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Utilization of food waste as fiber sources to produce special kinds of cake for spa

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Abstract

The investigation was carried out to study the feasibility of producing special cereal products such as cakes intended for people suffering from obesity and over weight in spa. Wastes such as carrot pomace , orange peel, corncobs, watermelon peel and cantaloupe peel powders were used as a dietary fiber sources to replace 5, 10 and 20% of wheat flour in the formulations of cake. The produced fiber substituted cakes achieved a reduction in calories. Sensory evaluation showed that all high fiber substituted cake samples were significantly lower than control cake in all sensory characteristics, except cake samples prepared by 5% carrot pomace had no significant differences (P>0.05) in crust color, texture, odor, volume and overall acceptability characteristics with control cake. The results indicated that replacement of fiber with wheat flour substitutes caused a significant decreased in cake properties. However, there were significant differences between cake samples containing the same type of fiber source at 5, 10 and 20% replacement levels. The highest score in the same type of fiber source for all attributes were achieved in 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 achieved in cake samples with fiber source at 20% replacement level.

Key words: dietary fiber, carrot pomace, orange peel, corncobs, watermelon peel and cantaloupe peel cake.

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INTRODUCTION

Many of the early popular spas were built around natural hot springs, and their programs emphasized sun, fresh air, and exercise under the supervision of trained health personnel. Today's health resort is somewhat more sophisticated, offering any thing from weight reduction programs, including supervised diets, and tailored exercise regimen, to behavioral modification programs. Some spa even features "life style centers" to assist guests in developing ways to live healthier lives (**Gee *et al.*, 1997**).

In Egypt, a great opportunity has been provided to resorts through the catering for the need of weight control. Since observation indicates that, Egyptian people of all ages and both genders-especially those with high disposable income have become more conscious about their weights. However, there is a remarkable lack in health services and facilities that could be provided by resorts for this new segment; people who have a desire to reduce their weights (**El Dief, 2001**).

Obesity:

To define the obesity and overweight, **Stanfield (1992)** agreed with **Williams (1995)** in that, a value of 20 percent above the desirable weight is the determining point of obesity (desirable weight is usually obtained from the height and weight charts, published by the Metropolitan Life Insurance Company.).

Obesity is a multifactor and complex affectation that as characterized by a long-term energy intake above expenditure (**Doucet and Tremblay, 1997**).

The World Health Organization (**WHO, 2003**) defines "overweight" as a (Body Mass Index) BMI equal to or more than 25, and "obesity" as a BMI equal to or more than 30. These cut-off points provide a benchmark for individual assessment, but there is evidence that risk of chronic disease in populations' increases progressively from a BMI of 21.

Causes of obesity:

Bray (1991) explained that, the average adult male eats nearly 1 million kcal/yr and expends essentially the same amount. An error of 1.0% (10000 kcal/yr more intake than expenditure) would increase the body weight by 1 kg every year or 10 kg (22 lb) per decade.

Some causes, such as overeating and physical inactivity, might be within a person's control, and some, such as genetics are beyond it **(Whitney and Rolfes, 1999).**

Modern technology proliferation showed an impact on obesity development. Using motor vehicles and spending hours watching T.V made the life style sedentary **(Blumenthal *et al.*, 2002).**

The report of World Health Organizations **(WHO, 2003)** declared that increased consumption of more energy-dense, nutrient-poor foods with high levels of sugar and saturated fats, combined with reduced physical activity, led to obesity rates risen three-fold or more since 1980 in some areas of North America, the United kingdom, Eastern Europe, the Middle East, the pacific Islands, Australia and China.

Many factors appeared to indicate their influence on development of obesity these include the Behavioral, Psychological, and Social and economic factors are some examples

High–fiber foods take longer to eat, which increases the feeling of satiety; they slow gastric emptying, thereby increasing the feeling of fullness; they decrease serum insulin concentrations, thereby decreasing food intake because insulin stimulates appetite; they decrease the absorption of nutrients, which decreases energy availability; they may increase rates of dietary thermogenesis; their fermentation products, such a short–chain fatty acids, may decrease food intake; they stimulate the release of peptides that modify eating behavior; and they may enhance adherence to the diet **Abd El Hafez (2005).**

In fact, weight loss programs with any degree of success integrate diet with exercise, frequently with behavior modification and always with nutritional

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education and possibly psychological support. When these approaches fail to bring about the desired reduction in weight, medication may be added to the program, and in the case of morbid obesity, surgical intervention may be required as reported by **Mahan and Arlin (1992)**.

(Mc Ardle *et al.*, 1994 and Mullen *et al.*, 1996) mentioned that the energy balance equation in the direction of weight loss, the following approaches can be considered:-

- Decrease caloric intake below the daily energy requirements through a particular diet.
- Maintain normal caloric intake and increase energy expenditure through additional physical activity above the daily energy requirements.
- Combine both methods by decreasing daily caloric intake and increasing daily energy expenditure.

Dietary fiber

Dietary fiber is defined as an indigestible fraction, which contains oligosaccharides and resistant starches, resistant proteins, and associated compounds such as polyphenols **(Davidson and McDonald, 1998)**. Most dietary fibers are components of the cell wall polysaccharides, which are resistant to digestion by the alimentary enzymes of humans **(Kotcharian *et al.*, 2004)**. Dietary fiber components are usually grouped into two major classes: water-soluble (pectins, gums) and water-insoluble (cellulose, lignin, some of the hemicellulose) **(Thebaudin and Lefebvre, 1997 and Grigelmo *et al.*, 1999)**.

Sources of dietary fiber:

Carrot pomace, which is fiber-rich, is available in large quantity in juice production; the carrot insoluble fiber-rich fraction could be a promising source of food fiber or as a low calorie bulk ingredient in functional food applications **Chau *et al.* (2007)**.

The carrot is an important root vegetable and is often used for juice production. In many countries, a steady increase of carrot juice consumption has been reported by **(Schieber *et al.*, 2001)**.

Corncobs are an important by-products of the sweet corn processing industry that have been either used as an animal feed or are returned to the field **(Inglett, 1970)**.

In contrast with other types of fruits, citrus fruits have a small edible portion and large amounts of waste material such as peels and seeds. Therefore, citrus processing produces a considerable amount of by-products, which are a problem since the plant material is usually prone to microbial spoilage and are commonly used in animal feed or fertilizer **(Famyima** and **Ough, 1982; Nikolic, *et al.*, 1986)** however some of these by-products could also be useful to the food industry. Most of these materials from citrus by-products could be used as functional ingredients when designing healthy foods (functional foods), especially non-digestible carbohydrates (dietary fiber) and bioactive compounds (ascorbic acid and flavonoids) **(Marín *et al.*, 2002** and **Puupponen *et al.*, 2002)**.

Moreover, fibers from citrus fruits have an additional advantage over dietary fibers from other sources due to the presence of associated bioactive compounds (i.e. flavonoids and vitamin C) with antioxidant properties. **Fernández *et al.* (2004)**.

Physiological properties of dietary fiber.

In recent years, fiber has become a buzz word among the general public, food processors, and ingredient suppliers because of its role in nutrition and reducing calories of foods. We have abundant information today relating the consumption of fiber to healthy living **(Scala, 1974; National Cancer Institute, 1984** and **Ang** and **Miller, 1991)**. Certain fibers have also been shown to lower serum and tissue cholesterol levels.

Levine *et al.* (1989) found that, high fiber diets tend to be lower in fat and thus lower in calories and should be appropriate for weight control and high fiber cereals eaten at breakfast lowered calorie intake. Consumption of this fiber delays gastric emptying **(Low, 1990** and **Roberfroid, 1993)** and expands the effective unstirred layer, thus slowing the process of absorption once in the small intestine (**Blackburn *et al.*, 1984**).This in turn can cause an extended feeling of fullness (**Bergmann *et al.*, 1992**).A slower emptying rate means delayed digestion and absorption of nutrients (**Ritz *et al.*, 1991** and **Roberfroid, 1993**).

Dietary fiber refers to parts of fruits, vegetables, crops, nuts and legumes that cannot be digested by humans. It is a well-established fact that the consumption of adequate amounts of dietary fiber reduces significantly the risk of degenerative diseases, including diabetes, obesity, coronary heart disease, bowl cancer and gallstones (**Ahmad, 1995** and **Horn, 1997**).

Various fiber sources have been developed for use in cereal foods to provide more fiber. Low dietary fiber intake has been associated with a variety of diseases such as diverticular disease, constipation, appendicitis, diabetes, obesity, coronary heart disease, and bowl cancer (**Spiller** and **Amen, 1975** and **Burton, 2000**)

Dietary fiber promotes regularity and is being studied by for its potential to reduce the risk of colon / rectal cancers (**Dreher, 2001**).

The (USA) Institute of Medicine set a standard for protection against heart disease by consumption of 38 g total dietary fiber /day for young men (**Monro, 2004**). **Romo *et al.* (2008)** reported that the recommended amount of dietary fibers (DF) intake per adult is of 25–38 g.

Cakes:

Shafer and **Zabik (1978)** compared the effect of replacing 30% of the flour with different dietary fiber sources (wheat, corn, soy, and oat brans) on raw batter and final cake quality parameters measured both instrumentally and sensorially. Cakes with wheat bran had little effect on cake quality, cakes made from corn bran had the largest volume of any cake, and cakes with soy and oat bran were scored with a poor flavor. The suitability of apple fiber (4%) in comparison to wheat and oat brans was studied by **Chen *et al.* (1988)**.

Hegazy *et al.* (1991), used peanut hull flour (49% fiber content) in preparation of low-calorie cakes by replacing wheat flour at different levels (10, 20 and

30%). Cakes were subjected to physical and sensory evaluation. Flavor and general acceptability of cakes prepared with 30% peanut hull flour was significantly less than that of cakes prepared with 10 and 20%, which scored values closer to those of control cakes. The conclusion was that peanut hull flour could be useful for preparation of dietetic foods. Effects of hot air dried carrot residue as a partial flour replacement (5, 10 and 15%) on characteristics and staling of cakes during storage at 20 °C for 10 days were studied **(Kim, 1998).** The most effective replacement levels for minimizing staling during storage were in the order: 5 greater than 10 greater than 15%. Sensory analysis indicated that 5% replacement caused no significant changes other than crust color, in cakes compared to control, while 10% replacement significantly influenced crust color, crumb color, crumb texture and mouthfeel.

Kim (2000) used biji powder (a by-product from manufacture of soymilk or tofu) as a dietary fiber source in the production of cakes. Replacement of flour by 20% biji caused a decrease in specific volume and hardness. Sensory analysis showed that crumb color, crumb texture, moistness, softness and overall preference were influenced significantly by the replacement of flour with 10 – 20 % biji. Cakes with 10 – 20 % biji powder were being described as coarse, dry and rough-However, there was no difference in softness and overall preference of the cake prepared with 5% replacement compared to the control. Isolated fibers from wheat, pineapple and field bean seed hulls were included (5% w/w) in a sponge cake preparation without altering the volume and sensory properties of the final product **Grigelmo *et al.* (2001).**

The major purpose of this research is to study:

- Producing some special foods for spa, to help people suffering from obesity and over weight, such as high fiber cereal products using the wastes i.e. carrot pomace ,orange peel, corncobs, watermelon peel and cantaloupe peel powders,.
- Organoliptic evaluation of these cereal products.

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MATERIALS AND METHODS

Materials:

- **Wheat flour:** Wheat flour (72 % extraction) was obtained from Five Stars Mills Co., EL-Suez, Egypt.
- **Dietary Fiber Sources:** carrot pomace, orange peel, peel of melon (Cantaloupe) and peel of watermelon were obtained from kitchen of Ras-Sudr Beach Inn hotel, South Sinai, Egypt, produced during food and beverages preparation. Corncobs were obtained from local farms, Fayoum, Egypt.
- **Eggs, skim milk powder, dry yeast, bread improver, sugar, salt, margarine, vegetable oil (corn oil) and baking powder (B.P):** All these materials were purchased from the local market in Giza.

Methods:

Preparation of dietary fiber sources:

Dietary fiber sources (carrot pomace, orange peel, peel of melon (cantaloupe) and peel of watermelon) powders were prepared as the following:

Carrot and all the kitchen wastes were washed, and chopped fairly thinly. The materials were dried in cabinet dryer at an airflow rate and temperature of 80 m /hrs and 60–65 °C, respectively for 24 hrs. After drying the pieces of kitchen waste and corn cobs were ground separately using a Maxy Hermetic Mill Grinder, patent N: 53985 B, Italy and sieved to produce the grade of flour (by using sieve No. 60 mesh) required.

Cake processing:

- **Control cake:**

High- ratio cakes (reach cake) types were processed according to the methods described in AACC (2002) with some modifications as follows:

All dry ingredients and egg were weighted using an electronic scale accurate to 0.1 g. The water was measured in a 100 ml graduated cylinder.

Table (A): Cake formula

1.	Flour	100gm
2.	Margarine	50 gm
3.	B.P	4 gm
4.	Water	98 ml.
5.	Vanilla	0.02 gm
6.	Sugar	140 gm
7.	Egg	60 gm
8.	Skim milk powder	12gm

The flour, baking powder and salt were sifted together, margarine were put in a medium-mixing bowl and creamed using a handheld electric mixer for 1 min at high speed for all mixing, and then sugar was added and mixed for additional 6 min. The vanilla was added to the egg. Egg was then added to the creamed mixture and mixed for an additional 4 min one third of the flour mixture and third of the water was added and mixed for 45 sec this was repeated twice. The mixing times were kept consistent for each sample preparation. The batter was poured into metal cake pans that were lightly coated with vegetable oil spray. The samples were baked at 180 °C for 35 min and were removed from the pans after cooling for 15 min. Cake samples were placed on individually coded square sampling dishes. The samples were placed on a tray and simultaneously presented to the panelists.

- **Preparation of cake product by replacement of wheat flour (WF) 72% ext. with dietary fiber sources:**

The formulations of cake control (Table A), flour-substituted cakes, in this mix, the dietary fiber sources powder used as a partial replacement for wheat flour in cake production at levels of 5, 10 and 20%.

Analytical methods:

Quality characteristics of cake:

Cake was organoleptically evaluated for taste, odor, crust color, crumb color, volume and texture. The evaluation was carried out according to the method of **Faridi and Rubenthaler (1984).**

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Statistical analysis:

All data collected from results of the sensory evaluation of baked products, were subjected to applying analysis of variance using (Microsoft office- excel 2003) followed by multiple comparisons using least significant difference (LSD) analysis, according to (**Spiegel and Stephens 2008**).

RESULTS AND DISCUSSION

Organoleptic evaluation:

The sensory evaluation of high fiber cake samples were evaluated. Ten panelists evaluated the products under investigation for their appearance, crust color, grains, texture, crumb color, taste, odor, volume and overall acceptability. The mean values were statistically analyzed using analysis of variance and least significant difference (LSD). In general, all cake samples were significantly different from control sample for all sensory properties.

The results indicated that replacement of wheat flour caused a significant decrease in cake properties scores.

- Sensory evaluation of fiber substituted cakes at 5, 10 and 20% replacement levels.

The results in Table (1 and 2) and illustrated in Figs. (1 and 2). showed that all high fiber substituted cake samples were significantly lower than control sample in all sensory characteristics i.e. appearance, crust color, texture, grains, taste, odor, crumb color, volume and overall acceptability, except cake samples prepared by 5% carrot pomace had no significant differences ($P>0.05$) in crust color, texture, odor, volume and overall acceptability characteristics with control sample. The results indicated that replacement of fiber with wheat flour substitutes caused a significant decreased in cake properties. However, there are significant differences between cake samples containing the same type of fiber source at 5, 10 and 20% replacement levels. 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 appearance, samples prepared at 5% level by using carrot pomace have a slight higher score (8.5) than the corresponding one of 5% orange peel (8.3), but the lowest score was that (4.1) for sample prepared with 20% cantaloupe peel compared with control sample scored (9.2). There are no significant differences (P>0.05) between cake samples substituted with carrot pomace, orange peel and corncobs at 5 and 10% replacement level, respectively.

Concerning crust color, the obtained values for 20% fiber substitution level by using cantaloupe peel and watermelon peel were the lowest score at (3.6) and (4.3), respectively. The control sample had the highest score (9.3), followed by 5% carrot pomace (8.7) and 5% corncobs (8.3), then 5% orange peel (8.2) and 10% carrot pomace (8.1), respectively.

For texture, the control sample was scored (14.3) and prepared sample by using 5% carrot pomace (13.7) had no significant differences (P>0.05). While the sample of orange peel was scored (13.1), otherwise, the two samples prepared by using watermelon peel and cantaloupe peel had the lowest scores at 20% replacement level by (7.2) and (7.1), respectively.

Concerning grain, the obtained values for 5 and 20% fiber substitution level by using carrot pomace, orange peel, corncobs, watermelon peel and cantaloupe peel as fiber sources were(13.4), (12.7), (12.1), (10.7) and (10.6) at 5% replacement level and (8.9), (8.3), (7.4), (5) and (4.7), at 20% replacement level, respectively, compared with control scored (14.1).

Statistical analysis indicated that all treatments are significantly different from control sample at every supplement levels, except samples contain 5% carrot pomace in odor attribute. Control sample scored 14.2 and 13.8, followed by 5% carrot pomace (12.8) and (13.2), while the lowest scores (4.2) and (5.3) for cantaloupe peel at level 20% for taste and odor attributes, respectively.

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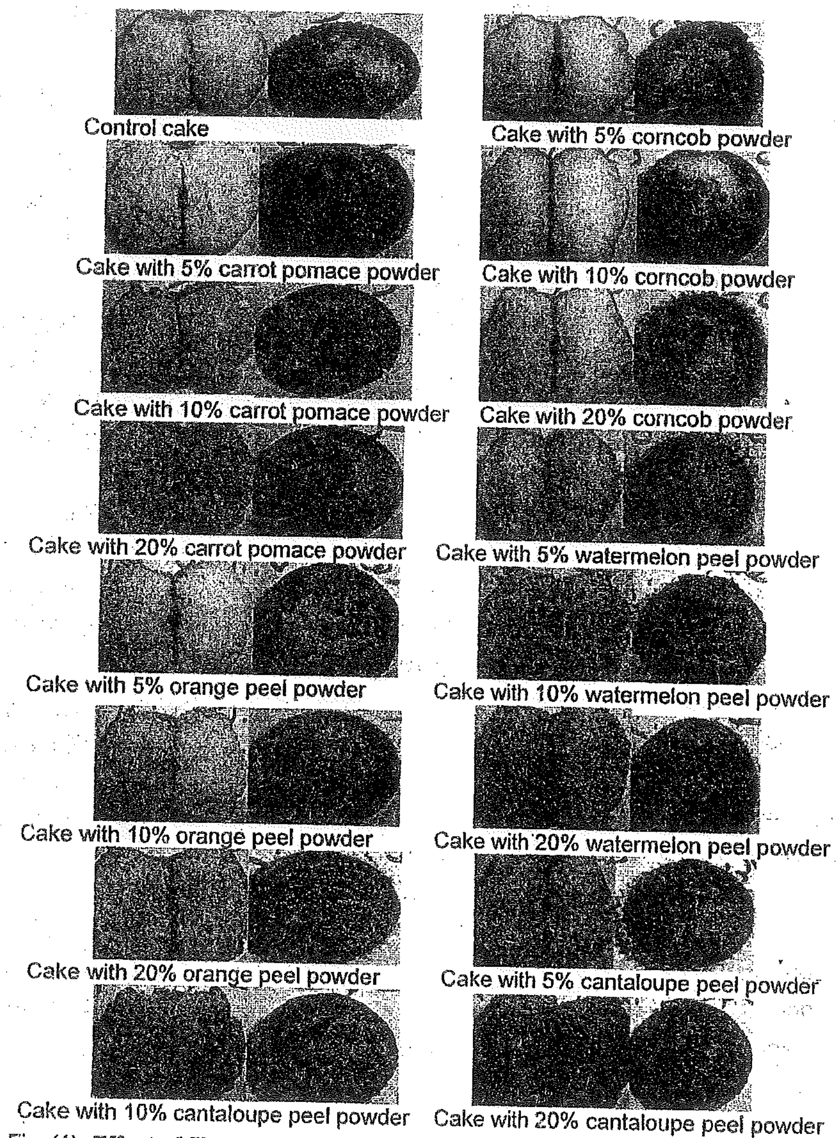

Fig. (1): **Effect of fiber sources on sensory characteristics in cakes**

Regarding crumb color property, control cake had the highest score of (9.5), followed by that contains 5 % carrot pomace (8.8), then 5% corncobs (8.5). While, the lowest score was 3.2 for the sample contain 20% cantaloupe peel.

Concerning volume, control sample scored (9.3). In comparison with cake samples produced with different levels of fiber sources, 5% carrot pomace had the highest volume characteristics with score value of (8.7), followed by cake contain 5% orange peel (8.2).

In general, replacement of wheat flour with cantaloupe peel and watermelon peel at 10 and 20% levels caused non-significant deterioration in cake samples properties, especially taste, odor and overall acceptability. Control sample had the highest score of overall acceptability, followed by 5% carrot pomace with no significant differences ($P>0.05$). There are no significant differences in overall acceptability between cake samples containing 5% orange peel and 10% carrot pomace, in addition, between 10% carrot pomace and 5% corncobs. Also, cake containing carrot pomace at 20% and watermelon peel at 5% had no significant differences in overall acceptability. The above results are in agreement with those obtained by **Abd el-Latife (1990)**; who reported that statistical analysis of sensory evaluation of the control cakes versus cakes containing apple pomace and carrot pomace powders showed insignificant differences until 5% replacement level. The above results are in agreement with those obtained by **Shamas (2001)**; who found that the addition of dry carrot to cake had insignificant effect until 6.95% for cake characteristics. While increase the percentage of carrot showed significant decrease in all sensory attributes of cake compared with control. Also, with **El-Hadidi(2006)**; who found that the increased of percentage of dry carrot showed significant decreased in all characteristics of the produced cake compared with control.

Table (1): Summary of ANOVA tables for cake sensory evaluation data.*

Source of Variation	df	F									
		F critical (α=0.05)	appearance	crust color	grains	texture	crumb color	taste	odor	volume	overall acceptability
Concentration	3	2.7	234.9	251.1	853.3	567.9	485.2	745.9	518.9	272.8	2994.2
Source	4	2.4	19.8	43.0	107.5	39.1	152.2	78.8	118.9	12.1	1098.4
Interaction	12	1.8	3.2	7.6	13.7	4.7	19.7	10.0	15.6	2.2	157.4
Within	180										
Total	199										

*There were significant differences ($P<0.05$) between variance in cake samples substituted with fiber sources.

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Table (2): Organoleptic evaluation of fiber-substituted cakes at 5, 10 and 20% replacement levels.

Blends	Substitution levels %	Appearance 10	Crust color 10	Texture 15	Grain 15	Taste 15	Odor 15	Crumb color 10	Volume 10	Overall acceptability 100
control	0%	9.2±0.25^{a}	9.3±0.21^{a}	14.3±0.26^{a}	14.1±0.23^{a}	14.2±0.25^{a}	13.8±0.20^{a}	9.5±0.17^{a}	9.3±0.21^{a}	93.7±0.54^{a}
Carrot pomace powder	5%	8.5±0.31^{b}	8.7±0.21^{ab}	13.7±0.21^{ab}	13.4±0.27^{b}	12.8±0.25^{b}	13.2±0.25^{ab}	8.8±0.25^{b}	8.7±0.21^{ab}	92.7±0.63^{a}
	10%	7.8±0.25^{cd}	8.1±0.23^{bcd}	12.4±0.16^{de}	12.4±0.27^{c}	11.3±0.37^{de}	12.4±0.27^{c}	8.3±0.21^{bc}	8±0.21^{cd}	88.2±0.55^{bc}
	20%	6.4±0.31^{e}	7.2±0.20^{e}	9.4±0.34^{i}	8.9±0.31^{e}	8.2±0.29^{g}	10.6±0.34^{ef}	7.4±0.16^{e}	6.6±0.22^{fg}	70±0.60^{g}
Orange peel powder	5%	8.3±0.21^{bc}	8.2±0.20^{bc}	13.1±0.28^{bc}	12.7±0.15^{c}	12.2±0.25^{bc}	12.9±0.23^{bc}	8.1±0.18^{cd}	8.2±0.20^{bc}	90±0.60^{b}
	10%	7.6±0.16^{d}	7.7±0.21^{cde}	11.8±0.25^{efg}	11.2±0.20^{d}	10.8±0.25^{ef}	11.2±0.29^{de}	7.3±0.15^{e}	7.4±0.27^{de}	83.9±0.60^{d}
	20%	6.1±0.23^{e}	6.2±0.25^{f}	9.3±0.26^{i}	8.3±0.30^{e}	7.8±0.29^{gh}	8.7±0.37^{g}	5.7±0.21^{g}	6±0.30^{g}	67±0.77^{h}
Corncobs powder	5%	8.2±0.25^{bc}	8.3±0.21^{bc}	12.7±0.21^{cd}	12.1±0.18^{c}	12±0.33^{cd}	13.1±0.23^{b}	8.5±0.17^{bc}	8±0.21^{cd}	87.1±0.67^{c}
	10%	7.6±0.22^{d}	7.4±0.22^{e}	11.2±0.20^{g}	10.8±0.20^{d}	10.2±0.25^{f}	11.5±0.27^{d}	7.7±0.21^{de}	7±0.21^{ef}	78.5±1.05^{e}
	20%	5.3±0.21^{f}	6±0.15^{f}	8.2±0.20^{j}	7.4±0.22^{f}	7±0.39^{i}	8.8±0.25^{g}	6.1±0.23^{fg}	4.9±0.18^{h}	60.7±1.51^{i}
Watermelon peel powder	5%	7.5±0.17^{d}	7.5±0.27^{de}	11.9±0.23^{ef}	10.7±0.21^{d}	10.4±0.16^{f}	10.5±0.17^{f}	6.5±0.17^{f}	7.9±0.18^{cd}	72.4±0.72^{f}
	10%	6.5±0.17^{e}	6.1±0.28^{f}	10.3±0.21^{h}	8.7±0.21^{e}	7.7±0.15^{ghi}	8.6±0.16^{g}	4.9±0.18^{h}	7.1±0.23^{ef}	51.5±1.10^{j}
	20%	4.7±0.30^{fg}	4.3±0.37^{g}	7.2±0.20^{k}	5±0.30^{g}	4.8±0.29^{j}	6±0.21^{h}	3.6±0.16^{i}	5.1±0.23^{h}	29±0.58^{k}
Cantaloupe peel powder	5%	7.5±0.17^{d}	7.4±0.16^{e}	11.3±0.26^{fg}	10.6±0.16^{d}	10.1±0.28^{f}	10.2±0.20^{f}	6.4±0.16^{f}	7.9±0.18^{cd}	70±0.42^{g}
	10%	6.2±0.25^{e}	5.9±0.18^{f}	10.1±0.23^{h}	8.4±0.22^{e}	7.4±0.27^{hi}	8.7±0.26^{g}	4.7±0.15^{h}	7±0.15^{ef}	50±0.79^{j}
	20%	4.1±0.23^{g}	3.6±0.27^{h}	7.1±0.18^{k}	4.7±0.21^{g}	4.2±0.20^{j}	5.3±0.30^{i}	3.2±0.20^{i}	4.9±0.23^{h}	27.5±0.83^{k}
L.S.D		0.66	0.63	0.67	0.65	0.75	0.68	0.51	0.60	2.08

Means, within the same column, with the same letters are not significantly different ($P < 0.05$).

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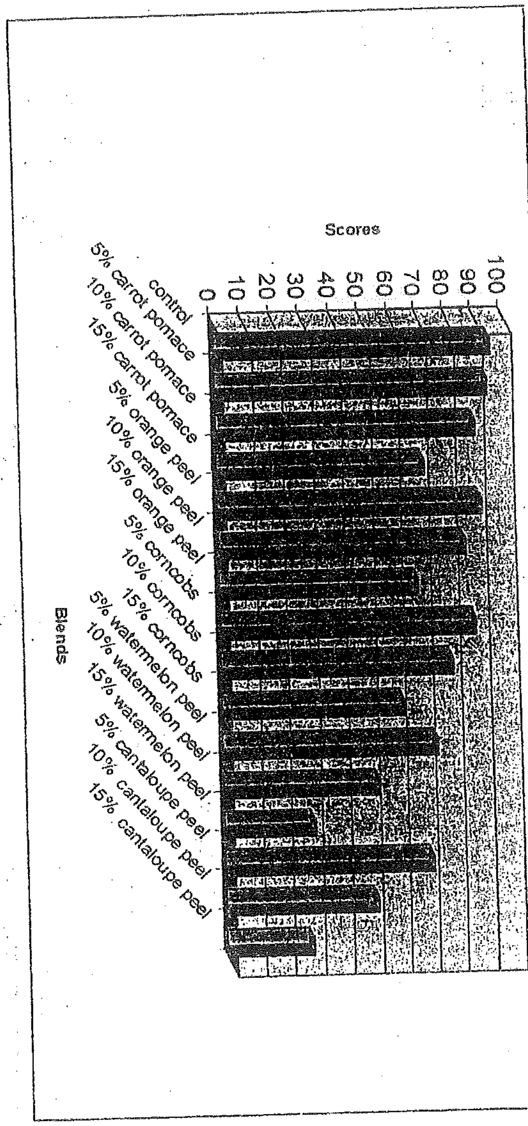

Fig. (2): Effect of fiber sources on overall acceptability of substituted cakes.

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Table (3): Effect of substitution levels of fiber sources on organoleptic characteristics of cake samples.

Substitution	Appearance 10	Crust color 10	Texture 15	Grain 15	Taste 15	Odor 15	Crumb color 10	Volume 10	Overall acceptability 100
0%	9.2±0.11 a	9.3±0.09 a	14.3±0.11 a	14.1±0.10 a	14.2±0.11 a	13.8±0.09 a	9.5±0.07 a	9.3±0.09 a	93.7±0.23 a
5%	8±0.11 b	8.02±0.12 b	12.54±0.16 b	11.9±0.18 b	11.5±0.19 b	11.98±0.21 b	7.66±0.17 b	8.14±0.09 b	82.44±1.37 b
10%	7.14±0.13 c	7.04±0.16 c	11.16±0.15 c	10.3±0.24 c	9.48±0.26 c	10.48±0.25 c	6.58±0.23 c	7.3±0.11 c	70.42±2.37 c
20%	5.32±0.17 d	5.46±0.22 d	8.24±0.18 d	6.86±0.27 d	6.4±0.26 c	7.88±0.31 d	5.2±0.24 d	5.5±0.14 d	50.84±2.70 d
L.S.D	0.30	0.28	0.30	0.29	0.33	0.30	0.23	0.27	0.93

Means, within the same column, with the same letters are not significantly different ($P < 0.05$).

Table (4): Effect of fiber sources type on organoleptic characteristics of cake samples.

Fiber sources (powder)	Appearance 10	Crust color 10	Texture 15	Grain 15	Taste 15	Odor 15	Crumb color 10	Volume 10	Overall acceptability 100
Carrot pomace	7.98±0.21 a	8.33±0.16 a	12.45±0.33 a	12.2±0.35 a	11.63±0.38 a	12.5±0.23 a	8.5±0.16 a	8.15±019 a	86.15±1.55 a
Orange peel	7.8±0.21 a	7.85±0.21 b	12.13±0.32 a	11.58±0.36 b	11.25±0.39 b	11.65±0.34 b	7.65±0.24 c	7.73±0.23 b	83.65±1.67 b
Corncobs	7.58±0.26 b	7.75±0.22 b	11.6±0.38 b	11.1±0.40 c	10.85±0.45 c	11.8±0.33 b	7.95±0.22 b	7.3±0.28 c	80±2.04 c
Watermelon peel	6.98±0.28 c	6.8±0.32 c	10.93±0.43 c	9.63±0.54 d	9.28±0.56 d	9.73±0.46 c	6.13±0.36 d	7.35±0.26 c	61.65±3.87 d
Cantaloupe peel	6.75±0.32 c	6.55±0.35 c	10.7±0.43 c	9.45±0.56 d	8.98±0.60 d	9.5±0.50 c	5.95±0.38 d	7.28±0.27 c	60.3±3.93 e
L.S.D.	0.33	0.32	0.33	0.32	0.37	0.34	0.26	0.30	1.04

Means, within the same column, with the same letters are not significantly different ($P < 0.05$).

- **Effect of substitution levels of fiber sources on organoleptic characteristics of cakes:**

Data in Table (3) showed that all high fiber substituted cake at 5, 10 and 20% replacement levels were significantly lower than cake control in all sensory characteristics i.e. appearance, crust color, grains, texture, taste, odor, crumb color, volume and overall acceptability. The cake samples at 0% substitution level (cake control) had the highest score, followed by 5% substitution level of all treatments for all attributes, then 10% substitution level for every type of fiber sources in all sensory characteristics. The cake samples at 20% substitution level had the lowest score. There are no significant differences (P>0.05) between cake samples at 5, 10 and 20% substitution levels.

- **Effect of fiber sources type on organoleptic characteristics of cakes:**

Data in Table (4) showed that all high fiber substituted cake were significantly (P<0.05) lower than cake samples containing carrot pomace in all sensory characteristics i.e. crust color, grains, odor, crumb color, and overall acceptability, except, appearance and texture, which were no significant differences (P>0.05) with cake prepared by using orange peel. On the other hand, all sensory characteristics, except, overall acceptability in cake samples contain watermelon peel and cantaloupe peel and also, (between crust color and odor for orange peel and corncobs) had no significant differences (P>0.05).

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Recommendations

The obtained data exhibited that a dietary fiber sources (carrot pomace, orange peel, and corncobs powders) could be suggested as substituted materials for flour, in producing baked products such as cakes.

This suggestion could be applied as a therapeutic nutrition for the spa that are looking for weight control combined with recreational programs for people suffering from obesity and over weight. This may be due to high fiber and low calories contents of these materials and its therapeutic effect.

The product must have a large announce program to give a good idea for its importance to spa resorts operators of health holiday markets.

The announcement must take place in the mass media; i.e. T.V., Radio, newspaper and magazines.

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