GLYCAEMIC INDICES OF DIFFERENT SUGARS

Uma P., Hariharan R.S., Ramani V. and Seshiah V.

Dietary advice to diabetic patients has conventionally included restriction of readily absorbable simple sugars.[1] Capro demonstrated that glucose and sucrose elicited similar plasma glucose response.[2] Fructose does not require insulin for its initial metabolism[3] and in non-diabetics the blood glucose response curves following ingestion of fructose, sucrose, glucose and starch differ significantly.[4] However, Nikkala found no difference between the glycaemic effect of fructose starch and sucrose in diabetic subjects.[5] Honey consists of 40% each of glucose and fructose[6] and the dextrose portion is quickly absorbed into the blood stream while the fructose portion must be changed first into glycogen and then into dextrose. This particular characteristic of honey had led to the speculation whether honey can be used as a substitute for sugar. Since varied and conflicting reports are available, we have compared changes in blood sugar levels in Non-Insulin Dependent Diabetes Mellitus (NIDDM) patients taking iso-caloric amounts of glucose, sucrose (cane sugar) honey, and jaggery, all sweeteners used commonly in Indian foods.

Materials and Methods

Eighteen subjects were studied. They were grouped into three groups of six patients each with fasting blood glucose levels between 80-120 mgm% (A group), 120-180 mgm% (B group) and above 180 mgm% (C group). The subjects belonged to 25-55 years age group. They were given 75 gms of dextrose monohydrate (to make up 300 calories) dissolved in 200 ml of water. Iso-caloric amounts of sucrose, honey and jaggery were given consecutively. Fasting and hourly (first and second hours) blood samples were collected and the blood glucose level was estimated using Ortho-Toludine method.

Results and Discussion

The effect of orally administered glucose, sucrose, honey and jaggery on blood glucose of Non-Insulin Dependent Diabetes was studied.

From Table-I, it can be seen that at one hour the blood glucose response was the highest for glucose, followed by jaggery, sucrose and honey respectively.

At two hours, the blood glucose increment was the highest for glucose, followed by jaggery, sucrose and honey respectively.

Department of Diabetology, Madras Medical College & Govt. General Hospital, Madras.

Table 1

Blood Glucose Increments at one and two hours

Group	Blood Glucose level (mg%)	Glucose		Jaggery		Sucrose		Honey	
		1 hr	2 hrs	1 hr	2 hrs	1 hr	2 hrs	1 hr	2 hrs
A	80-120	65.3± 18.45	41.26± 34.69	55.02± 36.71	13.88± 13.42	43.73± 24.34	18.26± 10.39	46.49± 36.63	16.42± 9.23
B	120-180	80.49± 43.49	67.40± 47.70	64.78± 28.19	41.2± 24.90	48.41± 15.43	30.89± 39.73	64.79± 39.73	33.45± 27.00
C	180	53.44 18.67	68.89± 16.92	48.60± 33.74	30.44± 39.40	43.42± 36.40	37.41± 46.80	39.25± 17.50	20.65± 15.73
All subjects		66.41± 29.92	56.86± 35.77	56.15± 29.27	28.37± 26.4	44.95± 20.05	28.85± 22.92	38.82± 27.9	23.8± 19.24

Table 2

Comparision between Sugars

Sugar	Mean ± S. D.		Glucose Vs. other sugars		Jaggery Vs. other sugars		Sucrose Vs. honey	
	1 hr.	2 hr.	1 hr.	2 hr.	1 hr.	2 hr.	1 hr.	2 hr.
Jaggery	56.08 ± 30.34	28.39 ± 30.42	$P < 0.001$	$P < 0.001$	—	—	—	—
Sucrose	45.95 ± 36.4	29.07 ± 18.12	$P < 0.001$	$P < 0.001$	$P < 0.001$	—	—	—
Honey	47.34 ± 36.59	24.03 ± 36.59	$P < 0.001$	$P < 0.001$	$P < 0.001$	—	—	—

Comparison between sugars

From Table 2, at one hour, there was significant difference between (a) glucose and jaggery drinks, (2) glucose and sucrose drinks and (c) glucose and honey drinks ($p < 0.001$). Similarly, at two hours, blood glucose increment was significant between (a) glucose and jaggery drinks (b) glucose and sucrose drinks, and (c) glucose and honey drinks ($p < 0.001$).

When jaggery was compared with sucrose and honey, at one hour level, there was significant difference between (a) jaggery and sucrose drinks and also between (b) jaggery and honey drinks. At two hours, there was no significant difference between jaggery, sucrose and honey drinks.

At one hour and two hour levels, there was no significant difference between sucrose and honey drinks.

Glycaemic Index

The glycaemic index for glucose was taken as 100. At one hour, glycaemic index for jaggery was 84.4. Sucrose and honey had almost similar glycaemic index of 69.2 and 70.1 respectively. At two hours, glycaemic index of jaggery, sucrose and honey were almost similar (Table-3). Thus among jaggery, sucrose or honey it cannot be said that one is less hyperglycaemic than the other.

Table 3
Glycaemic lndex

	1 hr.	2 hr.
Jaggery	84.4	50.5
Sucrose	69.2	51.7
Honey	70.1	48.3

Taking glucose as reference food, glycaemic index of different sugars was determined based on the formula (Table-4) :

$$\text{Glycaemic index (GI)} = \frac{\text{Blood glucose area of test food}}{\text{Blood glucose area of reference food}} \times 100$$

Table 4
Glycaemic index of sugars with reference to glucose

Glucose	100
Jaggery	87.4
Sucrose	83.9
Honey	78.8

Table 4 shows that blood glucose responses to oral glucose was the highest followed by jaggery, sucrose and honey drinks respectively. Table-3 shows that at one hour the glycaemic index was highest for glucose followed by jaggery. Sucrose and honey had similar glycaemic indices. At two hours, glycaemic index for jaggery, sucrose and honey drinks were similar, proving that there is no difference in glycaemic effect between the different sugars. These results correspond with other studies. Nikkala[5] found no difference between the glycaemic effect of fructose, starch and sucrose in diabetics. Judith et al[7] showed that blood glucose values were not significantly different between subjects given sucrose or invert sugar. Though honey contains 40% fructose which has less hyperglycaemic effect, this beneficial effect is off-set by the glucose content of honey and attains the glycaemic index similar to that of sucrose. Therefore, its use as an alternative sweetener for diabetics is not justified. Gur or jaggery contains cane sugar and fruit sugar in the proportion of 2:1 would be assimilated more rapidly than cane sugar alone taken in the same quantity[8]. In this study jaggery has a higher glycemic index compared to cane-sugar or sucrose.

Simple carbohydrates, that is, sucrose and glucose, traditionally have been banned from the diabetic diet primarily on the basis that they are 'fast' carbohydrates which will result in postprandial hyperglycaemia and also in the interest of caloric control and better nutrition because they have little nutritional value[9].

Since honey, sucrose and jaggery have almost similar glycaemic indices, honey cannot be recommended in preference to other sugars as a sweetening agent.

Summary and conclusions

Glycaemic response to glucose, sucrose, jaggary and honey in non-insulin dependent diabetic subjects was studied.

At both one and two hour levels the blood glucose response was the highest for glucose, followed by jaggery, sucrose and honey in that order respectively.

At one and two hours, there was significant difference between glucose and other sugars with glucose eliciting the highest glycaemic response.

When jaggery was compared with sucrose and honey drinks, at one hour there was significant difference with jaggery eliciting the highest glycaemic response. At two hours, there was no significant difference between the three drinks.

There was no significant difference between sucrose and honey drinks at both one and two hours.

The glycaemic index of glucose was taken as 100. At one hour, the glycaemic index of jaggery was 84.1. Sucrose and honey had almost similar glycaemic indices of 69.2 and 70.1 respectively. At two hours, the glycaemic indices for jaggery, sucrose and honey were almost similar, suggesting that jaggery, sucrose and honey are all equally hyperglycaemic. Hence honey and jaggery cannot be recommended as an alternative sweetener for sucrose.

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