J. Agric. Sci. Mansoura Univ., 29 (11): 6411 - 6419, 2004

PRODUCTION OF LOW FAT AND HIGH FIBER CAKE.

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ABSTRACT

In this study, it was used 75% of sugar in cake were substituted by stevioside to give the equivalent sweetness of replaced sugar. Shortening was also substituted at 50% level by maltodextrin gel. Wheat flour was replaced at 5, 10, 15 and 20% levels by okara, corn bran and peanut hulls as fiber sources. Chemical, physical measurements and sensory characteristics of produced cakes were studied. Increasing the level of fiber sources from 5 to 20% lead to a decrease in cakes volume for all fiber sources and its lead to an increase in the dietray fiber content of cakes as high 24 times of the control. Adding 5 and 10% levels of fiber sources into sugar-fat substitution cake resulted an acceptable cakes with reduction in calories and subtitution of weat flour with okara till 15% improved cake quality.
Keywords: Stevioside, Dietray fiber, Fat substitutes, cakes.

INTRODUCTION

In Egypt, it was roughly estimated that ther is about 5 million diabetics (El-Atawy *et al*, 1989). In addition, approximately 60% of the causes of diabetics can be controlled a dequately by diet alone about 20% will need an oral hypoglycemic drug and another 20% mainly in younger patients are obliged to adhere to a life long dietary regime (Sharaf, 1990).

High fat intake is associated with increased risk for obesity and some types of cancer, however saturated fat intake is associated with high blood cholesterol and coronary heart disease. Also, high fat diets have been associated with the development of diabetes and gallstone (Astrup *et al.*, 2000).

Cereals and legumes are the major sources of dietary proteins in all developing countries, as animal proteins are considared to be expensive. It is known that cereals and legumes are rich not only in proteins, but also in other nurients such as starch, oils, vitamins, minerals and dietary fiber.

High fiber diets are associated with the prevention and treatments of some diseases such as constipation, diverticular diseases, colonic cancer, coronary heart disease and diabetes (Tinker *et al.*, 1991; Anderson *et al.*, 1994 and Cassidy *et al.*, 1994). Although numerous health organizations suggest increasing the consumption of dietary fiber, they sterss upon specific recommendations of 30-45g per day(Bonfield, 1985; Schweizer and Wursch 1991). Unfortunately people in developed countries currently only eat about 11-12g per day (Saura-Calixto, 1993).

Okara contains high protein, fat and crude fiber. It is rich in dietary fiber considered as useful ingredent in the manufacture of low energy food, (Matsuo and Hitomi, 1993).

Sweeteners are important ingradients in all types of backed products. They are required for their inherent sweetness in cakes and other sweet

goods. There are two main groups of sweeteners, caloric and non-caloric sucrose subsitution. The non caloric sweeteners do not form an uniform chemical group, this due to the fact that most of non caloric sweeteners of these sweeteners ranges from 30 to about 200 times the sweetenss of sucrose (Nollet, 1992).

Stevia suger is a sweetening substances which is extracted and refined fom leaves of stevia (*Stevia Rebaudiana Bertoli*). The sweetening strength of stevia sugar is about 200-300 times more than that of sucrose, yet its caloric production is only 1/300 of that of sucrose. The acceptable daily intake is 7.938mg/kg human body weight of stevioside (Higginbotham, 1983 and Xili *et al.*, 1992).

There is a need to include dietary fiber in diets to reduce the total caloric intake and to provide more bulk to decrease intraluminal pressures of the gastrointestinal tract for diverticular diseases, irritable bowel syndrome and the like (Kimura, 1977). In addition, some types of plant fiber can lower serum cholesterol level (Forsyth *et al.*, 1976). The values of incorporating higher levels of dietary fiber to produce low calorie food products were evident (Sosulski and Wu, 1988 and Azlyn *et al.*, 1989).

Thus, the aim of this investigation is to evaluate the use of a combination between sugar substitutes and fat subsitutes with high fiber formula to produce low caloric cakes. Corn bran, okara or peanut hulls as fiber sources replaced 5, 10, 15 and 20% of wheat flour.

MATERIALS AND METHODS

Materials:

-Wheat flour (72% extraction rate) Commercial wheat flour was provided from Cairo Co. for Milling and Bakery, Cairo, Egypt.

-Eggs, Fresh milk, Sugar, Salt, Shortening and Baking powder were purshaced from the local market, Cairo.

-Corn maltodextrin (Starch and Glucose Manufacturing Co., Cairo).

-Corn bran (North Cairo Mills. Co., Cairo).

-Peanut hulls (Peanut dehullers, Mansouria, Giza).

-Okara extracted from soybean milk, was obtained from Soya Center, Food Technology Research Institute, Agriculture Research Center, Giza, Egypt.

-Stevioside, 200-300 times as sweet as sucrose (Nutrition Institute, Cairo, Egypt.

Methods:

Experimental treatments:

-Corn bran and peanut hulls were washed and dried according to the method described by Collins and Post (1981).

-Okara extracted from soybean milk, was air dried at 40°C.

Then, all fiber sources,i.e. corn bran, okara and cleaned dried peanut hulls were ground separately using Maxy Hermetic Mill Grinder, Patent N:53985B. Italy.

Maltodextrin gel (25%), used as a fat replacer was prepared using the method of Sobezynska and Setser (1991).

-Cake preparation: Cake was prepared using the formulation and the method outlined by A.A.C.C. (1983). In such formulation, sugar content was substituted at 75% level by using sugar substitutes (stevioside) to give the equivalent sweetness of replaced sugar.

Also, shortening was substituted at 50% level by maltodextrin gel. Wheat flour was replaced by 5, 10, 15 and 20% dietary fiber sources.

Analytical metheds:

Moisture and ether extract were detrmined as described by A.A.C.C. (1983); protein (N x 5.7), crude fiber and ash contents were detrmined using the method outlined in A.O.A.C. (1990).

Carbohydrates were calculated by difference. Caloric value was calculated to the following equation:

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

Soluble and insoluble dietary fiber were detrmined according to the method described by Asp *et al.*, (1983). Phytic acid was detrmined according to the procedure described by Camire and Clydesdole (1982).

Cake physical measurments and sensory evaluation were carried out using the methods of A.A.C.C. (1983).

Results were statistically analyzed by using the method reported by Steel and Torri (1980).

RESULTS AND DISCUSSION

Chemical composition of weat flour and fiber sources:-

Chemical analysis presented in Table (1) show that, wheat flour contained 11.73% protein, 1.52% ether extract, 0.66% ash, 1.21% crude fiber and 84.88% carbohydrates. Analysis of dietary fiber sources showed that okara contained high amount of protein (33.21%), ether extract (16.50%) and ash (5.30%). Crude fiber content of dietary fiber sources could be arranged in the following order 62.57, 24.83 and 8.45% for peanut hulls, okara and corn bran respectivily. Data in Table (1) showed that okara contained the lowest level of carbohydrates (20.16%), this result could be due to the highest content of crud fiber (24.83%) and protein (33.21%).

The carbohydrates content of other by-products were 28.57% and 80.31% for peanut hulls and corn bran, respectivily.

Table (1): Chemical composition of wheat flour and fiber sources (% on dry weight basis)

Component	Wheat flour	Corn bran	Peanut hulls	Okara
Moisture	12.65	7.13	8.15	7.11
Protein	11.73	9.24	4.75	33.21
Ether extract	1.52	0.88	1.60	16.50
Ash	0.66	1.12	2.51	5.30
Crude fiber	1.21	8.45	62.57	24.83
Carbohydrates	84.88	80.38	28.57	20.16

As can be shown in Table (2), the insoluble dietary fiber (IDF) values were higher than the soluble dietary fiber (SDF). According to IDF content, fiber sources could be arranged in descending order as follows: Peanut hulls (76.08), okara (47.85%) and corn bran (38.25%). Peanut hulls was the highest source in total dietary fiber (TDF) content (79.71%) followed by okara (60.18%) and corn bran (39.44%). These results are in agreement with those obtained by Prosky *et al.*, (1988) and Mahmoud *et al.*, (2002).

Generally, the percentages of crude fiber content (Table, 1) were lower than percentage of TDF. This may be due to method of estimation, since the crude fiber method gives an inaccurate estimation of cellulose and lignin contents in foods and does not estimate non cellulose polysaccharides (Schneeman, 1989).

Data in Table (2) indicated that, wheat flour had a lower phytic acid content (0.51%) than okara and corn bran. It could be noticed that corn bran had the highest phytic acid content (2.82%) followed by okara (1.45%). Peanut hulls was the lowest in phytic acid (0.12%).

Table (2): Dietary fiber and phytic acid contents of wheat flour and fiber sources. (on dry weight basis).

Materials	Dietary fiber content			SDF&IDF (as % of TDF)		Phytic acid
	SDF	IDF	TDF	SDF	IDF	
Wheat flour	0.98	2.21	3.19	30.72	69.28	0.51
Corn bran	1.19	38.25	39.44	3.02	96.98	2.82
Peanut hulls	3.63	76.08	79.71	4.55	95.45	0.15
Okara	12.83	47.85	60.68	21.14	78.86	1.45

Where: SDF=Soluble dietary fiber
IDF=Insoluble dietary fiber
TDF=Total dietary fiber

High fiber sugar-fat substituted cakes:-

Physical measurements:-

Results in Table (3) show that, all fiber sources containing cakes were lower in volume than control cakes. Cakes containing okara were higher in volume than cakes containig other fiber sources. From the same Table, it could be observed that increasing the level of fiber sources from 5% to 20% led to a decrease in cakes volume for all fiber sources except for cakes containing okara which achieved in cause in volume from 340 to 341 cm^3 when fiber sources level increased from 5% to 10%. These results are agreed with those obtained by Springsteen *et al.*, (1977) who reported that volume of the cakes with 50% of flour substituted with bran were significantly less than those of the control cake. Increased water holding capacity of the bran component may have contributed to the higher batter viscosity and if these components competed with the starch for water, incomplete gelatinization of the starch could have resulted in reduction of cake volume. Also, Shogren *et al.*, (1981) found that as the replacement level increased from 5 to 15g. the decrease in loaf volume went from 92 to 197cc for wheat bran and from 99 to 219cc for corn bran. For cake weight, it could be noticed

that cakes with fiber sources were lower in weight than control cake. Also, it could be observed that all cakes with 20% fiber sources were higher in weight than the corresponding containing 5% fiber sources. Cakes containg okara at 20% level were the highest in weight than other cakes containing other fiber sources (Table 3). This might be attributed to the higher water holding capacity of fiber sources (Galal,1998). The increases in cake weight and the decrease in cake volume associated with thew addition of fiber sources leaded to a decrease in cakes specific volumes. At 5% fiber addition level, cakes prepared with flour substituted with okara were higher in specific volume than cakes prepared with other fiber sources. These results are in agreement with Springsteen *et al.*, (1977); Shogren et al., (1981); Mahmoud *et al.*, (1996) and Mahmoud *et al.*, (2002).

Table (3): Physical measurements of high fiber sugar-fat subistituted cakes

Samples		Volum (cm^3)	Weight (gm)	Specific volum (cm^3/gm)
Control		380.5	148.6	2.56
Cake made with 50% maltodextrin + 75% steviosid and different levels of fiber sources				
Okara	5%	340	136	2.5
	10%	341	137.8	2.47
	15%	340	139.6	2.43
	20%	305	139.8	2.20
Corn bran	5%	308.2	125.8	2.45
	10%	291.3	126.1	2.31
	15%	272.8	126.9	2.15
	20%	270.5	127	2.13
Peanut hulls	5%	302.5	125	2.42
	10%	288.3	125.9	2.29
	15%	271.9	126.5	2.15
	20%	270.3	126.9	2.13

Chemical composition and caloric value:-

Results of the chemical composition are given in Table (4) The results showed that the addition of fiber sources led to an increase in moisture content, it is clear that moisture content of all cakes containing fiber sources was higher than of control. Also, it could be noticed that all cakes containing 20% fiber sources had higher moisture content than the corresponding cakes containing 5%fiber sources. Such increase in moisture may be due to the fact mentioned by Galal (1998) who stated that dietary fiber source has the capacity to hold three to four times in weight of water. Fat values of resulted cakes showed that high fiber sugar-fat substituted cakes were lower than control cakes by about one half in average. From the same table it could be shown that all fiber sources containing cakes were higher in protien than control cakes, cakes containing okara were higher in protein than cakes other fiber sources. This might be attributed to okara contain the highest protein

content as compared to other fiber sources. It was also increased by increasing fiber level, this could be attributed to the increase in protein content. At 20% fiber substitution level, cakes containing okara had a relatively higher fat content. Such high content may be attributed to the high fat content of okara. Concerning ash content, it could be observed that cakes contaning fiber sources were higher in ash content than control cakes. The increase in ash control associated with the use of such fiber sources was clearly noticed at 20% replacement level.

Dietary fiber content of control cake was clearly less than that of fiber containing cakes. This could be attributed to the replacement of 75% of sugar weight (with almost no fiber content). The value of dietary fiber content of control cake was 1.10%. Also, it could be noticed that the addition of okara, corn bran or peanut hulls leaded to an increase in fiber content.

Carbohydrates by its turn was lowered by increasing fiber sources addition. This could be attributed to the increase in dietary fiber content. Results showed that fiber contaning cakes were lower in calories than control cakes. Also increasing fiber sources level from 5% to 20% leaded to a decrease in caloric value. These results are in agreement with those obtained by Prosky *et al.*, (1988); Schneeman, (1989) and Mahmoud *et al.*, (2002).

Table (4): Chemical composition and caloric value of high fiber sugar-fat substituted cake. (on dry weight basis)

Cake samples		Moisture	protein	Fat	Ash	Fiber	Carbohy-drates	Caloric value (K cal/ 100g)
Contol		14.46	6.05	18.63	1.67	1.10	72.55	482.07
Cake made with 50% maltodextrin + 75% steviosid and different levelsof fiber sources								
Okara	5%	15.36	7.35	9.13	1.76	13.85	67.91	383.21
	10%	16.50	9.41	9.34	1.88	16.51	62.86	373.14
	15%	18.32	10.62	9.81	1.97	18.54	59.06	367.01
	20%	19.15	12.23	10.05	2.01	20.12	55.59	361.73
Corn bran	5%	16.12	6.10	9.22	1.69	18.49	64.50	365.38
	10%	17.32	6.21	9.24	1.70	19.52	63.33	361.32
	15%	19.11	6.23	9.27	1.72	22.71	60.07	348.63
	20%	20.05	6.25	9.26	1.73	23.35	59.41	345.98
Peanut hulls	5%	16.51	6.09	9.23	1.70	19.81	63.17	360.11
	10%	18.13	6.10	9.21	1.82	20.56	62.31	356.53
	15%	19.42	6.12	9.18	1.93	22.41	60.36	348.54
	20%	20.11	6.11	9.17	2.01	24.53	58.18	339.69

Sensory characteristics:-

All cakes were evaluated for shapeliness, crust characteristics, crump colour, brightness crump, grains, softness, aroma and over all acceptablity. Means of these scores are presented in Table (5). It was observed that in all cases, the addition of different levels (5 and 10%) of fiber sources (okara, corn bran and peanut hulls) had no effect on such characters when compared with those of control. Using higher levels (15 and 20%) of fiber sources had decreasing in means on such characters. This may be attributed to the fiber sources colour which reflected a dark colour of the produced cakes and the

other character had the same trend. The data were in agreement with those of Springsteen *et al.*, (1977); Gains and Donelson (1985) and Kaiser and Jank (1993). It could be concluded that incorporation of dietary fiber sources at levels of 5 and 10% into sugar-fat substitution cakes resulted in acceptable cakes with reduction in calories. The subtitution of wheat flour with okara till 15% improved cake quality.

Table (5) Sensory evaluation of high fiber sugar-fat substitution cakes.

Characteristics		Shapeliness	Crust characteristics	Crump colour	Brightness crump	Grains	Soft-ness	Aroma	Overall acceptablity
Control		9.6	9.0	9.8	9.2	9.4	9.6	8.8	9.2
Okara	5%	8.6	8.1	7.8	7.6	8.3	8.6	7.8	8.0
	10%	8.8	8.3	9.0	8.4	8.8	8.8	8.4	8.8
	15%	6.4	6.8	6.3	7.0	7.0	6.4	6.6	7.0
	20%	4.2	5.6	6.2	5.4	4.8	4.8	5.2	5.4
L.S.D.		1.14	1.02	2.79	1.47	1.26	1.08	0.81	2.34
Corn bran	5%	8.1	7.6	7.5	8.6	7.9	8.6	7.8	8.2
	10%	8.3	7.8	7.8	8.8	8.8	8.7	7.9	8.6
	15%	5.4	6.4	5.8	6.6	6.7	6.4	6.0	6.3
	20%	3.6	4.2	4.4	4.3	3.8	3.6	3.5	5.2
L.S.D.		1.08	1.05	1.80	1.11	1.35	1.11	1.23	1.26
Peanut hulls	5%	9.2	9.4	9.2	8.8	8.7	8.2	8.4	8.6
	10%	8.2	7.4	8.2	8.0	7.8	7.2	7.4	7.5
	15%	6.0	5.6	5.8	5.7	5.9	5.6	6.0	5.6
	20%	3.0	2.8	3.4	3.2	3.3	2.8	3.8	3.6
L.S.D.		1.32	1.23	1.71	1.32	1.59	1.41	0.95	1.32

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إنتاج كيك منخفض الدهن مرتفع الألياف

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أستخدم في هذه الدراسة استبدال ٧٥% من السكر المستخدم فى صناعة الكيك بالأستيفيوسيد لأعطاء نفس درجة التحلية للسكر المستبدل وتم استبدال ٥٠% من الدهن باستخدام هلام المالتودكسترين وقد تم أيضا استبدال نسب ١٠،٥،١٥،٢٠% من الدقيق المستخدم في صناعة الكيك وذلك باستخدام مصادر الألياف الغذائية مثل الأوكارا و ردة الذرة وقشور الفول السوداني المطحونة. وأجريت الاختبارات الكيماوية والقياسات الفيزيقية والتقييم الحسي على الكيك الناتج. وأظهرت النتائج بزيادة نسب الإضافة لمصادر الألياف الغذائية من ٥ إلى ٢٠% أدى إلى نقص حجم الكيك الناتج مقارنة بالكنترول. كما أدت إلى ارتفاع نسبة الألياف الغذائية في بنسبة تصل الى٢٤ ضعف تلك النسبة في الكيك الكنترول. كما أظهرت النتائج التقييم الحسي أن إضافة نسب ٥، ١٠% من مصادر الألياف الغذائية أدى إلى قبول الكيك الناتج مع تحقيق انخفاض في السعرات الحرارية وبذلك يمكن استبدال الدقيق المستخدم في صناعة الكيك حتى مستو ى ١٠% لكل من ردة الذرة وقشور الفول السوداني المطحونة ومستوى ١٥% من الأوكارا حيث أنه يحسن من جودة الكيك.