

NUTRACEUTICAL POTENTIAL OF *VERMICELLI* PREPARED BY GLUTEN-FREE COMPOSITE FLOUR

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ABSTRACT

Objective: Nutritional, phytochemical and antioxidant properties of all ratios of gluten free composite flour-based *Vermicelli* was evaluated in this study. The blend of proso millet flour (PF), adzuki bean flour (AF) and basil seeds flour (BF) was used in composite flour.

Methods: The variations of three composite flours were prepared as, A being (PF: AF: BF=50:45:5), B being (PF: AF: BF=60:35:5) and C being (PF: AF: BF=70:25:5), respectively. The macronutrients like moisture, ash, fat, fiber, protein and carbohydrate were assessed in this study. Minerals such as calcium, iron, phosphorus and zinc were analyzed in micronutrients.

Results: The result of macronutrient and micronutrient of a ratio were moisture (5.2 ± 0.1), ash (2.1 ± 0.2), protein (13.0 ± 0.0), fat (1.6 ± 0.0), fiber (3.0 ± 0.0) and carbohydrate ($60.0\pm 0.2\text{g}/100\text{g}$) respectively. Calcium (150.0 ± 0.3), iron (3.5 ± 0.1), zinc (2.0 ± 0.3) and phosphorus ($250.6\pm 0.6\text{mg}/100\text{g}$) were also there in gluten-free *Pasta*. The current study revealed that various macro and micronutrients were present in gluten-free *Vermicelli*. In the prepared products, flavonoids, saponins, tannin, glycosides, alkaloids and steroids are the few phytochemicals present. The study results also show that gluten-free *Vermicelli* has good antioxidant activity. In the A ratio, overall, all nutrients are found. It was found by the sensory evaluation *Vermicelli* on a 9 point hedonic scale that A ratio was more acceptable than the B and C ratio.

Conclusion: Therefore, it can be useful for celiac diseases as well as patients suffering from diseases like hypertension, anemia and diabetes.

Keywords: Composite flour, Chemical composition, Gluten-free *Vermicelli*, Antioxidant activity, Nutraceutical

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INTRODUCTION

Worldwide, genetically vulnerable individuals are affected by lifetime autoimmune disease in the small intestine, known as celiac disease or gluten intolerance. It is one of the most widespread diseases prevailing these days. This disease can be caused by both environmental (gluten) and genetic (HLA and non-HLA genes) factors [1]. The main problem occurs in this disease is the damage of the villi of the small intestine as the result absorption of nutrients from food is also hindered. A hundred percent gluten-free diet is the only existing treatment for celiac today as there is no pharmaceutical cure for celiac disease. So, it is essential to build up gluten-free foods that are consumer-acceptable. There is an increased require for gluten-free products like bakery and extruded items all over the world because of the larger awareness of celiac disease [2]. So, basically, composite flour is used to involve gluten-free products in the market. Composite flour is a combination of wheat and non-wheat flours. These non-wheat flours can be made out of cereals, roots, tubers, legumes, or other raw materials. Traditional products like chakli or new products like muffins can be made from this composite flour. Composite flours have been broadly used in the preparation of baked and other kinds of products due to their organoleptic acceptability and functional roles of flour components [3].

Vermicelli is a well-liked instant food product made up from wheat flour which comes under the type of extruded product. It is a snack food item liked by people from all walks of life, irrespective of age. Better awareness about health preference for instant food items like vermicelli has become very popular with changing lifestyle. However, gluten-free vermicelli is significant for people who have celiac disease and also for people who are interested in gluten-free products. Proso millet, adzuki beans and basil seeds are carefully selected for the present study. The nutritional or functional attribute of the product developed is determined by it. Proso millet contains all macro and micronutrients in substantial amounts as well as contains all essential amino acids. Adzuki beans pass on many

functional properties such as water and oil absorption capacity in the composite flour [4]. Basil seed flour was found to be very useful in terms of flavor, crispiness and texture [5]. Thus, as a result, composite flour-based baked products will have a good physical appearance and texture.

Thus, the main objective of the research is to evaluate prepared vermicelli with composite flour for its proximate composition, phytochemical and antioxidant activity that can further direct research towards its applications for gluten-free food product development in the market.

MATERIALS AND METHODS

Collection of plant material

The seeds were obtained from the local market of Delhi, India. The seeds were dried at 100 °C in an oven for half an hour. The dried sample of seeds was milled with a mechanical blender and stored in air-tight containers in a refrigerator for further analysis.

Determination of proximate composition

Cupcakes flour was taken in a clean, dry and weighed crucible. It was oven-dried later on at 110 °C. It was weighed repeatedly until a constant weight was acquired. The crucible was cool down in desiccators every time before weighing. Proximate analysis included the estimation of moisture ash, fat, protein, crude fiber and carbohydrate of seeds. Total ash was estimated by weighing the furnace in incinerated residue at 550 °C for 12 h. Protein was analyzed by using micro-Kjeldahl distillation method. Carbohydrate content was determined by the difference method.

Determination of minerals

Chemical estimations were carried out for determining calcium (Ca), iron (Fe) and zinc (Zn). The estimation of Ca, Fe, P, and Zn was done by using atomic absorption spectrophotometer (AAS) (model VGP 210, Buck Scientific, USA).

Phytochemical and antioxidant screening

The cupcake flour was screened for phytochemicals (flavonoids, saponins, tannin, glycosides and steroids) according to the procedure as described by (Tiwari *et al.*, 2011; Boakye *et al.*, 2015). Antioxidant analysis was done on DPPH (diphenylpicrylhydrazyl) activity, FRAP (ferric reducing ability of plasma) and nitric oxide scavenging activity [6-10].

Results and discussion

Macronutrients

Proso millet flour, adzuki beans flour and basil seeds flour were used to prepare gluten-free composite flour. Moisture, ash, protein, fat, fiber and carbohydrate content were then evaluated for gluten-free vermicelli. The chemical composition of vermicelli with

different ratios is presented in table 1. The variant C has the highest content of composite flour after standard. The reason for the same is that Proso millet has a high amount of moisture when compared with adzuki beans and basil seeds. Mandge *et al.*, (2014) [11] conducted the same study on adzuki beans in which moisture content was found to be 4.2 g/100g. Proso millet contains less amount of moisture which is beneficial for increasing the shelf life of millet in comparison to other gluten-free cereals like maize, brown rice and sorghum [12]. The result of the analysis shows that variant C has higher amount ash, fat, carbohydrate and fiber as compared to all variants. It is due to the highest ratio of Proso millet was present in variant C. Similar results were seen in a study conducted by Saturni *et al.*, (2010) in which Proso millet contains good amount of these nutrients as a comparison to other gluten free cereals. Among all the ratios, Protein was found higher in variant A.

Table 1: Proximate composition of gluten free vermicelli

Variants	Moisture	Ash	Protein	Fat	Fiber	Carbohydrate
Standard	5.0±0.0	1.9±0.1	8.0±0.2	0.5±0.1	1.0±0.0	70.0±0.3
Variant A	5.2±0.1	2.1±0.2	13.0±0.0	1.6±0.0	3.0±0.0	60.0±0.2
Variant B	5.6±0.0	2.4±0.3	12.5±0.1	1.8±0.1	2.5±0.3	65.2±0.1
Variant C	6.1±0.2	3.7±0.0	12.0±0.3	2.0±0.0	2.2±0.1	67.5±0.1
Standard = 100% Wheat flour				A = 50% Proso millets+45% Adzuki beans+5% basil seeds		
B = 60% Proso millets+35% Adzuki beans+10% Basil seeds				C = 70% Proso millets+25% Adzuki beans+10% Basil seeds		

Each value is a mean of three determinations±standard deviation, ^SSignificant, ^{NS}Non significant at the level of (p<0.05)

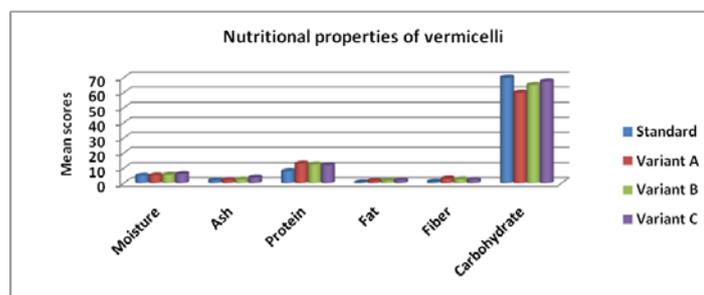


Fig. 1: Nutritional properties of vermicelli

Micronutrients

Minerals

The mineral content of all the nutrients was found to be highest in variant C except calcium, as shown in table 2. Adzuki beans are the

richest source of calcium in comparison to Proso millet as calcium content (150.0±0.3) was higher in variant A [13, 14]. Similar results were in a study conducted by [15], wherein high amount of iron, zinc and phosphorus was present in Proso millet when compared to Adzuki beans.

Table 2: Mineral composition of gluten free vermicelli

Variants	Calcium	Iron	Zinc	Phosphorus
Standard	50.2±0.0	1.4±0.2	1.0±0.0	100.3±0.2
A	150.0±0.3	3.5±0.1	2.0±0.3	250.6±0.6
B	132.5±0.0	3.7±0.5	2.6±0.6	241.2±0.0
C	128.9±0.1	3.9±0.0	2.8±0.2	232.0±0.4
Standard = 100% Wheat flour				A = 50% Proso millets+45% Adzuki beans+5% Basil seeds
B = 60% Proso millets+35% Adzuki beans+5% Basil seeds				C = 70% Proso millets+25% Adzuki beans+5% Basil seeds

Each value is a mean of three determinations±standard deviation, ^SSignificant, ^{NS}Non significant at the level of (p<0.05)

Phytochemicals

Phytochemicals are mainly produced by plants and are found in foods like whole grain, herbs, fruits and vegetables, which give them disease protective properties against various ailments, such as cancer and heart diseases. Dietary intake of phytochemicals has various health benefits. It is useful in reducing the damage caused by oxidative degeneration [16]. The qualitative phytochemical analysis of the aqueous extracts of gluten-free vermicelli flour showed positive results for the presence of flavonoids, saponin, tannin,

glycosides and steroid, which are shown in table 3. According to previous studies, tannin, saponin and alkaloids have been linked with antibacterial and anti-viral activity. In modern clinical studies, steroids play their role as anti-inflammatory and analgesic agents. Flavonoids are phenolic substances which show biological activities such as vasodilating actions. Phenolic compounds are particularly known for their antioxidant potential. This is because of their ability to decrease and scavenge free radicals and preventing oxidative cell damage and as a result combating cancer [17].

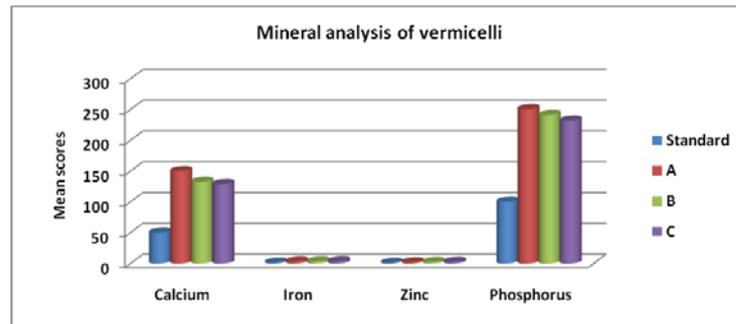


Fig. 2: Mineral analysis of vermicelli

Table 3: Phytochemical screening of gluten-free vermicelli

Phytochemical	Standard	A	B	C
Flavonoids	+	+	+	+
Saponin	+	+	+	+
Tannin	+	+	+	+
Glycosides	+	+	+	+
Steroids	+	+	+	+

FRAP

Table 5 shows ferric acid-reducing power for gluten-free vermicelli. The results revealed that C ratio exhibited the highest activity i. e

(15.772 µg/g) when compared with other respective variants and standard. On the contrary, reported by Chlopicka *et al.*, (2012) that other pseudo-cereal (buckwheat, amaranth and quinoa) had highest ferric acid-reducing power.

Table 5: Ferric acid-reducing power activity of gluten-free vermicelli

Standard	Variant A	Variant B	Variant C
10.19 µg/g	13.24 µg/g	14.64 µg/g	15.72 µg/g

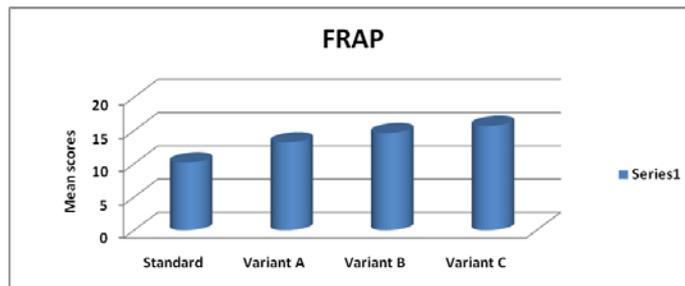


Fig. 5: FRAP activity of gluten free vermicelli

Table 4: Sensory quality attributes of gluten free vermicelli

Variants	Color	Appearance	Flavor	Texture	Taste	Overall acceptability
Standard	8.8±0.5	8.4±0.4	8.4±0.4	8.6±0.6	8.4±0.6	8.8±0.6
A	8.5±0.4	8.2±0.7	8.1±0.1	8.3±0.5	8.2±0.4	8.1±0.4
B	7.9±0.7	8.5±0.3	8.1±0.3	8.1±0.5	8.2±0.2	8.3±0.5
C	7.8±0.4	7.7±0.6	7.3±0.4	7.5±0.3	7.6±0.5	7.4±0.7

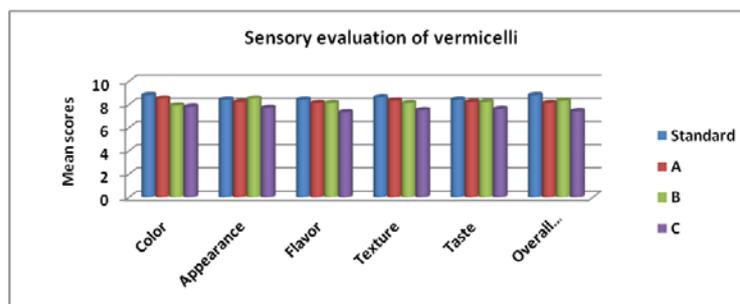


Fig. 3: Sensory evaluation of vermicelli



Fig. 4: Image depicting physical appearance of gluten free *Vermicelli*

Sensory evaluation

The mean sensory scores for colour, appearance, flavor, texture, taste and overall acceptability are presented in table 4. Control was the most acceptable for all the attributes. Variant B was the most acceptable for all the attributes among the all three variants of composite flour-based vermicelli.

CONCLUSION

From this study, it can conclude that gluten-free cupcakes prepared by using composite flour is beneficial for celiac patients, and the selected variants also fulfill the nutritional requirement in comparison to the one made up of wheat flour. The combination of millet, bean, and seeds makes these cupcakes good in taste, texture, enhance the overall acceptability and acceptable by the panelists.

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AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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