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USING UNTRADITIONAL SOURCES OF FIBER TO PREPARE CHOCOLATE CAKE

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ABSTRACT

This study aimed to examine the possibility of using some processed vegetable wastes as sources of new non-traditional fibers in the preparing of healthy bakery products (chocolate cake). During the processing a high percentage in the vegetable wastes are produced; about 70% in the Jew's mallow and 22% in okra. These residues are rich in dietary fibers and mucilage contents. Moreover, they contain other nutrients which are useful food supply and antioxidant (*i.e*., chlorophyll). They are also free of phytate comparing with cereal fibers. Wheat flour used for making cakes was replaced by dried Jews mallow or okra waste at levels of 3, 6, 9 and 12% separately in the preparing of chocolate cake. The produced cakes were chemically, organolyptically, physically and microbiologically evaluated. The obtained data indicated that, increasing the substitution levels of the previous two sources of fibers in the produced chocolate cake led to an increase in ash, crude fiber and mineral contents (*i.e*., Fe, Zn, Ca, and Mg), with slight increasing in each of protein and fat, while carbohydrates and energy decreased compared with the control.The decrease in caloric values was nearest the previous two sources of fiber at the same level of substitution, which ranged from 446.94 to 431.66 K.cal compared with 451.20 K.cal. for the control. The statistical analysis indicated that no significant difference was observed between the control and all samples of cakes supplemented with dried Jew's mallow or okra waste until level 6% for all evaluation characteristics and it showed a very good acceptance. While at the levels of 9 and 12% substitution it resulted in a good acceptance. The values of height, volume and specific volume in all the samples of produced cake decreased by increasing the level of substitution of the previous two sources of fiber while weight and moisture increased. Increasing the rates of substitution from each of dried Jew's mallow or okra waste decreased the decreased rate of freshness and less microbial counts, this was within the permissible limits. This leads to prolong the shelf life of the cake. The results showed that 100 gm of chocolate cake containing the previous fiber sources contribute 13.42 - 40.17% of the Recommended Dietary Allowances (RDA) of dietary fiber for children, and 6.32-19.28% for adults compared to the control which contribute 5.93 and 3.56% for children and adults, respectively. In addition, all values of % RDA for the studied nutrients were high in samples of chocolate cake compared with the control. It could be recommended that incorporation of the mentioned fibers with wheat flour 72% extraction to obtain healthy bakery products have high biological value.

***Key words**: bakery products, chocolate cake, dietary fibers, vegetable wastes.*

1. INTRODUCTION

Dietary fiber (DF) holds all the characteristics required to be considered as an important ingredient in the formulation of functional foods, due to its beneficial effects such as increasing the volume of fecal bulk, decreasing the time of intestinal transit, cholesterol and glycaemia levels, trapping substances that can be dangerous for the human organism (mutagenic and carcinogenic agents), stimulating the proliferation of the intestinal flora, etc. (Heredia *et al*., 2002). The importance of food fibers has led to the development of a large and potential market for fiber-rich products and ingredients and, in recent years, there is a trend to find new sources of dietary fiber that can be used as ingredients in the food industry (Chau and Huang, 2003).

The amount of dietary fiber in gram among children (age 3 to 18 years) needed every day is equal to, or greater than, their "Age plus five" (Williams *et al.,* 1995). The recommendations about the intake of DF are not the same in all countries. While UK proposes 18 g/day of DF expressed as non-starch polysaccharides, this amount is 30 g/day in Germany, and in the USA the intake should be 38 g/day for men and 26 g/day for women (Miller, 2004). The recommended intake of DF in Spain, Italy and Greece is 20g/day for men and 15.7 g/day for women (Capita and Alonso-Calleja, 2003).

The manufacture processing of vegetable leads to high waste, about 70% in Jew's mallow, 22% in okra, (Food Composition Tables, 2000). These wastes, already, lead to environmental pollution, in the same time it contained high levels of different nutrients, and healthy components, such as minerals, antioxidants and mucilage which could be used in human nutrition and solve some problems in bakery products such as stalling and mold growth. In comparison with cereal bran, Jew's mallow and okra fibers are characterized by (I) low or free phytate, which is of particular concern to nutritionists because of its possible adverse effects on mineral absorption (Graf, 1986) (II) better water binding and retention capacity, which is of particular interest for the baking industry (Stauffer,1993).

The chemical composition of dried Jew's mallow waste were, moisture (6.24%), protein from 9.10 to 12.2%, lipids from 2.3 to 3.3%, ash from 18.0 to 20.00%, crude fiber from 31.0 to 36.5% and total carbohydrate ranged from 30.8% to 31.2%, respectively (Mahmod 1996 and Arnaot 2003).

Jew's mallow is rich in antioxidant group (tocopherol, carotendoids, flavonoids, and vitamin C) beside its importance of a varied complement of antioxidants in the diet. Among the groups of antioxidant molecules, the flavonoids are somewhat distinctive because of their different active roles in human physiology. Carotenoids, tocopherols and ascorbate are all recognized as antioxidants in both plants and humans. (El-Hadidy, 2004).

The chemical composition of okra waste was moisture (5.54%), protein (12.8%), lipids (3.4%), ash (39.8%), fiber (9.9%) and total carbohydrate (30.1%), respectively (El-haolgy and Mokhtar, 1996). On the other hand, Ravi (2006), reported that okra is a rich source of many nutrients, including dietary fiber, vitamin B6 and folic acid each of 100g okra gave 25 Calories, 2 gm dietary fiber, 1.5 gm protein, 5.8 gm carbohydrates, 460 IU vitamin A, 13 mg vitamin C, 36.5 mcg folic acid, 50 mg calcium, 0.4 mg iron, 256 mg potassium and 46 mg magnesium on fresh weight basis.

Okra contains large variety of healthy nutrients. Also contains a compound called glutathione that attacks cancer, It is an antioxidant, and it protects healthy cells from cancerous damage (Dhillon, 2008). Bakery products, take a significant share in the food guide pyramid for daily food choices recommended by US Department of Health and Human Services (2004). Therefore, the development of enriched bakery products with higher fiber content is one of the efficient ways to increase the fibers intake. Cakes are a common popular bakery product, for a wide range of consumers as it is consumed in breakfast or tea time.

This study was an attempt to produce height fiber chocolate cakes by using new sources of dietary fibers (resulted as by-products of processing operation. *i.e*. dried Jew's mallow and okra waste) which have chemopreventive effects to meat some of RDA fibers and improvement the produced cakes. The produced cakes were chemically, organolyptically, physically and microbiologically evaluated.

2. MATERIALS AND METHODS

2.1. Materials

Soft wheat flour (72% extraction) was obtained from South Cairo Mills Company, Giza, Egypt.

Two vegetable waste samples, stems of Jew's mallow (*Corchorus olitorius* L.), fruit of top and pedestal Okra (*Abelmoschus esculentus* Moench.) were obtained from Montana Co for vegetable freezing at Qaluob, Qaluobia Governorate, Egypt.

All other materials used in cake making *i.e.* sugar, fat (Rawaby consider refined palm oil, 100% pure vegetable samna and it is cholesterol free), baking powder, eggs and vanilla were obtained from local market in Dokki, Giza Governorate.

2.2. Methods

2.2.1.Preparation of dried vegetable samples

Jew's mallow and okra wastes were washed, and cut to around 3 mm then dried promptly in convection oven air circulation at 50 ^{o}C for 24 hrs as described by Abdel-Hameed and Hareedy (2005), the dried vegetable wastes were milled using laboratory disc mill, then sieved on a 600 µm sieve and softening in cyclone mill, sieved again on a 160 µm (50-60 mesh). The resulted flours were packed in polyethylene bags and kept in a deep freezer until using.

2.2.2. Blends

Soft wheat flour was used to make control chocolate cake and the flour blends were formulated on replacement basis soft wheat flour at levels of 3, 6, 9 and 12% by dried Jew's mallow or okra waste. These levels were selected after conducting a series of trial experiments.

2.2.3. Preparation of chocolate cake

Chocolate cake formulas used in this study were in accordance to A. A. C. C. (2002), with some modification. The formulas are shown in Table (1).

Table (1): The formula of chocolate cake.

Ingredients	Amounts (gm)	Ingredients	Amounts (gm)
Soft wheat flour or its blends	100	Baking powder	5
Cacao powder	6	Skimmed milk powder	10
Fat	22	Sodium chloride	0.5
Sugars	80	Vanilla	0.25
Eggs	31	*Water (ml.)	as required

*water is added in ml. as required

For making chocolate cake, dried ingredients were combined except sugar. The sugar was added to the fat, and beaten for 3 min. Egg-vanilla mixture was added gradually to the creamed fat-sugar mixture and creaming continued for 2 min. The flour mixture was added gradually to the sugar-fat-egg mixture and were beaten for 5min. Seventy grams of butter cake was scaled into greased cup cake (Size 2) and baked at 180 ºC for 25 min in a preheated baking oven. The chocolate cakes were cooled for about 10 min, removed from cup cake and continued cooling for 1 hour.

2.2.4. Storage of chocolate cake

After chocolate cakes were cooled at room temperature they were stored at the refrigerator (6±2^{o}C.) in sealed polyethylene bags for 56 days to study the antimicrobial and staling rate of formula used during the storage.

2.2.5. Chemical analysis

Moisture, protein, ash, crude fiber content and ether extract were determined according to the methods described in A.O.A.C. (2005). Digestible carbohydrates (D.C.) were calculated by difference according to the following equation

D.C.=100- (%protein+ % total lipid+ % ash+ % fiber).

Caloric value was calculated according to the following equation (FAO/WHO, 1974):

E= 4(protein%+ digestible carbohydrate %)+9(fat %).

Mineral contents, *i.e*., Fe, Zn, Ca and Mg were determined in the diluted solution (Hcl, 0.1N) of ash samples by using the atomic absorption spectrophotometer (3300 Perkin-Elmer) as described in A.O.A.C. (2005).

2.2.6. Determination of Chlorophyll A and B and Total chlorophyll

Total chlorophyll (chlorophyll-A, and chlorophyll-B) were extracted from vegetable wastes according to the methods of Fedtke (1973) by grinding in a mortar with 80% acetone in the presence of washed sand. The homogenate was centrifuged for 5 min at 5000 rpm. The supernatant was made up to a known volume with 80% acetone. The optical density of the diluted supernatant was measured by using spectrophotometer (Stiemindz 1100C) at 662nm and 644nm. The concentrations of chlorophyll-A, B and total chlorophyll were calculated by means of Wettstian formula (Wettstian, 1957):

Chlorophyll-A=9.784XE_{662}– 0.99X E_{644} (mg/l)

Chlorophyll-B=21.426 XE_{644}–4.63XE_{662} (mg/l)

Total chlorophyll= 20.2 (E_{644})+ 8.02 (E_{662}) (mg/l)

E = Optical density

2.2.7.Determination of dietary fiber

Total dietary fiber (TDF) was determined according to the method described by Prosky *et al.* (1984), soluble dietary fiber (SDF) and insoluble dietary fiber (ISDF) were determined according to the methods described by Lee and Prosky (1995).

2.2.8.Extraction and Determination of crude polysaccharides (mucilage) from vegetable wastes

The crude mucilage of okra and Jew's mallow wastes were extracted from the wastes using the methods described by El-Mahdy and EL-Sebaiy (1984) and Kim *et al.,* (1999): with some modification as follows:-

Okra and Jew's mallow wastes were cut and blended with three times their weight of deionized water and heated at 70^{o}C for 15 min to inactivate enzymes; then cooled and squeezed through nylon cloth. The filtrate was clarified in a refrigerated centrifuge at 3,000 rpm for 5 min with the temperature set at 15 ^{o}C. Each crude mucilage was precipitated, from the resulting viscous solution, with three volumes of ethanol, then centrifuged at 5,000 rpm at 15 ^{o}C for 10 min and washed four times using a mixture of ethanol and acetone (2:1). The crude mucilage was dried overnight at 40 ^{o}C in an oven. Then mucilage was calculated.

2.2.9. HPLC analyses of hydrolysates of polysaccharides (mucilage)

The HPLC (Jacso) with refractive index detector was used. One column used for neutral sugars analysis (25 X 0.46 cm). Deionized water and acetonitrile mixture (13:87 w/w) were used as a mobile phase. The column temperature was maintained at 30 ^{o}C. Chromatograms were recorded and peak areas were calculated using a digital integrator comparing with standard sugars (Hicks *et al.*, 1985).

2.2.10. Determination of uronic acids

The content of uronic acids was determined using the carbazole method as described by Taylor and Buchanan- Smith (1992) and modified by Chaplin (1995).

2.2.11. Sensory evaluation of produced chocolate cake

Cakes were judged for cells (uniformity and size of cells), grain, texture (moistness, tenderness and softness), crumb color and taste and flavor. The overall score was 100 degrees by ten panelists as described in A.A.C.C.(2002).The panelists were chosen from the staff of Bread and Pastries, Res. Dept., Food Tech. Research Institute, to evaluate cake organoleptic characteristics. The data obtained from sensory evaluations were statistically analyzed by the least significant differences value (L.S.D.) at 0.05 levels probability procedure (Snedecor and Cochran, 1980).

2.2.12. Physical properties of produced chocolate cake

Height, weight, volume and specific volume of the cakes were determined according to the methods described in A.A.C.C. (2002).

2.2.13.Microbial analysis

Total bacteria, molds and yeast counts were determined in chocolate cakes after 14, 28, 42 and 56 days of storage at 6±2ºC according to the procedure described by A. O.A.C., (2005).

2.2.14. Determination of staling rate

The staling rate of the produced chocolate cakes was determined at zero time of baking and after 14, 28, 42 and 56 days at refrigerator (6±2^{o}C.) by using the alkaline water retention capacity method according to Kitterman and Rubentholor (1971).

3. RESULTS AND DISCUSSION

3.1. Chemical composition of raw materials

The data presented in Table (2), demonstrate that soft wheat flour (72% extraction) contained the highest values of total carbohydrate (88.09%) whereas it showed the lowest values of protein, fat, crude fiber and ash (9.94, 0.96, 0.48 and 0.53 %, respectively). Dried okra waste contained the highest values of protein, fat and ash (14.58, 3.95 and 34.06%, respectively.) while dried Jew's mallow waste contained the highest value of crude fiber (40.05%). These results are in agreement with those found by El-haolgy and Mokhtar, (1996), Farvili *et al.*, (1997) and Abdel-Hameed and Hareedy, (2005).

Concerning mineral content, it could be observed that dried Jew's mallow waste had the highest value of Fe, Zn and Ca (35.62, 12.91 and 860.96 mg/100 gm, respectively.) and dried okra waste had the highest value of Mg (360 mg/100g)

Table (2): Chemical composition of wheat flour (72% extraction), dried Jew's mallow and okra wastes (% on dry wight basis).

Component	Soft wheat flour (72% extraction)	dried Jew's mallow waste	dried okra waste
Protein	9.94	10.35	14.58
Fat	0.96	3.75	3.95
Crude fiber	0.48	40.05	14.50
Ash	0.53	22.75	34.06
*Total carbohydrate	88.09	23.10	32.91
Minerals content (mg/100gm)			
Fe	1.14	35.62	6.84
Zn	0.48	12.91	4.31
Ca	19.34	860.96	770
Mg	18.65	315.62	360
Chlorophyll (mg/100gm)			
Total Chlorophyll	-	20.23	8.79
Chlorophyll-A	-	19.64	6.45
Chlorophyll-B	-	0.577	2.34

* Calculated by difference

while soft wheat flour (72% extraction) had the lowest value in these previous minerals (1.14, 0.48, 19.34 and 18.65 mg/100 gm for Fe, Zn, Ca and Mg, respectively.). These results are confirmed by those of Mahmod, (1996) and Bahlol *et al.* (2000).

Also, the results in the same Table reveal that Jew's mallow waste had high content of total chlorophyll and chlorophyll-A (as antioxidant) than okra waste, while soft wheat flour (72% extraction) was free from these pigments.

Also, from the present data, It is clearly noticed that the combination of soft wheat flour (72% extraction) with dried Jew's mallow waste or dried okra waste as a flour substitution caused an increase in crude fiber, ash, minerals and total chlorophyll content, and reduced the total carbohydrate in the mixed flour.

3.2. Dietary fiber and its fractions

Dietary fiber (DF) may be divided into two parts when it is dispersed in water: a soluble and an insoluble fraction (Perigo *et al.,* 1993). Each fraction has different physiological effects. The insoluble part is related to both water absorption and intestinal regulation, whereas the soluble fraction is associated with the reduction of cholesterol in blood and the diminution in the intestinal absorption of glucose. Insoluble fiber include lignin, cellulose, and hemicelluloses; soluble fibres include pectins, beta-glucans, galactomanan , gums, and a large range of non digestible oligosaccharides including inulin (Meyer, 2004).

The results of dietary fiber and its fractions of the material under investigation are presented in Table (3). The results indicated that the values of total dietary fiber TDF, insoluble dietary fiber INSD and soluble dietary fiber SDF for dried Jew's mallow waste and dried okra waste were higher than that of soft wheat flour 72% extraction.TDF and ISDF were the highest for dried Jew's mallow waste (49.80% and 35.10%, respectively.). While SDF was the highest for dried okra waste (15.49%) compared to soft wheat flour 72% extraction which recorded 2.18, 0.49 and 1.69% for TDF, ISDF and SDF, respectively. These results are in agreement with Innami *et al.*, (1995); El-haolgy and Mokhtar, (1996) and Abdel-Hameed and Hareedy (2005).

3.3. Percentage of polysaccharides (Mucilage) in raw material under investigation and HPLC analysis for its hydrolyzate

Jew's mallow and okra fibers absorb water and ensure bulk in the stools. This helps prevent and improve constipation. Unlike harsh wheat bran, which can irritate or injure the intestinal tract, Jew's mallow and okra's mucilage soothe, and facilitate elimination more comfortably by its slippery characteristic. Mucilage of Jew's mallow and okra was evaluated as antioxidant and was found to have good activity. Antioxidant activity of this mucilage might be due to the protein complex or amino acids present in it. However, mucilage coats the various tissues, provides lubrication and gives protection against gastric ulcers (Shiny *et al.*, 2008) so hepalorotective action of mucilage could give protection to liver injury upon using it in human nutrition.

The present study was concerned with monosaccharide constituents of polysaccharides under investigation in order to obtain information on these constituents, mucilages were completely acid hydrolyzed and then analyzed by HPLC. On the other hand, the total uronic acids were chemically determined and the results are presented in Table (4). The obtained results showed that the mucilages are quantitatively and qualitatively differed in their contents of monosaccharides as well as they are quantitatively differed in their contents of total uronic acids. Regarding uronic acids, arabinose and ribose were the major monosaccharide of Jew’s mallow

Table (3): Dietary fiber and its fractions of used raw materials (% on dry wight basis).

Dietary fiber	Soft wheat flour (72% extraction)	Dried Jew’s mallow waste	Dried okra waste
Total dietary fiber (TDF)	2.18	49.80	28.4
Insoluble dietary fiber (ISDF)	0.49	35.10	12.91
Soluble dietary fiber (SDF)	1.69	14.70	15.49
ISDF/TDF %	22.48	70.48	45.46
SDF/TDF %	77.52	29.52	54.54

Table (4): Mucilage% (As percentage of raw material) and HPLC analysis of Mucilage .

Component	Dried Jew's mallow waste	Dried okra waste
Mucilage (%)	4.11	3.82
HPLC analysis of Mucilage.		
Xylose	0.91	0.41
Glucose	-	8.33
Galactose	-	5.91
Arabinose	30.16	4.01
Ribose	20.05	-
Fructose	1.22	3.15
Rhamnose	11.02	7.1
Uronic acids	36.14	41.59
Unknown	0.5	29.5

mucilage (36.14, 30.16 and 20.05%) respectively, then, rhamnose (11.02%), the small percentages of, fructose and xylose (1.22 and 0.91 %) were recorded, whilst glucose and galactose were absent. These results are confirmed by those of El-Mahdy and El-Sebaiy, (1984) and Hassan, (2004).

The major monosaccharides of okra mucilage were uronic acids, which reached 41.59% of polysaccharide and unknown neutral monosaccharide which reached 29.5%. Other monosaccharide including xylose, glucose, arabinose, galactose, fructose, and rhamnose were present in small quantities (0.41, 8.33, 4.01, 5.91, 3.15 and 7.1%), respectively, but ribose was absent. These results are in agreement with EL-Mahdy and EL-Sebaiy (1984). Certain beneficial effects of fibers in the human diet may be mediated by short-chain fatty acids (SCFAS) produced during anaerobic fermentation in the colon. The yield of SCFAS (mol) from substrate is dependent not only on the weight of substrate fermented but also on the average molecular weight (MW) of polysaccharide component sugars (Evan Titgemeyer *et al.*, 1991).

3.4.Chemical composition of the produced chocolate cake

The data presented in Table (5), prove that all samples of chocolate cake containing dried Jew's mallow or okra waste had the highest value of protein, fat, ash and dietary fiber and lowest value of digestible carbohydrate and total energy compared with the control. All samples of chocolate cake except the control had protein content ranged from 8.08-8.59%, fat 12.70-12.85%, ash 2.44-3.89%, dietary fiber 1.61-4.82%, digestible carbohydrate 74.91-70.87 % and total energy 446.94 - 431.66 K.cal. The control had protein 8.03%, fat 12.68%, ash 2.16%, dietary fiber 0.89%, digestible carbohydrate 76.24% and total energy 451.20 K.cal. The rate of decrease in total caloric for samples was ranged from 0.94 to 3.92 K.cal.

Also, the results presented in Table (5), show that all samples of chocolate cake had the highest values in mineral contents (*i.e*., iron, zinc, calcium and magnesium) compared with the control. Hence, chocolate cakes containing dried Jew's mallow or okra waste are favorable than the control because of their high content of important minerals which depend upon the dried Jew's mallow or okra waste levels of substitution.

3.5. Sensory evaluation of the produced chocolate cake

Organoleptic tests are generally the final guide to the quality from the consumer's point of view. The data in Table (6) indicate that uniformity, size of cells, softness and taste and flavor characteristics were decreased with increasing the replacement of wheat flour (72% extraction) with dried Jew's mallow and okra waste at level of 3, 6, 9 and 12%. While grain, moistness and tenderness characteristics were increased with increasing the percentage of substitution for each dried Jew's mallow and okra waste. On the other hand, no significant difference was observed in crumb color for all samples of chocolate cake compared with the control. Also, the statistical analysis indicted that no significant difference was observed between the control and the samples of cakes supplemented with dried Jew's mallow or okra waste until level 6% for all evaluation characteristics and it had very good acceptance. At the level of substitution 12% for each dried Jew's mallow and okra waste were good acceptance.

Table (5): Chemical composition of the produced chocolate cakes (on dry wight basis).

Components	Control	Dried Jew's mallow waste substitution levels				Dried okra waste substitution levels			
	0%	3%	6%	9%	12%	3%	6%	9%	12%
Protein	8.03	8.08	8.10	8.16	8.20	8.25	8.36	8.48	8.59
Fat	12.68	12.70	12.75	12.79	12.82	12.74	12.78	12.80	12.85
Ash	2.16	2.44	2.82	3.10	3.29	2.58	3.02	3.48	3.89
Dietary fiber	0.89	1.87	2. 83	3.89	4.82	1.61	2.35	3.10	3.79
* Digestible carbohydrate	76.24	74.91	73. 50	72.06	70.87	74.82	73.49	72.14	70.88
Caloric value (K.cal/100gm)	451.20	446.26	441.15	435.99	431.66	446.94	442.42	437.68	433.53
Rate of decreased for total caloric	-	1.1	2.23	3.37	4.33	0.94	1.95	3.00	3.92
Minerals content mg/100gm									
Fe	1.17	1.57	1.98	2.37	2.84	1.28	1.32	1.39	1.50
Zn	0.53	0.70	0.83	0.98	1.23	0.58	0.63	0.68	0.78
Ca	69.51	79.30	89.21	98.90	108.70	77.97	86.70	95.45	104.41
Mg	54.32	56.64	59.10	61.42	63.78	57.27	60.17	62.98	65.86

* Calculated by difference

Table (6): Effect of dried Jew's mellow or okra waste substitution levels on the organolyptic evaluation of chocolate cakes.

Treatments		Cells (20)		Grain	Texture (34)			Crumb Color	Taste and flavor	Overall score	Acceptance
		Uniformity	Size of cells		Moistness	Tenderness	Softness				
		10	10	16	10	14	10	10	20	100	
Control		9.5 ^{a}	9.5 ^{a}	14.5^{b}	8.0^{bc}	12.5^{b}	9.5^{a}	9.0^{a}	19.5^{a}	92.0^{a}	**V**
Dried Jew's mallow waste	3%	9.5 ^{a}	9.1 ^{a}	14.9^{ab}	8.5^{b}	12.7^{b}	9.0^{ab}	9.0^{a}	18.5^{ab}	91.2^{ab}	**V**
	6%	9.0 ^{ab}	9.0 ^{ab}	15.0^{a}	8.6^{ab}	13.0^{ab}	9.0^{ab}	9.1^{a}	18.0^{b}	90.7^{ab}	**V**
	9%	8.6^{b}	8.5^{b}	15.3^{a}	9.0^{a}	13.1^{a}	8.5^{b}	9.1^{a}	17.0^{bc}	89.1^{b}	**G**
	12%	7.5^{c}	8.2^{b}	15.5^{a}	9.1^{a}	13.5^{a}	8.0^{bc}	9.2^{a}	15.5^{d}	86.5^{c}	**G**
L.S.D.		**0.8443**	**0.9012**	**0.7317**	**0.5060**	**0.5320**	**0.8981**	**0.3988**	**1.0988**	**2.3816**	
Dried okra waste	3%	9.4^{a}	9.3^{a}	15.0^{ab}	8.5^{b}	12.6^{b}	9.5^{a}	9.1^{a}	18.0^{b}	91.4^{a}	**V**
	6%	9.1^{ab}	9.1^{ab}	15.1^{ab}	8.8^{ab}	13.1^{ab}	9.3^{a}	9.2^{a}	16.5^{c}	90.2^{ab}	**V**
	9%	8.5^{b}	8.4^{b}	15.4^{a}	9.2^{a}	13.3^{a}	9.0^{a}	9.2^{a}	15.0^{d}	88.0^{b}	**G**
	12%	7.3^{c}	7.6^{c}	15.3^{a}	9.4^{a}	13.6^{a}	8.2^{b}	9.3^{a}	14.0^{d}	84.7^{c}	**G**
L.S.D.		**0.7803**	**0.7012**	**0.6202**	**0.6351**	**0.5626**	**0.6921**	**0.4014**	**1.2110**	**2.5017**	

Each value with the same column is followed by the same letters is not significant different at level of 0.05.
90-100 Very Good (V). 80-89 Good (G). 70-79 Satisfactory (S). Less Than 70 Questionable (Q).

3.6. Physical properties of different types of produced chocolate cake

Table (7) shows that all samples of chocolate cake had higher moisture content. It ranged from 26.21 to 33.03% than the control (20.63%). Such increase in moisture may be due to the levels of substituted fibers which absorb more water than starch. Also, data in the same Table show that, height, volume and specific volume in all samples of resultant chocolate cakes decreased by increasing flour substitution from 3 to 12% for either dried Jew's mallow waste or dried okra waste. This could be due to a reduction in whipping and foaming ability. The highest decrease for height, volume and specific volume was found when dried okra waste was used at 12% substitution which recorded 6.2 cm, 136 cm^3 and 2.15 cm^3/gm, for these parameters, respectively comparing with control which recorded 7.62 cm, 170 cm^3 and 2.73 cm^3/gm for the same parameter, respectively. The weights of chocolate cakes were slight increased by increasing flour substitution from 3 to 12% and the highest increase of weight was found when dried Jew's mallow was used.

3.7. Alkaline water retention capacity (%) of different types of produced chocolate cake during storage

Data in Table (8) describe the alkaline water retention capacity (AWRC) as an indication of staling rate or freshness of chocolate cake affected by substitution of soft wheat flour (72% extraction) by different levels of dried Jew's mallow or dried okra wastes. These results indicate that the freshness of all chocolate cake samples decreased by increasing the time of storage from zero to 56, days. All samples of the chocolate cake at different levels (3, 6, 9, and 12%) for each dried Jew's mallow and dried okra wastes were better and it recorded higher values of AWRC and the percentage of freshness value at different storage time than the control. The results also indicated that the decreased rate of freshness decreased by increased the level substitution for each dried Jew's mallow and dried okra wastes, its ranged from 24.84 to 19.92 % compared with the control which recorded 29.51% after 56 days from storage. This means that the addition of dried Jew's mallow or dried okra wastes led to retardation of staling phenomena. It is attributed to dietary fiber especially soluble fiber (mucilage). These results are in agreement with Sudha *et al.,* (2007) who reported that the increasing water absorption may be caused by the strong water binding ability.

3.8. Microbiological evaluation for the produced chocolate cake during storage

The total microbial counts for different types of chocolate cake were investigated to assess the most important factors in evaluation of the chocolate cake safety and quality. The data in Table (9) indicate that no detection of any microbial count for all samples was noticed after 14 days of storage in polyethylene package at refrigerator (6±2^{o}C). This may be due to the packaging which plays a vital role in the maintenance of the shelf life of foods. The basic function for packaging is to keep the product free from contamination (Orville, 1981). Table (9) shows that by increasing the storage period from 14 to 56 days the total bacterial and mold & yeast counts were increased. All cake samples containing dried Jew's mallow or okra waste appeared to have a decrease in the total bacterial and mold & yeast counts at different storage period. It is also noticed that decrease in these microbial count increased by increasing the substitution level of dried Jew's mallow or okra waste. Meanwhile the highest total count of microbial was for the control. Generally these counts of microorganisms in all cake samples were considerable in limits permitted in food (Davidson, 1993). This indicates that using the dried Jew's mallow or okra waste clearly reduced the microbial growth and prolongs the shelf life of chocolate cake. These results may be due to the high contents of antioxidants component in dried Jew's mallow or okra waste as mentioned by Abdel-Hameed and Hareedy (2005).

3.9. Percentages of the recommended dietary allowances (% RDA) are provided by chocolate cake produced

From the data in Table (10), it could be observed that 100 gm of chocolate cake containing dried Jew's mallow or dried okra wastes at different substitution levels (3 to 12% from soft wheat flour 72% extraction) contribute 13.42 - 40.17% of the RDA of dietary fiber for children, and 6.32-19.28% for adults that compared to control which contributed 5.93 and 3.56% for children and adults, respectively. All values of %RDA for other studied nutrient were high in all samples of the chocolate cake compared the with control as shown in Table (10).

In conclusion, the present study demonstrated that incorporation of wheat flour with dried Jew's mallow or okra wastes increased dietary fiber, nutrition value, minerals content and shelf life of produced chocolate cake. It could be recommended

Table (7): Physical properties of the produced chocolate cakes.

Physical properties	Control	Dried Jew's mallow waste substitution levels				Dried okra waste substitution levels			
	0%	3%	6%	9%	12%	3%	6%	9%	12%
Moisture (%)	20.63	26.21	26.72	30.89	32.96	26.24	26.34	31.09	33.03
Height (cm)	7.62	6.90	6.80	6.50	6.30	6.80	6.60	6.40	6.20
Weight (gm)	62.26	62.49	62.96	63.26	63.53	62.34	62.66	63.28	63.34
Volume (cm^3)	170	168	165	152	140	160	152	145	136
Specific volume (cm^3/gm)	2.73	2.69	2.62	2.40	2.20	2.57	2.43	2.29	2.15

Table (8): Percentage of alkaline water retention capacity (AWRC%) and freshness value (F.V%) of the chocolate cake treatments during storage period at 6±2 ºC in sealed polyethylene bags.

Type of cake		Storage period (days)									
		Zero time	14 days		28 days		42 days		56 days		
		AWRC (F.V=100)	AWRC	F.V	AWRC	F.V	AWRC	F.V	AWRC	F.V	***R.D 100 - F.V**
Control	0 %	270.11	248.31	91.93	226.54	83.87	214.05	79.25	190.39	70.49	**29.51**
Dried Jew's mallow waste substitution levels	3%	274.32	254.83	92.90	231.20	84.28	222.14	80.98	206.18	75.16	**24.84**
	6%	287.47	267.44	93.03	243.17	84.59	234.96	81.73	221.72	77.13	**22.87**
	9%	294.59	279.88	95.01	252.82	85.82	242.15	82.20	235.41	79.91	**20.09**
	12%	298.62	284.41	95.24	260.51	87.24	249.96	83.71	240.51	80.54	**19.46**
Dried okra waste substitution levels	3%	271.57	251.53	92.62	228.11	84.00	219.03	80.65	205.91	75.82	**24.18**
	6%	284.42	264.11	92.86	239.66	84.26	230.98	81.21	219.92	77.32	**22.68**
	9%	292.11	275.93	94.46	248.12	84.94	238.68	81.71	229.16	78.45	**21.55**
	12%	296.32	281.82	95.11	257.25	86.81	244.48	82.51	237.30	80.08	**19.92**

*R.D {rate decrease in freshness after 56 days} = (AWRC at zero time - AWRC after 56 days / AWRC at zero time) x 100.

Table (9): The total microbial count (cell/gm) of different types of chocolate cakes during storage period at 6±2 ºC in sealed polyethylene bags.

Type of cake		storage period (days)							
		14 days		28 days		42 days		56 days	
		Total bacteria	M&Y	Total bacteria	M&Y	Total bacteria	M&Y	Total bacteria	M&Y
Control	**0 %**	**ND**	**ND**	**$9x10^1$**	**$5x10^1$**	**$2x10^2$**	**$8x10^1$**	**$6x10^2$**	**$1x10^2$**
Dried Jew's mallow waste substitution levels	3%	ND	ND	$6x10^1$	ND	$9x10^1$	$3x10^1$	$2x10^2$	$6x10^1$
	6%	ND	ND	$4x10^1$	ND	$7x10^1$	ND	$1x10^2$	ND
	9%	ND	ND	$2x10^1$	ND	$5x10^1$	ND	$8x10^1$	ND
	12%	ND	ND	$1x10^1$	ND	$3x10^1$	ND	$5x10^1$	ND
Dried okra waste substitution levels	3%	ND	ND	$7x10^1$	$2x10^1$	$1x10^2$	$5x10^1$	$3x10^2$	$7x10^1$
	6%	ND	ND	$5x10^1$	$1x10^1$	$9x10^1$	$2x10^1$	$2x10^2$	$4x10^1$
	9%	ND	ND	$3x10^1$	ND	$6x10^1$	ND	$9x10^1$	$2x10^1$
	12%	ND	ND	$2x10^1$	ND	$4x10^1$	ND	$6x10^1$	ND

M &Y = Mould and yeast. ND = Not detected.

Table (10): Percentage of the *Recommended Dietary Allowances, (1989) (RDA %) # for some nutrient provided from 100g of the produced chocolate cake for children and adults.

RDA*		Control	Dried Jew's mallow waste substitution levels				Dried okra waste substitution levels			
		0%	3%	6%	9%	12%	3%	6%	9%	12%
Children (7-10) years	Protein (28 gm)	28.68	28.86	28.93	29.14	29.29	29.46	29.86	30.29	30.68
	Energy (2000 K.cal)	22.56	22.31	22.06	21.80	21.58	22.35	22.12	21.88	21.68
	Fe (10 mg)	11.70	15.70	19.80	23.70	28.40	12.80	13.20	13.90	15.0
	Zn (10 mg)	5.30	7.0	8.30	9.80	12.30	5.80	6.30	6.80	7.80
	Ca (800 mg)	8.69	9.91	11.15	12.36	13.59	9.75	10.84	11.93	13.05
	Mg (170 mg)	31.95	33.32	34.76	36.13	37.52	33.69	35.39	37.05	38.74
	DF[1] (12 g/d)	7.42	15.58	23.58	32.42	40.17	13.42	19.58	25.83	31.58
Adults (19-24) years	Protein (58 gm)	13.84	13.93	13.97	14.07	14.14	14.22	14.41	14.62	14.81
	Energy (2900 K.cal)	15.56	15.39	15.21	15.03	14.88	15.41	15.26	15.09	14.95
	Fe (10 mg)	11.70	15.70	19.80	23.70	28.40	12.80	13.20	13.90	15.00
	Zn (15 mg)	3.53	4.67	5.53	6.53	8.20	3.87	4.20	4.53	5.20
	Ca (1200mg)	5.79	6.61	7.43	8.24	9.06	6.50	7.23	7.95	8.70
	Mg (350 mg)	15.52	16.18	16.89	17.55	18.22	16.36	17.19	17.99	18.82
	DF[2] (25 g/d)	3.56	7.48	11.32	15.56	19.28	6.44	9.40	12.40	15.16

*According to Food and Nutrition Board (1989). **DF**= recommendation of dietary fiber.
DF[1] = These values for children age 7 years (Age plus five) according to Williams *et al*, (1995).
DF[2]= According to ASP(2004) showed that the recommendation for dietary fiber intake range from 25 to 30 g/d.
% RDA=Value of nutrient in sample of cake × 100 / RDA for the same nutrient.

to incorporate the mentioned material in bakery products.

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إســتخدام مصادر غير تقليدية للألياف الغذائية في تحضير كيك الشيكولاتة

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ملخص

تهدف هذه الدراسة الى بحث إمكانية الإستفادة من بعض مخلفات تصنيع الخضر كمصادر جديدة غير تقليدية للألياف الغذائية لما لها من تأثيرات مفيدة علي صحة الإنسان في الوقاية من مدى واسع من الأمراض الشائعة أهمها إرتفاع الكولستيرول والسكر وتصلب الشرايين و الإمساك في إنتاج مخبوزات صحية (كيك الشيكولاتة) حيث يتخلف عن عمليات تصنيع الخضر نسبة عالية من المخلفات والتى تصل الي 70% في الملوخية و 22% في البامية. حيث تبين أن هذه المخلفات غنية في محتواها من الألياف الغذائية و الميوسيلاج. هذا علاوة علي محتواها من العناصر الغذائية الأخري المفيدة غذائيا ومضادات الأكسدة مثل الكلوروفيلات. كما إنها خالية من الفيتات بمقارنتها بمصادر الألياف الأخري من الحبوب . وبناءا علي ذلك تم إستبدال دقيق القمح إستخراج 72% المستخدم في صناعة الكيك بالمطحون الجاف لمخلف الملوخية أو البامية عند مستويات إستبدال 3، 6، 9، 12% كلا علي حده في إنتاج كيك الشيكولاتة وتقويم الكيك الناتج كيميائيا وطبيعيا وحسيا و ميكروبيولوجيا. أظهرت نتائج التقييم الكيميائي أنه بزيادة مستويات الإستبدال بأي من مصدري الألياف السابقين يزداد المحتوي من الرماد و الألياف الغذائية و العناصر المعدنية لكل من الحديد و الزنك و الكالسيوم والماغنسيوم . كانت الزيادة طفيفة في المحتوي من البروتين و الدهن بينما قل المحتوي من الكربوهيدرات والسعرات الحرارية مقارنة مع العينة المرجعية بدون إضافة. وكان الإنخفاض في القيمة السعرية متقارب عند نفس مستويات الإستبدال لكل من المطحون الجاف لمخلف الملوخية أو البامية حيث تروواحت مابين 446,94 – 431,66 كيلوكالوري / 100 جرام مقارنة بالقيمة 451 ,20 كيلوكالوري / 100 جرام لعينة الكيك المرجعية . و بإجراء التقييم الحسى للكيك الناتج أوضحت نتيجة التحليل الإحصائي عدم وجود فروق معنوية لكل خصائص التحكيم لأنواع الكيك الناتجة حتي مستوي إستبدال 6% لكل من المطحون الجاف لمخلف الملوخية أو البامية وكانت درجة قبولهما جيد جدا بينما قل الي جيد عند مستوي إستبدال 9،12%. ووجد أن كل من الإرتفاع و الحجم والحجم النوعي في كل عينات الكيك الناتجة تتناقص بزيادة نسب الإستبدال بأحد مصدري الألياف المستخدمين بينما تزداد قيم كل من الرطوبة و الوزن . كما وجد أنه بزيادة نسب الاستبدال بإستخدام المطحون الجاف لمخلف الملوخية أو البامية ينخفض معدل النقص في الطزاجة ويقل المحتوي الميكروبى والذي كان في الحدود المسموح بها لكل عينات الكيك الناتجة مما يعطي مؤشرا لإمكانية زيادة مدة الحفظ . وكذلك أوضحت النتائج أن كل 100جم من الكيك المدعم بمصادر الألياف السابقة يساهم بحوالي **13,42- 40,17%** من الإحتياجات اليومية من الألياف الغذائية للأطفال مقارنة ب **5,93%** لعينة الكيك المرجعية و يساهم بحوالي **6,44 - 19,28%** بالنسبة للبالغين مقارنة بالنسبة **3,56 %** لعينة الكيك المرجعية وكذلك كانت تلك العينات هي الأعلي في قيم المغذيات الأخري المدروسة. وتوصي نتائج هذه الدراسة بدمج المطحون الجاف لمخلف الملوخية أو البامية مع دقيق القمح 72% لعمل مخبوزات صحية عالية القيمة الحيوية.

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