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PHYSICOCHEMICAL AND ORGANOLEPTIC CHARACTERISTICS OF CAKES SUPPLEMENTED WITH TOMATO POMACE, MANGO SEEDS KERNEL AND POMEGRANATE PEELS POWDERS

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ABSTRACT

This study was carried out to evaluate the chemical and phenolic contents of some by products tomato pomace powders (peel and seeds) (TPP), mango seeds kernel powder (MSKP), and pomegranate peels powder (PPP), also the effect of substitution of wheat flour with 2.5, 5.0, 7.5, and 10 % of (TPP), (MSKP), and (PPP) on physical, chemical and sensory characteristics of cake were studied. Results showed that, wheat flour showed higher moisture and total carbohydrate contents, tomato pomace powder was showed a higher crude protein, and crude fiber contents, mango seeds kernel powder had the highest lipids content and pomegranate peels powder had the highest ash and crude fiber content. For total phenolic and flavonoid contents, TPP contain the highest total phenolic and flavonoid contents followed by PPP and finally MSKP. Also, the partial replacement of wheat flour with TPP, MSKP and PPP increased chemical composition % (moisture, crude protein, lipids, ash, and crude fiber), minerals content (i.e. K, Ca, Mg, Na, Mn, Fe, and Zn) and dietary fiber content (i.e. total, soluble and insoluble dietary fiber) of cake samples, while total carbohydrates were decreased in parallel with increasing the level of substitution compared with control cake samples. Cake treatments containing TPP, MSKP and PPP have also recorded the same trend of chemical composition, minerals, dietary fiber content. The partial replacement of wheat flour with TPP, MSKP and PPP increased total phenolic and flavonoid contents of cake samples compared with control sample in parallel with increasing the level of substitution, cake treatments containing TPP had the highest total phenolic and flavonoid contents followed by PPP and finally MSKP treatments. The sensory evaluation characters, cells, grain, texture, crumb color, flavor, and overall acceptability, have no significant difference between the control sample and cake samples which substituted with 2.5, 5.0, and 7.5 % of MSKP and TPP.

***Keywords*:** Tomato pomace, Mango seeds kernel, Pomegranate peels, Cake, Total phenolic contents, Sensory evaluation.

Introduction

Fruit and vegetable wastes are naturally rich with bioactive compounds like antioxidants, phenolic compounds, minerals, vitamins, and fiber. The peels, seeds and other wastes of numerous fruit can be used as functional foods. (Coman *et al.,* 2020).

As a result of the food insecurity associated with malnutrition and the possibility of infectious diseases. The consumer has taken great interest in the health and nutritional components of diets and has identified good strategies to tackle malnutrition and alleviate the various health disorders associated with it (Akhtar *et al.,* 2013a,b and Sagar *et al.*, 2018).

Tomato wastes have no commercial value; they are a rich source of nutrients and highly biologically active compounds. The skins of tomatoes have been found to be richer sources of lycopene and polyphenolic compounds than the pulp (Toorand Savage, 2005). Tomato seeds have been shown to contain. 20% oilof high nutritional quality, carotenoids, polyphenols, phytosterols, proteins, minerals and fibers (Nour *et al.*, 2015).

After the processing of mango fruits, a large amount of seeds are disposed of as waste, and nutritionally, fruit seeds are the most important part because they act as a storage location for nutrients. (Chandrasekaranand Bahkali, 2013). The mango seed, kernel is obtained by breaking the hard seed coat of mango. The kernel of mango seeds accounts for approximately 20 percent of the total fruit weight (Bisht *et al.,* 2020). Starch, fats and protein are the main ingredients of mango seed kernels as they contain a high amount of iron, potassium, calcium and magnesium and are a good source of natural antioxidants (Kittiphoom, 2012 and Kaur and Brar, 2017).

Pomegranate peel, a by-product of juice processing industries was reported to contain high phenolic compounds in addition to its properties as good source of crude fiber and inorganic residues that embrace wide health primitive features like prevention from the development of cardiovascular disorders, anti-inflammatory, hypoglycemic, apoptotic, anti-parasitic and as prebiotic (Abdel-Rahim *et al.,* 2013).

Supplementation of bakery products like cake, which are very popular among children and are a rich source of energy and protein, with tomato pomace powders, mango seeds kernel powder, and pomegranate peels powder will further help in improving the nutritional and chemical qualities of developed cake (Tharshini *et al.,* 2018). Keeping in view that development of value added products from diverse raw ingredients is receiving the prime focus of food processing industries and researchers, the present study was planned to exploit the feasibility of development of value added cake from different ratios of tomato pomace powders, mango seeds kernel powder, and pomegranate peels powder.

Materials and Methods

Materials

Wheat flour and by products

Wheat flour (72% extraction rate, Al-Mashreq Gardens Company For Trading & Distribution, Albagour, Elmonfia Egypt)was obtained from the local market in Zagazig City, Egypt. Tomato pomace (peel and seeds) was obtained from Kaha Company for Preservative Foods Kaha, Kalyobia, Egypt. The company used the varieties of Beto 86, Floraded, and Alex 63 for concentrated tomato puree production. Mango seed kernels were obtained from Misr-Italy Company for Concentrates and Food Industries, New Damietta, Egypt. Mangoes that used in pulp production are mixture varieties of Succary, Zebda, Balady, Mabroka, and Al-Owaisi. Fresh pomegranate fruit (Manfalouty) was obtained from the local marketin Zagazig City, Egypt.

Baking ingredients

Fresh whole egg, dry milk, shortening, sugar, vanilla, salt, and all other materials used in baking were obtained from the local market in Zagazig City, Egypt.

Chemicals

All chemicals used in this study for analysis were of analytical grade and were obtained from Al-Gomhouria Chemical Company, Egypt.

Methods

Preparation of tomato pomace (peel and seeds) powder:

Tomato pomace was separated manually after drying in air. Then it was dried in air circulation oven at 50˚C for 12 hr., milled to a fine powder, sieved on 110 mesh sieves, and kept in polyethylene bags and stored at - 18˚C until used.

Preparation mango seed kernels powder

Mango seeds kernel were removed by manual dehiscing from the hard coat. Afterward, the kernels were chopped and then dried in air circulation oven at 40˚C for 12 hr. The dried kernels were milled to a fine powder, sieved on the 110-mesh sieve, and kept in polyethylene bags and stored at - 18˚C until used.

Preparation of pomegranate peels powder

Pomegranate peels were collected, removed, washed with water, cut into small pieces (approx. 1×1 cm) and tray dried in air circulation oven at 40˚C for 5 - 6 hr. The dried peel was coarsely powdered in a blender, passed through a 110-mesh sieve, and kept in polyethylene bags and stored at - 18˚C until used.

Preparation of composite flour blends

Different composite flour samples were prepared by partially substituting wheat flour with 2.5, 5.0, 7.5, and 10 % of tomato pomace (peel and seeds), mango seed kernels, and pomegranate peel powders.

Processing of cake

The ingredients used in prepareddifferent cake samples are shown in **Table 1** according to the method of (Bent *et al*., 2013). The cake batter was formulated from 100 g flour, 85 g whole fresh egg, 85 g sucrose, 55 g shortening, 3 g dry milk, 3.8 g baking powder, salt 1.0 g, and 0.6 g vanilla. Shortening, egg, vanilla, and sucrose powder were creamed together using a kitchen machine (Braun Multiquick 5 K7000) for 5-10 min. Flour, dry milk, and baking powder were mixed together. This mixture was added gradually to the previously prepared cream and beaten for 3 min using the mixing machine (Braun Multiquick 5 K7000) at low speed. The batter was scaled at 40 g into baking pans, baked at 180˚C for 35 min, left to cool for 1.0 hr at room temperature until analysis.

Table 1 : Cake formula prepared and used in the current study

Level of substitution (%)		Wheat flour (72% ext.) (g)	Baking powder (g)	Vanilla (g)	Dry milk (g)	Fresh whole egg (g)	Shortening (g)	Sugar (g)	Salt (g)
Control sample		100	3.8	0.6	3	85	55	85	1.0
Tomato pomace powder	2.5%	97.5	3.8	0.6	3	85	55	85	1.0
	5.0%	95.0	3.8	0.6	3	85	55	85	1.0
	7.5%	92.5	3.8	0.6	3	85	55	85	1.0
	10.0%	90.0	3.8	0.6	3	85	55	85	1.0
Mango seed kernel powder	2.5%	97.5	3.8	0.6	3	85	55	85	1.0
	5.0%	95.0	3.8	0.6	3	85	55	85	1.0
	7.5%	92.5	3.8	0.6	3	85	55	85	1.0
	10.0%	90.0	3.8	0.6	3	85	55	85	1.0
Pomegranate peels powder	2.5%	97.5	3.8	0.6	3	85	55	85	1.0
	5.0%	95.0	3.8	0.6	3	85	55	85	1.0
	7.5%	92.5	3.8	0.6	3	85	55	85	1.0
	10.0%	90.0	3.8	0.6	3	85	55	85	1.0

Analytical methods

Chemical analyses

Chemical composition

Moisture, ash, protein, crude lipids and crude fiber contents (%) were determined according to the methods described by AOAC (2010). Total carbohydrate was calculated by difference.

Determination of mineral content

Mineral content (Na, K, Ca, Mg, Fe, Mn and Zn) were determined according to the method of AOAC (2010) using atomic absorption spectrophotometry (ICAP 6500 Duo, England Multi-element certified standard solution 100 mg/l Merk, Germany) at the Central Laboratory, Faculty of Agriculture, Zagazig University, Egypt.

Determination of dietary fibers

Total dietary fibers of samples were measured according to the method described by AOAC (2010). Soluble and insoluble dietary fibers were determined according to the method described by Prosky *et al.* (1988).

Determination of total phenolic content

Total phenolic compounds were determined using Folin-Ciocalteau reagent according to the method described by Szydłowska-Czerniak *et al.* (2008).

Determination of total flavonoids content

Total flavonoids content was determined according to the method described by Jia *et al.* (1998).

Fractionation and identification of phenolic and flavonoid compounds

A high-performance liquid chromatography system equipped with a variable wavelength detector (Agilent Technologies, Germany) 1200 series was used. Also, the HPLC was equipped with auto-sampler, quaternary pump degasser and column compartment set at 35°C. The analysis was performed on a C18 reverse-phase (BDS 5 µm, Labio, Czech Republic) packed stainless-steel column (4×250 mm. i.d). To determine phenolic acids and flavonoids, samples were prepared according to the method described by Atawodi *et al.* (2011).

Sensory evaluation of cakes

Cake produced was evaluated according to the method described by AACC (2000), using ten panelists from the Food Industries Department, Faculty of Agriculture, Zagazig University.

Cake samples were left to cool at room temperature for an hour after baking. Then it was cut with a sharp knife and subjected to panel test. The quality score was cells 30 (uniformity 10, size of cells 10, and thickness of walls 10), grain 20, texture 30 (moistness 10, tenderness 10, and softness 10), crumb color 10, flavor 10 and overall acceptability 100 degrees.

Statistical analysis

Data were analyzed by Analysis of Variance using the General Linear Model (GLM) procedure according to the procedure reported by Snedecor and Cochran (1980). Means were separated using Duncan's test at a degree of significance ($P \leq 0.05$). Statistical analyses were made using the producer of the SAS software system program (SAS, 1997).

Results and Discussion

Chemical composition of raw materials

Table 2 revealed that wheat flour (72 % ext.) recorded the highest moisture content being 12.58 %, while tomato pomace powder had lower moisture content being 6.65 %.

Furthermore, the highest value of crude protein was recorded for TPP followed by PPP and MSKP being 30.69, 16.22 and 10.16 %, respectively. Meanwhile, wheat flour (72% ext.) had the lowest crude protein value being 9.99 %. On the other side, MSKP had the highest lipid content followed by TPP and PPP being 33.06, 8.67 and 3.51 %, respectively. Meanwhile, wheat flour (72% ext.) had the lowest lipid content being 1.23 %.

PPP contained the highest ash content 4.72 % followed by TPP 3.12 % and MSKP 2.77 %. While the wheat flour (72% ext.) had the lowest ash content being 0.47 %. Also, TPP contained the highest crude fiber content 8.51 % followed by PPP 7.36 % and MSKP 2.36 %. Meanwhile, wheat flour (72% ext.) had the lowest crude fiber content being 0.61 %.

Wheat flour (72% ext.) recorded the highest value of total carbohydrate followed by PPP and MSKP being 87.70, 68.19 and 51.65 %, respectively. While, TPP had the lowest total carbohydrate being 49.01%. These results are in agreement with Sakr *et al.* (2012), El-badrawy and Sello (2016) and Abd-Elaziz (2018).

Minerals content of raw materials

The results present in Table 2, show the minerals content of wheat flour (72% ext.), TPP, MSKP and PPP. PPP contained the highest content of Magnesium (Mg), Sodium (Na), and Iron (Fe) compared with TPP, MSKP, and wheat flour. It was recorded 40.58, 130.48, and 4.30 mg/100g, respectively.

Also, MSKP contained higher amount of minerals being 280.71, 115.16 compared to TPP which recorded 56.50, 37.65 mg/100g for Potassium (K), Calcium (Ca). Additionally, the highest content of Mn and Zn were observed in TPP with a concentration of 21.96, 1.67 mg/100g.

While wheat flour (72% ext.) had the mean lowest mineral content being 27.33, 35.69, 15.76, 35.88, 1.46, 0.87, and 0.18 mg/100g, respectively for K, Ca, Mg, Na, Mn, Fe and Zn, respectively. Such results are in line with those obtained by Nour *et al*. (2015), Khedr *et al*. (2016), Romelle *et al*. (2016) and Abd-Elaziz (2018).

Total, soluble and insoluble dietary fiber of raw materials

Table 2 showed that PPP and TPP contain the highest percentage of TDF, which amounted to 54.39 and 36.28 %, respectively. These results are following those obtained by Thannoun and Younis (2013), Mosa and Kalil (2015) and Khedr*et al*. (2016).

However, wheat flour (72 % ext.) which contained 3.42 % TDF, 1.29 % SDF, and 2.13 % IDF. Gill and Johnson (2002) who reported that, wheat flour (72 % ext.) contained 4.19 % TDF, 2.28 % SDF, and 1.91 % IDF (on dry weight basis).

Total phenolic and flavonoid compounds of raw materials

According to the results presented in Table 2, TPP contain higher TPC and TFC with 848.52 mg/g of Gallic acid and 437.97 mg/g of quercetin, respectively. These results agree with that previously reported by Szabo *et al.* (2019), followed by PPP which content 386.47mg/g of Gallic acid and 252.26mg/g of quercetin, respectively. These results agree with that previously reported byAli *et al.* (2014), followed by MSKP with 247.18 mg/g of Gallic acid and 134.15 mg/g of quercetin, respectively. These results agree with that previously reported Abdalla *et al.* (2007), Ribeiro and Schieber (2010), Sogi *et al.* (2013), Dorta *et al.* (2014) and Abdel-Aty *et al.* (2018) and finally WF with 34.05 mg/g of Gallic acid and 25.30 mg/g of quercetin, respectively. These results agree with that previously reported Yu and Beta (2015).

Table 2 : Chemical, minerals, dietary fiber and antioxidant content of wheat flour, tomato pomace powder, mango seeds kernel powder and pomegranate peels powder

Component	Wheat flour	Tomato pomace powder	Mango seeds kernel powder	Pomegranate peels powder
Chemical composition (g/100gon a dry weight basis)				
Moisture	12.58	6.65	7.31	9.06
Crude protein	9.99	30.69	10.16	16.22
Crude Fat	1.23	8.67	33.06	3.51
Ash	0.47	3.12	2.77	4.72
Crude Fiber	0.61	8.51	2.36	7.36
Total carbohydrate	87.70	49.01	51.65	68.19
Minerals content (mg/100gon a dry weight basis)				
Ca	35.69	37.65	115.16	41.61
Zn	0.18	1.67	1.35	1.57
Fe	0.87	3.08	1.27	4.30
Mg	15.76	38.08	20.32	40.58
K	27.33	56.50	280.71	205.38
Na	35.88	79.45	60.32	130.48
Mn	1.46	21.96	2.03	18.16
Dietary fiber(g/100g on a dry weight basis)				
Total dietary fiber	3.42	36.28	25.17	54.39
Soluble dietary fiber	1.29	4.75	7.45	13.63
Insoluble dietary fiber	2.13	31.53	17.72	40.76
Total phenolic and flavonoids content (mg/g)				
Total phenolic content (mg/g)	34.05	848.52	247.18	386.47
Total flavonoids content (mg/g)	25.30	437.97	134.15	252.26

Identification of phenolic compounds content of raw materials

According to the results presented in Table 3, the phenolic compounds in wheat flour (WF) ranged from 1.00 to 199.64 µg/g dry matter. The predominant compound in WF was Naringenin (199.64 µg/g). These results are similar to those reported by Yu and Beta (2015) they indicated that the ethanol extraction of WF had high content of Naringenin. The phenolic compounds in TPP ranged from 3.22 to 296.48 µg/g dry matter. The predominant compound in TPP was Kaempferol(296.48 µg/g). These results are similar to those reported by Szabo *et al.* (2019), who indicated that the ethanol extraction of TPP had high content of Kaempferol.

The phenolic compounds in MSKP ranged from 33.67 to 7595.92 µg/g dry matter. The predominant compound in MSKP was Naringenin (7595.92 µg/g). These results are similar to those reported by Abdel-Aty *et al.* (2018), who indicated that the ethanol extraction of MSKP had high content of Naringenin.

The phenolic compounds in PPP ranged from 10.42 to 8671.04 µg/g dry matter. The predominant compound in PPP was Catechin (8671.04 µg/g). These results are similar to those reported by Ali *et al.* (2018), who indicated that the ethanol extraction of PPP had high content of Catechin.

Table 3 : Identification of phenolic compounds content of wheat flour, tomato pomace powder, mango seeds kernel powder, and pomegranate peels powder by HPLC (µg/g dry matter)

Phenolic Compound	Raw materials			
	Wheat flour (72% ext.)	**Tomato pomace powder**	**Mango seeds kernel powder**	**Pomegranate peels powder**
Gallic acid	15.22	42.03	0.00	1248.00
Chlorogenic acid	0.00	0.00	426.76	0.00
Catechin	3.00	41.84	0.00	8671.04
Methyl gallate	0.00	4.75	57.72	14.80
Coffeic acid	1.30	10.88	276.89	62.87
Syringic acid	0.00	0.00	406.72	0.00

Pyro catechol	0.00	46.47	0.00	0.00
Rutin	0.00	0.00	600.10	0.00
Ellagic acid	23.00	72.60	313.73	1698.35
Coumaric acid	6.00	43.03	0.00	66.10
Vanillin	7.54	3.22	2886.36	10.42
Ferulic acid	2.00	12.70	802.94	184.89
Naringenin	199.64	36.71	7595.92	59.81
Taxifolin	0.00	25.46	33.76	0.00
Cinnamic acid	1.00	17.00	0.00	58.00
Kaempferol	0.00	296.48	0.00	0.00

Chemical composition of produced cake

Results presented in Table 4, showed that The partial replacement of wheat flour with TPP, MSKP and PPP increased chemical composition % (moisture, crude protein, lipids, ash, and crude fiber) of cake samples in parallel with increasing the level of substitution compared with control cake sample, while total carbohydrates were decreased in parallel with increasing the level of substitution.

Cake treatments containing TPP, MSKP and PPP have also recorded the same trend of chemical composition. Such data are in line with those obtained by Isik and Topkaya (2016)and Das *et al*. (2019).

Table 4 : Proximate chemical composition of produced cake samples (% on a dry weight basis)

Cake sample	Substitution level (%)	Chemical composition (%)					
		Moisture	Crude protein	Lipids	Ash	Crude fiber	** Total carbohydrates
*Control sample		21.75	15.59	20.32	1.57	4.49	58.03
Tomato pomace powder	2.5	22.57	15.97	20.61	1.63	4.69	57.10
	5.0	23.35	16.35	20.90	1.68	4.87	56.20
	7.5	24.21	16.73	21.19	1.74	5.08	55.26
	10.0	25.04	17.11	21.48	1.80	5.25	54.36
Mango seeds kernel powder	2.5	22.23	15.59	20.64	1.60	4.53	57.64
	5.0	22.84	15.60	20.96	1.63	4.58	57.23
	7.5	23.36	15.60	21.28	1.66	4.62	56.84
	10.0	23.90	15.61	21.60	1.69	4.67	56.43
Pomegranate peels powder	2.5	23.14	15.60	20.52	1.68	4.66	57.54
	5.0	24.30	16.62	20.61	1.78	4.83	57.16
	7.5	25.75	15.64	20.70	1.89	5.00	56.77
	10.0	26.84	15.65	20.78	2.00	5.17	56.40

* 100 % wheat flour (72 % extraction rate).
** Calculated by difference.

Minerals content of produced cake

Results presented in Table 5 showed thatthe partial replacement of wheat flour with TPP, MSKP and PPP increased minerals content % (i.e. K, Ca, Mg, Na, Mn, Fe and Zn), of cake samples compared with control cake sample in parallel with increasing the level of substitution. Cake treatments containing TPP, MSKP and PPP have also recorded the same trend of minerals content. Such data are in line with those obtained by Isik and Topkaya (2016); Topkaya and Isik (2019) and Das *et al*. (2019).

Table 5 : Minerals content of produced cake samples (mg/100g on a dry weight basis)

Cake samples	Substitution level (%)	Minerals content						
		K	Ca	Mg	Na	Mn	Fe	Zn
*Control sample		22.61	40.07	14.09	68.53	0.21	0.95	0.12
Tomato pomace powder	2.5	23.34	40.12	14.65	69.62	0.72	1.00	0.16
	5.0	24.07	40.17	15.21	70.71	1.23	1.06	0.20
	7.5	24.80	40.22	15.76	71.80	1.75	1.12	0.23
	10.0	25.53	40.29	16.32	72.89	2.26	1.17	0.27
Mango seeds kernel powder	2.5	28.95	42.06	14.20	69.14	0.22	0.96	0.15
	5.0	35.28	44.14	14.32	69.75	0.24	0.97	0.18
	7.5	41.62	46.31	14.43	70.36	0.25	0.98	0.21
	10.0	47.95	48.02	14.55	70.97	0.27	0.99	0.24
Pomegranate peels powder	2.5	27.06	40.22	14.71	70.89	0.63	1.04	0.16
	5.0	31.51	40.37	15.33	73.26	1.04	1.12	0.19
	7.5	35.97	40.51	16.35	75.63	1.46	1.21	0.22
	10.0	40.42	40.66	16.97	77.90	1.88	1.29	0.26

* 100 % wheat flour (72 % extraction rate).

Total, soluble and insoluble dietary fiber of produced cake

Results presented in Table 6 revealed that the partial replacement of wheat flour with TPP, MSKP and PPP increased dietary fiber % (i.e. Total, soluble and insoluble dietary fiber) of cake samples compared with control cake sample in parallel with increasing the level of substitution. Cake treatments containing TPP, MSKP and PPP have also recorded the same trend of dietary fiber. Such data are in line with those obtained by Isik and Topkaya (2016); Topkaya and Isik (2019) and Das *et al*. (2019).

Table 6 : Total, soluble and insoluble dietary fiber of produced cake samples (g/100g dry basis)

Cake sample	Substitution level (%)	Dietary fiber		
		Total dietary fiber	Soluble dietary fiber	Insoluble dietary fiber
*Control sample		2.65	0.86	1.79
Tomato pomace powder	2.5	3.47	0.95	2.52
	5.0	4.29	1.03	3.26
	7.5	5.12	1.12	4.00
	10.0	5.94	1.22	4.72
Mango seeds kernel powder	2.5	3.19	1.02	2.17
	5.0	3.74	1.17	2.57
	7.5	4.28	1.32	2.96
	10.0	4.83	1.48	3.35
Pomegranate peels powder	2.5	3.93	1.17	2.76
	5.0	5.20	1.48	3.72
	7.5	6.47	1.79	4.68
	10.0	7.75	2.10	5.65

* 100 % wheat flour (72 % extraction rate).

Total phenolic and flavonoid compounds of produced cake

Results presented in Table 7 showed that the partial replacement of wheat flour with TPP, MSKP and PPP increased total phenolic and flavonoid content of cake samples compared with control cake sample in parallel with increasing the level of substitution.

Cake treatments containing TPP had the highest total phenolic and flavonoid content followed by PPP and finally MSKP. Such data are in line with those obtained by Isik and Topkaya (2016); Topkaya and Isik (2019) and Das *et al*. (2019).

Table 7 : Total phenolic and flavonoid contents of cake samples prepared by partial replacement of wheat flour by tomato pomace powder, mango seeds kernel powder and pomegranate peels powder

Cake sample	Substitution level (%)	Total phenolic	Total flavonoid
*Control sample		72.34	51.40
Tomato pomace powder	**2.5**	92.70	61.72
	5.0	113.06	72.03
	7.5	133.43	81.89
	10.0	154.79	92.66
Mango seeds kernel powder	**2.5**	77.67	54.12
	5.0	82.98	56.84
	7.5	88.32	59.56
	10.0	93.65	62.28
Pomegranate peels powder	**2.5**	81.15	57.08
	5.0	89.96	62.75
	7.5	97.83	68.42
	10.0	107.54	74.10

* 100 % wheat flour (72 % extraction rate).

Sensory evaluation of produced cake:

Table 8 revealed that substitution with TPP, and MSKP, all the sensory evaluation characters, cells, grain, texture, crumb color, flavor, and overall acceptability, have no significant difference between the control sample and cake and biscuit samples which substituted with 2.5, 5, and 7.5 % of MSKP and TPP.

These results are in agreement with Sharoba *et al.* (2013); Isik and Topkaya (2016) and Das *et al*. (2019).

Table 8: Sensory evaluation of cake samples

Cake samples	Substitution level (%)	Cells (30)			Grain (20)	Texture (30)			Crumb color (10)	Flavor (10)	Overall acceptability (100)
		Uniformity (10)	Size of cells (10)	Thickness of walls (10)		Moistness (10)	Tenderness (10)	Softness (10)			
**Control sample		9.90^{A}	9.70^{A}	9.90^{A}	19.80^{A}	10.00^{A}	10.00^{A}	9.70^{A}	10.00^{A}	10.00^{A}	99.00^{A}
Tomato pomace powder (TPP)	2.5	9.40^{AB}	9.50^{AB}	9.30^{AB}	19.30^{A}	9.10^{B}	9.20^{B}	9.10^{AB}	9.50^{AB}	8.60^{BC}	93.00^{AB}
	5.0	9.30^{AB}	9.40^{ABC}	8.80^{BC}	18.70^{A}	9.10^{B}	9.20^{B}	9.00^{AB}	9.35^{AB}	8.60^{BC}	91.45^{B}
	7.5	9.10^{AB}	8.90^{BC}	8.70^{BC}	18.70^{A}	9.10^{B}	9.10^{B}	8.70^{BC}	9.20^{B}	8.50^{BC}	90.00^{BC}
	10.0	8.90^{B}	8.70^{CD}	8.20^{CDE}	18.20^{AB}	8.30^{CD}	8.70^{BC}	8.50^{BCD}	8.50^{C}	8.30^{BCD}	86.30^{BC}
Mango seeds kernel powder (MSKP)	2.5	9.50^{AB}	9.40^{ABC}	9.30^{AB}	19.20^{A}	8.70^{BC}	9.00^{B}	8.70^{BC}	8.10^{CD}	9.00^{B}	90.90^{BC}
	5.0	9.20^{AB}	9.00^{ABC}	8.80^{BC}	18.60^{A}	8.60^{BC}	8.80^{BC}	8.50^{BCD}	7.30^{EF}	8.70^{BC}	87.50^{BC}
	7.5	8.10^{C}	8.10^{DE}	8.20^{CDE}	18.20^{AB}	8.10^{CD}	8.00^{DE}	8.10^{CD}	6.90^{EFG}	8.40^{BCD}	82.10^{C}
	10.0	7.60^{C}	7.60^{EFG}	8.00^{CDE}	18.20^{AB}	7.90^{DE}	7.90^{DE}	7.90^{CD}	6.50^{G}	8.30^{BCD}	79.90^{CD}
Pomegranate peels powder (PPP)	2.5	8.10^{C}	8.00^{DEF}	8.50^{BCD}	16.70^{BC}	8.60^{BC}	8.20^{CD}	8.00^{CD}	7.45^{DE}	8.30^{BCD}	81.85^{C}
	5.0	7.90^{C}	7.50^{EFG}	7.80^{DE}	16.60^{BC}	7.80^{DE}	7.90^{DE}	7.80^{DE}	7.20^{EFG}	7.85^{CDE}	78.35^{D}
	7.5	7.70^{C}	7.30^{FG}	7.70^{DE}	15.70^{C}	7.70^{DE}	7.70^{DE}	7.80^{DE}	6.90^{EFG}	7.60^{DE}	76.10^{E}
	10.0	7.60^{C}	7.10^{G}	7.50^{E}	15.50^{C}	7.30^{E}	7.40^{E}	7.10^{E}	6.60^{FG}	7.10^{E}	73.20^{F}

*Means followed by different letters in the same column are significantly different by Duncan's multiple tests ($p < 0.05$).
** 100 % wheat flour (72 % extraction rate).

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