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# UTILIZATION OF SOME PLANT WASTES AS NATURAL SOURCE OF DIETARY FIBER AND SOME BIOACTIVE COMPONENTS IN CUPCAKE

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## ABSTRACT

This study investigate the impact of partical replacement of wheat flour by some plant wastes such as watermelon rind powder (WRP) and orange peel powder (OPP) at different levels (0, 5, 10 and 15%) of cupcake for improving the quality properties (chemical composition, physical properties) and antioxidant potential of cupcake by increasing the replacement levels of cupcake samples without compromising its sensory quality. The results showed that WRP had higher content of protein, fat, fiber and ash (11.14%, 2.35%, 16.15 and 12.87%), as compared with OPP which recorded (7.24%, 1.96%, 14.16%, and 5.19%); respectively. While, OPP had higher content of total phenolics (2860.40 mg/100g), total flavonoids (8230.25 mg/100g) and antioxidant activity (74.19%) than in WRP (total phenolics 226.71 mg/100g, total flavonoids 384.97 mg/100g and antioxidant activity 37.25%). The replacement of wheat flour by WRP and OPP improved in total phenolic contents and total flavonoid contents which reached to (28.35 mg/100g, 26.11 mg/100g) and (32.55 mg/100g, 38.12 mg/100g) in fortified cupcake with 15% WRP and OPP; respectively. Also, the addition of WRP and OPP at different levels to cupcake were effective in enhancing antioxidant activity, as evaluated by means of DPPH, which increased to 3.12 and 4.97% in cupcake containing 15% WRP and OPP; respectively

compared with control cupcake (1.42%). Moreover, the substitute of wheat flour by WRP and OPP in cupcake at all studied levels enhanced the weight, volume and specific volume of the baked cakes. Data of sensory evaluation showed that the best cupcake samples resulting from the replacement levels under study were at levels (up to 10% in WRP) and (up to 15% in OPP) to given them good sensory properties in addition to enhancing their content of dietary fiber and antioxidant compounds, which have a numerous beneficial effects in human health.

**Key words:** Watermelon rind, Orange peel, Fortified, Bioactive compounds and Cupcake.

## INTRODUCTION

Fruit and vegetable wastes recently have become more popular to study by taking into account that these residues are one of the important sources of phenolic compounds. Researchers were interested to study the residues because agricultural and industrial residues were attractive sources of antioxidant besides reducing environmental pollution **(Larrosa *et al.*, 2002).** For example, fruit wastes were so many in Egypt but the constraint was the lacking information regarding their activity and content of antioxidant compounds **(Al-Sayed and Ahmed 2013).**

The antioxidant property the plant materials due to many active phytochemicals which include the phenolics, flavonoids، terpenoids, carotenoids, cumarins, lignin, saponin, plant sterols etc **(Arora and Kaur 2013).** Phytochemicals, including phenolic compounds have much more valuable materials that known have healthy effect for their bioavailability in human body's whereas antioxidants, anticarcinogenic and also considered as chemo-preventive for inhibition of pathogenic bacteria. Many researchers were found by that phenolic compounds in diets could play this roles in our bodies **(Gowers, 2010 and Picchi *et al.*, 2012).**

Watermelon (*Citrullus lanatus*) has consisting about more 35% rind and 15% peel goes to waste (USDA, 2004). Watermelon was utilized for the production of juices, nectars and fruit cocktails, etc . **(Ahmed, 2014)** and **Koocheki *et al.*, (2007).** Whereas major by-product "the rind" is utilized for the products such as pickle, preserve, pectin and other products, etc. Watermelon contains significant

quantities of phenolics **(Rimando and Perkins-Veazie, 2005 and Brat *et al.*, 2006).**

Researchers have becoming more interest to study the watermelon rind by using it in making of bakery products by turning the watermelon rinds to powder and mixed with the flour to make a cake batter **(Al-Sayed and Ahmed 2013).** The therapeutic effect of watermelon has been reported and has been ascribed to antioxidant compounds **(Lewinsohn *et al.*, 2005).**

Orange peel contains more than 170 different phytonutrients and more than 60 flavonoids combinations which highly evaluated as anti-cancer, anti-oxidant and anti-microbial agents **(Al-Anbari *et al.*, 2019),** and also a rich source of natural phenolic compounds unique to citrus, especially the characteristics flavone glycosides **(Bocco *et al.*, 1998).** Total phenol contents of dried orange peel ranged from 1.13 to 7.30 g/100g **(Kammoun *et al.*, 2011).**

Cupcake was the most consumed bakery product owing to unique products and is always used in festivals as well as in joyous celebrations **(Hafez 2012).** Cupcake usually made from a higher extraction soft wheat flour caused deficient in phytochemicals and fibers **(Gómez *et al.*, 2010).** Food residues could be incorporated into cake making such as carrot leaves **(Santos *et al.*, 2014)** watermelon rind and sharlynmelon peel powders **(Al-Sayed and Ahmed 2013).**

The aim of this work was to study the impact of partial replacement of wheat flour by watermelon rind powder and orange peel powder as natural sources of dietary fiber and antioxidant compounds at different levels (0, 5, 10 and 15 %) of wheat flour on chemical composition, physical, sensory properties and antioxidant characteristics of cupcake.

## MATERIALS AND METHODS

### MATERIALS*:*

Soft wheat flour (72% extraction) for cupcake was obtained from Five Star Flour Mills Company, Giza, Egypt. Watermelon fruit (*Citrullus lanatus*) and orange fruits *(Citrus sinesis)* used in this investigation were obtained from local market in Cairo, Egypt. Waste materials used were namely watermelon rinds powder (WRP) and orange peel powder (OPP). Corn starch, skim milk powder, fresh

whole egg, shortening (palm oil), sugar (sucrose), corn oil, vanilla and baking powder were purchased from local market, Cairo, Egypt.

All chemicals used in this study were analytical grade and purchased from El- Gamhouria Trading Chemicals and Drugs Company, Egypt.

**METHODS:**

**Preparation of watermelon rind powder:**

The watermelon fruits were sliced to remove the rind. The rinds were washed and left to dry at ambient temperature. The colored part of the fruit's peels was carefully scrapped to minimize the inclusion of albedo which is an inner layer of sponge white tissue. Then dried at 50±5°C till its moisture content reached to 11.82%. After that the dried samples were grinded in electric grinder a mesh size of 60 to obtained fine powder. Powder stored in plastic bags at (4 ±2°C).

**Preparation of orange peel powder:**

The orange were washed well using tap water. The peel is separated and cut into small pieces then it was dried in an oven at 50±5°C till its moisture content reached to 8.12%. The dried samples were grinded in electric grinder to a mesh size of 60 to obtained fine powder. Powder stored in plastic bags at (4 ±2°C).

**Preparation of cupcake:**

Cupcake was prepared from blends containing 0% (as control), 5%, 10%, and 15% replacement of wheat flour with watermelon rinds and orange peels powder according to the method described by **Salehi *et al.*, (2016).** The ingredients used in preparation of different cupcakes were presented in **Table (1).**

**Table (1): Amount (g) of ingredients used in cupcake samples:-**

| Ingredients(g) | Substitution levels | | | |
|---|---|---|---|---|
| | Control | 5% | 10% | 15% |
| Wheat flour | 100 | 95 | 90 | 85 |
| MRP | - | 5 | 10 | 15 |
| OPP | - | 5 | 10 | 15 |
| Sucrose | 72 | 72 | 72 | 72 |
| Whole egg | 72 | 72 | 72 | 72 |
| Corn oil | 57 | 57 | 57 | 57 |
| Milk powder | 2 | 2 | 2 | 2 |
| Baking powder | 2 | 2 | 2 | 2 |
| Vanilla | 0.5 | 0.5 | 0.5 | 0.5 |

The sugar and corn oil were creamed for 3 min at speed 5 in an Oster Kitchen Center mixer (Model 972-26 H, Sunbeam Corporation, and Milwaukee, Wisconsin, USA). The whole eggs were added and mixed in at the same speed for 2 min. The flour and baking powder were added and the batter was mixed for 4 min at speed 6. After scraping down the bowl the batter was mixed for an additional 1 min at speed 6. All different cupcakes formula were baked at 180 $^{0}$C for 25-30 min. then cooled at room temperature and packaged in polyethylene bags **(Salehi *et al.*, 2016).**

**Chemical analysis:**

Moisture, protein, fat, ash and fiber for cupcake were determined according to **A.O.A.C., (2005).** Total carbohydrates were calculated by difference.

**Determination of the total phenolics (TP) content:**

The total phenol content was determined as suggested by **Pereira *et al.* (2014).** Briefly, appropriate dilutions of the extracts were oxidized with 2.5 mL 10% Folin-Ciocalteau's reagent (v/v) and neutralized by 2.0 mL of 7.5% sodium carbonate. The reaction mixture was incubated for 40 min at 45 $^{o}$ C and the absorbance was measured at 765 nm using a Visible Spectrophotometer (Model

Spekol 11 No. 849101, Carl Zeiss JENA USA). The total phenolic content was subsequently calculated as gallic acid equivalent.

**Analysis of phenolic compounds by HPLC:**

Phenolic compounds were determined by HPLC according to the method described by **Riedel *et al.*, (2012).**

**Determination of the total flavonoid content:**

Total flavonoid was analyzed according to the method described by **Bahorun *et al.*, (2004).** The absorbance of extracted flavonoids was measured at 510 nm on a spectrophotometer (Spekol 11 No. 849101, Carl Zeiss JENA) against the blank (distilled water) and the total flavonoids content was expressed as mg quercetin equivalents/100 g (dry weight basis).

**Determination of antioxidant activity (1,1 Diphenyl - Picrylhydrazyl (DPPH) radical scavenging activity):**

The DPPH free radical scavenging activity of WRP and OPP was determined according to the DPPH method of **Abdulwahab *et al.* (2011).**

**Physical characteristics for cupcake:**

The weight (g) for cupcakes was determined individually within one hour after baking the average was recorded. The volume ($cm^3$) and specific volume was calculated according to the method of **A.A.C.C. (2000).**

**Organoleptic quality of cupcake:**

Sensory properties of cupcakes was evaluated after cooling by using ten members of staff of food science and technology Department, Faculty of Agriculture, Al-Azhar University, and semi training staff members of the Egyptian Baking Technology Center, Egypt. Randomly coded samples were served to panelists individually. Six sensory attributes were evaluated (appearance, crust color, crumb color, taste, aroma, and overall acceptability) according to the method described by **Pyler (1973).**

**Statistical analysis:**

The results were expressed as mean values and standard error of their mean using one-way analysis of variance and test significant differences tests (ANOVA) according to the method described by **McClave and Benson (1991).** Duncan's multiple range tests was also

used to test the significant differences between the mean values by using SPSS (version 16.0 software Inc. Chicago, USA).

## RESULTS AND DISCUSSION

***Chemical composition of watermelon rind and orange peel powders:-***

Watermelon rinds powder (WRP) and orange peels powder (OPP) were analyzed for proximate chemical composition on dry basis and data were presented in **Table (2).**

**Table (2): Proximate chemical composition of watermelon rind and orange peel powders (on dry basis).**

| Proximate composition | Raw materials (M ± SE)▲ | |
|---|---|---|
| | WRP | OPP |
| Moisture (%) | 11.82 ± 0.575 | 8.12 ± 0.074 |
| Protein (%) | 11.14 ± 0.058 | 7.24 ± 0.165 |
| Fat (%) | 2.35 ± 0.049 | 1.96 ± 0.008 |
| Fiber (%) | 16.15 ± 0.146 | 14.16 ± 0.112 |
| Ash (%) | 12.87 ± 0.086 | 5.19 ± 0.025 |
| Carbohydrates • (%) | 57.49 ± 0.837 | 71.45± 0.916 |

▲ M ± SE: Means ± standard error for proximate composition. • Total carbohydrate was calculated by difference.

Data in **Table (2)** showed that the watermelon rinds powder had higher protein, fat, fiber and ash (11.14%, 2.35%, 16.15 and 12.87%) as compared to orange peel powder which recorded (7.24%, 1.96%, 14.16%, and 5.19%; respectively). These results agreement with **Magda *et al.*, (2008).**

***Quantification of phenolic compounds in watermelon rinds and orange peels powder:***

Phenolic compounds protect against degenerative diseases involving oxidative damage due to their antioxidant action and their potential as health promoting phytochemicals, also exhibited antioxidant and antimicrobial properties and have been investigated extensively regarding their ability to lower the risk of cardiovascular diseases antioxidant properties, disease prevention and activity against toxins **(Kondratyuk and Pezzuto 2004, and volden *et al.*, 2009).** The amount of phenolic compounds is an important factor when evaluating the quality of different extracts; it involved for their resistance to

oxidation and the properties attributed to this antioxidant **(Moure *et al.*, 2001).**

WRP and OPP were analyzed for Qualitative and Quantification of phenolic compounds and the results were listed in **Tables (3 and 4)**.

From the results in **Table (3)**, it was cleared that the orange peels had higher content of total phenols, total flavonoids and antioxidant activity % which recorded 2860.40 mg/100g, 8230.25 mg/100g and 74.19% compared with 226.71 mg/100g, 384.97 mg/100g and 37.25% in watermelon rinds; respectively.

**Table (3): Total phenolics, total flavonoids and antioxidant activity (DPPH) of watermelon rinds and orange peels:-**

| Antioxidant properties | Raw materials (M ± SE)▲ | |
|---|---|---|
| | WRP• | OPP•• |
| Total phenolics (mg/100g) | 226.71 ± 9.94 | 2860.40 ± 40.39 |
| Total Flavonoids (mg/100g) | 384.97 ± 12.94 | 8230.25 ± 69.55 |
| DPPH (%) | 37.25 ± 0.28 | 74.19 ± 0.21 |

▲ M ± SE: Means ± standard error for proximate composition.

WRP•: Watermelon rind powder. OPP••: Orange peel powders

Also, the obtained data **(Table 4),** indicated that the WRP containing different types of phenolic compounds, the major compound of these phenolic compounds was Syringic acid (36.58 mg/100g) followed by Pyrogallol (26.25 mg/100g), Chlorogenic (3.565 mg/100g), Gallic acid (1.365 mg/100g) and 4-Hydroxybenzoic acid (0.958 mg/100g). Other phenolic compounds were identified in extracts of WRP, but their amounts were ranged between (0.209-0.841 mg/100g). Also, data shows the contents of identified phenolics in OPP include: Neohesperidin(1365.28 mg/100g), Hesperidin(997.30 mg/100g), Nobiletin(115.19 mg/100g), Eriocitrin(68.50 mg/100g), Naringin(59.14 mg/100g), Didymin(51.75 mg/100g), Sinensetin(48.25 mg/100g), Narirutin(36.90 mg/100g) and Tangeretin(16.38 mg/100g).

The mentioned data are in accordance with those reported by **Al-Sayed and Ahmed, (2013); Mhiri *et al.* (2015)** and **Zaker *et al.* (2017).** According to **Gil-Izquierdo *et al.* (2002), Scalbert *et al.* (2005)** and **Kondratyuk and Pezzuto, (2004),** the daily intake of

phenolics may be about 600-1000 mg per day without any side effects, which is about 10 times higher than that of daily intake of vitamin C and 100 times higher than those of daily intake of vitamin E and carotenoids.

**Table (4): *Quantification* of some phenolic compounds extracted from watermelon rinds and orange peels powder.**

| Phenolic compounds for WRP• (mg/100g) | | Phenolic compounds for OPP•• (mg/100g) | |
|---|---|---|---|
| Syringic acid | 36.58 | Neohesperidin | 1365.28 |
| Pyrogallol | 26.25 | Hesperidin | 997.30 |
| Chlorogenic | 3.565 | Nobiletin | 115.19 |
| Gallic acid | 1.365 | Eriocitrin | 68.50 |
| 4-Hydroxybenzoic acid | 0.958 | Naringin | 59.14 |
| E-vanillic | 0.841 | Didymin | 51.75 |
| Epicatechen | 0.593 | Sinensetin | 48.25 |
| Catechol | 0.271 | Narirutin | 36.90 |
| Catechin | 0.225 | Tangeretin | 16.38 |
| Ellagic | 0.209 | | |

WRP•: Watermelon rind powder. OPP••: Orange peel powders

From the former results, it could be mentioned that possibility of utilization of watermelon rinds and orange peels in some bakery products as a good source of phytochemicals and antioxidants.

Generally, it could be concluded that watermelon rinds and orange peels powder contained considerable amount from phenolic compounds which characterized as antioxidant properties, disease prevention and activity against toxins.

***Chemical Composition of fortified cupcake with different levels of watermelon rind and orange peel powder:-***

The chemical composition of cupcake fortified with different levels (5, 10 and 15 %) of WRP and OPP compared with control sample (100% wheat flour) was listed in **Table (5).**

As shown in the obtained results **(Table 5),** it could be noticed that, the moisture content was found to be (24.80%) in control sample. It is clear that increased by (27.38% & 26.33%), (33.28% & 31.43%) and (39.10% & 35.09%) in cupcake at replacement levels (5, 10 and 15%) of WRP and OPP; respectively. Also, data shows a gradual decrease in protein and fat content of cake samples containing WRP

and OPP by increasing the replacement levels from 5 to 15% as compared with the control sample. On the other hand, the results observed that increasing of fiber related to the addition of WRP and OPP which reached to (11.26% and 10.58%) in cupcakes containing 15% WRP and OPP compared with (4.95%) in control sample; respectively. The same behavior was also observed for ash content which was increased gradually by increasing the percent of WRP and OPP. The ash content was increased from (1.35%) in the control sample to (3.06 % and 2.44%) in cupcake samples contained 15% WRP and OPP; respectively. Concerning, the carbohydrates content were slight decreased as the substitution levels increased from 5% to 15% in fortified cupcake samples, which reached to (62.28% and 64.54%) in fortified cupcakes with 15% WRP and OPP compared with (69.53%) in control cupcake; respectively. The decrease in protein and fat contents in fortified cupcakes may be due to their lower content in the used substitution materials than in wheat flour, while the increased in fiber and ash contents were due to their higher content in WRP and OPP than wheat flour.

The obtained results were similar to the results reported by **(Al- Sayed and Ahmed, 2013; Awad 2017 and Zaker *et al.*, 2017).**

**Table 5: Proximate chemical Composition of fortified cupcake with different levels of watermelon rind and orange peel powder (on dry basis):-**

| Cupcakes samples | Proximate chemical composition (%) (M±SE) | | | | | |
|---|---|---|---|---|---|---|
| | Moisture | Protein | Fat | Fiber | Ash | Carbohydrates |
| Control (0%) • | 24.80±0.534$^{f}$ | 11.82±0.145$^{a}$ | 12.35±0.199$^{a}$ | 4.95±0.048$^{g}$ | 1.35±0.005$^{g}$ | 69.53±0.837$^{a}$ |
| Watermelon rind powder (WRP) | | | | | | |
| 5% WRP | 27.38±0.574$^{e}$ | 11.52±0.392$^{a}$ | 12.32±0.023$^{a}$ | 6.85±0.028$^{e}$ | 1.98±0.038$^{d}$ | 67.33±1.341$^{a}$ |
| 10% WRP | 33.28±0.577$^{c}$ | 11.31±0.038$^{ab}$ | 12.26±0.017$^{a}$ | 9.16±0.103$^{c}$ | 2.65±0.011$^{b}$ | 64.62±0.525$^{b}$ |
| 15% WRP | 39.10±0.123$^{a}$ | 11.20±0.028$^{ab}$ | 12.20±0.011$^{a}$ | 11.26±0.063$^{a}$ | 3.06±0.049$^{a}$ | 62.28±0.629$^{c}$ |
| Orange peel powder (OPP) | | | | | | |
| 5% OPP | 26.33±0.005$^{e}$ | 11.35±0.226$^{ab}$ | 12.33±0.118$^{a}$ | 6.14±0.023$^{f}$ | 1.54±0.035$^{f}$ | 68.64±0.017$^{a}$ |
| 10% OPP | 31.43±0.552$^{d}$ | 10.83±0.218$^{b}$ | 12.29±0.021$^{a}$ | 8.26±0.043$^{d}$ | 1.86±0.018$^{e}$ | 66.76±0.090$^{a}$ |
| 15% OPP | 35.09±0.108$^{b}$ | 10.17±0.109$^{c}$ | 12.27±0.015$^{a}$ | 10.58±0.073$^{b}$ | 2.44±0.029$^{c}$ | 64.54±0.131$^{b}$ |

M ± SE: Means ± standard error for chemical composition; the means within the same column having different superscript are significantly varied ($P \leq 0.05$); • Control cakes prepared from 100% wheat flour.

***Total phenolics, total flavonoids and antioxidant activity of cupcake samples fortified with different levels of WRP and OPP:***

Phytochemicals including phenolics, flavonoids and carotenoids from vegetables and fruit wastes may play a key role in reduced risks of some cancer and cardiovascular disease because of its bioactivity as antioxidant and anticancer agents **(Boyer and Liu, 2004).** The results of total phenolics (mg gallic acid equivalent /100 g dry weight), total flavonoids (mg quencetine equivalent /100g dry weight) and antioxidant activity (%) of fortified cupcake with different concentration of WRP and OPP are shown in **Table (6).**

The results obtained that there were a significant increase *($P \leq 0.05$)* in total phenolics; total flavonoids and antioxidant activity among all treatments reflecting that addition of WRP and OPP increase the former contents in cupcake samples. The total phenolics content of cupcake were ranged from (13.51 mg/100g and 18.20 mg/100g) in 5% WRP and OPP additives to reach (28.35 mg/100g and 32.55 mg/100g) in fortified cupcake with 15% WRP and OPP; respectively comparing to control sample which was 3.72 mg/100g. Also, the total flavonoids was increased from 13.36 mg/100g and 24.34 mg/100g in fortified cupcake with 5% WRP and OPP to reach

26.11 mg/100g and 38.12 mg/100g in 15% WRP and OPP additives comparing to control sample (3.61 mg/100g); respectively. Concerning, the antioxidant activity of fortified cupcakes were increased by increasing replacement levels from 5% and 15% which reached to 3.12% and 4.97% in WRP and OPP; respectively

These results are in agreement with **(Hanaa and Eman, (2010); El-Badry *et al.*, (2014) and Mahmoud *et al.*, (2017).**

From the former results, it could be mentioned that WRP and OPP are a good source of bioactive compounds like total phenols; total flavonoids and antioxidant activity, and can utilization from these wastes incorporate into cupcake.

**Table (6): Total phenolic, total flavonoid and antioxidant activity (DPPH) of fortified cupcake with different concentration of WRP and OPP (M±SE).**

| Cupcakes samples | Total phenolic (mg/100g) | Total Flavonoid (mg/100g) | DPPH (%) |
|---|---|---|---|
| Control (0%) • | 3.72±0.090$^{g}$ | 3.61±0.038$^{g}$ | 1.42±0.005$^{g}$ |
| Watermelon rind powder (WRP) | | | |
| 5% WRP | 13.51±0.109$^{f}$ | 13.36±0.253$^{f}$ | 2.17±0.093$^{f}$ |
| 10% WRP | 20.62±0.623$^{d}$ | 19.60±0.309$^{e}$ | 2.72±0.040$^{e}$ |
| 15% WRP | 28.35 ± 0.317$^{b}$ | 26.11 ± 0.598$^{c}$ | 3.12 ± 0.081$^{d}$ |
| Orange peel powder (OPP) | | | |
| 5% OPP | 18.20±0.124$^{e}$ | 24.34±0.049$^{d}$ | 3.85±0.023$^{c}$ |
| 10% OPP | 24.63±0.266$^{c}$ | 30.80±0.150$^{b}$ | 4.26±0.059$^{b}$ |
| 15% OPP | 32.55±0.509$^{a}$ | 38.12±0.487$^{a}$ | 4.97±0.162$^{a}$ |

• Control cakes prepared from 100% wheat flour; M ± SE: Means ± standard error for total phenolic, flavonoid compounds and DPPH; the means within the same column having different superscript are significantly varied ($P \leq 0.05$).

***Physical Characteristics of cupcake samples fortified with different levels of WRP and OPP:-***

It is worth to mention that the specific volume indicates the amount of air that can remain in the final product. A higher gas retention and higher expansion of the products lead to a higher specific volume **(Chaiya and Pongaswatmanit, 2011).** The physical properties of cupcake made from wheat flour and supplemented with

5, 10 and 15% WRP and OPP were measured in weight, volume, and specific volume, and results are presented in **Table (7).**

Results indicated that increasing the substitution level (5%, 10% and 15%) with WRP and OPP resulted increasing the specific volume of fortified cupcakes compared with control samples. The specific volume was 2.38 $cm^3/g$ for cupcake containing 5% WRP increased to 2.55 $cm^3/g$ with increasing substitution level of WRP to 15% compared with control samples (2.06 $cm^3/g$). Concerning, the specific volume of fortified cake with OPP at 5%, 10% and 15% were 2.43 $cm^3/g$, 2.44 $cm^3/g$ and 2.51 $cm^3$ /g; respectively, compared with control sample.

These results are in agreement with **Al-Sayed and Ahmed, (2013); Sharoba *et al.* (2013)** who reported that specific volume of cupcake significantly increased with the increased level of WRP and OPP.

**Table (7): Physical characteristic of cupcakes produced by different replacement level of WRP and OPP:-**

| Cupcakes samples | Weight (g) | Volume ($cm^3$) | Specific volume ($cm^3/g$) |
|---|---|---|---|
| Control (0%) • | 138.61 ± 0.789$^f$ | 286.34±1.21$^g$ | 2.06 ±0.005$^f$ |
| Watermelon rind powder (WRP) | | | |
| 5% WRP | 143.89 ± 0.434$^e$ | 344.08 ± 0.96$^f$ | 2.38 ± 0.003$^e$ |
| 10% WRP | 148.04 ± 0.199$^c$ | 360.75 ± 1.58$^d$ | 2.43 ± 0.131$^d$ |
| 15% WRP | 150.33 ± 0.148$^b$ | 384.20 ± 0.763$^b$ | 2.55 ± 0.019$^a$ |
| Orange peel powder (OPP) | | | |
| 5% OPP | 146.39 ± 0.680$^d$ | 356.15 ± 1.390$^e$ | 2.43 ± 0.035$^d$ |
| 10% OPP | 150.24 ±1.230$^b$ | 367.09 ± 2.416$^c$ | 2.44 ± 0.104$^c$ |
| 15% OPP | 154.81 ± 1.690$^a$ | 389.45 ± 1.520$^a$ | 2.51 ± 0.008$^b$ |

• Control cakes prepared from 100% wheat flour, Means ± standard error; the means within the same column having different superscript are significantly varied ($P \leq 0.05$).

***Sensory evaluation of fortified cupcake with watermelon rind and orange peel powders:***

The sensory evaluation characteristics of the cupcake fortified with different concentration 5%, 10% and 15% of WRP and OPP were evaluated and results were presented in **Table (7).** The organoleptic

properties (appearance, crust color, crumb color, taste, aroma and overall acceptability) of cupcake containing substituted flour at different levels of watermelon rinds were significantly affected. Cupcake samples containing 5% WRP showed no significant differences in all their sensory properties and were acceptable compared with control cupcake, while further increase in substituted levels results in drastic reduction in most sensory properties. The overall acceptability of cupcake was determined by taking average of all the value pertaining to appearance, crust color, crumb color, taste and aroma. It was found that cupcake containing 5% of WRP found to secure maximum score (8.78) while the minimum score (6.48) was found in cupcake containing 15% WRP compared with control sample (8.84). On the other hand, results revealed that fortified cupcake samples with OPP had market improvement in appearance, crust color; crumb color, taste and aroma profile of prepared cake from 5% and 10% OPP and were acceptable compared with control samples while further increase results in drastic reduction in most sensory properties. Also, data indicated that cupcake containing 10% OPP recorded a maximum score in overall acceptably 8.77 followed by 8.61 and 8.10 in cupcake containing 5% and 15% OPP; respectively. These results are in approximately similar with those reported by **Awad (2017); Zaker *et al.* (2017).**

From these results, it could be concluded that cupcakes produced by partially replacement of their wheat flour with WRP at level up to 10% and OPP at level up to 15% characterized have a good sensory properties and were acceptable cupcakes which were not significant difference from the control.

**Table 8: Sensory evaluation of cupcakes partially substituted of wheat flour with watermelon rind and orange peel powders.**

| Cupcakes samples | Appearance | Crust color | Crumb color | Taste | Aroma | Overall acceptability |
|---|---|---|---|---|---|---|
| Control• (0%) | 9.0±0.109$^{a}$ | 8.79±0.084$^{a}$ | 8.55±0.035$^{a}$ | 8.86±009$^{a}$ | 9.0±0.022$^{a}$ | 8.84±0.004$^{a}$ |
| Watermelon rind powder (WRP) | | | | | | |
| 5% WRP | 9.0±0.109$^{a}$ | 8.64±0.157$^{a}$ | 8. 47±0.102$^{a}$ | 8.85±0.124$^{a}$ | 8.98±0.148$^{a}$ | 8.78±0.027$^{a}$ |
| 10% WRP | 8.71±0.146$^{b}$ | 8.10±0.107$^{a}$ | 8.05±0.026$^{a}$ | 7.60±0.016$^{b}$ | 7.55±0.029$^{b}$ | 8.00±0.015$^{a}$ |
| 15% WRP | 6.50±0.148$^{c}$ | 6.11±0.241$^{c}$ | 6.80±0.140$^{c}$ | 6.25±0.030$^{c}$ | 6. 75±0.016$^{c}$ | 6.48±0.204$^{b}$ |
| Orange peel powder (OPP) | | | | | | |
| 5% OPP | 9.0±0.112$^{a}$ | 8.76±0.033$^{a}$ | 8.50±0.180$^{a}$ | 8.70±0.117$^{a}$ | 8.12±0.005$^{a}$ | 8.61±0.024$^{a}$ |
| 10% OPP | 9.0±0.051$^{a}$ | 8.70±0.096$^{a}$ | 8.48±0.060$^{a}$ | 8.80±0.020$^{a}$ | 8.90±0.125$^{a}$ | 8.77±0.198$^{a}$ |
| 15% OPP | 8.76±0.009$^{b}$ | 7.60±0.120$^{b}$ | 7.25±0.005$^{b}$ | 8.15±0.109$^{a}$ | 8.75±0.039$^{a}$ | 8.10±0.021$^{a}$ |

• Control cakes prepared from 100% wheat flour, Means ± standard error; the means within the same column having different superscript are significantly varied ($P \leq 0.05$).

## Conclusion

The replacement of wheat flour by different levels of watermelon rind and orange peel powders (0, 5, 10 and 15%) had a noticeable effect on chemical characteristics of produced cupcake like improve dietary fiber, total phenolic and total flavonoids in cupcake samples. Also, cupcake fortified up to 10% watermelon rind powders and up to 15% orange peel powders found to be the most accepted samples as compared to the control samples. Overall, it could be recommended that the feasibility utilization of watermelon rinds and orange peel in bakery products and other food products as a natural source of bioactive components which having a numerous beneficial effects in human health.

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# الإستفادة من بعض المخلفات النباتية كمصدر طبيعى للألياف الغذائية وبعض المركبات النشطة حيوياً فى كيك القوالب

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تهدف هذه الدراسة إلى الاستفادة من بعض المخلفات النباتية مثل قشور البطيخ وقشور البرتقال كمصادر جيدة للألياف وبعض المركبات النشطة حيوياً في إعداد كيك القوالب لتحسين خصائص الجودة الكيميائية والفيزيائية ونشاط مضادات الأكسدة لعينات الكيك عن طريق زيادة مستويات الاستبدال من عينات الكيك دون المساس بجودتها الحسية. أظهرت النتائج احتواء قشور البطيخ على نسبة أعلى من البروتين والدهون والألياف والرماد (١١,١٤ ٪ ، ٢,٣٥ ٪ ، ١٦,١٥ و ١٢,٨٧ ٪) مقارنة بقشور البرتقال التي سجلت (٧,٢٤ ٪ ، ١,٩٦ ٪ ، ١٤,١٦ ٪ و ٥,١٩ ٪) ؛ على التوالي. بينما ، كان لقشور البرتقال محتوى أعلى من الفينولات الكلية (٢٨٦٠,٤٠ ملجم /١٠٠جم) ، الفلافونويدات الكلية (٨٢٣٠,٢٥ ملجم / ١٠٠ جم) ونشاط مضادات الأكسدة (٧٤,١٩٪) من قشور البطيخ. أدى استبدال دقيق القمح بمسحوق قشور البطيخ وقشور البرتقال إلى تحسين المحتوي الكلى من الفينولات والفلافونويدات التي وصلت إلى (٢٨,٣٥ مجم / ١٠٠ جم و ٢٦,١١ مجم / ١٠٠ جم) و (٣٢,٥٥ مجم / ١٠٠ جم و ٣٨,١٢ مجم / ١٠٠ جم) في الكيك المدعم بنسبة ١٥ ٪ من قشور البطيخ والبرتقال؛ على التوالي. أيضا ، كانت لإضافة تلك المساحيق بمستويات مختلفة إلى الكيك فعالة كبيرة في تعزيز نشاط مضادات الأكسدة (على أساس تقدير DPPH) ، والتي ارتفعت إلى ٣,١٢ و ٤,٩٧ ٪ في عينات الكيك التى تحتوي على ١٥٪ من مساحيق قشور البطيخ والبرتقال؛ على التوالي مقارنة مع العينة الكنترول (١,٤٢ ٪). علاوة على ذلك ، فإن استبدال دقيق القمح بواسطة مساحيق قشور البطيخ والبرتقال في الكيك في جميع المستويات محل الدراسة قد عزز من الصفات الفيزيائية متمثلة فى الوزن والحجم والحجم النوعى للكيك. أظهرت نتائج التقييم الحسى أن أفضل عينات الكيك الناتجة من نسب الإستبدال محل الدراسة كانت عند مستويات (وصلت الى ١٠% من مسحوق قشور البطيخ) ، (والى ١٥% من مسحوق قشور البرتقال)لإعطائها خصائص حسية جيدة علاوة على تعزيز محتواها من الألياف الغذائية والمركبات المضادة للأكسدة والتى لها العديد من الاثار المفيدة على صحة الانسان.