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FORMULATION OF VALUE-ADDED MILLET-BASED ALTERNATIVE TO BREAKFAST CEREAL FOR COELIAC DISEASE MANAGEMENT

Priya Dharshini .T, **Ms. Sneha. S,** **Dr. Prathibha. P.S**
PG Scholar **Assistant Professor** **Program Head**
Department of Food Science, Nutrition and Dietetics
Dr. M.G.R. Educational and Research Institute, University, Chennai, India.

ABSTRACT

The demand for gluten-free food products is increasing due to the rise in celiac disease cases and growing awareness of gluten-free food in the management of such disease conditions. The gluten-free diet is a complicated and expensive one, and might also result in deficiency of certain nutrients. The development of gluten-free products is a significant challenge for manufacturers who aim to create baked goods with a similar composition to their gluten-containing counterparts. This study focused on developing a gluten-free Ready to Eat (RTE) breakfast millet by adding a standardized proportion of finger millet and sweet potato flour. The value-added ingredient used in this study is *senna auriculata* which has numerous health benefits, including antioxidant, anti-inflammatory, and antibacterial properties. Organoleptic evaluation of the two-finger millet-based breakfast cereal formulations was undertaken based on sensory characteristics such as appearance, taste, flavor, texture, and overall acceptability. Two variants named sample A and sample B were developed by incorporating finger millets each at, 60% and 50% respectively. The sample A was highly acceptable. Based on the findings of this study, it is evident that the product garnered high levels of acceptance across various parameters such as its visual appeal, taste, aroma, flavor, and texture. These results suggest a promising market potential among consumers interested in acquiring such products. This breakfast millet could offer substantial advantages for individuals affected with coeliac disease and gluten sensitivity due to its health-promoting attributes and nutritional composition.

Keywords: Coeliac Disease, Gluten-free, Breakfast cereal, Finger millet, Sweet potato, Senna flower.

1. INTRODUCTION

Coeliac disease is an autoimmune disorder triggered by ingesting gluten found in wheat, barley, and rye. It damages the small intestine's lining, causing bloating, diarrhea, exhaustion, and weight loss. If left untreated, it can lead to malnourishment, osteoporosis, infertility, and an increased risk of developing certain cancers. A gluten-free diet is the main treatment to relieve symptoms and promote intestinal healing. Awareness is important for managing this condition (Catassi, C., et al, 2022). The prevalence of celiac disease in India is known to vary and it might be higher than what was previously estimated. Prevalence rates range from 0.2% to 1.04%, with certain populations having higher rates (Makharia, G. K., et al, 2022). One percent of people worldwide suffer from celiac disease. Prevalence rates vary based on dietary preferences, genetics, and geographical differences (Singh, P., et al, 2018).

One common protein present in wheat, barley, and rye is gluten. For certain individuals who are sensitive to it, it might lead to inflammation and intestinal issues. The gluten-sensitive people should avoid foods that contain gluten, including certain prescription medications. Symptoms of gluten intolerance can cause symptoms such as bloating, flatulence, and fatigue. Gluten sensitivity refers to adverse reactions caused by the consumption of gluten or other cereal components (Cabanillas, B., et al, 2020). Celiac disease is an autoimmune response that is caused by a genetic defect, while gluten sensitivity can lead to inflammation (Woomer, J. S., et al, 2021).

A gluten-free diet may assist with symptoms, but planning your meals carefully is important. T cells release cytokines that can hinder nutrient absorption, and HLA-DQ2 and HLA-DQ8 genes increase susceptibility (Aboulaghras, S., et al. 2022). Millets are an excellent gluten-free grain option that provides essential nutrients, supports digestive health, and has a lower glycemic index than wheat. The gluten-free diet (GFD) is popular but expensive and can lead to dietary inadequacies and social obstacles. It requires eliminating all gluten-containing items from the diet, including gluten proteins found in cereals. People on the GFD should eat other healthy food sources such as fruits, vegetables, fish, meat, and gluten-free products. The gluten-free diet is primarily used to treat celiac disease, but it has become popular beyond its medical use. (Simón, E., et al, 2023).

Finger millet *(Eleusine coracana. L*), also known as ragi, is a grain that is free from gluten and suitable for vegans. It is one of the important millets grown in various parts of India (Ambre, P. K ., et al, 2020). It is a great source of carbohydrates, protein, and fiber, and is rich in micronutrients, especially calcium. Finger millet is a low-glycemic, gluten-free grain with nutritional and nutraceutical benefits. It is a popular grain in many households in Sri Lanka and India. The market demand for gluten-free is increasing due to frequent incidences of celiac disease and increasing awareness of gluten-free foods Millets are gluten-free and rich in nutrients. Finger millet is the most common variety. Processing and production of gluten-free ready-to-eat foods and nutritional supplements have increased their market value (Selladurai, M., et al, 2023).

Sweet potato flour *(Ipomoea batatas*) is a gluten-free source of protein, starches, and other carbohydrates. The tubers come in different colors and produce gluten-free food products. Sweet potato varieties have been utilized to create a range of value-added products that can help combat vitamin A deficiency (Namrata Ankush Giri, et al, 2021). Moreover, sweet potato roots are rich in β-carotene, phenolic compounds, dietary fiber, B vitamins (B1, B2, B3, B5, and B6), and minerals (iron, calcium, magnesium, manganese, and calcium). The gluten-free diet may be deficient in vitamin B6, especially if it excludes all gluten-containing grains. Consuming foods rich in vitamin B6 may help alleviate depression associated with celiac disease. Sweet potatoes contain bioactive phytochemicals such as polyphenols with anti-inflammatory and anticancer properties. Sweet potato powder can be used in baking, reducing dependence on wheat for non-wheat-producing nations (Ayo-Omogie, H. N., et al, 2021).

Medicinal plants are important in developing countries where modern medicines are expensive (Sahoo, J., et al, 2020). Senna flower powder (*Cassia angustifolia)* is a value-added ingredient with numerous health benefits, including antioxidant, anti-inflammatory, and antibacterial properties. Due to specific ingredients and production methods, gluten-free breakfast cereals are usually more expensive than ordinary cereal. Prices may vary based on the brand and variety of cereal. Breakfast cereals are typically made through extrusion, but this product is made using a baking method, making it cost-effective. In this study, instead of using white sugar, we have employed palm jaggery, which improves digestion, boosts immunity, and prevents anemia. It's rich in zinc, potassium, and iron, which helps the body fight against diseases and maintain hemoglobin levels (Upadhyaya, A., et al, 2023). This study highlights the development of gluten-free breakfast millet with value-added ingredients for coeliac disease management.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Raw materials

For the preparation of gluten-free breakfast millet, raw materials such as finger millet flour, sweet potato flour, senna flower powder, palm jaggery, cocoa powder, cow milk, and butter were procured from the local supermarket, in Chennai.

2.2 Methodology

2.2.1 Standardization of gluten-free millet-based breakfast cereal

All the ingredients, including finger millet flour, sweet potato flour, senna flower powder, palm jaggery, cocoa powder, cow milk, and butter, were measured according to the formulation given below. The butter and palm jaggery were mixed well, and then the dry ingredients (finger millet flour, sweet potato flour, senna flower powder, and cocoa powder) were added and kneaded to form a dough. Next, the dough was flattened with a rolling pin and cut into the desired shapes. The shaped cereal was then arranged on a tray and baked in a deck oven at 165°C for 10-15 minutes. Finally, the cereal was left to cool and weighed to determine the final product weight. Two variations of the breakfast millet were prepared to find out the most acceptable proportions of finger millet and sweet potato flour.

Table 1. Formulation of Breakfast Cereal

Ingredients	Sample A	Sample B
Finger millet	60	40
Sweet potato flour	50	50
Palm jaggery	50	50
Senna flower power	2	2
Butter	10	10
Cocoa powder	10	10
Milk	60	60

2.2.2 Flow of work

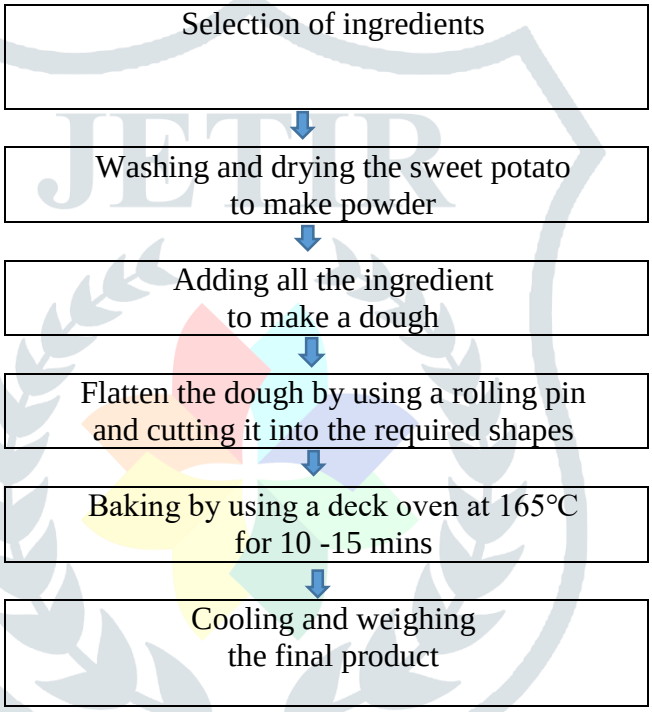


Figure 1. Sample A

Figure 2. Sample B

2.2.3 Sensory analysis

The sensory evaluation of samples was done by a group of 50 members including academicians, students, and consumers. Each member rated the two variations of breakfast millet using a 5-point Hedonic Scale based on appearance, taste, aroma, texture, and overall acceptability. The exclusion criteria for sensory analysis include individuals with impaired taste and olfactory abilities.

2.2.4 Statistical analysis

The data obtained through a sensory analysis were analyzed using descriptive statistics – mean and standard deviation.

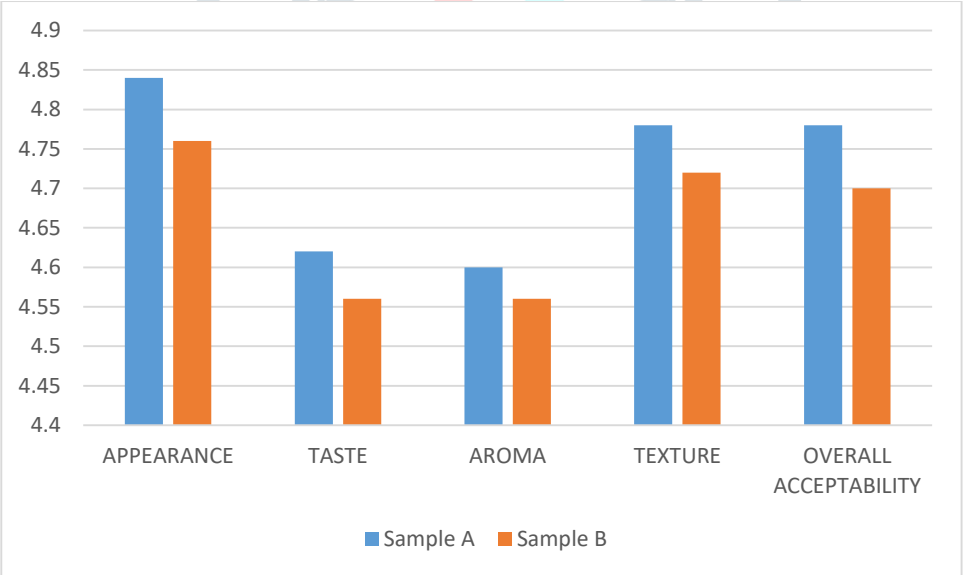
3. RESULT AND DISCUSSION

3.1 Organoleptic characteristic of breakfast millet

Organoleptic evaluation of the finger millet-based breakfast cereal formulations was undertaken based on sensory characteristics such as color, flavor, texture, taste, and overall acceptability. Two variants named sample A and sample B were developed by incorporating finger millets each at, 60% and 50% respectively. Acceptability evaluation scores of millet-based breakfast cereal (Table 2) reveal that sample A was most acceptable with an overall acceptability score of 4.78±0.64 followed by sample B (4.7±0.58). In terms of appearance, sample A was most preferred (4.84±0.37) followed by sample B (4.84±0.37). The texture of sample A was given the rank one by the assessors. The product had good texture (4.78±0.64) and contained baked cereal flavor (4.62±0.69) which was a desirable property. The breakfast cereal induces a desirable aroma (4.6±0.59) and gluten-free products based on them are highly acceptable. Since the A sample was highly acceptable as compared to the B sample thus, this variant was used as a standardized product. This indicates that Sample A is well accepted. The result findings for appearance, taste, aroma, texture, and overall acceptability of Sample B were significantly lower when compared with sample A. In this study, the millet-based breakfast cereal justified its suitability based on the highest organoleptic score for appearance, taste, aroma, flavor, texture, and overall acceptability.

Table 2. Organoleptic Characteristics of Breakfast Millet

Sample	Appearance	Taste	Aroma	Texture	Overall Acceptability
Sample A	4.84±0.37	4.62±0.69	4.6±0.59	4.78±0.64	4.78±0.64
Sample B	4.84±0.37	4.56±0.57	4.56±0.61	4.72±0.49	4.7±0.58



Graph 1. Results of Sensory Analysis of Breakfast Millet

4. CONCLUSION

From this study, it can be concluded that the product was highly acceptable in terms of its appearance, taste, aroma, flavor, and texture. This indicates that there is a potential market for consumers who would be interested in purchasing these products. The product is a great choice for a refreshing breakfast millet and is particularly beneficial for people with coeliac disease and gluten sensitivity, as it provides health benefits and nutritional properties. The breakfast millet formulated in this study is a great value-added alternative to traditional breakfast cereals that contains finger millet, sweet potato flour, and senna flower powder and is gluten-free, making it ideal for people with coeliac disease. Additionally, it provides another gluten-free option for people who are intolerant to gluten, who often have limited choices. This type of research is crucial because coeliac disease patients rely on products like these for their diets. Nutritional deficiencies have been reported for coeliac disease patients, and it is important to ensure that the nutritional quality of gluten-free products is not compromised.

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REFERENCES

1. Catassi, C., Verdu, E. F., Bai, J. C., & Lionetti, E. (2022). Coeliac disease. *The Lancet*, *399*(10344), 2413-2426.
2. Makharia, G. K., Chauhan, A., Singh, P., & Ahuja, V. (2022). Epidemiology of coeliac disease. *Alimentary Pharmacology & Therapeutics*, *56*, S3-S17.
3. Singh, P., Arora, A., Strand, T. A., Leffler, D. A., Catassi, C., Green, P. H., ... & Makharia, G. K. (2018). Global prevalence of celiac disease: systematic review and meta-analysis. *Clinical gastroenterology and hepatology*, *16*(6), 823-836.
4. Cabanillas, B. (2020). Gluten-related disorders: Celiac disease, wheat allergy, and nonceliac gluten sensitivity. *Critical reviews in food science and nutrition*, *60*(15), 2606-2621.
5. Woomer, J. S., & Adedeji, A. A. (2021). Current applications of gluten-free grains–a review. *Critical reviews in food science and nutrition*, *61*(1), 14-24.
6. Aboulaghras, S., Piancatelli, D., Oumhani, K., Balahbib, A., Bouyahya, A., & Taghzouti, K. (2022). Pathophysiology and immunogenetics of celiac disease. *Clinica Chimica Acta*, *528*, 74-83.
7. Simón, E., Molero-Luis, M., Fueyo-Díaz, R., Costas-Batlle, C., Crespo-Escobar, P., & Montoro-Huguet, M. A. (2023). The Gluten-Free Diet for Celiac Disease: Critical Insights to Better Understand Clinical Outcomes. *Nutrients*, *15*(18), 4013.
8. Ambre, P. K., Sawant, A. A., & Sawant, P. S. (2020). Processing and value addition: A finger millet review. *Journal of Pharmacognosy and Phytochemistry*, *9*(2), 375-380.
9. Selladurai, M., Pulivarthi, M. K., Raj, A. S., Iftikhar, M., Prasad, P. V., & Siliveru, K. (2023). Considerations for gluten-free foods-pearl and finger millet processing and market demand. *Grain & Oil Science and Technology*, *6*(2), 59-70.
10. Giri, N. A., & Sakhale, B. K. (2021). Effects of incorporation of orange-fleshed sweet potato flour on physicochemical, nutritional, functional, microbial, and sensory characteristics of gluten-free cookies. *Journal of Food Processing and Preservation*, *45*(4), e15324.
11. Ayo-Omogie, H. N. (2021). Gluten-Reduced sweet Potato-Wheat bread: Influence of fermented sweet potato flour addition on bread quality and dough rheology. *Journal of Culinary Science & Technology*, *19*(3), 187-213.
12. Sahoo, J., Kamalaja, T., Devi, S. S., & Sreedevi, P. (2020). Nutritional composition of cassia auriculata flower powder. *Journal of Pharmacognosy and Phytochemistry*, *9*(5), 867-870.
13. Upadhyaya, A., Bhalerao, P. P., Bhushette, P., Dabade, A., & Sonawane, S. K. (2023). Optimization study of palm jaggery and palm candy production and process. *Applied Food Research*, *3*(1), 100269.