soyabean and buckwheat were selected for the present study due to their gluten free properties. For carrying out the present study required samples like two varieties of rice namely, V<sub>1</sub> (*Bahadur*) was a non-waxy grain collected from local market of Jorhat town and V<sub>2</sub> (*Aghuni bora*) was a waxy grain collected from Regional Agricultural Research Station (RARS), Titabor, Jorhat. SoyafLOUR was procured from local market, buckwheat was collected from Gosaigaon, Krishi Vigyan Kendra (KVK), Kokrajhar. Other ingredients required for preparation of biscuits were bought from local market.

#### 2.1.2 Processing of rice varieties into flour

Rice were cleaned and soaked for 2 hours. After that water was drained off and soaked rice were dried for 1 hour in the sunlight. Rice flour was obtained by grinding it to fine powder in an electric grinder and sieved through 72 size sieve. The process of making rice flour is depicted in Fig.

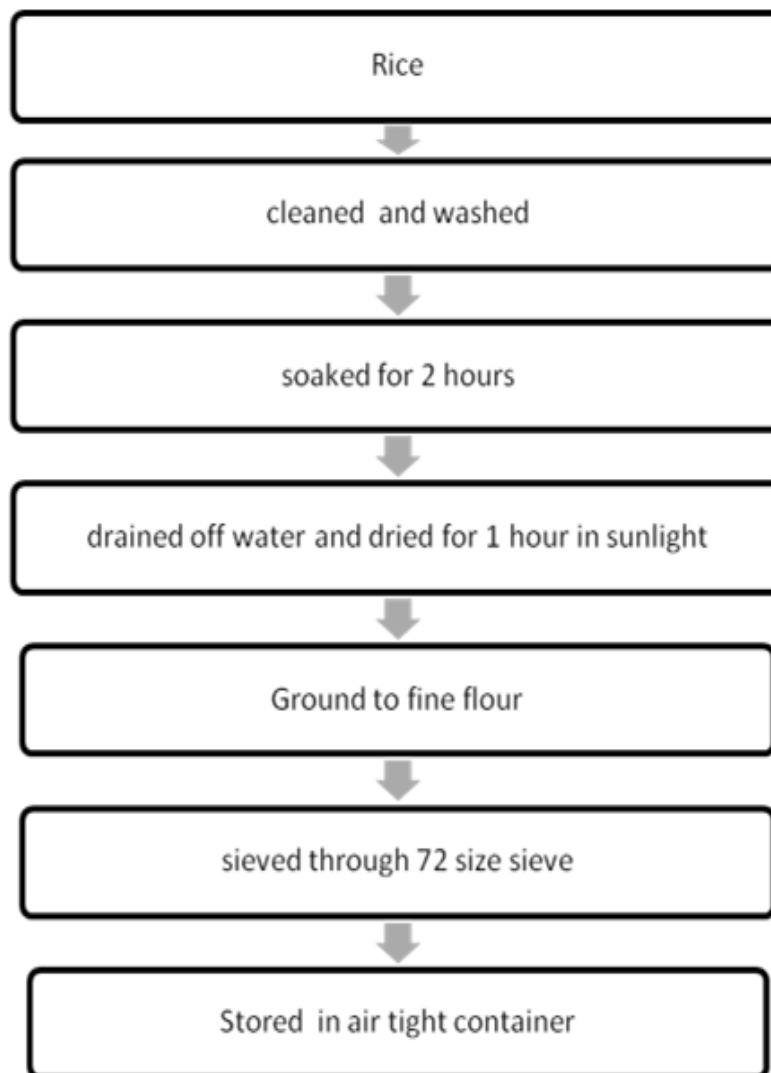


Fig 1: Flow diagram of processing rice varieties into flour

#### 2.1.3 Processing of buckwheat into flour

Buckwheat was cleaned and washed properly and dried in full sunlight for 2 days. After drying the grains were subjected to milling and winnowing was done for separating the kernels

from husk. Buckwheat flour was obtained by grinding it to a fine powder. The process of making buckwheat flour is depicted in Fig. 2.

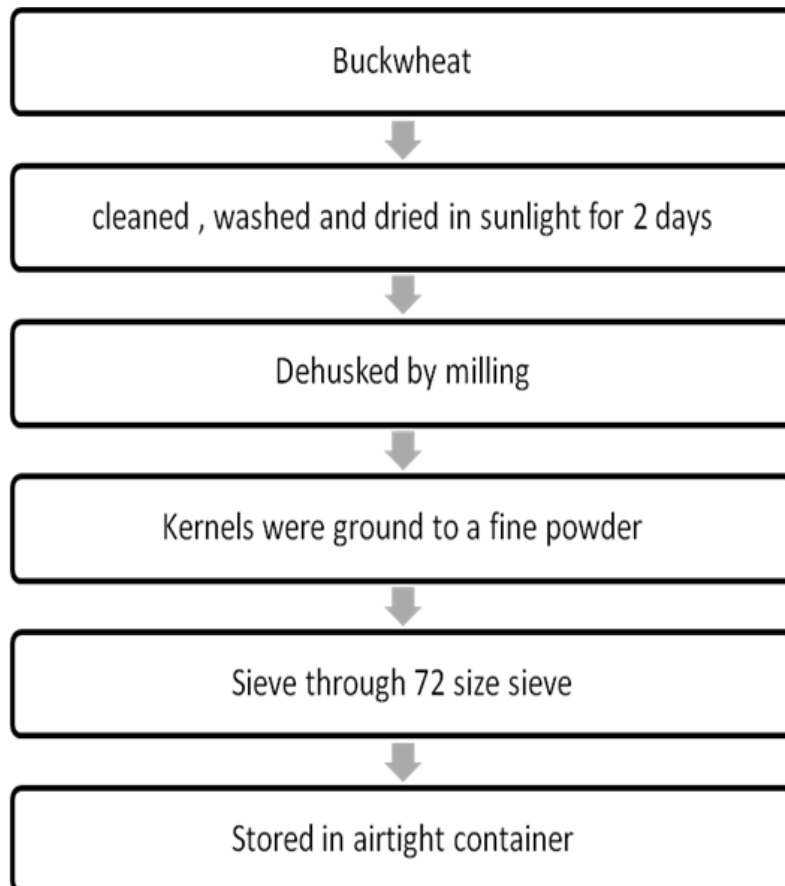


Fig 2: Flow diagram of processing buckwheat into flour

**2.2 Statistical analysis**

Data obtained from the sensory evaluation of biscuits were subjected to simple completely randomized design to determine differences between treatment means by using Microsoft excel (2007). The significance of treatment difference was tested by F-test at 5% probability level. The means were separated using the Duncan’s Multiple Range Test (DMRT) (Snedcor and Cochran, 1980). The standard error of differences (S.Ed ±) was calculated by using the following expression:

$$S.Ed \pm = \sqrt{\frac{\text{Error mean square} \times 2}{\text{No. of replication}}}$$

**3. Results and Discussion**

**3.1 Standardization and formulation of rice based biscuits**

Standardization of rice based biscuit was done with various trials. Two types of rice were experimented in three ways in the process of standardization of rice based biscuit with two variation in each method of preparation. Rheological behavior is important for handling of dough for product development. It is particularly important for biscuit making which requires pre baking steps like compression, flattening and sheeting or rolling. Rice is free from gluten thus absence of gluten makes the dough to be significantly less stretchable. Therefore, various trials were conducted to overcome those challenges.

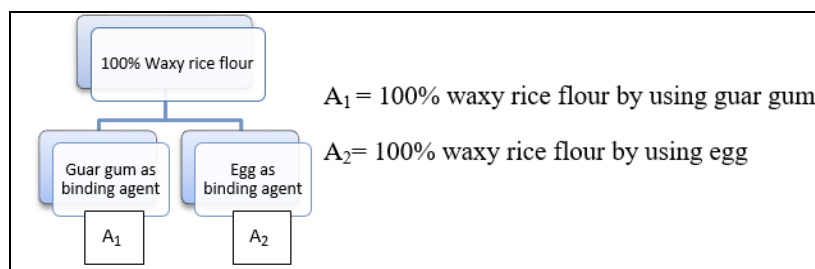


Fig 3: Flow Diagram for Conduction of Trial 1

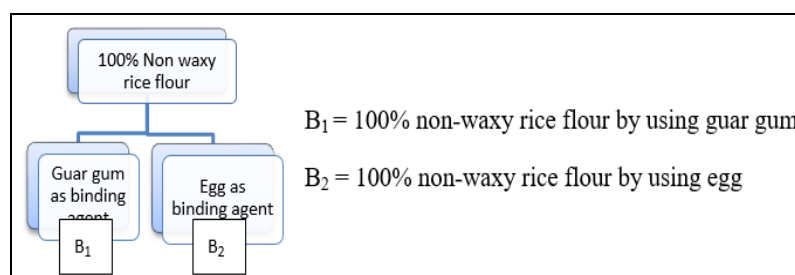


Fig 4: Flow diagram for conduction of trial 2

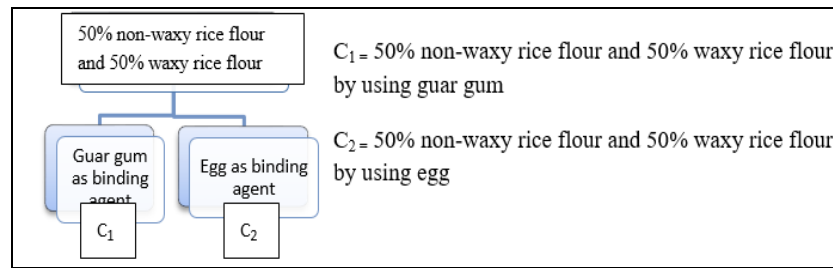


Fig 5: Flow diagram for conduction of trial 3

- First trial was done by preparing biscuit by using 100 per cent waxy rice with binding agent gum and egg separately. But both the biscuits were found very compact and hard in texture.
- Second trial was done by preparing biscuit using 100 per cent non-waxy rice with binding agent guar gum and egg. The biscuit prepared by using 30 per cent gum was found acceptable while biscuit made by using egg was not found acceptable in texture. It was observed that rice dough possess undesirable handling properties for preparation of biscuit.
- Third trial was conducted for development of biscuit by using 50 per cent non-waxy rice and 50 per cent waxy rice using 5 per cent gum and egg as binding agent

separately. Both the variations were found to be acceptable in every aspects. Out of two variations, biscuit prepared by using egg was selected for further study because egg is more nutritious and also act as both binding and emulsifying agent. Moreover, egg is also easily available in local markets.

It was expected that judicious combination of non-waxy and waxy rice with appropriate levels of binding agent can serve as a base for development rice dough that possess the desirable handling properties for preparation of biscuit.

The standardized products were evaluated for their acceptability through sensory evaluation by a set of 10 trained and semi-trained panels. The organoleptic scores of the members for different products trials is presented in Table 1.

Table 1: Mean sensory scores of trials of biscuits

Parameters	Trials							CD <sub>(0.05)</sub>	S.Ed
	A <sub>1</sub>	A <sub>2</sub>	B <sub>1</sub>	B <sub>2</sub>	C <sub>1</sub>	C <sub>2</sub>			
Appearance	6.40 <sup>c</sup>	6.40 <sup>c</sup>	6.20 <sup>c</sup>	5.00 <sup>c</sup>	6.60 <sup>b</sup>	7.00 <sup>a</sup>	0.63	1.2	
Colour	6.00 <sup>c</sup>	6.40 <sup>b</sup>	6.00 <sup>c</sup>	5.80 <sup>d</sup>	6.50 <sup>b</sup>	6.80 <sup>a</sup>	0.44	0.90	
Taste	5.20 <sup>c</sup>	5.40 <sup>c</sup>	4.40 <sup>c</sup>	5.40 <sup>c</sup>	6.60 <sup>b</sup>	8.80 <sup>a</sup>	0.58	1.19	
Texture	4.20 <sup>d</sup>	3.00 <sup>e</sup>	4.60 <sup>cd</sup>	5.40 <sup>c</sup>	6.80 <sup>b</sup>	9.00 <sup>a</sup>	0.86	1.77	
Aroma	5.00 <sup>e</sup>	5.80 <sup>c</sup>	5.60 <sup>c</sup>	5.40 <sup>d</sup>	6.40 <sup>b</sup>	6.80 <sup>a</sup>	0.42	0.86	
Overall acceptability	5.00 <sup>e</sup>	5.60 <sup>b</sup>	5.80 <sup>b</sup>	5.60 <sup>b</sup>	5.40 <sup>b</sup>	8.00 <sup>a</sup>	0.71	1.46	

Means in the same row with the different superscript are significantly different ( $p < 0.05$ )

From Table 1, data reveals that out of six rice based products, C<sub>2</sub> exhibits highest scores for all sensory attributes in terms of appearance (7.00), colour (6.80), taste (8.80), texture (9.00), aroma (6.80), over all acceptability (8.00). Statistically significant difference was observed among the samples at  $p < 0.05$ . Thus, considering above points, biscuit prepared by using a mixture of waxy and non-waxy rice with egg as a binding agent was selected for further study in formulation of gluten

free biscuit and was considered as control. Other gluten free flours were also added to enhance the nutritional quality of the developed product. The biscuit was formulated from flour mix prepared by mixing two varieties of rice flours, buckwheat flour and soya flour. For preparing of gluten free biscuit the flour mix was prepared in four different ratios of 60:10:20:10, 50:20:20:10, 40:30:20:10, 30:40:20:10 and were used to prepare 100gm flour mix for biscuit (Table: 2).

Table 2: Treatment description for formulation of rice based biscuits

Treatment	Non waxy rice flour %	Waxy rice flour %	Buckwheat flour %	Soya flour %
T <sub>1</sub> (control)	50	50	-	-
T <sub>2</sub>	60	10	20	10
T <sub>3</sub>	50	20	20	10
T <sub>4</sub>	40	30	20	10
T <sub>5</sub>	30	40	20	10

T<sub>1</sub> = 50:50, (NW: W)

T<sub>2</sub> = 60:10:20:10, (NW: W: BF: SF)

T<sub>3</sub> = 50:20:20:10, (NW: W: BF: SF)

T<sub>4</sub> = 40:30:20:10, (NW: W: BF: SF)

T<sub>5</sub> = 30:40:20:10, (NW: W: BF: SF)

NW= Non waxy rice, W= Waxy rice, BF= Buckwheat flour, SF= Soya flour

#### 4. Conclusion

Rice is important crop to cope up with ever increasing worldwide demands for gluten free foods. It is free from gluten and is the least allergenic. From this study, it can be concluded that rice flour may be gainfully utilized as a base ingredient with egg as a binding agent for preparing a biscuit.

All six rice based standardized products were found acceptable but out of all, C<sub>2</sub> exhibits highest scores for all sensory attributes. The Problems of dough handling and binding during baking can overcome by judicious combination of waxy and non-waxy rice varieties. Rice flour was found to be a good substitute for wheat flour.

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