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Utilization of Pomegranate Peels Flour to Improve Sponge Cake Quality

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ABSTRACT

Pomegranate *(Punica granatum L.)* peels are rich in nutrients especially phenolic contents. Utilization of pomegranate peel flour as residue to produce sponge cake in present study was targeted. This study reports on the effect of composite flour consisting of wheat and pomegranate peel flour (PPF) on the physicochemical, sensorial and microbial characteristics. Wheat flour was substituted with PPF at 0, 5, 10, 15 and 20% ratios. The results showed that the sponge cakes 4 containing up to (20% PPF) had the lowest volume (33.046) and the highest weight (20.20) among all of the used samples, while Sponge cake 1 (5% PPF) had the lowest weight as (12.30) and the highest volume as (52.704) The control sample recorded the highest scores for all sensory attributes compared with other samples. The chemical analysis revealed that significantly increases were found in ash and crude fibers content compared with control sponge cake. Protein and fat contents significantly decreased as a resulting of PPF increases. Pomegranate peels has been previously referred as good source of Ca, K and Fe. Sponge cake 4 (20% PPF) had the highest total phenolic compounds as (0.669 mg GAE/100 g). Sponge cake 4 with 20% PPF gave the highest protection against some microbial contamination. TBC (1.8 and 2.7 log10 CFU), respectively, after 4 and 6 days comparing with control. On the other hand, sponge cake 4 (20% PPF) was the lowest in coliform and Yeast & Molds counts (3.9 and 2.9 log10 CFU), respectively after 6 days of storage. In summary, our results concluded that pomegranate peel flour can be used in cake preparation to improve fibers, minerals and phenolic contents that recommended gaining nutritional and healthy.

Keywords*: Pomegranate peel, sponge cake, Physical properties, phenolics, chemical, microbiological properties*

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INTRODUCTION

Food is any substance of animal or plant origin consumed to provide the body with nutrients, which help to build and maintain the human body's structure, functions and supplies the energy need of the system (Sarkiyayi and Agar, 2010).

Fruit and vegetable wastes are naturally rich with bioactive compounds like vitamins, antioxidants, phenolic compounds minerals and fiber. Compelling evidences justify and designate peels and relative extracts of numerous fruit as functional foods. In a present scenario of food insecurity related malnutrition and likelihood of infectious diseases, consumer of these healthier and nutritional ingredients in diets have widely discussed and established as excellent strategies to address malnutrition and attenuate different health related disorders (Ismail *et al.,* 2012 and Akhtar *et al.,* 2013a,b).

Some natural chemical substances in plant and animal food products could also be anti-nutrients preventing the absorption of nutrients from food. Food processing is meant not only to improve the taste of the food, improve palatability and digestibility, but also serves to detoxify chemical constituents and destroy/ reduce the microbial load of the food. Contrary to these, processing procedures can also introduce contaminants of pathogenic microorganisms and toxic chemicals (ICSMF, 1996 and MGFRF, 2007).

The non-edible ingredients of pomegranate fruit are considered as waste materials (i.e., peels and seeds), contain even higher quantity of biologically active components compared to the edible part of fruit (Orgil *et al.,* 2014). Pomegranate is considered one of the oldest fruit and one of the earliest to appear in human diet (Chalfoun-Mounayar *et al.,* 2012). Pomegranate *(Punica granatum L.)* peel, a residues of juice processing industries was recoded to contain a several of bioactive compounds, minerals and crude fibers for a extended range of human dietary requirements (Mirdehghan and Rahemi, 2007). The waste fraction of pomegranate fruit holds up relatively high phenolic compounds (1.261%) in addition to its properties as good source of crude fiber (12.17%) and inorganic residues that embrace a wide health promotive features like prevention from the development of cardiovascular disorders, anti-inflammatory, hypoglycemic, apoptotic, anti-parasitic and as prebiotic (Anderson *et al.,* 2009 and Abdel-Rahim *et al.,* 2013). Each and every part of pomegranate provides health benefits, that is, a nutraceutical food (Sreekumar *et al.,* 2014).

Spongy cakes are the most utilized bakery product owing to unique products and are always used in celebrations (Hafez, 2012 and Zhang *et al.,* 2012). It's increasing worldwide by 1.5% per year (Ahmed, 2014). It's usually made from wheat flour at extra extraction caused deficient in crude fibers and phytochemicals. At the present time, crude fibers from alternative sources are obtainable which may provide crude fibers and bioactive compounds as natural components, like vegetable, fruit, and their residues (Rodríguez *et al.,* 2006).

Many epidemiological studies confirm that crude fibers utilization helps to prevent or reduce some cancer tumor kinds, obesity and cardiovascular diseases (King, 2005 and Slavin, 2005). Therefore, the fibers consumption recommended being up to 20 to 35 gram daily (Gómez *et al.,* 2010).

The aim of this study is to evaluate pomegranate peel flour as a high source of fibers, minerals and total phenolic bioactive compounds. As well as, evaluate sponge cake made with pomegranate flour chemically, microbial and organoleptically.

MATERIALS AND METHODS

Materials:

Pomegranate fruits, wheat flour (72%), succrose, fresh eggs, vanilla and baking powder were procured from a local market of Kafrelsheikh City, Egypt. All chemicals and media were purchased from El-Gomhoria Company for Chemicals and Drugs, Tanta, Egypt.

Methods:

Preparation of samples:

Pomegranate fruits were washed using tape water and dried. Samples were manually peeled and divided into small pieces and sun dried under shade. Dried peels were

milled to fine powder using electric mill and passed throw 40 mesh sieve screen and packed in polyethylene bags and stored at - 18º C until used (Ismail *et al.,* 2014).

Sponge cake preparation:

Sponge cake was prepared according to the method described by Sapa, (1991). Wheat flour (72%) was substituted by pomegranate peel flour at ratios 0, 5, 10, 15 and 20%.

Organoleptic evaluation:

The organoleptic properties of different substituted sponge cakes were carried out according to AACC (2000).

Storage conditions:

Cake samples were divided to two groups The first was stored at room temperature (25±5 ºC) and the second was stored at refrigerator at (5 ºC) .Microbiological analysis was determined every two days for one week for the samples stored at room temperature, but it determined after the first week for 4 weeks for the samples stored at refrigerator.

Chemical compositions:

Moisture, total nitrogen, total lipids, ash, crude fibers were determined according to the methods described by AOAC (2010). Total carbohydrates were calculated by difference. Sodium and potassium were determined using a flame photometer. Other minerals were determined using atomic absorption.

Total phenolics:

Total phenolic contents were determined by Folin-Ciocalteu method as adopted by Li *et al.* (2006) and the results were expressed as mg gallic acid equivalent (GAE).

Microbiological analysis:

Total bacterial count (TBC), coliform group (CG) and yeast & molds (Y & M) counts were determined periodically in all sponge cakes samples during storage periods. Under septic conditions, a series of sequential dilutions were performed and inoculated then TGYA, RBA and VRBA media were poured. All petri plates were incubated at 37˚C for two days for TBC and CG while at 28˚C for about three to five days for Y & M. These tests were performed in triplicates.

Statistics

The statistical analysis was performed using SPSS program (ver. 19) with multi-function utility regarding to the experimental design. P values less than 0.05 were considered to indicate statistical significance and multiple comparisons were analyzed applying with Duncan according to Steel *et al.* (1996).

RESULTS AND DISCUSSION

Physical properties of sponge cake:

Physical properties (weight, volume and specific volume) of all samples are shown in Table (1).

Table 1. Effect of replacement ratios on weight, volume and specific volume of sponge cake substituted with pomegranate peel flour (PPF).

Physical attributes Samples	Weight (g)	Volume (cm^3)	Specific volume
Control sponge' cake	$16.20^{c} \pm 1.15$	$52.704^{a} \pm 0.57$	$0.3074^{d} \pm 1.13$
Sponge cake 1 (5% PPF)	$12.30^{d} \pm 2.07$	$36.608^{c} \pm 1.12$	$0.3359^{c} \pm 1.65$
Sponge cake 2 (10% PPF)	$16.90^{bc} \pm 2.40$	$38.688^{b} \pm 0.64$	$0.4368^{bc} \pm 1.54$
Sponge cake 3 (15% PPF)	$17.00^{b} \pm 1.92$	$35.250^{d} \pm 1.78$	$0.4823^{b} \pm 0.83$
Sponge cake 4 (20% PPF)	$20.20^{a} \pm 1.08$	$33.046^{e} \pm 1.23$	$0.6113^{a} \pm 0.41$

Values are means ± SD of 3 replicates. Mean values in each column designated by the same letter are not significantly different at 5.0% level using Duncan's multiple range tests.

Levels of PPF have approximately the equal width and length but different height.

The results showed that the sponge cake 4 containing up to (20% PPF) have the lowest in volume (33.04) and the highest in weight (20.20) compared with control while Sponge cake 1 (5% PPF) was the lowest weight as (12.30) and the highest volume as (52.70). Gas retention in dough during baking is a property of wheat flour gluten which becomes strong and extensive. This prevents escape of the gas during baking and allows the dough to rise (Akubor and Ishiwu, 2013). On the contrary, specific volume was increased as a function of increasing levels of PPF to reach (0.61) in sponge cake 4 (20% PPF).

Sensory evaluation:

Sensory properties of sponge cake made from wheat flour and pomegranate peel flour (PPF) as well as the 100% wheat flour (72 %) are shown in Table (2).

Table 2. Effect of replacement ratios on organoleptic properties of sponge cake substituted with pomegranate peel flour (PPF).

Sponge cake samples	Crust colour	Thickness	Size	uniformity	colour	softness	tenderness	odour	taste	Over all acceptability
Control sponge cake	9.36^{a} ±1.75	9.16^{a} ±1.35	9.08^{b} ±1.92	8.96^{a} ±0.37	9.48^{a} ±1.83	8.24^{a} ±2.49	8.80^{a} ±1.05	8.00^{a} ±1.	8.60^{a} ±0.63	9.04^{a} ±1.76
Sponge cake 1 (5% PPF)	8.76^{b} ±1.03	8.60^{b} ±2.59	8.56^{c} ±2.13	8.52^{b} ±1.10	8.56^{b} ±1.07	8.24^{a} ±2.50	8.08^{b} ±1.85	7.80^{b} ±82	8.56^{b} ±0.19	8.71^{b} ±1.08
Sponge cake 2 (10% PPF)	8.20^{c} ±2.43	8.16^{cd} ±2.04	8.28cd ±1.60	8.48^{bc} ±1.72	8.04^{c} ±2.12	7.44^{bc} ±1,76	7.72^{c} ±0.93	7.60^{c} ±2.14	7.20^{cd} ±2.51	8.35^{c} ±0.35
Sponge cake 3 (15% PPF)	8.12^{cd} ±1.19	8.20^{c} ±1.28	11.6^{a} ±0.04	8.00^{c} ±2.55	8.36^{bc} ±1.98	7.76^{b} ±2.18	7.64^{cd} ±0.81	7.68^{cd} ±2.70	7.36^{c} ±1.03	8.11^{d} ±1.44
Sponge cake 4 (20% PPF)	7.64^{d} ±2.02	7.80^{d} ±1.76	7.76^{d} ±1.73	7.32^{d} ±1.08	7.76^{d} ±1.63	6.80^{c} ±1.82	6.84^{d} ±1.16	6.84^{d} ±2.63	6.48^{d} ±1.71	7.51^{e} ±1.65

Values are means ± SD of 3 replicates. Mean values in each column designated by the same letter are not significantly different at 5.0% level using Duncan's multiple range tests.

The control sample recorded the highest scores for all sensory attributes compared with treated sponge cakes. It was noticed that sponge cake 1 (5% PPF) had the second highest scores after control, that recorded (8.71) for over all acceptability, while sponge cake 4 (20% PPF) was the lowest over all acceptability as (7.51). Sponge cakes with PPF substitution will be superior in sensory. Taste score was decrease significantly as a function of PPF increased 20%, it may be due to slight bitter of phenolics and tannins compounds.

The observed colour of control sponge cake could be attributed to the presence of phenolic compounds like tannic acids in the PPF sponge cakes (Ahenkoro *et al.,* 1996). The acceptability of the PPF sponge cakes colour decreased with the addition of PPF due to the PPF had dark brown colour. The score for taste reduced slightly with increased level of PPF, possibly because the presence of phenolic compounds having bitter taste in PPF (Izonfuo and Omuoru, 1998).

Chemical Composition of Sponge Cake:

Chemical compositions (g/100g) of pomegranate peel flour (PPF) and sponge cake supplemented with PPF are shown in Table (3). Data referred that PPF contains high crude fibers and ash; while contained low amounts of crude protein and ether extract.

Table 3. Effect of replacement ratios on chemical composition of sponge cake (on dry weight) substituted with pomegranate peel flour (PPF).

Sponge cake samples	Moisture	Crude protein	Ether extract	Ash	Crude fibers	Carbohydrates
PPF	13.70	3.10	1.73	3.30	11.22	80.65
Control sponge cake	13.62^{bc} ±1.08	5.72^{a} ±2.99	5.22^{a} ± 2.67	1.33^{cd} ± 1.90	0.03^{e} ±1.57	86.77^{c} ±2.73
Sponge cake 1 (5% PPF)	13.67^{b} ±1.91	5.60^{ab} ±1.18	5.10^{ab} ±2.70	1.75^{c} ±1.83	0.64^{d} ±0.92	86.91^{c} ±1.05
Sponge cake 2 (10% PPF)	14.40^{a} ±2.05	4.66^{b} ±1.30	4.14^{b} ±1.98	1.72^{c} ±2.38	0.96^{c} ±1.73	89.45^{a} ±2.19
Sponge cake 3 (15% PPF)	14.21^{ab} ±0.39	4.25^{c} ±2.62	3.75^{bc} ±1.17	2.21^{b} ±0.45	1.36^{b} ±0.14	88.43^{b} ±1.38
Sponge cake 4 (20% PPF)	14.59^{a} ±1.13	3.95^{d} ±2.04	3.46^{c} ±1.24	2.50^{a} ±1.03	2.04^{a} ±2.20	88.05^{b} ±0.27

Values are means ± SD of 3 replicates. Mean values in each column designated by the same letter are not significantly different at 5.0% level using Duncan's multiple range tests.

Results also showed that significantly increases were found in ash and fiber content compared with control sponge cake. It may be due to the high content of crude fibers and ash in pomegranate peel flour .No significant difference in protein content was observed between control sample and supplemented with 5%PPF and both them were the highest. Generally, protein and fat contents significantly decreased as a resulting of PPF increases. It may be due to the excess of crude fibers and minerals in PPF that led to decrease of protein and fat. Ash and crude fibers contents increased significantly as a function of PPF levels increases ash and crude fibers contents recorded 2.50% and 2.04% in cake supplemented with 20% PPF compared to 1.33% and 0.96% in control sample , respectively . Nowadays, functional foods ingredients, which in principle apart from their basic nutritional functions provide great physiological and healthy benefits and are very important (Viuda-Martos *et al.,* 2010). There has been a virtual explosion of interest in the pomegranate as nutritional and medicinal plant due to its multifunction ability and its benefit in the human.

Minerals Contents:

The minerals content (mg/kg) of PPF and sponge cake prepared with PPF and control are presented in Table (4). The results show that, PPF contains high levels of K and Ca, but contained low levels of Na, Fe and Zn.

Table 4. Effect of replacement ratios on some minerals content (mg/kg) of sponge cake (on dry weight) substituted with pomegranate peel flour (PPF).

Minerals mg/kg Sponge cake samples	Na	K	Ca	Fe	Zn
PPF	670.45	1460.40	3390.60	10.01	8.42
Control sponge cake	3533^{a} ± 1.38	1089^{e} ± 3.17	291.50^{e} ± 2.62	45.50^{d} ± 2.58	14.65^{a} ± 1.93
Sponge cake 1 (5% PPF)	3451^{b} ± 2.05	1245^{d} ± 2.74	360.50^{c} ± 1.98	41.50^{e} ± 3.34	12.65^{b} ± 2.22
Sponge cake 2 (10% PPF)	3308^{d} ±0.69	1440^{c} ± 3.06	334.50^{d} ± 0.95	49.90^{c} ± 3.15	11.55^{c} ± 2.64
Sponge cake 3 (15% PPF)	3439^{c} ± 0.51	1477^{b} ± 0.82	368.50^{b} ± 1.03	55.50^{b} ± 2.06	12.40^{bc} ± 1.03
Sponge cake 4 (20% PPF)	3256^{e} ± 2.41	1709^{a} ± 3.11	371.00^{a} ± 0.84	65.50^{a} ± 2.91	12.60^{b} ± 1.31

Values are means ± SD of 3 replicates. Mean values in each column designated by the same letter are not significantly different at 5.0% level using Duncan's multiple range tests.

Results also reflected that, sodium and zinc contents decreased significantly as a result of increase PPF in cake. It decreased from 3533 to 3256 mg/kg and decreased from 14.65 to 12.60 mg/kg for zinc for both control and sample supplemented with 20% PPF; respectively. On contrary, potassium, calcium and iron

contents increased significantly as a function of increase PPF ratio from 0 to 20%. It may be due to the high contents for potassium, calcium and iron in PPF compared to wheat flour.

The American Diabetes Association (2002) reported that the average daily intake of sodium in the diet should be limited because sodium helps to increase the tendency to retain fluid and blood pressure. The ADA (2002) recommended an average amount daily intake of less than 200/mg per day however foods that contain 140 mg of sodium or less are considered as low sodium foods. The required daily intake average for sodium is 0.12 to 1.8g per day (ADA, 2002). The high potassium/sodium ratio (41.12:1), obtained in the 20% PPF spongy cake, is desirable due to an average human diet is low in potassium but high in sodium (ADA, 2002).

Total phenolics:

Total phenolic contents of PPF and cake substituted by PPF are tabulated in Table (5). The data reflected that PPF had high content of phenolic contents reached about 56.20 mg gallic acid equivalent/100g sample. The results show also that total phenolic contents in cake substituted with PPF significantly increased as a result of increases substituted ratios from zero to 20% PPF.

Low phenolic profile (0.234 mg GAE/100 g) has been found in control sponge cake, while sponge cake 4 (20% PPF) had the highest total phenolic content as (0.669 mg GAE/100 g). These results are in agreement with that reported by Vaher *et al.* (2010) and Han and Koh, (2011). Findings from the current report suggest complimentary effect of PPF on phenolics profile of supplemented sponge cakes.

Table 5. Effect of replacement ratios on total phenolic ((mg GAE/100 g)) contents of sponge cake substituted with pomegranate peel flour (PPF).

Sponge cake samples	Total Phenolics (mg GAE/100 g)
PPF	56.20
Control sponge cake	$0.234^{de} \pm 1.75$
Sponge cake 1 (5% PPF)	$0.289^{d} \pm 1.13$
Sponge cake 2 (10% PPF)	$0.429^{c} \pm 2.51$
Sponge cake 3 (15% PPF)	$0.577^{b} \pm 0.82$
Sponge cake 4 (20% PPF)	$0.669^{a} \pm 1.04$

Values are means ± SD of 3 replicates. Mean values in each column designated by the same letter are not significantly different at 5.0% level using Duncan's multiple range tests.

Microbiological attributes:

The microbiological attributes such as total aerobic plate counts (TBC), coliform counts (CC) and yeast and molds counts of the different sponge cakes substituted with PPF during storage at 0, 2, 4 and 6 day at room temperature (25 °C) were tested; data was shown in Table (6).

Table 6. Total microbial counts (log CFU g−1) of sponge cake substituted with pomegranate peel flour (PPF) and stored at room temperature (25±5 °C) for 6 days.

Storage time per days / Sponge cake samples	Total aerobic plate counts TBC [log CFU g−1]				Coliform counts CC [log CFU g−1]				Yeast and molds counts Y & M [log CFU g−1]			
	0	2	4	6	0	2	4	6	0	2	4	6
Control sponge cake	0	0	$2.9^{a} \pm 2.75$	$3.7^{ab} \pm 1.24$	0	0	$3.7^{a} \pm 0.18$	$4.5^{a} \pm 1.93$	0	0	$3.9^{a} \pm 2.76$	$4.5^{a} \pm 1.42$
Sponge cake 1 (5% PPF)	0	0	$2.5^{b} \pm 1.17$	$3.8^{a} \pm 2.40$	0	0	$3.6^{ab} \pm 1.34$	$4.5^{a} \pm 1.06$	0	0	$3.5^{b} \pm 1.80$	$3.9^{b} \pm 1.56$
Sponge cake 2 (10% PPF)	0	0	$2.2^{bc} \pm 1.87$	$3.8^{a} \pm 1.11$	0	0	$3.6^{ab} \pm 0.54$	$4.3^{b} \pm 2.85$	0	0	$3.3^{c} \pm 1.94$	$3.5^{c} \pm 2.70$
Sponge cake 3 (15% PPF)	0	0	$2.1^{cd} \pm 2.05$	$3.7^{ab} \pm 1.93$	0	0	$2.7^{c} \pm 2.30$	$4.3^{b} \pm 3.01$	0	0	$2.5^{d} \pm 2.17$	$3.5^{c} \pm 1.51$
Sponge cake 4 (20% PPF)	0	0	$1.8^{d} \pm 1.14$	$2.7^{c} \pm 1.08$	0	0	$2.7^{c} \pm 2.19$	$3.9^{c} \pm 2.77$	0	0	$2.5^{d} \pm 1.03$	$2.9^{d} \pm 1.05$

Mean values in each column designated by the same letter are not significantly different at 5.0% level using -Duncan's multiple range test. Values are means of triplicate determinations.

The TBC, CC and Y & M increased as storage period was prolonged significantly ($p < 0.05$). Control sponge cakes had higher contamination in TBC, CC and Y & M than cake substituted with PPF. Sponge cake 4 with 20% PPF recorded the lowest contamination with TBC (1.8 and 2.7 log CFU g−1); respectively, after 4 and 6 days comparing with control. On the other hand, sponge cake 4 (15% PPF) was the lowest in CC and Y & M, especially during storage periods as (3.9 and 2.9 log CFU g−1, respectively, at 6th day.

Sponge cakes stored at room temperature (25±5 °C) were seen to be moldy on the 6th day of storage but less than control sponge cake. Based on this study, TPC, CC and Y&M increased during storage period of 6 days at room temperature. This happened because the room temperature (25°C ± 5°C) is the optimum temperature that allows growth of microorganism and this temperature also falls below the danger zone temperature which is 4.4-60ºC. Leaving food out too long at room temperature can cause bacteria to grow to dangerous levels that can cause illness because the bacteria grow most rapidly in danger zone temperature, which doubling in number in as little as 20 minutes (USDA, 2013). Furthermore, it is also due to the presence of oxygen which allows growth of aerobic microorganisms (Jariyawaranugoon, 2013).

When the cake dries up the yeast growing will probably decrease but molds were able to grow even in dried substrate. Hence, molds still were viable and can rejuvenate into new molds when condition is conducive. As reported by USDA (2013), molds form spores which, when dry, floated in the air and find suitable conditions where they can start the growth life cycle again. Besides, most molds like moderately high temperatures; however they can also grow at lower temperatures. In addition, the

depletion of nutrients will slow down the growth of bacteria.

Normally, cake manufacturers kept their product at chill temperature for a maximum of 30 days to ensure the product is safe for consumption. However, from this study it was found that the sponge cakes were still acceptable in term of the microbial count since it is below the unsatisfactory level (Cengel and Ghajar, 2014). In (Sandra, 2007) stated the recommended storage times for maintaining good quality of pound cakes at room temperature were between 3 to 5 days and 6 months if stored in the freezer. Therefore, the results of the present study showed that the sponge cake prepared from PPF stored at room temperature might not be safe to consume on the 6th day of storage onwards as the results of TPC and Y&M were greater than the permitted level.

Total microbial counts of the diverse sponge cakes substituted with PPF during cold storage at (5 ±1 °C) for 4 weeks were determined and the results are shown in Table (7). There is no contamination with yeast and mold for both control and cake substituted with PPF during the first three weeks. Also, there is no contamination with total counts for cake samples substituted with 10 and 15% and both of them were the best. Generally, addition of PPF instead of wheat flour led to protection of cake against microbial contamination.

Table 7. Total microbial counts (log CFU g−1) of sponge cake substituted with pomegranate peel flour (PPF) and cold stored at (5 ±1 °C) for 4 weeks.

Sponge cake samples	Total aerobic plate counts TBC [log CFU g−1]				Coliform counts CC [log CFU g−1]				Yeast and molds counts Y & M [log CFU g−1]			
	Storage time (week)											
	1	2	3	4	1	2	3	4	1	2	3	4
Control sponge cake	0	3.2	3.3	3.5	0	0	0	3	0	0	0	3.9
Sponge cake 1 (5% PPF)	0	0	0	3.5	0	3	3.2	3.7	0	0	0	3
Sponge cake 2 (10% PPF)	0	0	0	0	0	0	0	0	0	0	0	0
Sponge cake 3 (15% PPF)	0	0	0	0	0	0	3.3	3.2	0	0	0	3
Sponge cake 4 (20% PPF)	0	0	0	3.7	0	3.3	3.3	4	0	0	0	3.3

CONCLUSION

In summary, an innovative and successful formulation of spongy cake production with PPF residues was developed. Sponge cakes with PPF at diverse substituted levels recorded lower calories value than control sponge cakes. The substitutions of wheat flour with PPF were at 5, 10, 15 and 20% recommended to produce an acceptable sponge cake by consumers. The results suggested that sponge cake substituted with pomegranate peel flour had high crude fibers, minerals content and antioxidative activities. So it is recommended to considered hypolipidemic diet, nutritional and healthy benefits to weight loss activity and the risk of obesity with acceptable physical and organoleptic quality. However, it could be recommended that using of PPF should be encouraged the local food industries to utilize pomegranate residues economically into sponge cake to produce low energy as functional and nutritive food products.

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الاستفادة من دقيق قشور الرمان لتحسين صفات الجودة في الكيك الاسفنجي

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قسم الإقتصاد المنزلي – كلية التربية النوعية – جامعة كفر الشيخ – مصر

تعتبر قشور الرمان (*Punica granatum L.*) غنيه بالعناصر الغذائيه وخاصة المواد الفينوليه. تم استخدام دقيق قشور الرمان لإنتاج الكيك الإسفنجي في الدراسة الحالية. تتناول هذه الدراسة تأثير الدقيق المركب المكون من القمح ودقيق قشر الرمان (PPF) على الخصائص الفيزيائية والكيميائية، والخصائص الحسية، والميكروبية حيث تم استبدال دقيق القمح بدقيق قشر الرمان بأربعة مستويات استبدال هي ٥ و ١٠ و ١٥ و ٢٠٪.أوضحت النتائج أن الكيك الاسفنجي (٤) المحتوية على (٢٠٪ دقيق قشر الرمان) كانت أقل في الحجم (٣٣.٠٤٦) وأعلى في الوزن (٢٠.٢٠) مقارنة بالكنترول، بينما كانت الكيك الإسفنجي ١ (٥٪ دقيق قشر الرمان) أدنى وزن لها (١٢.٣٠) وأعلى حجم (٥٢.٧٠٤). سجل الكنترول (١٠٠٪ WF) أعلى الدرجات لجميع الصفات الحسية مقارنةً بالكيك الاسفنجي المدعم بدقيق قشر الرمان. لوحظ أن الكيك الإسفنجي ١ (٥٪ دقيق قشر الرمان) كانت ثاني أعلى الدرجات بعد الكنترول. وكشف التحليل الغذائي أن الكيك الإسفنجي ٤ (٢٠٪ دقيق قشر الرمان) تحتوي على أعلى نسبة من الرطوبة والرماد والألياف (١٤.٥٩ و ٢.٥٠ و ٢.٠٤) على التوالي. احتوت الكيك الاسفنجي ٤ (٢٠٪ دقيق قشر الرمان) على أقل نسبة دهون (٣.٤٦) مقارنة مع الكنترول (٥.٢٢). انخفضت محتويات البروتين في جميع عينات الكيك الإسفنجي مقارنة مع أعلى محتوى بروتين (٥.٧٢) في الكنترول، مع كون الكيك الاسفنجي ٢ (١٠٪ دقيق قشر الرمان) أعلى محتوى كربوهيدراتي (٨٩.٤٥). وتعتبر هذه الأطعمة التقليدية مصادر جيدة من المواد الغذائية. كما تعتبر القشور وهي فضلات من الرمان مصدراً جيداً للكالسيوم، البوتاسيوم، الحديد والزنك. كما تواجد اعلى محتوى للفينولات الكلية في الكيك الاسفنجي ٤ (٢٠ ٪ PPF) بواقع (٠.٦٦٩ مللجم 100/GAE جم). وقل محتوى الكيك الاسفنجي ٤ من TPC (١.٨و ٢.٧ log10 CFU) ، على التوالي بعد ٤ و ٦ يوم مقارنة بالكنترول. وعلى الجانب الاخر و CC و Y & M خلال فترة التخزين ٦ أيام في درجة حرارة الغرفة ولكن بشكل اقل من الزيادة الموجودة في كيك الكنترول. سجلت الكيك الاسفنجي ٤ (٢٠٪ PPF) الحد الأدنى من بكتيريا القولون والخمائر والأعفان خلال فترات التخزين (log10 CFU 2.7; 3.9; 2.9)، على التوالي، في اليوم السادس. وقد لخصت النتائج إلى أن مسحوق قشور الرمان المدعم بالألياف المرتفعة والمواد المضادة للأكسدة يوصى به للحصول على فوائد غذائية وصحية.

الكلمات المفتاحية : قشور الرمان، الخواص الطبيعية، الخواص الميكروبيولوجية، الكيك الاسفنجي.