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Use of Low Absorptive Sweeteners in Cakes

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ABSTRACT

The present project was designed to study the effect of low absorptive sweeteners i.e. fructose, sorbitol, and mannitol on the cakes by replacing the sucrose to make dietetic cakes for energy conscious people. Eight different treatments depending upon different levels of sweeteners were prepared. Sensory evaluation of the cakes at different intervals of storage was carried out to find the best treatment for commercialization. The chemical analysis of wheat flour used for cakes indicated that it contained moisture11.20%, protein 10.17%, fat 1.12%, ash 0.53%, fiber 0.28% and NFE 76.70%. It was further noted that T3 (50% sucrose + 50% fructose) improved the sensory characteristics i.e. cell uniformity, cell size, grains, crumb colour, tenderness and taste etc. of cakes. Proximate analysis of cakes showed moisture, ash, protein, fat, fibre, and NFE contents ranging from 20.1 - 21.9%, 0.80 - 0.91%, 6.48 - 6.62%, 31.70 - 32.10%, 0.19 - 0.28% and 38.96 - 40.28%, respectively. The results indicated that the increase in concentration of dietetic sweeteners progressively decreased the calorific value. Highest calorific value 4260.87 cal/g was obtained by T1 (100%, sucrose) while lowest calories 3851.09 cal/g was obtained by T8 (fructose 60% + sorbitol 20% + mannitol 20%).

Key Words: Sweeteners; Cakes; Low absorptive; Sorbitol; Mannitol

INTRODUCTION

In baked goods, sweeteners provide sweetness, texture, humectency and also increase shelf life (Salminen & Halikainen, 1990). 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 and mannitol, are used in special dietary foods as a bulking agent and as 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).

Anonymous (2001) investigated that sugar alcohols (such as maltitol, sorbitol, mannitol, xylitol, or HSH/lycasin) affect the blood glucose levels less dramatically than regular table sugar (sucrose) as they are digested and absorbed much slower. The fructose is absorbed more slowly than glucose in the bloodstream. Unlike glucose, fructose is metabolized in the liver, meaning it does not require a large initial insulin response to move from the blood directly into the cells for metabolism. For this reason, some diabetics' patients found it useful in controlled amounts. Polyols and fructose can be used in sugar-free chewing gums, candies, frozen desserts and baked goods.

Increased awareness about diets having calorific value have led to the proposal of searching low absorptive sweeteners without sacrificing the sweet taste. This paper describes the evaluation of fructose, sorbitol and mannitol for replacement of sugar in cakes.

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 contents according to the methods described in AACC (2000).

Preparation of cakes. Cakes were prepared with some modifications in the method given in AACC (2000). In the formulation of cakes, sucrose was replaced with different sweeteners. The proportions of the sweeteners used are mentioned in Table I.

All the ingredients required for cake preparation were weighed accurately. First of all, creaming of vegetable ghee and sugar was done. Then eggs were added and mixed well till foamy mass and then all the remaining ingredients were added and at last flour (with baking powder) was added and homogenous mixture was formed. Then this homogenous mixture was put in the pans, which were lined the internal surface with paper. The pans were placed in the oven at 350-375°F until baked properly for about 25-30 min. The tooth pick was inserted in the center of the cake to test proper baking. The clean tooth pick showed proper baking.

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

After completion of baking, the pans were taken out of the oven and cakes were cooled in pans for 30 min and then taken out.

Analysis of cakes

Chemical analysis of cakes. Cakes were analyzed for proximate composition. The moisture content, total ash, crude protein, crude fat, crude fibre and NFE were analyzed as described in AACC (2000).

Sensory evaluation. The cakes were evaluated by a panel of judges for cell size, uniformity of cell, cell thickness, grains, texture, flavour, and crumb colour etc. at 0, 24, 48, 72 and 96 h of storage according to the procedure described by Meilgaard *et al.* (1991).

Gross energy. The amount of heat measured in calories that is released when a substance is completely oxidized in a bomb calorimeter is called the gross energy of the substance. Calorific Value (C.V) of the cakes was estimated by using parr Oxygen Bomb Calorimeter method (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%. Similar results were given by Fazil (1998) and Ayaz (1998).

Sensory evaluation of cakes. Results regarding to means of sensory characteristics of cakes are presented in Table II. Sensory evaluation of cakes was carried out by a panel of judges. There were significant differences among treatments. It was noted that T3 (Sucrose 50% + fructose 50%) improved the sensory characteristics i.e. cell uniformity, cell size, grains, crumb colour, tenderness and taste etc. of cakes. While T8 (60% fructose + 20% sorbitol + 20% mannitol) was at second position. T6 (80% fructose + 20% mannitol) was least acceptable by the judges. Significant difference among storage hours was observed. Results indicated that there was a decreasing trend through out the storage period (Table III). It was further noted that all the treatments were liked at 0 and 24 h of storage and remained acceptable after 96 h of storage. The results of this study correlates with the findings of Bashir (1997) and Siddique (1995).

Chemical analysis of cakes. Proximate analysis of cakes showed moisture, ash, protein, fat, fibre, and NFE contents ranging from 20.1-21.9%, 0.80-0.91%, 6.48-6.62%, 31.70-32.10%, 0.19-0.28% and 38.96-40.28%, respectively (Table IV). The results of this study are in accordance with the results of Imran (1996) who reported that the protein content of cakes was 8.95%, fat content 30.01%, crude fiber 0.24% and ash content was 0.87%.

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

Treatments	Cell Uniformity	Cell Size	Cell Thickness	Grains	Moistness	Tenderness	softness	Crumb Colour	Flavour	Taste
T1	6.60 d	6.16 d	6.12 c	9.72 c	6.52 cd	9.04 cd	5.76 ef	5.92 d	5.84 d	5.84 c
T2	6.92 c	6.28 d	6.16 c	9.16 d	6.80 bc	10.04 b	6.72 bc	6.72 b	6.48 bc	6.12 dc
T3	7.80 a	7.56 a	7.36 a	11.28 a	7.08 b	10.64 a	7.08 a	7.40 a	6.84 a	7.04 a
T4	5.12 f	4.88 f	4.80 e	8.36 ef	5.08 f	7.76 f	5.36 fg	5.40 e	5.04 e	5.04 e
T5	6.24 e	6.64 c	5.68 d	8.52 ef	6.40 d	8.76 de	6.04 de	5.92 d	6.16 cd	6.32 b
T6	4.84 f	4.52 g	4.60 e	8.16 f	5.76 e	7.36 f	5.16 g	5.24 e	5.16 e	5.16 de
T7	5.96 e	5.68 e	5.52 d	8.80 de	6.28 d	8.40 e	6.36 cd	6.28 c	5.44 e	5.44 d
T8	7.44 b	7.04 b	6.80 b	10.40 b	7.48 a	9.44 c	7.44 ab	6.80 b	7.04 ab	6.84 a

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

Storage (Hours)	Cell Uniformity	Cell Size	Cell Thickness	Grains	Moistness	Tenderness	Softness	Crumb Colour	Flavour	Taste
0	6.90 a	7.02 a	6.90 a	11.32 a	7.67 a	10.57 a	7.57 a	7.57 a	7.42 a	7.35 a
24	6.62 b	6.80 a	6.70 a	10.62 b	7.25 b	9.55 b	6.82 b	7.02 b	6.70 b	6.67 b
48	6.30 c	6.15 b	5.97 b	9.07 c	6.35 c	8.87 c	6.25 c	6.12 c	6.00 c	5.97 c
72	6.17 c	5.60 c	5.32 c	8.25 d	5.80 d	8.12 d	5.65 d	5.52 d	5.30 d	5.30 d
96	5.82 d	4.90 d	4.50 d	7.22 e	5.05 e	7.52 e	4.90 e	4.80 e	4.57 e	4.57 e

Table IV. Proximate composition of cakes prepared with different sweeteners

Treat.	Moist. (%)	Ash (%)	Crude protein (%)	Crude fat(%)	Crude fibre (%)	NFE
T1	20.1	0.80	6.59	31.95	0.28	40.28
T2	20.5	0.83	6.62	31.93	0.25	39.87
T3	20.2	0.84	6.60	31.99	0.27	40.10
T4	20.7	0.82	6.55	32.01	0.21	39.71
T5	21.7	0.83	6.53	31.70	0.22	39.02
T6	20.9	0.91	6.48	32.10	0.24	39.37
T7	21.6	0.85	6.57	31.75	0.19	39.04
T8	21.5	0.87	6.61	31.80	0.26	38.96

Calorific value of cakes. The calorific value of the cakes prepared by the use of the different low absorptive sweeteners has been presented in Table V. The results indicated that the calorific value reduced by the use of low absorptive sweeteners. The increase in concentration of low absorptive sweeteners progressively decreases the calorific value. Highest calorific value 4260.87 cal/g was given by T1 (100% sucrose) while lowest calories 3851.09 cal/g was given by T8 having fructose (60%), sorbitol (20%) and mannitol (20%). The results of this study are in close agreement with the findings of Siddique (1995) who reported that increasing levels of artificial sweeteners in cakes progressively decreased the calorific value of biscuits. Shafiq (1999) stated that the increasing levels of dextrose and golden syrup decreased the C.V. of the biscuits while increasing levels of hydrol increased the C.V. of the biscuits.

Table V. Effect of sweeteners on the calorific value of cakes

Treatments	Gross energy (cal / g)
T1	4260.87
T2	3879.71
T3	4202.37
T4	4136.17
T5	4105.64
T6	4063.63
T7	3991.22
T8	3851.09

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