accounted for by the perceived need for more intensive treatment for especially aggressive tumours, but in the absence of detailed histological reports on many of the cases this cannot be confirmed or refuted. Nevertheless, in a large proportion of cases nephrectomy and chemotherapy together evidently constitute sufficient treatment for the cure of infants with nephroblastoma. In the very youngest babies and some older patients nephrectomy alone has been followed by long-term disease-free survival.

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Effect of guar crispbread with cereal products and leguminous seeds on blood glucose concentrations of diabetics

DAVID J A JENKINS, THOMAS M S WOLEVER, RODNEY H TAYLOR, HELEN M BARKER, HASHMEIN FIELDEN, ALEXANDRA L JENKINS

Summary and conclusions

To compare the effect on blood glucose concentrations of guar incorporated into crispbreads with that of unprocessed high-fibre foods groups of four to six diabetics took a total of seven test breakfasts on separate days. By comparison with a breakfast of wholemeal bread and cheese, guar crispbread combined with bread reduced the area under the glucose response curve to 51% ($p < 0.05$); bread and soya beans reduced the area to 65% ($p < 0.05$); guar crispbread with soya beans to 25% ($p < 0.002$); and soya beans with lentils to 29% ($p < 0.002$). Porridge and cornflake breakfasts showed no difference.

The favourable results with leguminous seeds may not make such meals more acceptable than meals of guar products, but a combination of leguminous seeds and guar may allow smaller and more acceptable amounts of both to be used.

Department of the Regius Professor of Medicine, Radcliffe Infirmary, Oxford
DAVID J A JENKINS, DM, research associate

University Laboratory of Physiology, Oxford
THOMAS M S WOLEVER, MSC, research fellow
ALEXANDRA L JENKINS, research associate

Department of Gastroenterology, Central Middlesex Hospital, London NW10
RODNEY H TAYLOR, MRCP, Wellcome senior research fellow
HELEN M BARKER, BSC, SRD, research dietitian
HASHMEIN FIELDEN, SRN, research sister

Introduction

Studies on the use of purified fibre preparations in treating diabetes have often prompted comments unsupported by fact that using natural foods may be an effective and more palatable approach to this problem.[1 2] To identify such foods 50-g carbohydrate portions of a wide range of foods were taken by groups of healthy volunteers and the effect on the blood glucose response noted.[3] These foods were then divided into two groups according to whether they caused small or large rises in blood glucose concentration. Foods were selected from each group and taken as breakfasts by diabetic volunteers so that their effects on blood glucose concentration could be studied and compared with the effect of a purified fibre product, guar crispbread. We report here the results.

Methods

Six diabetics (four women, two men; mean age 43 ± SEM 5 years; 99 ± 3% ideal body weight; five receiving insulin 16-60 U/day and one controlled by diet alone) who had previously participated in a study testing the effect of guar and high-fibre foods on diabetic control were interested in testing the effect on their own blood glucose concentrations of taking meals of different composition and comparing this with the effect of guar. The food used had in earlier studies resulted in either large or small postprandial blood glucose responses in normal volunteers.[3]

The group met regularly on one or two Saturday mornings each month over four and a half months to test breakfasts in which a carbohydrate content equivalent to each subject's normal breakfast was derived from the following: wholemeal bread (88 ± SEM 13 g); wholemeal bread (46 ± 8 g) and guar crispbreads (7 ± 1 crispbread); wholemeal bread (46 ± 8 g) and soya beans (91 ± 11 g); guar crispbread (7 ± 1 crispbreads) and soya beans (96 ± 18 g); soya beans (75 ± 6 g) and lentils (41 ± 8 g); cornflakes (22 ± 5 g) and wholemeal bread (45 ± 10 g); or porridge oats (26 ± 6 g) and wholemeal spaghetti (27 ± 6 g).

Edam, Cheddar, and cottage cheeses were used to balance the fat and protein of the guar and leguminous-seed meals, which also included 120 g tomato and 500±40 ml tea made with 50 ml milk. The cereal breakfasts contained less fat and protein, the fat being balanced by added butter in the cornflake breakfast. Table I shows the composition of the breakfasts calculated with food tables.[4]

After overnight fasts the subjects took their usual morning insulin doses at the same time before each breakfast. The meal was eaten over 15-20 minutes. Finger-prick blood samples were taken for glucose analysis[5] at 0, 30, 60, 90, 120, and 180 minutes. Some results on two of the meals (wholemeal bread and cheese, and mixed lentils and soya beans) have been reported.[6]

Results were expressed as means±SEM and the significances of differences calculated with Student's *t* test for paired data.

The study was approved by the ethical committee of the Brent Area Health Authority.

Results

All the meals were well received, and no subject had difficulty in eating them in the prescribed time. The fat and protein in the wholemeal bread, wholemeal bread and crispbread, wholemeal bread and soya bean, and soya bean and lentil meals were balanced as closely as possible, the range of protein in the four meals being 35·4±2·3 to 38·4±3·19 g and of fat 15·6±1·0 to 18·6±1·8 g. The combination of soya beans and crispbread resulted in an increased intake of protein of 54·5±8·2 g and of fat 19·4±2·9 g. The cornflakes and porridge breakfasts, though of the same composition as each other, contained less protein (9·5±0·5 g and 10·2±0·9 g respectively) and fat (6·4±0·5 g in both meals) than the other meals (table I).

Before each meal the ranges of mean fasting blood glucose concentrations (10·3±2·1 to 12·9±2·7 mmol/l; 185±38 to 232±49 mg/100 ml), insulin dose (31±5 to 39±8 U/day), and body weight (58·3±3·5 to 61·1±5·7 kg) were similar. The slight increase in mean insulin dose and fasting blood glucose concentration seen before the porridge and cornflake breakfasts (table II) occurred because the subject with the lowest dose and fasting concentration did not take these meals.

Figures 1 and 2 show that the blood glucose concentrations measured after all except the porridge and cornflake breakfasts were below those measured after the wholemeal-bread breakfasts. The three-hour glucose areas show the same trend (table II): when expressed as a percentage of the area under the bread breakfast curve they show that a combination of soya beans and guar crispbread was the most effective in flattening the glycaemic response (to 25±8% of the area under the bread and cheese curve, $p < 0.001$) followed by soya beans and lentils (29±11%, $p < 0.002$), wholemeal bread and guar crispbread (51±16%, $p < 0.05$), and wholemeal bread and soya beans (65±13%, $p < 0.05$). The porridge and cornflake breakfasts were not significantly different from wholemeal bread (108±30% and 95±49% respectively).

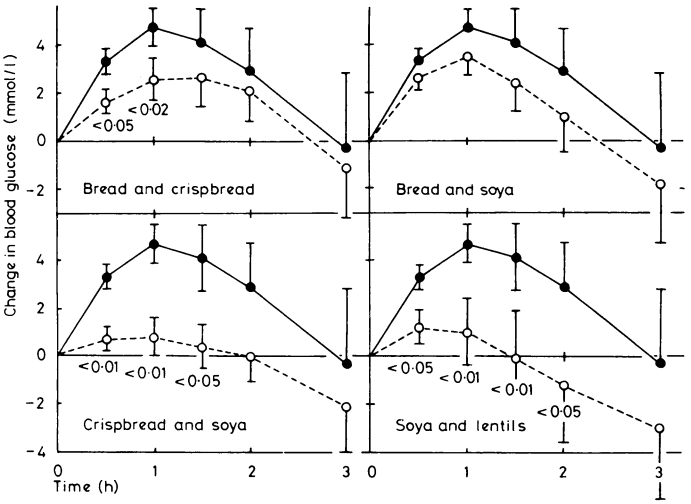

FIG 1—Mean (±SEM) blood glucose response of six diabetics to guar and leguminous-seed breakfasts (○- - -○) compared with response to bread and cheese breakfast (●——●). For dietary composition of each breakfast see table I.

Conversion: SI to traditional units—Glucose: 1 mmol/l ≈ 18 mg/100 ml.

TABLE I—*Mean compositions of seven breakfasts tested**

	Protein (g)	Fat (g)	Carbohydrate (g)	Dietary fibre (g)
Bread and cheese	35·4±2·3	15·6±1·0	42·8±5·3	9·0±1·2
Bread and guar crispbread	36·5±4·2	18·4±1·8	41·9±5·2	12·4±1·5
Bread and soya beans	36·5±4·2	18·5±1·8	41·9±5·2	16·5±2·0
Guar crispbread and soya beans	54·5±8·2	19·4±2·9	41·9±5·2	19·8±2·9
Soya beans and lentils	38·4±3·9	15·6±1·0	42·3±5·2	15·5±1·7
Porridge and spaghetti	10·2±0·9	6·4±0·5	43·8±7·5	4·8±0·8
Cornflakes and toast	9·5±0·5	6·4±0·5	43·8±7·5	7·7±1·4

*Calculated according to food tables.[4]

TABLE II—*Mean (±SEM) data on six test meals, showing fasting blood glucose concentrations, insulin dose, body weight, and area under blood glucose response curve (expressed both as absolute value and as percentage of area under curve for bread and cheese meal)*

	Fasting blood glucose (mmol/l)	Insulin dose (U/day)	Body weight (kg)	3-h glucose area (mmol min/l)	% of bread meal
Bread and cheese	11·4±1·7	34±7	58·5±3·4	557±156*	100
Bread and guar crispbread	11·8±1·6	31±5	58·4±3·4	333±138*	51±16 ($p<0.05$)
Bread and soya beans	11·4±2·1	31±5	58·7±3·3	365±158*	65±13 ($p<0.05$)
Guar crispbread and soya beans	10·3±2·1	34±7	58·9±3·5	153±71*	25±8 ($p<0.001$)
Soya beans and lentils	11·8±1·9	34±7	58·3±3·5	209±111*	29±11 ($p<0.002$)
Porridge and spaghetti	12·9±2·7	39±8	60·3±5·3	560±263†	95±49
Cornflakes and toast	12·8±2·9	38±7	61·1±5·7	552±207†	108±30

*n = 6. †n = 4.

Conversion: SI to traditional units—Glucose: 1 mmol/l ≈ 18 mg/100 ml.

Discussion

The present study shows that certain foods may be used in a meal to reduce the postprandial blood glucose response of diabetics. The results are similar to those seen with purified fibre formulations. In the present study there was an overall relation between glucose area expressed as a percentage of the area under the curve for wholemeal bread and the dietary fibre content ($n=7$, $r=0.8696$, $p<0.02$). This effect is weighted, however, by the high fibre content of the leguminous-seed meals. In a previous study, in which data on wholemeal bread compared with soya beans and lentils were presented, leguminous seeds were shown to be digested more slowly in vitro by human

digestive juices than wholemeal bread.[6] An increasing amount of data now suggests that dried leguminous seeds as a class are among the foods that cause the smallest change in blood glucose concentrations.[7] Whether this is due to their fairly high fibre content, to the nature of the starch they contain, or perhaps to inhibitors of carbohydrate absorption is not clear.

Previous studies have shown that guar crispbread reduces the glycaemic response to carbohydrate.[8] Soya and lentils in normal subjects cause a low glycaemic response compared with cornflakes and wholemeal bread, which cause high responses. Spaghetti and porridge give intermediate rises.[3 9]

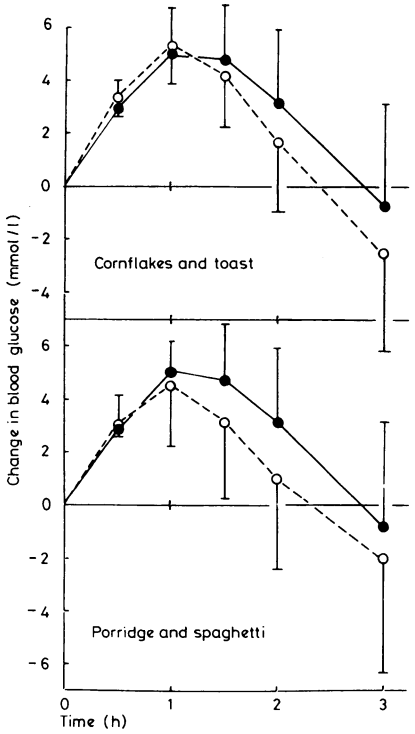

FIG 2—Mean (±SEM) blood glucose response of four diabetics to cereal breakfasts (○- - -○) compared with response to bread and cheese breakfast (●——●). For dietary composition of each breakfast see table I.

Conversion: *SI to traditional units*—Glucose: 1 mmol/l ≈ 18 mg/100 ml.

Guar, which itself is a leguminous seed fibre, flattens the glycaemic responses to mixed meals.[10-12] Its mechanism of action appears to depend on reducing the rate of absorption as judged by studies using xylose[13] and paracetamol[14] as markers. Its effect on blood glucose concentration is independent of increased insulin secretion[13] and in general depresses the postprandial responses of the hormones of the enteroinsular axis.[13 15]

Guar crispbread added to the diabetic diet in short-term studies reduced urinary glucose output[16] and in long-term studies[17] also reduced the insulin requirement. This method of treatment has been criticised by workers who, through failing to mix the fibre with the food,[1 2] have been unable to confirm the action of guar in test-meal and longer-term studies of diabetics. These workers have suggested that "natural" high-fibre foods may be both more acceptable and more effective than purified fibre preparations. The present study indicates that changes in cereal fibre content in terms of wholemeal bread, porridge, and cornflake breakfasts have little effect on the blood glucose response. Other studies have indicated a lack of effect of cereal fibre in improving glucose tolerance.[13 18] Nevertheless, unprocessed cereal products are undoubtedly the most acceptable and readily available source of fibre in Western nutrition. Although leguminous seeds may be eaten in large quantities in poor communities, they are no longer common foods in the West and may prove difficult to reintroduce.

We conclude that although both purified fibre formulations and certain unprocessed foods may lower postprandial glycaemia in diabetics, the use of one need not necessarily mean the exclusion of the other. A combination of leguminous seed fibre preparations and whole leguminous seeds certainly increases effectiveness and may cut down on the total amount of each required to be taken and so increase acceptability for long-term inclusion in the diet.

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Correction

Response of antidiuretic hormone to chlorpropamide

We regret that an error occurred in this paper by Dr M C Champion and others (6 September, p 645). The units for plasma concentrations of antidiuretic hormone should have read ng/l, not μg/l.