Malaysian Journal of Pharmaceutical Sciences,
Vol. 4, No. 1, 13–19 (2006)

GLYCEMIC RESPONSE AND GLYCEMIC INDEX OF BANGLADESHI HONEY IN TYPE 2 DIABETIC PATIENTS

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The hyperglycemic effect of carbohydrate in the forms of 20 g each of glucose and sucrose and 26 g of honey were studied in eight normal volunteers and 22 type 2 diabetic patients. There was no significant ($p>0.05$) change in the glycemic response in normal group when challenged with glucose, sucrose or honey. However, in the diabetic group there was some attenuation in the glycemic response and was significant ($p<0.05$) after two hours of treatment with glucose, sucrose or honey used. The glycemic index (GI) showed considerable variability within subject groups. The results led us to speculate that honey could be a valuable sugar substitute for type 2 diabetic individuals and have a favorable GI for diabetes.

***Keywords**: Honey, Diabetes mellitus, Glycemic index*

INTRODUCTION

> *And thy LORD taught the bee to build its cells in hills, on tree and in men's habitations, then to eat of all the produce of the earth and find with skill the spacious paths of its LORD, there issues from within their bodies a drink of varying colors, wherein is healing for men, verily in this is a sign for those who give thought.*
>
> (Holy Quran, Al-Nahl, 16: 68–69)

It is now recognized that dietary carbohydrate components influence the prevalence and severity of common degenerative diseases such as diabetes, heart disease and obesity. Fructose and sucrose have been evaluated and compared to glucose using glucose tolerance tests, but few such comparisons have been performed for a "natural" sugar source such as honey (Shanbaugh, Worthington and Herbert 1990).

Therapy with bee products is an age-old tradition as it is mentioned in several renowned ancient traditional medicinal records from India and China. Indeed the traditional importance and use of honey as therapeutics has been mentioned by the Egyptian and Sumerian

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physicians as early as 4000 years ago (Maryann 2000). The Chinese, Indian, Greeks and Romans have also recorded similar practices. Hippocrates, the father of Western Medicine, used honey to treat a number of diseases and Ibne Sina, the Prince among Muslim physicians listed several beneficial uses of honey in his monumental work of "The Canon of Medicine" (Eva 1976).

As we have mentioned it is frequently voiced that honey is good for diabetics. This is unlikely to find a conclusive claim regarding the use of honey in diabetes because of its high sugar content. However, it is claimed that honey could be better than products made with cane sugar, as stated by Katsilambros *et al*. (1988). In their study it is revealed that insulin levels were lower when compared to the uptake of equal caloric values of other foods, but blood sugar level was equal or higher than in the other compared products shortly after eating. In another study with healthy individuals, it is observed that the consumption of honey caused lowering of blood sugar level than the consumption of the same quantity of sucrose (Shanbaugh, Worthington and Herbert 1990). In another interesting study, it was observed that honey could cause an attenuated glycemic condition in non-insulin-dependent diabetes mellitus (NIDDM) patients (Ionescu-Tirgoviste *et al*. 1983). Beneficial effect of honey on glycemic status has been also reported by other country but not in Bangladesh. Further, an attempt has been made to find the GI of honey as it has been emphasized as an important factor used as the basis for dietary recommendations for diabetic individuals (Jenkins, Wolever and Taylor 1981; Jenkins et al. 1984).

To our knowledge, there have been no studies investigating the GI of Bangladeshi honey. The present study was designed to investigate the glycemic response to common type of Bangladeshi honey along with glucose and fructose in diabetic patients suffering from type 2 diabetes. Type 2 diabetes is the most common and prevailing type of diabetes in Bangladesh.

MATERIALS AND METHOD

Subjects

Eight normal volunteers aged 25 to 33 years (mean 29 years) and 22 patients with NIDDM, aged 32 to 66 years (mean 49 years) and asymtomatic on diet alone were used in this study. All subjects were

within 90—115% of their ideal body weight, had glycosylated haemoglobin (HbA_{1C}) values within the normal range (4.5—8.5%), and were on diet providing 200 g to 260 g of carbohydrate daily. The blood glucose level two hours after breakfast exceeding 7.7 mmol/L was used to ascertain diabetes mellitus. The diagnosis of diabetes was based on World Health Organization (WHO) criteria (WHO 1985).

Experimental design

This was a prospective crossover study where the patients themselves acted as their own control. The patients took their dinner according to dietary chart strictly for diabetes. After an overnight fast, 20 g glucose or 20 g sucrose or 26 g honey (approximately one table spoon) was given to each subject over 5 minutes, in random order, on different mornings. Glucose and sucrose were diluted in 20 mL water (isovolaemic with honey). Venous blood was sampled just before the treatments and then every 15 minutes for two hours. Plasma were separated and kept frozen (–80˚C) until analyzed for glucose.

Biochemical analysis

Blood glucose was estimated by the GOD-PAP method (Barham and Trinder 1972) using a commercially available kit (Human-Diagnostica, USA).

Statistical analysis

Statistical analysis was performed by using one way ANOVA at a priori significance level of 0.05.

RESULTS AND DISCUSSION

The experimental data showed (Tables 1 and 2) that there was no significant ($p>0.05$) change in the glycemic response in normal group when challenged with glucose, sucrose and honey. However, in the diabetic group there was some attenuation in the glycemic response and was significant ($p<0.05$) after two hours of treatment with either glucose or sucrose used.

Table 1: Mean plasma glucose (mean ± S.D.) (mmol/L) in normal volunteers (n = 8) following ingestion of equivalent amounts of either glucose, sucrose or honey

Time (min)	Glucose	Sucrose	Honey
0	4.5 ± 0.21	4.5 ± 0.19	4.6 ± 0.13
15	6.1 ± 0.27	6.0 ± 0.23	5.4 ± 0.18
30	6.7 ± 0.13	6.5 ± 0.20	6.0 ± 0.22
45	6.4 ± 0.36	6.3 ± 0.22	6.3 ± 0.19
60	5.7 ± 0.20	5.8 ± 0.24	5.8 ± 0.22
90	4.9 ± 0.52	5.0 ± 0.66	5.0 ± 0.60
120	4.3 ± 0.33	4.3 ± 0.36	4.3 ± 0.37

Table 2: Mean plasma glucose (mean ± S.D.) (mmol/L) in NIDDM (n = 22) following ingestion of equivalent amounts of glucose or sucrose or honey

Time (min)	Glucose	Sucrose	Honey
0	8.2 ± 2.03	8.1 ± 2.05	7.9 ± 1.94
15	9.3 ± 1.89	8.8 ± 1.96	8.3 ± 1.94
30	10.6 ± 2.01	9.9 ± 2.17	8.9 ± 1.95
45	11.5 ± 2.11	10.9 ± 2.23	9.5 ± 2.06
60	12.0 ± 2.15	11.3 ± 2.26	10.1 ± 2.14
90	10.8 ± 1.99	10.3 ± 2.10	9.4 ± 2.10
120	9.7 ± 1.97	9.3 ± 2.00	8.7 ± 2.04

The mean GI of sucrose and honey were presented in Table 3 which was calculated using the GI of glucose as 1. It was observed that the GI of honey was lower in the case of both normal and NIDDM subjects. However, it is worthwhile to mention that when sucrose is taken with a meal it may not significantly exacerbate postprandial hyperglycemia (Bantle, Laine and Castle 1983; Slama, Haardt and Jean-Joseph 1984). Nevertheless, as it was observed that there was an attenuated glycemic response to honey, it could be usefully substituted for sucrose. The results obtained in this study were further in accord with findings of others. In a study on diabetic subjects, it was observed that in diabetic patients, honey compared with dextrose caused a significantly lower rise of plasma glucose level. The elevation of plasma glucose level was greater in honey than sucrose at 30 minutes, and was lower in honey than it was in sucrose at 60, 120, and 180 minutes. Honey caused greater

elevation of insulin than sucrose did after 30, 120, and 180 minutes (Al-Waili 2004). Similar observations have been reported by others as well (Sharafetdinov *et al.* 2002).

Table 3: Glycemic index of sucrose and honey

Subjects	Sucrose	Honey
	GI	GI
Normal volunteers (n = 8)	0.99	0.96
NIDDM (n = 22)	0.95	0.87

GI of glucose is considered as 1 and GI is calculated by comparing with glucose

In the dietary management of diabetes or in proposing any food suitable for diabetic individual the grading of different foods in terms of a GI has been suggested to be very useful (Ionescu-Tirgoviste *et al*. 1983). However, such index may at times be confusing because of the experimental error. In our study, we have used glucose to challenge the glycemic status of either group of subjects and thus we believe that the error is apparently decreased. We have observed considerable variation in the GI for honey and were quite obvious in case of diabetes group (Table 3). However, it is worth to mention that the GI does not differentiate between foods like glucose which produce a rapid high peak (from rapid absorption) and those with slow absorption producing a more potent glycemic effect.

There is a need for sweeteners in the diabetic diet (Kiovisto 1978) to improve overall dietary compliance of diabetic people. Sugar substitutes can be achieved conveniently and cheaply from commonly available food items (Talbot and Fisher 1978) and the present study suggested that honey could be useful for this purpose. It is equally important to use foods that produce the least postprandial blood glucose variation (Cudworth *et al.* 1982) which was also observed in this study.

The present study with normal individuals and individuals with type 2 diabetes has a significantly lower GI with honey than with glucose or sucrose. So honey has an advantage as a sweetening agent for type 2 diabetes than glucose, sucrose or foods sweetened with sucrose when included as part of the total carbohydrate in an individual's diet. However, their use should be kept to a minimum. This study is unable to measure the insulin and C-peptide which is related to the plasma glucose

level. Further in-depth studies are needed which may provide valuable information for the investigation of Bangladeshi honey.

CONCLUSION

Honey produced less postprandial hyperglycemia than glucose and sucrose in normal volunteers and NIDDM patients. Our findings showed that Bangladeshi honey could be beneficial as sugar substitute for type 2 diabetic patients.

REFERENCES

AL-WAILI, N. S. (2004) Natural honey lowers plasma glucose, C-reactive protein, homocysteine, and blood lipids in healthy, diabetic, and hyperlipidemic subjects: Comparison with dextrose and sucrose, *Journal of Medicinal Food,* 7: 100–7.

BANTLE, J. P., LAINE, D. C. & CASTLE, G. W. (1983) Postprandial glucose and insulin responses to meals containing different carbohydrates in normal and diabetic subjects, *New England Journal of Medicine,* 309: 7–12.

BARHAM, D. & TRINDER, P. (1972) An improved colour reagent for the determination of blood, *Analyst,* 97: 142–145.

CUDWORTH, A. G., ANDREANI, D., BODANSKY, H. J. & SQUADUTO, G. (Eds.). (1982) Nutrition Sub-committee of the British Diabetic Association's Medical Advisory Committee. *Dietary recommendations for diabetics for the 1980s: Diabetes and Its Late Complications*, pp. 157–167 (London: John Libbey).

EVA, C. (1976) History of Honey. IN: EVA, C. *Honey a Comprehensive Survey*, pp. 454–465, (London: Morrison and Gibb Ltd).

IONESCU-TIRGOVISTE, C., POPA, E., SINTU, E., MIHALACHE, N., CHETA, D. & MINCU, I. (1983) Blood glucose and plasma insulin responses to various carbohydrates in type 2 (non-insulin-dependent) diabetes, *Diabetologia*, 24: 80–4.

JENKINS, D. J. A., WOLEVER, T. M. S., JENKINS, A. L., JOSSE, R. G. & WONG, G. (1984) The glycemic response to carbohydrate foods, *Lancet,* II: 388–391.

JENKINS, D. J. A., WOLEVER, T. M. S. & TAYLOR, R. H. (1981) Glycemic index of foods: A physiological basis for carbohydrates exchange, *The American Journal of Clinical Nutrition,* 34: 362–366.

KATSILAMBROS, N. L., PHILIPPIDES, P., TOULIATOU, A., GEORGAKOPOULOS, K., KOFOTZOUL, L., FRANGAKI, D., SISKOUDIS, P., MARANGOS, M. & SFIKAKIS, P. (1988) Metabolic effects of honey (alone or combined with other foods) in type II diabetics, *Acta Diabetologica Latina,* 25: 197–203.

KIOVISTO, V. A. (1978) Fructose as a dietary sweetener in diabetes mellitus, *Diabetes Care*, 1: 241–246.

MARYANN, N. (2000) Honey as medicine has a long history — New Zealand honey is focus of intensive research, *Health Facts,* 25: 4–5.

SHANBAUGH, P., WORTHINGTON, V. & HERBERT, J. H. (1990) Differential effects of honey, sucrose, and fructose on blood sugar levels, *Journal of Manipulative and Physiological Therapeutics,* 13: 322–5.

SHARAFETDINOV, K. H., MESHCHERIAKOVA, V. A., PLOTNIKOVA, O. A. & GAPPAROV, M. G. (2002) Comparative study of postprandial glycemia in type 2 diabetic patients after consumption of mono- and disaccharides and sweeteners, *Voprosy Pitaniia,* 71: 22–6.

SLAMA, G., HAARDT, M. J. & JEAN-JOSEPH, P. (1984) Sucrose taken during mixed meal has no additional hyperglycemic action over isocaloric amounts of starch in well-controlled diabetics, *Lancet,* II: 122–124.

TALBOT, J. M. & FISHER, K. D. (1978) The need for special foods and sugar substitutes by individual with diabetes mellitus, *Diabetes Care*, 1: 231–240.

WORLD HEALTH ORGANIZATION. (1985) *Diabetes Mellitus. WHO Technical Report Serial No. 727*, pp. 1–113 (Geneva: World Health Organization).