RESEARCH | Egyptian Journal of Agricultural Research | Food Technology

Utilization of garden cress seeds, flour, and tangerine peel powder to prepare a high-nutrient cake

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Received:01-12-2022 ; **Accepted**: 11-02-2023 ; **Published**:23-02-2023 **DOI:**10.21608/ejar.2023.176562.1309

ABSTRACT

This works shows the influence of blending garden cress seeds flour (GCSF) and tangerine peel powder (TPP) on preparing cake from refined wheat flour(WF). The chemical composition of raw materials (GCSF, TPP and WF) was investigated. GCSF had higher protein and fat contents (21.50 and 28.50 % respectively) and had lower available carbohydrate content(34.43%). GCSF had higher contents of most minerals than both TPP and WF. Different proportions of GCSF (2.5, 5, 7.5, and 10% replaced WF)with TPF (fixed 10% was added for all, except control sample-100% WF) were blended with wheat flour to prepare the cake. The cakes were analyzed for physicochemical, sensory, and textural properties. The physical characteristics of cakes such as weight, volume, and specific volume increased while the density decreased. Cakes containing GCSF and TPF exhibited high crude protein contents with improved color and a slight decrease in sensory properties. Textural attributes such as hardness, gumminess, chewiness and adhesiveness of cakes decreased with GCSF addition, while, there was a change in the parameters of color in comparison to control cakes. All proportions of supplemented cake samples were fresher and suitable for human consumption especially up to 7.5 % GCSF substitution. Hence GCSF and TPP can be used to improve the nutritional and physical characteristics of cakes.

Keywords: Garden cress, tangerine peels, cakes, texture, color, sensory properties

INTRODUCTION

Bakery manufacturing is one of the world's largest organized food businesses, with biscuits, crackers, and cakes being the most popular goods due to their easy, ready-to-eat form, and extended shelf life. Although processed wheat flour is the primary component in bread goods, its protein content is a lower quantity than that of other cereals. This is mostly due to wheat proteins' low lysine, methionine, and threonine levels. Furthermore, the processing of wheat into refined wheat flour resulted in a significant loss of nutrients. Such goods, however, may readily be supplemented with proteins, fibers, different vitamins, and minerals to satisfy the unique needs of target groups and vulnerable sections of malnourished individuals. Aside from increasing the availability of wheat flour, composite flour baking items offer other advantages. Baked goods can function as nutritional transporters (Shafi *et al.,* 2016; Shafi *et al.,*2017). Many diseases can benefit from alternative medicine in terms of prevention, slowing the progression, and even complete therapy (Patel *et al.,* 2017; Ung *et al.,* 2018; Balthazar *et al.,* 2021; Los *et al.,* 2021; Rabail *et al.,* 2021; Shabbir *et al.,* 2021;). To offer adequate nutrition, promote good health, and avoid illness, fresh ingredients are being enhanced due to the growing popularity of functional meals. Due to their nutritional advantages, omega-3 polyunsaturated fatty acids (omega-3 PUFA) are one of the most well-liked functional foods. To help achieve the RDA, a significant effort has been made to increase the daily dietary intake of omega-3 PUFA (Konieczka*et al.,* 2017). The term "baked goods" describes a wide range of food products made with flour, typically whole wheat flour (Martinez and Gomez, 2019).

Cookies and other baked goods like cakes/muffins are heavy in sugar and fat but yet make a delightful treat. By including a variety of plant-based elements with great nutritional value, several contemporary research organizations aim to enhance common bread products. Oilseeds include more protein than cereals and are rich in fiber, important PUFAs omega-3 and omega-6, tocopherol, beta-carotene, caffeic acid, chlorogenic acid, and flavonoids, which are all-natural antioxidants (Martinez and Gomez, 2019). A lower risk of various chronic diseases has been associated with a larger intake of plant-based diets. Functional nutrients that are present in a wide variety of plant species are the cause of these health advantages (Khan *et al.,* 2021; Wang *et al.,*2017). Customers are giving up on dietary supplements in favor of better eating practices (Rasheed *et al.,*2022). Garden cress (*Lepidium sativum*) is a delicious annual herbaceous plant. It is indigenous to Egypt and Southwest Asia and has long been used to cure a range of ailments. Its leaves, seeds, and roots offer medicinal properties, as well as significant levels of fat, protein, iron, and calcium (Doke and Guha, 2014; Jain and Grover, 2018). It contains angular, reddish-colored seeds that are slightly curled on one end. The seed is the same in texture, odorless, and pungent in flavor (Amawi and Aljamal, 2012). The seeds are extremely tiny and round (Vaishnavi and Choudhary, 2020).

The largest citrus by-product is citrus peels, which account for almost half of the fruit weight after processing. These by-products are discarded and are a substantial environmental burden (Wang *et al.,* 2008 and 2014). Because of their low-cost usable components, these byproducts can be used as ingredients and food additives in the food industry (Galanakis, 2012). In Egypt and many other Mediterranean countries, a considerable share of citrus peels is not used in the appropriate applications. Several projects have been launched to use these leftovers as animal feed (Farhat *et al.,* 2011). Citrus peels contain natural ingredients that are beneficial to both human health and the food industry, such as carotenoids, flavonofolic acid, vitamin C, pectin, dietary fibers, and essential oils. Furthermore, citrus peels are an excellent source of phenolic chemicals, which can be isolated and used as natural antioxidants to prevent food from oxidizing or to create functional meals (Zaker *et al.,* 2017). Citrus peels can provide vital minerals that the human system requires to function normally. Iron (Fe) is required for haemoglobin synthesis and is also involved in oxygen and electron transport in the human body (Mahapatra *et al.,* 2012), as well as the correct functioning of the central nervous system and the oxidation of carbohydrates, proteins, and lipids. Anaemia with Fe deficiency is most likely connected to its role in aiding iron absorption and iron incorporation into haemoglobin.

The baking industry is regarded to be one of Egypt's most important food processing businesses. People enjoy baked foods because they are easily accessible, easy to consume, and have a long shelf life (Vijayakumar et al., 2013; Zaker*et al.,*2017). Cakes and cookies are examples of ready-to-eat goods enjoyed at home. These foods are deficient in phytochemicals, which are substances that help digestion, such as bioactive compounds and dietary fibers. These compounds can be obtained in modest amounts by supplementing wheat with flour prepared from citrus peels such as orange, mandarin, and lemon peels (Nassar *et al.,*2008; Youssef and Mousa, 2012; Akubor and Ishiwu, 2013; Kolo *al.,* 2016; Zaker *et al.,* 2017). Although these peels are high in dietary fibers and nutraceuticals, employing them as food components would conflict with attempts to decrease waste related to the development of new food sources (Mahmoud *et al.,* 2015; Ojha and Thapa, 2017).

The purpose of this study was to investigate the nutraceutical and functional potential of garden cress (*Lepidium sativum*) seeds flour (GCSF) based on its high nutritional value and low cost. Tangerine peels powder is added at a fixed percentage up to 10% in all GCSF-cake blends, to give the distinctive orange flavor, as well as to benefit from minerals such as iron, as well as vitamin C and beta-carotene, which increase the efficiency of iron absorption in the body. In addition, a healthy GCSF-fortified cake can be prepared for the general population that may be taken daily as a snack or breakfast.

MATERIALS AND METHODS

Preparation of cake:

We received garden cress seeds from the Agricultural Research Center in Giza, popularly known as "habarachad" in Egypt (2022). The seeds were cleaned of dirt, debris, foreign objects, and broken seeds. To create garden cress seeds flour (GCSF), the seeds were pulverized (Moulinex A59, France). For the sifting process, a sieve with a mesh size of 60 was utilized. The wheat flour was provided by the North Cairo Flour Mills Company in Egypt (72 percent ext.). Tangerine peels were washed, dried in the lab at 60°C for 4 hours, ground, and then filtered through a 60-mesh screen to create tangerine peel powder. The eggs, maize oil, sugar (sucrose), vanilla, salt, and baking powder were from the neighborhood market in Giza. El-Gomhoria Company for Trading Drugs, Chemicals, and Medical Instruments was used to get all analytical grade chemicals and reagents. Egypt's capital is Cairo.

The seeds were ground to make garden cress seeds flour (GCSF) by Moulinex A59, France. A 60 mesh size sieve was used for sieving GCSF, TPP and wheatflour (72 % ext.). The creamery procedure was defined by Masoodi*et al.,*(2002)for preparing cakes utilizing the components listed in Table 1. A beaten egg was added after completely mixing melted butter and sugar (sucrose). Using an electric mixer, a combination of flour was introduced and properly combined with baking powder. The baking was done in an electric oven at 180°C.

Table 1. Blends of cakes

Ingredients	Control	B1	B2	B3	B4
Wheat flour(g)	100	97.5	95	92.5	90
Garden cress seeds flour (g)	---	2.5	5.0	7.5	10
Tangerine peelsflour (g)	---	10	10	10	10
Powdered sugar (g)	84	84	84	84	84
Whole egg(g)	84	84	84	84	84
Baking powder (g)	7.0	7.0	7.0	7.0	7.0
Fat (vegetable fat) (g)	84	84	84	84	84

Proximate analysis of flours and cakes:

The proximate analysis was performed on flours (GCSF, TPP and WF) and prepared cakes to determine their chemical composition (Crude protein, crude fat, ash contents) of them according to the methods outlined by AACC, (2000). The carbohydrate content (%) was estimated by subtracting the crude ash, lipid, and protein contents from the total dry matter. The value of energy was calculated and given in calories. It was estimated using Atwater's conversion factors from protein, fat, and total carbohydrates:

Energy(kcal/100g)=protein% x4.1 + carbohydrates% x4.1 + fat% x9.1(FAO, 2002).

Determination of total phenolic content:

The total phenolic content of GCSF, TPP, and WF was determined using a UV spectrophotometer (Jenway-UV-VIS Spectrophotometer) and a colorimetric oxidation/reduction procedure reported by Skerget *et al.* (2005). Folin-Ciocalteu reagent is used.

Determination of total flavonoid content:

The total flavonoid content of the studied GCSF, TPP and WF was measured using the spectrophotometric technique (Quettier*etal.,* 2000).

Determination of Vitamin C:

Vitamin C was determined according to the method described by Sadasivam and Balasubraminan (1987).

Determination of minerals content:

Minerals were determined according to the procedures outlined by AOAC (2005).

Determination of amino acids:

Amino acids of GCSF and WF were determined according to the method described in AOAC (2005).

Estimation of tryptophan:

The tryptophan contents of GCSF and WF were calorimetrically estimated according to the method outlined by Miller (1967).

Computed protein efficiency ratio (C-PER):

C-PER was evaluated as outlined by the equation of Alsmeyer *et al.* (1974):

C-PER = -0.684+0.456 (Leucine) -0.047 (proline)

Biological value (BV):

Biological value was determined as outlined according to the equation of Farag et al. (1996)-

BV =49.9+10.53C-PER.

Physical Properties of Cakes:

The specific volume was calculated as the ratio of apparent volume to weight. Cake height was measured to the nearest millimetre with a micrometre. Volume (ml)and weight (g) was determined according to the methods of AACC (2010). Water activity (a_w) was measured with a MotronicHygro Lab EA10-SCS (Switzerland) a_w meter. The measurements were performed in triplicate.

Texture Analysis:

According to Baixauli et al. (2008), a Texture Profile Analyzer (TPA) was utilized to ascertain the hardness, cohesiveness, and springiness of the crumb. Universal testing equipment was used to identify the parameters governing the texture (Brookfield Engineering Lab. Inc., Middleboro, MA 02346- 1031, USA). In a TPA, a cylindrical probe with a diameter of 25 mm and a speed of 2 mm/s was used.

Color characteristics of cakes:

A Hunter's Lab color analyzer (Mini Scan XE Plus, Model 45/0-S, Inc., Reston, VA, USA) was used to measure the color characteristics of cake samples. *L*, a*, and b** color values were recorded, with each result being the average of three measurements.

Sensory Evaluation:

Cake samples were allowed to cool (25°C) for 4 hours after baking before being tested for organoleptic properties. Cakes were scored by 20 well-trained reviewers (ten males and ten females)from the Food Technology Research Institute for crust and crumb color, texture, taste, flavor, and total score, as reported by Bennion and Bamford (1997).

Statistical analysis:

To conduct the analysis, the SPSS 17.0 program was utilized. Analyses of means and standard deviations were carried out with the assistance of descriptive statistics. Estimates of sample comparisons were determined through the application of analysis of one-way variance (ANOVA) and multiple range tests. P 0.05 was the threshold used to define statistical significance. For the purpose of conducting the analysis, the SPSS 17.0 program was utilized. Analyses of means and standard deviations were carried out with the assistance of descriptive statistics. Estimates of sample comparisons were determined through the application of analysis of one-way variance (ANOVA) and multiple range tests. P 0.05 was the threshold used to define statistical significance.

RESULTS

Chemical Composition of Raw Materials:

The chemical composition of raw materials used for the preparation of cake is shown in Table 2. The obtained data revealed that the highest content of protein found in GCSF was 21.5%. While the lowest value was found in tangerine peel powder (TPP)9%. The ether extract was 28.50,3.00 and 1.80% GCSF, TPP and WF, respectively.

TPP had the highest content of ash 7.80% followed by GCSF (6.07%). Fiber content was (9.5%, 13.0%and 0.78%) for GCSF, TPP and WF, respectively. WF and TPP had high available carbohydrate contents 84.75 and 67.20, respectively. While GCSF had the lowest value 34.43%. GCSF and WH had high caloric values (kcal/100g) 488.66 and 413.47, respectively. While TPP had the lowest value 339.72 kcal/100g.The offered Data in Table 2, displayed the mineral content of GCSF, TPF, and WF as mg/100g. The results revealed that the mean value of minerals (K, P, Na, Mg, and Mn) in GCSF was higher than that of TPP or WF. On the contrary, Fe and Zn levels are lower in GSCF and WF than TPP.ObtainedData in Table 2 presented the total phenolic, total flavonoids, and ascorbic acid content of GCSF, TPP, and WF as mg/100g. The results revealed that the mean value of total phenolic contents of GCSF, TPF, and WF was (520, 2400and 150mg/100g), respectively, while total flavonoids were (395, 400and 2.80mg/100g), respectively. Also, the mean values of ascorbic acid contents of GCSF, and TPF were (19.50, and 90.50mg/100g), respectively.

Table 2. Chemical Composition of GCSF, TPF, and WF

Components (dry weight basis)	Garden cress seeds flour(GCSF)	Tangerine peelspowder(TPP)	Wheat flour (WF)
Crude protein%	21.50^{a} ±0.06	9.00^{c} ±0.03	12.10^{b} ±0.04
Ether extract%	28.50^{a} ±0.45	3.00^{b} ±0.05	1.80^{c} ±0.02
Ash%	6.07^{b} ±0.06	7.80^{a} ±0.02	0.57^{c} ±0.01
Crude fiber%	9.5^{b} ±0.04	13.00^{a} ±0.30	0.78^{c} ±0.01
*Available carbohydrates%	34.43^{c} ±0.45	67.2^{b} ±0.70	84.75^{a} ±0.30
Caloric value (kcal/100g)	488.66^{a} ±0.40	339.72^{b} ±0.20	413.47^{c} ±0.10
Total phenolic (mg /100g)	520^{b} ±0.50	2400^{a} ±0.50	150^{c} ±0.50
Total Flavonoids (mg/ 100g)	395^{b} ±1.50	400^{a} ±2.50	2.80^{c} ±0.03
Vitamin C (mg / 100g)	19.50^{b} ±0.02	90.50^{a} ±1.50	ND
Minerals (mg/100g)			
K	1250^{a} ±2.50	205.35^{b} ±1.50	125.30^{c} ±0.90
Ca	305^{a} ±3.50	140.40^{b} ±2.00	18.70^{c} ±0.30
P	530^{a} ±2.50	25.45^{c} ±0.35	139^{b} ±1.40
Na	22^{a} ±0.40	13.50^{b} ±0.30	5.30^{c} ±0.20
Mg	290^{a} ±0.50	12.40^{c} ±0.650	109^{b} ±0.70
Fe	10.50^{b} ±0.10	11.30^{a} ±0.02	2.05^{c} ±0.01
Mn	3.50^{a} ±0.01	1.50^{b} ±0.02	1.30^{c} ±0.01
Zn	5.50^{b} ±0.02	10.65^{a} ±0.03	4.50^{c} ±0.05

-Each value(dry weight bass) was an average of three determinations ± standard deviation.
- a, b ,c different superscript letters in the same rows are significantly differentatp ≤ 0.05.
*Available carbohydrates = 100 – (crude protein + ash + ether extract + crude fiber).

Amino acids composition of GCSF and WF (g. amino acid /100g protein):

The amino acid contents of GCSF and WF were calculated as g/100g protein, and the amino acid values are reported in **Table 3**. The total replaceable amino acid and total essential amino acid content of the GCSF were 53.08 and 45.31 /100 of protein, respectively, according to the results. According to the essential amino acid composition, GCSF has a greater percentage of leucine (8.50 %), lysine (6.90 %), and valine (6.30 %), While glutamic and aspartic constituted 19and 8% of the replaceable amino acids, respectively, arginine 7.50%, proline alanine, glycine, and serine were 6, 4.38,4.20, and 4%.

Furthermore, the total non-essential amino acid content and total essential amino acid content of wheat flour (WF) were 64.10 and 34.55g /100g of protein, respectively. Wheat flour contained a greater amount of phenylalanine (5.5 %), valine (4.80 %), and leucine (4.70 %). While glutamic and proline were 32 % and 11.90 %, followed by serine at 5.50 %, alanine, aspartic, arginine, and glycine were 4.60, 4.50, 3.30, and 2.30 %, respectively. The computed protein efficiency ratio C- PER and biological value BV of GCSF and WH were obtainable in Table 4. The C-PER of GCSF and WF were (2.99 and 0.90). Meanwhile, BV of GCSF and WF were (81.43 and 59.37), respectively.

Table 3. Amino acids content of GCSF and WF

Amino acids	Garden cress flour	Wheat flour 72%	FAO ⁄ WHO ⁄ UNU (g/100g)
Essential amino acids			
Lysine	6.90	3.70	5.80
Isoleucine	4.90	4.15	2.80
Leucine	8.50	4.70	6.60
Phenylalanine	5.80	5.50	6.30
Tyrosine	2.80	2.05	
Histidine	3.00	4.30	1.90
Valine	6.30	4.80	3.50
Threonine	4.90	2.70	3.40
Methionine	1.00	1.50	2.20
Tryptophan	1.21	1.15	1.00
Total(EAA)	45.31	34.55	
Aspartic acid	8.00	4.50	
Glutamic acid	19.00	32.00	
Proline	6.00	11.90	
Alanine	4.38	4.60	
Arginine	7.50	3.30	
Serine	4.00	5.50	
Glycine	4.20	2.30	
Total(NEAA)	53.08	64.10	
C-PER	2.99	0.90	
BV	81.43	59.37	

Total (EAA) = Total Essential Amino Acids Total (NEAA) = Total Non-Essential Amino Acids
C-PER = Computed protein efficiency ratio BV = Biological Value

The physical properties of cakes:

The results of the physical properties of cakes prepared from GCSF, TPFand WF are shown in Table 4. The height, volume, weight, specific volume, density and water activity (a_w)were significantly affected (P≤ 0.05) in all prepared cakes, height values were significantly increased(P ≤ 0.05) from 5.3 to 5.5 cm, volume values increased from 193.3to199.3 cm^3 in comparison to control (5.03 and 187.3), respectively. The addition of GCSF and TPF also increased the weight values from 99.03 to 99.98 gm in comparison to the control (98.31gm). Also, specific volume values significantly increased(P ≤ 0.05) from 1.95 to 1.99 in comparison to the control (1.91), on contrary, there was a significant decrease(P ≤ 0.05) in the density values in all obtained cakes. The addition of GCSF and TPP also increased the water activity values in comparison to the control.

Table 4. Physical properties of cakes prepared with different levels of garden cress

Sample	Height (cm)	Volume (cm^3)	Weight (g)	Specific volume (cm^3/g)	Density (g/cm^3)	Water activity(a_w)
Control	5.03^d ±0.02	187.3^e ±0.20	98.31^e ±0.08	1.91^c ±0.01	0.52^a ±0.02	0.78^d ±0.01
B1	5.03^d ±0.01	193.3^d ±0.10	99.03^d ±0.04	1.95^b ±0.01	0.51^a ±0.02	0.87^a ±0.02
B2	5.20^c ±0.07	196.7^c ±0.30	99.26^c ±0.06	1.98^a ±0.01	0.51^a ±0.03	0.84^b ±0.01
B3	5.27^b ±0.03	197.7^b ±0.40	99.79^b ±0.07	1.98^a ±0.01	0.51^a ±0.04	0.81^c ±0.01
B4	5.50^a ±0.05	199.3^a ±0.40	99.98^a ±0.05	1.99^a ±0.01	0.50^a ±0.02	0.81^c ±0.01

- a, b, c different superscript letters in the same columns are significantly different at p ≤ 0.05.
-Each value was an average of three determinations ± standard deviation.

Proximate analysis of cakes:

The proximate analysis of cakes made from GCSF, TPP and WF is presented in Table 5. Incorporation of GCSF with different levels in cake blends significantly affected on proximate composition of obtained cakes, protein content significantly increased(atP ≤ 0.05) from 10.55 to10.82 % respectively, in comparison to the control cake (10.40%). Fatcontentsalso significantly increased to 34.85 comparedto the control (32.05%). The ash and crude fiber contents of cakes significantly increased in comparison to the control, but on the contrary, carbohydrate content of cakes decreased to 52.12 %in comparison to the control (56.49%). B4 had the highest caloric value (575.19kcal) of the energy content of cakes, and the lowest caloric value was found in the control cake (565.90kcal). The mineral contents of prepared cakes from GCSF, TPPand WF are presented in Table 5. The addition of GCSF had a significant effect on the mineral contents of cakes. K, Ca, P, Na, Mg, Fe and Mn contents significantly increased by increasing the level of GCSF. On contrary, zinc content of cakes of GCSF significantly decreased(P ≤ 0.05) in comparison to control.

Table 5. Proximate composition of cake

Components(dry weight bass)	Control	B1	B2	B3	B4
Crude protein%	10.40^e ±0.02	10.55^d ±0.05	10.63^c ±0.05	10.75^b ±0.04	10.82^a ±0.01
Ether extract%	32.05^e ±0.01	32.71^d ±0.03	33.45^c ±0.02	34.15^b ±0.01	34.85^a ±0.02
Ash%	0.35^e ±0.02	0.75^d ±0.05	0.89^c ±0.06	1.02^b ±0.02	1.15^a ±0.03
Crude fiber%	0.71^e ±0.03	0.85^d ±0.01	0.89^c ±0.04	1.03^b ±0.05	1.06^a ±0.03
***Available carbohydrates%**	56.49^a ±0.02	55.14^b ±0.04	54.14^c ±0.05	53.05^d ±0.04	52.12^e ±0.01
Caloric value (kcal/100g)	565.90^e ±0.01	566.99^d ±0.02	569.95^c ±0.03	572.35^b ±0.04	575.19^a ±0.01
Minerals (mg/100g)					
K	56.28^e ±0.02	63.83^d ±0.03	75.08^c ±0.03	86.32^b ±0.05	97.57^a ±0.08
Ca	11.69^e ±0.08	12.03^d ±0.07	14.89^c ±0.03	17.75^e ±0.04	20.61^d ±0.05
P	56.33^e ±0.02	59.82^d ±0.05	63.73^c ±0.07	67.64^b ±0.07	71.55^a ±0.06
Na	2.55^d ±0.02	2.47^e ±0.05	2.64^c ±0.07	2.78^b ±0.03	2.95^a ±0.01
Mg	43.97^e ±0.05	45.56^d ±0.04	47.37^c ±0.03	49.18^b ±0.09	50.99^a ±0.05
Fe	1.16^d ±0.02	1.04^e ±0.01	1.13^c ±0.01	1.21^b ±0.02	1.30^a ±0.02
Mn	0.57^c ±0.01	0.56^c ±0.01	0.58^{ab} ±0.02	0.60^b ±0.01	0.63^a ±0.02
Zn	2.1^a ±0.03	1.90^c ±0.01	1.95^b ±0.02	1.96^b ±0.01	1.97^b ±0.02

-Each value(dry weight bass) was an average of three determinations ± standard deviation.
- a, b and c different superscript letters in the same rows are significantly different at p ≤ 0.05.

Sensory analysis of cakes:

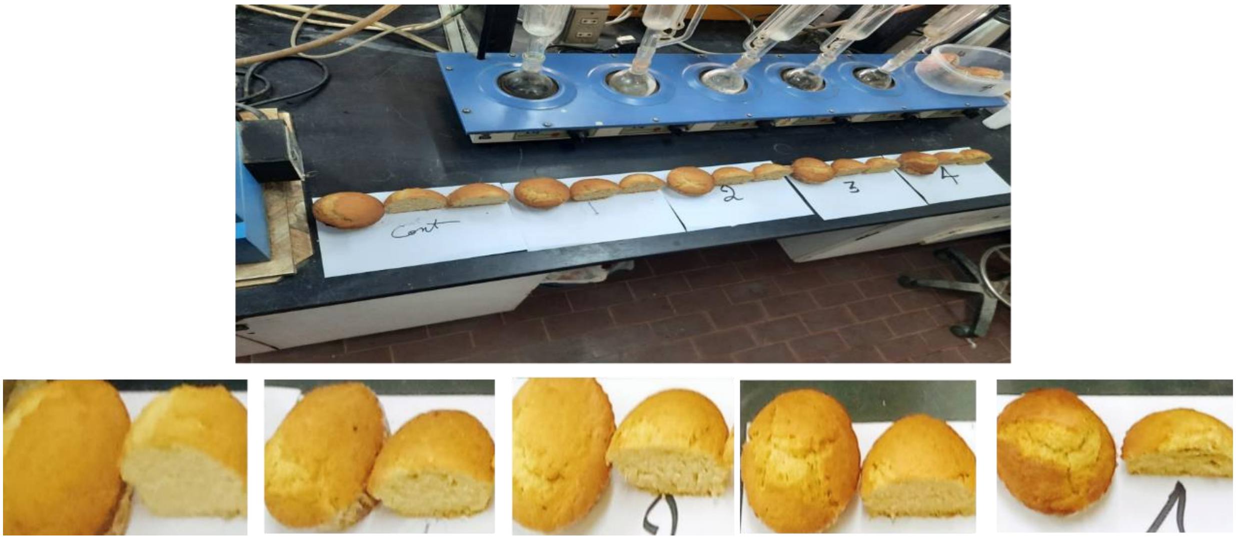
Table 6 and Fig. 1 show the sensory analysis of cakes made from WF, GCSF, and TPP. The sensory qualities of the resulting cakes were substantially altered (p 0.05) by blending GCSF and WF. In comparison to the control (9.3 and 9.2), the introduction of GCSF reduced crust and crumb color values to 8.40 and 8.2, respectively. In addition, there was a substantial drop (P 0.05) in texture value when compared to the control (9.2).On contrary; the Replacement of wheat by GCSF significantly ($P \leq 0.05$) increases the moistness score of the cakes from 8.4 in control to 9.33 in the last cakes (B4). The addition of GCSF, also decreased the taste value to 7.3 in comparison to control (8.7). The appearance score of the cakes significantly decreased ($P \leq 0.05$) from 9.0 in control to 8.40, also, flavor score gradually decreased from 8.9 in control to 7.35in B4 cakes. There were no significant differences in the overall acceptability of supplemented cakes up to 7.5 % level of GCSF.

Table 6. Sensory evaluation of cakes

samples	Crust color	Crumb color	Texture	Moistness	Taste	Flavor	Appearance	Overall acceptance
control	9.30^{a} ±0.01	9.20^{a} ±0.03	9.20^{a} ±0.10	8.40^{d} ±0.10	8.70^{a} ±0.09	8.90^{a} ±0.06	9.00^{a} ±0.03	8.96^{a} ±0.03
B1	9.20^{a} ±0.02	8.90^{b} ±0.04	8.55^{b} ±0.05	8.90^{c} ±0.12	8.50^{b} ±0.06	8.65^{b} ±0.05	8.80^{b} ±0.05	8.79^{ab} ±0.02
B2	9.00^{b} ±0.03	8.70^{c} ±0.05	8.30^{c} ±0.09	9.10^{b} ±0.11	8.20^{c} ±0.05	8.09^{c} ±0.04	8.50^{c} ±0.08	8.56^{ab} ±0.03
B3	8.60^{c} ±0.04	8.30^{d} ±0.03	8.10^{d} ±0.07	9.39^{a} ±0.21	8.00^{d} ±0.07	7.97^{d} ±0.10	8.25^{d} ±0.10	8.37^{ab} ±0.03
B4	8.40^{e} ±0.05	8.20^{e} ±0.01	7.70^{e} ±0.04	9.33^{a} ±0.11	7.30^{e} ±0.10	7.35^{e} ±0.11	8.40^{e} ±0.12	8.10^{b} ±0.01

- a, b, c different superscript letters in the same columns are significantly different at $p \leq 0.05$.

-Each value was an average of twenty determinations ± standard deviation.



CONTROL B1 B2 B3 B4

Fig. 1. Picture presented the tested Sensory analysis samples.

Texture characteristics of cakes prepared with different levels of garden cress seeds flour:

Table 7 shows the textural parameters of cakes made from mixes including WF and GCSF. The textural characteristics of cakes were significantly affected by blending with varied quantities of GCSF., the hardness of cakes significantly decreased by increasing GCSF level (from 26.01 to 21.98N) in comparison to control cake (30.78N), cohesiveness of cakes gradually increased from 0.42 to 0.47 respectively. In comparison to the control, blending with varied quantities of GCSF considerably reduced the springiness content of cakes (6.32 to 6.10, respectively) relative to control (6.41mm). The gumminess of cakes also significantly decreased(12.40–10.04) in comparison to control 13.82 N, and the chewiness of cakes was decreased significantly ($P \leq 0.05$) to 61.50mj (B4) in comparison to the control (89.40mj).

Table 7. Texture parameters of cakes prepared with different levels of GCSF, TPP and WF

Samples	Control	B1	B2	B3	B4
Hardness (N)	30.78[a] ±0.06	26.01[b] ±0.10	24.59[c] ±0.08	23.14[d] ±0.02	21.98[e] ±0.09
Cohesiveness	0.42[ab] ±0.01	0.42[ab] ±0.01	0.44[a] ±0.02	0.47[a] ±0.03	0.47[a] ±0.01
Springiness (mm)	6.41[a] ±0.02	6.32[b] ±0.01	6. 21[c] ±0.03	6.12[d] ±0.05	6.10[d] ±0.02
Gumminess (N)	13.82[a] ±0.01	12.40[b] ±0.03	11.75[c] ±0.04	11.03[d] ±0.10	10.04[e] ±0.01
Chewiness (mJ)	89.40[a] ±0.05	80.10[b] ±0.05	77.00[c] ±0.02	67.30[d] ±0.10	61.50[e] ±0.06

-Each value was an average of three determinations ± standard deviation.
- a, b, c,. different superscript letters in the same rows are significantly different at $p \leq 0.05$.

Color analysis:

Color has a significant impact on the perceived acceptance of the cake. Table 8 displays the degree of redness; the positive '*b**' value represented yellowness; and the '*L**' value represented lightness. The findings here demonstrated an increase in a dark tone with a reduction in L* in both crust and crumb, a reduction in yellowness with an increase in *b** along the crust color with continuing to increase the GCSF level in cakes, but the opposite results have been found in the crumb color, with decreased *b** values indicating an increase in yellowness. Crumb color data showed negative *a** scores for minor greenness. The addition of GCSF to white wheat flour resulted in considerable color changes. *L*, a*,* and *b** values for GCSF-fortified cakes at varying degrees of fortification. The '*a**' value represented

Table 8. Crust and crumb colors of cakes prepared with different levels of GCSF and TPF by replacing WF

Samples	**Crust color**			**Crumb color**		
	L	*a*	*b*	*L*	*a*	*b*
Control	53.72[a] ±0.30	11.81[e] ±0.10	22.22[e] ±0.20	72.42[a] ±0.30	-1.54[a] ±0.02	30.57[a] ±0.25
B1	52.20[b] ±0.20	12.95[d] ±0.05	23.36[d] ±0.12	70.50[b] ±0.20	-1.86[b] ±0.03	24.34[b] ±0..23
B2	50.36[c] ±0.10	13.74[c] ±0.20	24.78[c] ±0.09	69.80[c] ±0.08	-1.88[bc] ±0.04	23.26[c] ±0.10
B3	47.74[d] ±0.40	14.43[b] ±0.25	25.90[b] ±0.07	67.35[d] ±0.05	-1.90[d] ±0.02	23.89[d] ±0.20
B4	45.16[e] ±0.30	15.85[a] ±0.07	26.69[a] ±0.08	66.27[e] ±0.20	-1.97[e] ±0.031	22.84[e] ±0.30

Means in the same column with different letters are significantly different ($p \leq 0.05$).
Each mean value is followed by ± SE (standard error).

DISCUSSION

Cakes and cookies, in particular, are examples of ready-to-eat goods enjoyed at home. These foods are deficient in phytochemicals, which are substances that help digestion, such as bioactive compounds and dietary fibers. These compounds can be obtained in modest amounts by supplementing wheat with powder prepared from dried citrus peels such as orange, mandarin, and lemon peels (Nassar *et al.,* 2008; Youssef and Mousa, 2012; Akubor and Ishiwu, 2013; Kolo *et al.,* 2016; Zaker *et al.,* 2017). Although these peels are high in dietary fibers and nutraceuticals, employing them as food components would conflict with attempts to decrease waste related to the development of new food sources (Mahmoud *et al.,* 2015; Ojha and Thapa, 2017). Bakery manufacturing is one of the world's largest organized food businesses, with biscuits, crackers, and cakes being the most popular goods due to their easy, ready-to-eat form, and extended shelf life. Although processed wheat flour is the primary component in bread goods, its protein content is a lower quantity than that of other cereals, Gómez *et al.,(*2010) reported that wheat flours used in baking have a lower protein level. These findings were confirmed by the reported work of (Gokavi *et al.,* 2004; Toliba and Mohamed, 2019; El-Hadidy**,** 2020), where garden cress seeds powder is a rich source of dietary fiber, carbohydrates, protein, fat, ash, calcium, potassium, phosphorus, magnesium, iron, zinc, polyphenols and flavonoids. Cake industry challenges include increased storage, quality control, and cost reduction (Cauvain and Young, 2006). Toliba and Mohamed, (2019) reported that blending of WF with 5, 10 and 15% of garden cress seeds led to a significant increase ($p \leq 0.05$) in volume, weight and specific volume of resulting cupcakes. According to Deshmukh et al., (2017)sensory study of cookies with 10% garden cress bran demonstrated the highest overall acceptance as well as considerably improved dietary fiber and mineral content. Toliba and Mohamed, (2019) investigated the advancement and quality evaluation of GCSP-containing cupcakes and concluded that, based on sensorial properties, GCSP can be substituted up to 15% in wheat flour for the preparation of garden cress cupcakes without impacting the quality characteristics. Patil *et al.* (2015) investigated the creation and quality assessment of biscuits using GCSP and concluded that, based on sensory features, GCSP may be substituted up to 10% in wheat flour for the preparation of garden cress biscuits without altering quality characteristics. Blending with GCSF significantly decreased the texture parameter of cakes by increasing the level of garden cress seeds flour, it is known that the lower the hardness of the cake the more evidence of acceptability and freshness, Toliba and Mohamed (2019) demonstrated that adding GCSP to the cupcake enhanced its freshness. Two more parameters were calculated from the measured parameters: Soleimanifard et al., (2018) defined gumminess as a product of hardness, while chewiness was defined as the product of gumminess and springiness

Complementary color changes have been observed in the works of Alshehry, (2019); El-Kherbawy and Omaima, (2019), which can be attributed to the enhanced protein and phytochemical contents of the dough. Variations in protein throughout baking have also been related to changes in the lightness of baked products, with greater protein percentages in cooking resulting in darker muffins (Fagundes *et al.,* 2018; Alshehry, 2019). Cakes are essential bakery items that are globally consumed; the cake market rises at a rate of one and a half percent each year. Cake industry challenges include increased storage, quality control, and cost reduction (Cauvain and Young, 2006).

CONCLUSION

The incorporation of GCSF and TPF improved the nutritional, sensorial properties and color of obtained cakes. Supplemented cakes were softer and fresher compared to the control cakes. GCSF is considered a good support food for the preparation of fortified cakes however TPP improved consumer acceptance of cakes. Finally, some high-quality bakery products could be prepared using GCSF and TPF with WF that are suitable for consumers, then this work confirms the great importance of applied science in bakeries' foods.

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استخدام مطحون بذور حب الرشاد ومسحوق قشور اليوسفى لتحضير كيك غني بالمغذيات

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يوضح هذا العمل تأثير خلط مطحون بذور حب الرشاد (GCSF) ومسحوق قشور اليوسفي (TPP) على تحضير الكيك من دقيق القمح (WF). تم فحص التركيب الكيميائي للمواد الخام (GCSF، TPP، WF). احتوى GCSF على محتوى أعلى من البروتين والدهون (21.50٪ و 28.50٪ على التوالي) ويحتوى اقل نسبة كربوهيدرات كلية (34.43٪). يحتوي GCSF على معظم المعادن بنسب اعلى من كل من TPP و WF. تم خلط نسب مختلفة 2.5(، 5، 7.5، % 10) من مطحون بذور حب الرشاد استبدال لدقيق القمح معإضافة 10٪ ثابتةلجميعالخلطات من مسحوق قشور اليوسفى، باستثناء عينة التحكم - 100٪ دقيق القمح لتحضير الكيك. تم تحليل الكيك من حيث الخصائص الفيزيائية والكيميائية والحسية والخصائص الميكانيكية للقوام ، وزادت الخصائص الفيزيائية للكيك مثل الوزن والحجم والحجم النوعي بينما انخفضت الكثافة.عينات الكيك التي تحتوي على GCSF و TPF أظهرت محتوى بروتينى عالى مع تحسن اللون وانخفاض طفيف في الخصائص الحسية. تراجعت صفات مثل الصلابة واللزوجة والمضغ والإلتصاق مع إضافة GCSF ، بينما كان هناك تغيير في خصائص اللون مقارنة بعينة الكيك المحكمة. كانت جميع نسب عينات الكيك المدعم ب GCSF و TPP أكثر نضارة ومناسبة للاستهلاك البشري خاصة حتى 7.5٪ من استبدال GCSF. ومن ثم يمكن استخدام GCSF و TPP لتحسين الخصائص الغذائية وبعض الخصائص الفيزيائية للكيك.

الكلمات المفتاحية: حب الرشاد، قشور اليوسفى، الكيك، القوام، اللون، الخصائص الحسية