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UTILIZATION OF TOMATO POMACE AND ORANGE PEEL POWDERS WITH WHEAT FLOUR FOR THE PRODUCTION OF CAKES

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ABSTRACT

This study was carried out to evaluate the effect of substitution of soft wheat flour (SWF) with 3, 6, 9 and 12 % tomato peel powder (TPP) and 5, 10, 15 and 20% orange peel powder (OPP) on rheological, chemical, baking quality, color, sensory characteristics, texture, stalling and shelf- life of cake.

Results showed that, rapid visco-analyzer (RVA) parameters showed that substitution of OPP and TPP to SWF (72% extraction) at different levels decreased the peak viscosity, trough, breakdown, final, and setback viscosities. While peak time and pasting temperature values ranged between 10.7 to 11.7min and 55.3 to 94.7ºC respectively for both OPP and TPP supplementation percent. Also, the partial replacement of SWF with OPP and TPP increased chemical composition % (moisture, crude protein, lipids, ash, and crude fiber) of cake samples, while total carbohydrates were decreased in parallel with increasing the level of substitution compared with control cake samples. Baking quality cake treatments containing OPP and TPP have also results showed that with increasing levels of OPP and TPP in cake, weight was gradually increased, while volume, specific volume and weight loss were decreased significantly when compared to control cake. The control cake had the highest L values (37.93 and 61.25) for crust and crumb with significant ($p \leq 0:05$) increases compared to other cake samples, while a and b* values decreased compared to cake samples containing OPP and TPP at different levels. The results of sensory evaluation show that OPP and TPP enhanced all sensory characteristics (taste, texture, odor, color, appearance and overall-acceptability) of cake comparing with the control. The enhancement increased with increasing the level of OPP and up to 15% and TPP up to 9%.*

The results of texture profile show that, all additions were increase hardness by increasing addition levels comparing with control sample, while cohesiveness, springiness, gumminess, chewiness, adhesiveness and resilience. The results showed a decrease in the percentage of freshness in the cake

samples containing OPP and TPP at 5, 10, 15, and 20%; 3, 6, 9 and 12%, respectively.

Conclusively, *from the results it could be concluded that, it is feasible to produce functional cake samples from mixture of SWF, OPP and TPP with good nutritional value and high sensory characteristics nearest to cake samples from control (100 %SWF). Finally, Wheat flour could be replaced by 3.0 to 6.0% of TPP and 5.0 to 10.0 % OPP with good properties and high nutritional value of cakes.*

Key words: *Tomato pomace powder (TPP), orange peel powder (OPP) Rheological, chemical, baking quality, color, sensory characteristics, texture, stalling, shelf- life and cake*

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)**. 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 (**Toor and Savage, 2005**). Tomato seeds have been shown to contain 20% oil of high nutritional quality, carotenoids, polyphenols, phytosterols, proteins, minerals and fibers (**Nour *et al.*, 2015**). By-products from the fruit and vegetable industry, in particular, are of interest since they are inexpensive and available in large quantities. Some of the agricultural by-products such as apples, citrus fruits and Brassica vegetables have already been used in the production of dietary fiber (**Figuerola *et al.*, 2005**). According to the Statistical Database of the Food and Agriculture Organization of the United Nations (FAOSTAT), world orange production in 2007 was estimated to be 63,906,094 tons. A high percentage of this production (70%) is used to manufacture products such as juice or marmalade. The processing of many fruit and vegetable products generate a large amount of waste. Unused waste not only adds to the issue of disposal, but also aggravates environmental pollution (**Kaur *et al.*, 2005**). Industrial waste issues are becoming more difficult to resolve and a great deal of effort will be needed to improve the nutritional and industrial value of by-products and waste.. Recently, more attention has been focused on the use of byproducts and waste for food production. Obviously, such utilization this will contribute to

optimizing the resources available and lead to the production of different foods (**Khedr *et al.*, 2016**).

Pomace is the by- product material that remains after extraction of juice from fruits. In commercial fruits processing, about 25 percent of the fruit comes out in the form of pomace and also was the residue remaining when fruits are processed for juice, wine, or other products. Many studies have reported that fruit pomace are rich sources of phenolic compounds and these byproducts, obtained from the juice and wine industry, might be useful raw materials for creating new value-added products (**Zhou *et al.*, 2009; Shah *et al*.,1994 and Masoodi *et al.* , 2002**). Citrus is an important crop, mainly used in food industries for fresh juice production, and peel and pomace are the main byproducts during its processing Citrus pomace has been used as a source for molasses, pectin, and limonene. Citrus pomace has also been widely studied, because it contains numerous biologically active compounds (**Li *et al.*, 2006a and Li *et al.*, 2006b**). Cake is a product obtained from flour, liquid and auxiliary raw materials through kneading the dough, fluffing, forming and baking in an oven. A series of chemical and physical changes occur in the dough during baking which make the final product easy available to a human organism, tasty and durable enough. In pastry-cooking the cakes are a numerous group of products. 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.

Therefore, the research objective was to develop a new cake formulation from different combinations of the common orange peel powder and tomato pomace powder with soft wheat flour as well as to determine the effect of processing procedures on the rheology, chemistry, color, backing quality, sensory properties, texture and shelf- life of the finished cake.

MATERIALS AND METHODS

Materials:

1. Tomato pomace (peel and seeds) and Orange waste (Citrus sinensis) Balady orange variety were obtained from Kaha Company for canned food, Kaha city, Kalyobia, Egypt.

2. Wheat Flour (72% extraction) was obtained from the North Cairo Flour Mills Company, Egypt.
3. Shortening, fresh eggs, sugar, baking powder, salt (sodium chloride), whole milk and vanilla were purchased from a local market in Dokki, Egypt.
4. 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 processing wastes were collected after juice extraction by cold-break treatments and dried at 50 ℃ for 12 h in an air circulating oven, submitted to a milling process, sieved (110 mesh), and maintained in polyethylene bags, and stored at -18 ℃ until use (**Curutchet *et al*, 2021**).

Preparation of orange waste (peel and pulp) powder:

Orange waste fibres: the by-products obtained from orange peel and the remaining pulp after juice extraction could be suitable sources of DF by cutting, extraction of juice, peel residue chopping, the material was washed under mild conditions to avoid or minimize losses of some soluble fibre components, then dried at temperatures below 65 ºC for 12 hrs. in an electric oven drier, and grinding to a particle size of 500–600 µm, according to (**Kethireddipalli *et al*., 2002**).

Preparation of composite flour blends

Different composite flour samples were prepared by partially substituting wheat flour (72% extraction) with 3, 6, 9, and 12 % of tomato pomace powder (TPP) and 5, 10, 15 and 20% orange peel powders (OPP) and kept in polyethylene bags and stored at 4˚C until used.

Preparation of sponge cakes:

Sponge cakes were prepared according to **Hussein *et al*. (2019)** with some modifications as showen in Table (1).

Analytical methods: Moisture, protein, Fat, ash and crude fiber contents of raw materials and pasta were determined according to **AOAC (2005)**. Carbohydrates were calculated by difference as mentioned as follows: Carbohydrates = 100 – (% protein + % fat + % ash + % crude fiber).

Caloric value: The total calories of the samples were calculated according to James (2013) as follows: Total calories (Kcal/100 g) = (Fat × 9 Kcal) + (Protein × 4 Kcal) + (Carbohydrate × 4 Kcal)

Baking Quality of Cakes: Volume (cm3) and weight (gm) of three cake samples of each treatment were recorded. Specific volume (gm/ cm3) was

Table (1): Formula of Cake

Samples	Control	Orange peel powder (%)				Tomato peel powder			
		5	10	15	20	3	6	9	12
Formula of Sponge Cake									
Soft Wheat Flour (SWF) (gm)	100	95	90	85	80	97	94	91	88
Orange peel powder (OPP)	-	5	10	15	20	-	-	-	-
Tomato peel powder (TPP)	-	-	-	-	-	3	6	9	12
Carboxy methyl cellulose (CMC)	-	1	1	1	1	1	1	1	1
Whole fresh milk (ml)	40	40	40	40	40	40	40	40	40
sugar (gm)	75	75	75	75	75	75	75	75	75
Fresh egg	125	125	125	125	125	125	125	125	125
Butter (gm)	15	15	15	15	15	15	15	15	15
baking powder (gm)	3	3	3	3	3	3	3	3	3
Vanilla (gm)	2	2	2	2	2	2	2	2	2

calculated by dividing of the volume to weight according to the method described in **A.A.C.C. (2000).**

Sensory evaluation of cakes : Control and supplemented cake samples were assessed by 15 panelists for the acceptability of sensory parameters; color, taste, odor, texture, appearance and overall acceptability as described by **Hussein *et al*. (2019).**

Texture characteristics: Texture profile analysis (TPA) was carried out using a testing system (Brookfield, CT3-10 kg, USA . The TPA parameters of the control and supplemented samples with SCGs were evaluated in triplicate using double compression tests.

Freshness of cakes: Freshness of cakes was tested after wrapping in polyethylene bags and storage at room temperature for 1, 3 and 5 days. It was determined using Alkaline Water Retention Capacity test (AWRC) according to the method of **Kitterman and Rubenthaler (1971).**

Color determinations: The color values of cake and biscuits samples were measured. Hunter a*, b* and L* parameters were measured with a color difference meter using a spectro- colourimeter (Tristimulus Colour Machine) with the CIE lab color scale (Hunter, Lab Scan XE - Reston VA, USA) in the reflection mode.

Lipid Auto-Oxidation: The Acid value (AV), peroxide value (PV) and Thiobarbutric acid number (TBA) were determined according to the methods

of **(AOAC, 2005).** The extracted oil was kept in tightly closed dark bottle in a deep freezer at (-20º C) for subsequent analysis.

Statistical analyses :

Standard Deviation (SD) calculations have been done using the software Excel 2010. Statistical analysis was conducted with the Co State program using a one-way analysis of variance (ANOVA). **(Tudor-Radu *et al*., 2016)**.

RESULTS AND DISCUSSION

Chemical composition of cakes containing different levels of OPP and TPP:

Chemical composition of cake samples was determined and the obtained results are shown in Table (2). The results indicated that, the moisture contents were gradually increase where the percentages of OPP and TPP increased and significant difference between the cake samples which content 5% to 20% OPP and the samples content 3% to 12% .While the lowest value of moisture content (24.83%) was recorded by the sample content 100% SWF (control) with significant difference. These results may be due to the ability of OPP and TPP to bind more amount of water (WHO was 3.66 g/g) when preparing the cake, and it can keep the moisture for long time without loss. Concerning the fat and fiber content, these results indicated that the cake sample contained 20% OPP recorded the highest values of fat and the cake sample contained 12% TPP recorded the highest values of fiber content with significant differences (14.96 and 4.85% respectively). While, the control samples of biscuit (Soft wheat flour 72%) recorded lowest values of protein and fiber content with significant differences. Slight increase was found in the ash content of all prepared cake samples when incorporating OPP and TPP at different levels, and the highest value was 1.93% appeared by cake with 12% TPP. In addition, it could be noticed clearly significant ($p \leq 0{:}05$) increases in fibre of prepared cake with TPP compared to control cake (4.85%). The crude fibre values ranged from 2.17% for cake with 3% TPP to 4.85% with 12% of TPP. It may be due to the high content of ash and dietary fibre in TPP. These results were in agreement with **Sharif *et al*., 2009, Cansu and Isik (2018) and Lotfy and Barakat (2018)**. They mentioned that a significant increase was found in the ash and fibre content of sponge cake compared with the control sample.

From Table 2, it be concluded that the partial replacement of soft wheat flour (SWF) with orange peel powder (OPP) increased chemical composition (%) (moisture, lipids, ash, and crude fiber) of cake samples in parallel with increasing the level of substitution compared with control cake sample, while protein and total carbohydrates were decreased in parallel with increasing the level of substitution. These data were in accordance with **Ammar and EL-demary (2009)** who reported that addition of baladi orange peels to cake could decreased the amount of carbohydrates , moisture , ether extract while crude

Table (2): Chemical composition of cakes containing different levels of OPP and TPP

Treatment groups	Moisture (%)	Chemical composition of fortified cake (% on dry weight basis)				
		Ash	Protein	Fiber	Fat	T.C.
Control (100%SWF72%)	24.83^{e}	0.95^{f}	9.05^{e}	1.35^{h}	14.28^{d}	74.37^{a}
5% OPP+95%SWF72%	25.37^{e}	1.13^{e}	8.31^{f}	1.68^{g}	14.48^{cd}	74.42^{a}
10% OPP+90%SWF72%	26.02^{d}	1.32^{c}	8.01^{g}	1.86^{f}	14.74^{b}	74.08^{a}
15% OPP+85%SWF72%	26.20^{d}	1.60^{b}	7.73^{h}	2.19^{e}	14.80^{ab}	73.69^{b}
20% OPP+80%SWF72%	27.03^{bc}	1.87^{a}	7.33^{i}	2.58^{d}	14.96^{a}	73.28^{c}
3% TPP+97%SWF72%	25.97^{d}	1.21^{d}	9.37^{d}	2.17^{e}	14.31^{b}	72.95^{c}
6% TPP +94%SWF72%	26.89^{c}	1.35^{c}	9.84^{c}	3.05^{c}	14.42^{b}	71.35^{d}
9% TPP +91%SWF72%	27.54^{ab}	1.62^{b}	10.05^{b}	4.05^{b}	14.65^{bc}	69.64^{e}
12% TPP+88%SWF72%	28.10^{a}	1.93^{a}	10.27^{a}	4.85^{a}	14.78^{ab}	68.18^{f}
LSD	**0.571**	**0.079**	**0.207**	**0.179**	**0.213**	**0.354**
F	**	**	**	**	**	**

Where: SWF: Soft wheat flour; OPP: orange peel powder; TPP: Tomato peel powder; T.C.: Total carbohydrate

fiber content was increased .On the same time the ash content was not affected by adding orange peels powder. Cake treatments containing tomato pomace powder (TPP) had also recorded the same trend of chemical composition except for protein content were increased. Results are in line with those obtained by **Lotfy and Barakat (2018) and Mohamed *et al*.(2022)**.

Baking quality of cakes containing different levels of OPP and TPP:

Results in Table (3) showed the weight (g), volume (cm3), specific volume (v/w), and weight loss (%) of cake samples. The results indicated that evident discrepancy was observed for instrumental weight, volume, specific volume (v/w), and weight loss (%) between the control cake and the other cake samples according to statistical analysis. However, the higher values of specific volume were recorded by the control cake sample and the cake sample which contained 20% OPP and 12%TPP (3.20, 2.72 and 2.57 cm3/g respectively) with significant differences, while the other samples where gradually decreased in the same character by increasing of OPP and TPP. However, the cake samples contained 20% OPP and sample contained 12% TPP recorded the higher values of weight (280.50 and 283.50 gm, respectively) with significant differences. Also, results showed that with increasing levels of OPP and TPP in cake, weight was gradually increased, while volume, specific volume and weight loss were decreased significantly when compared to control cake. This is due to high content of OPP in the cake samples caused the cohesion and convergence of molecules, which leads to an increase in weight. Incorporating OPP and TPP in cake had negative effect on volume and specific volume, where the highest values of 870 cm3 and 3.20 cm3 /g were recorded by control cake. Statistical

Table (3): Baking quality of cakes containing OPP and TPP at different levels

Samples	Physical properties of fortified cake			Weight loss (%)
	Weight (g)	Volume (cm3)	Specific volume (cm3/g)	
Control (100%SWF72%)	271.50^{c}	870.00^{a}	3.20^{a}	16.46^{a}
5% OPP+95%SWF72%	275.00^{bc}	845.00^{ab}	3.07^{b}	15.38^{ab}
10% OPP+90%SWF72%	274.00^{bc}	827.50^{bc}	3.02^{bc}	15.69^{ab}
15% OPP+85%SWF72%	279.00^{abc}	805.00^{cd}	2.89^{d}	14.15^{abc}
20% OPP+80%SWF72%	280.50^{ab}	762.50^{e}	2.72^{e}	13.69^{bc}
3% TPP+97%SWF72%	276.00^{abc}	832.50^{bc}	3.02^{c}	15.08^{abc}
6% TPP +94%SWF72%	279.00^{abc}	802.50^{cd}	2.88^{d}	14.15^{abc}
9% TPP +91%SWF72%	280.50^{ab}	777.50^{de}	2.77^{e}	13.69^{bc}
12% TPP+88%SWF72%	283.50^{a}	727.50^{f}	2.57 ^{f}	12.77^{c}
LSD	8.136	34.292	0.056	2.499
F- test	**	**	**	**

Where: SWF: Soft wheat flour; OPP: orange peel powder; TPP: Tomato peel powder

analysis of the obtained results shows significant differences in all measured physical properties of the tested cakes. These results were in agreement with those of **Sharoba *et al.* (2013), Yusufu and Akhigbe (2014)**, **Lotfy and Barakat (2018)**, and **Akbaş and Kılmanoğlu(2022)**.

Color Parameters of cakes containing OPP and TPP:

The color of the cakes is one of the characteristics is firstly perceived by the consumer and affects the acceptability of the product. Therefore, the Hunter parameters L*, a* and b* at both crust and crumb of cakes were determined and the obtained results are shown in Table 4.

The control cake had the highest L values (37.93 and 61.25) for crust and crumb with significant ($p \leq 0{:}05$) increases compared to other cake samples, which ranged between 37.49 and 36.16; 59.59 and 55.10 for crust and crumb by 5% and 20% of OPP respectively. While, ranged between 36.53 and 33.33; 60.47and 52.20 for crust and crumb by 3% and 12% of TPP respectively. The control sample recorded the lowest b value of 11.88, while OPP and TPP caused a significant decrease

in the b values. Cakes containing 20% of PPP recorded the highest significant value at 19.09; on the other hand, significant differences were observed between cake samples. These results were in agreement with Noor *et al.*(2011), Jung *et al.*(2015) and Salehi *et al.*(2016).

Table (4): Color values of cakes containing OPP and TPP at different levels

Cake samples	Crust color values			Crumb color values		
	L	a	b	L	a	b
Control (100%SWF72%)	37.93^{a}	11.13^{abc}	24.15^{d}	61.25^{a}	2.00^{e}	11.86^{f}
5% OPP+95%SWF72%	37.49^{ab}	10.54^{bcd}	24.10 ^{d}	59.59^{bc}	2.11 d^{e}	13.63^{d}
10% OPP+90%SWF72%	37.18^{ab}	10.07 ^{cd}	25.61^{bc}	58.77 ^{cd}	2.37b^{cde}	15.90^{c}
15% OPP+85%SWF72%	36.68^{bc}	9.73^{d}	26.63^{ab}	56.75^{e}	2.65^{abc}	17.89^{b}
20% OPP+80%SWF72%	36.16^{cd}	9.21^{d}	27.27^{a}	55.10^{f}	2.88^{a}	19.09^{a}
3% TPP+97%SWF72%	36.53^{bc}	11.16^{abc}	24.00^{d}	60.47^{ab}	2.25^{cde}	11.88 ^{f}
6% TPP +94%SWF72%	35.20^{d}	11.56^{ab}	24.14^{d}	58.33^{d}	2.56^{abcd}	12.02 ^{f}
9% TPP +91%SWF72%	34.03^{e}	11.91^{ab}	24.88^{cd}	55.14^{f}	2.78^{ab}	12.29^{ef}
12% TPP+88%SWF72%	33.33^{e}	12.03^{a}	24.99^{cd}	52.20^{g}	2.93^{a}	12.68^{e}
LSD	0.972	1.402	1.039	1.006	0.460	0.556
F- test	**	**	**	**	**	**

Where: SWF: Soft wheat flour; OPP: orange peel powder; TPP: Tomato peel powder

Sensory evaluation of cake substituted with OPP and TPP:

Cakes prepared from blends containing different proportions (0, 5, 10, 15 and 20%) OPP and (0, 3, 6, 9 and 12%) of TPP were evaluated for sensory characteristics and the results are recorded in Table (5). The results show that OPP and TPP enhanced all sensory characteristics of cake comparing with the control. The enhancement increased with increasing the level of OPP and up to 15% and TPP up to 9%. These results are in the line of **Abd El-Galeel and Shoughy (2013**) who found that highly acceptable cakes when incorporating 15% orange and mandarin peel powders in the formulation. From the same Table, it could be noticed that sensory characteristics of the cake samples contained the highest level of OPP (20%) TPP (12%) have lower scores compared to control. This may be attributed to the citrus peel and tomato pomace have high content of pigments which changed during baking resulted undesirable color especially at higher substitution level (**Abd El-Galeel and Shoughy, 2013**). This indicates that a higher level of incorporation of OPP or TPP in cake influenced the taste and texture adversely. This could be due to extremely high content of fiber in OPP and TPP, which would tend to make the product rough (**Nagarajaiah and Prakash, 2015**). Results in Table (5) revealed that the sensory quality score for crumb and crust taste, texture, odor,

Table (5): Sensory evaluation for cake supplemented with OPP and TPP at different levels

Treatment groups	Sensory-Evaluation of Cake					
	Taste	Texture	Odor	Color	Appearance	Overall-Acceptability
Control (100%SWF72%)	19.80^{a}	19.80^{a}	19.80^{a}	19.80^{a}	19.70^{a}	98.90^{a}
5% OPP+95%SWF72%	19.40^{a}	19.30^{a}	19.30^{a}	19.60^{a}	18.30^{b}	95.90^{b}
10% OPP+90%SWF72%	19.20^{a}	17.10^{bc}	17.90^{b}	19.30^{ab}	16.60^{c}	90.10^{c}
15% OPP+85%SWF72%	15.80 ^{c}	16.60^{cd}	16.50^{c}	19.00^{ab}	15.70^{c}	83.60^{e}
20% OPP+80%SWF72%	14.00^{d}	14.90^{e}	13.40^{d}	15.90^{d}	14.50^{d}	72.70^{f}
3% TPP+97%SWF72%	18.00^{b}	17.60^{b}	16.80^{bc}	18.40^{bc}	16.30^{c}	87.10^{d}
6% TPP +94%SWF72%	15.20^{c}	16.60^{cd}	15.90^{c}	17.90^{c}	15.90^{c}	81.50^{e}
9% TPP +91%SWF72%	13.80^{de}	16.00^{d}	14.50^{d}	14.10^{e}	13.10^{e}	71.50^{f}
12% TPP+88%SWF72%	12.90^{e}	12.70^{f}	11.60^{e}	12.90^{f}	12.00^{f}	62.10^{g}
LSD	1.066	0.934	1.152	1.051	0.964	2.474
F- test	**	**	**	**	**	**

Where: SWF: Soft wheat flour; OPP: orange peel powder; TPP: Tomato peel powder

color, Appearance and overall acceptability significantly differences affected in all prepared cakes formula. Appearance properties namely height and both of crumb and crust color were examined and results were also showed in Table (5), results indicated that both of crumb and crust colour were acceptable in cakes formula up to 10% substitution level with OPP and also the same trend was detected in height. With regard to the effect of addition OPP on the sensorial properties it could be concluded that addition of OPP at the level of 5 and 10 % have the superiority in improvement the prepared cakes quality and were also accepted by the panelists . These data were nearly in accordance with those given by **Abozeid *et al*.,(2011).**

Texture characteristics of cakes substituted by different levels of OPP and TPP:

The results presented in Table (6) show the texture characteristics hardness, Cohesiveness, Springiness, gumminess, chewiness, Adhesiveness and Resilience of the cake samples. The results show that, all additions were increase hardness by increasing addition levels comparing with control sample. The results in the same table showed that, the addition OPP and TPP to produced cakes improved the hardness due to the effect of fibers, the fibers' function had high adsorption capacity of oil and water and therefore the hardness increased with adding fibers. These results agree with **Sowmya *et al.* (2009)**. The hardness of the cake ranged from 16.69 and 14.60 for control sample and the addition of 20% OPP sample, respectively**.** The above results indicated that the addition of types of fiber sources is beneficial in improving the maximum force and texture. Adhesiveness of cake (control) was higher than cakes of mixed SWF with OPP and TPP at different mixing level.

Table (6): Texture profile analysis of cake supplemented with OPP and TPP

Samples	Texture profile analysis of cake samples						
	Hardness (N)	Cohesiveness	Springiness (mm)	Gumminess (N)	Chewiness (g.cm)	Adhesiveness	Resilience
Control (100%SWF 72%)	16.69	0.34	44.47	5.6	220	6.0	0.07
5% OPP+95%SWF72%	13.07	0.23	10.55	3.51	378	5.0	0.07
10% OPP+90%SWF72%	16.59	0.23	9.96	4.42	449	4.0	0.06
15% OPP+85%SWF72%	19.99	0.22	9.14	3.49	325	1.0	0.06
20% OPP+80%SWF72%	14.60	0.15	8.07	2.68	254	0.0	0.06
3% TPP+97%SWF72%	18.28	0.18	9.52	3.27	318	1.0	0.05
6% TPP +94%SWF72%	24.06	0.14	10.77	4.05	445	3.00	0.05
9% TPP +91%SWF72%	26.06	0.14	8.60	4.23	370	2.0	0.05
12% TPP+88%SWF72%	19.67	0.12	10.33	2.94	310	3.0	0.05

Where: SWF: Soft wheat flour; OPP: orange peel powder; TPP: Tomato peel powder .

Springiness of testing cakes decreased in mixed SWF with OPP and TPP at different mixing level (8.07 -10.55mm) compared to cake of control sample (44.47mm). Also, mixing SWF with OPP and TPP in cake at different mixing level exhibit a similar trend like springiness, where gumminess ranged between 2.68-4.42N while cake of control sample reached to 5.6N. Chewiness was minimized in cake of control sample (220mJ), while it was maximized in cakes of mixed SWF with OPP and TPP at different mixing level (ranged between 254-254mJ). These results were in agreement with **Sowmya *et al.* (2009), Zaker *et al*.(2016), Lotfy and Barakat (2018) and Hussein *et al*. (2019).**

Freshness of cake substituted by different levels of OPP and TPP:

Freshness of cake samples supplemented with different levels of OPP and TPP and cake control (produced from 100% SWF) during storage for 12 days at room temperature was investigated and reported in Table (7). Supplemented cake sample with 20% OPP and 12% TPP had the highest

Table (7): Freshness of cake supplemented with OPP and TPP at different levels during storage

Samples	AWRC (%) for cake samples incorporated with OPP and TPP at different levels				
	Zero time	3 days	6 days	9 days	12 days
Control (100%SWF72%)	380.00 ±3.45	354.00 ±5.16	336.00 ±4.46	314.00 ±2.46	306.00 ±2.89
5% OPP+95%SWF72 %	382.00 ±2.46	362.00 ±6.96	347.00 ±6.63	325.00 ±4.52	315.00 ±2.55
10% OPP+90%SWF72%	391.00 ±9.59	373.00 ±4.56	359.00 ±6.06	339.00 ±4.00	321.0 ±3.22
15% OPP+85%SWF72%	398.00 ±6.50	382.00 ±4.94	368.00 ±3.68	345.00 ±1.26	332.00 ±5.35
20% OPP+80%SWF72%	410.00±6.60	392.00 2±8.05	374.00 ±8.47	355.00 ±1.08	340.00 ±2.47
3% TPP+97%SWF72%	385.00 ±4.435	368.00±4.15	355.00±5.10	320.00±2.81	312.00±4.45
6% TPP +94%SWF72%	395.00 ±5.22	375.00±1.85	362.00±4.30	345.00±3.70	315.00±3.17
9% TPP +91%SWF72%	405.00 ±7.15	385.00±3.90	370.00±2.85	350.00±2.19	320.00±4.32
12% TPP+88%SWF72%	415.00 ±8.45	392.00±2.70	380.00±1.79	360.00±3.65	325.00±3.90

Where: SWF: Soft wheat flour; OPP: orange peel powder; TPP: Tomato peel powder AWRC: Alkaline water retention capacity .

values of AWRC; however, a stable decrease could be noted during 0, 3, 6, 9 and 12 days of storage to 410, 392, 374, 340 and 300%, and 415, 392, 380, 360 and 325 %, respectively. Such decline in AWRC values was noticeable also for the control sample as well as the other supplemented ones at the same storage period. The results in Table (7) showed that the ratio of staling for cake samples with OPP during the storage period ranged between 315% and 340%. The highest freshness (410%) was recorded by cake sample with 20% OPP ate zero time, because the storage period was very short, and the percentage of staling was low but there are other materials that delay the staling, while the highest level of staling (340%) was given by the cake sample replaced with OPP at 20% after the 12 day of storage. The results showed a decrease in the percentage of freshness in the cake samples containing OPP and TPP at 5, 10, 15, and 20%; 3, 6, 9 and 12%, respectively and these results are consistent with the results of **Masoodi *et al* (2002), Ammar *et al*.(2013) and Hussein *et al*.(2019).** Generally it could be noticed that, there was a gradual decrease in freshness for all prepared cake samples during storage period.

Chemical quality attributes of cakes:

The changes in fat quality parameters, *i.e.* AV, PV and TBA of the cakes fortified with OPP and TPP were followed throughout the storage period for 2 weeks at room temperature and the results obtained in Tables 8-10. From these tables, it could be noticed that AV, PV and TBA increased gradually up to the

end of the storage time in all samples. Cakes fortified with OPP and TPP had a lower AV than control.

At the same time, Table 8 shows that an increase in AV value was observed in all cake samples after storage. The increase was considerably higher in cake prepared from 100% SWF (control). AV of lipids extracted from the control cake (at zero time) was 1.41% which did not differ considerably from those of other variations, which ranged between 1.17 and 1.40 %. Also, control and cake samples with OPP and TPP at different levels showed significant change in acid values of extracted fat after storage of cake samples up to 15 days and this may be because of OPP and TPP high antioxidant activity compared to control. Similar findings were reported by **(Mohamed *et al*., 2014; Omran, Azza *et al*., 2016; Mostafa *et al*., 2017; Mostafa *et al*.,2023)** they found that the percentage of acid value increased with the increase in biscuit additives and with the extension of the storage period.

Table 9, shows the changes in the peroxide value of the cakes during storage. For the first two weeks of storage, no peroxides were formed in the biscuits. From the table, it could be noticed that PV increased gradually up to the end of the storage time in all samples. Cakes fortified with OPP and TPP had a lower PV than control. The cakes contained OPP (3.46 meq/kg) and TPP (4.27 meq/kg) had lower peroxide values when compared to the 100 % wheat biscuit which had 5.72 meq/kg peroxide value in the end storage. The differences in the peroxide value of the cakes was probably due to the incorporation of the OPP and TPP which have high total phenols contents and antioxidant activity. The addition of OPP and TPP to cakes reduced the extent of oxidative rancidity which is attributed to the antioxidant effect of the OPP and TPP. The antioxidant property observed may be due to the presence of phenols, including numerous flavonones in the OPP and TPP OPP and TPP. Peroxide value is used as an indicator of rancidity development during storage. The delay in the formation of peroxides during the early months of storage was due to the low environmental temperature as it was at the peak of rainy season. High temperatures are known to accelerate the rate of oxidative rancidity and peroxide formation **(Magda *et al*., 2008). Aruna (2000) and Seevaratnam *et al*. (2012)** reported that there was no rancidity development observed in formulated biscuits up to 60 days of storage. The odour and flavour associated with typical oxidative rancidity are mostly due to carbonyl type compounds. Peroxide values of fresh oils are less than 10 milliequivalent/kg. When the peroxide value is between 30 and 40 millequivalent/kg, a rancid taste is noticeable. Similar findings were reported by **Jeyasanta *et al*. (2013) and Nwosu and Akubor (2018)**.

An increase in Thiobarbituric acid value (TBA) was observed in all cake samples after storage. The increase was considerably higher in cake prepared from 100% SWF (control). TBA of lipids extracted from the control cake (at zero

Table (8): Acid values of cake supplemented with different levels of OPP and TPP during storage for two weeks

Treatment	Acid values of cake samples (%)		
	Zero time	After one week	After two weeks
Control (100%SWF72%)	1.41[a]	1.71[a]	2.45[a]
5% OPP+95%SWF72%	1.36[ab]	1.57[b]	1.95[bcd]
10% OPP+90%SWF72%	1.26[bcd]	1.44[c]	1.76[cde]
15% OPP+85%SWF72%	1.22[cde]	1.34[c]	1.63[de]
20% OPP+80%SWF72%	1.13[e]	1.16[d]	1.52[e]
3% TPP+97%SWF72%	1.40[a]	1.68[ab]	2.15[ab]
6% TPP +94%SWF72%	1.34[abc]	1.65[ab]	2.07[abc]
9% TPP +91%SWF72%	1.21[de]	1.58[b]	1.91[cde]
12% TPP+88%SWF72%	1.17[de]	1.44[c]	1.76[cde]
LSD	0.127	0.116	0.387
F	**	**	**

Where: SWF: Soft wheat flour; OPP: orange peel powder; TPP: Tomato peel powder .

time) was 0.13mg/kg which did not differ considerably from those of other variations, which ranged between 0.13 and 0.14mg/kg. Also, control and cake samples with OPP and TPP at different levels showed significant change in TBA of extracted fat after storage of cake samples up to 15 days and this may be because of OPP and TPP high antioxidant activity compared to control. The Thiobarbituric acid value (TBA) also was well within the acceptable limit which was less than 3 mg malonaldehyde kg of sample which indicates good quality fishery -1 products. This indicates that the level of quality indicators such as hydrolysis of lipid (FFA), primary and secondary lipid oxidation does not increase during storage. This is because there was low fat content in the sample and also there was increase in extraction of total lipids at the time of processing. In the current study, the increase in the value of the Thiobarbituric acid value (TBA) of the bakery products were observed during storage. But, the PV of all the products even afer storage period of three months was found below the permissible limits (<10 meq/kg) as recommended by **FSSAI (2021). Manzocco *et al.* (2020)** stated that shelf life of the product was dependent on the oxidative stability of the fat components.

Conclusion:

This study demonstrated the possibility of using some by-product from plants of food industry to produce dietary fiber powder which may be used as a food ingredient. The results suggested that tomato pomace and orange peel powders were becloud be used as a good raw material which containing a high amount of bioactive compounds to produce functional foods specially bakery products. Also, tomato pomace and orange peel powders fibers had high functional properties, which are good for food applications. From industrial

Table (9): Peroxide values of cake supplemented with different levels of OPP and TPP during storage for f two weeks

Treatment	Peroxide values of cake samples (mEq/kg)		
	Zero time	After one week	After two weeks
Control (100%SWF72%)	3.17[a]	4.51[a]	5.72[a]
5% OPP+95%SWF72%	3.13[a]	4.27[ab]	4.65[c]
10% OPP+90%SWF72%	3.10[a]	3.87[cd]	4.21[d]
15% OPP+85%SWF72%	2.98[ab]	3.26[e]	3.63[e]
20% OPP+80%SWF72%	2.62[b]	3.10[e]	3.46[e]
3% TPP+97%SWF72%	3.14[a]	4.42[ab]	5.67[a]
6% TPP +94%SWF72%	3.10[a]	4.15[bc]	5.17[b]
9% TPP +91%SWF72%	3.06[a]	3.83[cd]	4.79[c]
12% TPP+88%SWF72%	2.94[ab]	3.65[d]	4.27[d]
LSD	0.381	0.338	0.324
F- test	**	**	**

Where: SWF: Soft wheat flour; OPP: orange peel powder; TPP: Tomato peel powder

point of view, the fiber sources which are the residues from processing could be further processed to add value to the products**.** From the results it could be concluded that, it is feasible to produce functional cake samples from mixture of SWF, OPP and TPP with good nutritional value and high sensory characteristics nearest to cake samples from control (100 %SWF). Finally, Wheat flour could be replaced by 3.0 to 6.0% of TPP and 5.0 to 10.0 % OPP with good properties and high nutritional value of cakes.

REFERENCES

AACC, (2000,). *Approved methods of American Association of Cereal Chemists* (10th Ed.). Published by American Association of Cereal Chemists, Ins. Saint Paul, Minnesota, USA.

Abd El-Galeel, M.A. and Shoughy, M.I. (2013): Investigation the drying characteristics of some citrus peels to utilize preparation of cakes. *J. Food and Dairy Sci., Mansoura Univ.,* 4 (7): 343 – 358.

Abozeid ,W.M., Salama, F. and Moawad, R. (2011). Utilization of Fat Replacer in the Production of Reduced Cakes and Cookies . *Australian Journal of Basic and Applied Sciences*, 5(12): 2833-2840.

Akbaş, M., Kılmaoğlu, H. (2022). Evaluation of the effects of the use of vegetable and fruit extracts on bread quality properties. *Turkish Journal of Agriculture-Food Science and Technology,* 10(10), 1838-1844.

Akhtar, S.; Ismail, T.; Atukorala, S. and Arlappa, N. (2013). Micronutrients deficiencies in South Asiacurrent status and strategies. *Trends Food Sci. Technol.,* 31: 55-62.

Ammar A. S.M. and Abd El-Razik M. M. (2013). Quality characteristics of gluten free cake produced from cassava, pumpkin and potato flours. *J. Food and Dairy Sci., Mansoura Univ.*, Vol. 4 (8): 401 – 412.

Ammar K. and EL-demary M. (2009). Utilization of defatted baladi orange peel in production of low caloric sponge cake . *J .Agric.Sci. Mans. Univ*., 34 (6): 6487-6498.

AOAC (2005). *Official Methods of Analysis*, 18th ed. Association of Official Analytical Chemists AOAC International, Gaithersburg, MD, USA.

Aruna, M.C. (2000). Development of vitamin fortified soy biscuits and its effect on the nutritional status of selected school children. MSc. Thesis HSC and RI Tamil Nadu Agricultural University, India.

Cansu T. and Isik F. (2018). "Effects of pomegranate peel supplementation on chemical, physical, and nutritional properties of muffin cakes," Journal of *Food Processing and Preservation*, Vol. 3, pp. 211–224.

Coman, V.; Teleky, B.E.; Mitrea, L.; Martău, G.A.; Szabo, K.; Călinoiu, L.F. and Vodnar, D.C. (2020). Bioactive potential of fruit and vegetable wastes. *In Advances in Food and Nutrition Research* (91): 157-225.

Curutchet A., Trias J., Tárrega A. and Arcia P. (2021). Consumer Response to Cake with Apple Pomace as a Sustainable Source of Fibre. *Foods*, 10(3): 499.

Figuerola, F.; Hurtado, M.L.; Estevez, A.M.; Chiffelle, I. and Asenjo, F. (2005) : Fiber concentrates from apple pomace and citrus peel as potential fiber sources for food enrichment. Food Chem., 91 (3): 395-401.

FSSAI. .(2010*).* *Food Safety and Standards* (Advertising and Claims) Regulations, 2010. Government of India Press, New Delhi.

Gómez, M.; Oliete, B.; Rosell, C.M.; Pando, V. and Fernández, E. (2008). Studies on cake quality made of wheat chicken pea flour blends. *LWT – Food Sci. Tech.* 41, 1701–1709.

Hussein A.S., Ali H.S., Bareh G.F. and Farouk A.M.(2019). Influence of spent coffee ground as fiber source on chemical, rheological and sensory properties of sponge cake. *Pakistan Journal of Biological Sciences*, 22(6): 273–282

Jeyasanta, K.I., V. Aiyamperumal and J. Patterson(2013). Utilization of Trash Fishes as Edible Fish Powder and its Quality Characteristics and Consumer Acceptance. *World Journal of Dairy and Food Sciences*, 8: 1-10.

Jung J, Cavender G, Zhao Y. .(2015). Impingement drying for preparing dried apple pomace flour and its fortification in bakery and meat products. *Journal of Food Science and Technology*. 52(9): 5568-78.

Kaur, D., D.S. Sogi, S.K. Garg and A.S. Bawa, .(2005). Flotation-cu sedimentation system for skin and seed separation from tomato pomace. *J. of Food Eng.*, 71(4): 341-344.

Kethireddipalli P., Hung Y.C., Phillips R. O. and McWatters K. H. (2002). Evaluating the role of cell material and soluble protein in the functionality of cowpea (Vigna unguiculata) pastes. *Journal of Food Science*, 67(1): 53–59.

Khedr, M. A., M. A. Abdelgaleel, B. A. Bessar and Salama, (2016). Effect of using tomato peels as a fat replacer on the sensory, nutritional and physical properties of beef burger and sausages. *J. Agric. Res. Kafr El-Sheikh Univ*., 42(1)469-489.

Kitterman J.S. and G.L. Rubenthaler (1971). Assessing quality of early generation wheat selections with micro AWRC test. *Cereal Sci. Today*, 16: 313-316

Li, B. B., Smith, B., and Hossain, M. M. (2006a). Extraction of phenolics from citrus peels: I. Solvent extraction method. Separation and Purification Technology, 48, 182–188.

Li, B. B., Smith, B., and Hossain, M. M. (2006b). Extraction of phenolics from citrus peels: II. Enzyme-assisted extraction method. *Separation and Purification Technology*, 48, 189–196.

Lotfy L. M. and Barakat E. H. (2018). Utilization of pomegranate peels flour to improve sponge cake quality. Journal of Food and Dairy Science: 91–96.

Lotfy Lamiaa M. and Barakat Ekram H. (2018). Utilization of Pomegranate Peels Flour to Improve Sponge Cake Quality. *J. Food and Dairy Sci., 3rd Mansoura International Food Congress (MIFC) October:* 91 – 96

Magda R.A., Awad A.M. and Selim K.A. (2008). Evaluation of Mandarin and Navel orange peels as natural sources of antioxidants in biscuit. *Journal of Food Science and Technology*, (Special Conference Volume):75-82.

Manzocco, L., Romano, G., Calligaris, S. & Nicoli, M. C. (2020). Modeling the efect of the oxidation status of the ingredient oil on stability and shelf life of low-moisture bakery products: the case study of crackers. *Foods*, 9, 749.

Masoodi, F., Bhawana,S.and Chauhan,G. (2002). Use of apple pomace as a source of dietary fiber in cakes , *Plant Foods for human Nutrition* , 57 : 121- 128 .

Mohamed Gadallah , Zeinab Shabib and Taghreed El-Hazmi (2022). Development of High Dietary Fibre-Enriched Cupcake Using Pomegranate Peel Powder. *International Journal of Food Science* , 2(6461949):1-77.

Mohamed, G.F., Sulieman, A.M., Soliman, N.G. and Bassiuny, S.S. .(2014).. Fortification of biscuits with fish protein concentrate. World Journal of Dairy and Food Sciences. 9(2): 242-249.

Mostafa K. Mostafa , Ahmed R. M. Maray, Eid Ahmed Helmy and Doaa Ali El-Mohammady (2023). Effect of using high fiber plant wastes, by-products and composite flouronthe quality of the resulted biscuits. *Fayoum Journal of Agricultural Research and Development* 37 (2):138 – 155.

Mostafa K. Mostafa, El-Fakhrany, A. M. A and Maray, A R. M. .(2017). Effect ofaddition dried oyster mushroompowder onthe quality attributes of biscuits. Egypt. J. Food Sci., 45 (1): 1-7.

Nagarajaiah, S.B. and Prakash, J. (2015): Nutritional composition, acceptability and shelf stability of carrot pomace - incorporated cookies with special reference to total and β-carotene retention. *Cogent Food and Agriculture*, 1 : 1 – 10.

Noor Aziah A, Lee Min W, and Bhat R. .(2011). Nutritional and sensory quality evaluation of sponge cake prepared by incorporation of high dietary fiber containing mango (*Mangifera indica* var. Chokanan) pulp and peel flours. *International Journal Of Food Sciences And Nutrition*.; 62(6): 559-567.

Nour, V.; Ionica, M.E. and Trandafir, I. (2015). Bread enriched in lycopene and other bioactive compounds by addition of dry tomato waste. *Journal Of Food Science And Technology*, 52(12): 8260-8267.

Nwosu A. N. and Akubor P.I. (2018). Acceptability and Storage Stability of Biscuits Produced with Orange Peel and Pulp Flours. *Journal of Environmental Science Toxicology and Food Technology* 12(12): 08-15.

Omran, A. A., Ibrahim, O.S. and Mohamed, Z-E. M. .(2016). Quality characteristics of biscuit prepared fromwheat and flaxseed flour. *Advances in Food Sciences*. 38(4):129-138.

Salehi F, Kashaninejad M, Alipour N. .(2016). Evaluation of physicochemical, sensory and textural properties of rich sponge cake with dried apples powder. *Innovative Food Technologies*. 3(3): 39-47.

Seevaratnam, V, Banumathi, P., Premalatha, M. R., Sundaram, S. P. and Arumugam, T. (2012). Studies on the prepararion of biscuits incorporated with potato flour. *World Journal of Dairy and Food Science*, 7 (1): 79-84.

Shah G.H. and Masoodi F.A. (1994). Studies on utilization of wastes from apple processing plants. *Indian Food Packer*, 48: 47–52.

Sharif M.K., Masood S.B., Faqir, M.A. and Nawaz H. (2009) . Preparation of fiber and mineral enriched defatted rice bran supplemented cookies. *Pakistan J Nutr* 8(5):571–577.

Sharoba A.M. , Farrag, M.A. and Abd El-Salam, A.M.(2013). Utilization of some fruits and vegetables waste as a source of dietary fiber and its effect on the cake making and its quality attributes. *Journal of Agroalimentary Processes and Technologies*, 19(4), 429-444.

Sowmya, M. , Jeyarani T., Jyotsna, R. and Indrani D. (2009). Effect of replacement of fat with sesame oil and additives on rheological, microstructural, quality characteristics and fatty acid profile of cakes .Food Hydrocolloids , 23 1827–1836.

Tharshini, G.; Sangwan, V. and Suman, M. (2018). Organoleptic and chemical characteristics of soybean and pomegranate peel powder supplemented biscuits. *Journal of Pharmacognosy and Phytochemistry*, 7(2): 35-39.

Toor, R.K. and Savage, G.P. (2005). Antioxidant activity in different fractions of tomatoes. *Food Research International*, 38(5): 487-494.

Tudor-Radu, M., Vijan, L. E., Tudor-Radu, C.M., Ion, T. I. Ț. A., Rodica, S. I. M. A., and Mitrea, R.. (2016). Assessment of ascorbic acid, polyphenols, flavonoids, anthocyanins and carotenoids content in tomato fruits. *Notulae Botanicae Horti Agrobotanici Cluj Napoca*, 44(2): 477-483

Yusufu; M.I and Akhigbe.A.O (2014). The production of pawpaw enriched cookies: Functional, Physico-chemical and sensory characteristics. *Asian J. Agriculture and Food Sc.* 2 (2): 100- 106

Zaker, M.A.; Sawate, A.R.; Patil, B.M.; Sadawarte, S.K. 2016. Studies on Effect of Orange Peel Powder Incorporation on Physical, Nutritional and Sensorial Quality of Cookies. *Int. J. Eng. Res. Technol*., 5, 78–82

Zhou, S. H., Fang, Z. X., Lü, Y., Chen, J. C., Liu, D. H., & Ye, X. Q. (2009). Phenolics and antioxidant properties of bayberry (Myrica rubra Sieb. et Zucc.) pomace. *Food Chemistry*, 112, 394–399.

الاستفادة من مسحوق قشر الطماطم و مسحوق قشر البرتقال مع الدقيق فى انتاج الكيك

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تم إجراء هذه الدراسة لتقييم تأثير استبدال دقيق القمح بنسبة ٣، ٦، ٩ و ١٢٪ من مسحوق قشر الطماطم و ٥، ١٠، ١٥ و ٢٠٪ من مسحوق قشر البرتقال على الخصائص الريولوجية، الكيميائية، جودة الخبز، اللون، الخصائص الحسية، الملمس، الصلابة، ومدة صلاحية الكيك. أظهرت النتائج أن الاستبدال الجزئي لـ دقيق القمح بـ مسحوق قشر البرتقال و مسحوق قشر الطماطم زاد من التركيب الكيميائي ٪ (الرطوبة، البروتين الخام، الدهون، الرماد، والألياف الخام) لعينات الكيك، بينما انخفضت الكربوهيدرات الكلية بشكل متوازٍ مع زيادة مستوى الاستبدال مقارنةً بعينات الكيك الكنترول. وأظهرت جودة الخبيز أن الكيك التي تحتويً على مسحوق قشر البرتقال و مسحوق قشر الطماطم أظهرت أنه مع زيادة مستويات OPP و TPP في الكيك، زاد الوزن تدريجيًا، بينما انخفض الحجم، وفقدان الوزن النوعى بشكل كبير مقارنةً بكيك الكنترول. أظهرت نتائج التقييم الحسي أن OPP و TPP حسّن جميع الخصائص الحسية (الطعم، الملمس، الرائحة، اللون، المظهر، والقبول العام) للكيك مقارنةً بالكيك الكنترول. وازدادت التحسينات مع زيادة مستوى OPP إلى ١٥٪ و TPP إلى ٩٪. وأظهرت نتائج الملمس أن جميع الإضافات زادت من الصلابة بزيادة مستويات الإضافة مقارنةً بعينة الكنترول، بينما انخفضت التماسك، المرونة، اللزوجة، القابلية للمضغ، الالتصاق، والمرونة. وأظهرت النتائج انخفاضًا في نسبة الطزاجة في عينات الكيك التي تحتوي على OPP و TPP بنسب ٥، ١٠، ١٥، و٢٠٪؛ ٣، ٦، ٩ و ١٢٪ على التوالي. من النتائج، يمكن استنتاج أنه من الممكن إنتاج عينات كيك وظيفية من مزيج من SWF و OPP و TPP ذات قيمة غذائية جيدة وخصائص حسية عالية تشبه عينات الكيك الضابطة (١٠٠٪ SWF). وأخيرًا، يمكن استبدال دقيق القمح بنسبة ٣ إلى ٦٪ من TPP و ٥ إلى ١٠٪ من OPP مع الحصول على كيك بخصائص جيدة وقيمة غذائية عالية.

التوصية : اقترحت النتائج أنه يمكن استخدام مسحوق ثفل الطماطم وقشر البرتقال كمواد خام جيدة تحتوي على كمية عالية من المركبات النشطة بيولوجيًا لإنتاج أغذية وظيفية وخاصة منتجات المخابز(الكيك). كما أن ألياف مسحوق ثفل الطماطم وقشر البرتقال لها خصائص وظيفية عالية، وهي جيدة لأنتاج الأغذية من وجهة نظر صناعية، يمكن معالجة مصادر الألياف بشكل أكبر لإضافة قيمة غذائية اعلى إلى المنتجات.

الكلمات الدالة: مسحوق ثفل الطماطم ، مسحوق قشر البرتقال ، التركيب الكيميائي، الخواص الريولوجية، جودة الخبز، سمات اللون، المظهر، الملمس والخصائص الحسية و مدة الصلاحية .