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Product development with the enrichment of fenugreek seeds for celiac disease (CD)

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Abstract

Celiac disease (CD) is an autoimmune disorder in which the inability to digest cereals protein gluten. Patients may suffer from malabsorption diarrhea, abdominal pain, anemia, osteoporosis, and failure to thrive. Either CD is a genetic disorder but diet could play an important role to control from pathogenic symptoms. The susceptible person's slow growth rate, it also affects the productive life and also produces low immunity. The present study aimed to develop a gluten-free diet for celiac disease and analyses the acceptability by hedonic rating scale at 9 point scale, like extremely to dislike extremely. The study has done with the enrichment of fenugreek seeds to the preparation of fermented food Idli for celiac patients. Idli batter is prepared by soaking raw milled rice and decorticated black gram for 4 hour at 30 ± 1 °C in water. The soaked mass was ground using a mixer grinder with adequate amount of water. Fenugreek seeds contain protein, with the mixing of other pulses the quality of proteins enhances. Fenugreek seeds also contain mucilaginous fiber which is good for health promotion growth, improves immunity.

Keywords: Celiac disease (CD), genetic disorder, malabsorption, gluten, mucilaginous fiber, immunity

Introduction

This research study focuses on the contemporary approaches that are used to increase nutrient and bioactive compound contents of gluten-free Idli (GFI) and highlights the use of nutrient-dense alternative raw materials, nutritional and functional ingredients, and their combinations. In this study evaluation of the sensory and nutritional properties was done. The gluten-free products can be fortified with health-promoting active ingredients to produce based functional food. The viability of the active ingredients such as probiotics in the final products should be sufficient to confer beneficial influence on consumer health. However, for the fermenting process, it is there are certain other nutrients and vitamins are also activated. This research aims to focus on recent advances and challenges in the development of fermented products. Traditionally, Idli preparation is as follows: i) rice and black gram were soaked separately, ii) after draining the water, rice and black gram were grind separately with occasional addition of water during grinding process, iii) the rice and black gram batters were then mixed together with addition of a little salt, iv) the mixture was allowed to ferment overnight at room temperature, v) the fermented batter was dispensed in special Idli pans and allowed for steaming for 5–8 min (Balasubramaniam *et al.*, 2006) [5]. There are many changes, reported during fermentation include an increase in free sugar, non-protein nitrogen (Desikachar *et al.*, 1962) [6], free nicotinic acid (Rajalakshmi *et al.*, 1964) [7], methionine and choline in Idli (Doughty, 1964) and a breakdown of phytate occurs in bread dough (Davidson *et al.*, 1963) and of trypsin inhibitors in certain fermented legume preparations (Aykroyd, 1963) [9]. These changes during fermentation are highly significant for nutritional point of view. An increase in methionine, a limiting essential amino acid in legumes, greatly improves protein value. The vitamins content of Idli batter per 100 g are 0.59 mg riboflavin, 0.59 mg thiamine and 0.76 mg folic acid.

Green gram

Moisture 10.1, Energy- 348, CHO-59.9, Protein-24.5 Fat-1.2 Minerals- 3.5, Fibre-0.8, Calcium-75, Iron-8.5, Thiamin- 0.72, Riboflavin-0.15 Niacin- 2.4 Vit- A 49 (Sumati *et al.*, 2007) [4].

Black gram

Moisture- 10.9, Energy- 347, CHO- 59.6, Protein- 24.0, Fat- 1.4 Minerals- 3.2, Fibre-0.9, Calcium-154, Iron-9.1, Thiamin-0.42, Riboflavin- 0.37, Niacin- 2.0, Vit.A - 38 (Sumati *et al.*, 2007) [4].

Raw, milled Rice

Moisture- 13.7, Energy- 345, CHO-78.2, Protein-6.8, Fat- 0.5 Minerals-0.6, Fibre- 0.2, Calcium- 10, Iron- 3.1, Thiamin 0.06, Riboflavin- 0.06, Niacin- 1.9 (Sumati *et al.*, 2007) [4].

Fenugreek seeds

It is used as an appetizer, a tonic and an aphrodisiac, and it is included in many foods and beverages. Fenugreek has a long history of dubious indications, including fevers, colic, flatulence, dyspepsia, dysentery, cough, tuberculosis, edema, rickets, leg ulcers, gout, diabetes and baldness. The chemical trigonelline is converted into niacin when the seed is roasted. The seeds also provide a mucilaginous fiber content that may benefit the bowel. Of more current interest is the evidence that fenugreek has a minor hypoglycemic effect, thus suggesting it may, in fact, help with diabetes. There is also some evidence that it can reduce hypercholesterolemia in animals (Bentley *et al.* 1880) [3]. Fenugreek seeds provide 1,350 kilojoules (323 kcal) of food energy and contain 9% water, 58% carbohydrates, 23% protein and 6% fat, with calcium at 40% of the Daily Value (USFDA, 2017).

Materials and Methods**Procurement of raw materials**

The raw materials selected for this study were raw, milled rice (*Oryza sativa*), decorticated black gram (*Vigna mungo*) and decorticated green gram (*Vigna radiate*), fenugreek seeds (*Trigonella foenum-graecum*) and salt that were procured from a local market.

Standardization of recipe: rice and decorticated black gram taken 100:40 for the control sample, the second sample contains 5%, the third sample 10% and the fourth one was 15% level standardization of raw materials with fenugreek seeds.

- **Preparation of Idli product:** raw materials taken in given proportions, clean, wash and soak for overnight. Drains the water from it grind in mixer grinder make a smooth Idli batter. Add salt and mix properly then put it on Idli stand for steaming for 8- 12 minutes.
- **Sensory evaluation of Idli by hedonic rating scale and organoleptic taste:** Admixture of 15% of fenugreek seeds and 20% green gram dal was more acceptable.

Detail of treatments and symbols used in the experiment**Table 1.**

Treatment standardization of Idli mix	Symbol
100:40	T ₀
100:20:10:5	T ₁
100:20:15:10	T ₂
100:20:20:15	T ₃

Statistical analysis

Table:-Mean \pm SD of characteristics of the sample (Sample T₀, T₁, T₂, T₃)

Table 2.

	T ₀	T ₁	T ₂	T ₃
Characteristics	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
Colour	2.6 \pm 0.49	5.2 \pm 0.46	3.0 \pm 0.50	3.2 \pm 0.68
Flavor	2.8 \pm 0.57	3.2 \pm 0.78	3.2 \pm 0.78	3.2 \pm 0.79
Texture	2.8 \pm 0.42	2.9 \pm 0.72	3.1 \pm 0.64	2.8 \pm 0.68
Taste	2.8 \pm 0.52	3.2 \pm 0.59	3.2 \pm 0.70	3.2 \pm 0.96
Overall	2.8 \pm 0.7	2.8 \pm 0.64	2.9 \pm 0.60	3.06 \pm 0.59

Discussion

For the preparation of Idli, each batch 100-gram rice was soaked and change the proportion of fenugreek seed (T₀:T₁:T₂:T₃ is 5:10:15 and T₀ is the control sample) the all these ingredient ground in a domestic mixture grinder and prepared in paste form. Fermentation required a minimum of 4 hours. Except for the control sample, added decorticated green gram dal and black gram dal, fenugreek seed and rice in changed proportion (these samples are T₁, T₂, and T₃ respectively). In the present research study three sets of treatment samples as above but the following modification, were subjected to sensory evaluation.

In all the four samples organoleptic score of all the parameter viz. Colour, flavor, texture, appearance, and acceptability show at the approximately same score with the added fenugreek seed but the overall more acceptable sample in three incorporated samples was T₃ sample. Admixture containing fenugreek seed with Moog shows a remarkably high score overall with a control sample it also confirmed by statistical analysis and evaluation of mean and standard error. The study was brings forth a highly significant conclusion that the present study 15 gram fenugreek seed Idli was more acceptable. Based on color sample A was attractive based on flavor and taste all the sample was the same. Based on texture sample C was more acceptable. Overall acceptability of four samples, sample A was more acceptable because it is controlled but in three variations of the sample, sample D was more acceptable.

Summary and Conclusion

The research study was an attempt to explore the possibility of preparing a gluten-free fermented product. The work was designed to produce gluten-free product preparing different samples of Idli by adding modified or so-called standardized fenugreek seeds and green gram dal in different proportion, preparing a product with the addition of two different types of dal and fenugreek seeds in different proportion and evaluation of sensory properties.

For studying the extent of replacement of the standardized fenugreek seed with green gram dal three different admixtures containing 5%,10%,15% fenugreek seeds, and 10%,15%,20% of green gram dal along with 100% of rice and 20% of urad dal. These were symbolized as T₁, T₂, and T₃. And one controls T₀ respectively. Based on the color sample A was attractive. Based on flavor and taste all the samples were the same along with added T₀. Based on texture sample C was more acceptable. Overall acceptability of four samples, sample A was more acceptable because it is controlled but in three variations of the sample, sample D was more acceptable. Based on observation made in the present study following conclusion may be drawn-

1. Gluten-free product Idli standardized with fenugreek seeds and green gram dal is protein-rich.

2. The admixture of 15% of fenugreek seeds and 20% green gram dal was more acceptable.
3. Approximately the same score in T1 and T2 samples in organoleptic evaluation.
4. Based on a significant difference without the addition of T0 all three samples are not different at the 1% level and a 5% level.
5. With the addition of the control sample there is a significant difference between all four samples at 1% level and 5% level.

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