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Effect of Ingestion of Natural Food Fibre on Glucose Tolerance and Plasma Immuno-Reactive Insulin Response

The beneficial effect of the high carbohydrate, high fibre diet in the management of diabetes has been proved by us and is gaining acceptance all over the world.

The effect of natural food fibre, added in the form of cooked peas (Pisum Sativum) on glucose tolerance and the immunoreactive insulin levels was studied in 9 normal volunteers. A standard oral glucose tolerance test with insulin assay was performed. The G.T.T. and insulin assays were repeated on the next day adding 50 gms of cooked whole peas which was ingested 30 minutes prior to the test.

A definite improvement in the glucose tolerance was noted after ingestion of grams. The insulin response was correspondingly lower. The improved glucose tolerance with lower insulin output suggested an enhancement in the tissue sensitivity to insulin. It is likely that the beneficial effects of pulses on glucose tolerance are due to a combined action of the fibre and protein on the absorption and utilisation of the carbohydrate.

Introduction

The High Carbohydrate High Fibre Diet for Diabetes evolved by Viswanathan et al at the Diabetes Research Centre[1] Madras, is now gaining acceptance all over the world, as an almost ideal diet for diabetics. Studies with this diet at this centre have shown the beneficial effect of the diet in control of diabetes,[1] as well as control of hyperlipidaemia. The effects were sustained for anumber of years.[2,3]

The two most important features of our diet at the High Carbohydrate content and the High - Fibre content. The plant fibre content of our diet was worked out by computer analysis in collaboration with Prof. James Anderson of University of Kentucky, U.S.A. and found to be about 38 grams which is

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double that of the traditional American Diabetic Association diet. In this diet the source of fibre is natural foods like pulses (legumes) and leafy vegetables.

This paper deals with a specific study of the effect of natural fibre in the form of pulses on glucose tolerance and immuno reactive insulin levels.

Materials and methods:

Standard oral glucose tolerance test with 75 gms of glucose load (G.T.T.I) was done in 9 normal volunteers of ideal body weight. Blood sugar was estimated by the method of Somogyi.[4] Serum samples were collected at each interval for assay of immuno reactive insulin (IRI). The samples were stored at–20°C till the assay was carried out. The method of Herbert et al[5] was employed. The RIA kit supplied by the Bhabha Atomic Research Centre, Bombay, was used.

The volunteers were subjected to a second G.T.T. (G.T.T. II) a day or two later. After collecting the fasting sample of blood for sugar and IRI estimations, 75 gms of glucose was given 30 minutes after the ingestion of 50 gms of cooked whole dried peas. (Pisum sativum). The G.T.T. and IRI assays were repeated as above.

Results

The main blood sugar values obtained during the two GTTs are shown in Table I and Fig. 1. There is an improvement in glucose tolerance after addition of the peas.

TABLE I

Blood Sugar Values During the G.T.Ts

	Load	Blood Sugar mg% ± SD				
		Fasting	*30'*	*60'*	*90'*	*120'*
G.T.T. I	75 gms of glucose	80.1 ± 10.2	114.5 ± 16.6	105.1 ± 13.8	96.5 ± 11.7	82.8 ± 9.4
G.T.T. II	75 gms of glucose	82.8 ± 8.1	113.1 ± 15.3	97.5 ± 17.5	84.8 ± 13.2	74.0 ± 9.4
	50 gms peas	N.S.	N.S.	N.S.	P < 0.05	P 0.05

Table II shows the mean increment and fall in blood sugar after addition of fibre. It is seen that during the second G.T.T., that is, with the addition of peas, the increment in blood sugar was lower than with glucose alone. The fall of sugar was also greater with the peas than in the first G.T.T.

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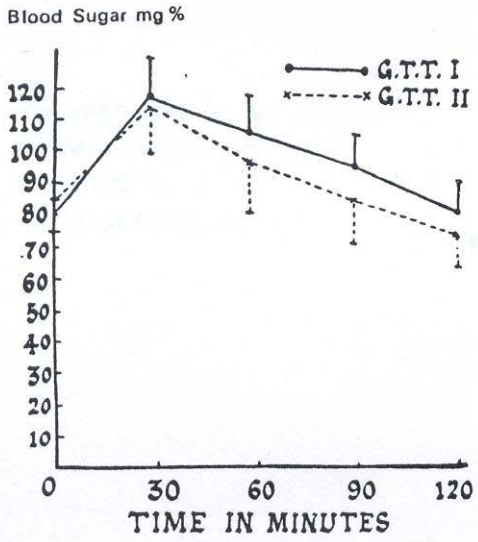

Fig. 1

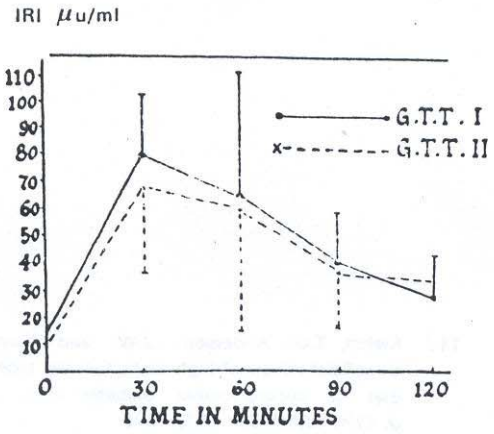

Fig. 2

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TABLE II

Changes in Blood Sugar during the G.T.T.

	Mean increment mg% ± SD	*Mean fall mg% ± SD*
G.T.T. I	35.1 ± 12.0	32.4 ± 14.3
G.T.T. II	28.3 ± 7.2	43.0 ± 14.5

The insulin responses were studied during the two G.T.Ts. The IRI responses was found to be less after addition of the peas, (Table III & Fig. 2).

TABLE III

IRI Responses during the G.T.T.

	IRI in μu/ml ± SD				
	Fasting	*30'*	*60'*	*90'*	*120'*
G.T.T. I	16.0 ± 10.2	74.1 ± 27.6	62.6 ± 52.2	41.0 ± 17.6	25.9 ± 15.1
G.T.T. II	14.5 ± 5.1	66.4 ± 31.7	58.3 ± 41.0	39.1 ± 20.1	30.1 ± 6.8

Discussion:

This study indicates that ingestion of pulses with glucose tends to improve the glucose tolerance. The lower glucose peak obtained in the second G.T.T. may be due to slower or reduced absorption of glucose. Dietary proteins are known to inhibit glucose absorption as they appear to have a common carrier mechanism.[6] However, the greater fall in glucose in the second G.T.T. indicates an enhanced rate of utilisation. Interestingly this effect is elicited with a lower concentration of insulin, suggesting increased sensitivity to insulin.

The improved glucose tolerance with low insulin secretion appears to have been effected by the action of food fibre. Whole grams (pulses) are good sources of food fibre. Addition of food fibre is shown to flatten the blood glucose curve and correspondingly reduce the insulin levels in normal as well as diabetic patients.[7,8,9,10] Studies by Anderson et al, [11,12] and Jenkins et al[8,9,13] have also demonstrated that high carbohydrate, high fibre diet with low fat and protein is useful in improving the control of diabetes and reducing the insulin requirement.

Our findings of improved glucose tolerance with addition of a source of protein is in agreement with those of Estrich et al,[14] Rabinowitz et al,[15] and Nigam and Goyal;[16] but the

insulin responses in this study are contrary to those recorded by by the first two groups of workers. In their studies, the improvement in glucose tolerance resulted due to substantial increment in insulin outpout. This disparity in insulin responses may have occured due to the sources of protein used. Using casein as the protein supplement, Nigam and Goyal[16] noticed a fall in insulin requirement by insulin-dependent diabetics. This corroborates our observation that the efficacy of insulin is enhanced by co-ingestion of protein and carbohydrate.

The use of natural foods such as whole cereals, pulses (legumes) and green leafy vegetables in the diet of the Diabetes Research Centre, Madras, helped to increase the fibre content of the diet.[17] In many countries the fibre content of the diet is increased by adding artificial fibre such as bran, gaur gum etc. But natural fibres seems to be far superior. The fibre of natural foods is distributed in the outercoat (as in cereals) or distributed more evenly throughout as in pulses and will thus act as a barrier to enzymatic degradation.[13]

From this study, it appears that the addition of whole grams to the high carbohydrate diet exerts a beneficial effect on the carbohydrate tolerance by a combined action of protein plus fibre, on the absorption and utilisation of sugars.

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