J. Agric. Sci. Mansoura Univ., 30 (9): 5431 - 5441, 2005

PRODUCTION AND EVALUATION OF LOW-CALORIE BISCUITS AND CAKES.

Yaseen, A.A.E.; Waffa M.M. Abo Zeid and K.I. Hamad
Food Technology Dept., National research Centre, Dokki, Cairo, Egypt.

ABSTRACT

Utilization of commercial stevia sugar and fructose as natural sweeteners in preparation of low-calorie cakes and biscuits was evaluated. Based on replacing sucrose with stevia sugar end fructose either singly or in various combinations, eleven formulas were prepared four levels of replacement using i.e. 25, 50, 75 and 100%. Cake and biscuit made of 100% sucrose were also prepared for comparison. The effect of such substitution on baking tests and sensory evaluation of cakes and biscuits was determined. Sensory characteristics showed that cakes and biscuits prepared with stevia sugar or fructose scored lower levels than those prepared with sucrose however these differences were not significant ($P < 0.05$) for biscuits. Mixtures of sugar substitutes gave better cake and biscuit quality, hence, optimum results were achieved by using (50%) sucrose in combination with 30% stevia sugar and 20% fructose. At the same time, cake and biscuit samples achieved about 30% reduction in calories. Consequently these bakery products could be used for diabetes and body weight reduction.

INTRODUCTION

Cakes and biscuits are widely used by consumers all over the world. However, due to their high caloric content, over-consumption may contribute to obesity. One way to achieve a healthy food product is to reduce or to omit some of the calorie-laden ingredients-especially sugar and fat. At the same time there is a constant demand for diebetic foods suitable for diabetics, that may have the same calorie-value being also sucrose-free, since this sugar cannot be metabolized without insulin (Ronda. *et al.*, 2005).

Sucrose is a principal ingredient in cakes and biscuits, and its role extends beyond providing energy and sweetness. In consequence, it cannot be substituted only by intense sweeteners. It acts as a tenderizer by retarding and restricting gluten formation, increasing the temperatures of egg protein denaturation and starch gelatinization, and contributing to bulk and volume (Kulp *et al.*, 1991 and Shukla, 1995). Therefore, the reduction of sucrose levels in a cake or biscuits system affects structural and sensory properties (Frye and Setser, 1991). It is, thus necessary to investigate the substitution of traditional and nutritional sweeteners to generate healthy foods and maintaining, at the same time, original colour, texture and flavour (Altschul, 1993). Bulking agents, which replace the non sweet functional characteristics of sucrose, can be used as alternatives to sucrose in bakery products (Deis, 1993 and Giese 1993), but none of them seems to possess all of sucrose's properties.

Hess and Setser (1983) tested layer cakes sweetened with aspartame, and found that its combination with low levels of fructose led to cakes more tender, more uniform and with higher overall eating quality than the non-bulking aspartame layer cakes.

Stevia sugar is a sweetening substance which is extracted and refined from leaves of stevia (a natural plant). The sweetening strength of stevia sugar is about 200-300 times more than that of can sugar, yet its calorie production is only 1/300 of that of sucrose. The acceptable daily intake of stevia sugar is 7.938 mg/Kg human body (Higginbotham, 1983 and Xu *et al.*, 1992).

El-Azab and Bothagna (1997), reported that cake containing 50% of stevioside, 10% wheat bran and 30% of lacty and packed with polyethylene, had acceptable weight, volume, low calorie value and softness (texture) as well as a good overall acceptability. Hassan (2000) found that addition of stevioside at 75% was the nearest to control and stevioside at 100% had the lowest value concerning taste, odour, texture, shape, light and total acceptability with control.

Geuns (2000) reported that stevia and stevioside are safe when used as sweeteners. Both are suited for diabetics and phenylketonuria patients, as well as for obese persons intending to lose weight by avoiding sugar supplements in the diet.

Thus, it would be beneficial to develop the novel formulations for cakes and biscuits production with sugar substitute as stevia sugar and fructose.

MATERIALS AND METHODS

Materials

Soft wheat flour (72% extraction), sucrose (commercial grade), shortening (hydrogenated palm oil), fresh eggs, skimmed milk powder, salt, baking powder and vanilla were purchased from the local market. Fructose, crystalline and food grade from Xyrofin LTD, Switzerland. Commercial natural sweetener (ISI-diet, stevia sugar), each 100g contains 2.5g stevia sugar and 97.5g maltodextrine and every 1g contains ≤1 calories, made in Egypt, packed by ISIS Co. for Food Industries, Egypt.

Preparation and evaluation of low-calorie sponge cakes:

Eleven blends were prepared and control sample was made with 100% sucrose for comparison(Table, 1). Cake samples were processed according to El-Samahy, *et al.* (1980). Sponge cake butters prepared using the ingredients (Fresh eggs, sugar and vanilla) were blended for minutes using 110 ml of water followed by addition of the milk, soft wehat flour, baking powder and salt. 100g butter were added for each pre-greased aluminum cake pans (8 cm diameter). The sponge cake was baked at 170°C for 30 minutes. Weight, volume, specific volume, height and bulking density of cakes were recorded. Organoleptic characteristics of cakes were evaluated according to El-Samahy *et al.*, (1980).

Table (1): Cake Formulations

Sample*	Sucrose		Sugar Substitutes**			
			Fructose		Commercial stevia sugar	
	(g)	%	(g)	%	(g)	%
Control	100	100	-	-	-	-
Blend 1	75	75	16.7	25	-	-
Blend 2	50	50	33.4	50	-	-
Blend 3	25	25	50.1	75	-	-
Blend 4	-	-	66.8	100	-	-
Blend 5	75	75	-	-	25	25
Blend 6	50	50	-	-	50	50
Blend 7	25	25	-	-	75	75
Blend 8	75	75	6.7	10	15	15
Blend 9	50	50	13.4	20	30	30
Blend 10	25	25	20.1	30	45	45
Blend 11	-	-	26.8	40	60	60

* 100 g soft wheat flour, 108g fresh eggs, 3g baking powder, 3g vanilla, 30 g milk and 0.83 g salt were added to all formulas.

** The relative sweeteners: 1.5 and 1.0 times of sucrose for each fructose and commercial stevia sugar, respectively.

Preparation and evaluation of low-calorie biscuits:

Eleven blends were prepared and control sample was made with 100% sucrose for comparison (Table 2). Biscuit samples were processed according to the procedure described in A.A.C.C. (1990). Weight, volume, specific volume, diameter, thickness and spread ratio of biscuits were recorded. Organoleptic characteristics of biscuits were evaluated with some modifications, according to Zabik and Hoojjat (1984).

Table (2): Biscuit formulations

Sample*	Sucrose		Sugar Substitutes**			
	(g)	%	Fructose		Commercial stevia sugar	
			(g)	%	(g)	%
Control	57.8	100	-	-	-	-
Blend 1	43.4	75	9.6	25	-	-
Blend 2	28.9	50	19.3	50	-	-
Blend 3	14.4	25	28.9	75	-	-
Blend 4	-	-	38.5	100	-	-
Blend 5	43.4	75	-	-	14.4	25
Blend 6	28.9	50	-	-	28.9	50
Blend 7	14.4	25	-	-	43.4	75
Blend 8	43.4	75	3.9	10	8.7	15
Blend 9	28.9	50	7.7	20	17.3	30
Blend 10	14.4	25	11.6	30	26.1	45
Blend 11	-	-	15.4	40	34.7	60

* 100 g soft wheat flour, 28.44g shortening, 0.93g salt, 1.11g sodium bicarbonate, 0.2 smmonium bicarbonate and water for optimal dough handling were added to all formulas.

** The relative sweeteners: 1.5 and 1.0 times of sucrose for each fructose and commercial stevia sugar, respectively.

Hunter colour evaluation:

Colour of cakes and biscuits was measured with hunter lab colorimeter model D_{25}. Cake and biscuit samples index were measured based on the parameters: L, measure the lightness on a scale ranging from 0 (balck) to 100 white, a denoting greenness when negative and redness when positive; b, denoting blueness when negative and yellowness when positive. The instrument was adjusted on the white standard tile which L= + 92.06, a = 0.8 and b = -1.0, total colour difference (ΔE) was calculated as:

$$\Delta E = [\ (\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{\frac{1}{2}}$$

Statistical analysis:

The results of organoleptic evaluations were evaluated by analysis of variance and least significant difference (LSD) was calculated according to McClave and Benson (1991)

RESULTS AND DISCUSSION

Baking quality and energy value of cakes.

The effect of replacing sucrose by fructose and commercial stevia sugar on the baking quality and energy value of sponge cakes is presented in Table (3). Weight of sponge cake increased, while volume, height and specific volume decreased by increasing the levels of fructose and stevia sugar. The reduction in volume and specific volume was 38.5, 42.7 and 28.2, 37.4% when the fructose and stevia sugar were added at 75% replacement level, respectively. Mixtures of sugar substitutes gave better cake baking quality than those produced when sugars added separately. Optimum results were achieved using sucrose (50%) in combination with 30% stevia sugar and 20% fructose. Lower cakes baking quality was elaborated with 60% stevia sugar and 40% fructose. Similar findings were observed by Peck (1994) and Ludewig and Laukamp (1994).

The decrease in sugar-free cake expansion or specific volume seems to have two main causes: Decrease in butter stability during the heating stage-related to butter viscosity decrease and foam bubble size increase – and changes in the thermosetting mechanism, due to different interactions among the bulking agent used and starch and proteins of the butter that affect starch gelatinization and protein denaturation temperatures. A decrease in any of these temperatures is expected to cause a premature thermosetting of protein or starch matrix, which will start at the crust due to direct contact with the heating medium. This, then, lowers, the heat transfer rats and produces a vapour pressure build-up, causing inadequate expansion of individual bubbles (Hiesasmaz *et al.*, 2003 and Stauffer, 1990).

The energy value Kcal or KJ of control cake (Table 3) was 400 or 1674, whereas when fructose and commercial stevia sugar were used in 50 % level individual, the energy values were 333.6 or 1396 KJ and 250 or 1046 KJ, respectively. So, substitution of sucrose by fructose or stevia sugar lowered the calorilic value in the product. The percent reduction in energy

value was 16.6 and 37.5% when fructose and commercial stevia sugar were used at 50%replacement level, respectively.

Table (3): Cakes baking quality and energy value.

Sample*	Baking quality					Energy value/100g**		
	Weight [g]	Volume [cc]	Specific volume [cc/g]	Height [Cm]	Bulk density [g/cc]	KcaL	KJ	Reduction %
Control	54	195	3.61	3.4	0.276	400.0	1674	0.0
Blend 1	55	170	3.09	3.2	0.324	366.8	1535	8.3
Blend 2	57	150	2.63	2.8	0.380	333.6	1396	16.6
Blend 3	58	120	2.07	2.5	0.483	300.4	1257	24.9
Blend 4	57	95	1.67	2.0	0.600	267.2	1118	33.2
Blend 5	55	175	3.18	3.2	0.314	325.0	1360	18.8
Blend 6	56	160	2.86	2.9	0.350	250.0	1046	37.5
Blend 7	62	140	2.26	2.6	0.443	175.0	732	56.3
Blend 8	56	115	2.05	3.0	0.487	341.8	1431	14.6
Blend 9	58	178	3.07	2.9	0.562	28.3.6	1187	29.1
Blend 10	60	165	2.75	2.7	0.364	240.4	1006	43.7
Blend 11	61	100	1.64	1.6	0.610	167.2	700	58.3

* See Table (1)

** Estimated by sweeteners (sucrose, fructose and stevia sugar) of each cake

Colour of cakes

The effect of replacing sucrose by fructose and stevia sugar on the colour properties of spange cakes is indicated in table (4). A noticed difference of crumb and crust cakes colour was reported. Adding fructose or steiva sugar reduced colour or lightness "L" values. This lightness reduction was more pronounced in fructose cakes. The excessive exterior brown colour given to the fructose and stevia sugar cakes was mainly related to promote browning reactions as a result of thermal degradation.

Table (4) : Colour quality of cakes.

Sample*	Crust				Crumb			
	Lightness "L"	Redness "a"	Yellowness "b"	ΔE	Lightness "L"	Redness "a"	Yellowness "b"	ΔE
Control	80.06	-2.7	-3.7	0.00	85.76	-5.4	1.4	0.00
Blend 1	77.16	-1.5	-6.9	4.48	83.46	-4.7	-0.6	5.02
Blend 2	79.16	-1.7	-4.2	1.44	82.86	-5.1	-1.4	4.35
Blend 3	77.86	-2.3	-5.8	3.07	82.66	-4.7	-0.7	4.45
Blend 4	78.26	-1.4	-5.0	2.57	82.06	-1.8	-1.5	13.11
Blend 5	84.66	-1.8	-3.9	4.69	84.66	-4.6	-0.3	6.03
Blend 6	78.76	-2.0	-4.4	1.63	84.76	-8.3	0.0	8.19
Blend 7	80.06	-2.6	-2.7	1.00	83.06	-3.3	-1.0	4.08
Blend 8	79.16	-0.5	-3.8	2.38	84.96	-4.7	-0.1	6.40
Blend 9	78.76	-1.1	-4.5	2.21	80.66	-2.9	-3.2	0.81
Blend 10	79.26	-2.7	-3.8	0.81	80.56	-2.2	-3.3	0.81
Blend 11	78.96	-0.3	-4.0	3.21	82.06	-3.2	-2.0	2.67

* See Table (1).

Comparison among "a" values (degree of redness) and "b' values (degree of yellowness) of cakes indicated that cakes prepared using fructose and stevia sugar were clearly less red and less yellow than those of cakes prepared using sucrose only (control). These results are in agreement with Attia, *et al.*,(1993), who found that the presence of fructose in the cake formula caused the development of a greenish colour. Total colour difference "ΔE" ranged between 0.81-4.69 and 0.81-8.19 for crust and crumb cakes, respectively indicating substantial colour differences among the samples.

Sensory evaluation of cakes.

The results of sensory evaluation of cakes are presented in Table (5). All blends were rated lower than the control sample. Significant differences at ($P < 0.05$) were observed within all cakes and between the control sample. Cakes for blends 1, 2, 5, 6 and 8 received slightly higher sensory scores than other blends. Cakes prepared with commercial stevia sugar or fructose more than 50% replacement level, received the lowest scores. The colour of the crust and crumb of the cakes were changed and became darker by increasing levels of stevia sugar in the blends. Panelist scores agreed with Hunter L, a and b values, which indicated that the crust of cakes became darker, less red and less yellow as the stevia sugar content increased (Table, 4).

A slightly bitter aftertaste appeared when stevia sugar was used at levels of 75 and 100%. Soijarto *et al.*, (1983) reported that the bitter taste, common to many stevia species, was probably due to sesquiterpene lactones. It was also, suggested that volatile aromatic or essential oils, tannins and flavonoids contributed to the implant flavour associated with stevia.

Table (5): Sensory evaluation of cake samples.

Sample*	Characteristics				
	Tenderness (10)	Colour (10)	Texture (10)	Flavour (10)	Taste (10)
Control	8.1^{a}	8.4^{a}	8.8^{a}	7.8^{a}	7.8^{a}
Blend 1	7.7^{ab}	7.1^{abc}	6.4^{bc}	7.1^{a}	7.2^{ab}
Blend 2	6.6^{bcde}	7.3^{ab}	6.6^{b}	6.5^{abcd}	6.5^{ab}
Blend 3	7.7^{ab}	6.8^{abc}	6.6^{b}	6.9^{ab}	6.6^{ab}
Blend 4	6.5^{bcde}	6.0^{bc}	5.5^{bcd}	6.8^{ab}	6.2^{abc}
Blend 5	7.6^{abc}	7.1^{abc}	7.0^{b}	6.8^{ab}	6.3^{ab}
Blend 6	7.4^{abc}	6.9^{abc}	7.1^{b}	6.7^{abc}	6.1^{abc}
Blend 7	6.6^{bcde}	6.6^{bc}	5.9^{bcd}	6.2^{abcd}	5.9^{bcd}
Blend 8	7.0^{abcd}	6.9^{abc}	6.3^{bc}	6.3^{abcd}	5.9^{bcd}
Blend 9	6.3^{cde}	5.7^{bc}	4.4^{d}	5.0^{cd}	4.5^{cde}
Blend 10	6.0^{de}	5.8^{bc}	4.9^{cd}	4.8^{d}	4.1^{e}
Blend 11	5.6^{e}	5.6^{bc}	4.6^{d}	5.2^{bcd}	4.2^{de}

* See Table (1).

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

Addition of commercial stevia sugar and fructose to sucrose in a combination form decreased the mean scores of all sensory characteristics of cakes. As shown in the same table, it could be noticed that accepted results were achieved using sucrose (50%) in combination with 30% stevia sugar and 20% fructose. The differences in sensory characteristics of the mixtures were attributed to be influence of each molecule on water structure and to the nature of their hydration. Hutteau, *et al.*, (1998) reported that synergy arises when sweeteners with the same type of hydration are mixed, while suppression and addition occur when sweeteners with different type of hydration are mixed and when there is a decrease in water mobility around the sweeteners. It is concluded that determination of the compatibility of bulk and intense sweeteners with water structure may be useful for prediction of optimal sweetener formulations.

Baking quality and energy value of biscuits.

Quality characteristics of biscuits are given in Table (6). The results indicated that the reduction in volume, specific volume, diameter and spread ratio of biscuits when fructose was used in biscuit preparation. The reduction in specific volume and spread ratio of biscuit was 12.34 and 16.93% when fructose was used at 75% level, respectively. Doescher and Hoseney (1985) showed that the cookie dough containing sucrose had a much greater spread than doughs containing either glucose or fructose. In contrast, using commercial stevia sugar in the biscuit formula yielded biscuit samples having better baking quality than the control sample. For instance, the improvement in specific volume and spread ratio of biscuit was 5.19 and 26.9% when stevia sugar was used at 50% level, respectively. Same findings were noticed when fructose and stevia sugar used in combination form, hence, spread ratio of biscuit containing 15% stevia sugar + 10% fructose was increased by 13.76%.

Table (6): Biscuit baking quality and energy value.

Sample*	Baking quality							Energy value / 100g**		
	Weight [g]	Volume [cc]	Specific volume [cc/g]	Diam-eter [cm]	Thick-ness [cm]	Spread ratio [Cm]	Spread ratio [+ %]	KcaL	KJ	Reduc-tion %
Control	25.9	40	1.54	6.8	1.2	5.67	0.00	231.2	968	0.0
Blend 1	26.1	38	1.46	6.7	1.3	5.15	-9.17	212.0	887	8.2
Blend 2	26.4	36	1.36	6.5	1.3	5.00	-11.82	192.8	807	16.5
Blend 3	26.0	35	1.35	6.6	1.4	4.71	-16.93	173.2	725	25.0
Blend 4	26.1	35	1.35	6.5	1.2	5.42	-37.31	154.0	645	33.3
Blend 5	27.0	42	1.56	7.0	1.0	7.00	+23.46	188.0	787	18.6
Blend 6	27.2	44	1.62	7.2	1.0	7.20	+26.90	144.5	605	37.4
Blend 7	26.5	46	1.74	7.2	1.1	6.55	+15.52	101.0	423	56.3
Blend 8	26.8	41	1.53	7.1	1.1	6.45	+13.76	197.9	828	14.3
Blend 9	26.6	43	1.62	7.1	1.1	6.45	+13.76	163.6	685	29.1
Blend 10	26.7	44	1.62	7.2	1.2	6.00	+5.82	130.1	545	43.7
Blend 11	26.5	45	1.70	7.1	1.2	5.92	+4.41	96.3	403	58.3

* See Table (2).

** Estimated by Sweeteners (sucrose, fructose and stevia sugar) of each biscuit.

This means that the presence of commercial stevia sugar in the formula succedded to reduce dough stability and produce weaker dough. Saxena *et al.*,(1992) reported that biscuits prepared from soft dough had a significantly higher spread than those prepared from hard dough. A slight increase in biscuit weight samples occurred after baking with fructose or stevia sugar compared with the control sample.

The energy value of the biscuit sample (Table 6) was 231.2 Kcal in the control, while, 173.2 and 101 Kcal when fructose and stevia sugar were used each in a proportion of 75% individual, respecively. Same findings were noticed when mixtures of sugar substitutes were considered. Biscuit sample contained 30% stevia sugar + 20% fructose showed 29% reduction in calories.

Colour of biscuits:

Colour quality of processed biscuit is summarized in Table (7). Fructose or stevia sugar affected the colour of biscuit especially the lightness "L" values. Colour of biscuits made with fructose was slightly darker (lower L values) and more red (positive a values) than those of biscuits made with stevia sugar prepared with different levels. Total colour differences "ΔE" reanged between 2.25 and 5.06. The highest colour difference was recorded for fructose incorporation, which could be attributed to the reaction of fructose with non-reducing sugars. A decrement in colour differences was observed by using commercial stevia sugar in biscuit formula in comparison with fructose biscuit. However, mixtures of sugar substitutes minimized such differences in colour biscuit than when used seperately.

Table (7) : Colour quality of biscuits.

Samples *	Lightness "L"	Redness "a"	Yellowness "b"	ΔE
Control	80.96	-1.4	-2.1	2.25
Blend 1	77.86	+0.1	-5.2	3.86
Blend 2	78.66	-0.5	-4.1	2.64
Blend 3	77.86	+1.7	-4.9	5.06
Blend 4	78.06	+1.1	-4.4	4.35
Blend 5	79.76	-0.5	-2.9	2.36
Blend 6	82.46	-1.8	-0.8	3.87
Blend 7	81.96	-0.4	-0.9	4.09
Blend 8	80.76	-1.3	-2.0	2.31
Blend 9	80.56	-0.6	-2.3	2.57
Blend 10	80.46	-0.4	-2.3	2.72
Blend 11	80.56	-0.4	-2.0	2.90

*** See Table (2)**

Sensory evaluation of biscuits.

Means of the sensory evaluations of the biscuits prepared with varying levels of sweeteners are presented in Table (8). No significant differences at the 5% level was noted between control biscuit and those

prepared by using commercial stevia sugar or fructose. Biscuits prepared with stevia sugar or fructose more than 50% replacement level received the lowest sensory scores. When fructose was incorporated with the stevia sugar the sensory properties of the biscuits was generally higher than that of those samples prepared with stevia sugar. The hights values of sensory scores of biscuit were achieved using sucrose (50%) in combination with 30% stevia sugar and 20% fructose (Bland 9).

Based on these results, it could be recommended that sucrose could be replaced by commercial stevia sugar or fructose at levels up to 50% to produce low-calorie biscuits and cakes. Optimum results were achieved using sucrose (50%) in combination with 30% stevia sugar and 20% fructose.

Table (8) : Sensory evaluation of biscuit samples.

Samples*	Characteristics						
	Surface colour (10)	Shape (10)	Surface characteris-tics (10)	Distribution of cell (10)	Mouth feel (20)	Texture (20)	Flavour (20)
Control	7.9	7.7	7.5	7.7	13.5	11.0	13.8
Blend 1	7.9	7.6	6.7	6.6	12.1	12.7	13.2
Blend 2	6.7	7.6	6.5	6.6	12.1	12.3	11.9
Blend 3	6.7	7.0	6.5	6.4	11.4	12.2	12.6
Blend 4	7.1	7.1	6.4	5.8	10.7	10.7	11.9
Blend 5	6.9	7.7	7.4	7.6	13.2	13.8	12.6
Blend 6	7.0	7.7	7.3	6.5	12.5	12.5	10.5
Blend 7	7.0	7.5	7.3	6.5	11.0	11.1	9.7
Blend 8	7.5	7.5	7.2	7.2	12.0	13.0	13.0
Blend 9	7.7	7.8	7.5	7.7	12.4	13.0	12.9
Blend 10	6.8	7.0	6.9	6.3	11.0	10.4	11.2
Blend 11	6.5	6.4	6.2	6.0	10.5	10.2	10.7
L.S.D 0.05	NS	NS	NS	NS	NS	NS	NS

* See Table (2)

REFERENCES

Altschul, A.M. (1993). Low-calorie foods. Handbook, New York; Marcel Dekker.

A.A.C.C. (1990). American Association of Cereal Chemists. Approved Method of the AACC. 8th ed. American Association of Cereal Chemists, INC. St. Paul, Minnesota, USA.

Attia, E.; Shehata, H.A. and Askar, A. (1993). An alternative formula for the sweetening of reduced-calorie cakes. Food Chem. 48 : 169-172.

Deis, R. (1993). Low-calorie and bulking agents. Food Technology (December, 94).

Doescher, L.C., and Hoseney, R.C. (1985). Effect of sugar type and flour moisture on surface cracking of sugar-snap cookies. Cereal Chem. 62: 263.

El-Azab, M.A. and Bothagna, M.A. (1997). Production of a cake containing bran, sweetener sugar substitutes and bulking agents. Arab Univ. J. Agric. Sci. 5 (2): 278-296.

El-Samahy, S.K.; Morad, M.M.; Seleha, H. and abdel-Baki, M.M. (1980). Cake-mix supplementation with soybean, sweet potato or peamut flours. Bakers Digost, October; 32-34.

Frye, A.M. and Setser, C.S. (1991). Optimising texture of reduced-calorie sponge cakes. Cereal Chem.. 69, 338-343.

Geuns, J.M.C. (2000). Safety of Stevia and Stevioside. Recent Research. Developments-inphyto chemistry, 4 : 75-88.

Giese, J.H. (1993). Alternative sweeteners and bulking agents. Food Technology (January, 114-126).

Hassan, H.K. (2000). Studies on the utilization of stevia plant in some bakery products. M.Sc. Thesis, Faculty of Agric. Moshtoher, Zigazg University.

Hess, A. and Setser, C.S. (1983). Alternative systems for sweetening layer cake using aspartame with and without fructose. Cereal Chem.. 60 : 337-341.

Hiesasmaz, Z.; Yazgan, Y.; Bozoglu, F. and Katnas, Z. (2003). Effect of polydextrose-substitution on the cell structure of the high-ratio cake system. Lebensmittal-Wissanschaft und -Technologie, 36: 441-450.

Higginbotham, J.D. (1983). Recent development in non-nutritive sweeteners. In: Develoin sweeteners-2-Grenby. T.H. Parker, J. and Lindlay, H.G. (eds) El-Sevier, Applied Sci. New York. P. 134.

Hutteau, F.; Mathlouthi, M.; Portmann, M.D. and Kieast, D. (1998). Physicochemical and physicopnysical characteristics of binary mixtures of bulk and intense sweeteners. Food Chem.., 63 (1): 9-16.

Kulp, K.; Lorenz, K. and Stone, M. (1991). Functionality of Carbohydrate ingredients in bakery products. Food Tech. 3: 136-142.

Ludewig, H.G. and Laukamp, M. (1994). The mixture is the Key. Brot and Backwaren: 42 (11) 20-22, 27.

McClave, J.T. and Benson, P.G. (1991). Statistics for business and economics. Max Well Macmillian international editions. Dellen Publishing Company, USA.

Peck, A. (1994). Intense sweeteners for bakery products. Technical Bulletin, American Institute of Baking. Research Department. 16 (2) 1-8.

Ronda, F.; Manuel, G.; Carlos, A.B. and Pedro, A.C. (2005). Effects of polyols and nondigestible oligosaccharides on the quality of sugar-free sponge cakes. Food Chemistry, 90 : 549-555.

Saxena, A.K.; Bakksh:, a.K.; Seghal, K.L. and Sandha, G.S. (1992). Effect of grain texture on various milling and end use parameters of newly bread advanced tritical lines. J. of Food Sci. & Technology-Mysore, 29 (1): 14-13.

Shukla, T.P. (1995). Problems in fat-free and sugarless baking. Cereal Food World. 40 (March), 159-160.

Soijarto, D.D.; Compadre, C.M.; Medon, P.J.; Kamath, S.K. and Kinghorn, A.D. (1983). Potential sweetening agents of plant origin. II. Field

research for sweettasting stevia species. Economy Botany 37 (1), 71-79.

Stauffer, C.E. (1990). Functional additives for bakery foods. New York; Van Nostrand Reinhold.

Xili, L.D.; Chengjiany, B.; Eryi, X.; Reimings, S.; Yuenging, W.; Haodongs. S.J. and zhiyian, H. (1992). Chronic oral toxicity and carcinogenicity study of stevioside in rats. Food and Chemical Toxicology, 30 (11): 959-965.

Zabik, M.E. and Hoojjat, P. (1984). Sugar-Snap cookies prepared with navybean sesame seed flour, blends. Cereal Chem.. 61 (1): 41-44.

إنتاج وتقييم بسكويت وكيك منخفضا السعرات الحرارية

عطية عبد الفتاح السيد ياسين – وفاء محمد محمد أبو زيد و كمال الشناوي ابراهيم محمد حمد

قسم الصناعات الغذائية – المركز القومي للبحوث – الدقي – القاهرة – مصر.

نظرا لزيادة الاهتمام بالمحليات الطبيعية والرغبة في الابتعاد عن المحليات الصناعية استهدفت هذه الدراسة إمكانية إنتاج بسكويت وكيك منخفضا السعرات الحرارية عن طريق إحلال جزء من السكروز بنسب مختلفة من سكر الاستيفيا التجاري أو الفركتوز كمحليات طبيعية. حيث تم تصنيع إحدى عشر خلطة مختلفة علاوة على التجربة القياسية (بدون إضافة فركتوز أو سكر الاستيفيا) وقد استخدمت أربع نسب إحلال هي ٢٥، ٥٠، ٧٥، ١٠٠%و تم تقدير الخواص الطبيعية مع اختبارات الخبير والصفات الحسية لكل من الكيك والبسكويت.

أوضحت النتائج أنه يمكن استخدام سكر الاستيفيا التجاري أو الفركتوز في صناعة بسكويت وكيك منخفضا السعرات الحرارية حتى نسبة استبدال ٥٠% للسكروز. وأن استخدام أكثر من محلى في الخلطة الواحدة يعطى بسكويتا وكيكا ذات جودة عالية وقد أظهرت الخلطة المحتوية على ٥٠% سكروز + ٣٠% سكر إستيفيا + ٢٠% فركتوزتفوقا واضحا عن الخلطات المقترحة الأخرى بالنسبة للمظهر العام واللون والقوام والطعم والرائحة لكل من البسكويت والكيك بالإضافة إلى انخفاض السعرات الحرارية في هذه الخلطة إلى ٣٠% مقارنة بالعينة القياسية.