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Nutraceutical Potential of *Sweetened chips* Prepared by Gluten-Free Composite Flour

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ABSTRACT

Gluten free composite flour based *chips* was evaluated in this study for their nutritional, phytochemical and antioxidant properties of all ratios. The composite flour is made up of the mix of proso millet flour (PF), adzuki bean flour (AF) and basil seeds flour (BF). The composite flour is prepared in three ratios that are, 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 such as moisture, ash, fat, fiber, protein and carbohydrate were analyzed along with the assessment of micronutrients calcium, iron, phosphorus and zinc. The result of macronutrient and micronutrient of C ratio were moisture (6.21±0.2), ash (3.9±0.0), protein (12.0±0.0), fat (9.0±0.0), fiber (4.2±0.1) and carbohydrate (69.5±0.1g/100g) respectively. Calcium (218.0±0.1), iron (4.9±0.0), zinc (3.3±0.2) and phosphorus (312.0±0.4 mg/100g) were as follows. The present study was evident the presence of various macro and micro nutrients in gluten free *chips*. In the developed products, phytochemicals like flavonoids, saponins, tannin, glycocides, alkaloids and steroids are also there. The study revealed that gluten free sweetened chips also possess antioxidant activity. In the A ratio, overall all nutrients are found. It was found by the sensory evaluation *of sweetened chips* on a 9 point hedonic scale that A ratio was more acceptable than the B and C ratio. Therefore, this product can be suggestive for people suffering from celiac disease and the diseases like hypertension and anemia.

HIGHLIGHTS

- This article focuses on development new and innovative product which has been not developed before.
- This product is gluten free so can be consumed by people with celiac and non celiac disease.
- Composite flour that is mix of millet, beans and seeds are used for making this product which make its nutritionally balanced.
- The product was prepared in three ratios among which A ratio was most acceptable.

Keywords: Composite flour, chemical composition, gluten free *chips*, antioxidant activity, nutraceutical

Celiac disease is one of the most prevalent diseases worldwide of small intestine with is lifelong autoimmune disease. Both genetics (HLA and non-HLA genes) and environment (gluten) is responsible for this disease (Gujral *et al*. 2012). The main problem in this is the absorption of important nutrients because the harm in the villi of small intestine leads to hindrance of nutrients. The only solution for this disease is gluten free diet lifetime because no concrete cure has been developed for the same till now. So, formulation of consumer acceptable gluten free food becomes. As the knowledge about celiac disease is increasing worldwide, awareness about gluten free products are also increasing (Kaur *et al.* 2017). So, one of the ways to incorporate gluten free foods into the market are by preparing them with the help of composite flour. Composite flour is a combination of

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wheat and non-wheat flours. Cereals, roots, tubers, legumes, or other raw materials are used for non wheat flours. Traditional products like sev as well as novel products like cupcakes, both products can be made using composite flour. Due to the sensory, nutritional and functional properties, composite flours can be broadly used in preparation of baked and other kinds of products (Menon *et al.* 2015).

Chips are an instant snack food item which can be eaten readily by people from all walks of life, irrespective of age. Both the sweet and savory chips are eaten. The fast and changing life in the modern era, preference for instant food items like chips are becoming very popular. The increasing awareness about health has also increased the trend for gluten free foods. However, gluten-free chips are considerable for people who have celiac disease and also for people who are involved in gluten-free products for other health benefits. For the current study, proso millet, adzuki beans and basil seeds are selected. This selection of raw material determines the nutritional and functional features of the product. Hence the combination is carefully selected. All the macro and micro nutrients are present in generous amount in proso millet. But as these are gluten free products, along with the nutrients functional properties like water and oil absorption are also important for well structured products. Adzuki beans give many functional attributes in the composite flour (Singh *et al.* 2015). Basil seed flour found to be very valuable in terms of flavor and crispiness (Wani *et al.* 2015). Thus, as a result, composite flour-based extruded products have acceptable properties.

Thus, the main objective of the research is to evaluate prepared chips 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 purchased locally from Delhi, India. After that, at temperature of 100 °C they are being dried for half an hour in an oven. In the next step, mechanical blender was used for the milling of the seeds and storage of it in refrigerator in air tight container for further analysis.

Determination of proximate composition

Chips flour was taken in a clean, dry and weighed crucible. At 110 °C, it was dried in oven. Until the constant weight is attained, it was weighed repeatedly. Before weighing the crucible, it has to be cool down completely. Proximate analysis of the seeds was then done. Moisture ash, fat, protein, crude fiber and carbohydrate of seeds were analyzed. Difference method was used for carbohydrate. Total ash was estimated by weighing the furnace in incinerated residue at 550°C for 12 hours. Micro-Kjeldahl distillation method is used for protein content estimation.

Determination of minerals

Calcium (Ca), iron (Fe) and zinc (Zn) and phosphorus (P) were assessed for minerals. The evaluation of Ca, Fe, P, and Zn was done with the help of atomic absorption spectrophotometer (AAS) (model VGP 210, Buck Scientific, USA).

Phytochemical and Antioxidant screening

The screening of the chips flour for phytochemicals (flavonoids, saponins, tannin, glycocides and steroids) is been done according to the procedure as described by (Tiwari *et al.* 2011; Boakye *et al.* 2015). Antioxidant analysis was done on DPPH (diphenylpicryhydrazyl) activity and FRAP (ferric reducing ability of plasma) (Brand-William *et al.* 1995; Benzie and Strain, 1996; Kumar *et al.* 2008).

RESULTS AND DISCUSSION

The evaluation of moisture, ash, protein, fat, fiber and carbohydrate content were done for gluten free sweetened chips. Table 1 shows the chemical composition of chips with different ratios. The variant C has highest content of nutrients in composite flour after standard. The reason for the same is that Proso millet has high amount of nutrients when compared with adzuki beans and basil seeds except the protein. Protein is high in adzuki beans. Similar results were seen in a study conducted by Saturni *et al*. (2010) in which Proso millet contain good amount of these nutrients as comparison to other gluten free cereals. Mandge *et al.* (2014) conducted the same study on adzuki

Table 1: Proximate composition of gluten free sweetened chips

Variants	Moisture	Ash	Protein	Fat	Fiber	Carbohydrate
Standard	5.0±0.0	1.9±0.1	8.0±0.2	5.5±0.1	1.0±0.0	70.0±0.3
Variant A	5.2±0.1	3.5±0.2	13.0±0.0	8.6±0.0	4.0±0.0	66.0±0.2
Variant B	5.6±0.0	3.7±0.3	12.5±0.1	8.8±0.1	4.1±0.3	68.2±0.1
Variant C	6.1±0.2	3.9±0.0	12.0±0.3	9.0±0.0	4.2±0.1	69.5±0.1

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

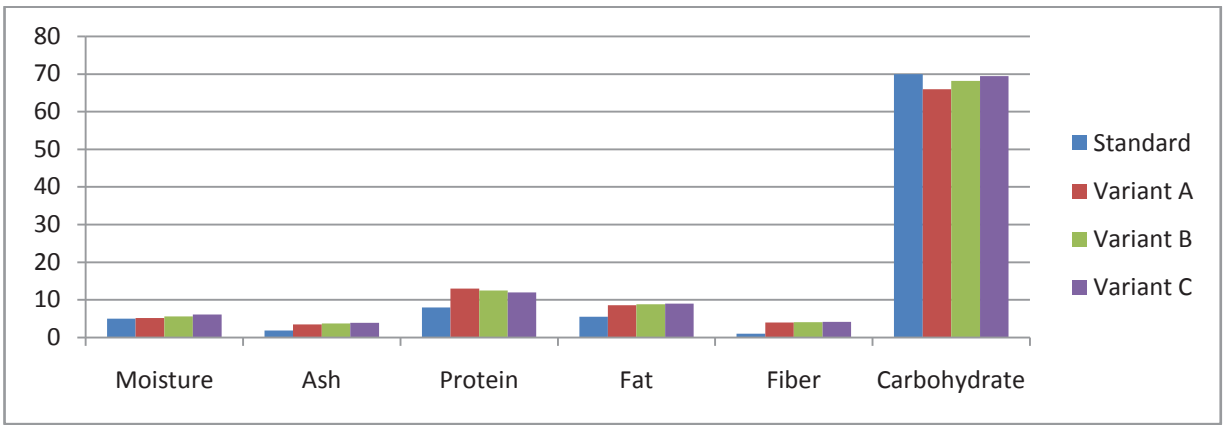

Fig. 1: Graph representing macronutrients

beans in which moisture content was found to be 4.2 g/100g. Proso millet contains less amount of moisture when compared with other cereals and pseudo cereals which is such as like maize, brown rice and sorghum advantageous for increasing the shelf life of prepared products (Gebremariam *et al.* 2014).

Table 2: Mineral composition of gluten free chips

Variants	Calcium	Iron	Zinc	Phosphorus
Standard	50.2±0.0	1.4±0.2	1.0±0.0	100.3±0.2
A	252.0±0.3	4.5±0.1	3.1±0.3	350.6±0.6
B	232.5±0.0	4.7±0.5	3.2±0.6	341.2±0.0
C	218.9±0.1	4.9±0.0	3.3±0.2	312.0±0.4

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

Amount of calcium and phosphorus are found to be highest in Variant A and zinc and iron is found to be highest in variant C. Adzuki beans are richest source of calcium and phosphorus in comparison to Proso millet as ratio of adzuki beans (150.0±0.3) was higher in variant A (Devi and Pai, 2006).

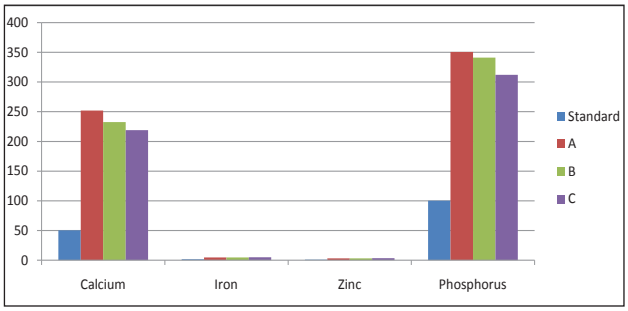

Fig. 2: Graph representing mineral content of the chips

Similar results were in a study conducted by (Parida *et al.* 2018), wherein proso millet contain high amount of iron and zinc when compared to Adzuki beans.

Phytochemicals are found in whole grains, herbs, fruits and vegetables which are chiefly produced by plants have disease preventing properties. The consumption of phytochemicals has various health enhancing properties. The damage caused by oxidative degeneration can be decreased by free radical scavenging activities using these

phytochemicals (Prakash *et al*. 2012). Phenolic compounds are particularly known for their antioxidant potential (Saio and Syiem 2015). The qualitative phytochemical analysis of the aqueous extracts of gluten free chips was done. It showed positive results for the presence of flavonoids, saponin, tannin, glycosides and steroid which are presented in Table 3.

Table 3: Phytochemical screening of gluten free chips

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

Tannin, saponin and alkaloids possess antibacterial and anti-viral activity as observed in previous studies. In modern clinical studies, steroids play their role as anti-inflammatory and analgesic agents. Flavonoids show biological activities like vasodilating actions.

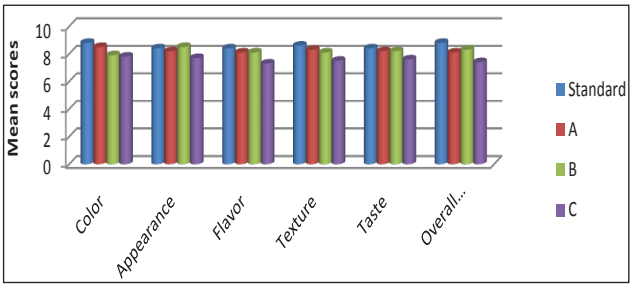

Fig. 3: Graph representing sensory evaluation of products

Fig. 4: Image depicting physical appearance of gluten free chips

The mean sensory scores for colour, appearance, flavor, texture, taste and overall acceptability are presented in Table 4. Control was the most

Table 4: Sensory quality attributes of gluten free chips

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

Table 5: Ferric acid reducing power activity of gluten free chips

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

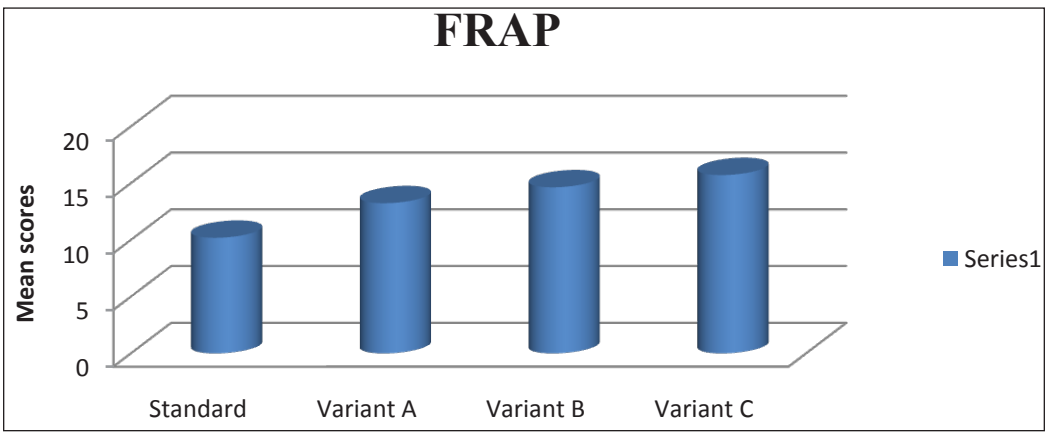

Fig. 5: Graph representing FRAP values of chips

acceptable for all the attributes. Variant B was the most acceptable for all the attributes among the all three variants of composite flour based sweetened chips.

Table 5 shows ferric acid reducing power for gluten free chips. The results revealed that C ratio exhibited highest activity i.e. (15.772 µg/g) when compared with other respective variants and standard. On contrary, reported by Chlopicka *et al*. (2012) that other pseudocereal (buckwheat, amaranth and quinoa) had highest ferric acid reducing power.

CONCLUSION

From this study, composite flour based sweetened chips are beneficial for celiac patients and all the variants fulfill the nutritional requirement in comparison to the one made up of wheat flour. The combination of millet, bean, and seeds makes these chips good in taste, texture, enhance the overall acceptability and acceptable by the panelists.

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