



## **Studies on formulation of Gluten-free biscuits using *Moringa oleifera* leaf powder**

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### **ABSTRACT**

*Biscuit is a ready-to-eat, convenient and most popular baked product often made with wheat flour. Since people with gluten sensitivity (celiac disease) cannot consume wheat flour, the present study aimed to manufacture gluten-free biscuits. Considering the medicinal properties and high nutritional value of Moringa oleifera, the gluten-free biscuits were fortified with Moringa dehydrated leaf powder. Gluten free biscuits were prepared using various flours such as oat flour, rice flour, soy flour, butter, powdered sugar and milk. The four different formulations of MGFB were formulated using different concentrations of Moringa leaf powder i.e. 1.0% in MGFB1, 1.5% in MGFB2, 2.0 % in MGFB3 and 2.5% in MGFB4. The sensory analysis of different formulated biscuits showed that sample MGFB2 fortified with 2.0% moringa leaf powder was rated as good and acceptable. Proximate analysis of same sample revealed that the fortified biscuit contains 5.70%, 2.43%, 12.4%, 14.5%, 60.72% and 2.45 % percentages of moisture, ash, protein, fat, carbohydrates and fibre respectively. It was also found to contain good amount of calcium (13.7 %) and iron (16.2 %). Oats and soybeans are rich sources of dietary fibre, calcium, iron, proteins, carbohydrates and also have low glycemic index. Moringa is rich in vitamin C, vitamin B6 and fibre. The fortification of Gluten-free biscuits with various flours and Moringa leaf powder showed considerable changes in physiochemical properties of biscuits and resulted in enhanced nutritional quality. Such formulated product can function as the best option for the patients suffering from celiac disease.*

**Keywords:** *Gluten-free, Biscuits, Moringa, Glycemic index, Physico-chemical, Sensory, medicinal value.*

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### **INTRODUCTION**

Biscuit is one of the wheat flour-based products and is widely consumed due to low manufacturing cost and convenience [1]. However, the gluten in wheat flour limits its consumption, especially for people who suffer from gluten intolerance. Furthermore, wheat flour also has low fibre content. The recent trend has shown an increase in dietary fibre consumption and gluten-free products [2].

Celiac disease is a genetically predisposed autoimmune disorder resulting in damage to the small intestine lining due to consumption of gluten-containing product. Nowadays, there is a high demand for the development of food products that increase the availability of gluten-free food in order to attend an increasing demand. This constitutes an actual technological challenge with a wide possibility for investigation.

The moringa leaf powder is rich in protein, vitamins A, B and C, and a whole range of minerals. A 100g portion of fresh moringa leaf has 9.3g protein, 434mg calcium, 404mg potassium, 738µg vitamin A, and 164mg vitamin C [3]. The leaves have bioactive molecules which include carbohydrates, phenolic compounds, oils and fatty acids, proteins and functional peptides and have great potential to be used in several formulations of food products [4]. The leaves of the Moringa plant contain all amino acids, uncommon among plant sources, and a very high amount of unsaturated fatty acids including linoleic acid. Additionally, Moringa leaf is abundant in almost all vitamins, including vitamin A, vitamin B1 including folic acid, pyridoxine, and nicotinic acid, vitamin C, vitamin D, and vitamin E [5]. A study by Hasaballa et al. also reported that *Moringa* leaf contained the highest amount of calcium and iron compared to other parts. In addition, polyphenols present in Moringa also contribute to sensory qualities of natural foods derived from it. The purpose of this study is to develop value added gluten-free biscuits using oat flour, rice flour, soy flour, butter, powdered sugar and milk and their fortification with Moringa leaves.

## MATERIAL AND METHODS

The ingredients such as oat flour, rice flour, soy flour, butter, powdered sugar, milk and Moringa leaves were purchased from local market. The entire process was carried in Department of Food Technology at CNCVCW, Kolhapur.

### Preparation of Moringa Leave Powder:

Moringa leaves were purchased from the local market. They are cleaned well using distilled water and are separated from the stalks. Briefly explained, the freshly harvested moringa leaves were detached from the stalks, washed, slightly blanched and dehydrated in a tray drier at a temperature of 60°C, 3 hours. The dried leaves were reduced to powder in a grinder and sifted through a fine mesh to remove extraneous matters. The powder was packaged in air-tight HDPEbags and stored under room temperature for further use.

### Production of Moringa gluten-free biscuits (MGFB):

Various flours like oat flour, rice flour and soy flour were sieved together using a proper mesh sieve to obtain flour mix. Later flour mix is blended with moringa leave extract and was subdivided into various proportions. Other ingredients like butter, powdered sugar and milk were measured carefully and mixed well with the flour mixture to obtain required consistency. The dough was further kneaded for 5-10 mins to obtain a soft dough. The dough was divided into small portions and were flattened using rolling pin. The flattened sheets were cut into desired shapes were using cookie cutter. Biscuits were baked at 180°C for 20-25 minutes, allowed to cool and packed well in air-tight containers. The different formulations made were as follows:

**Table: 1 Composition of ingredients-**

| Ingredients             | Control | MGFB1 | MGFB2 | MGFB3 | MGFB4 |
|-------------------------|---------|-------|-------|-------|-------|
| Refined Wheat flour (g) | 100     | -     | -     | -     | -     |
| Oat flour (g)           | -       | 50    | 40    | 30    | 20    |
| Rice flour (g)          | -       | 30    | 30    | 30    | 30    |
| Soy flour (g)           | -       | 20    | 30    | 40    | 50    |
| Moringa leaf powder (g) | -       | 1.5   | 2.0   | 2.5   | 3.0   |
| Butter (g)              | 15      | 25    | 25    | 25    | 25    |
| Powdered sugar (g)      | 25      | 30    | 30    | 30    | 30    |
| Salt (g)                | 1       | 1     | 1     | 1     | 1     |
| Milk (ml)               | 5       | 10    | 10    | 10    | 10    |

\*MGFB1, MGFB2, MGFB3 and MGFB4 are gluten-free biscuits with different composition of ingredients.

### Sensory Evaluation:

The sensory evaluation of formulated gluten-free biscuits was performed by evaluating five major sensory attributes such as colour, flavour, taste, texture, and overall acceptability using nine-point hedonic rating scale (9 = like extremely, 1 = dislike extremely). Twenty-five members including staff members and students from the department were included in the panel of sensory evaluation of this study.

### Proximate Analysis:

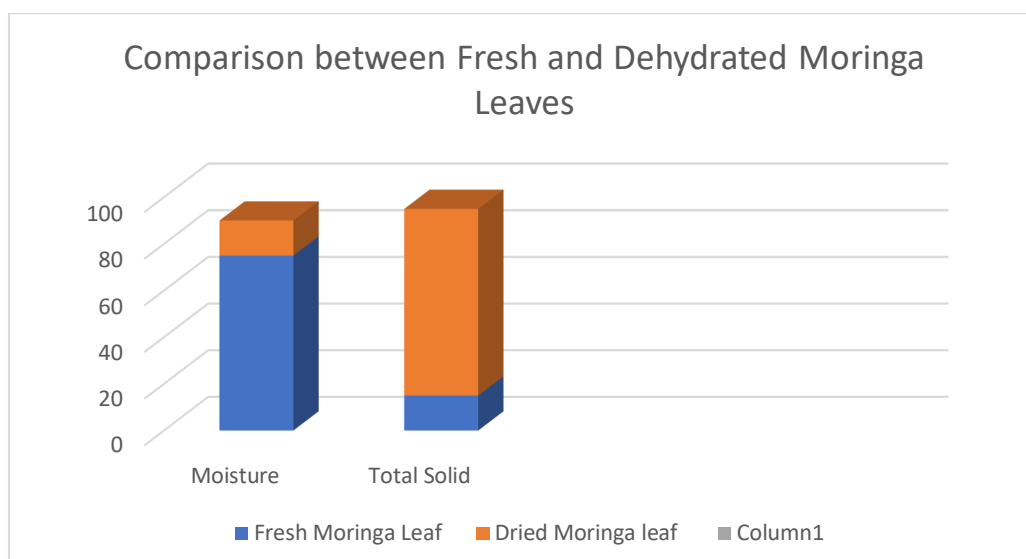
The formulated gluten-free biscuits were subjected for proximate analysis and the nutrient content was determined by the standard AOAC methods. The analysis was performed for the estimation of nutrient content in terms of carbohydrates, moisture, protein, crude fat, crude fibre, ash and energy.

Physical Properties: The weight (g), diameter(mm) and thickness(mm) of the formulated biscuits were evaluated. The spread ratio of biscuits was calculated as follows-

Spread ratio = Diameter (mm) of the biscuits / Thickness (mm) of the biscuits

## RESULTS AND DISCUSSION

The prime objective of incorporation of Moringa leaves in gluten-free biscuit preparation was to enhance the nutritional value of biscuits. Considering the perish ability of the fresh Moringa leaves, the moisture content of both fresh and dehydrated Moringa leaves were analysed. The use of fresh leaves in formulating gluten-free biscuits, due to their high moisture percentage would have decreased the shelf-life of the biscuits. Hence, dehydrated Moringa leave powder was used for the formulation of same.



**Figure 1: Graphical representation of Comparison between Fresh and Dehydrated Moringa Leaves**

The high nutritional content found in the dried leaves are important nutritional indicators indicating significant use of such plant in formulating many value-added products. The dehydration technology used in preparing the Moringa leaf powder aids in concentrating the important nutrients and also helps to conserve and consume through one or the other form of food. Similarly, the dried leaf powder can be stored for longer duration and the same being made available throughout the year.

#### **Proximate analysis of dehydrated *Moringa oleifera* leaves**

The proximate analysis of *Moringa oleifera* leaves showed that the leaves are rich source of protein, sugars, energy and minerals. The high ash content directly indicates high mineral content contained in the leaves. Along with the high protein content, Moringa leaves also shows significant amount of lipids i.e. 5.85%, which helps in increasing the palatability of foods prepared from Moringa by absorbing and retaining flavours.

**Table 2: Proximate composition of the petroleum ether extract of Moringa leaves**

| Sr. No. | Nutrient              | Estimated Values |
|---------|-----------------------|------------------|
| 1       | Moisture (g/100g)     | 16.5 ± 0.10      |
| 2       | Carbohydrate (g/100g) | 41.20 ± 0.04     |
| 3       | Protein (g/100g)      | 14.82 ± 0.15     |
| 4       | Crude fat (g/100g)    | 5.85 ± 0.24      |
| 5       | Crude fibre (g/100g)  | 10.97 ± 0.12     |
| 6       | Ash (g/100g)          | 12.86 ± 0.11     |
| 7       | Energy (kcal/100g)    | 275.52 ± 1.05    |

[Mean ± SD of three determinations]

#### **Sensory evaluation of Moringa fortified Gluten-free Biscuits**

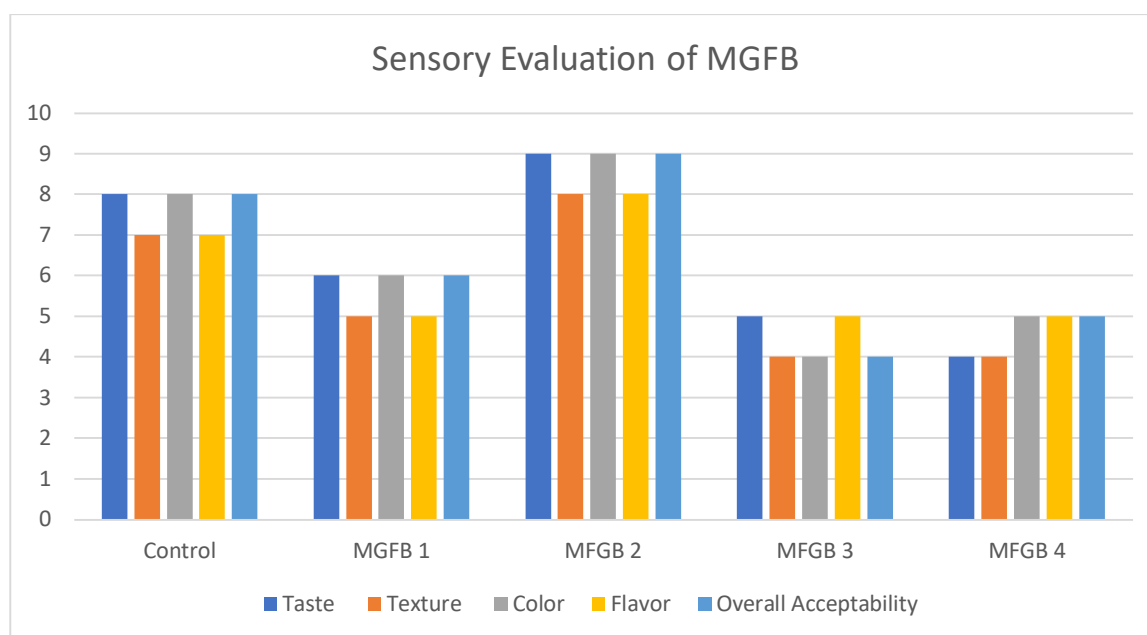
The organoleptic evaluation of the Refined wheat flour Biscuit (control) and Moringa leaf enriched Gluten-free Biscuit (MGFB) have been evaluated colour, flavour, taste, texture, and overall acceptability using nine-point hedonic rating scale (9 = like extremely, 1 = dislike extremely). The graph of sensory evaluation clearly indicates that the formulation MGFB2 was highly rated for acceptance than the control sample and the other formulations. The biscuits of MGFB2 formulation were good in terms of texture and colour, but slightly showed the bitter taste which was acceptable. The study also showed that increasing the percentage of Moringa leaf powder in the gluten-free biscuits decreases its consumer acceptance due to strong leafy flavor and bitterness in formulations.

#### **Proximate analysis of Moringa fortified Gluten-free Biscuits**

The Refined wheat flour Biscuit (control) and Gluten-free Biscuit formulated with Moringa leaf powder were analysed for proximate composition and the results are included below:

**Table No 3: Proximate analysis of Moringa fortified Gluten-free Biscuits**

| Nutrients            | Control  | MGFB1      | MGFB2       | MGFB3       | MGFB4      |
|----------------------|----------|------------|-------------|-------------|------------|
| Moisture (%)         | 12.32    | 8.25       | 5.70        | 7.42        | 9.29       |
| Carbohydrates (%)    | 56.43    | 65.38      | 60.72       | 59.23       | 60.11      |
| Protein (%)          | 10.87    | 11.65      | 12.48       | 12.89       | 11.42      |
| Crude fat (%)        | 12.24    | 13.02      | 14.59       | 13.69       | 13.42      |
| Crude fibre (%)      | 1.48     | 1.62       | 2.45        | 2.36        | 2.05       |
| Ash (%)              | 1.06     | 1.50       | 2.43        | 2.37        | 2.41       |
| Energy (kcal/100 gm) | 420 kcal | 425.3 kcal | 424.11 kcal | 411.69 kcal | 406.9 kcal |
| Calcium (%)          | 6.24     | 8.32       | 13.7        | 11.56       | 10.51      |
| Iron (%)             | 8.62     | 15.11      | 16.2        | 15.42       | 15.78      |
| Magnesium (%)        | 2.63     | 1.53       | 1.63        | 1.89        | 1.76       |

**Figure2: Graphical Representation of Sensory evaluation of MGFB**

The Gluten-free Biscuit formulated with Moringa leaf powder showed high percentage of carbohydrate, protein, fat and energy. The study showed that MGFB contains 5.7%, 2.43%, 12.48%, 14.5%, 60.72% and 2.45 % percentages of moisture, ash, protein, fat, carbohydrates and fibre respectively. It was also found to contain good amount of calcium (13.7 %) and iron (16.2 %). The results indicate that the formulated biscuits are highly nutritious and can form a good option for the celiac patients.

#### Physical analysis of MGFB

The physical characteristics (Weight, Thickness, Diameter and Spread ratio) of five biscuits are shown in Table 4. Results showed that there was significant difference between each sample. From the results it was noticed that the thickness of the composite biscuits displayed an increasing substitution level of soy flour.

**Table No 4: Physical analysis of MGFB**

| Samples | Weight (g) | Thickness (mm) | Diameter (mm) | Spread Ratio |
|---------|------------|----------------|---------------|--------------|
| Control | 10.11      | 5.7            | 40.2          | 7.02         |
| MGFB 1  | 10.45      | 5.5            | 40.3          | 7.32         |
| MGFB 2  | 10.26      | 5.6            | 40.1          | 7.16         |
| MGFB 3  | 10.23      | 5.6            | 40.2          | 7.17         |
| MGFB 4  | 10.36      | 5.7            | 40.2          | 7.05         |

#### CONCLUSION

In the present study concluded that the development of gluten free biscuits has high acceptances. The formulation Gluten-free Biscuit with moringa leaf powder showed enhanced nutrition content, texture, color and flavor. The incorporation of oat flour, rice flour, soy flour and dehydrated Moringa leaves

powder into biscuits had considerable changes in the physiochemical and sensorial properties of the biscuits. It is concluded from this study that flour mix (oat flour, rice flour, soy flour) and dehydrated Moringa leaves powder can be successfully incorporated in gluten-free biscuits to yield biscuits of enhanced nutritional quality with acceptable sensory attributes. Moringa has been reported to possess many medicinal properties and hence its inclusion in the value-added products as nutritional supplements or in the process of fortification of foods is highly promising.

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