

## Almond Consumption Decreases Fasting and Post Prandial Blood Glucose Level in Female Type 2 Diabetes Subject

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**Abstract: Problem statement:** Population studies indicate that individuals who regularly consume nuts have reduced risk for cardiovascular diseases and diabetes. The beneficial role of almonds has been established with respect to serum lipid profile however, its beneficial effects on glycemia is still to be established. Aim of the study was to investigate the response of almond feeding on fasting and post prandial blood glucose levels in T2DM female subjects. **Approach:** Twenty female T2DM subjects (40-60 years), having mean height 151.59±6.02 cm, body weight 59.3±10.57 kg, BMI of 25.73±4.10 kg m<sup>-2</sup> and fasting blood glucose levels between 130-180 mg dL<sup>-1</sup>, free from any other disease, non smoker, teetotaler participated in this study. The subjects continued their free life style and in addition were given to eat 10 g of raw almonds per day as part of their first meal. Twelve hours fasting and 2 h post prandial blood was analyzed for glucose in blood collected after finger prick by a sterile disposable stellate on glucose analyzer (one touch basic plus complete diabetes monitoring system life scan, Inc. USA). **Results:** The mean fasting blood glucose levels gradually decreased from 152.7±19.44 (pre intervention) to 140.25±27.14, 137.15±25.82, 132.45±24.11 and 126.05±26.48 mg dL<sup>-1</sup> respectively after 1, 2, 3 and 4 week of almond feeding. Similarly post prandial glucose during 0, 1, 2, 3 and 4 week were 216.5±51.08, 194.50±48.31, 194.55±63.78, 177.75±43.33 171.0±42.43 mg dL<sup>-1</sup> showing a decline. **Conclusion:** Almond feeding significantly (p<0.01) reduced both fasting and post prandial blood glucose levels in female T2DM subjects. The active principle and mechanism needs to be elucidated.

**Key words:** Almond, T2DM, fasting blood sugar, females

### INTRODUCTION

Population studies indicate that individuals who regularly consume nuts have reduced risk for cardiovascular diseases and diabetes<sup>[1]</sup>. The beneficial role of almonds has been established with respect to serum lipid profile<sup>[2]</sup> however, its beneficial effects on glycemia are still to be established. Some studies indicate that almond consumption decreases blood glucose<sup>[3]</sup> while others were unable to observe such effects<sup>[4]</sup>. Although almost 50% of almond weight is fat, incremental intakes of 7 g day<sup>-1</sup> of this tree nut reduce Low-Density Lipoprotein (LDL) cholesterol concentration by 1%, especially within the context of diets recommended by the National Cholesterol Education Program. Habitual almond consumption does not lead to weight gain<sup>[4]</sup> and their inclusion in low-calorie diets appears to promote more weight loss than a comparable carbohydrate-based low-calorie diet.

Almonds in addition to lowering serum cholesterol levels may also reduce the glycemic impact of carbohydrate foods with which they are eaten<sup>[5]</sup>. Almonds are an excellent source of bioavailable  $\alpha$ -tocopherol and increasing their intake enhances the resistance of LDL against oxidation. In addition, the polyphenolic constituents of almonds have been characterized and found to possess antioxidant actions. The benefits of almonds for cardiovascular health, obesity and age related diseases appear promising and thus in the present investigation effects of almond addition to diet on fasting and post prandial blood glucose was investigated in T2DM female subjects.

### MATERIALS AND METHODS

**Almonds:** American almonds (*Prunus amygdalus*) were purchased from the local market in single lot. Their proximate composition was determined using standard procedures and they contained protein 21.08%,

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Table 1: List of drugs taken by subjects

Sr. No.	Name of the drug	Quantity (mg)	Active compound	No. of times	B = Before meal A = After meal
1	Glucosid	5+500	Glibenclamide + Metformin HCl	2	B
2	Diacon-M	5+500	Glipizide and Metformin	2	A
3	Diabend-M	80+500	Gliclazide and Metformin HCl	2	B
4	X met	500	Metformin HCl	2	B
5	Glimcip 1	1	Glimepiride	2	B
6	Glynase-MF	5+500	Glipizide and metformin HCl	2	B
7	Metaglez-forte	500+5	Metformin HCl and glipizide in beta-cyclodextrin complex	2	B
8	Pioglar	15	Pioglitazone	2	B
9	Piopod-30	30	Pioglitazone	2	B
10	Diabetrol SR	5+500	Glibenclamide + metformin sustained release	2	B
11	Metride-2	2	Glimepiride	1	B
12	Gemer-2	2	Glimepiride	2	B
13	G-REG-SR-1000	1000	Metformin HCl sustained release	1	A
14	Metformin HCl	500	Metformin HCl	2	A
15	Glynase 50	50	Gliclazide	2	B
16	Trigluco red forte	5+500+2	Glibenclamide metformin HCl and Rosiglitazone maleate	2	B
17	Diabose 25	25	Metformin HCl	1	B

fat 53.3%, carbohydrate (12.9%), moisture (6.3%), fiber (2.38%) and ash (4.0%).

Mean  $\pm$  SD values were calculated and Paired 't' test was used to assess the effect of intervention.

**Subjects:** Twenty locally residing female T2DM subjects (40-60 years) having fasting blood sugar 130-180 mg dL<sup>-1</sup> volunteered (consent taken) in this study approved by Institutional ethical committee. Information regarding their history of diabetes, eating habits, medication (17 subjects took medications as shown in Table 1) was collected by interviewing them. Subjects resorting to smoking-drinking or suffering from any other disease were not included in the study. Their dietary intake of nutrient was ascertained prior to study by 24 h dietary recall for three consecutive days while their nutritional status was judged by height weight and BMI measurement.

## RESULTS

These women of average age 51.60 $\pm$ 6.07 (range 40-60 years) consumed on an average of 1274.94 $\pm$ 307.65 Kcal which was 91.6 % of their energy requirement based on BMI. The average height (cm), weight (kg) and BMI ((kg m<sup>-2</sup>) respectively were 151.59 $\pm$ 6.02, 59.30 $\pm$ 10.56, 25.73 $\pm$ 4.10. Almond intervention had no effect on body weight and BMI of the subjects.

**Study protocol:** These subjects continued their existing free life style in terms of eating habits, medication and activity pattern. Their blood glucose (both fasting and 2 h post prandial) was assessed at 0, 7th and 14th day (these three gave the pre intervention status) after which they were provided with raw almonds @ 10 g day<sup>-1</sup> person<sup>-1</sup> and they were advised to consume the same with their first meal every morning. This intervention continued for four weeks and during which blood glucose (fasting and two hr post prandial) was estimated on weekly basis i.e.; on 21st, 28th, 35th and 42nd day of study. Blood collected after finger prick by a sterile disposable stilet was analyzed on Portable Glucose analyzer (one touch basic plus complete diabetes monitoring system Life Scan, Inc. USA)

Data in Table 2 gives the fasting and post prandial blood glucose levels in the subjects. The observations prior to intervention were recorded thrice, these served as pretest control values. The mean fasting blood glucose levels at 0, 1, 2 weeks pre intervention were 152.4 $\pm$ 17.45, 152.5 $\pm$ 23.57, 152.8 $\pm$ 27.14 while in the 4 weeks after almond intervention were 140.25 $\pm$ 27.14, 137.15 $\pm$ 25.82, 132.45 $\pm$ 24.11 and 126.05 $\pm$ 26.48 mg dL<sup>-1</sup> respectively. The effect of almond on lowering blood glucose was evident from the very first week and it successively decreased with the duration of intake (Table 2). Similarly, the mean post prandial blood glucose levels during preintervention period were 216.6 $\pm$ 59.78, 213.8 $\pm$ 55.28 and 218.7 $\pm$ 53.31. While after intervention they were 194.50 $\pm$ 48.31, 194.55 $\pm$ 63.78, 177.75 $\pm$ 43.33 and 171.0 $\pm$ 42.43 mg dL<sup>-1</sup>. The effect of almond intervention on post prandial glucose was also evident after 1 week (Table 2).

Table 2: Blood glucose levels before and after almond intervention

	Blood glucose (mg dL <sup>-1</sup> )						
	Before almond intervention			After almond intervention			
	0 day	7th day	14th day	21st day	28th day	35th day	42nd day
Fasting blood glucose	152.4 <sup>a</sup> ±17.45	152.5 <sup>a</sup> ±23.57	152.8 <sup>a</sup> ±27.14	140.3 <sup>b</sup> ±27.14	137.15 <sup>c</sup> ±25.82	132.45 <sup>d</sup> ±24.11	126.05 <sup>e</sup> ±26.48
2 h post prandial	216.6 <sup>a</sup> ±59.78	213.8 <sup>a</sup> ±55.28	218.7 <sup>a</sup> ±53.31	194.5 <sup>b</sup> ±48.31	194.60 <sup>b</sup> ±63.78	177.80 <sup>c</sup> ±43.33	171.70 <sup>c</sup> ±42.43

All values are Mean ± SD of twenty subjects. Values with different superscript p<0.01

**DISCUSSION**

The present study has demonstrated that inclusion of 10 g of almonds in diet of T2DM female subjects led to significant reduction in their fasting and post prandial blood glucose levels. T2DM and other age related disorders work in synergy to manifest health problems in elderly. The management of these thus becomes interrelated. Post prandial events have attracted much attention for the potentially important role they play in cardiovascular disease risk and diabetic complications<sup>[6]</sup>. A number of cohort studies have shown a negative association between nut consumption and risk of CVD diseases, cancers, glucose metabolism and insulin regulation<sup>[7]</sup>. Analysis of almonds and their seed coats demonstrated high level of antioxidants, phytochemicals and biologically active compounds in them<sup>[8]</sup>. Moreover, soluble fiber in almonds lowers cholesterol and controls blood sugar level in people with diabetes. The almond skin contains fiber, which is good for digestion. Regular almond consumption can thus be recommended as life style intervention to promote better health.

**CONCLUSION**

Almond feeding significantly (p<0.01) reduced both fasting and post prandial blood glucose levels in female T2DM subjects.

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