# Evaluation of Carrot and Orange by-Products as a Source of Natural Antioxidants in Cake

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## ABSTRACT

Natural antioxidants are in great demand due to both consumer preference and health concerns, so this study was proposed to investigate the possibility of utilization of carrot pomace (CP) and orange peel (OP) powders for producing different products for human consumption such as cakes, which consider richest source in phytochemicals compounds. The purpose of the present study was investigate the chemical, physical, bioactive compounds and antioxidant activity of CP and OP and using it as natural antioxidant incorporation at levels 5, 10, 15, 20 and 25% in cake formula and sensory evaluation was investigated. The results suggested that carrot pomace and orange waste could be used as a good raw material which containing a high amount of bioactive compounds to produce functional foods specially bakery products. Also, carrot and orange fibers had high WHC and SWC values, which are good for food applications. From industrial point of view, the fiber sources which are the residues from processing could be further processed to add value to the products.

***Key words: Carrot pomace, orange peels, chemical composition, antioxidants, sensory evaluation, cake***

## INTRODUCTION

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 havealready 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. Moreover, approximately 50–60% of the processed fruit is transformed into citrus peel waste, which is composed of the peel, seeds and membrane residues **(Wilkins *et al.*, 2007**). The industry of fruit juice produces significant amounts of by-products which could cause problems in their disposal. Usually, these products are used in animal feeding. However, their high amount ofdietary fibre could permit the use of them in developing new natural ingredients for the food industry **(Figuerola *et al.*, 2005)**. Carrot pomace is a major by-product obtained during the industrial juice extraction process, which is discarded contributing to environmental pollution (**Hernandez-Ortega *et al.,* 2013**). Carrot pomace refers to the wet carrot shavings produced from carrot juice extraction. However, this pomace contains large amounts of valuable compounds such as carotenoids, dietary fiber, uronic acids and neutral sugars (**Stoll *et al.,* 2003).** During commercial juice processing, 30–50% of carrot is recovered as pomace and up to 50% of the carotene is lost with this pomace **(Schieber*et al.*, 2004)**.

The orange juice waste water can be suitable for applications on the food industry. It is an important source of phenolic compounds in which antioxidant properties could be much appreciated in a big number of foods processing to avoid its oxidation during processing but also during storage period **(Viuda-Martos*et al.*, 2011**).

Bakery products are widely consumed and are becoming a major component of the international foodmarket (**Kotsianis*et al.*, 2002**). Cake is one of the most common bakery products consumed by people in the world. Nowadays, cake manufacturers face a major problem of lipid oxidation which limits the shelf life of their products **(Lean and Mohamed, 1999)**. Bakery products such as cakes particularly those with high lipid content end to become rancid after prolonged storage owing to the oxidation of polyunsaturated fatty acids **(Smith *et al.*, 2004)**. Addition of antioxidant is effective in delaying the oxidation and extending the shelf life of food **(Decker, 1998)**.

This work was conducted to study the utilization of carrot pomace (CP) and orange peel (OP) as powders for producing cakes, which consider richest source in phytochemicals compounds.

## Materials and Methods

### Materials

Wheat flour (72% Extraction), eggs, sunflower oil, baking powder, sugar powder and vanillin were purchased from local market at Tanta city, El-Gharbia governorate, Egypt.

Fresh orange peels and carrot roots were purchased from local market, Tanta city, El-Gharbia governorate, Egypt.

All chemicals (chloroform, ethyl and methyl alcohol, petroleum ether, sulfuric acid, sodium hydroxide which used in analytical methods and nutrient agar media was used for total bacterial count, potato dextrose agar media was used for moulds and yeasts count were obtained from El-Gomhouria Company for Chemicals, Drugs and Medical Instruments at Tanta city, El-Ghabia governorate, Egypt.

## Methods

### Preparation of carrot pomace

Carrot (*Daucus carota*) was obtained from the local market, cleaned, peeled, grated, homogenized and filtered for separating juice. The pulp left after juice extraction was dried in an oven at 50ºC using hot air oven (Model EBC930) for 18 hr. The dried carrot pomace was milled using a grinder and was sieved through a 150 mm sieve and packing in poly ethylene under refrigeration at 4ºC till use. This powder was taken for further analysis and product development.

## Preparation of orange peel

The orange fruits (*Citrus sinenis*) used in the present study were purched from local market. Orange peels were well washed and dried at 50°C for 24 h using a hot air oven (Model EBC930). A laboratory grinder was used to give powderand sieved through a 150 mm sieve and packing in poly ethylene under refrigeration at 4ºC till use.

## Preparation of cakes

Cakes were made from wheat flour only (control) along with wheat flour blends with CP or OP at 5, 10, 15, 20 and 25% substitution levels (w/w). The formula consisted of 100g wheat flour (or blend), 137.5g sugar, 100g whole egg, 104g liquid milk, 25g shortening, 0.5g baking powder and 1.5g salt**.** Creaming method described by **Bennion and Bamford (1973)** was used to prepare cakes, where shortening was first creamed with sugar then eggs were beaten into the creamed mixture, flour (sifted with baking powder and salt) was added alternately with milk. Cake batter was poured into an aluminum foil pan and baked at 180ºC for 30 min, then the temperature was reduced to 160ºC and continued for 30 min. Cakes were cooled to room temperature and packed in polyethylene bags.

## Analytical methods

### Proximate chemical composition

Moisture content was determined by drying weight samples in an air oven dryer (Model EBC 930) at 105°C until constant weight, crude protein measured by using Micro-Kjeldahl method to determine the total nitrogen by the factor of 6.25 for carrot pomace and orange peel and 5.7 for wheat flour, ash content was determined by ashing the sample in an electric muffle at 550°C until constant weight and crude fibers were determined according to the methods described in the **(AOAC, 2010**). Crude fat content was determined as the ether extract as described by **(AOCS, 1994**). The content of total carbohydrate was determined by difference = 100 – (crude protein + ether extract + ash + crude fiber) as reported by **Tadrus**, **(1989**). All samples triplicate determinations were made.

### Physical properties of cakes

Water holding capacity (WHC) and oil holding capacity (OHC) were measured according the methods reported by **Anderson *et al*., (1969)**, while, swelling capacity (SWC) was measured using the bed volume technique described by **Gould *et al*., (1989)**. Triplicate measurements were taken for all WHC, OHC and SWC. The weight (g) for cake was determined individually within one hour after baking the average was recorded. The volume ($cm^3$) of different types of produced cakes was determined by rape seeds displacement method according to **(AACC, 2000**). Specific volume was calculated according to the method of **(AACC, 2000**), using the following equation Specific volume = Volume ($cm^3$)/Weight (g) Density (g ⁄ $cm^3$) = Weight (g) ⁄ Volume ($cm^3$)

### Determination of bioactive compounds

The total phenolic content was determined by the Folin-Ciocalteu method according to **Thaiponga *et al*., (2012).** The total flavonoid content in extracts was determined according to **Djeridane *et al*., (2006)**. Carotenoids content were determined using the method described in the **AOAC (2005)**. Ascorbic acid was estimated by 2, 6-dichlorophenol indophenol visual titration method, which is based on reduction of the dye colour from blue to pale pink by ascorbic acid **(Ranganna, 1986)**

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## Determination of antioxidant activity

Free radical scavenging capacity was determined using the stable DPPH and ABTS assay according to **Byrnec (2006)**. Antioxidant activity was according to method described by FRAP according to **Byrnec (2006)**.

### Sensory evaluation

Sensory evaluation of prepared cake was done by 10 panelists from staff members in Food science and technology Department, Fac. of Home Economic, Al-Azhar Univ., Tanta using ten point hedonic scale ratings for color, taste, aroma, texture and overall acceptability according to the procedure described by **Watts *et al.*, (1989)**. Judgments were made through rating products on a 9 point Hedonic scale with corresponding descriptive terms ranging from 9 "like extremely" to 1 "dislike extremely".

### Statistical analysis

The results were statistically analyzed by analysis of variances as described by **SPSS (1997**). Significant differences among individual means were analyzed by Duncan's multiple range tests **(Duncan, 1955**).

## Results and Discussion

**Proximate analysis of wheat flour, carrot pomace (CP) and orange peel (OP):**

The chemical composition of wheat flour (WF), carrot pomace (CP) and an orange peel (OP) is recorded in Table (1). The obtained results show that WF contain a significant high content of moisture and crude protein (11.32% and 9.75%, respectively) compared with that of CP (6.76% and 8.71%, respectively) and OP (5.22% and 6.88%, respectively). CP powder scored the highest content of ash and crude fiber (6.61; 62.78%, respectively) followed by OP (7.17; 60.56%, respectively), while WF has the lowest contents (0.68 and 1.83%, respectively). In this respect, **Gazalli*et al.*, (2013)** reported that average contents of moisture, ash, protein, ether extract and crude fiber in carrot powder were 8.78; 5.05; 6.16; 2.43 and 24.66%, respectively. Also**, Shyamala and Jamuna (2010),** they reported that 100 g of carrot contains moisture 7.54 g, ash 5.78 g, protein 6.21 g, ether extract 2.72g and crude fiber 32 g. From the tabulated data, it could observed that the crude fiber content in CPP (62.78%) was higher than OPP (60.56%), it means that the utilization of CPP in some bakery products increase their contents of fiber.

**Table (1): Gross chemical composition of wheat flour (72%), carrot pomace and orange peel (on dry weight basis)**

| Constituent | Wheat flour (72%) | Carrot pomace | Orange peel |
|---|---|---|---|
| **Moisture** | 11.32 ± $0.09^{a}$ | 6.76 ± $0.21^{b}$ | 5.22 ± $0.17^{c}$ |
| **Crude protein** | 9.75 ± $0.12^{a}$ | 8.71 ± $0.07^{b}$ | 6.88 ± $0.08^{c}$ |
| **Ether extract** | 1.77 ± $0.23^{c}$ | 2.12 ± $0.2^{b}$ | 2.97 ± $0.04^{a}$ |
| **Total ash** | 0.68 ± $0.05^{c}$ | 6.41 ± $0.05^{b}$ | 4 ± $0.11^{a}$ |
| **Crude fiber** | 1.83 ± $0.22^{c}$ | 62.78 ± $0.11^{a}$ | 60.56 ± $0.13^{b}$ |
| **Carbohydrates** * | 83.12 ± $0.16^{a}$ | 19.98 ± $0.05^{c}$ | 22.45 ± $0.21^{b}$ |

Carbohydrate was calculated by difference*

Mean ± Standard deviation of three determinations

In a row, means have the same small superscript letter are not significantly different by Danken's test at 5% level.

**Oluremi*et al.*, (2007)** reported that sweet orange peels contained 9.30 – 10.96% crude protein, 13.66 – 14.94% crude fiber, 2.33 –2.90% ether extract, 65.30 – 67.95% nitrogen free extract and 5.07 – 5.56% ash. Also, **Raj and Masih (2012)** showed that orange peels contained 3.5%, 2.67%,6.69%,2.0%,2.35%,85.37% moisture protein, ash, fat, fiber and carbohydrates, respectively**.**

**Functional properties of carrot pomace and orange peel**

It is well known that the functional properties of dietary fibers have the greatest effect on their functions in foods (**El-Refai*et al.*, 2006)**. The data in Table (2) shows that water holding capacity (WHC) of carrot pomace and orange peel were 17.28 g/g and 16.52 g ⁄g, respectively which higher than those reported for other fibrous residues such as grape, mango, peach and tomato (7.8 – 9.4 g water ⁄ g product (**El-Refai *et al.*, 2006**). These values are in accordance with that obtained by **Sharoba *et al.*, (2013)** who reported that WHC of orange wastes and carrot pomace was 16.39 and 19.72 g water ⁄ g, respectively.

Both water absorption and oil absorption are very important in relation to dough handling. The values obtained here indicated a good ability of CP and OP to absorb water and bind oil which is an advantage of the flour for preparing several baked products like biscuits, cookies, crackers, cake and pizza. The functional properties of plant fiber depend on the IDF⁄ SDF ratio, particle size, extraction condition, structure of the plant polysaccharides and vegetable source. The water holding capacity (WHC) is the quantity of water that remains bound to the hydrated fibre following the application of an external force (pressure or centrifugation), also WHC is the ability of a moist material to retain water when subjected to an external centrifugal gravity force or compression.

The OHC is a technological property related to the chemical structure of the plant polysaccharides and depends on surface properties, overall charge density, thickness and hydrophobic nature of the fiber particle **(Figuerola *et al.*, 2005; Fernandez-Lopez *et al.*, 2009)**.

Data also in Table (2) displays that OHC of CP and OP was 2.70 and 1.83 g oil ⁄ g, respectively. This is similar the OHC of orange by-products (1.81 g oil ⁄ g fibre), lemon by-products (6.60 g oil ⁄ g fibre) and tiger nut by-product (6.90 g oil ⁄ g fibre) **(Lario *et al.*, 2004; Lopez-Zapata *et al.*, 2009**). Also, **Figuerola *et al.* (2005**) reported that oil absorption index values exceed those recorded for apple pomace and orange peel (0.6 - 1.8 ml g-1). Swelling capacity (SWC) was between 15.98 ml ⁄g in carrot pomace and 21.34 ml ⁄g in orange peel. SWC values ranged from 15.98 g ⁄ g for CP to 21.34 g ⁄ g for OP. These values were higher than reported by **Figuerola *et al.*, (2005**) for fiber concentrates for Valencia orange (6.11 ml ⁄ g DM), Liberty apple (8.27 ml ⁄ g DM), Fino 49 lemon (9.19 ml ⁄g DM).

**Table (2): Functional properties of carrot pomace and orange peels powder**

| Functional properties | Carrot pomace | Orange peels |
|---|---|---|
| **Water holding capacity (g water ⁄ g) (WHC)** | **17.28 ± 0.12** | **16.52 ± 0.04** |
| **Oil holding capacity (g oil ⁄ g) (OHC)** | **2.70 ± 0.09** | **1.83 ± 0.13** |
| **Swelling capacity (%) (SWC)** | **15.98 ± 0.17** | **21.34 ± 0.03** |

Each value is expressed as mean of triplicates ± Standard deviations

**Phytochemicals content of carrot pomace and orange peel:**

Data presented in Table (3) showed that total phenolic compounds, total carotenoids, total flavonoids and vitamin C contents of CPP were 2.20 (mg/g), 27.48 (mg/100g), 1.53 (mg/g) and 4.09 (mg/100g), while in OPP were 10.48, 22.20, 16.95 and 56.13, respectively. **Adeleye *et al.*, (2016**) reported that vitamin C was 3.60 and 0.79 mg ⁄100g in fresh and dried carrot pomace, respectively. The orange peel which represents almost one half of the fruit mass includes valuable compounds and an important source of bioactive compounds including antioxidants such as terpenoid, ascorbic acid (vitamin C), flavonoids, phenolic compounds that are important to human nutrition (**Jayaprakasha and Patil, 2007**). The maximum phenolic compounds(178.90 mg GAE/100 g) were obtained from Orlando orange peel followed by Kinnow mandarin peel (169.54 mg GAE/100 g) **Al-Juhaimi, (2014**).

**Table (3): Bioactive compound in carrot pomace and orange peels powder**

| Compounds | CPP | OPP |
|---|---|---|
| **Total phenolic (mg ⁄g)** | **2.02** | **10.48** |
| **Total carotenoids (mg ⁄100g) (as β-carotene)** | **27.48** | **22.20** |
| **Total flavonoids (mg ⁄g)** | **1.53** | **16.95** |
| **Vitamin C (mg ⁄100g)** | **4.09** | **56.13** |

## Antioxidant activity

Data presented in Table (4) showed that antioxidant activity which measured by DPPH (AA equi.), ABTS (mM troloxequi.) and FRAP (mM trolox equiv.) was 1.84, 20.028, 8.84 and 4.07, 86.76, 26 for CPP and OPP, respectively. It could be noticed that orange peel extract had high antiradical efficiency as compared to carrot pomace extract. From these results, it could be concluded that the orange peels extract is more effective as an antioxidant than carrot pomace. The antioxidant property was observed in orange peel may be due to the presence of phenol including numerous flavanones, flavone glycocides, poly-methoxylated flavones, hydroxylcinnamates and other miscellaneous phenolic glycosides and amines **(John, 2004**). Also, **Do *et al.*, (2014)** reported that orange pulp exhibited the highest radical scavenging activity (69.31%) followed by kinnow mandarin peel (68.57%), and lemon peel had the lowest radical-scavenging activity (46.98%).

**Table (4): Antioxidant activity of carrot pomace and orange peels powder**

| Methods | CP | OP |
|---|---|---|
| DPPH (*AA equiv.) | 1.84 ± 0.08 | 4.07 ± 0.10 |
| ABTS (mMtrolox equiv.) | 20.028 ± 0.20 | 86.76 ± 0.03 |
| FRAP (mMtrolox equiv.) | 8.84 ± 0.03 | 26.46 ± 0.07 |

* AA = ascorbic acid equivalent   Mean ± Standard deviation

The reason is that the total antioxidant activity is closely related to the phenolic compounds (**Lu and Foo 2001**).

**Physical properties of cakes containing different levels of carrot pomace (CP):**

The physical properties of cakes substituted with carrot pomace at 5 – 25% including weight (g), volume (cm3), density (g ⁄ cm3) and specific volume (cm3 ⁄ g) were determined and the results was shown in Table (5). As the substitution levels of carrot pomace (CP) powder increased the weight, volume and density of the prepared cakes significantly increased. In contrary, specific volume was slightly decreased with increasing of substitution levels with CP powder. On the other hand using CP in cake has significantly improved the volume and density. These results are disagreement with those reported by **Masoodi *et al*., (2002)** reported that the cake volume decreased with increasing apple pomace levels. **Sharoba *et al*., (2013)** indicated the important of adding dietary fiber sources on the volume of cake. Also, the same authors reported that addition of dietary fiber sources was increased specific volume. Increasing in the specific volume was go high after adding dietary fiber sources.

**Table (5): Physical properties of cakes supplemented with different levels of carrot pomace powder**

| CP (%) | Weight (g) | Volume (cm3) | Density (g⁄cm3) | Specific volume (cm3⁄g) |
|---|---|---|---|---|
| 0 (Control) | 579.11f | 1372.34f | 0.422d | 2.369b |
| 5 | 582.42e | 1384.17e | 0.421d | 2.377a |
| 10 | 588.28d | 1392.22d | 0.423c | 2.367b |
| 15 | 593.32c | 1396.49c | 0.425b | 2.354c |
| 20 | 621.36b | 1438.33b | 0.432a | 2.315d |
| 25 | 634.22a | 1464.26a | 0.433a | 2.309e |

Values followed by the same letter in column are not significantly different at $p \leq 0.05$

**4.11. Physical properties of cakes containing different levels of orange peels (OP):**

Weight, volume, density and specific volume of cakes containing substituted flour with different levels of orange peel powder are given in Table (6). The utilization of orange peel powder in cakes resulted in an increase in their weight, volume and specific volume more than of the control one. The trend of increasing in the specific volume gone high after adding dietary fiber sources (**Zaker*et al.*, 2017**).

Statistical analysis of the obtained results shows significant differences in all measured physical properties of the tested cakes.

**Table (6): Physical properties of cakes supplemented with different levels of orange peel powder**

| OP (%) | Weight (g) | Volume (cm3) | Density (g/cm3) | specific volume (cm3/g) |
|---|---|---|---|---|
| 0 (Control) | 456.33f | 1126.32f | 0.405a | 2.468d |
| 5 | 458.29e | 1248.24e | 0.397b | 2.724c |
| 10 | 459.81d | 1367.35d | 0.386c | 2.973c |
| 15 | 460.23c | 1376.13c | 0.380c | 2.990b |
| 20 | 463.11b | 1438.21b | 0.322d | 3.011b |
| 25 | 467.23a | 1484.34a | 0.315e | 3.177a |

Values followed by the same letter in column are not significantly different at $p \leq 0.05$

**4.12. Sensory evaluation of carrot pomace (CP) substituted cakes**

The sensory evaluation is very important criterion in food industry (**Nagarajaiah and Prakash, 2015**). The cake prepared with different levels (5, 10, 15, 20 and 25%) of dried carrot pomace were evaluated for their various sensory attributes (Table,7). It was obvious that cake supplemented with CP at level higher than was significantly different from the control as judged by the panelists.

Panelists gave lower scores for cake samples containing 25% CP powder due to their flavor, texture and appearance. This indicates that a higher level of incorporation of carrot pomace in cake influenced the taste and texture adversely. This could be due to extremely high content of fiber in carrot pomace, which would tend to make the product rough **(Nagarajah andPrakash, 2015**).**Sharoba*et al.* (2013)**found significant decrease in crumb color and flavor scores of cake when carrot pomace (CP) was added at 5, 10, 15and 20% levels. **Akubor and John (2012)** found that 10 and 20% oven dried carrot flour had no significant effects on cake flavor, texture, taste and overall acceptability. While, 30, 40, 50 and 100% significantly affects the above mentioned sensory attributes. The scores for all the sensory attributes of the cakes decreased steadily with increased level of carrot flour in the blends. In general, cake samples were significantly different from control sample for all sensory properties. Hence, it can be concluded that carrot pomace can be used up to 10% level to incorporate into cake. The highest score in the same type of fiber source for all attributes were that achieved by cake samples with fiber source at 5%replacement level. On the other hand, the lowest scores in the same type of fiber source for all attributes were that achieved by cake samples with fiber source at 20% replacement level for overall acceptability.

**Table (7): Sensory evaluation of cake as affected by supplemented of CPP at different levels**

| Substi-tution level | Crust color | Crumb color | Texture | Flavor | Appearance | Overall acceptability |
|---|---|---|---|---|---|---|
| 0% | 8.00 ± 0.31c | 8.22 ± 0.18c | 8.20 ± 0.08b | 7.16± 0.33c | 8.00± 0.22d | 7.56± 0.12f |
| 5% | 8.22 ± 0.22 b | 8.35 ± 0.04b | 8.26 ± 0.12a | 7.66± 0.13a | 8.22 ± 0.50c | 8.16 ± 0.14b |
| 10% | 8.34 ±0.52a | 8.46 ±0.22a | 8.11± 0.23c | 7.32 ± 0.45b | 8.50± 0.07b | 8.61 ± 0.33a |
| 15% | 7.83 ± 0.11c | 8.23 ± 0.01c | 8.00±0.51c | 7.21 ± 0.41c | 8.64 ± 0.09a | 8.22 ± 0.25c |
| 20% | 7.80± 0.08d | 7.64 ± 0.32d | 7.76 ± 0.42d | 7.15 ± 0.11d | 8.11 ± 0.23d | 8.11± 0.11d |
| 25% | 7. 38 ± 0.21e | 7.53 ± 0.07e | 7.52 ± 0.13e | 6.83± 0.32e | 7.26 ± 0.22e | 7.83 ± 0.07e |

Mean ± Standard deviation of three determinations

In a column, means have the same small superscript letter are not significantly different by Danken's test at 5% level.

**4.13. Sensory evaluation of orange peels (OPP) substituted cakes**

Cakes prepared from blends containing different proportions (0, 5, 10, 15, 20 and 25%) orange peels were evaluated for sensory characteristics and the results are recorded in Table (8). The results show that orange peels powder enhanced all sensory characteristics of cake comparing with the control. The enhancement increased with increasing the level of orange peels powder up to 15%. 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 orange peels powders (25%) has lower scores compared to control. This may be attributed to the citrus peel have high content of pigments which changed during baking resulted undesirable color especially at higher substitution level **(Abd El-Galeel and Shoughy, 2013)**. Also, they reported that citrus peel contains high content of essential oils which contain some bitter compounds and give (at higher level) a bitter taste in the final product.

**Table (8): Sensory evaluation of cake as affected by supplemented of OPP at different levels**

| Subst- -itution level | Crust color | Crumb color | Texture | Flavor | Appeara nce | Overall accepta bility |
|---|---|---|---|---|---|---|
| 0% | 7.89 ± 0.31c | 8.12 ± 0.08c | 8.10 ± 0.12b | 7.63 ± 0.31c | 8.21 ± 0.33d | 8.13 ± 0.14f |
| 5% | 8.24± 0.06b | 8.39 ± 0.44b | 8.30 ± 0.12a | 8.46± 0.15a | 8.36± 0.04c | 8.52± 0.17b |
| 10% | 8.34± 0.33a | 8.42± 0.19a | 8.62 ± 0.01c | 8.52 ± 0.12b | 8.60± 0.22b | 8.76 ± 0.08a |
| 15% | 8.65± 0.27c | 8.19± 0.09c | 8.27 ± 0.11c | 8.86 ± 0.42c | 8.64± 0.12a | 8.79± 0.05c |
| 20% | 8.22 ± 0.17d | 7.52 ± 0.22d | 7.53 ± 0.51d | 8.23± 0.12d | 8.11 ± 0.45d | 8.34± 0.11d |
| 25% | 7.78 ± 0.32e | 7.28 ± 0.42e | 7.33 ± 0.08e | 7.55 ± 0.33e | 7.26 ± 0.21e | 7.75 ± 0.40e |

Mean ± Standard deviation of three determinations

In a column, means have the same small superscript letter are not significantly different by Danken's test at 5% level.

**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 carrot pomace and orange was becloud be used as a good raw material which containing a high amount of bioactive compounds to produce functional foods specially bakery products. Also, carrot and orange fibers had high WHC and SWC values, which are good for food applications. From industrial point of view, the fiber sources which are the residues from processing could be further processed to add value to the products

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# إستخدام وتقييم تفل الجزر وقشور البرتقال كمصدرلمضادات الأكسدة الطبيعية فى الكيك

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## الملخص العربى

هناك حاجة ملحة وطلب متزايد على مضادات الأكسدة الطبيعية وذلك بسبب المخاوف الصحية بالإضافة رغبة المستهلكين فى أستخدام مواد طبيعية. لذا الهدف من هذه الدراسة هو بحث إمكانية إستخدام مساحيق تفل الجزر وقشور البرتقال فى إنتاج منتجات مختلفة صالحة للأستهلاك الآدمى مثل الكيك والتى تعتبر غنية فى المركبات الفيتوكيميائية. تهدف هذه الدراسة إلى بحث التركيب الكيماوى ، الخصائص الفزيائية ، المركبات النشطة حيويا والنشاط المضاد للأكسدة لكل من تفل الجزر وقشور البرتقال وأستعمال تلك المواد المضادة للأكسدة الطبيعية فى الخلطات عند مستويات ٥ ، ١٠ ، ١٥ ، ٢٠ و ٢٥% فى خلطة الكيك.

وقد أوضحت النتائج إنه يمكن أستعمال كل من تفل الجزر وقشور البرتقال كمواد خام جيدة حيث تحتوى على كميات مرتفعة من المركبات النشطة حيويا فى خلطات وإنتاج الأغذية الوظيفية خاصة فى منتجات المخابز. أظهرت النتائج أن ألياف تفل الجزر وقشور البرتقال لها قدرة عالية على الإنتفاج وأمتصاص الماء والتى تجعله جيد ومناسب للتطبيقات الغذائية ومن وجهة النظر الغذائية حيث تعتبر مصدر للألياف الناتجة من مخلفات التصنيع الغذائى ويمكن أستخدامها فى إنتاج منتجات غذائية ذات قيمة.