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Physiochemical and Sensory Properties of Functional Cupcake Made With Wheat Flour Substituted With Chickpea, Purslane, Doum and Carob Powders

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Abstract

This study aimed to produce functional cupcake from wheat flour (72% ext.) substituted with chickpea powder at 10, 20 and 30%. Sensory evaluation of cupcake performed at all levels replacement highly acceptable cupcake obtained by substituting 20% chickpea powder and considered as the control cupcake. The control sample will be a partial replacement of wheat flour with purslane leaves, doum and carob powders enriched separately as natural sources to produce a functional cupcake suitable for iron deficiency anemia patients. Purslane leaves, doum and carob powders were added with different replacement levels from wheat flour at 2.5, 5.0, 7.5 and 10.0% for both purslane and doum powders and 5, 10, 15 and 20% for carob powder. Highly acceptable cupcake were these substituted with 7.5, 7.5 and 15% for purslane leaves, doum and carob powders, respectively. Proximate chemical composition and minerals of raw materials and favorite substituted cupcake samples were studied. Also the physical and sensory properties of prepared cupcakes were studied. Results showed that chickpea, purslane leaves, doum and carob powders had good nutritional characteristics and increasing substitution ratios also resulted in increased fat, crude fiber , ash content and minerals in produced cupcakes compared to control sample. Physical attributes of the produced cupcakes were evaluated and results showed that the volume of substituted cupcakes decreased.with increasing the level of replacement. The Sensory evaluation results indicate an insignificant decrease in acceptability by increasing storage time.

Keyword: Cupcake – Wheat flour - Chickpea powder - Purslane leaves powder – Doum powder - Carob powder.

Introduction

Cakes are the most commonly consumed bakery product and are increasing globally by almost 1.5% per year. **(Jabeen *et al.*, 2022)**. Cakes are popular bakery items that are consumed by nearly all levels of society in Egypt due to their low price, good nutritional quality and easy availability **(Abdallah *et al.*, 2017)**. The consumption of cake produced from wheat flour is very popular but has a low protein content which is the most vital ingredient used for the production has been a major concern in its utilization **(Khalifa *et al.*, 2016).**

Legumes have been regarded as a rich source of protein throughout the world and contain approximately three times more protein than cereals. Legumes are important sources of protein, calories, minerals and vitamins in the human diet (**Abdallah *et al.*, 2017**).Chickpea powder contains proteins, fibers, minerals and other bioactive compounds, making it one of the best ingredients for improving nutritional value of breads and bakery products. **(El-Said *et al.*, 2021).**

Chickpea *(Cicer arietinum* L.) is an important source of protein, carbohydrates and minerals, especially for developing nations' population groups. It contains 21.1 g protein, 3.1 g fat, 53.4 g carbohydrate, 11.1 g fiber and 5.9 g ash, 360 mg Ca, 315 mg P, 8.2 mg Fe, 5.4 mg Zn, 5.4 mg Mn, 1.1mg Cu per 100 g **(El-Bushuty and Shanshan, 2019).**

Purslane (*Portulaca oleracea* L.)is known in Arabic and Egypt as "Rejlah" to the family "Portulacaceae" **(El Gindy, 2017).** Egypt produces 9.35 tons of Rejlah, which is high in protein, ash and fiber **(Hussien and Salem, 2016)**. Purslane leaves had 11.5% moisture, 16.1%fat, 26.2%protein, 15.1%, crude fiber and 13.84%, ash contents, respectively **(Benam et al., 2022).** Additionally, it contains vitamin C, carotene, vitamin E and B complex vitamins, such as riboflavin, thiamin, niacin and pyridoxine. It contains the highest levels of minerals like potassium, magnesium, calcium, phosphorus and iron **(Safaeian *et al.*, 2018).** Microelements found in Purslane leaves include zinc, iron, manganese and chromium that are 4.1, 315, 18.2 and 110 mg/100g, respectively. In addition, some macro minerals like calcium, potassium and magnesium were higher than wheat flour **(El-Gindy, 2017).**

Doum *(Hyphaene thebaica* L.) has been cultivated in ancient Egypt and can be found along the Nile River in Egypt and Sudan, where groundwater is present. Doum is globally recognized for its benefits and its powder is an ingredient in food as fiber, minerals and stabilizer, **(Shehata, 2020).** Doum pulp contains 7.05% proteins, 2.57% fat, 20.88 % crude fiber, 6.60% ash and 62.72% total carbohydrate, **(Seleem, 2015).** Doum fruit is rich in dietary fiber, carbs, minerals, vitamins, flavonoids and polyphenols, **(Aboshora, 2019).** The doum fruits are a comparative source of essential minerals and proteins. The doum contains more essential mineral elements than a person's daily needs. Thus, a balance may occur in the body's needs for mineral elements. The Doum fruit is a rich source of both carbohydrates and dietary fiber. Furthermore, the presence of micronutrients such as B vitamins and minerals like K, Na, Ca, Mg and P plays a crucial role in the regulation of bodily functions and impart health benefits, **(Shahin and Helal, 2021).**

Carob (*Ceratonia siliqua* L.) contains sugars, tannins, amino acids, minerals (K, Ca, Zn, Na, P and Fe) and vitamins (D, E, C, B6, Niacin and folic acid) vital for health, **(Shehata, 2022).** Carob pods contain high levels of carbohydrates (67.48%), moderate amounts of protein (6.64%), low levels of fat (2.24%) and around 11% dietary fibers. Carob is high in minerals, phenolic compounds and vitamins D, E, C, B6 and folic acid, **(Hafez and Mahgoub, 2023)**. Carob contains various minerals including potassium (843-1215 mg/100g), calcium (251-361mg/100g), magnesium (63-326 mg/100g), phosphorous (85-681 mg/100g), magnesium (63-326 mg/100g), sodium (4-7 mg/100g), iron (1.25 – 5.44 mg/100g) and zinc (0.61-4.27 mg/100g) ,**(Pazir and Alper, 2017).**

Material and Methods:

1. Materials:

1.1. Wheat flour (W.F.72% ext.):

Wheat flour (*Triticum aestevum*) (72% ext.) was obtained from North Cairo Powder Mills and Bakeries Company ,Cairo Governorate, Egypt.

1.2. Chickpea:

Chickpea (*Cicer arietinum* L.) dehulled and roasted were obtained from a local market in Benha Kalyuobia, Governorate, Egypt.

1.3. Purslane Leaves:

Fresh purslane (*Portulaca oleracea* L.) was harvested from a private field in Benha, Kalyuobia Governorate, Egypt before the flowering period during August 2020.

1.4. Doum fruit flakes and carob pods:

Flakes of doum fruit (*Hyphaene thebaica* **L.**) and carob pods (*Ceratonia siliqua* **L.**) were obtained from Ragab El-Attar market store located in Cairo Governorate, Egypt.

1.5. Baking ingredients:

Fresh eggs, vanilla, salts, baking powder, shortening, skim milk powder and sugar were obtained from the local market at Benha, Kalyuobia, Governorate, Egypt.

2. Methods:

2.1.a. Preparation of chickpea, doum and carob powders:

Chickpea, doum and carob powders were prepared by grinding (**Moulinex A59, France**) and sieved by using a sieve at 60 mesh.

2.1.b Preparation of purslane leaves powder:

Plants cleaned from dust and foreign matter, washed with tap water and then dried in a hot air oven maintained at 55ºC, milled, sieved by using a sieve at 60 mesh and kept in polyethylene bags until used. After that, all materials stored at 5°C until used.

2.2.1 Preparation of cupcake in the laboratory:

The cupcake processing method was taken according to **Dubat (2010)** with some modifications as follows:

The shortening was melted thoroughly, then, sugar and salt were added while mixing hard. We mixed the whole egg with vanilla and whipped it until became fluffy and had a creamy texture. Additionally, substituted wheat flour (72% ext.) with chickpea powder at 0, 10, 20 and 30% were separately mixed with baking powder and skimmed milk powder then gradually added to the whipped egg mixture. This mixture was mixed gently until got homogenous dough using a mixing machine (Braun M1000). After getting the appropriate texture the dough was poured into paper cups and then bakked at 180±5°C for 20-25 min. The cupcakes were left to cool for one hour before sensory evaluation and packaged in polyethylene bags and stored at 5°C. The cupcake formula is shown in Table (A).

Table (A): Cupcake formula

Ingredients	Grams
Soft wheat flour (72% ext.)	150
Whole fresh egg	39.75
Skimmed milk powder	15
Shortening	32
Sugar	75
Salt	2

Baking powder	6.81
Vanilla	1.5
Water	As required

2.2.2 Preparation of experimental cupcake:

Getting a trial cupcake will be in two stages :

1. Obtaining the best sample resulting from the replacement of wheat flour with chickpea powder and this sample is the control sample.

2. Adding powders of dried purslane leaves, doum powder and carob powder in different proportions, by replacing the aforementioned powders with wheat flour in the control sample as shown in Table (B).

Table (B) Experimental cupcake samples

Samples	Component
T1 :(W.F.72% ext.)	Wheat flour only.
T2*:(W.F.72% ext.+ chickpea powder)	90% W.F.72% ext. +10% chickpea powder.
T3*:(W.F.72% ext.+ chickpea powder)	80% W.F.72% ext. +20% chickpea powder.
T4*:(W.F.72% ext.+ chickpea powder)	70% W.F.72% ext. +30% chickpea powder.
T5: (W.F.72% ext.+ chickpea powder + purslane leaves powder)	Control sample + 2.5% substitution of dried purslane leaves powder from wheat flour.
T6: (W.F.72% ext.+ chickpea powder + purslane leaves powder)	Control sample + 5% substitution of dried purslane leaves powder from wheat flour
T7: (W.F.72% ext.+ chickpea powder + purslane leaves powder)	Control sample + 7.5% substitution of dried purslane leaves powder from wheat flour
T8: (W.F.72% ext.+ chickpea powder + purslane leaves powder)	Control sample + 10% substitution of dried purslane leaves powder from wheat flour
T9: (W.F.72% ext.+ chickpea powder + doum powder)	Control sample + 2.5% substitution of doum powder from wheat flour.
T10: (W.F.72% ext.+ chickpea powder+ doum powder)	Control sample + 5% substitution of doum powder from wheat flour.
T11: (W.F.72% ext.+ chickpea powder + doum powder)	Control sample + 7.5% substitution of doum powder from wheat flour.
T12: (W.F.72% ext.+ chickpea powder + doum powder)	Control sample + 10% substitution of doum powder from wheat flour.
T13: (W.F.72% ext.+ chickpea powder + carob powder)	Control sample + 5% substitution of carob powder from wheat flour.
T14 :(W.F.72% ext.+ chickpea powder + carob powder)	Control sample + 10% substitution of carob powder from wheat flour.
T15: (W.F.72% ext.+ chickpea powder + carob powder)	Control sample + 15% substitution of carob powder from wheat flour.
T16 (W.F.72% ext.+ chickpea powder + carob powder)	Control sample + 20% substitution of carob powder from wheat flour.

* From T2, T3 and T4 samples the most acceptable sample will be control sample

3.4. Methods:

3.4.1. Chemical analytical methods:

3.4.1.1. Proximate chemical analysis:

Moisture, crude protein, ether extract, ash and crude fiber contents were determined according to the methods described in the **(AOAC., 2012).** All determinations were performed in triplicates and the means were reported.

3.4.1.2. Determination of available carbohydrates:

Available carbohydrates were calculated by difference, according to **Kerolles (1986).**

3.4.1.3. Determination of total calories:

The determination of total calories was accomplished through application of the **FAO and WHO (1974)** specified equation as well as the equation as follows:

E = 4 (Carbohydrate % + protein %) + 9 fat %.

Where: E = Energy as calories per 100g sample.

3.4.2.8. Determination of essential minerals:

Calcium, magnesium, zinc, iron, copper and manganese were determined according to the method described in (**AOAC. 2016**) by using the atomic absorption spectroscopy technique. Potassium and sodium were determined by using a flame photometer **(Pye Unicom Sp. 1900 England)** in the laboratories of the Agricultural Research Center, Giza, Egypt. USA). Phosphorus content was determined calorimetrically by a spectrophotometer at 650 nm according to the method described in **AOAC (2016)**.

3.4.2. Sensory evaluation:

Sensory properties were carried out by 15 panelists from staff of the Food Tech. Res. Institute, Agric., Res. Center. Randomly coded samples were served to panelists individually. Seven sensory attributes were evaluated (crumb color, odor desirability, porosity, appearance, flavor, texture and overall acceptability) by using nine –points hedonic scale for each trait where 9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much and 1 =dislike extremely.

3.4.3. Statistical analysis:

The statistical analysis was carried out using two-way ANOVA using SPSS, ver. 25 (**IBM Corp. Released 2013**). Data were treated as a complete randomization design according to **Steel *et al.* (1997).** Multiple comparisons were carried out applying Duncan test the significance level was set at < 0.05.

Results and Discussion:

1. Proximate chemical composition of raw materials:

Data in Table (1) show the proximate chemical composition of wheat flour, chickpea, purslane leaves, doum and carob powders. The moisture content in wheat flour ranged from 3.73 to 11.77%, while it was significantly lower in chickpea powder. Doum powder contained significantly higher moisture content than those of carob and purslane leaves powders, which contained 10.46, 9.71 and 6.26% of doum, carob and purslane leaves powders respectively. These findings coincide with those obtained by **Sharoba *et al.* (2013), Abd El-Aziz *et al.* (2014), Abd Rabou and Al-Sadek (2018), Limam (2020) and Papageorgiou *et al.* (2020).**

Crude protein content varied from 5.30 to 24.39%. Purslane leaves powder had the highest level and doum powder had the lowest level. No significant difference in protein content was observed between purslane leaves powder and chickpea powder, with both containing 24.39% and 24.36%, respectively. This result was in harmony with **El-Hadidy *et al.* (2013), Higazy *et al.* (2018), Khalaf *et al.* (2018), El-Said *et al.* (2021) and Kolla *et al.* (2021).**

Ether extract was found to be between 0.97% and 6.28%. The purslane leaves powder had a considerably higher level, whereas the doum powder had a significantly lower level. The statistical analysis found no noteworthy distinctions in the ether extract content of purslane leaves and chickpea powder, both having 6.28% and 5.99%, respectively. This result was in harmony with **Rizk *et al.* (2015), El-Refai *et al.* (2015), El-Hadidy *et al.* (2020), Shehata (2020) and Gabr *et al.* (2021)**

Table 1. Proximate chemical composition of raw materials (mean±SE).

Component (%)	Raw materials				
	Wheat flour 72%ext.	**Chickpea powder**	**Purslane powder**	**Doum powder**	**Carob powder**
Moisture	**11.77 ± 0.06^{A}**	**3.73 ± 0.19^{E}**	**6.26 ± 0.05^{D}**	**10.46 ± 0.10^{B}**	**9.71 ± 0.28^{C}**
Crude protein*	**12.72 ± 0.08^{B}**	**24.36 ± 0.17^{A}**	**24.39 ± 0.08^{A}**	**5.30 ± 0.08^{D}**	**7.24 ± 0.15^{C}**
Ether extract*	**1.03 ± 0.01^{B}**	**5.99 ± 0.15^{A}**	**6.28 ± 1.07^{A}**	**0.97 ± 0.01^{B}**	**1.72 ± 0.04^{B}**
Ash*	**0.66 ± 0.01^{E}**	**2.86 ± 0.06^{D}**	**19.97 ± 0.09^{A}**	**8.29 ± 0.14^{B}**	**3.69 ± 0.12^{C}**
Crude fiber*	**0.76 ± 0.01^{E}**	**4.55 ± 0.08^{D}**	**10.51 ± 0.07^{B}**	**19.15 ± 0.15^{A}**	**9.30 ± 0.2^{C}**
Available carbohydrate*@	**84.83 ± 0.07^{A}**	**62.24 ± 0.22^{D}**	**38.85 ± 1.01^{E}**	**66.29 ± 0.05^{C}**	**78.05 ± 0.22^{B}**

* On dry weight basis. @; calculated by difference.

A, B & C: There is no significant difference (P>0.05) between any two means, within the same row has the same superscript letter.

The ash content values ranged between 0.66 and 19.97%.The purslane leaves powder demonstrated significantly greater ash content compared to wheat flour, which have a significantly lower ash content value. The comparative analysis of doum, carob and chickpea powders reveled that doum powder displays a significant increase in ash content as compared to the carob and chickpea powders. Specifically, the ash content of doum, carob and chickpea powders was found to be 8.29, 3.69 and 2.86%, respectively. These results are agreement with the ones reported by **El-Refai *et al.* (2015), Hana (2019), Gabr *et al.* (2021) and Makram *et al.* (2023).**

Crude fiber content, ranged from 0.76 to 19.15%. The doum powder exhibited higher levels of crude fiber content, in contrast to the wheat flour which showed significantly lower values .Purslane leaves powder contained significantly higher content of crude fiber than those of carob and chickpea powders, which contained 10.51, 9.30 and 4.55% of purslane, carob and chickpea powders, respectively. The results agreed with the ones reported by **El-Hadidy *et al.* (2013), El-Refai *et al.* (2015), Hana (2019), Shahin and Helal (2021) and Shehata (2022).**

The available carbohydrates exhibited a range of 38.85 to 84.83%. Wheat flour had the highest level, while purslane leaves powder had the lowest level. Carob powder contained a significantly higher content of available carbohydrates (78.05%) than those in doum powder (66.29%) and chickpea powder (62.24%). These results are agreement with the ones reported by **Hadidy *et al.* (2013), El-Refai et al. (2015), Hana (2019), Shehata (2020) and El-Said *et al.* (2021).**

2. Minerals content of raw materials:

Data in Table (2) displays the minerals content of wheat flour, chickpea, purslane leaves, doum and carob powders. Potassium (K) ranged from 120.06 to 5357.87 mg/100 g. The observed value demonstrated a statistically significant elevation in purslane leaves powder, while it was significantly lower in wheat flour. Carob powder contained significantly higher content from K than those of doum and chickpea powders, which contained 1276.89, 842.45 and 292.28 mg/100 g of carob, doum and chickpea powders, respectively.

Calcium (Ca) content ranged from 20.87 to 926.71 mg/100 g, which exhibited significantly higher levels in purslane leaves powder, while it was exhibited significantly lower levels in in wheat flour. Carob powder contained significantly higher content from Ca than those of doum and chickpea powders, which contained 377.74, 286.64 and 137.31 mg/100 g of carob, doum, chickpea powders, respectively.

Magnesium (Mg) content ranged from 115.39 to 1207.86 mg/100g.Magnesium in purslane leaf powder had a significantly higher content while, wheat flour had a lower one. Doum powder contained significantly higher content of Mg than those of carob and chickpea powders, which contained 171.10, 120.84 and 140.08 mg/100 g of doum, carob and chickpea powders, respectively. No significant differences in Mg content between carob powder and wheat flour. `

Sodium (Na) content ranged from 4.14 to 247.24 mg/100 g, which exhibited significantly higher levels in purslane leaves powder, while it was exhibited significantly lower levels in wheat flour. Doum powder contained significantly higher content of Na than those of chickpea and carob powders, which contained 214. 49, 114.95 and 52.43 mg/100 g of doum, carob and chickpea powders, respectively.

Phosphorus (P) content ranged from 184.04 to 836.29 mg/100 g, which exhibited significantly higher levels in purslane leaves powder, while it was exhibited significantly lower levels in wheat flour Carob powder contained significantly higher content from P than those of chickpea and doum powders, which contain 476.85, 395.46 and 377.92 mg/100g of carob, chickpea and doum powders, respectively.

Iron (Fe) content ranged from 1.17 to 79.59 mg/100 g, the observed value demonstrated a statistically significant elevation in purslane leaves powder, while it was significantly lower in wheat flour. Carob powder contained significantly higher content from Fe (25.31 mg/100 g) than those of chickpea powder (5.47 mg/100 g) and doum powder (5.40 mg/100 g).

Table 2. Minerals content of raw materials (mg/100 g on dry weight basis) (mean±SE)

Mineral elements	Raw materials				
	Wheat flour 72%ext.	**Chickpea powder**	**Purslane powder**	**Doum powder**	**Carob powder**
K	**120.06±2.47^{E}**	**292.28±2.63^{D}**	**5357.87±13.82^{A}**	**842.45±2.75^{C}**	**1276.89±2.98^{B}**
Ca	**20.87±0.25^{E}**	**137.31±1.46^{D}**	**926.71±3.51^{A}**	**286.64±3.27^{C}**	**377.74±3.82^{B}**
Mg	**115.39±1.85^{D}**	**140.08±1.17^{C}**	**1207.86±3.28^{AA}**	**171.10±1.08^{B}**	**120.84±1.14^{D}**
Na	**4.14±0.06^{E}**	**114.95±2.13^{C}**	**247.24±1.30^{A}**	**214.49±1.51^{B}**	**52.43±0.71^{D}**
P	**184.04±3.48^{E}**	**395.46±2.26^{C}**	**836.29±3.67^{A}**	**377.92±2.66^{D}**	**476.85±0.70^{B}**
Fe	**1.17±0.01^{D}**	**5.47±0.06^{C}**	**79.59±0.41^{A}**	**5.40±0.06^{C}**	**25.31±0.29^{B}**
Zn	**1.89±0.01^{D}**	**2.29±0.06^{B}**	**5.12±0.41^{A}**	**1.95±0.06^{D}**	**2.15±0.29^{C}**
Cu	**0.84±0.02^{C}**	**0.83±0.02^{CD}**	**1.53±0.02^{A}**	**0.99±0.01^{B}**	**0.79±0.01^{D}**
Mn	**2.69±0.03^{D}**	**3.29±0.03^{C}**	**4.66±0.02^{A}**	**3.76±0.03^{B}**	**1.33±0.01^{E}**

A, B & C: There is no significant difference (P>0.05) between any two means, within the same row has the same superscript letter.

Zinc (Zn) content ranged from 1.89 to 5.12 mg/100 g and purslane leaf powder had a significantly higher content than wheat flour**.**Chickpea powder contained significantly higher content from Zn (2.29 mg/100 g) than those of carob powder (2.15 mg/100 g) and doum powder (1.95 mg/100 g).

Copper (Cu) ranged from 0.79 to 1.53 mg/100 g. The obtained value demonstrated a statistically significant elevation in purslane leaves powder, while it was significantly lower in carob powder. Doum powder contained significantly higher content of Cu (0.99 mg/100 g) than those of wheat flour (0.84 mg/100 g), chickpea powder (0.83 mg/100 g) and carob powder (0.79 mg/100 g).

Finally, manganese (Mn) content ranged from 1.33 to 4.66 mg/100g .The obtained value demonstrated a statistically significant elevation in purslane leaves powder, while it was significantly lower in carob powder. which was significantly higher in purslane leaves powder, while it was significantly lower in carob powder. Doum powder contained significantly higher content from Mn (3.76 mg/100 g) than those chickpea powder (3.29 mg/100 g) and wheat flour (2.69 mg/100 g). These results agreedt with those obtained by **Alajaji and El-Adawy (2006), Abdel-aal *et al.* (2011), Aboshora *et al.* (2014), Rosiak *et al.* (2015), El-Gindy (2017), Abd Rabou and Al-Sadek (2018), Datti *et al.* (2020), Kolla *et al.* (2021) and Mousa (2022).**

3. Sensory evaluation of cupcake:

The evaluation of a product's sensory attributes is a significant criterion that enables the assessment of its acceptability by consumers. The organoleptic quality criteria crumb color, odor desirability, porosity, appearance, flavor, texture and overall acceptability of cupcake partially substituted of wheat flour with chickpea powder at levels 0 % (T1), 10% (T2), 20% (T3) and 30% (T4)) were evaluated to determine the best replacement level which will be the control sample in the following part in sensory evaluation and determine the best of level partially substituted of wheat flour with purslane leaves, doum and carob powders. The means of sensory scores of cupcake partially substituted wheat flour with chickpea powder are shown in Table (3). Results indicate that the overall acceptability among the samples ranged from 6.72 to 8.01, with the T1 sample had the highest score. Conversely, the T4 sample exhibited a significantly lower acceptability scores. As revealed through the statistical analysis there were non significant disparities in the general level of acceptance between T1 and T3 samples, as well as between T2 and T4 samples.

Table 3. Sensory evaluation of cupcake supplemented with different ratios of chickpea powder (mean±SE).

Sample	Sensory properties						Overall acceptability
	Crumb color	Odor desirability	Porosity	Appearance	Flavor	Texture	
T1	8.22 ±0.14^{a}	8.03 ±0.13^{a}	7.91 ±0.30^{a}	7.88 ±0.22^{a}	8.09 ±0.11^{a}	8.11 ±0.15^{a}	8.01 ±0.12^{a}
T2	7.78 ±0.19^{ab}	7.78 ±0.22^{a}	7.00 ±0.22^{b}	7.45 ±0.18^{ab}	7.47 ±0.29^{ab}	7.17 ±0.28^{bc}	7.26 ±0.26^{b}
T3	7.78 ±0.20^{ab}	8.00 ±0.18^{a}	7.13 ±0.19^{b}	7.78 ±0.18^{a}	7.91 ±0.18^{a}	7.61 ±0.25^{ab}	7.88± 0.20^{a}
T4	7.34 ±0.24^{b}	7.16 ±0.29^{b}	6.92 ±0.34^{b}	6.88 ±0.26^{b}	6.88 ±0.24^{b}	6.89 ±0.25^{c}	6.72 ±0.18^{b}

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter

T1: (100% wheat flour 72% ext.) T2: (90% wheat flour +10% chickpea powder)

T3: (80% wheat flour +20% chickpea powder) T 4 :(70% wheat flour +30% chickpea powder)

In general, from the obtained results in Table (3) it could be concluded that the T3 sample characterized with good sensory properties and acceptability when compared with T1 and two other samples (T2 and T4). The mentioned data are in accordance with those obtained by **Makram *et al.* (2023).** Sensory evaluation of control sample partially substituted wheat flour with purslane powder at levels 0% (control or T3), 2.5% (T5), 5% (T6), 7.5% (T7) and 10% (T8), doum powder at levels 0% (control or T3), 2.5% (T9), 5% (T10), 7.5% (T11) and 10% (T12) and carob powder at levels 0% (control or T3), 5% (T13), 10 % (T14), 15% (T15) and 20% (T16) were evaluated to determine the best replacement level is shown in Table (4).

Overall acceptability of cupcake partially substituted wheat flour with purslane leaves powder ranged from 7.68 to 8.27, which was significantly higher in T7, while significantly lower in T8.

In general, from the obtained results, it could be observed that the T7 sample characterized with good sensory properties and acceptability when compared with the other samples. Results agree with previous findings by **El-Gindy (2017).**

Overall acceptability of cupcake produced by control cupcake with partial replacement of their wheat flour with doum powder ranged from 7.56 to 8.11, that was higher in T3 sample, while it was lower in T12 sample. Statistical analysis did not appear any significant differences in overall acceptability between control, T9, T10 and T11 and also between T9, T10, T11 and T12 samples, respectively. In general, from the obtained results, it is observed that the cupcake produced by partial replacement of their wheat flour with doum powder at level 7.5% (T11 sample) it has good sensory characteristics and acceptability when compared with the other samples except T3sample .The results were in agreement with that of **Abd Rabou and Al-Sadek (2018).** The means of sensory scores of cupcake produced by control cupcake with partial replacement of their wheat flour with carob powder is presented in Table (4). In general, from the obtained results, it could be noticed that the cupcake produced by partial replacement of their wheat flour with carob powder at level 15% (T15 sample) it has good sensory characteristics and acceptability when compared with the other samples except T3sample. These results are in agreement with that of reported by **Abd Rabou and Al-Sadek (2018)** as shown in doum sample.

Table 4. Sensory evaluation of control cupcake partially substituted of wheat flour with purslane , doum and carob powders (mean±SE).

Samples	Properties						
	Crumb color	**Odor desirability**	**Porosity**	**Appearance**	**Flavour**	**Texture**	**Overall acceptability**
Control cupcake with purslane							
T3	**8.23±0.19^{a}**	**8.15±0.27^{a}**	**7.65±0.23^{a}**	**8.00±0.21^{ab}**	**8.19±0.17^{a}**	**8.15±0.27^{a}**	**8.07±0.2 ^{ab}**
T5	**7.91±0.21^{a}**	**8.15±0.19^{a}**	**7.77±0.21^{a}**	**8.00±0.20^{ab}**	**8.00±0.23^{a}**	**8.22±0.23^{a}**	**8.00±0.17 ^{ab}**
T6	**7.85±0.20^{a}**	**8.18±0.25^{a}**	**7.87±0.23^{a}**	**7.82±0.17^{ab}**	**7.69±0.26^{ab}**	**7.98±0.29^{a}**	**7.90±0.18 ^{ab}**
T7	**8.17±0.21^{a}**	**8.14±0.19^{a}**	**8.00±0.28^{a}**	**8.31±0.16^{a}**	**8.25±0.16^{a}**	**8.62±0.20^{a}**	**8.27±0.15 ^{a}**
T8	**7.84±0.25^{a}**	**7.63±0.23^{a}**	**7.57±0.21^{a}**	**7.59±0.26^{b}**	**7.38±0.21^{b}**	**7.94±0.27^{a}**	**7.68±0.18 ^{b}**
Control cupcake with doum powder							
T3.	**8.42±0.29^{a}**	**8.08±0.14^{a}**	**7.83±0.17^{a}**	**8.25±0.18^{ab}**	**7.83±0.17^{a}**	**8.17±0.17^{a}**	**8.11±0.15 ^{a}**
T9	**8.00±0.25^{a}**	**7.25±0.13^{c}**	**7.50±0.19^{ab}**	**8.50±0.19^{a}**	**7.58±0.19^{a}**	**7.33±0.14^{b}**	**7.69±0.1 ^{ab}**
T10	**8.25±0.28^{a}**	**7.50±0.15^{bc}**	**7.08±0.26^{b}**	**8.33±0.26^{ab}**	**7.58±0.19^{a}**	**7.33±0.14b**	**7.68±0.13 ^{ab}**
T11	**8.33±0.26^{a}**	**7.88±0.14^{ab}**	**7.00±0.25^{b}**	**8.13±0.35^{ab}**	**7.96±0.39^{a}**	**7.04±0.18^{bc}**	**7.73±0.21 ^{ab}**
T12	**8.33±0.26^{a}**	**7.50±0.22^{bc}**	**7.00±0.30^{b}**	**7.67±0.28^{b}**	**8.04±0.39^{a}**	**6.75±0.21^{c}**	**7.56±0.21 ^{b}**
Control cupcake with carob powder							
T3	**8.25±0.22^{a}**	**7.79±0.26^{a}**	**8.08±0.26^{a}**	**7.96±0.13^{a}**	**7.67±0.28^{a}**	**7.79±0.23^{a}**	**7.93±0.2 ^{a}**
T13	**8.00±0.30^{a}**	**7.75±0.23^{a}**	**7.58±0.19^{ab}**	**7.54±0.23^{ab}**	**7.96±0.25^{a}**	**7.63±0.22^{a}**	**7.75±0.2 ^{a}**
T14	**8.25±0.22^{a}**	**7.67±0.22^{a}**	**7.42±0.22^{ab}**	**7.33±0.23^{ab}**	**8.00±0.19^{a}**	**7.58±0.20^{a}**	**7.72±0.15 ^{a}**
T15	**8.25±0.22^{a}**	**8.04±0.27^{a}**	**7.38±0.30^{ab}**	**7.25±0.20^{b}**	**8.17±0.26^{a}**	**7.54±0.23^{a}**	**7.79±0.16 ^{a}**
T16	**8.17±0.24^{a}**	**7.92±0.29^{a}**	**7.21±0.31^{b}**	**7.08±0.33^{b}**	**8.21±0.26^{a}**	**7.63±0.22^{a}**	**7.72±0.21 ^{a}**

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column has the same superscript letter.
T3: Control cupcake (80%wheat flour +20% chickpea powder)
T5: (Control cupcake +2.5% substitution of purslane powder) T6: (Control cupcake +5% substitution of purslane powder)
T7: (Control cupcake +7.5% substitution of Purslane powder) T8: (Control cupcake +10% substitution of purslane powder)
T9: (Control cupcake +2.5% substitution of doum powder) T10: (Control cupcake +5% substitution of doum powder)
T11: (Control cupcake +7.5% substitution of doum powder) T12: (Control cupcake +10% substitution of doum powder)
T13: (Control cupcake +5% substitution of carob powder) T14: (Control cupcake +10% substitution of carob powder)
T15: (Control cupcake +15% substitution of carob powder) T16: (Control cupcake +20% substitution of carob powder)

4. Proximate chemical composition of cupcake:

Data in Table (5) show moisture content of cupcake samples ranged between 30.83 to 33.90%, that was higher in T3, while it was significantly lower in T1. Non significant differences in moisture content between T3 and T7 and also between T7 and T15, respectively. These results are in agreement with the ones reported by **Lee *et al.* (2008)**

Crude Protein content ranged between 12.87 to 16.28 %, that was significantly higher in T7, but was significantly lower in T1.T3 sample contained significantly higher content from crude protein (15.33%) than those of T4 (14.16%) and T5 (14.60%), respectively. There were non-significant differences in crude protein content between T11 and T15 samples. These results agreed with those obtained by **Fidan *et al.* (2019), Siddeeg *et al.* (2019), Benam *et al.* (2022) and Jabeen *et al.* (2022).**

Ether extract ranged between17.38 to 19.66 and it was significantly higher in T3 sample but was significantly lower in T1 sample. Statistical analysis showed non-significant differences in ether extract between T3 and T7, also between T3, T11 and T15 samples, respectively. These results are in agreement with those obtained by **Abdel-Haleem and Hafez (2015), Seleem (2015), El-Naggar and Hassan (2018) and Benam *et al.* (2022).**

Table 5. Chemical composition of cupcake treatments (mean±SE).

Component (%)	Type cupcake				
	(T1)	(T3)	(T7)	(T11)	(T15)
Moisture	30.83±0.33^{D}	33.90±0.13^{A}	33.39±0.17^{AB}	32.43±0.15^{C}	33.11±0.34^{BC}
Crude Protein*	12.87±0.18^{D}	15.33±0.15^{B}	16.28±0.22^{A}	14.16±0.25^{C}	14.60±0.25^{C}
Ether extract*	17.38±0.25^{C}	18.90±0.25^{AB}	19.66±0.28^{A}	18.41±0.46^{B}	18.69±0.22^{B}
Ash*	2.95±0.06^{D}	3.71±0.08^{C}	4.72±0.11^{A}	4.07±0.06^{BC}	3.89±0.04^{BC}
Crude fiber*	0.89±0.03^{D}	1.00±0.01^{C}	1.46±0.03^{B}	1.71±0.03^{A}	1.69±0.04^{A}
Available carbohydrate*@	65.92±0.06^{A}	61.05±0.17^{B}	57.89±0.60^{C}	61.65±0.42^{B}	61.14±0.48^{B}

* On dry weight basis @; calculated by difference
A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.
T1: (100%wheat flour)
T3: (80%wheat flour +20% chickpea powder)
T7: (72.5% wheat flour +20% chickpea powder+7.5% purslane leaves powder)
T11: (72.5% wheat flour +20% chickpea powder+7.5% doum powder)
T15:(65 % wheat flour +20% chickpea powder+15% carob powder)

Total ash ranged between 2.95 to 4.72%, that was significantly higher in T7, however it was significantly lower in T1. T11 contained significantly higher content from total ash (4.07%) than those of T3 (3.71%). Non-significant differences of total ash content between T11 and T15, also between T3 and T15 of samples, respectively. These results are in agreement with those obtained by **Abdel-Haleem and Hafez (2015), Shahin and Helal (2021), Benam *et al.* (2022) and Hafez and Mahgoub (2023).**

Crude fiber ranged between 0.89 to 1.71% on dry weight basis, that was significantly higher in T11. Non-significant differences of crude fiber content between T11 and T15 samples. T7 contained significantly higher content from crude fiber (1.46%) than those of T3. These results are comparable with those obtained by **El-Bushuty and Shanshan (2019), Siddeeg *et al.* (2019), Shanshan and El-Bushuty (2020) and Hafez and Mahgoub (2023).**

Available carbohydrates of cupcake ranged between 57.88 to 65.91% on dry weight basis that was significantly higher in T1, while it was significantly lower T7 samples. Statistical analysis showed non-significant differences in significant differences in available carbohydrates between T3, T11 and T15, which contained 61.06 .61.65 and 61.13%, respectively. These results are similar to those obtained by **Seleem (2015), Abd Rabou and Al-Sadek (2018), Mastud *et al.* (2018) and Makram *et al.* (2023).**

5. Minerals content of cupcake:

Data in Table (6) show minerals content of different samples of cupcake. Potassium content (K) ranged between 233.53 to 383.86 mg/100 g that was significantly higher in T7, while it was significantly lower in T1. T15 contained significantly higher content from K (317.82 mg/100 g) than those of T11 (269.69 mg/100 g) and T3 (248.90 mg/100 g), respectively.

Calcium (Ca) content ranged between107.95 to 144.49 mg/100 g, that was significantly higher in T7, while it was significantly lower T1. Non-significant differences in Ca content between T7 and T11, which contained 144.49 and 140.74 mg/100 g, respectively. T11 contained significantly higher content from Ca (130.13 mg/100 g) than those of T3 (117.83).

Magnesium (Mg) content ranged between 66.77 to 98.21 mg/100 g on that was significantly higher in T7, while it was significantly lower T1. Statistical analysis showed non- significant in Mg content between T3, T11 and T15 samples, which contained 69.45, 69.47 and 68.06 mg/100g, respectively.

Sodium content (Na) ranged between 378.84 to 403.30 mg/100 g, that was significantly higher in T11, while it was significantly lower in T1. Statistical analysis showed non- significant differences in Na content between T7 (399.61 mg/100 g) and T4 (403.31 mg/100 g); T3 (395.60 mg/100 g) and T7 (399.61 mg/100 g) and between T3 (395.60 mg/100 g) and T15 (392.57 mg/100 g) of the cupcake, respectively.

Phosphorus (P) content ranged between 165.16 to 200.41 mg/100 g, that was significantly higher in T7, while it was significantly lower T1. Non- significant differences in Ca content between T7 and T15 and also between T2 and T11 which contained 200.41, 200.14 mg/100 g, 184.26 and 188.35 mg/100 g, respectively.

Iron (Fe) content of between 1.27 to 3.28 mg/100 g, that was significantly higher in T7 , while it was significantly lower T1. T15 samples contained significantly higher content from Fe (2.96 mg/100 g) than those of T11 (1.77 mg/100 g) and T3 (1.64 mg/100 g), respectively.

Zinc content (Zn) ranged between 1.25 to 1.35 mg/100 g , that was significantly higher in T7 ,whiler it was significantly lower in T1. Statistical analysis showed non- significant differences in Zn content between T3, T7 and T15; T3 T11 and T15 and finally between T1 and T11 samples, respectively.

Table 6. Minerals content of cupcake (mean±SE)

Minerals (mg/100 g)	Type cupcake				
	Wheat(T1)	**Chickpea(T3)**	**Purslane(T7)**	**Doum(T11)**	**Carob(T15)**
K	**233.53±0.99E**	**248.9±3.25^{D}**	**386.86±3.43A**	**269.69±2.26C**	**317.82±1.59B**
Ca	**107.95±1.50D**	**117.83±1.63^{C}**	**144.49±1.24A**	**130.13±1.19B**	**140.74±10A**
Mg	**66.77±0.73B**	**69.45±0.69^{B}**	**98.21±1.54A**	**69.47±0.97B**	**68.06±0.90B**
Na	**378.84±2.74D**	**395.60±1.41^{BC}**	**399.61±1.51AB**	**403.31±2.44A**	**392.57±2.64C**
P	**165.16±1.96C**	**184.26±0.81^{B}**	**200.41±2.23A**	**188.35±1.85B**	**200.14±1.50A**
Fe	**1.27±0.01E**	**1.64±0.01^{D}**	**3.28±0.03A**	**1.77±0.02C**	**2.96±0.03B**
Zn	**1.25±0.01C**	**1.33±0.01^{AB}**	**1.35±0.03A**	**1.29±0.02BC**	**1.31±0.03AB**
Cu	**0.43±0.01^{A}**	**0.43±0.01^{A}**	**0.43±0.00A**	**0.42±0.00A**	**0.42±0.00A**
Mn	**1.25±0.01^{C}**	**1.31±0.01^{B}**	**1.35±0.01A**	**1.31±0.01B**	**1.22±0.00D**

A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.
T1: (100%wheat flour)
T3: (80%wheat flour +20% chickpea powder)
T7: (72.5% wheat flour +20% chickpea powder+7.5% purslane leaves powder)
T11: (72.5% wheat flour +20% chickpea powder+7.5% doum powder)
T15:(65 % wheat flour +20% chickpea powder+15% carob powder)

Cupper content (Cu) ranged between 0.42 to 0.43(mg/100 g on dry weight basis), that was higher in T7, while it was lower in T15. Non- significant differences in Cu content between all samples.

Manganese content (Mn) between 1.22 to 1.35 mg/100 g, that was significantly higher in T7, while it was significantly lower in T 15. T3 and T11 contained a similar amount of Mn (1.31 mg/100 g), that was significantly higher than those of T1 (1.25 mg/100 g).

Physical properties of cupcake:

Physical properties i.e. volume (cm3), weight (g) and specific of cupcake samples are shown in Table (7). Volume ranged between 82.33 to 88.00 cm3, that was significantly higher in T15, while it was significantly lower in T3. Statistical analysis showed non- significant differences in volume between control, T11 and T15 samples, also between control and T7 samples, while weight ranged between 34.53 to 35.90g, which was significantly higher in T7, while it was significantly lower in T3 sample. Statistical analysis showed non- significant differences of cupcake weight between T7, T11 and T15 samples and also between T1 and T3 samples, respectively. On the other hand, the specific volume of cupcake ranged between 2.37 to 2.52 cm3/g,that was significantly higher in the control sample, whoever it was significantly lower in T7 sample. Statistical analysis showed non- significant differences in specific volume between control and T11; between T11 and T15 samples, also between T3 and T7 samples, respectively. These results agreed with those obtained by **Jabeen *et al.* (2022) and Seleem (2015).**

Table 7. Physical properties of produced cupcake partially substituted of wheat flour with chickpea, purslane, doum and carob powders (mean±SE)

Properties	Cupcake samples				
	(T1)	**(T3)**	**(T7)**	**(T11)**	**(T15)**
Volume (cm^3)	**87.33±0.88^{AB}**	**82.33±0.67^{C}**	**85.33±0.88^{B}**	**87.67±0.33^{A}**	**88.00±0.58^{A}**
Weight (g)	**34.73±0.15^{B}**	**34.53±0.09^{B}**	**35.90±0.18^{A}**	**35.57±0.24^{A}**	**35.63±0.25^{A}**
Specific volume	**2.51±0.02^{A}**	**2.38±0.02^{C}**	**2.37±0.01^{C}**	**2.46±0.02^{AB}**	**2.45±0.02^{B}**

A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.
T1: (100%wheat flour)
T3: (80%wheat flour +20% chickpea powder)
T7: (72.5% wheat flour +20% chickpea powder+7.5% purslane leaves powder)
T11: (72.5% wheat flour +20% chickpea powder+7.5% doum powder)
T15:(65 % wheat flour +20% chickpea powder+15% carob powder)

Effect of storage period (at 5±2°C) on the sensory properties of produced cupcake:

Changes in sensory properties of crumb color, odor desirability, porosity, appearance, flavor, texture and overall acceptability of different cupcake samples during cold storage at (5±2°C) for 4 weeks are shown in Tables (8),

Crumb color:

Crumb color ranged between7.31 to 7.86, that was significantly higher in T3 sample, while it was significantly lower in T7 sample. Statistical analysis showed no significant differences in crumb color between T7 and T15 samples.

In the same table, it can be noted that the increas of storage period was accompanied by a significant decrease in crumb color score from 8.31

to 6.38, respectively. Statistical analysis showed non-significant differences in crumb color between zero time and 1 week.

Odor desirability:

Odor desirability ranged between6.98 to 7.74, that was significantly higher in T3 sample, while it was significantly lower in T7 sample. Statistical analysis showed no significant differences in crumb color between T3 and T11 samples.

In the same table it could be noticed that the increase of cold storage period was accompanied by a significant decrease in odor desirability score from 8.20 to 6.35. Statistical analysis showed no significant differences in odor desirability between zero time and 1 week.

Table 8. Sensory properties scores of cupcake samples during storage period at 5±2°C (mean±SE).

Cupcake samples	Storage period (week)					Mean of period
	0	1	2	3	4	
			Crumb color			
T3	8.58±0.12^{aA}	8.58±0.12^{aA}	7.88±0.13^{aB}	7.33±0.11^{aC}	6.92±0.06^{aD}	7.86±0.1^{a}
T7	8.08±0.14^{dA}	8.04±0.16^{dA}	7.83±0.14^{abB}	6.58±0.14^{C}	6.00±0.09^{dD}	7.31±0.13^{d}
T11	8.38±0.11^{bA}	8.25±0.18^{bA}	7.71±0.14^{bcB}	7.04±0.11^{bC}	6.42±0.1^{bD}	7.56±0.11^{b}
T15	8.21±0.13^{cdA}	8.13±0.2^{cdA}	7.63±0.14^{cB}	6.79±0.11^{cC}	6.17±0.11^{cD}	7.38±0.12^{cd}
Mean	8.31±0.07^{A}	8.25±0.09^{A}	7.76±0.07^{B}	6.94±0.07^{C}	6.38±0.07^{D}	
			Odor			
T3	8.29±0.11^{abA}	8.21±0.1^{abAB}	8.00±0.16^{aB}	7.54±0.14^{aC}	6.67±0.07^{abD}	7.74±0.09^{a}
T7	7.83±0.17^{cA}	7.71±0.18^{cA}	7.42±0.24^{cB}	6.42±0.1^{dC}	5.50±0.15^{cD}	6.98±0.14^{c}
T11	8.46±0.1^{aA}	8.33±0.15^{aA}	7.63±0.27^{bB}	7.21±0.07^{bC}	6.75±0.12^{aD}	7.68±0.11^{a}
T15	8.21±0.1^{bA}	8.13±0.14^{bA}	7.54±0.21^{bcB}	7.00±0.09^{cC}	6.50±0.12^{bD}	7.48±0.10^{b}
Mean	8.20±0.07^{A}	8.09±0.08^{A}	7.65±0.11^{B}	7.04±0.08^{C}	6.35±0.09^{D}	
			Porosity			
T3	8.08±0.22^{aA}	7.88±0.25^{aA}	7.21±0.13^{aB}	6.92±0.1^{aC}	6.42±0.14^{aD}	7.30±0.11^{a}
T7	7.63±0.19^{cA}	7.42±0.24^{bA}	7.00±0.17^{abB}	6.71±0.21^{abC}	5.50±0.12^{cD}	6.85±0.13^{c}
T11	7.83±0.21^{bA}	7.58±0.21^{bB}	7.17±0.13^{abC}	6.83±0.11^{abD}	6.17±0.11^{bE}	7.12±0.1^{ab}
T15	7.83±0.14^{bA}	7.50±0.14^{bB}	6.96±0.21^{bC}	6.67±0.24^{bD}	6.17±0.11^{bE}	7.03±0.11^{bc}
Mean	7.84±0.1^{A}	7.59±0.11^{B}	7.08±0.08^{C}	6.78±0.09^{D}	6.06±0.08^{E}	
			Appearance			
T3	8.42±0.18^{aA}	8.21±0.24^{aA}	7.54±0.14^{aB}	7.13±0.14^{aC}	6.67±0.07^{aD}	7.59±0.11^{a}
T7	7.88±0.19^{bA}	7.71±0.21^{cA}	7.38±0.22^{aB}	6.13±0.07^{cC}	5.17±0.07^{cD}	6.85±0.15^{c}
T11	7.96±0.23^{bA}	7.83±0.24^{bcA}	7.46±0.23^{aB}	6.67±0.07^{bC}	6.08±0.1^{bD}	7.20±0.12^{b}
T15	8.08±0.12^{bA}	8.00±0.15^{abA}	7.38±0.28^{aB}	6.46±0.13^{bC}	5.92±0.06^{bD}	7.17±0.13^{b}
Mean	8.08±0.09^{A}	7.94±0.11^{A}	7.44±0.11^{B}	6.59±0.07^{C}	5.96±0.09^{D}	
			Flavor			
T3	8.21±0.11^{bA}	8.17±0.11^{bA}	7.54±0.14^{bB}	7.04±0.1^{bC}	6.67±0.11^{aD}	7.53±0.09^{b}
T7	7.42±0.12^{cA}	7.33±0.13^{cA}	7.08±0.1^{cB}	6.42±0.15^{dC}	5.08±0.06^{cD}	6.67±0.12^{d}
T11	8.08±0.1^{bA}	8.08±0.1^{bA}	7.46±0.16^{bB}	6.88±0.15^{cC}	6.33±0.11^{bD}	7.37±0.1^{c}
T15	8.63±0.11^{aA}	8.67±0.09^{aA}	7.92±0.2^{aB}	7.38±0.09^{aC}	6.67±0.07^{aD}	7.85±0.11^{a}
Mean	8.08±0.08^{A}	8.06±0.09^{A}	7.50±0.09^{B}	6.93±0.08^{C}	6.19±0.10^{D}	
			Texture			
T3	8.08±0.1^{aA}	7.83±0.07^{aB}	6.75±0.16^{aC}	6.75±0.08^{aC}	6.33±0.14^{aD}	7.15±0.10^{a}
T7	7.13±0.15^{dA}	6.83±0.11^{cB}	6.67±0.15^{aB}	6.21±0.07^{cC}	5.00±0.00^{cD}	6.37±0.11^{c}
T11	7.50±0.15^{cA}	7.21±0.11^{bB}	6.71±0.23^{aC}	6.46±0.1^{bD}	5.67±0.11^{bE}	6.71±0.10^{b}
T15	7.71±0.11^{bA}	7.17±0.09^{bB}	6.67±0.24^{aC}	6.42±0.16^{bD}	5.67±0.14^{bE}	6.73±0.11^{b}
Mean	7.60±0.08^{A}	7.26±0.07^{B}	6.70±0.10^{C}	6.46±0.06^{D}	5.67±0.09^{E}	
			Overall acceptability			
T3	8.29±0.11^{aA}	8.14±0.12^{aB}	7.50±0.09^{aC}	7.13±0.05^{aD}	6.63±0.06^{aE}	7.54±0.09^{a}
T7	7.67±0.1^{cA}	7.50±0.10^{cB}	7.23±0.13^{cC}	6.40±0.09^{cD}	5.38±0.03^{cE}	6.84±0.12^{c}
T11	8.05±0.1^{bA}	7.90±0.09^{bB}	7.35±0.14^{bC}	6.83±0.02^{bD}	6.25±0.05^{bE}	7.28±0.1^{b}
T15	8.10±0.07^{bA}	7.93±0.06^{bB}	7.35±0.17^{bC}	6.78±0.07^{bD}	6.18±0.05^{bE}	7.27±0.10^{b}
Mean	8.03±0.06^{A}	7.87±0.06^{B}	7.36±0.07^{C}	6.78±0.05^{D}	6.11±0.07^{E}	

a, b & c: There is no significant difference (P>0.05) between any two means for the same attribute, within the same column have the same superscript letter.

A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

T3: (80%wheat flour +20% chickpea powder)

T7: (72.5% wheat flour +20% chickpea powder+7.5% Purslane leaves powder)
T11: (72.5% wheat flour +20% chickpea powder+7.5% doum powder)
T15 :(65 % wheat flour +20% chickpea powder+15% carob powder)

Porosity

Porosity ranged between 6.85 to 7.30, that were significantly higher in T3 sample, while it was significantly lower inT7 sample. Statistical analysis showed non- significant differences in porosity between T3 and T11 samples, between T11 and T15, T7 and T15 samples, respectively.

From the same table, it could be seen that the increase of cold storage period was accompanied by significantly decrease in porosity score from 7.84 to 6.06. Statistical analysis showed no significant differences in porosity between zero time and 1 week.

Appearance:

Appearance ranged between 6.85 to 7.59, that was significantly higher in T3 sample, while was significantly lower in T7 sample. Statistical analysis showed no significant differences in appearance between T11 and T15 samples.

In the same table, it could be noticed that the increase of cold storage period was accompanied by significantly decrease in appearance score from 8.08 to 5.96. Statistical analysis showed no significant differences in appearance between zero time and 1 week.

Flavor:

Flavor ranged between 6.67 to 7.85, that was significantly higher in T15 sample, while it was significantly lower in T7 sample.

In the same table, it could be noticed that the increase of cold storage period was accompanied by significantly decrease in in flavor score from 8.08 to 6.19. Statistical analysis showed no significant differences in flavor between zero time and 1 week.

Texture:

Texture ranged between 6.37 to 7.15, that was significantly higher in T3 sample, while it was significantly lower in T7 sample. Statistical analysis showed non- significant differences in texture between T11 and T15 samples

In the same table, it could be noticed that the increase of cold storage period was accompanied by significantly decrease in texture score from 7.60 to 5.67.

Overall acceptability

Overall acceptability ranged between 6.84 to 7.54, that was significantly higher in T3 sample, while it was significantly lower in T7 sample. Statistical analysis showed non- significant differences in overall acceptability between T11 and T15 samples.

In the same table, it could be noticed that the increase of cold storage period was accompanied by significantly decrease in overall acceptability score from 8.03 to 6.11 These results are completely in agreement with **Toliba and Mohamed (2019) and Jabeen *et al.* (2022).**

Conclusion

It can be concluded that chickpea, purslane leaves, doum and carob powders can be used as a successful replacer sources in cupcake, which contained higher of minerals, protein, fiber, polyphenols and other bioactive components, which are involved in protection against several diseases (cardiovascular, neuronal and anemia). In addition to that purslane leaves, doum and carob should be increasing interest as an ingredient in food industry, particularly in the development of functional and healthy food formulations such as cupcake, biscuits and bread for some patients.

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الخواص الفيزيوكيميائية والحسية لكب كيك وظيفى مصنوع من دقيق القمح المستبدل بمسحوق الحمص ، مسحوق الرجلة ، مسحوق الدوم و مسحوق الخروب

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هدفت هذه الدراسة إلى إنتاج كب كيك وظيفى منتج من دقيق القمح (72% إستخلاص) مستبدلا بمسحوق الحمص بنسبة 10 ،20 و 30%).وكانت أعلى درجات التقييم الحسي للكب كيك المعد من 80٪ دقيق قمح و 20٪ مسحوق حمص وتم إعتبار هذه المعاملة هى عينة الكنترول .تم الإستبدال الجزئى لدقيق القمح (80%) فى معاملة الكنترول بكل من مساحيق أوراق الرجلة ، الدوم والخروب بشكل منفصل كمصادر طبيعية لإنتاج كب كيك وظيفي مناسب لمرضى فقر الدم بسبب نقص الحديد.وكانت نسب إستبدال كل من مسحوق أوراق الرجلة ومسحوق الدوم 2.5،5.0 ،7.5و10.0% بينمامسحوق الخروب بنسب إستبدال 5.0 ،10 ،15 و20% وتبين من التقييم الحسى أن أفضل نسب الإستبدال بمسحوق أوراق الرجلة ومسحوق الدوم ومسحوق الخروب كانت بنسب 7.5، 7.5 و15٪ ،على التوالي كما تم دراسة التركيب الكيميائي التقريبي والعناصر المعدنية للمواد الخام وكذلك لمعاملات الكب كيك المفضلةأيضا. تم دراسة الخصائص الفيزيائية والحسية للكب كيك المحضر. أظهرت النتائج أن دقيق الحمص ،مسحوق أوراق الرجلة ،مسحوق الدوم ومسحوق الخروب كان لها خصائص غذائية جيدة وأن زيادة مستويات الاستبدال أدت إلى زيادة نسبة الدهن ،الألياف الخام ،الرماد و العناصر المعدنية في الكب كيك المنتج مقارنة بعينة الكنترول. أظهرت نتائج تحليل الرماد للكب كيك المنتج زيادة في معظم العناصر المعدنية. تم تقييم الصفات الفيزيائية للكب كيك المنتج وأظهرت النتائج أن حجم الكب كيك المنتج انخفض مع زيادة مستوى الاستبدال من مسحوق كل من أوراق الرجلة ، الدوم ، الخروب . أظهرت نتائج التقييم الحسي انخفاضًا غير معنوي في القبول عن طريق زيادة وقت التخزين.

الكلمات المفتاحية: كب كيك – دقيق القمح – مسحوق الحمص – مسحوق أوراق الرجلة – مسحوق الدوم – مسحوق الخروب.