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Effect of Dietetic Sweeteners on the Quality of Cookies

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ABSTRACT

Cookies were prepared by replacing sucrose with dietetic sweeteners fructose, sorbitol, and mannitol. Sensory evaluation of the cookies at different intervals of storage i.e. 0, 15, 30, 45 and 60 days was carried out to find the best treatment for commercialization. The chemical analysis of wheat flour used for cakes indicated that it contained moisture 11.20%, protein 10.17%, fat 1.12%, ash 0.53%, fiber 0.28% and NFE 76.70%. The results pertaining to overall acceptability of cookies indicated that T3 (50% sucrose + 50% fructose) got the highest scores for fresh cookies that was subsequently decreased but remained highest during storage after 60 days. Physical studies of cookies revealed that 50% replacement of sucrose with fructose increased the width (26.4 cm) of cookies. The thickness was highest in T8 (60% fructose + 20% sorbitol) i.e. 8.5 cm. Maximum spread factor 41.5 cm was obtained by T7 (70% fructose + 15% sorbitol + 15% mannitol). There were significant changes in moisture contents and non-significant changes in fat, ash, protein, fiber and NFE contents. The increase in moisture content and decreasing trend in other parameters with storage was observed in cookies. The increase in concentration of dietetic sweeteners progressively decreased the calorific value. Highest calorific value 4398.74 cal/g was observed in T1 (100% sucrose) while lowest calorific value 3718.31 cal/g was attained by T4 (fructose 75% + sucrose 25%). During storage, although there was a decreasing trend in acceptability of cookies, however, the cookies remained acceptable even after 60 days.

Key Words: Cookies; Quality; Sweeteners; Dietetic; Storage

INTRODUCTION

In baked goods, sweeteners provide sweetness, texture, humectency (Salminen & Halikainen, 1990) and also increase shelf life (Hett & Butterill, 1999). Sweeteners provide the fermentable substrate for yeast-leavened products. Sweeteners also reduce or retard starch gelatinization and gluten development. Fructose and Sugar alcohols such as sorbitol, mannitol, are used in special dietary foods as a bulking agent and humectant with sweet taste (Francis, 2000). People, now a days are more quality and health conscious. Their demand for sugar free products without compromising on calories is increasing day by day (Diffy & Anderson, 1998). The absorption of polyols (sorbitol and mannitol) in our body is very slow and is incomplete. There is incomplete metabolism and due to fermentive degradation, the products are short chain fatty acids and gases, so the energy absorbed is less as compared to energy absorbed in complete metabolism of polyols. These also do not cause rapid increase in blood glucose level. This is the reason; polyols are used in diabetic and dietetic cakes and cookies (Warshaw & Powers, 1999).

Keeping in view the factors like improvement in sweetness, flavour, crust colour, spread, tenderness, keeping quality, nutrition and general appearance of cookies, the project was undertaken to replace sucrose with fructose, sorbitol and mannitol (nutritive sweeteners).

MATERIALS AND METHODS

Procurement of samples. Commercial flour sample was obtained from Crescent Flour Mills, Faisalabad. Different sweeteners i.e. fructose, sorbitol and mannitol were obtained from the local market.

Proximate analysis of wheat flour. The wheat flour sample was analyzed for moisture, crude protein, crude fat, crude fiber, nitrogen free extract and total ash content according to the methods described in AACC (2000).

Preparation of cookies. Cookies were prepared with some modifications in the method given in AACC (2000).

In the formulation of cookies, sucrose was replaced with different sweeteners. The proportions of the sweeteners used are mentioned in Table I.

The ingredients needed for the preparation of cookies were weighed accurately. Then creaming of vegetable ghee and sugar was done, followed by the addition of eggs. Creaming was continued till foaming occurred. The flour and baking powder were added to the creamy mass and mixed to a homogenous mass. The batter was then rolled out and was cut with the help of a biscuit cutter. The cookies were placed on baking trays at a proper distance and were baked at 425°F in the baking oven for 10-12 min. After baking, the cookies were cooled at room temperature and packed in polythene bags for further studies.

Table I. Different treatments of sweeteners used

Treatments	Sucrose (%)	Fructose (%)	Sorbitol (%)	Mannitol (%)
T1	100	-	-	-
T2	-	100	-	-
T3	50	50	-	-
T4	25	75	-	-
T5	-	80	20	-
T6	-	80	-	20
T7	-	70	15	15
T8	-	60	20	20

Analysis of cookies

Physical analysis. The width, thickness, and spread factor for cookies was estimated according to the method described in AACC (2000).

Sensory evaluation. The cookies were evaluated by a panel of judges for taste, colour, flavour, texture, and overall acceptability at 0, 15, 30, 45 and 60 days intervals of storage for cookies according to the procedure described by Meilgaard *et al.* (1991).

Chemical analysis. The cookies were analyzed for moisture, crude protein, crude fat, crude fiber, NFE and ash content according to the methods described in AACC (2000).

Gross energy value. Cakes and cookies were also analyzed for gross energy value. (Krishna & Ranjhan, 1981)

Statistical analysis. The data was analyzed statistically by the methods described by Steel *et al.* (1996).

RESULTS AND DISCUSSION

Chemical composition of wheat flour. The results regarding chemical composition of wheat flour indicated that wheat flour contained moisture 11.20%, crude protein 10.17%, crude fat 1.12%, crude fiber 0.28%, ash 0.53% and nitrogen free extract 76.70%. The results are in close agreement with the findings of Shafiq (1999) and Ayaz (1998).

Sensory evaluation of cookies. The cookies prepared from different sweeteners were subjected to sensory evaluation for colour, taste, flavour, texture and overall acceptability at 0, 15, 30, 45 and 60 days interval of storage. Results pertaining to sensory evaluation of cookies are presented in Table II. The results showed that T3 (50% sucrose + 50% fructose) improved the sensory characteristics i.e. colour, taste, texture etc. of the cookies. While T4 (25% sucrose + 75% fructose) was at second position. T8 (fructose 60% + sorbitol 20% + mannitol 20%) was least accepted by the judges. Analysis of variance disclosed a highly significant difference among treatments and storage means, but the interaction was non-significant. There was a gradual decrease in the overall acceptability of the cookies during storage days but cookies remain acceptable even after 60 days storage (Table III).

Table II. Effect of different sweeteners on the means of sensory characteristics of cookies

Treat.	Colour	Taste	Texture	Flavour	Overall acceptability
T1	6.32 cd	6.56 c	6.80 bc	5.92 de	6.64 b
T2	6.04 de	6.04 d	5.96 d	6.20 cd	5.92 c
T3	7.80 a	7.48 a	7.24 a	7.40 a	7.16 a
T4	7.04 b	7.04 b	7.04 ab	6.84 b	6.96 a
T5	5.92 e	5.48 e	5.56 e	5.68 e	5.88 cd
T6	6.96 b	6.84bc	6.60 c	7.16 a	6.44 b
T7	6.44 c	6.24 d	6.24 d	6.44 c	6.36 b
T8	5.60 f	5.12 f	5.12 f	5.24 f	5.60 d

Table III. Effect of storage period on the means of sensory characteristics of cookies

Storage (Days)	Colour	Taste	Texture	Flavour	Overall acceptability
0	7.57 a	7.55 a	7.45 a	7.52 a	7.40 a
15	7.22 b	6.87 b	6.80 b	6.95 b	7.02 b
30	6.57 c	6.40 c	6.37 c	6.37 c	6.45 c
45	6.07 d	5.77 d	5.80 d	5.80 d	5.85 d
60	5.12 e	5.15 e	5.17 e	5.15 e	5.12 e

Maximum score for each treatment was observed at 0 days storage interval. In earlier studies, a gradual decrease in overall acceptability of biscuits during storage was reported by Elahi (1997) who attributed it to moisture absorption and increase in peroxide value and free fatty acid contents in biscuits. The quantity of sweeteners to be added in biscuits has significant effects on the appearance, flavor and texture of biscuits (Matz, 1968). Rao *et al.* (1995) also reported similar trend. They found that colour, taste, aroma, texture and overall acceptability of whole egg incorporated biscuits were adversely affected during six months storage in various packaging materials.

Physical tests of cookies. The results pertaining to physical tests of cookies are presented in Table IV. It showed that width of cookies varied from 26.4 cm in T3 to 23.0 cm in T5. A decreasing trend in width of cookies was observed with increasing levels of dietetic sweeteners. T3 having 50% fructose and 50% sucrose got highest width. The width of control treatment was 25.01 cm. The thickness of cookies ranged from as high as 8.5 cm in T8 to as low as 6.4 cm in T3. It was noted that 50% replacement of sucrose with fructose decrease the thickness of cookies. While 100% replacement of sucrose with fructose, sorbitol and mannitol increased the thickness of cookies. The thickness of control treatment was 6.7 cm.

The spread factor was highest 41.5 cm in T7 and lowest 27.8 cm in T8. Increasing levels of dietetic sweeteners increased the spread factor of cookies. The spread factor of control treatment was 36.8 cm. The results obtained could be compared with those of Siddique (1995) who reported that use of artificial sweeteners in biscuits decreased the width and thickness of biscuits irrespective of

the concentration of the sweeteners. However, the spread factor of biscuits increased progressively with the increase in concentration of sweeteners. It can also be supported through the studies of Shafiq (1999) who observed a decreasing trend in width of biscuits with increasing levels of dextrose and hydrol, while use of golden syrup first increased then decreased the width of biscuits. Thickness of cookies was increased by increasing level of dextrose and decreased by increased level of hydrol and golden syrup. Spread factor was decreased by increasing levels of dextrose while increased with increasing levels of golden syrup and hydrol.

Table IV. Effect of different sweeteners on the physical characteristics of cookies

Treatments (cm)	Width (cm)	Thickness (cm)	S. F (cm)
T1	25.0	6.7	36.8
T2	24.6	7.1	34.6
T3	26.4	6.4	40.8
T4	25.8	6.6	38.7
T5	23.0	7.9	29.1
T6	24.1	7.5	32.1
T7	24.9	6.7	41.5
T8	23.7	8.5	27.8

Chemical analysis of cookies. Chemical studies of cookies showed that during the whole storage, there ware significant changes in moisture content and non-significant changes in fat, ash, protein, fiber and NFE contents (Table V, VI).

Table V. Effect of different sweeteners on the means of proximate composition of cookies

Treatments	Moisture %	Fat %	Ash %	Protein %	Fiber %	NFE
T1	2.78	23.48	0.45	6.47	0.09	66.73
T2	2.82	23.38	0.48	6.48	0.13	66.70
T3	2.90	23.54	0.54	6.51	0.13	66.37
T4	2.79	23.45	0.46	6.45	0.11	66.74
T5	3.35	23.57	0.46	6.46	0.08	66.07
T6	2.99	23.46	0.42	6.46	0.13	66.52
T7	3.40	23.48	0.40	6.48	0.10	66.11
T8	3.52	23.49	0.37	6.46	0.10	66.05

Table VI. Effect of storage period on the means of proximate composition of cookies

Storage (Days)	Moisture (%)	Fat (%)	Ash (%)	Protein (%)	Fiber (%)	NFE
0	3.51 a	23.56	0.53	6.52	0.13	66.73
15	3.39 b	23.53	0.49	6.50	0.12	66.55
30	3.19 c	23.50	0.47	6.47	0.11	66.40
45	2.78 d	23.44	0.40	6.44	0.10	66.33
60	2.49 e	23.39	0.36	6.41	0.08	66.31

The increase in moisture content and decrease in other parameters during storage was observed in cookies. The chemical analysis revealed that moisture content, ash content, crude protein, crude fat, crude fiber and nitrogen free extract were ranging between 2.78-3.52, 0.37-0.54, 6.45-6.51, 23.38-23.54, 0.08-0.13 and 66.03-66.70%, respectively. Same results were observed by Ahad (1999) and Akbar (2000).

Calorific value of cookies. The calorific value of the cookies prepared by the use of the different dietetic sweeteners has been presented in Table VII. The results indicated that the calorific value reduced by the use of dietetic sweeteners. The increase in concentration of dietetic sweeteners progressively decreases the calorific value. Highest calorific value 4398.74 cal/g was given by T1 while lowest calories 3718.31 cal/g was given by T4 having fructose (75%) and sucrose (25%). The cookies containing 100% sucrose showed the calorific value of 4398.74 cal/g.

The results of this study are in close agreement with the findings of Siddique (1995) who reported that increasing levels of artificial sweeteners in biscuits progressively decreased the calorific value of biscuits.

Table VII. Effect of dietetic sweeteners on the calorific value of cookies

Treatments	Gross energy (cal / g)
T1	4398.74
T2	3884.98
T3	4057.43
T4	3718.31
T5	4199.18
T6	4040.20
T7	3915.63
T8	3891.42

CONCLUSION

Cookies having 50% sucrose and 50% fructose showed better performance with regard to sensory characteristics and the above mentioned samples are suitable to be used for commercial purpose.

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