GLYCEMIC RESPONSE TO THREE DIFFERENT TYPES OF LOCALLY PRODUCED NATURAL HONEY COMPARED WITH DEXTROSE AND ORDINARY TABLE SUGAR IN APPARENTLY HEALTHY VOLUNTEERS

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ABSTRACT

Background: **The composition of honey and its therapeutic benefits depend partly on the type of the trees from which bees extract their nutrients. It is, therefore, expected that honey produced at various seasons or at different locations might have different properties.**

Objective**: To investigate the glycemic response to three types of locally produced natural honey in comparison to dextrose and table sugar.**

Design: **A cross-over study on healthy volunteers**

Settings: **College of Medicine, University of Basrah**

Methods: **Five apparently healthy volunteers, 3 males and 2 females, took part in the study. Each volunteer received, the three types of honey (Seeba, Sarraji and Nahr-Khooz, one of them spring-type and other two are autumn-type), dextrose, and sugar (75g in 200 ml distilled water) in a cross-over design. Blood glucose level was measured before ingestion and 30 minutes, 1 hour, 1.5 hours and 2 hours after ingestion.**

Results: **The three types of honey raised the blood glucose level 30 minutes after ingestion by a range of 31-39% with respect to pre-ingestion level. There was no statistically significant differences between the three types, although, "Sarraji" type-an autumn-type, tended to result in a lower and "Seeba" honey-a spring type-in a higher blood glucose levels. Generally, the effect of honey on blood glucose was more gentler, on a per gram basis, than dextrose or table sugar, representing 61.8% of the level reached after dextrose or sugar load. Honey glycemic effect is also short-lived; occurring mainly in the first hour after ingestion.**

Conclusion: **Different types of natural honey did not seem to differ significantly in their effect on blood glucose. Their effect in raising the blood glucose is milder and shorter than that caused by same amount of dextrose or table sugar. Studying the effect of smaller doses of honey in diabetic patients is recommended.**

INTRODUCTION

Honey is traditionally used for treatment of different types of diseases. This use is said to depend on the type and source of honey which is, in turn, partly related to the type of trees from which bees extract their nutrients. Thus, different types of honey might be expected to produce different clinical and biochemical changes in the blood and other parts of human body.[1-4] Among these changes is the level of glucose in normal and diabetic subjects. There is a common public belief that honey might not be harmful to patients with hyperglycemia. However, there is a lot of controversy regarding this issue. Akhter and Khan [1] in their investigation of the glycemic response to three different types of honey given to normal and alloxan-diabetic rabbits, found that the two sources of natural honey used in their study did not raise blood glucose significantly, but the commercial honey which was adulterated with a saturated sucrose solution raised blood glucose significantly. However, another study[2] showed that natural honey can lower plasma glucose, C-reactive protein, and plasma lipids in healthy, diabetic and hyperlipidemic subjects when compared with dextrose and sucrose.[2] In the latter study, plasma glucose level was found to be elevated to a greater extent after honey than after sucrose only at 30 minutes post-ingestion.[2] Honey, also, was found to produce attenuated postprandial glycemic response in normal volunteers compared with glucose and sucrose.[3] The present study, therefore, aims at investigating the glycemic effects of three types of honey from different areas of Basrah city, and to compare their effects, on a per gram basis, with dextrose and ordinary table sugar in healthy volunteers.

SUBJECTS AND METHODS

Sources of honey**:** Three types of locally produced honey were taken directly from authentic honey makers. The first type was a spring-type of honey from an area called "Seeba"; the second and third were autumn-type from "Sarraji" and "Nahr-Khooz", to the south of Basrah.

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***Participants*:** Five apparently healthy volunteers, three males and two females, with age around 22 years, took part in this study at the Department of Pharmacology and Biochemistry/College of Medicine/University of Basrah during April 2008. Subjects, before each experiment, should be fasted overnight, and at 9.00-9.30 AM of the experimental day, a blood sample (1-ml) was taken for glucose measurement. Then, each subject took one of the five treatments in a cross-over design with a wash-out interval of 2-4 days between treatments, as shown in the table below:

	Volunteer 1	Volunteer 2	Volunteer 3	Volunteer 4	Volunteer 5
1	Sarraji H.	N. Khooz H.	Dextrose	Sugar	Seeba H.
2	N. Khooz H.	Dextrose	Sugar	Seeba H.	Sarraji H.
3	Dextrose	Sugar	Seeba H.	Sarraji H.	N. Khooz H.
4	Sugar	Seeba H.	Sarraji H.	N. Khooz H.	Dextrose
5	Seeba H.	Sarraji H.	N. Khooz H.	Dextrose	Sugar

H.= Honey

Measurements were made in a similar way to glucose tolerance test i.e. 75 g of honey, dextrose or sugar were taken orally with 200 ml of distilled water after an overnight fast, and blood samples were taken 30 minutes, one hour, one and a half hours, and two hours after ingestion of each material. Blood glucose was measured using commercial kits for serum glucose measurement (type Humains-France).[5] The kit contains enzyme buffer (with two enzymes: glucose oxidase and peroxidase), chromagen (chloro-4-phenol), and a standard (glucose 100mg/dl). It depends on the method of Trinder.[6] The absorbance of the colored complex (quinoneimine) is proportional to the concentration of glucose in the specimen which is measured spectrophotometrically at 500 nm. Subjects were followed according to a follow-up form containing personal data together with potential signs and symptoms that might be experienced after ingestion. Statistical analysis was made using SPSS package version 11. Data were presented as means ± SD and P-value less than 0.05 is considered significant.

RESULTS

1. The effect of three different types of honey on blood glucose level in normal volunteers

The three types of honey raised blood glucose in the five apparently healthy volunteers, taking them in a cross-over design, by an average of 34.8% (ranging from 30.1% to 39.8%) 30 minutes after ingestion as compared with pre-ingestion level. This increase is reduced to 13.3% one hour after ingestion and to near pre-ingestion level 1.5 and 2 hours thereafter (Table-1). There is no statistically significant difference between the glycemic effect of the three types of honey (different geographic areas, one spring and two autumn types). However, "Seeba" honey (a spring-type) resulted in a higher blood glucose level and "Sarraji" honey (an autumn-type) in a lower level **(Table-1, figure-1)**. In addition, there is a wide variation in the response of the five volunteers to the glycemic effect of honey.

Table 1. ***The average glycemic effect of the three types of honey in the five healthy volunteers***

Type of honey	Time after honey ingestion				
	0	30 min	1 hour	1.5 h	2 h
Seeba N=5	86.8±11.1	120.8**±32.5	99.4±27.8	96.4±27.1	77.8±29.6
Sarraji N=5	83.6±10.7	108.8*±9.6	87.8±11.9	80.2±15.3	77±14.9
N. Khooz N=5	83.6±19.6	112.8*±23.98	100.6±39.8	85±19.9	83.6±12.6
Mean ±SD N=15	84.7±13.4	114.1*±22.8	95.9±27.4	87.2±20.98	79.5±19.2

Data are presented as Means ± SD. Significant results with respect to pre-ingestion levels: * P<0.05, ** P<0.001.

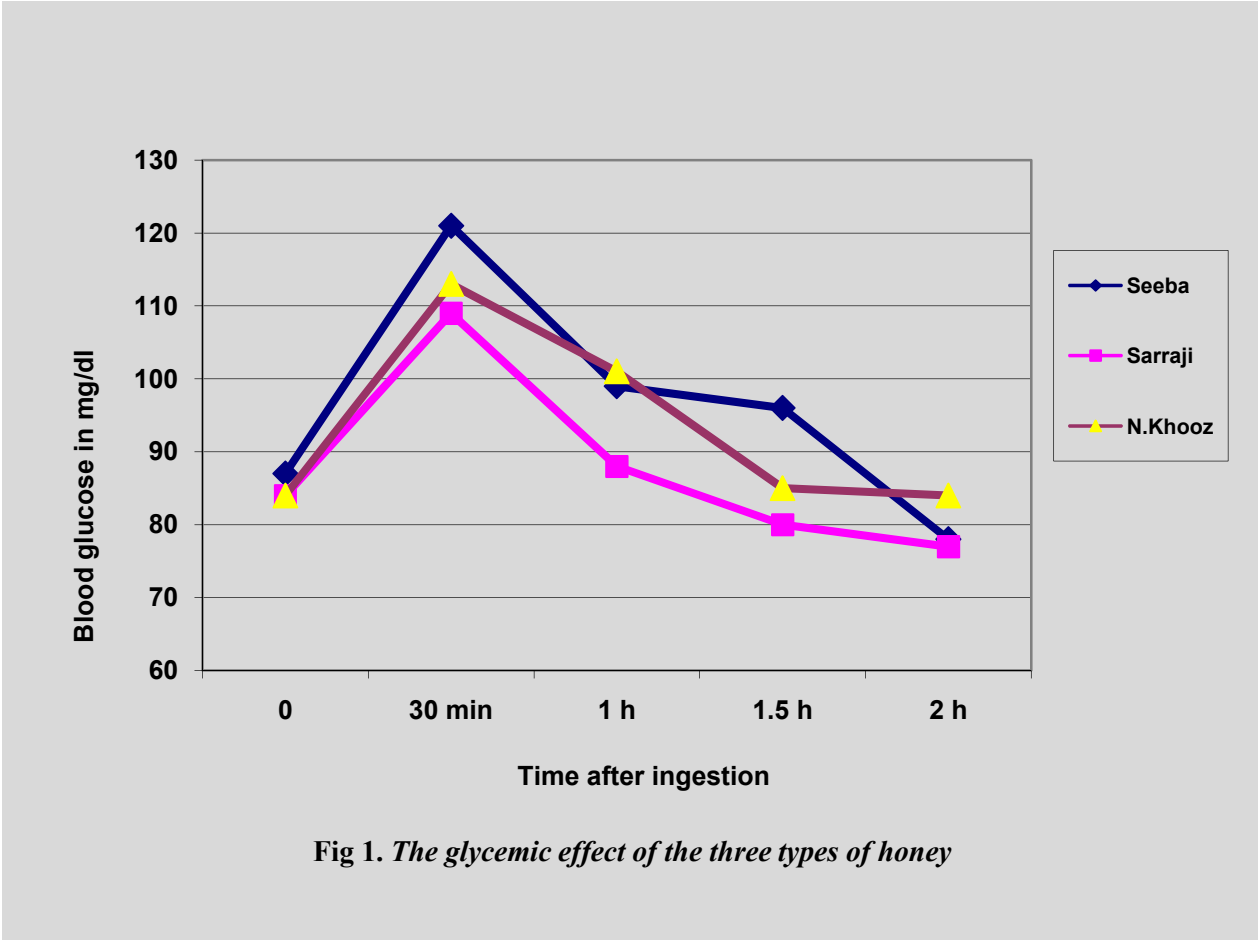

Fig 1. ***The glycemic effect of the three types of honey***

2. Comparison between the glycemic effect of honey and that of a dextrose meal

The average glycemic effect of the three types of honey resulted in a lower glucose level compared with that produced by a dextrose meal. The glucose rise-induced by honey represented 61.8% and 28.2% of that produced by a dextrose meal, 30 minutes and one hour after ingestion respectively. The honey effect on blood glucose is also short-lived, occurred mainly in the first 30 minutes while the effect of glucose meal continued for 1.5 hours (Table-2, figure 2).

Table 2. ***The glycemic effect of the three types of honey grouped together in comparison to the effect of dextrose load.***

Type	Time after ingestion				
	0	30 min	1 h	1.5 h	2 h
Honey	84.7±13.4	114.1±22.8	95.9±27.4	87.2±20.98	79.5±19.2
Dextrose	78.8±27.61	123.2**±26.8	116*±24.98	102.6*±28.7	89.8±22.8

Data are presented as means ± SD. Significant results with respect to pre-ingestion levels: * P<0.05, ** P<0.001.

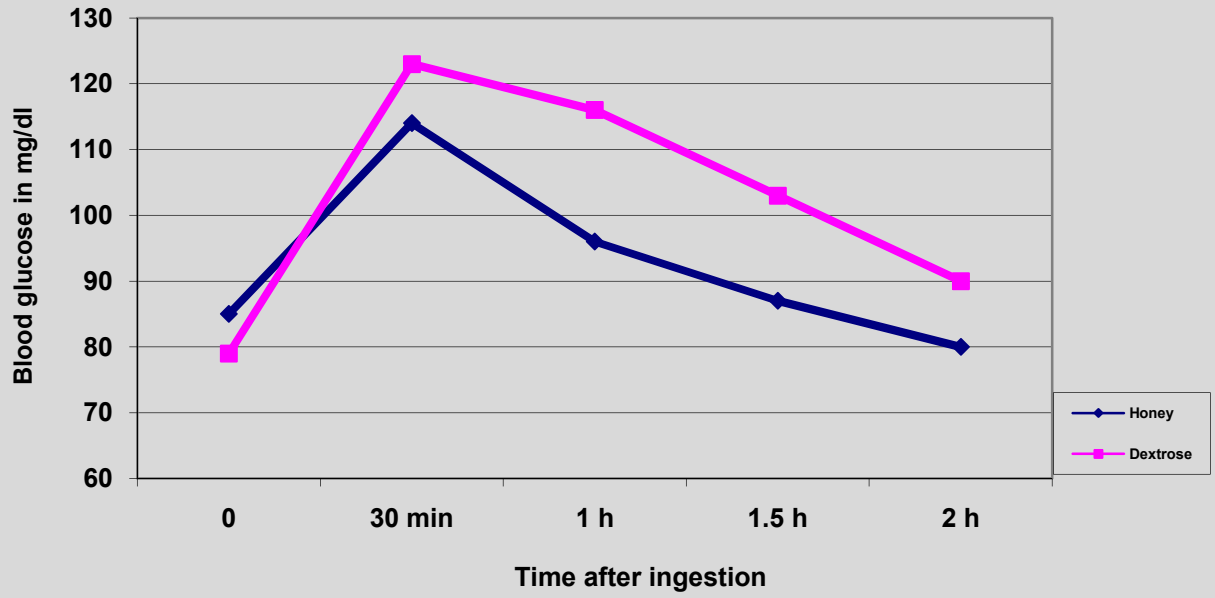

Fig 2. ***Comparison between the glycemic effect of honey (average of the three types) and dextrose***

2. *The glycemic effect of ordinary table sugar in comparison to dextrose*

Ordinary table sugar (sucrose) produced a rise in blood glucose similar in extent to that of dextrose meal in the first hour after ingestion. More rapid decline in glucose level occurred after one hour of sugar ingestion compared with dextrose meal (Table-3, figure-3).

Table 3. ***Comparison between the glycemic effect of ordinary table sugar with that of dextrose load.***

Type	Time after honey ingestion				
	0	30 min	1 hour	1.5 h	2 h
Sugar	75.4±9.98	118.6**±28.7	114.4*±14.3	87.4±24.8	77.8±20
Dextrose	78.8±27.61	123**±26.8	116*±24.98	102.6±28.7	89.8±22.8

Data are presented as means ± SD. Significant results with respect to pre-ingestion levels: * P<0.05, ** P<0.001.

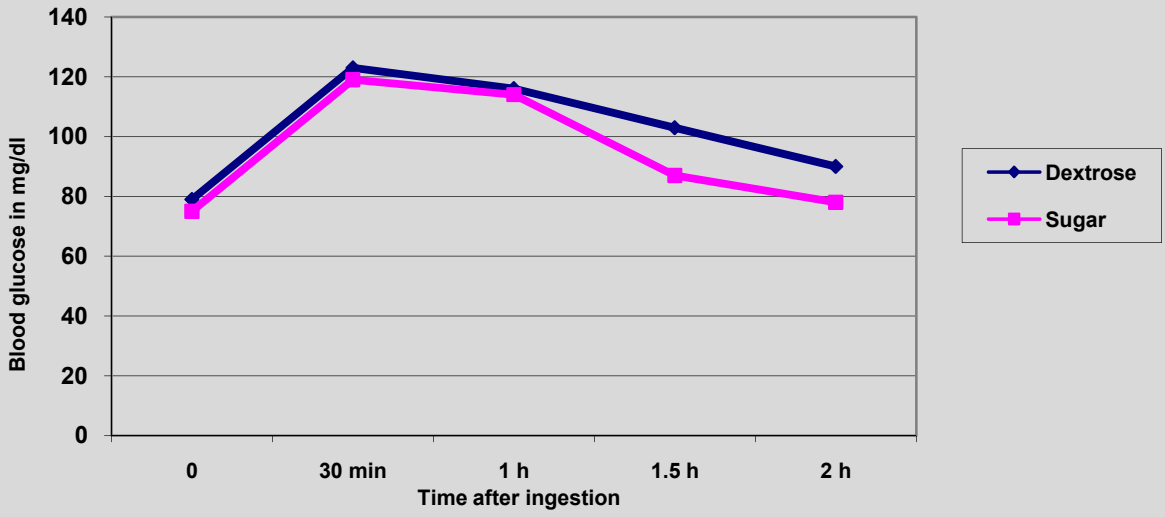

Fig 3. ***The glycemic response to dextrose in comparison to ordinary sugar***

DISCUSSION

Honey is, generally, composed of approximately 17% water, 82% carbohydrate and less than 1% proteins, aminoacids, vitamins a nd minerals.[7] The carbohydrate is primarily glucose and fructose and a small amount of sucrose, maltose and other sugars. These percentages are not constant and vary according to the type of nutrient on which bees feed on.[7] There is also, and as cited above, a traditional belief that the type of disease that may benefit from the use of honey depends partly on the trees from which bees extract their nutrients. The present work, therefore, tries to answer two main questions. First, to what extent does honey produced at different geographical regions in Basrah and at different seasons, affect the glycemic responses if ingested by healthy volunteers? The second: how do these responses compare with that of dextrose and with ordinary table sugar if the same amount (in grams) of each is taken? It is clear that all the three types of honey used in the present study raised blood glucose significantly, 30 minutes after ingestion, by a proportion ranging from 31% to 39% in comparison to pre-ingestion level. This effect is reduced to an average of 13% one hour after ingestion; then returned to normal level after that. This is in agreement with the study of Alwaili.[2] However, the results of Akhtar and Khan[1] did not agree with these findings. This might be resulting from different dosage regimens used. The large dose used in this study (75g), which is not the usual amount to be consumed normally, was used for the sake of comparison with dextrose in a pattern similar to glucose tolerance test. Yaghoobi et al,[8] on the other hand, found that administration of 70g of natural honey daily for 30 days reduced fasting blood sugar in overweight individuals by only 4.2% and body weight by 1.3% compared to a group receiving 70g sucrose. The raised blood glucose after Sarraji-type of honey is lower than the other two types, however, the difference is not statistically significant. The glycemic effect of the three types of honey is gentler than that of dextrose or sugar. It represented an average of 61.8% of dextrose glycemic effect 30 minutes after ingestion and 28.2% after one hour. Honey's effect is also shorter than the effect of dextrose or sugar. At 1.5 hour after ingestion of honey, blood glucose returns to pre-ingestion level. Honey contains fructose, in addition to glucose. Unfortunately, kits to measure fructose in the blood is not available at the time of the study, so that one may be able to detect changes in blood glucose-fructose ratio among the three types of honey. However, Ischayek and Kern [9] did not find a significant difference between two sources of natural honey in the USA with respect to this ratio. It is surprising to find that ordinary table sugar, supposed to be sucrose, is able to raise blood glucose level to an extent similar to an equal amount of dextrose. Sucrose is a compound sugar made of dextrose and fructose, and therefore, on a per gram basis, the blood glucose is expected to be around half that of dextrose load. One can speculate that the 75g dextrose meal is not absorbed as a whole for one reason or another. While the dextrose part of sucrose is efficiently and fully absorbed. Since, the volunteers participating in this study experienced honey as more sweeter than ordinary sugar, and because the glycemic effect of honey is gentler than sugar, this study might agree with that of Shambangh et al[10] and Agrawal et al [11] in that honey could be a valuable substitute for sugar as a sweetening agent. None of our volunteers experienced any important adverse effects apart from a mild and occasional flushing and headache. To conclude, the three types of honey, different in season of collection and from different geographical areas in Basrah, did not differ significantly in their ability to raise blood glucose in healthy volunteers. Honey was gentler on blood glucose level compared with dextrose or ordinary sugar when taken on a per gram basis. Testing the effect of much smaller amounts of honey in diabetic patients, together with measurement of serum insulin level and for a duration longer than 2 hours might be worthy in the future. Care should be taken in using commercial types of honey since they might be adulterated with sucrose.

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