Comparison of glycaemic response to honey and glucose in type 2 diabetes

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Abstract

Objective: To compare the glycaemic effect of 75 gram and 30 gram of natural honey in a honey tolerance test with that of 75 gram glucose in type 2 diabetics.
Methods: The experimental study was conducted at the Jinnah Medical College Hospital, Karachi, and comprised 97 type 2 diabetic patients who came to the out-patient department between March and August 2011. The patients were randomly divided into 75 gram honey group (group 1), 30 gram honey group (group 2), and 75 gram glucose group (group 3). Fasting blood samples were obtained as well as after 1 and 2 hour. SPSS 11 was used for statistical analysis.
Results: Of the 97 participants, 62 (64%) were females and 35 (36%) males.Their ages ranged from 25-68 years. Mean rise in blood glucose after two hours in group 2 was 30 mg/dl; group 1, 85mg/dl, and group 3, 170 mg/dl. The difference was statistically significant ($p < 0.005$). The glucose response was significantly lower at 2 hours in group 2 ($p < 0.001$) compared to group 1 or group 2. A significant difference was also seen in group 1 and 3 ($p < 0.0001$). The plasma glucose level in response to honey peaked at 60 min and showed a rapid decline compared to that of glucose, indicating a lower glycaemic response of honey. A small proportion of patients 3 (10.7%) even showed a glucose lowering effect after low dose of honey.
Conclusion: Low dose of honey can be a valuable sugar substitute for patients with diabetes.
Keywords: Honey, Type 2 diabetes mellitus, Glucose tolerance test, Insulin, Fructose. (JPMA 64: 69; 2014).

Introduction

The history of honey dates back to 3000 BC Egyptians and Chinese used it as medicine while Greeks considered it as food for the gods. For the Muslims, benefits of honey had been revealed more than 1400 years ago. The Holy Qur'an tells us about the healing power of honey.[1]
Honey is a natural sweetener and the making of honey is purely undoctored. Bees collect nectar from many plants, including some medicinal plants such as the Red Clover. So it is postulated that the medicinal properties of such plants are transmitted by the bees into the honey that they produce. Sugar, on the other hand (composed of 99% sucrose) is normally extracted from sugarcane and this process destroys valuable nutrients such as protein, organic acid and other enzymes,[2] Thus, honey remains the best natural sweetener with excellent nutritional and healing properties.
The honey used in our study was clover honey. It is a complex solution of many sugars, including fructose (38%), glucose (32%), sucrose (2%), maltose (7%) and other sugars, acids and flavour compounds (4%).[3]
Being a sweetener containing various types of sugars, honey is supposed to have a hyperglycaemic aggravating effect. However, contrary to this, studies on animal models[4] and humans with type 1 diabetes[5] and impaired insulin tolerance[6] have shown hypoglycaemic effects of honey. However, the

precise mechanism(s) of this hypoglycaemic effect remain(s) unknown. Similar studies in type 2 diabetes mellitus (T2DM) patients were lacking in Pakistan.
The current study aimed at confirming these findings by comparing the effects of 30grams and 75 grams honey with 75grams oral glucose tolerance (OGT) test solution5,6 on plasma glucose in T2DM patients.

Patients and Methods

The open-labelled experimental study based on, convenience sampling involved 97 adult T2DM patients who attended the outpatient department of Jinnah Medical College Hospital, Karachi, during March and August 2011.
Patients with renal impairment, pregnancy and those who smoked or were on steroids were excluded. All adult T2DM patients aged 18 years and above with fasting plasma glucose <200mg/dl were selected.
Approval was taken from the Hospital Ethical Committee which was in accordance with the latest version of Helsinki declaration. Informed consent was taken from all the participants. The natural honey brand used was Sue Bee Honey which is a clover honey, 100% pure.[3] After an overnight fast, the patients were randomly divided into 3 groups: 39 (40%) patients in group 1 ingested 75 grams pure natural honey; 28 (29%) in group 2 were given 30 grams pure natural honey; and 30 (31%) in group 3 were given 75 grams glucose. Each was mixed with 250 mls of water and was consumed immediately. Blood samples were taken at zero hour (fasting status), then at one and two hours after ingestion. Patients who had a plasma glucose levels >250mg/dl 2 hours after the test were retained for 12 hours in day care for observation. None of the patients developed any serious complication.
Data was analysed on SPSS Version 11. Descriptive values were taken and means were calculated for each group. One-way analysis of variance (ANOVA) was used for comparison of means between different groups. Multiple comparisons were done using the Tukey post-hoc test.

Results

Of the 97 patients, 62 (64%) were females and 35 (36%) males. The ages of the patients ranged from 25-68 years with a mean of 50±9.7 years. The duration of diabetes ranged from 1 to 20 years with a mean of 5.3±4.9 years. Six (6.2%) patients were on diet control alone, 65 (67%) were taking oral hypoglycaemic agents alone, 26 (26.8%) were taking insulin in combination with metformin and/or Thiozolidinediones (TZDs). In groups 1 and 2, the blood glucose level peaked at one hour followed by a fall at two hours. On the contrary, the blood glucose level in group 3 kept on rising even in the second hour (Table).

Table: Mean blood glucose levels at fasting and after ingestion of glucose or honey.

	FBS mg/dl	After 1 hr mg/dl	After 2 hrs mg/dl
75 gms honey	175.9	277.8	261.8
30 gms Honey	191.7	246	222.4
75 gms Glucose	187.4	290	358.3

FBS: Fasting blood sugar.

The mean rise in blood glucose levels after 2 hours was also noted (Figure-1).

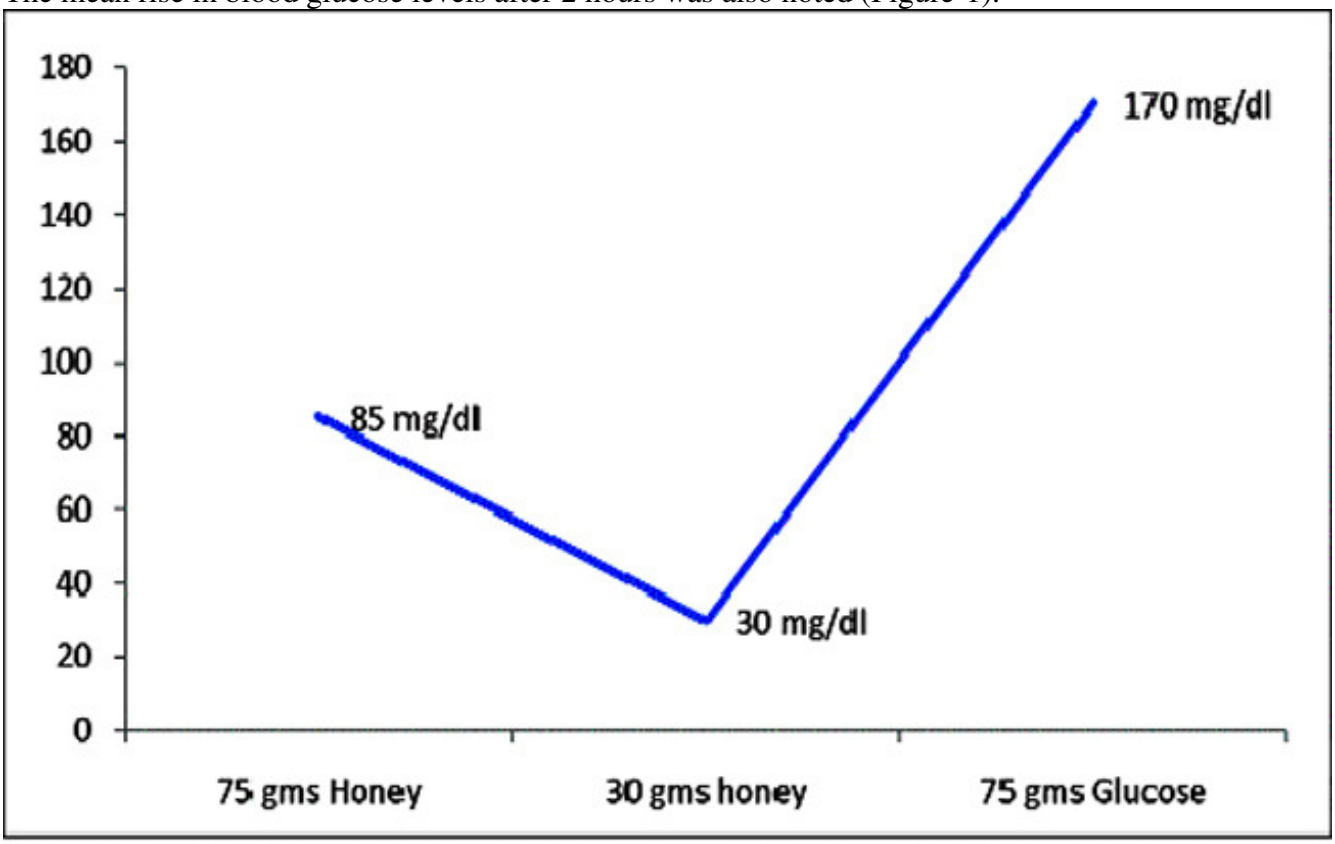

Figure-1: Mean rise of blood glucose level from baseline after 2 hours.

When comparing group 1 and 3, 5 (13.3%) patients in group 3 had a rise of > 200 mg /dl above the baseline compared to 1 (2.5%) in group 1. In group 2, 19 (68%) had a rise of <50mg/dl above baseline while none showed a rise above 200 mg/dl. Surprisingly, 3 (10.7%) had a blood glucose at 2 hours which was below the fasting level (Figure-2).

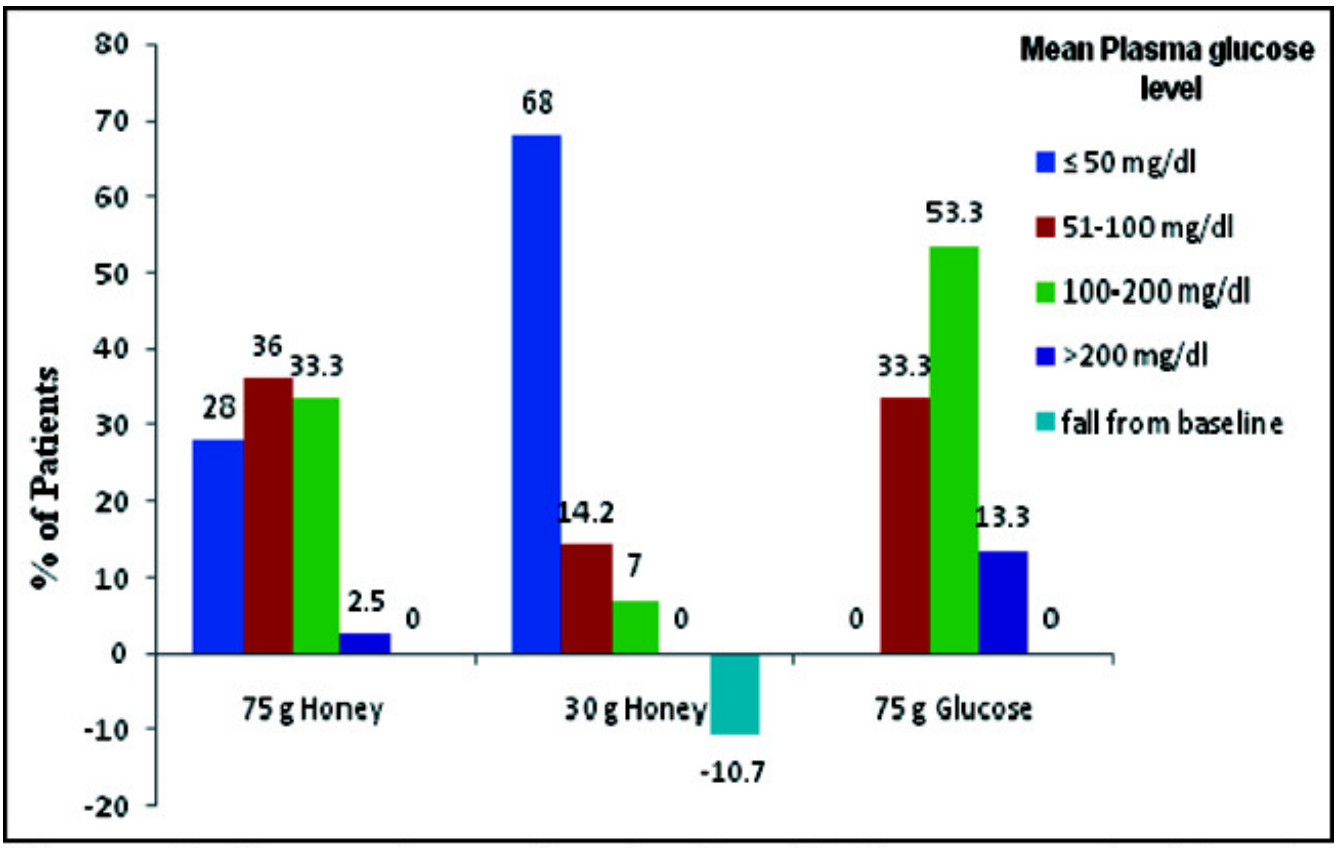

Figure-2: Percentage of patients with the amount of rise in blood glucose above baseline at 2 hours.

Results, when analysed by ANOVA, showed significant difference between all the three tested groups ($p < 0.005$). Tukey post-hoc test on one-way ANOVA showed that the glucose response was significantly lower at 2 hours in group 2 ($p<0.001$) compared to group 1 or group 3. A significant difference was also seen in groups 1 and 3 ($p<0.001$).

Discussion

The study was undertaken to compare the glycaemic response to low and high quantity of honey and glucose in diabetic patients.

The rise in blood glucose level at 60 and 180 minutes was significantly lower in the natural honey group compared to the standard 75g grams glucose solution. This is similar to the study done on healthy individuals taking either glucose or natural or artificial honey showing a low plasma glucose rise in the natural honey group.[7] Another study done on normal healthy subjects revealed that honey had less effect on serum glucose than the honey-comparable glucose-fructose solution.[8]

It is interesting to note that at 2 hours after ingesting 30 grams and 75 grams of honey, the mean blood glucose levels were lower than that at first hour after ingestion. The exact reason for this glucose-lowering effect following an initial rise is unknown. Study done by Deibert et al[9] suggested that the effect of honey might depend partly on the fructose content of honey. The clover honey brand used in our study had a fructose content of 38% compared to glucose content of 32%.[3] The exact mechanism of this fructose-lowering mechanism is yet to be ascertained. However, a review article revealed several mechanisms which include enhanced hepatic glucose uptake via activation of glucokinase and promotes synthesis and storage of glycogen via activation of glycogen synthase in the liver, another

mechanism is that glucose and fructose might exert a synergistic effect in the intestine and pancreas. This might enhance intestinal fructose absorption in the intestine and stimulate insulin secretion in the pancreas. Fructose might improve glycaemic control independent of its insulinotropic effect.[10]
Certain other mechanisms have been proposed, a study suggests that honey causes less effect on serum insulin and C-peptide levels in normal healthy subjects.[8] Another study revealed a lower rise in blood glucose after royal jelly ingestion, suggesting that substances originating from the pharyngeal glands of the honey bee with insulin-like activity are likely to have caused this effect and may thus be, at least partially, responsible for the lowering impact of honey on blood glucose levels.[11] A study on animal model suggests that glucotoxicity contributes to beta-cell dysfunction through oxidative stress, whereas the hypoglycaemic effect of honey might be attributed to its anti-oxidative effect on the pancreas.[9] This effect is further strengthened by a study concluding that honey can lower the concentrations of prostaglandins in plasma of normal individuals.[12] However, the exact mechanism functioning in T2DM patients is yet to be ascertained as studies are lacking in this area.
Prevailing beliefs over the past 20 years regarding sugars and diabetes admonished that added sugar, primarily sucrose, should be avoided in diabetic diet13 as it would confer a higher postprandial glycaemia.[14] Consequently, diets for diabetic patients have been sugar-restricted for fear of stimulating hyperglycaemia.[13] Our study found that 68% T2DM patients had a rise of <50gm/dl of blood sugar after ingestion of low-dose honey, suggesting its use in T2DM patients as a blunted glycaemic response may be beneficial for reducing glucose intolerance.[15]
The current study was not designed to address long-term benefits of using honey by T2DM patients. Though small, the study highlights the blunted response of blood glucose level after honey consumption. Further large-scale studies are needed to confirm this.

Conclusion

Low dose of honey can be a valuable sugar substitute for patients with diabetes. Identification of substances in honey responsible for this glucose-lowering effect could lead to the development of new treatment adjuncts in the field of diabetology.

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