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Original Article

# NUTRACEUTICAL PROPERTIES OF GLUTEN-FREE CUPCAKES PREPARED BY GLUTEN-FREE COMPOSITE FLOUR

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**ABSTRACT**

**Objective:** The present study was aimed to evaluate the nutritional, phytochemical and antioxidant properties of all ratios of gluten-free composite flour-based cupcakes.

**Methods:** Composite flour was the blend of teff millet flour (TF), navy bean flour (NF) and watermelon seeds flour (WF). The variations of three composite flours were prepared as, A being (TF: NF: WF=45:45:10), B being (TF: NF: WF=55:35:10) and C being (TF: NF: WF=65:25:10) respectively. Moisture, ash, fat, fiber, protein and carbohydrate were analyzed in this study. Minerals like calcium, iron, phosphorus and zinc were also analyzed.

**Results:** The result of macronutrient and micronutrient of C ratio was moisture (28.1±0.2), ash (2.5±0.0), protein (12.2±0.3), fat (24.5±0.0), fiber (2.8±0.1) and carbohydrate (32.2±0.1 g/100g) respectively. Calcium (36.9±0.1), iron (7.5±0.0), zinc (3.8±0.2) and phosphorus (235.0±0.4 mg/100g) were also present in gluten-free Cupcakes. On the basis of the present study, it was found that gluten-free cupcakes contain different macro as well as micronutrients. It also has some phytochemicals such as flavonoids, saponins, tannin, glycocides and steroids.

**Conclusion:** The study result revealed that gluten-free Cupcakes had higher phenols content as well as antioxidant activity. The overall good amount of all nutrients found in the C ratio. The sensory evaluation of Cupcakes on a 9 point hedonic scale revealed that a ratio was more acceptable than the B and C ratio. Therefore, it can be beneficial for celiac diseases, hypertension, anemia, diabetes and cancer condition.

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


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## INTRODUCTION

Worldwide, individuals are affected by this disease known as gluten intolerance or celiac disease. It is a lifelong disease in which small intestine of the person is affected adversely and hence there is poor absorption of nutrients. It is a disease where genetic (HLA and non-HLA genes) and environment (gluten) both the factors play important roles [1]. No pharmaceutical cure for this disease is available. The only solution is to have hundred percent gluten-free diets. So, it is important that consumer-acceptable gluten-free foods are developed. Higher demand for gluten-free products such as cookies, bread, pasta and cakes are there as the awareness about celiac disease is also increasing [2]. So, one of the ways to do that is by incorporating composite flour-based gluten-free products in the market. In simple terms, composite flour is a combination of wheat and non-wheat. It is usually prepared from mixtures of raw materials like legumes, roots and tubers. Traditional or new products can be made out of it. Composite flours have been widely used in developing of different kind of products like baked, steamed and many others. These products also have better functional roles and organoleptic acceptability [3]. Each component of composite flour is carefully selected in the present study, namely teff millet, navy beans and watermelon seeds. It plays a significant role in contributing towards the nutritional or functional quality of the product developed.

To make products better in taste, texture and nutritional profile, composite flour-based products are chiefly made from whole grain [4]. These products also provide necessary amount macro like protein and fat and micronutrients like calcium and iron along with the essential bioactive compounds, including good amount of fiber. They also have anti-oxidant, antimicrobial and anti-inflammatory properties [5].

A sweet and spongy breakfast or evening snacks prepared, which is now broadly consumed by people all over the world. It is traditionally made from wheat flour, sugar, oil/fat, milk and eggs. As it contains wheat flour, people suffering from celiac disease cannot consume those [6]. However, gluten-free muffins not only grabs the interest of celiac patients but also of people who are interested in having gluten-free products may be due to other reasons [7].

The aim of this study was to evaluation of nutritional properties and to test the sensory acceptability of composite flour-based gluten-free cupcakes.

## 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 the 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 [8, 9]. Antioxidant analysis was done on DPPH (diphenylpicryhydrazyl) activity, FRAP (ferric reducing ability of plasma) and nitric oxide scavenging activity [10-12].

**Table 1: Proximate composition of gluten-free Cupcakes**

| Variants | Moisture (g) | Ash (g) | Protein (g) | Fat (g) | Fiber (g) | Carbohydrate (g) |
|---|---|---|---|---|---|---|
| Standard | 25.6±0.0 | 0.9±0.1 | 8.3±0.2 | 25.7±0.1 | 0.5±0.0 | 39.0±0.3 |
| Variant A | 24.9±0.1 | 1.3±0.2 | 10.7±0.0 | 23.5±0.0 | 1.5±0.0 | 38.1±0.2 |
| Variant B | 25.5±0.0 | 1.9±0.3 | 11.6±0.1 | 24.0±0.1 | 2.1±0.3 | 34.9±0.1 |
| Variant C | 25.8±0.2 | 2.5±0.0 | 12.2±0.3 | 24.5±0.0 | 2.8±0.1 | 32.2±0.1 |

**RESULTS AND DISCUSSION**

The chemical composition of cupcakes with different ratios is presented in table 1. The moisture content of composite flour was highest in variant C after standard. Almost similar results were found in a study conducted by [2] in which moisture content 23.12±1.4 g/100g was found in wheat flour-based muffins. The result of the analysis shows that variant C contained a higher amount protein, ash, fat and fiber as compared to all variants. It may be due to the highest ratio of teff millet was present in variant C. Similar results were seen in a study conducted by [13] in which teff millet contain good amount of these nutrients as a comparison to other gluten-free cereals. Among all the ratios carbohydrate was found higher in variant A.

**Table 2: Mineral composition of gluten-free cupcakes**

| Variants | Calcium (mg) | Iron (mg) | Zinc (mg) | Phosphorus (mg) |
|---|---|---|---|---|
| Standard | 30.2±0.0 | 1.5±0.2 | 0.5±0.0 | 110.3±0.2 |
| Variant A | 92.0±0.3 | 4.2±0.1 | 2.0±0.3 | 225.6±0.6 |
| Variant B | 87.5±0.0 | 6.5±0.5 | 3.2±0.6 | 230.2±0.0 |
| Variant C | 36.9±0.1 | 7.5±0.0 | 3.8±0.2 | 235.0±0.4 |

The mineral content of all the nutrients was found to be highest in variant C except calcium. Calcium content (92.0±0.3) was good in variant A may be the higher presence of navy beans which are richest source of calcium as a comparison to teff millet [14]. Similar results were in a study conducted by [15] teff millet contain a good amount of minerals (iron, zinc and phosphorus) as a comparison to navy beans. Thus, the micronutrient content enhanced with the increment ratio of teff millet.

**Table 3: Phytochemical screening of gluten-free cupcakes**

| Phytochemical | Standard | Variant A | Variant B | Variant C |
|---|---|---|---|---|
| Flavonoids | + | + | + | + |
| Saponin | + | + | + | + |
| Tanin | + | + | + | + |
| Glycosides | + | + | + | + |
| Steroids | + | + | + | + |

Phytochemicals are also known as phytonutrients. They are non-nutritive plant chemicals which helps to prevents from various chronic diseases such as cardiovascular disease, cancer, diabetes, osteoporosis and vision disease [16]. The selected qualitative phytochemical analysis of the aqueous extracts of gluten-free cupcake power showed positive results for the presence of flavonoids, saponin, tannin, glycosides and steroid.

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

Table 5 shows ferric acid-reducing power for gluten-free cupcakes. The results revealed that C ratio exhibited highest activity i. e (29.2±0.6 µg/g) when compared with other respective variants and standards. On contrary, reported by [17] in which gluten free bread made with gluten free flour had lower ferric acid-reducing power.

**Table 4: Sensory quality attributes of gluten free cupcakes**

| Variants | Color | Appearance | Flavor | Texture | Taste | Overall acceptability |
|---|---|---|---|---|---|---|
| Standard | 8.8±0.5 | 8.4±0.4 | 8.4±0.4 | 8.4±0.6 | 8.4±0.6 | 8.4±0.6 |
| Variant A | 8.5±0.4 | 8.2±0.7 | 8.1±0.1 | 7.9±0.5 | 7.9±0.4 | 8.0±0.4 |
| Variant B | 7.9±0.7 | 7.8±0.3 | 7.8±0.3 | 7.8±0.5 | 7.6±0.2 | 7.9±0.5 |
| Variant C | 7.8±0.4 | 7.7±0.6 | 7.7±0.4 | 7.5±0.3 | 7.5±0.5 | 7.6±0.7 |

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

| Standard | Variant A | Variant B | Variant C |
|---|---|---|---|
| 11.2±0.4 µg/g | 20.4±0.5 µg/g | 24.7±0.1 µg/g | 29.2±0.6 µg/g |

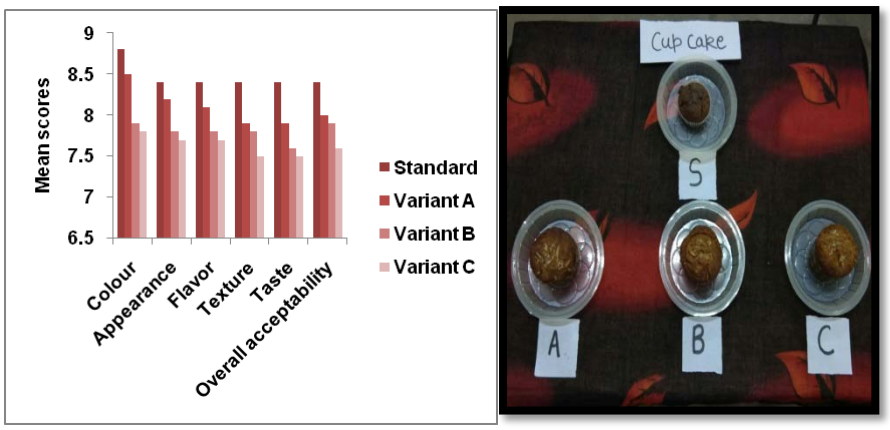


**Fig. 1: Image depicting physical appearance of gluten free cupcakes**

**Table 6: Total phenols content of gluten free cupcakes**

| Standard | Variant A | Variant B | Variant C |
|---|---|---|---|
| 25.5±0.7 mgGAE/g | 37.3±1.2 mgGAE/g | 45.4±0.9 mgGAE/g | 50.8±1.4 mgGAE/g |

Table 6 shows the total phenols content for gluten-free Cupcakes. The results revealed that C variant showed the highest phenols content i.e. (50.8±1.4 mg/GAE/g) when compared with other respective variants and standard. On the contrary, conducted a study in which gluten-free flatbread made from water chestnut flour had a low content of phenols [18].

## CONCLUSION

From this study, it can conclude that cupcakes prepared by using composite flour is beneficial for celiac disease patients, and the selected variants of gluten-free cupcakes also fulfill the micro nutrients requirement in comparison to the one made up of wheat flour. Apart from nutrients, composite-based cupcakes are also good in phytochemical and antioxidant activity. So, it will be beneficial to prevent from various diseases. The combination of composite flour 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

Authors declare no conflicts of interest.

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