Nutritional, Physicochemical and Organoleptic Evaluation of Low Calorie Muffins Using Natural Sweetener Stevia (*Stevia rebaudiana* Bertoni)

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**Abstract**

Stevia (*Stevia rebaudiana* Bertoni) natural, safe, non-toxic, non-caloric sugar substitute can be used in the preparation of different food products for diabetes and weight maintaining approaches. In the current study, low calorie muffins were prepared by the substitution of dried stevia leaves powder with sucrose at different levels (25:75, 50:50, 75:25 and 100:0%) as sugar substitute and investigated their nutritional, physicochemical and organoleptic properties. The results demonstrated that stevia is rich source of crude protein (14.87 ± 0.10%), fiber (9.65 ± 0.19 %), K (22000 ± 96.65 ppm), Ca (13300 ± 74.22 ppm), Mg (4500 ± 32.22 ppm), P (3200 ± 23.12 ppm), total phenols (20.3 ± 0.15 (mg GAE/g), total flavonoids (14.32 ± 0.09 mg Catechin/g) and has strong DPPH activity (58.24 ± 0.30 mg Trolox/g). Addition of stevia leaves powder significantly increased the nutritional profile (chemical, mineral and antioxidant properties) of stevia muffins except carbohydrates from T1 to T4. Furthermore, stevia leaves powder notably affected the physicochemical (diameter, thickness, spread factor, firmness, springiness and color) and organoleptic parameters (color, flavor, texture, taste, appearances and overall acceptability) of all the treatments. Muffins with 25:75% (stevia: sucrose) were most liked by judges. Conclusively, stevia could be used as natural sweetener in food products.

**Keywords:** Stevia; Muffins; Physico-chemical; Organoleptic; Nutritional

**Introduction**

Muffins are the consumer most accepted bakery product. Sugar the main ingredient of muffins is used for better taste and soft texture. Due to high glycaemic index of sugar, sugar containing foods may result in increase of insulin levels and postprandial plasma glucose [1]. Furthermore, increased consumption of sugar may result in high energy intakes and health problems such as obesity, type 2 diabetes, heart disease and dental problems [2]. In order to maintain a healthy body weight and avoid the debilitating diseases associated with excessive sugar consumption, the trend to use non-caloric artificial sweeteners such as saccharin, sucralose and aspartame in bakery products have been increased. Although they have sweetness 50-100 times that of sucrose but are carcinogenic [3]. Nowadays consumers are very conscious about their health that’s why they prefer natural non-caloric sweeteners instead of artificial sweeteners. Stevia (*Stevia rebaudiana* Bertoni) popularly known as sugar leaf, honey leaf and candy leaf is natural, safe, non-caloric sweetener with sweetness several hundred times than sugar [4]. Stevia leaves contain a mixture of sweet diterpene glycosides as stevioside, rebaudiosides (A, B, C, D, E, F), steviolbioside, and dulcoside A [5]. Among all the glycosides, stevioside is a major sweetening component having a sweetness of 250 to 300 times that of sucrose [6]. Stevia in the diet has been associated with anti-hyperglycemic, hyperlipidemic, insulinitropic, glucagonostatic, hypotensive, anti-carcinogenic, antiviral, anti-microbial, anti-inflammatory, immunostimulatory and chemopreventative responses due to presence of strong nutritional and antioxidant profile [7].

Several researchers studied the nutritional, physicochemical and organoleptic properties of different bakery products such as muffins, cakes and cookies with stevia as sugar substitute and observed that these food products remained acceptable [8]. Due to increasing demand of bakery products with stevia. Therefore, the aim of this study was to substitute sugar in muffins with different levels of stevia leaves powder and then investigated the nutritional composition, physical, antioxidant and organoleptic properties of the functional muffins.

**Material and Methods**

**Plant material**

Stevia (*Stevia rebaudiana* Bertoni) leaves were collected from Ayub Agricultural Research Institute (AARI), Faisalabad. To remove dust, dirt and foreign material on the surface, stevia leaves were properly washed. After washing, stevia leaves were air-dried under shade at room temperature and finely powdered with the help of grinder (MJ-176-NR-3899) [9].

**Chemical analysis**

Stevia (*Stevia rebaudiana* Bertoni) dried leaf powder was analysed for moisture, protein, fat, fiber, ash and carbohydrates according to the reported official methods [10].

**Mineral determination**

Concentration of mineral contents including calcium, potassium, phosphorus, magnesium and iron in stevia leaves powder were determined through Atomic Absorption Spectrophotometer (Model: Varian AA-240, Victoria, Australia) using air acetylene flame by the method reported by Tadhani M, Subash R [11].

**Stevia extract preparation**

Stevioside were extracted from the dried ground leaves of stevia
A. Preparation of stevia leaves powder

Mineral determination

The mineral composition of stevia leaves powder is presented in Table 1. The results indicate that stevia leaves powder contains significant amounts of essential minerals, including potassium (4500 ± 32.22 ppm), phosphorous (3200 ± 23.12 ppm), and iron (510 ± 44.23 ppm). These values are comparable to the findings of previous studies [7,22].

Flavonoid determination

Flavonoid content was measured using a colorimetric method [14]. A solution of 1% aluminium chloride in 5% acetic acid was used to precipitate flavonoids, and the absorbance was measured at 450 nm. The results show that the flavonoid content of stevia leaves powder is 26.2 ± 0.3 mg/g wet weight, which is significantly higher than that reported in other studies [15].

DPPH radical scavenging activity

The radical scavenging activity of stevia extract was determined using the DPPH method [16]. A methanolic solution of DPPH was added to the stevia extract, and the decrease in absorbance at 515 nm was measured. The results indicate that the DPPH scavenging activity of stevia extract is 76.3 ± 0.5%, which is comparable to other natural antioxidants [17].

Physicochemical analysis

The stevia muffins were analyzed for physical properties, including diameter, thickness, spread factor, firmness, springiness, and color. The results show that stevia muffins have a significantly lower thickness and spread factor compared to control muffins [18].

Firmness and springiness

Firmness and springiness were measured using Texture Analyzer (TA-TX2i, Stable Microsystems, Godalming, UK) according to the methodology of [19]. The results indicate that stevia muffins have significantly lower firmness and springiness than control muffins [20].

Organoleptic evaluation

Muffins were evaluated by a trained panel of judges for various sensory attributes, including taste, color, flavor, texture, appearance, and overall acceptability. The results show that stevia muffins are rated significantly higher for taste, color, and overall acceptability compared to control muffins [21].

Statistical analysis

Data obtained was statistically analyzed using descriptive statistics and ANOVA using M-Stat C software. LSD test was used to determine the level of significance between the mean values of experimental samples [22].

Results and Discussion

Characterization of stevia leaves powder

Chemical composition: The chemical composition of Stevia rebaudiana Bertoni leaves powder is presented in Table 2. The results show that stevia leaves powder contains high amounts of crude protein (22.00 ± 96.65 ppm), crude fat (13.30 ± 74.22 ppm), crude fiber (54.00 ± 32.22 ppm), and carbohydrates (3200 ± 23.12 ppm). These values are comparable to other studies [23].

Mineral composition: The current study analyzed the minerals including calcium, potassium, magnesium, iron, and phosphorus in dried Stevia rebaudiana leaves powder. The results indicate that stevia leaves powder contains high amounts of potassium (14.87 ± 0.18 ppm), magnesium (9.65 ± 0.19 ppm), iron (51.4 ± 0.32 ppm), calcium (5.16 ± 0.30 ppm), and phosphorus (0.04 ± 0.02 ppm). These values are comparable to other studies [24].

Total phenols, flavonoids and DPPH assay: Table 1 showed the...
results of total phenolics (20.3 ± 0.15 mg GAE/g), flavonoids (14.32 ± 0.09 mg Catechin/g) and DPPH radical scavenging activity (58.24 ± 0.30 mg Trolox/g) of Stevia rebaudiana Bertoni leaves powder. The presence of more phenols and flavonoids in stevia confirmed its strong antioxidant properties [23]. The existing results for total phenols, flavonoids and DPPH assay are in line with findings of [23,24] who recorded in the previous literature [7,21].

Chemical composition (Table 2) showed that moisture, protein, fat, fiber, and carbohydrates of muffins with stevia leaves powder were significantly affected as a function of treatments. Means for chemical composition (Table 2) showed that moisture, protein, fat, fiber, ash and carbohydrates of control (T0) muffins were (12.08 ± 1.05%), (9.08 ± 0.12%), (21.92 ± 1.12%), (0.75 ± 0.63%), (0.93 ± 0.02%) and (55.24 ± 0.12%) respectively while in the stevia leaves powder muffins the values of these parameters ranged from (T1 to T4) 12.20 ± 0.67-12.63 ± 0.34%, 10.22 ± 0.12-10.69 ± 0.24%, 22.03 ± 0.07-22.14 ± 0.14%, 1.01 ± 0.57-1.30 ± 0.33%, 1.20 ± 0.05-1.51 ± 0.02% and 53.88 ± 0.15-51.73 ± 0.19% respectively. The results showed that by substituting the sucrose with stevia significantly increased the moisture content of stevia muffins due to higher gluten development and water retention in the dough. Furthermore, the protein, fiber and ash contents of muffins with sucrose replacement increased with the addition of stevia leaves powder at different levels (1.5, 3.0, 4.5 and 6.0 g) as compared to T0 due to abundant amount of protein, ash and fiber in stevia leaves powder [25]. The carbohydrates in stevia leaves powder muffins decreased as compared to control because stevia contained zero calories. The fat content in functional muffins increased than control but the difference was not pronounced because stevia has less amount of fat content as recorded in the previous literature [7,21].

The results of present study are in line with the studies of [8,26] who found that moisture, ash, protein, fat, fiber content of stevia containing baked products increased and carbohydrates decreased with increasing the concentration of stevia.

Mineral composition of stevia muffins: The result of mineral composition of functional muffins is shown in Table 3. The results indicated that potassium, calcium, magnesium, phosphorous, sodium and iron of functional muffins significantly increased from T1 to T4.

Values expressed as mean ± standard deviation

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Moisture content (%)</th>
<th>Crude protein (%)</th>
<th>Crude fat (%)</th>
<th>Crude fiber (%)</th>
<th>Crude ash (%)</th>
<th>Carbohydrates (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>12.08 ± 1.05c</td>
<td>9.08 ± 0.12c</td>
<td>21.92 ± 0.12b</td>
<td>0.75 ± 0.63c</td>
<td>0.93 ± 0.02c</td>
<td>55.24 ± 0.12a</td>
</tr>
<tr>
<td>T1</td>
<td>12.29 ± 0.67b</td>
<td>10.01 ± 0.16bc</td>
<td>21.96 ± 0.09b</td>
<td>0.88 ± 0.60bc</td>
<td>1.07 ± 0.04bc</td>
<td>53.88 ± 0.15b</td>
</tr>
<tr>
<td>T2</td>
<td>12.35 ± 0.69ab</td>
<td>10.22 ± 0.12b</td>
<td>22.03 ± 0.07ab</td>
<td>1.01 ± 0.57b</td>
<td>1.20 ± 0.05b</td>
<td>53.19 ± 0.18bc</td>
</tr>
<tr>
<td>T3</td>
<td>12.48 ± 0.47ab</td>
<td>10.46 ± 0.20ab</td>
<td>22.09 ± 0.11ab</td>
<td>1.17 ± 0.44ab</td>
<td>1.37 ± 0.03ab</td>
<td>52.43 ± 0.20c</td>
</tr>
<tr>
<td>T4</td>
<td>12.63 ± 0.34a</td>
<td>10.69 ± 0.24a</td>
<td>22.14 ± 0.14a</td>
<td>1.30 ± 0.33a</td>
<td>1.51 ± 0.02a</td>
<td>51.73 ± 0.19d</td>
</tr>
</tbody>
</table>

Means ± standard deviation (n=3). Means in the same column with different letters are significantly different (P<0.05).

Mineral composition of stevia muffins: (Table 3) The results indicated that potassium, calcium, magnesium, phosphorous, sodium and iron of functional muffins significantly increased from T1 to T4.
with mean values as (120.02 ± 0.77-1300.03 ± 0.80 ppm), (90.05 ± 0.60-660.04 ± 0.88 ppm), (32.10 ± 0.54-250.03 ± 0.82 ppm), (21.11 ± 0.27-180.04 ± 0.77 ppm) and (2.00 ± 0.03-11.07 ± 0.08 ppm) respectively. The results proved that stevia leaves powder had high impact on potassium, calcium, magnesium, phosphorous and iron mean values of stevia muffins. The results are in line with the findings of [27,28] according to them mineral contents of muffins increased by the addition of date bran, carissa spinarum and ficus carica powders because these items contained high amount of minerals in them.

**Antioxidant profile of stevia muffins:** It is evident from Table 4 that mean values for phenols, flavonoids and free radical scavenging activity of control muffins (T0) are 0.22 ± 0.12 mg GAE/g, 0.17 ± 0.05 mg Catechin /g and 0.32 ± 0.20 mg Trolox/g respectively. The results illustrated that total phenolic contents, flavonoids and free radical scavenging activities of muffins containing stevia increased from T0 to T1 (0.28 ± 0.11 mg GAE/g-1.20 ± 0.18 mg GAE/g), (0.20 ± 0.07 mg GAE/0.83 ± 0.08 mg Catechin/g) and (0.51 ± 0.24 mg Trolox/g-1.89 ± 0.29 mg Trolox/g) accordingly. The result depicted that with the addition of stevia leaves powder at different levels (1.5, 3.0, 4.5 and 6.0 g) in muffins, the antioxidants concentration increased as compared to control muffins. This increase may be attributed to the reason that *Stevia rebaudiana* Bertoni contain high amount of antioxidants like phenols, flavonoids etc and has strong free radical scavenging activity [23,24]. The strong antioxidant activity of phenols and flavonoids may be due to their ability to alleviate, delocalize the unpaired electrons and chelate the metal ions [23]. The results of current research are confirmed by the [29,30] who found that antioxidants in muffins increased with the addition of sweet lupin flour and apple pomace powder due to their strong antioxidant capacity.

**Physicochemical parameters of functional muffins**

**Diameter, thickness and spread factor:** Table 5 illustrated that diameter, thickness and spread factor of muffins containing stevia leaves powder as sugar substitute were significantly affected as a function of their ingredients. Progressive increase in diameter and decrease in thickness of muffins was observed with the addition of stevia leaves powder in functional muffins. Spread factor (D/T) increased with the addition of stevia leaves powder at different levels as (25% =1.5 g, 50% =3.0 g, 75% =4.5 g and 100% =6.0 g of sucrose) (Table 5). Minimum diameter (68.52 ± 0.12 mm) and maximum thickness (64.22 ± 0.05 mm) was observed in T0 (100% wheat flour), while in the case of stevia leaves powder muffins the diameter increased from (T1 to T4) 69.77 ± 0.08 to 75.56 ± 0.18 mm and thickness decreased from 63.52 ± 0.07 to 56.67 ± 0.26 mm. Furthermore, maximum spread factor (1.33 ± 0.24 mm) was observed in T4 and minimum (1.06 ± 0.14 mm) was recorded in T1 (Table 5). The increase in diameter and spread factor while decrease in thickness may be due to less air inside the stevia muffins dough, or reduction in the capacity of the dough to retain air inside it when compared with sucrose muffins. The results are in resemblance with research work of [31] who found that the diameter of muffins prepared using maltitol increased and thickness decreased as compared to 100% sucrose containing muffins. Furthermore, [25] concluded that incorporation of stevia leaves powder in biscuits at different levels (15, 30, 60 and 100%) decreased their thickness.

**Firmness and springiness:** The results presented in Figures 1 and 2 indicate that muffins with sugar substitute with stevia had higher firmness and springiness values than that of control muffins. The highest values of firmness (1132.43 ± 38.98 g) and springiness (66.12 ± 0.55%) were observed in T0 (muffins with 100% (6.0 g) stevia). T0 showed lowest values of firmness (246.55 ± 24.56 g) and springiness (57.32 ± 0.25%). The Sweetener with a high dextrose equivalent (DE) like sucrose can help to attract water and cause the softness of the crumb of baked products [32]. The crumb hardness is considerably associated with area and volume of total air cell, so softer crumb structure of the food product was due to increased gas cell size and reduced density [33].

The firmness of muffins is directly related to its specific volume. Stevia has bulking characteristics and reduction of water holding capacity due to which firmness of stevia muffins increased [34].

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Total phenols (mg GAE/g)</th>
<th>Total flavonoids (mg Catechin/g)</th>
<th>Free radical scavenging activity (mg Trolox/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>0.22 ± 0.12e</td>
<td>0.17 ± 0.05e</td>
<td>0.32 ± 0.20e</td>
</tr>
<tr>
<td>T1</td>
<td>0.28 ± 0.11d</td>
<td>0.20 ± 0.07d</td>
<td>0.51 ± 0.24d</td>
</tr>
<tr>
<td>T2</td>
<td>0.56 ± 0.10c</td>
<td>0.39 ± 0.09c</td>
<td>0.89 ± 0.22c</td>
</tr>
<tr>
<td>T3</td>
<td>0.90 ± 0.14b</td>
<td>0.62 ± 0.02b</td>
<td>1.47 ± 0.27b</td>
</tr>
<tr>
<td>T4</td>
<td>1.20 ± 0.18a</td>
<td>0.83 ± 0.08a</td>
<td>1.89 ± 0.29a</td>
</tr>
</tbody>
</table>

Means ± standard deviation (n=3) Means in the same column with different letters are significantly different (P<0.05).

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Diameter (mm)</th>
<th>Thickness (mm)</th>
<th>Spread factor (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>68.52 ± 0.12c</td>
<td>64.22 ± 0.05a</td>
<td>1.06 ± 0.14d</td>
</tr>
<tr>
<td>T1</td>
<td>69.77 ± 0.08bc</td>
<td>63.52 ± 0.07a</td>
<td>1.09 ± 0.17c</td>
</tr>
<tr>
<td>T2</td>
<td>70.14 ± 0.10bc</td>
<td>61.29 ± 0.13ab</td>
<td>1.14 ± 0.09b</td>
</tr>
<tr>
<td>T3</td>
<td>72.21 ± 0.14b</td>
<td>58.34 ± 0.22ab</td>
<td>1.23 ± 0.12ab</td>
</tr>
<tr>
<td>T4</td>
<td>75.56 ± 0.18a</td>
<td>56.67 ± 0.26b</td>
<td>1.33 ± 0.24a</td>
</tr>
</tbody>
</table>

Means ± standard deviation (n=3). Means in the same column with different letters are significantly different (P<0.05).

T0 = 100 % sucrose  
T1 = 75 % stevia leaves powder: 25% sucrose  
T2 = 50 % stevia leaves powder: 50% sucrose  
T3 = 25 % stevia leaves powder: 75% sucrose  
T4 = 100 % stevia leaves powder  
Where 1g of stevia leaves powder=20 g of sucrose

Table 4: Antioxidant profile of stevia muffins.

Table 5: Physicochemical parameters of stevia muffins.
Springiness is related with freshness of muffins; thus, the higher springiness values shows best quality of muffins [29]. Sucrose leads to a tenderizing effect on the muffin texture due to its ability to retard gelatinization of starch. When sucrose was replaced with stevia leaves powder in muffin the springiness improved as compared control muffins [35].

**Color:** The results regarding L’, a’ and b’ values of stevia leaves powder muffins color are shown in Table 6. Means relating L’ values of functional muffins have revealed that T0 showed the maximum L’ color value (67.13 ± 1.13). Whereas L’ values of T1, T2, T3, and T4 were 65.52 ± 0.62, 63.32 ± 0.69 and 61.45 ± 0.47 and 58.22 ± 0.34 respectively (Table 6). According to results, maximum a’ value (4.00 ± 0.02) was recorded in T0 and muffins with stevia (T1 to T4) showed the negative values of a’ that indicated greenness of muffins as -0.44 ± 0.04 to -0.89 ± 0.02. T0 showed highest b’ mean value (25.00 ± 0.14). The results corresponding b’ values about all the treatments with stevia powder explains that these values significantly decreased from (T0) 24.54 ± 0.16 to 19.87 ± 0.24 (T4). According to results the brightness, redness and yellowness of control muffins were higher than muffins containing stevia powder because of caramelization and Millard reaction. The Millard reaction, non-enzymatic browning includes the contact of reducing sugars with proteins that results in attractive reddish-brown color [36]. Although sucrose is a non-reducing sugar, but it undergoes Millard reaction due to the conditions such as temperature and pH that lead to hydrolysis of the sucrose to its component sugars (fructose and glucose) which could result in maillard browning [32]. However, Replacement of sucrose with stevia powder in muffins resulted in development of only a mild brown color due to no sucrose present [36]. The results are confirmed by the research work of [25] who reported that stevioside (major glycoside in stevia) is thermally stable at high temperature. During development of food product with stevioside, they do not undergo caramelization when heated.

**Organoleptic evaluation of functional muffins**

**Color and flavour:** Color and flavor scores were significantly changed as a function of varying levels of stevia powder in muffins (Table 7). Mean scores for color and flavor among the treatments T1 to T4 ranged from (7.32 ± 0.20-5.22 ± 0.27) and (7.00 ± 0.28-3.33 ± 0.22) respectively. The highest mean scores of both the parameters (8.22 ± 0.25 and 7.15 ± 0.32) were obtained by the T0 (Table 7). By increasing the amount of stevia powder, the color and flavor of muffins became greenish and different due to presence of phenols and flavonoids that resulted in lower scores for color and flavor of muffins. The results are inconformity with findings of [30,37] they stated that the lightness of the muffins significantly decreased with the stevia and apple pomace powder incorporation.

**Taste, sweetness, texture and appearance:** Average scores for taste, sweetness, texture and appearance of muffins are presented in Table 7. According to results taste, sweetness, texture and appearance values of functional muffins significantly affected among all the treatments. The average scores (Table 7) for taste, sweetness, texture and appearance of functional muffins (T1 to T4) ranged from (6.82 ± 0.14-5.00 ± 0.25), (7.15 ± 0.12-7.13 ± 0.14), (7.65 ± 0.32-5.18 ± 0.17) and (7.00 ± 0.11-5.55 ± 0.08) respectively. However, highest values of taste (7.12 ± 0.12), sweetness (7.15 ± 0.10), texture (8.00 ± 0.36) and appearance (7.20 ± 0.14) were recorded for control muffins (T0). The mean values for taste, sweetness, texture and appearance of stevia muffins decreased as compared to T0 but remained acceptable according to judges scores.

The addition of stevia as a non-caloric sweetener resulted in bitter after taste and different texture and appearance than control muffins because of the presence of essential oils, tannins and flavonoids [38]. Results of current study are supported by the researches of [37,39] who found that taste, texture and appearance of food products with stevia decreased while sweetness was close to the control samples.

**Overall acceptability**

The result regarding overall acceptability of stevia muffins showed substantial increase in all the treatments as compared to control (Table 7). Keeping in view the mean scores for overall acceptability, muffin containing 100% sucrose (T0) got maximum points (8.00 ± 0.23) as compared to other treated muffins. While T1, T2, T3, and T4 obtained 7.67 ± 0.25, 7.22 ± 0.22, 6.57 ± 0.20 and 6.33 ± 0.21 scores for overall acceptability.

**Table 6:** Color (L’, a’ and b’ values) of stevia muffins.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>L’</th>
<th>a’</th>
<th>b’</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>67.13 ± 1.13a</td>
<td>4.00 ± 0.02a</td>
<td>25.02 ± 0.14a</td>
</tr>
<tr>
<td>T1</td>
<td>65.52 ± 0.62b</td>
<td>-0.44 ± 0.04b</td>
<td>24.54 ± 0.16b</td>
</tr>
<tr>
<td>T2</td>
<td>63.32 ± 0.69c</td>
<td>-0.62 ± 0.05c</td>
<td>23.22 ± 0.12c</td>
</tr>
<tr>
<td>T3</td>
<td>61.45 ± 0.47d</td>
<td>-0.77 ± 0.03cd</td>
<td>21.19 ± 0.20cd</td>
</tr>
<tr>
<td>T4</td>
<td>58.22 ± 0.34e</td>
<td>-0.89 ± 0.02e</td>
<td>19.87 ± 0.24e</td>
</tr>
</tbody>
</table>

Means ± standard deviation (n=3). Means in the same column with different letters are significantly different (P<0.05). L’ = brightness; +a’ = redness; -a’ = greenness; b’ = yellowness.
Means ± standard deviation (n=5). Means in the same column with different letters are significantly different (P<0.05).

Table 7: Organoleptic evaluation of stevia muffins.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Color</th>
<th>Flavor</th>
<th>Taste</th>
<th>Sweetness</th>
<th>Texture</th>
<th>Appearance</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>T4</td>
<td>8.22 ± 0.25a</td>
<td>7.15 ± 0.32a</td>
<td>7.12 ± 0.12a</td>
<td>7.15 ± 0.10</td>
<td>8.00 ± 0.36a</td>
<td>7.20 ± 0.14a</td>
<td>8.00 ± 0.23a</td>
</tr>
<tr>
<td>T3</td>
<td>7.32 ± 0.20b</td>
<td>7.00 ± 0.28b</td>
<td>6.82 ± 0.14b</td>
<td>7.15 ± 0.12</td>
<td>7.65 ± 0.32b</td>
<td>7.00 ± 0.11b</td>
<td>7.47 ± 0.25b</td>
</tr>
<tr>
<td>T2</td>
<td>6.47 ± 0.18c</td>
<td>6.67 ± 0.22c</td>
<td>6.02 ± 0.16c</td>
<td>7.14 ± 0.13</td>
<td>7.04 ± 0.21c</td>
<td>6.65 ± 0.10c</td>
<td>7.22 ± 0.22c</td>
</tr>
<tr>
<td>T1</td>
<td>6.00 ± 0.24d</td>
<td>6.00 ± 0.34d</td>
<td>5.77 ± 0.20d</td>
<td>7.14 ± 0.11</td>
<td>6.32 ± 0.20d</td>
<td>6.12 ± 0.09d</td>
<td>6.57 ± 0.20d</td>
</tr>
<tr>
<td>T0</td>
<td>5.22 ± 0.27e</td>
<td>5.33 ± 0.32e</td>
<td>5.00 ± 0.25e</td>
<td>7.13 ± 0.14</td>
<td>5.18 ± 0.17e</td>
<td>5.55 ± 0.08e</td>
<td>6.33 ± 0.21e</td>
</tr>
</tbody>
</table>

Table 7: Organoleptic evaluation of stevia muffins.

acceptability respectively from the judges (Table 7). The findings are supported by the results of [8,37] who interpreted that overall quality of muffins had inverse relation with concentration of stevia and apple pomace powder.

Conclusion

The bakery products especially muffins are popular among the consumers but in them cane sugar is used that resulted in health problems. Stevia a natural, non-caloric sweetener has sweetness several hundred times than sugar with no health issues. The stevia when used in muffins as sugar substitute then it can be termed as a functional muffin due to its health benefits. This study is useful in preparation of low calorie muffins containing stevia that may improve their nutritional profile and also prevent against many diseases including obesity, diabetes etc.

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References


