



## Preparation and evaluation of formulated functional cheesecake for diabetics

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### Abstract

The aim of this study was to prepare and evaluate a formulated functional cheesecake for diabetics to assess benefits on health. The ingredients of the regular cheesecake were replaced by other ingredients of low caloric value and functional properties. Sucrose was replaced by fructose, butter by olive oil, full cream milk by skimmed milk, whole egg by egg white and cottage cheese by kareesh cheese. Sensory evaluations for both the regular cheesecake and functional cheesecake for diabetics were carried out using scores of the appearance, color, odor, flavor, texture and overall properties. The regular cheesecake and the low calorie cheesecake had a good score. Mean blood glucose level after 120 minutes for the subjects who ate the low calorie cheesecake was  $247.28 \pm 42.92$  mg/dl, while the mean blood glucose level for the subjects who ate the regular breakfast diet was  $360 \pm 25.05$  mg/dl. It can be deduced from the present study that formulated functional cheesecake with fructose, whole wheat, egg white, skimmed milk, kareesh cheese and olive oil would be a great meal replacement diet for diabetics.

**Key words:** Kareesh cheese, cheesecake, low calorie, diabetics.

### Introduction

The increasing need for foods, particularly low fat and carbohydrate dairy products to face a common health problems such as obesity, diabetes mellitus, coronary heart disease and hypertension, has paved the way for the formulation of a food product that is sweet in taste and of a high nutritive value but at the same time low in fat and carbohydrate<sup>1</sup>. Cheese therefore provides an ideal vehicle for preserving the valuable nutrients in milk and making them available throughout the year. Cheese is an excellent source of protein and minerals such as calcium and phosphorus and essential amino acids and therefore an important food in the diet of both young and old people<sup>2</sup>.

High carbohydrate foods induce weight gain by raising insulin levels in the body which is important because insulin deposits not just sugar inside cells<sup>3</sup>, but also fat. The increase in the level of insulin leads to the storage of glucose rather than the burning of protein. Alternative non-carbohydrate sweeteners are recommended on low carbohydrate diets<sup>4</sup>. Excessive consumption of carbohydrates, including sucrose, causes obesity and diabetes in a significant portion of population. One objective of the health program for this population is the partial replacement of sucrose by fructose<sup>5</sup>. The goal of a diabetes nutrition plan is to provide a mixture of fats, carbohydrates and proteins at an appropriate calorie level to provide essential nutrients as well as create an even release of glucose into blood from the meal<sup>6</sup>. The aim of the present study was to prepare and evaluate a low calorie functional cheesecake, using fructose, whole wheat, egg white, skimmed milk powder, kareesh cheese and olive oil, useable for both healthy and diabetic people.

### Materials and Methods

**Materials:** Fructose powder was obtained from Halwani Ekhwan, Saudi Arabia. Sucrose, vanillin, olive oil, skim and full cream milk, butter, egg and lemon rind were obtained from the local market. Whole wheat flour was purchased from the local market.

**Preparation of kareesh cheese:** Fresh skim milk was standardized to achieve 16% total solids contents, heated at 90°C for 15 min and cooled to 40°C. Once the cheese milk was prepared, starter culture was added to generate lactic acid from lactose. Acidification occurs until the pH is lowered to 4.6, which causes precipitation of the casein proteins. A very small amount of rennet was added to the milk to make the curd firmer and promote whey expulsion. After coagulation, the curd was cut and cooked at 50°C for approximately 2 hours. During this time, whey is expelled from the curd and the texture of the curd becomes firmer. The whey is then drained off and the curd is washed repeatedly with chlorinated water. The washings were intended to remove lactose and prevent further acidification of the curd. The kareesh cheese was stored at 4°C until use in cheesecake manufacture<sup>7,8</sup>.

**Preparation of cheesecake for diabetics:** The preparation of low sugar and fat cheese-cake was carried out using the replacement of sugar with fructose of equal sweetness, white flour with whole wheat flour, fresh milk with skim milk, butter with olive oil and whole egg with egg white only. Table 1 shows ingredients of low-sugar and -fat functional cheesecake and regular cheesecake.

**Preparation of cheesecake crust:** The ingredients were all blended in butter oil (regular) or olive oil (diabetic) in a medium

mixing bowl and mixed manually. The dough was divided into two equal portions. One half was used to line the bottom of a greased 6-inch spring form pan, the other half was used to line the sides of the pan. The dough was rolled out and pressed with fingers and chilled before filling.

**Preparation of cheesecake mixture:** Oven enclosed the crust was preheated to 250°C for 10 min, kareesh cheese was pressed through a sieve and the baking powder was combined and set aside. In a large mixing bowl, kareesh cheese was combined with fructose, egg white, lemon rind and vanilla and mixed until becoming very smooth. The skim milk was stirred and added to the cheese and blended very well. The cheese mixtures were poured into the prepared crust and baked and poured in the oven at 100°C for one hour. The center remained soft, then the oven was turned off and the door was opened and the cake was left and allowed to cool at room temperature and then served.

**Study subjects:** Total of 30 volunteers with diabetes (10 women and 20 men) was selected to participate in the study by coordination and arrangement with medical staff in Qassim Hospitals. Their age ranged between 38 and 60 years. All subjects completed a routine medical examination. Inclusion criteria were for those who came to follow up their blood glucose level for 3 weeks and had blood glucose level (average fasting blood glucose)  $\leq 252.57$  mg/dl. Subjects were excluded if they had clinically significant illnesses (hepatic disease, heart disease and/or hypertension). Female pregnant or lactating, or those taking medications to loose weight were also excluded.

Blood glucose samples were collected by finger prick method on two separate occasions. One occasion, the same volunteers were asked to eat a piece of the regular cheesecake (about 100 g) as a breakfast food item (control). On another day the volunteers were asked to eat a piece of the tested cheesecake (about 100 g) as a breakfast food item (test). Blood glucose sampling was withdrawn as fasting (0 min) and at 120 minutes postprandial<sup>9</sup>, then volunteers were allowed to take their usual oral hypoglycemic drug. Blood glucose concentration was determined according the method described by ADA<sup>10</sup>, using hexokinase method (Boehringer Mannheim, Gambi-D-68298).

**Sensory evaluation:** Sensory evaluation for the low calorie functional cheesecake was assessed by 30 panelists from volunteers of diabetics and normal people in three hospitals in Qassim area. The cake was evaluated for appearance, color, odor, flavor, texture and overall acceptability, a scoring system for sensory evaluation was adopted from N.A.S.A.<sup>11</sup>.

**Statistical analysis:** Statistical analysis of variance (t-test) of data within groups and between groups was conducted as described by Miller and Miller<sup>12</sup>.

### Results and Discussion

Table 1 shows the ingredients of tested cheesecake for diabetics compared with control (regular cheesecake). As shown in Table 1, whole wheat flour was used instead of refined wheat flour according to Fung *et al.*<sup>13</sup> who stated that whole grains reduce the postprandial glucose and increase insulin response for diabetic people.

The fat content of the cake (Table 2) was minimized in order to lower its caloric value, since it is well documented that obese and diabetic people have a tendency towards hypercholesterolemia<sup>14</sup>. Thus the following precautions were taken during formulation of the cake: i) Unbleached flour was used because carbohydrate and fiber may play a role in enhancing early insulin secretion in individuals with metabolic syndrome, which may lower the risk of deteriorating glucose tolerance and development at type II diabetes<sup>15</sup>. ii) Whole egg was replaced with egg white in the tested formula. iii) Olive oil was used, avoiding butter and margarine addition to the cake. iv) Skimmed milk was preferred to fresh milk. v) Kareesh cheese was used because of its high protein and low fat content.

Sensory scores for the appearance, odor, texture, flavour and overall acceptability of the cheesecake were compared to those of the control cake as shown in Table 3. The panelists could not find any significant difference between the test and control cakes as regards to the appearance (score 7.95 and 6.85), the odor (score 7.75 and 6.40), texture (score 8.2 and 7.70), flavour (score 8.30 and 6.50) and overall character (score 8.70 and 6.55) respectively. The scoring system used for sensory evaluation is shown in Table 4.

The mean values of blood glucose level after 120 minutes for the subjects on the low calorie cheesecake was 247.28±42.92 mg/dl and for the same subjects who ate the regular breakfast diet 360±25.05 mg/dl (Table 5). The tests were repeated for three times. The decrease in the glucose level in the blood of the subjects may be related to the contents of the tested cheesecake.

**Table 1.** Ingredients of tested cheesecake for diabetics compared with control cake.

Tested cheesecake		Regular cheesecake	
Crust			
210 g	Whole wheat flour	200 g	Refined flour
50 g	Fructose powder	75 g	Sucrose granulated
1 t	Baking powder	1 t	Baking powder
80 g	Olive oil	80 g	Butter
2	Egg white	2	Whole egg
Cheesecake mixture			
525 g	Kareesh cheese	500 g	Kareesh cheese
1 t	Baking soda	1 t	Baking soda
4	Egg white; large	4	Whole egg; large
½ t	Vanilla extract	1/2 t	Vanilla extract
155 ml	Skim milk	150 ml	Full cream milk
100 g	Fructose powder	150 g	Sugar granulated
1/4 t	Lemon rind	1/4 t	Lemon rind
50 g	Olive oil	50 g	Sour cream

**Table 2.** Composition of regular and diabetic's cheesecake.

	Diabetic cheesecake	Regular cheesecake
Serving size (g)	100	100
Fat	13.31	15.29
Protein (g)	17.84	18.63
Carbohydrates(g)	17.36	22.12
Dietary fiber	2.54	0.48
Ash (g)	4.38	4.84
Moisture	51.49	43.88
Calories from carbohydrates	69.44	88.48
Calories from fat	119.79	137.16
Calories from protein	71.36	74.52
Total calories	260.59	300.20

Fiber content of the cheesecake increased by the use of unbleached wheat flour. This increase in the fiber content has hypoglycemic effects. The increase in fiber using unbleached flour which based on carbohydrate modification enhances early insulin secretion in persons with metabolic syndrome, which may lower the risk of deteriorating glucose tolerance and development of type II diabetes<sup>15</sup>.

Fructose, which is absorbed through the intestinal wall directly into the blood stream, does not need insulin help to get into cells, has some advantage as a sweetener for use by people with diabetes. Fructose is also preferred to glucose because it is thought to take longer period to raise blood glucose level<sup>16</sup>. Fructose is the sweetest natural sugar and is reported to have 1.5 to 2.0 times the sweetness of sucrose. The ingestion of normal amounts of fructose by humans does not depend on insulin, thus, fructose is suitable for consumption by diabetics who can enjoy the same sweetness with fewer calories<sup>17-19</sup>.

The tested cheesecake contained olive oil which plays an important role in diabetes. Researches have demonstrated that people who include olive oil in their diet have a better control over their diabetes and lower levels of some fats in the blood when compared with diets rich in butter and carbohydrates normally recommended for this type of diabetes<sup>16, 20, 21</sup>.

From the previous findings, ingredients of the tested cake had the following advantages: i) creation of an even release of glucose into the blood, as evident from the reduction in the postprandial peak blood glucose of the test subjects when compared to that of the control subjects; ii) reduced effect on the magnitude of postprandial hyperglycemia, noticed from the lower mean 2 hours blood glucose level of subjects who ate the test cake<sup>22</sup>. It is worth of mentioning that previous studies have demonstrated that the reduction in postprandial hyperglycemia significantly reduces microvascular and macrovascular complications in patients with diabetes<sup>23</sup>. It is recommended that this ready prepared low calorie formulated functional cheesecake with fructose, whole wheat, egg white, skimmed milk, kareesh cheese and olive oil would be a great meal replacement diet for diabetics.

### Conclusions

A formulated functional cheesecake for diabetics was prepared and evaluated to assess benefits effect on health. The tested cheesecake contained low caloric value ingredients. Sensory evaluations showed that the regular cheesecake and the low calorie cheesecake have a good score. Also, data showed that mean blood glucose level after 120 minutes for the subjects who ate the low calorie cheesecake was 247.28±42.92 mg/dl, while the mean blood glucose level for the subjects who ate the regular breakfast diet was 360±25.05 mg/dl. It is concluded that tested formulated functional cheesecake would be a great meal replacement diet for diabetics.

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**Table 3.** Sensory evaluation of the regular cheesecake and cheesecake for diabetes.

	Regular cheesecake			Diabetic cheesecake		
	Mean	SD	C.V.	Mean	SD	C.V.
Appearance	6.85	2.084	30.42	7.95	1.669	20.99
Odor	6.40	2.348	36.69	7.75	1.650	21.29
Texture	7.70	1.894	24.60	8.20	1.067	13.09
Flavour	6.50	1.986	30.56	8.30	1.490	17.95
Overall	6.55	2.064	31.51	8.70	1.174	13.49

SD Standard deviation, C.V. Coefficient of variation

**Table 4.** Scoring system used for sensory evaluation.

High scores	Mid scores	Low scores
9-Like extremely	6-Like slightly	3-Dislike moderately
8-Like very much	5-Neither like nor dislike	2-Dislike very much
7-Like moderately	4-Dislike slightly	1-Dislike extremely

**Table 5.** Comparison of blood glucose level between control and test cakes after 120 min postprandial blood.

	Mean	SD	C.V.
Fast (mg/dl)	252.57	32.80	12.98
Control (mg/dl)	360.85	25.05	6.94
Test (mg/dl)	247.28	42.92	17.35

SD Standard deviation, C.V. Coefficient of variation

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