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The Effect of Honey Consumption Compared with Sucrose on Blood Pressure and Fasting Blood Glucose in Healthy Young Subjects

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ABSTRACT

Background: Several studies have shown that honey consumption can have beneficial effects on cardiovascular disease indicators. This study aimed to assess the effect of honey consumption compared with sucrose on fasting blood glucose and blood pressure among young healthy subjects.
Methods: Sixty healthy subjects, aged 18 to 30 years, enrolled to this double blind randomized trial for one month. Participants assigned randomly to honey (received 70 gram honey per day) and sucrose (received 70 gram sucrose per day) groups. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured and fasting blood sugar was collected from all participants in the beginning and end of study.
Results: In this trial, the baseline FBS, SBP and DBP were not different between honey and sucrose groups ($P > 0.3$). We found that consumption of honey can decrease the FBS in healthy young subjects, but intake of sucrose increase it. Moreover, reduction of the FBS in honey group was significant than sucrose group ($P < 0.001$). Honey and sucrose consumption cannot decrease the SBP and DBP, significantly ($P > 0.4$). In all of these analyses, confounding variable including age, physical activity and some nutrient intake were adjusted.
Conclusion: Honey consumption can decrease the FBS, but has no effect on SBP and DBP. Further studies are needed to confirm our findings.

Introduction

Cardiovascular diseases (CVDs) are described as a group of disorders of the blood vessels and heart that are main causes of morbidity and mortality worldwide (1, 2). About 17.3 million people died of CVDs in 2008 that contains 30% of all deaths in the world and this number is estimated to grow to over 23.6 million by 2030 (3, 4). According to WHO, over 45% of deaths occurring in Iran are due to cardiovascular diseases (5). Untreated CVD can end in Ischemic Heart Disease that is the most common cause of death in the world. Myocardial infarction is another fatal end point of cardiovascular disease that leads to heart attack in turn. Finally, untreated CVD can bring along high individual and social burden (6).
In addition to smoking that is the most important risk factors for CVD other risk factors include elevated blood cholesterol, obesity, and diabetes, all related to inappropriate eating habits (7). Among these, are elevated blood pressure and high fasting blood glucose (FBG) that both can be modified by change in diet (8). Displacing sucrose by honey is claimed that can improve

fasting blood glucose (9). There are conflicting results in earlier studies that have assessed the different effects of sucrose and honey intake on fasting blood glucose. Some of the studies on FBG have reported reduction in its levels (10, 11), the study by L.CHEPULIS – N.STARKEY showed that honey intake increased HbA1c (12) and another study found no significant difference between the two groups (13). Overall, no definite conclusion is available on the effect of honey intake on fasting blood glucose. Earlier findings in this regard have controversy and several previous studies were performed in mice and obese subjects or patients. Furthermore, there are limited data on the effect of sucrose and honey intake on fasting blood glucose and blood pressure in healthy subjects. If the positive effects of honey intake on FBS and blood pressure be proven then we can expect to reduce some of the risk factors of cardiovascular disease and therefore decrease the heavy burden of it. The purpose of this study was to investigate the effect of honey consumption compared with sucrose on fasting blood glucose and blood pressure among young healthy subjects.

Materials and Methods

Subjects

A total of 60 male students, aged between 18 and 30 years, were selected from Isfahan University of Medical Science. They had been selected using systematic clustering sampling method. Students were eligible if they were healthy, non-athlete, non-smoker and had no history of inflammatory diseases or cardio metabolic disorders. Participants randomly allocated to honey and sucrose groups using permuted block allocation method. Subjects' sample size was calculated by following formula as: $n = \frac{2(Z1+Z2)\sigma^2}{d^2}$, α=0.05, 1-β=0.8 and d=0.8

By predicting 5% dropout for the participants we selected 30 subjects in each group. Students were asked not to change their common diet or physical activity during the study period. Subjects, who took any sort of medications or supplements, consumed a substantial amount of honey daily or changed their usual diet and those who did not follow 80% of study guideline were excluded from the study. Subjects in intervention group consumed 80 grams honey solved in 250 milliliters tap water and control group received 80 grams sucrose solved in 250 milliliters tap water as snack once a day for 6 weeks. Physical activity and dietary intake of participants were evaluated using long form of international physical activity questionnaire (IPAQ) and 3-day diet record respectively at baseline and end of the study. We used NUTRITIONIST IV Software (Version 7.0; N-squared Computing, Salam, OR, USA) which was modified for Iranian food items to obtain nutrient intake of students. We estimated Physical activity level as metabolic equivalent minutes per week (MET-hour/wk). In order to calculate MET-hour/wk, the MET-hour/wk for each exercise was calculated (Days per week × hour of exercise each time × MET equivalent of exercise) and all MET-hour/wk values were summed to estimate total MET- hour /wk for each person. All subjects provided Informed consent that was approved by the Isfahan University of Medical Science Ethics Committee.

Biochemical Analysis and Blood Pressure Measurement

A 5 ml blood sample was obtained from all subjects after an overnight fasting and collected into the test tubes to obtain serum, which was obtained by low speed centrifugation at 1500 × g for 10 min. Serum was separated and used for the assessment of fasting blood glucose. Fasting blood sugar (FBS) concentration was measured with enzymatic kits (Pars Azmoon, Tehran, Iran). Blood pressure was determined at baseline and end of the study by trained observer using a sphygmomanometer with a suitable cuff. Blood pressure was determined in a quiet room with a stable temperature that was maintained at 20 to 25°C. Measurements were done 3 times at each visit in a seated position after 15 minutes rest. Baseline and end-of-period blood pressure was defined as average of all 3 values. The same observer did the measurements to avoid any measurement bias.

Statistical Analysis

Quantitative data are expressed as average and standard deviation of mean and qualitative values are expressed as frequency and their percent. Differences between means of quantitative and qualitative values in intervention and control groups at baseline were assessed using unpaired Student's t-test and chi square test, respectively. Paired- sample t test was used for comparing means value between before and after intervention period within groups and Independent sample t-test for comparing between groups. Analysis of covariance was used for assessing variations after adjusting for confounders, such as age and physical activity. Statistical analyses were performed with Statistical Package for the Social Sciences, (version 21; SPSS, Chicago, Ill). P≤.05 was considered as significant level.

Result

Totally, 60 participants (30 subjects in honey group and 30 in sucrose group) completed the trial. Demographic characteristics of participants in honey and sucrose groups are presented in **Table 1**.

Table 1: General characteristics of participants in honey and sucrose groups

Variables	Honey group[1]	Sucrose group[2]	P-value†

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Age (year)	21.53 ± 1.63	24.23 ± 1.88	< 0.001
Weight (kg)	73.63 ± 14.23	68.33 ± 12.71	0.13
BMI (kg/m2)	23.37 ± 4.04	22.55 ± 3.92	0.43
FBS (mg/dl)	82.80 ± 7.51	82.76 ± 6.88	0.98
SBP (mmHg)	126.43 ± 6.48	128.16 ± 6.88	0.32
DBP (mmHg)	82.16 ± 5.43	83 ± 7.38	0.62
PAL (Met-hour/week)	1899.5 ± 450.2	1923.5 ± 494.9	0.84

Data is presented as mean and standard
Abbreviation: Body mass index, fasting blood sugar, systolic blood pressure, diastolic blood pressure, physical activity level, Daily Metabolic Equivalent
[1]Recieved 70 gram honey per day
[2]Recived 70 gram sucrose per day
†Obtained from independent sample t test.

Individuals in sucrose group were older than participants in honey group (No differences were found between the two groups on physical activity, BMI, FBS, SBP and DBP (P > 0.1). **Table 2** presents the nutrient intake of subjects in honey and sucrose groups. Intake of energy, protein and fat were higher in honey group participants compared with subjects in sucrose group.

Table 2: Nutrient intake of participants in honey and sucrose groups

Nutrients	Honey group[1]	Sucrose group[2]	P-value†
Energy (kcal/d)	2270.63 ± 1045.14	1841.34 ± 614.63	0.05
Protein (g/d)	91.97 ± 42.1	68.87 ± 21.8	0.01
CHO (g/d)	325.67 ±141.28	279.4 ± 90.94	0.13
Fat (g/d)	68.45 ± 40.67	51.64 ± 23.74	0.05
EPA (mg/d)	39.9 ± 56.6	34.3 ± 42.8	0.66
DHA (mg/d)	105.8 ± 148.8	90.4 ± 112	0.65
Mg (mg/d)	299.1 ± 172	266.9 ± 132.4	0.41
Cr (µg/d)	57.8 ± 36.6	56 ± 27.3	0.83
Fiber (g/d)	5.31 ± 2.91	4.86 ± 1.84	0.47

Data is presented as mean and standard deviation
Abbreviation: Carbohydrate, eicosapentaenoic acid, docosapentaenoic acid, magnesium, chromium
[1]Recieved 70 gram honey per day
[2]Recived 70 gram sucrose per day
†Obtained from independent sample t test

Table 3 shows the effects of honey and sucrose consumption on FBS, SBP and DBP. At the end of trial, fasting blood sugar decreased in the honey group and increased in sucrose group compared with the beginning of trial. Moreover, reduction of the FBS in honey group was significant than sucrose group (P < 0.001). In comparison to beginning of study, no significant change was seen in SBP and DBP in both groups at the end of study. In all of these analyses, confounding variable including age, physical activity and some nutrient intakes were adjusted.

Table 3: Adjusted changes of FBS, SBP and DBP in participants who received either honey or sucrose

	Group	Before	After	Mean Square	F	P†
		Mean ± SD	Mean ± SD			
FBS				1322.06	42.13	< 001
	Honey group[1]	82.80 ± 7.51	78.43 ± 8.06			
	Sucrose group[2]	82.76 ± 6.88	88.73 ± 6.06			
SBP				14.53	0.49	0.48
	Honey group	126.43 ± 6.04	126.90 ± 5.46			
	Sucrose group	128.16 ± 6.88	129.16 ± 5.84			
DBP				13.95	0.52	0.47
	Honey group	82.16 ± 5.43	81.86 ± 4.73			
	Sucrose group	83 ± 7.38	83.66 ± 6.79			

All values are adjusted for age and intake of energy, protein, carbohydrate, fat, physical activity
Abbreviation: Fasting blood sugar, systolic blood pressure, diastolic blood pressure
[1]Recieved 70 gram honey per day
[2]Recived 70 gram sucrose per day

†Obtained from ANCOVA

Discussion

In this double blind randomized trial, we found that consumption of honey can decrease the FBS in healthy young subjects. Honey and sucrose consumption cannot decrease the SBP and DBP, significantly. To the best of our knowledge, this study is the first to assess the effect of honey consumption on blood pressure in Iran population.

Cardiovascular diseases are the leading causes of death and disabilities in the world. Prevalence of cardiovascular diseases is high word wide. According to WHO, 17.3 million people died of cardiovascular disease in 2008 that this was 30% of the whole world deaths. Several factors including diet, smoking, lack of activity and alcohol drinking are involved in its etiology (14).

Among cardiovascular risk factors, are high blood pressure and blood sugar. Although, it is claimed that honey decreases blood pressure and blood sugar, data on the relationship between honey consumption and blood pressure or sugar are rare. Earlier studies have mostly examined the association between honey and lipid profile or body weight in diabetic or obese patients (11, 15, 16). Some studies showed a decrease in lipid profile and body weight in intervention group. However, some others did not reach such results. We found a positive relationship between honey consumption and lowering fasting blood glucose. In line with our findings, Al-Waili et al reported that honey decreased FBS compared to control group (10). However, some other studies did not show such findings. Alagwu ea et al, reported that honey significantly increased hemoglobin A1C level (10). These inconclusive findings might be due to differences in methods used or the lack of standardization of measurements as well as variety of sample size and study population.

Blood pressure was not statistically significant between honey or sucrose group in current study. There is no evidence about the effect of honey consumption on blood pressure and our study is one the only studies in this regard.

The exact mechanisms through them honey might affect FBS are unknown; however, The effect of honey on FBS might be due to its trace elements such as antioxidants, zinc, copper, and unidentified materials . Its content of fructose and glucose might have an important role in its effect as well.

The current study has several limitations. First, despite several adjustments for a wide range of variables, residual confounding cannot be excluded. Second, we cannot generalize the relation between honey consumption and fasting blood sugar. Further studies are required to confirm our findings. Moreover, because of some limitations, we were unable to examine the favorable effects of honey in genders, separately. In summary, we found a negative association between honey consumption and fasting blood sugar. Honey consumption was not associated with blood pressure. Further studies are needed to confirm this relation.

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