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# UTILIZATION OF ORANGE POMACE IN PROCESSING LOW CALORIES CAKE

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## ABSTRACT

This research was aimed to utilized from baladi orange pomace (*Citrus sinensis*) as by-products from juices factories which causes some environmental problems in processing low cup calories cakes. Wheat flour 72% extraction was substituted with powdered orange pomace at different three levels i.e. 5, 10 and 15%. Effect of orange pomace on physical, chemical, textural characteristics and microstructure properties of cup cakes were determined. A gradual decrease in moisture, ether extract, carbohydrates, while fiber and ash contents were increased with the increase in concentration of powdered orange pomace. with substitution of 15 % orange pomace to cake batters and cake formulae was negatively effect on physical characteristics namely , pH, line spread, and volume $cm^3$, texture profile and volume measurements. Results of scanning electron microscope showed that substitution with 15 % orange pomace caused undesirable changes in the structure of starch granules, gluten matrix and the gas cells comparing with the other cup cake formulae. Results of sensory evaluation indicated that cup cake formulae containing 5% and 10% orange pomace have the highest scores for taste ,odour, height , crumb colour and crust colour in compared with cup cake formula with 15 % orange pomace. So, substitution wheat flour 72 % with orange pomace powder up to 10 % in processing low calories cup cake is recommended .

**Keywords**: orange pomace - cup cake- physical properties - nutritional value – scanning electron microscope .

## INTRODUCTION

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 and Shah 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.

**Baked products** with various high-fiber additives such as biscuits, cookies, cakes, and pancake mixes have been introduced to satisfy consumer

demands for increased fiber content in foods without sacrificing sensory quality. High-fiber additives range from minimally processed materials such as finely ground bran and seed hulls to extensively processed, purified cellulose fractions derived from wood pulps very rich and diversified. Depending on the quantity and kind of raw materials entering into composition of the short cake as well as on the technological procedure, the following cakes may be distinguished: short, half-short, French and half-French. The cooked cake may also be included herein (Baik *et al.*, 2000).

**Dietary fiber** is that part of plant material in the diet which is resistant to enzymatic digestion which includes cellulose, noncellulosic polysaccharides such as hemicelluloses, pectin substances, gums, mucilages and a non-carbohydrate component lignin. The diets rich in fiber such as cereals, nuts, fruits and vegetables have a positive effect on health since their consumption has been related to decreased incidence of several diseases. Dietary fiber can be used in various functional foods like bakery, drinks, beverages and meat products. Dietary fiber is a complex mixture of polysaccharides with many different functions and activities as it passes through the gastrointestinal tract. Many of these functions and activities depend on their physico-chemical properties. Devinder *et al.,* 2010 and De Fouw *et al.,* 1982

The objective of the present study was to utilized from baladi orange pomace (*Citrus sinensis* ) as by-products from juices factories which causes some environmental problems in processing low cup calories cakes**.**

## MATERIALS AND METHODS

**Materials:**

Cake ingredients: Imported Wheat flour (72% extraction), sugar, skim milk, commercial pastry margarine namely FRISCA (low fat spreads) , whole egg, salt, baking powder and vanillin were obtained from Metro market –el-Mansoura city- Egypt ,

Orange pomace was obtained from Egyptian canning company BEST- El-Dakhleia – governorate -Egypt.

Chemicals : all chemicals used were obtained from El-Gomhoria Co. for trading in Medicines, Chemicals and Medical Supplies, El-Mansoura , Egypt.

**Preparation of orange pomace** : orange pomace was frozen at -20$^{o}$C until further use, then , after thawing dried at 45 ± 5$^{o}$C For six hours at electric dryer model [Officine specializzate, GARBUIO, Essiccatioi, TREVISO, ITALY] for 6 hours, then mill and powdered using (BRAUN grinder) Then sieved using sieve to obtain a powder particle size 0.4 mm .finally, packaging into air tight polyethylene packets .and stored at 3±2$^{o}$C until used.

**Preparation of processed cake formulae** : preparation of cup cakes with the substituted level i.e. 5, 10 and 15 % of orange pomace was done according to Penfield and Camphell (1990 a, b). Cake formulae were presented in table (1), the cake samples were baked at 180 $^{o}$C for 45 min., at electric oven model [SASHO, No.: JL -166 Multi toaster oven, CHINA] the cakes were removed from the cups and cooled for 1 h.,then, placed on a coded fiber foam plates and sealed with plastic wraps to prevent it from drying until further analysis were carried out .

**Table (1): Formulae of prepared cakes using different level from orange pomace .**

| Ingredients | Control | Substitution level | | |
|---|---|---|---|---|
| | | 5% | 10% | 15% |
| Wheat flour | 110 g. | 104.5 g. | 99 g. | 93.5 g. |
| Orange pomace | ------ | 5.5 g. | 11 g. | 16.5 g. |
| Sugar | 60 g. | 60 g. | 60 g. | 60 g. |
| margarine | 62.5 g. | 62.5 g. | 62.5 g. | 62.5 g. |
| egg | 67.5 g. | 67.5 g. | 67.5 g. | 67.5 g. |
| Skim milk | 60 ml | 60 ml | 60 ml | 60 ml |
| Baking powder | 5 g. | 5 g. | 5 g. | 5 g. |
| Salt | 1 g. | 1 g. | 1 g. | 1 g. |
| Vanillin | 5 g. | 5 g. | 5 g. | 5 g. |

**Methods**:

**Chemical properties:**

Moisture, ether extract were determined using (A.O.A.C. 2000) ,protein was determined using microkjelahel method as described by (A.O.A.C.1990). and ash as percentage was estimated according to(A.O.A..C.2000) Carbohydrate content was determined by differences according to the following equation: [100- (moisture% + ash%+ether extract% + crude protein% +crude fiber%)]. Total, soluble and insoluble dietary fiber were determined according to (AOAC 2007), at Food Technology Research Institute. Agricultural Research Center - Giza-Egypt.

Quality attributes evaluation of cup cakes: Physical properties measurements were done on cake batter namely, batter volume $cm^3$ , specific gravity and line spread and While the processed cake measurements after baking namely volume measurements ( volume index, symmetry index and uniform index) according to Penfield and Camphell (1990 a,b). While weight loss ($w_l$) was calculated according to (A.A.C.C.2000) Using the following equation = $w_l = (w_i - w_f) / w_i \times 100$

$w_i$ = weight of cake before baking $w_f$ = weight of cake after baking

**pH measurement :** was determined according to A.O.A.C (2000) using pH meter model Jenway, 3505 .U.K.

**Cake texture profile analysis** : was performed at Food Technology Research Institute using an QC-Tech universal testing machine (Cometech Ltd, Taiwan) , the data were analyzed to measure cake hardness, gumminess, chewiness, springiness and resilience as described by (Gomez *et al.*, 2007) .

**Cake microstructure:** using Leo scanning electron Microscope (SEM) (Leo Electronic Systems, Cambridge, UK). Cake samples were dried under vacuum freeze. Cake samples were separately placed on the sample holder using double sided scotch tape and was exposed to Gold sputtering (4min, 2mbar).Finally , each sample was transferred to the microscope where it was observed at30kV.according to the method described by (Akin and Morrison, 1988)

**Sensory evaluation of processed cake formulae**: was carried out according to Klien (1984) and Penfield and Camphell (1990a,b).the evaluated

cup cakes characteristics included taste , odour ,colour (crust and crumb) and overall acceptability ,at home economics Dept. Faculty of Specific Education, Mansoura University .

Energy values were calculated according to Zambarano *et al.*, (2004) using the following equation : Energy value (Kcal /100g ) =( protein content x 4)+ ( fat content x 9 )+ ( carbohydrate content x4 ) .

**Daily needs of energy and protein:**

Grams consumed of food to cover the daily needs of energy and proteins for adult man (25-50 year) were calculated using the daily requirements for adult (2900 calorie / day ) as given by Anon. 1989 .

GDR of energy calculated using the following equation

GDR of energy (g) = [2900 / % energy] x100

GDR of protein (g) = [63 / % protein ] x 100

Percent satisfaction of energy and protein : for adult man (25-50 year) when consumed 200 g of sample were calculated using the equation given by Anon. 1989.

$$\text{P.S. of energy (\%)} = \left[ 200 \times \frac{\text{energy value(k cal / 100g sample )}}{\text{( 2900 cal /day )}} \quad X100 . \right]$$

$$\text{P.S. of protein (\%)} = \left[ \frac{200 \times \text{g protein value / 100g sample )}}{\text{Protein requirements of adult (g/day )}} \quad X100 . \right]$$

**Statistical Analysis:**

Values represented are the means and standard error, significance was used at $p \leq 0.05$,(ANOVA) was done using SPSS 17 program for windows, 2007 .

## RESULTS AND DISCUSSION

**Chemical properties :**

**Some chemical properties of powdered orange pomace used in cup cake formulae processing:**

Orange pomace powder was chemically analyzed and the results for its content of moisture and dietary fiber namely, total, soluble and insoluble were presented in Table (2). Our obtained results indicated that powdered orange pomace have the amount of moisture content was 11. 5 ±0.01 % and the total dietary fiber and dietary fiber fractions TDF, INSDF and SDF were 54.21, 29.47 and 24.71 respectively these results were agreement with Ammar and El-demary (2009) who stated that peels from baladi orange contained 62.93 % total fiber.

**Table (2) some chemical properties of orange pomace powder:**

| Constitutes | Moisture % | FIBER % | | |
|---|---|---|---|---|
| | | TDF | INSDF | SDF |
| | 11.5±0.01 | 54.21 | 29.47 | 24.71 |

**TDF = total dietary fiber** **SDF = soluble dietary fiber**

**INSDF= insoluble dietary fiber** **All values are means of three replicates ± SD**

**Chemical properties of processed cup cake formulae using orange pomace:**

The effect of substituting orange pomace with different concentration i.e 5 , 10 and 15 % to cake formulae were studied and the results were presented in Table (3) . Results showed that the increasing amount of orange pomace in all cake formulae caused a clear decrease in moisture and ether extract contents. It was found that , all cake formulae have nearly the same amounts of protein. Whereas ash content were higher in prepared cake samples comparing with control, the amount of ash was ranged from 1.5 to 1.9 % this results were in accordance with Sharif *et al.*, (2009)

Also, increasing level of orange pomace to cake formulae decreased the amount of total carbohydrates in all cake formulae as compared with control sample and the decreases ranged from 35.54 to 21.34 % . Results also in the same table indicated that the amount of dietary fiber was increased in all prepared cake samples, the formula prepared with 15 % orange pomace exhibited the highest amount of TDF, SDF and INDSF which were 28.90 ,8.22 and 20.68% respectively . 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 fiber content was increased .On the same time the ash content was not affected by adding orange peels powder .

**Table (3): Chemical properties of processed cup cake formulae using orange pomace (gm/100g. on wet weight basis ).**

| Constitutes | Control | Processed cup cake formulae | | |
|---|---|---|---|---|
| | | Formula 1 | Formula 2 | Formula 3 |
| Moisture | 24.15±0.03 | 22.10* ±0.02 | 20.45* ±0.02 | 20.37* ±0.01 |
| Protein | 2.20±0.1 | 2.50*±0.10.1 | 2.80*±0.1 | 2.90*±0.1 |
| Ether extract | 25.7±0.04 | 25.07* ±0.03 | 24.70* ±0.03 | 24.50* ±0.01 |
| Ash | 1.3±0.04 | 1.5* ±0.02 | 1.7* ±0.04 | 1.9* ±0.02 |
| Carbohydrates | 36.52 | 35.54 | 26.55 | 21.43 |
| TDF | 10.13 | 13.26 | 23.80 | 28.90 |
| SDF | 4.53 | 5.73 | 7.94 | 8.22 |
| INSDF | 5.60 | 7.53 | 15.86 | 20.68 |
| Total calories (Kcal/100g ) | 386.18 | 377.91 | 339.70 | 317.82 |

**TDF = total dietary fiber SDF = soluble dietary fiber INSDF= insoluble dietary fiber**
**All values means of three replicated ±SD *= p≤ 0.05**

**Physical properties** :

**Physical properties in cake batter formulae:**

Different physical properties of cake batter namely pH , line spread , volume and specific gravity were determined and the results were tabulated in Table 4.

pH values affects on the typical alveolar structure and the taste of cakes (Pyler, 1988). Thus, the pH can be viewed as one of the objective measurements for the quality control of cakes. Results in Table (4) indicated that values of pH were significantly decreased in all cake batters comparing with control cake sample. On the other hand the initial pH values decreased

in all cake batter with the increasing addition of orange pomace , this decreases in pH values were ranged from 6.93 to 6.03 and could be attributed to the acid content of orange pomace . (Baik *et al.*, 2000 and Bath *et al.*, 1992).

Results in Table (4) indicated that all prepared cake batter formulae specific gravity were increased comparing with control cake sample. Effect of substitution of wheat flour with 5 , 10 and 15 % from orange pomace caused a heavier prepared cakes batters as compared with control sample and this decrease in specific gravity could be due the differences in the physicochemical characteristics of orange pomace (Masoodi *et al.*, 2002). Also results in the same table indicated that addition of orange pomace to cake batters formulae effect on the line spread parameter and reduced the spreadability of cake batter formulae , this could be due to that orange pomace contained high content of fiber which absorbed water and induced high water holding capacity.( Sowmya *et al.*, 2009).

Results of Volume showed that ,there were an observed decreases in volume in all prepared cake batters comparing with control cake sample and there were a significant decrease observed with an increase of pomace level. Control cake batter sample had an average cake volume 52.5 ±0.01$cm^3$ which decreased to 51.4±0.03,50.77 ±0.03 and 49.43±0.02 $cm^3$ at the level of 5 , 10 and 15 % orange pomace, respectively as prepared cake batters. This could be attributed to increase replacement of flour with pomace which weaked the gluten matrix responsible for retaining gases in baked foods . (Sowmya *et al.*, 2009 and Masoodi *et al.*, 2002 ) .

**Table (4) Physical properties of cake batter formulae:**

| Physical properties | Control | Cake batter formulae | | |
|---|---|---|---|---|
| | | Formula 1 | Formula 2 | Formula 3 |
| pH | 7.13 | 6.93 ±0.01 | 6.31 ±0.02 | 6.03 ±0.02 |
| Line Spread (l.S) (inch) | 2.5 ±0.01 | 1.19 ±0.02 | 1.08 ±0.01 | 1.05 ±0.04 |
| Volume ($Cm^3$) | 52.5 ±0.01 | 51.4±0.03 | 50.77 ±0.03 | 49. 43 ±0.02 |
| Specific gravity | 1.04±0.02 | 1.08 ±0.02 | 1.16 ±0.02 | 1.24 ±0.03 |

**Formula 1= cake batter preparedwith5% orange pomace**
**Formula 2= cake batter preparedwith10 % orange pomace**
**Formula 3 cake batter prepared with 15% orange pomace .**
**All values means of three replicated ±SD**

**Physical characteristics of prepared cake formulae :**

Different physical characteristics. namely, volume measurements, weight loss and cake texture profile: Hardness, Cohesiveness, Gumminess, Chewiness, Springiness, Resilience Were evaluated and tabulated in Table 5.

Results in Table (5) indicated that Volume measurements of cake is one of the most important quality attributes as it influences consumer acceptance. (Masoodi *et al.*, 2002) The volume measurements namely, volume index, symmetry index and uniformity index.

**Uniformity index (**UI), which is an indicator related to the symmetry of the cake. Results in Table( 5) indicated that there were no significant differences at ($p \leq 0.05$) with increasing pomace level in all prepared cake formulae

(Table 5), while significant differences were observed between cake formulae and control sample at .

**Symmetry index,** which represents the contour of the cake, results in table (5) indicated symmetry index of cake formulae was decreased significantly at ($p \leq 0.05$) in compared with control cake sample.

**Volume index**, No Significant differences ($P \leq 0.05$) with increasing pomace level for volume index were found among all prepared cupcake formulae in comparing with control sample .

Weigh loss % which represented the lost of cup cake weight % after baking , results showed that there were a decrease and increase in weight loss % among the cake samples and control observed the changes ranged from 5.75 ± 0.11to 7.23 ± 0.12

Results in Table( 5) showed also , that the effect of addition orange pomace at the level of 5, 10 and 15 % on texture profile of prepared cup cake The hardness of all prepared cup cakes formulae was increased from 1 to 3 times higher than that of control cakes. This data agreeded with Sych *et al.*, (1987) who stated that moisture losses from cake crumb caused a rigidifcation of its crumb structure as a primary firming process.

**Table (5): Volume measurements and weight loss of different processed cake formulae using orange pomace :**

| Constitutes | Control | Processed cup cake formulae | | |
|---|---|---|---|---|
| | | Formula 1 | Formula 2 | Formula 3 |
| Uniform index $U_I$ | 0.1 ±0.1 | 0.01*±0.01 | 0.02±0.02 | 0.01±0.02 |
| Symmetry index $S_I$ | 0.3 ±0.02 | 0.1*±0.01 | 0.1*±0.01 | 0.1*±0.01 |
| Volume index $V_I$ | 10.5 ±0.01 | 9.7±0.04 $^{ns}$ | 9.5±0.03 $^{ns}$ | 9.4±0.02 $^{ns}$ |
| Weight loss $W_I$ | 6.39 ±0.12 | 5.75*±0.11 | 7.23*±0.12 | 6.38±0.13 $^{ns}$ |
| **Cake texture profile** | | | | |
| Hardness | 9.28 | 13.34 | 20.59 | 26.67 |
| Cohesiveness | 0.281718473 | 0.407072836 | 0.522157454 | 0.808493391 |
| Gumminess | 3.758124 | 13.92594 | 8.38163 | 7.502819 |
| Chewiness | 1.5701 | 3.145 | 4.3284 | 8.5029 |
| Springiness | 0.417801 | 0.610582 | 0.516411 | 0.419181 |
| Resilience | 0.161257 | 0.289947 | 0.282276 | 0.200431 |

**values are average ± SD of three replicates. Ns = Non significant at p ≤0.05**

*** = significant at p ≤0.05**

Sensory definition for cohesiveness is the extent to which a material can be deformed before it ruptures (Abbott, 1973). Addition of orange pomace to cup cake formulae caused some transformation which weaken bonds strength occurred since cohesiveness of all prepared cup cake formula This could be observed in the formula prepared with substitution of 15 % orange pomace .

Both of springiness and resilience showed the elasticity of cake samples after stress recovery capacity and how the product physically springs back after it has been deformed. or Springiness, the rate at which a deformed material reverts to its undeformed condition after the deforming force is removed (Gomez, *et al.*, 2007, and Abbott, 1973 ) . Results in the

Table(5) indicated that texture profile measurements namely Springiness and resilience were higher than the control cake sample and there were an observed changes by substitution of wheat flour with orange pomace at different level of substitution from 5 to 15 % .

**Microstructure of prepared cup cake formula :**

Scanning electron microscope (SEM) permits three-dimensional observation of a number of interesting features of cup cake formulae . from fig.(1) it could be observed that control cup cake sample have a starch granules have been gelatinized ,partial outlines of a few distorted starch granules can be seen embedded in the protein gluten matrix and the small starch granules with spherical shape .

Best micrograph were observed in figs. (2 and 3) which contained cake formulae prepared with 5 and 10 % orange pomace, most of the starch granules have gelatinized ,fine starch granules were observed , most of the granules were in the spherical shape. Fig.(4). showed large starch granules can be observed and the carbohydrate cell become thicker and more compact, a few particles out line of starch granules are visible in the micrograph of cake, the gas cells were more observed and the smooth structure were disapered and fibers were observed like sheets , especially cake formula prepared with 15% of pomace.

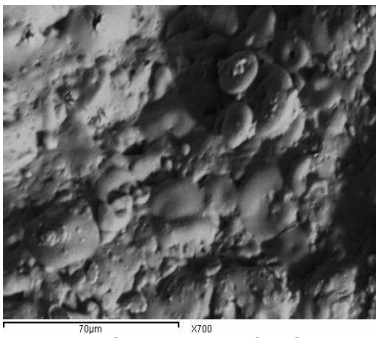


**Fig .1: Control cake**

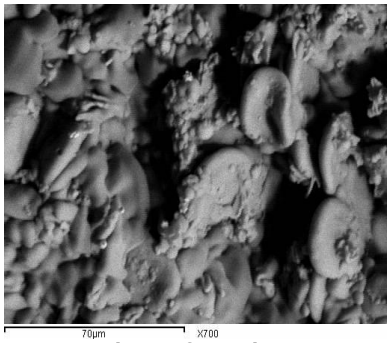


**Fig. 2: formula 1**

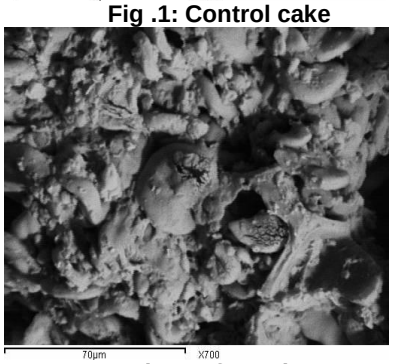


**Fig .3 : formula 2**

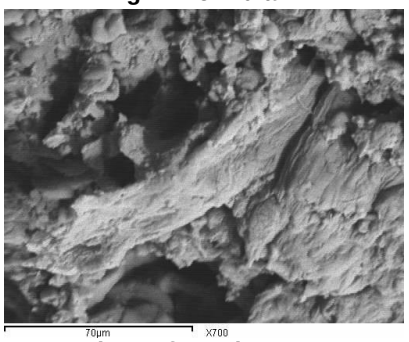


**Fig .4 : formula 3**

**Fig . 1 : control cake sample**
**Fig . 2 : Formula 1= cup cake preparedwith5% orange pomace**
**Fig . 3 :Formula 2= cup cake preparedwith10 % orange pomace**
**Fig. 4 : Formula 3 = cup cake prepared with 15% orange pomace .**

These results were in accordance with (Blaszeczak, *et al.*, 2004 and Brys and Zabik 1976) .

**Nutritive values for protein and energy of prepared cake .**

Nutritive values for protein and energy of prepared cake formulae were tabulated in Table (6) results indicated that addition of orange pomace up to 15 % decreased the $K_{cal}$ /100g for all prepared cup cake formulae in compare with control cake sample. .

Concerning to the data in the same table it could stated that the percent satisfaction of the daily requirements of protein for adult when consumed 200 grams of cup cake was higher than the control sample which were 8,9 and 9 % respectively .

The P. S./ 200 for energy of all cup cake samples was lower in all prepared cake formulae with different level of orange pomace comparing with control sample . Results also, showed that, The PS /200 for energy for all prepared cake samples were ranged from 22 to 26% .The energy value was decreased in all cake formula which contained the orange pomace powder this results agreed with Mckee and Latner (2000),who mentioned that citrus fiber had a low caloric content and high water capacity .

**Table (6): Nutritive value of prepared cake formulae with orange pomace**.

| Cup cakes formula | $K_{cal}$ / 100g. | GDR For Protein (g) | P.S./ 200 for protein% | GDR For Energy(g) | P.S./ 200 for energy% |
|---|---|---|---|---|---|
| control | 386.18 | 2363 | 7 | 715 | 27 |
| Formula 1 | 377.91 | 2520 | 8 | 767 | 26 |
| Formula 2 | 339.7 | 2250 | 9 | 853 | 23 |
| Formula 3 | 317.82 | 2172 | 9 | 912 | 22 |

**G.D.R = Gram consumed of food to cover the daily requirements of protein and energy for adult.**

**P. S. / 200 = percent satisfaction of the daily requirements of protein or energy for adultswhen consumed 200gm of food.**

**Sensory evaluation**

Results in Table (7) revealed that the sensory quality score for crumb and crust colour , taste, odour, height and overall acceptability significantly differences affected in all prepared cup cakes formula .

Appearance properties namely height and both of crumb and crust color were examined and results were also showed in Table (7) , results indicated that both of crumb and crust colour were acceptable in a cup cakes formula up to 10% substitution level with orange pomace and also the same trend was detected in height . On the other hand, prepared cakes formula containing orange pomace at the level of 15 % which exhibited low scores in crust , crumb colour and taste were significantly different from control and other prepare cake samples . In conclusion, acceptability of prepared cakes with 5 and 10% orange pomace were quite similar to those with control samples.

So, With regard to the effect of addition orange pomace on the sensorial properties it could be concluded that addition of orange pomace at

the level of 5 and 10 % have the superiority in improvement the prepared cup cakes quality and were also accepted by the panelists . These data were nearly in accordance with those given by . (Abozeid *et al.*, 2011 and Nassar *et al.*, 2008) stated that 10% of orange peel and pulp could be incorporated as an ingredient in making biscuits and cakes , as they are a suitable source of dietary fiber with associated bioactive compounds (Flavonids, Carotenoids etc.). The addition of dietary fiber to bakery products also improves their nutritional quality since it makes possible to decrease the fat content, by using dietary fiber as substitutive of fat without loss of quality Sharif *et al.* (2009) concluded that replacement of wheat flour with defatted rice bran could be used without adversely affecting physical and sensory characteristics of cookies.

**Table (7): Sensory evaluation of processed cup cake formulae with orange pomace** .

| Cup cakes formula | Taste | Height | Odour | Crust colour | Crumb Colour | Overall Acceptability |
|---|---|---|---|---|---|---|
| Control | 9.50± 0.04 | 9.50± 0.04 | 9.8±0.01 | 9.7±0.02 | 9.6±0.02 | 9.7±0.01 |
| Formula 1 | 9.30*±0.03 | 9.30* ±0.03 | 8.5*±0.02 | 9.2*±0.03 | 8.5* ±0.04 | 8.9* ±0.01 |
| Formula 2 | 9.20*±0.04 | 9.20*±0.04 | 8.6*±0.03 | 9.3*±0.01 | 8.4* ±0.05 | 8.7*±0.04 |
| Formula 3 | 8.03*±0.03 | 8.03*±0.03 | 8.0*±0.02 | 7.5*±0.02 | 8.0* ±0.01 | 7.5* ± 0.03 |

**values are average ± SD of three replicates * = p≤ 0.05**

## REFERENCES

A.A.C.C. (1983). AACC. 1983. Approved Methods of the American Association of Cereal Chemists, 8th ed. AACC. St. Paul, MN.

A.A.C.C. (2000). American Association of cereal chemists: Approved methods of the AACC, 2000 (10th ed.) The Association, St. Paul, MN.

A.O.A.C. (1990). Official Methods of Analysis, 12th Ed. Association of Official Analytical Chemists, Washington, D.C., USA.

A.O.A.C. (2000). Official Methods of Analysis, 17th Ed. Association of Official Analytical Chemists, Washington, D.C., USA.

A.O.A.C. (2007). Official Methods of Analysis, 18th Ed. Association of Official Analytical Chemists, Washington, D.C., USA.

Abbott, J. A. (1973).. Sensory assessment of textural attributes of foods. Chapter III In A. Kramer, & A. S. Szczesniak, Texture measurements of foods. Dordrecht, (Holland)/Boston: D. Reidel Publishing.

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,

Akin, D.E. and Morrison, W.H. (1988). Ozone treatment of froge : structure and digestability of different types of lignified cell walls . Crop Sci. 28:337.

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 .

Anonymous (1989). Recommmended ditery allowances . National research Council of food and nutrition –Board-national - Academy of sciences revised Washington ,D.C.,USA

Baik , O., Marcotte, M. Castaigne,F. (2000) . Cake baking in tunnel type multizone industrial ovens Part II. Evaluation of quality parameters . Food Research International 33 (2000) 599- 607 .

Blaszeczak, W., Sadowska, J., Rosell, C. M., and Fornal, J. (2004). Structural changes in the wheat dough and bread with the addition of alpha-amylases. European Food Research and Technology, 219, 348–354.

Brys, K.D.and Zabik,M.E. (1976) . Microcrystalline cellulose replacement in cakes and biscuits. J Am Diet Assoc 69: 50–55.

De Fouw C, Zabik ME, Uebersa MA, Aguilera JM and Lusas E (1982) Use of unheated and heat treated navy bean hulls as a source of dietary fiber in spice flavored layer .Cereal Chem. .59: 229–230.

Devinder D., Michael. M., Rajput H. and Patil, R. T., (2010 ) Dietary fiber in foods: a review, J Food Sci and Technoly. 223

Gomez, M., Felicidad, R. Pedro, A., Carlos, A. and Rosell, M. (2007 ). Functionally of different hydrocollodis on the quality and shelf life of yellow layer cake. Food Hydrocolloids, 21, 167-173.

Klien, B. (1984 ). The Experimental Study of Food . University of Illions,U.S.A.,pp :82.

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.

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 .

Mckee L.H and Latner,T.A. (2000 ). Under utilization sources of dietary fiber : A review Plant Foods for Human Nutrition , 55 : 285-304.

Nassar A.G., AbdEl-Hamied A.A. and El-Naggar EA (2008). Effect of citrus by-products flour incorporation on chemical, rheological and organoleptic characteristics of biscuits. World J Agric Sci 4 (5):612–616.

Penfield, M.P. and Campbell, A.M. (1990a). Shortened Cakes. In “Experimental Food Science,”3rd ed. pp. 452-70. Academic Press, Inc. San Diego, CA.

Penfield, M.P. and Campbell, A.M. (1990b). Appendix D: Improvised Tests. In “Experimental Food Science,” 3rd ed. pp. 519-23. Academic Press, Inc. San Diego, CA.

Pyler, E. J. (1998). Baking science and technology (Vol. 2, 3rd Ed.) Merriam, Kansas: Scotland- Publishing.

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.

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.

SPSS, (2007). Statistical Package for Social Science program version 17 for Windows, SPSS Inc, Chicago , IL , USA.

Sych, J., Castaigne, F., and Lacroix, C. (1987). Effects of initial moisture content and storage relative humidity on textural changes of layer cakes during storage. Journal of Food Science, 52,1604±1610.

Zambrano, F., Despinoy, P., Ormenese, R. C. S. C., and Faria, E. V. (2004). The use of guar and xanthan gums in the production of 'light' low fat cakes. International Journal of Food Science and Technology, 39, 959–966.

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 تفل البرتقال في تصنيع كيك منخفض السعرات الحرارية

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يهدف هذا البحث الي الاستفادة من تفل البرتقال البلدي كمنتج ثانوي لمصانع العصائر الذي يسبب بعض المشاكل في تصنيع كيك منخفض السعرات. وفي هذه الدراسة تم استخدام مسحوق تفل البرتقال البلدي بنسب استبدال مختلفة ٥و ١٠ و١٥ % من دقيق القمح استخلاص ٧٢% في تصنيع كب كيك منخفض السعرات . اوضحت نتائج الاختبارات الكيماوية حدوث انخفاض ملحوظ في محتوي الرطوبة والدهون والكربوهيدرات وزيادة نسبة الالياف والرماد بزيادة النسب المضافة من مسحوق تفل البرتقال ودلت نتائج الاختبارات الطبيعية لعجائن خلطات الكيك والكيك المصنع ان الاستبدال بنسبة ١٥% من دقيق القمح بتفل البرتقال اثرت تاثيرا سلبيا علي الخواص الطبيعية وهي درجات pH و الانتشار والحجم وخواص القوام علي التوالي . كما اوضحت نتائج الفحص الميكروسكوبي باستخدام الميكروسكوب الالكتروني انة بزيادة نسب الاستبدال( ١٥ %) بمسحوق تفل البرتقال ادي الي حدوث تغيرات غير مرغوبة في تركيب حبيبات النشا والجلوتين والخلايا الغازية . كما اوضحت نتائج الاختبارات الحسية ان اضافة مسحوق تفل البرتقال بنسبة ٥ و ١٠ % اعطت قبولا ملحوظا في تقديرات الطعم والرائحة ولون القصرة ولون اللبابة والارتفاع والقبول الكلي مقارنة بعيبات الكيك المصنع بالاستبدال ب١٥ % من مسحوق تفل البرتقال .

ولذا توصي الدراسة بامكانية تصنيع كيك منخفض السعرات بالاستبدال من دقيق القمح بمسحوق تفل البرتقال حتي نسبة ١٠% .

**قام بتحكيم البحث**

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