ABSTRACT SERVICE

Dietary Fibre

Dhananjaya S. Rao

Low-dose guar improves diabetic control

Jones D. B., Lousley S., Jelfs R. et al. – J. R. SOC. MED. 1985, 78, 546-548

Twenty diabetic outpatients (12 non-insulin-treated and 8 insulin-treated) were given guar granulate in a dose of 10 g daily for tow months in order to study the effect on glycaemic control and lipid levels. Mean glycosylated haemoglobin levels (HbA1c%) fell from 11.1 ± 2.0% preguar to 10.5 ± 2.2% ($p < 0.001$) after one month on guar and to 10.1 + 2.3%) ($P < 0.0001$) after two months. Following discontinuation of guar, HbA 1c% rose to 11.1 ± 2.5% ($P < 0.002$). However, there were no significant changes in fasting, blood glucose excretion or in lipid levels. Gastrointestinal side effects occurred in 4 patients during treatment with guar. Four patients reduced their dose of insulin and 2 patients reduced their dose of sulphonylurea therapy during this time because of symptoms suggestive of hypoglycaemia. We suggest that the low dose of guar used in this study may help improve glycaemic control in diabetic patients and that this may be achieved with a low incidence of gastrointestinal side effects.

Effect of guar gum on glipizide absorption in man

Huupponen R., Karhuvaara s. and Seppala P. EUR. J. CLIN. PHARMACOL. 1985, 28, 717-719

The effect of 4.75 g. guar gum, a fibre preparation, on the absorption of 2.5mg glipizide has been studied in 10 healthy volunteers given a standard breakfast. Three different experimental protocols were used: glipizide without guar gum (Treatment I), glipizide with guar gum (Treatment 2) and guar gum 30 min after the drug together with breakfast (Treatment 3). The serum glipizide at 30 minutes was higher during Treatment 2 than Treatment 3 ($p < 0.01$), but neither differed from the control treatment. The AUCs for glipizide were calculated up to 8 hours. They did not differ significantly between treatments, although there was a non-significant trend to lower values during Treatment 3. Serum insulin and blood glucose levels were determined up to 3 h. Corresponding to differences in the glipizide concentration, serum insulin was highest and bloods glucose lowest at 30 minutes during Treatment 2. According to this single dose study, guar gum does not have any substantial deleterious effect on the absorption of glipizide. The lack of effect may be due to the complete gastrointestinal absorption of glipizide.

Long-term ingestion of guar gum is not toxic in-patients with non-insulin-dependent diabetes mellitus

Mclvor M.E., Cummings C.C. and Mendeloff A. I. AM. J. CLIN. NUTR. 1985, 41 89-894

The use of diets rich in unabsorbable carbohydrate (fiber) has been advocated for the treatment of non-insulin-dependent diabetes mellitus (NIDDM). The soluble viscous fibers such as guar gum are most effective in normalizing carbohydrate intolerance in such patients; particulate fibers such as celluiose have little or no effect. While the latter are known to affect may aspects of nutrition when consumed in great quantity, little is known of the toxicity of guar gum. Eight adults with NIDDM are reported here who consumed at least 30 grams of guar gum for at least 16 weeks without any change in hematologic, hepatic, or renal function. Serologic screening revealed no change in lipid, protein or mineral metabolism, and no change in electrolyte balance. It is concluded that consumption of 30 guar gum per day for prolonged periods is without serious consequences.

Dietary guar gum supplementation dose not modify insulin resistance in gross obesity

Cavallo-Perin P., Bruno A., Nuccio P. et al.- ACTA DIABETOL. LAT. 1985, 22, 139-142

Obesity is considered an insulin resistant state. Dietary guar gum supplementation is able to reduce blood glucose and plasma insulin response to a carbohydrate meal. In order to evaluate whether guar is able to reduce hyperinsulinemia and insulin resistance in gross obesity, we studied 9 obese patients, > 50% overweight with impaired glucose tolerance before and after 4 + 4 g/day guar for 6 weeks. Six patients repeated the treatment with 8 + 8 g/day guar after a 3-month interval. Guar was added to the usual diet in order to

maintain the body weight constant. Pretreatment and post treatment study included: total specific insulin binding on circulating monocytes; 3H-glucose infusion and euglycemic hyperinsulinemic clamp at ~ 100 U/ml. The difference between post-treatment and pre-treatment values were not significant for any of the parameters studied. Fasting glucose production was: 2.17 ± 0.33 SEM (pretreatment) vs. 2.18 ± 0.18 (4 + 4 g/day) vs. 2.28 ± 0.14 (8 + 8 g/day) mg/kg/min; glucose utilization was: 3.52 ± 0.43 vs. 3.22 ± 0.44 vs. 3.49 ± 0.63 mg/kg/min; total specific insulin binding was: 2.80 ± 0.20 vs. 2.75 ± 0.25 vs. 2.78 ± 0.31%; body weight was: 101.4 ± 5.4 vs. 100.2 ± 6.2 vs. 100.5 ± 7.0 kg. These results indicate that dietary guar gum supplementation per se is unable to reduce insulin resistance in gross obesity if overweight is maintained constant.

Use of xanthan gum in dietary management of diabetes mellitus

Osilesi O., Trout D. L., Glover E. E. et al. – AM J. CLIN. NUTR. 1985, 42, 597-603

Xanthan gun (12 g/day) was fed in muffins during either the first or second half of a 12-wk period of muffin feeding, to free-living subjects. Nine subjects were diabetic, having moderately elevated serum glucose but managing without insulin or hypoglycemic drugs, and four were non-diabetic controls. Before the study and at the end of the xanthan and xanthan-free periods, bloods were taken before and 2 > after an oral glucose load. The feeding of xantham gum lowered fasting and postload serum glucose and reduced fasting levels of total plasma cholesterol in diabetic subjects. Xanthan gum also tended to lower fasting and postload levels of gastrin and gastric inhibitory polypepticle (GIP) and fasting levels of total and VLDL triglyceride and cholesterol in VLDL and LDL fractions subjects reported a sense of fullness after consuming xanthan muffins but no severe digestive systems.

Carbohydrates and dietary fiber in diabetes diet (Germ)

Teuscher A. – SCHWEIZ. MED. WOCHENSCHR. 1986, 116, 282-287

Dietary fibre has a blood-glucose reducing effect, as is manifested by a diminished glycemic index. In 1980 the consumption of dietary fibre in Switzerland is 22 g/day in comparison to 27 g in 1956. Thirty-five patients with diabetes (15 with insulin and 20 without) were treated with a high carbohydrate-high fibre diet (55% of total calories) for a period of 12 months. There were no changes in postprandial blood glucose values. HbA, cholesterol or bodyweight (in insulin-treated patients the weight decreased $p < 0.05$) despite a high carbohydrate diet.

Acute metabolic effects of the addition of fiber to test meals in patients with type I and type II diabetes mellitus (Ital)

Baroni G.C., Faglia E., Favales F. et al. – CLIN. TER. 1986, 116, 101-108

Three test meals were given to 15 diabetic patients, 8 with insulin-dependent and 7 with non insulin-dependent diabetes mellitus, on separate days at a week's distance, in the morning after an overnight fast. The test meals were identical in composition and calorie content (about 400 kcal) except for their fiber content: the control meal (A) was followed by meal B with addition of 10 g HFB a new bran preparation with an 80% concentration of dietary fiber, and by meal C with addition of 10 g MFB, a traditional wheat bran. Plasma glucose, insulin, C-peptid, total and HDL-cholesterol, triglycerides, apolipoprotein A and B were tested before and after each meal. Postprandial plasma glucose showed useful changes; the addition of MFB and even more of HFB reduced the post-prandial rise of glycemia. These findings suggest the usefulness of the addition of products rich in non-water-soluble fiber to the diet of diabetic patients. These fibers are less effective but better tolerated than water-soluble ones and therefore allow long-term use and lead to better results.

Dietary fibre, diabetes and obesity

Smith U. – INT. J. OBESITY 1987, 11/SUPPLE. 1 27-31

An increased intake of dietary fibre appears to be useful for the treatment of both obesity and diabetes mellitus. Fiber-rich food is usually satisfying without being calorically dense. Supplementing a normal diet with gel-forming fibers, such as guar gum leads to an increased satiation probably due to a slower gastric emptying. (2) Recent long-term studies have confirmed the usefulness of viscous fibres as an adjunct to regular dietary treatment of obesity. Apart from a beneficial effect during caloric restriction, dietary fibre may improve some of the metabolic aberrations seen in obesity. Gel-forming fibres are particularly effective in reducing elevated LDL-cholesterol without changing the

HDL-fraction. Impaired glucose tolerance of manifest diabetes is also improved. These effects are probably in part associated with the gelling property of the fibre, which leads to an increased viscosity of the unstirred layer thereby delaying the absorption process. (3) Other sources of dietary fibre with a high content of viscous gums, such as oats, have been shown to reduce LDL cholesterol. (4) Increased intake of viscous fibre leads to a gradual reduction in fasting glucose levels in diabetes. The reason for this is unclear but it cannot readily be explained by a delayed absorption process. Since insulin levels are also reduced these findings suggest that insulin resistance is alleviated. Recent studies with the euglycemic clamp technique support this possibility. Glucose uptake by isolated fat cells and both insulin sensitivity and responsiveness are also increased.

Guar by-product improves carbohydrate tolerance in healthy human subjects

Track N. S., Lai V.W. and Chiu S. S. - DIABETES RES. CLIN. PRACT. 1985, 1, 115-119

Guar gum possesses distinct hypoglycemic properties. The other fraction of the guar bean, guar by product (GBP), was studied to determine if it possesses any hypoglycemic properties. When 25g GBP or wheat bran was consumed with a carbohydrate test meal by 10 healthy subjects, at 15 and 30 min after GBP test meal significantly lower normalized plasma glucose responses were measured. Postprandial plasma insulin responses were similar after both test meals. During the first 60 min postprandially, the mean integrated plasma glucose response area was significantly lower after the GBP test meal. These data indicate that GBP, like guar gum, possess hypoglycemic properties; because of the different chemical characteristics of these 2 guar bean fractions, if seems that their hypoglycemic properties are due probably to different mechanisms.

The influence of guar-gum bread on the regulation of diabetes mellitus type II in elderly patients

Sels J. P., Flendrig J. A. and Postmes Th. J. - BR. J. NUTR. 1987, 57, 177-183

1. The effect of a high-fibre bread mixed with guar-gum 975 g/kg flour) on serum glucose, connecting peptide (C-peptide), haemoglobin A1 (HbA1), high density-lipoprotein-cholesterol (HDL-cholesterol) and triglycerides was examined in fourteen elderly patients with diabetes mellitus type II. 2. The mean daily consumption of guar gum was 8.1 g. Gastrointestinal, disorders were not observed. 3. Consumption of guar-gum bread resulted in a significant decrease in C-peptide values on the 1st day and blood glucose values after 3 weeks (both measured 90 min after breakfast). C-peptide values remained low, while an unaccountable ' rebound' phenomenon was seen in the blood glucose values 90 min after breakfast at the end of the study. 4. No significant change was seen in respect to HDL-cholesterol and triglycerides. However, a small significant increase in HbA1 was noted.

Low does guar in a novel food product: improved metabolic control in non-insulin-dependent diabetes

Peterson D. B., Ellis P. R., Baylis J. M. et al. DIABETIC MED. 1987, 4, 111-115

Sixteen non-insulin-dependent diabetic patients, mean age 60 years (range 47-69 years) and duration of diabetes 9 years (2-20years), completed a randomized cross-over study of three 6-week periods separated by 2-week intervals to minimize carry-over effects, in which their usual bread was replaced by either control bread, guar bread (100 g guar/kg wheat flour), or control bread plus a guar granulate. The mean (± SEM) intake of guar taken in bread was 7.6 ± 0.7 g/day (range 3.1-14.3 g/day). The granulate was taken in a dose of 5 g twice daily which provided 8.3 g guar/day. Significant reductions were found in glycosylated haemoglobin after guar bread (11.5 ± 0.8% to 10.7 ± 0.8%; $p < 0.02$) and after guar granulate (11.2 ± 0.8% to 10.6 ± 0.7%; $p < 0.05$) compared with control bread. Total cholesterol was also reduced significantly after both guar bread and guar granulate ($p < 0.01$, $p < 0.02$), the changes being

High-fibre, low sodium and low fat diet in white and black Type 2 diabetics with mild hypertension

Pacy P. J., Dodson P.M., Kubucki A. J. et al. DIABETES RES. 1986, 3, 287-292

White and black mildly hypertensive Type 2 diabetics were given an intended diet high in unrefined carbohydrate (50 % daily energy) and fibre (40-45 g/day) white low in fat (25% daily energy) and sodium (60-80 mmol/day) for 3 months. Both white and black diabetic hypertensive patient groups demonstrated a significant reduction systolic ($p < 0.01$ and p ±

0.001 respectively) and diastolic blood pressure ($p < 0.001$ and $p < 0.01$ respectively). This was accompanied by a significantly reduction of daily urine sodium excretion, urine sodium: potassium ratio, weight and glycosylated haemoglobin in both groups. Only whites had a significant reduction of serum triglyceride level ($p < 0.05$) although blacks showed similar trends. Compliance to the dietary regimen, assessed by scoring method appeared comparable in both groups. These data suggest this modified dietary regimen might be considered an attractive alternative to conventional antihypertensive drug therapy in mildly hypertensive Type 2 diabetic black as well as white patients.

Beneficial effects of palatable guar and guar plus fructose diets in diabetic children

Paganus A., Maenpaa J., Akerblom H. K. et al. ACTA PAEDIATER. SCAND. 1987, 76, 76-81

This randomized crossover, study evaluates the effects of extended, guar and guar + fructose diets on the metabolic balance of children with insulin-dependent diabetes mellitus (IDDM). We studied 22 children; mean age 12.2 years, mean duration of diabetes 4.4 years. The diet was supplemented for three weeks with guar in palatable form (5% of daily carbohydrate intake) and with guar + fructose (1 g of fructose/kg body weight, max 30 g/d) for another three weeks. A control group (8 children, mean age 12.3, duration of diabetes 4.3 years) followed the same experimental protocol without guar supplementation. The metabolic balance was assessed by glucosuria index (per cent of tests than 1% glucosuria from all urine tests) and measurements of red cell glycohaemoglobin A (1c) (HbA (1c)). Serum total and HDL-cholesterol, C-peptide, pancreatic and enteroglucagon were also measured. HbA (1c) decreased during guar ($p < 0.001$) and guar + fructose diet ($p < 0.001$). The glucosuria index improved ($p < 0.02$) and the serum total cholesterol concentration decreased ($p < 0.02$) (during the experimental guar diets. Guar in acceptable from and quantity in the diet appears to improve metabolic control if diabetic children.

Guar sprinkled on food: Effect on glycaemic control, plasma lipids and gut hormones in non-insulin dependent diabetic patients

Fuessl H. S., Williams G., Adrian T. E. and Bloom S. R. - DIABETIC MED. 1987, 4, 463-468

The effects of guar granules sprinkled over food on carbohydrate and lipid metabolism were studied in a double blind, crossover trial in 18 patients with non-insulin-dependent diabetes mellitus (mean ± SEM age 61.3 ± 2.5 years). Five-gram guar granules (Guaremr, Rybar Laboratories, Amersham, Bucks) were sprinkled over food at each main meal for 4 weeks, and during a 4-week placebo period (separated by a 2-week ' washout' period), 5g wheat bran was taken in the same way. Diabetic treatment was not changed during the study. Mean fasting plasma glucose (FPG) concentration and glycosylated haemoglobin (HbA_1) concentration after treatment were significantly lower than after the placebo period (FPG 8.29 ± 0.47 vs. 8.78 ± 0.53 mmol/1, $p < 0.05$; Hba1: 8.70 ± 0.39 vs. 9.09 ± 0.39%, $p < 0.05$) There was a 50% reduction in incremental area under the postprandial glucaemic curve when guar was eaten with a standardized test meal. Total plasma cholesterol decreased from 5.79 ± 0.29 to 5.19 ± 0.22 mmol/1 ($p < 0.05$) after the guar treatment period. Guar ingestion reduced postprandial insulin and enteroglucagon responses, the latter significantly so, but had no apparent effect on gastric inhibitory polypeptide, pancreatic glucagon, gastric, and pancreatic polypeptide.

Effects of leguminous seeds in a mixed diet in non-insulin-dependent diabetic patients

Karlstrom B., Vessby B., Asp N.G. et al. DIABETES RES. 1987, 5, 199-205

The effects of moderate addition of leguminous seeds to a mixed diabetic diet were evaluated in 15 inadequately controlled patients with non-insulin-dependent diabetes mellitus. A control diet and a diet with an increased content of peas and beans (leguminous diet) were given consecutively for a 3 week period each on a metabolic ward. Seven of the patients started with the control diet and 8 with the leguminous diet. On an energy basis the diets comprised 20% protein and 33-34% fat, the ratio between polyunsaturated and saturated fatty acids was 1.4. The analysed dietary fibre contents of the control and leguminous diets were 24 and 37 g/day per 6.7 MJ (1,600 kcal) respectively. The content of digestible carbohydrates was similar in the 2 diets. The mean body weight did not differ after the 2 dietary treatment periods. All patients showed improved glucose control during treatment irrespective of the type of diet given. The fasting blood glucose concentration on admission was 14.3 ± 0.9 mmol/1 (mean ± SEM). This value had decreased to 9.9 ± 0.8 during the last week of the control period and to 9.7 ± 0.6 during the last week of the leguminous diet period. The mean postprandial glucose concentration a 3 p.m. was

significantly lower during the leguminous diet period. The mean urine glucose excretion was significantly lower during the leguminous diet period. The fasting serum lipid concentrations decreased during treatment with each diet, but there were no significant differences between these values at the end of the 2 diet treatment periods. There were no differences in fasting blood glucose, fasting insulin or insulin sensitivity (the latter measured by the intravenous insulin tolerance test) at the end of the 2 diet periods. This study confirms that a moderate amount of leguminous seeds in the diabetic diet results in improved diabetic control in patients with high blood glucose values as compared with a control diet with the same contents of energy, protein, fat and carbohydrate. This improvement may be related to slower intestinal absorption of glucose.

Usefulness and side effects of a high fiber diet in a group of adolescents affected by insulin-dependent diabetes mellitus (Fren)

Cerutti F., Vigo A., Guidoni C. et al. - HELV. PAEDIATR. ACTA 1987, 42, 281-288

The influence on metabolic control and the possible side effects of diet rich in vegetable fibers was evaluated in a group of insulin-dependent adolescents. After two weeks of controlled diet, a new dietary regime with a higher vegetable fiber content (66 g/day vs. 15 g/day) and an increased iron content (22.5 mg/day vs. 11.5 mg/day) was as signed to each patient for a period of two months. At the end of the dietary trial, a decrease of the insulin requirement, of the mean daily blood glucose values, and of glycosylated haemoglobin (HbA1) was observed. Serum iron levels were statistically lowered, but still in the normal range. These data suggest that high fibre diet can improve metabolic control of type I diabetes, but cast some doubts because of possible side effects on intestinal absorption of oligoelements.

Does adding fibre to a low energy, high carbohydrate, low fat diet confers any benefit to the management of newly diagnosed overweight type II diabetes?

Beattiee V. A., Edwards C. A., Hosker J. P. et al. - BR. MED. J. 1988, 296/6630, 1147-1149

The effect of supplementing a low energy (roughly 5.0 MJ), high carbohydrate (180 g), low fat (roughly 25 g) diet with 10-15 g of either cereal fibre or guar gum was investigated in 24 newly diagnosed over-weight non-insulin-dependent (type II) diabetes. The patients were divided into three treatment groups: one received a low fibre control diet throughout the study period of 20 weeks and the other received two supplements of cereal fibre and guar gum in a crossover manner. The nutrient content of the diets was kept constant throughout. Though patients taking the low fibre diet showed a smaller reduction in fasting plasma glucose concentrations over the first eight weeks than patients taking a high fibre diet, this difference was not evident at the end of 20 weeks; reductions in weight and glycated haemoglobin values were similar for each dietary regimen throughout the trial. There was little evidence that supplementing a low energy a low energy, high carbohydrate diet with fibre confers any therapeutic benefit to type II diabetics and no evidence that taking fibre as viscous polysaccharides is any more beneficial to overweight diabetics than taking a similar fibre supplement as cereal. On the contrary, guar gum caused more abdominal discomfort and flatulence than the other diets.

Soluble and insoluble dietary fibre in diabetic diets

Del Toma E., Lintas C., Clementi A. and Marcelli M. - EUROP. J. CLIN. NUTR. 1988, 42, 313-319

The possibility of modulating postprandial metabolic responses in diabetics by an increase in the amount of soluble fibre rather than by the use of the high amounts of total dietary fibre (DF), so far strongly advocated, was investigated. Soluble and insoluble DF components of common foodstuffs were analysed and the data utilized to formulate three different meals with similar quantities of available carbohydrate, protein and fat and differing only in the quantity and quality of DF: low fibre (LF), high soluble fibre (HSF) and high insoluble fibre (HIF). Ten NIDDM patients in good metabolic control received each test meal in randomized order at 2-week intervals. The postprandial blood glucose and serum insulin responses to the LF and HIF test meals were similar. The HSF meal produced significantly lower glucose ($p < p.001$) and insulin ($P < 0.05$) responses, compared to either LF or HIF meals. Such results may be of relevance in the formulation of diabetic diets in order to prevent an excess of insoluble fibre, so improving patients' compliance. Fruits and vegetables may be used advantageiously to increase quantities of soluble fibre limiting excess of legumes or guar additives.

Dietary fiber decreases fasting blood glucose levels and plasma LDL concentration in non-insulin-dependent diabetes mellitus patients

Hagander B., Asp N.-G., Efendic S. et al. - AM. J. CLIN. NUTR. 1988, 47, 852-858

Realistic high-fibre and regular low-fibre diets were given for 8 wk each to non-insulin-dependent diabetes mellitus (NIDDM) patients whose diabetes was being controlled satisfactorily by diet alone. The purpose of the study was to evaluate the metabolic effects of dietary fibre without changing energy intake or proportions of protein, fat, and car-bohydrates. The high-fibre diet induced lower fasting blood glucose levels ($p < 0.01$) and decreased the ratio of low-density lipoproteins ($p < 0.025$); no difference was found in HbA (1c) between the two diet period. Continuous glucose monitoring also showed a difference in fasting glucose levels that remained after identical low-fibre test meals. The incremental glucose responses did not differ. The fasting and incremental postprandial levels of insulin, C-peptide, glucagon, and somatostatin did not change, whereas the mean triglyceride concentrations were lower after the high-fibre diet. The results suggest a beneficial effect of dietary fibre in the metabolic control of NIDDM.

Effects of four meals with different kinds of dietary fibre on glucose metabolism in healthy subjects and non-insulin-dependent diabetic patients

Karlstrom B., Vessby B., Asp N.-G. and Ytterfors A. - EUROP J. CLIN. NUTR. 1988, 42, 519-526

The effects of four mixed meals on glucose metabolism were studied during a 4-h period in 12 healthy women and in 13 women with non-insulin-dependent diabetes. Three test meals containing different types of dietary fibre in realistic amounts (cereal, leguminous and mixed-fibre), and one control meal were prepared. Each meal was calculated to contain 2.1 MJ (500 kcal) and the energy distribution protein, fat and carbohydrate (by difference) were 15, 29-31 and 56-58 per cent, respectively. Results of analyses of the mixed meals, performed after the clinical study, showed unexpectedly large deviations from the calculated values regarding digestible carbohydrates in the leguminous meal. In the healthy group the blood glucose concentrations after the four meals did not differ significantly. In the diabetic group the area under the curve of blood glucose values was significantly smaller after both the leguminous meal and that containing mixed dietary fibre than after the control meal ($P < 0.001$). There were also significant differences in blood glucose between the cereal meal and the leguminous and mixed-fibre meals ($P < 0.001$), and between the leguminous meal and the mixed-fibre meal ($P < 0.05$). In the healthy group the insulin response was significantly lower after leguminous meal than after the control meal ($P < 0.05$) whilst the diabetic group showed lower insulin responses after all the high fibre test meals. Serum triglycerides, cholesterol and HDL cholesterol were similar after the different meals. The lower content of digestible carbohydrates, especially in the leguminous meal, complicates the interpretation of the results. The beneficial effects of the leguminous and mixed-fibre meals in diabetic patients may be due both to the fibre content and to the different content of digestible carbohydrates. The present study shows that differences in glycaemic response between meals may be overlooked when studying only blood glucose response in healthy subjects. It also stresses the desirability of food analyses in dietary studies.

Starchy foods and glycemic index

Jenkins D.J.A., Wolever T.M.S. and Jenkins A.L. DIABETES CARE 1988, 11, 149-159

Different starcy foods produce different glycemic responses when fed individually, and there is some evidence that this also applies in the context of the mixed meal. A major reason appears to relate to the rate at which the foods are digested and the factors influencing this. A similar ranking in terms of glycemic response to specific foods is seed independent of the carbohydrate tolerance status of the groups tested. Potentially clinically useful starchy foods producing relatively flat glycemic responses have been identified. Many of these are considered ethnic or traditional and include legumes; pasta; grains such as barley, parboiled rice, and bulgur (cracked wheat); and whole-grain breads such as pumpernickel. Specific incorporation of these foods into diets has been associated with reductions in low-density lipoprotein cholesterol and triglyceride levels in hyperlipidemia and with improved blood glucose control in insulin-dependent diabetic patients. To facilitate identification of such foods, it has been suggested that the glycemic response should be indexed to a standard (e.g., white bread) to allow comparisons to be made between the glycemic index of foods tested in different groups of subjects. The scope of application of this principle

is subject to further investigation. It may be used to expand the range of possibly useful starch foods for trial in the diets of diabetic patients.

Dietary fibre in management of diabetes

Vinik A. I. and Jenkins D.J.A. - DIABETES CARE 1988, 11, 160-173

Current evidence suggests that high-fibre diets, especially of the soluble variety, and soluble fibre supplements may offer some improvement in carbohydrate metabolism, lower total cholesterol and low-density lipoprotein (LDL) cholesterol, and have other beneficial effects in patients with non-insulin-dependent diabetes mellitus (NIDDM). Diets enriched with wheat bran and guar gum induce 10-20% reduction in serum cholesterol and LDL in both normo-and hypercholesterolemic subjects and have the ability to blunt the hypertriglyceridemic effects of diet high in carbohydrate and low in fibre. In insulin-dependent diabetes mellitus (IDDM) the situation is less clear, but a decrement of the circadian glucose profile has been shown. Americans, in general, consume too little fibre. With the need to restrict fat and reduce protein, an increase in carbohydrates is mandatory. A practical goal would be to establish the present level of fibre intake (15-g/day) and to gradually increase it. An intake of up to 40g of fibre per day or 25g/1000 kcal of food intake appears beneficial; in many individuals on weight-reducing diets higher levels may be unacceptable because of gastrointestinal side effects. The level of maximum benefit has not been determined. Fibre supplementation appears beneficial only if given with a diet comprising approximately half of the calories as carbohydrate. Foods should be selected with moderate to high amounts of dietary fibre from a wide variety of choices to include both soluble and insoluble types of fibre. Insufficient data are available on the long-term safety of high-fibre supplements. People at risk for deficiencies, such as postmenopausal women, the elderly, or growing children, may require supplements of calcium and trace minerals. People with upper gastrointestinal dysfunction are at risk of bezoar formation and cautioned against a diet high in fibre of the leafy vegetable type. Careful attention must be paid to insulin dose because hypoglycemia can result if there is a radical change in fibre intake and insulin dose is not reduced appropriately. Care must be exercised in the use of novel fibers, including the wood cellulose, because little is known of their safety and efficacy.

Glucose and lipid metabolism and insulin sensitivity in type 1 diabetes: The effect of guar gum

Ebeling P., Yki-Jarvinen H., Aro A. et al. -A.M. J. CLIN. NUTR. 1988, 48, 98-103

The effect of guar gum on glucose and lipid metabolism and on body insulin sensitivity was examined in nine type 1 diabetic patients treated with continuous subcutaneous insulin infusion. The study was done in a randomized, double-blind, crossover fashion with either guar gum or a placebo added to the usual diet four times per day for 4 wk each. Blood glucose levels after breakfast and lunch and daily insulin requirements were significantly lower during the guar gum than the placebo diet. After a 4-wk guar-gum supplementation, blood glucose response to a test meal was significantly reduced by guar gum compared with the placebo. Hemoglobin A_1 (HbA_1) and insulin sensitivity remained unchanged. Serrum total cholesterol fell by 21% (p f 0.025). Thus, guar gum can reduce postprandial blood glucose, insulin requirements, and serum total cholesterol levels in type 1 diabetic patients.

Metabolic consequences of feeding a high-carbohydrate, high-fiber diet to diabetic patients with chronic kidney failure

Parillo M., Riccardi G., Pacioni D. et al. -A.M. J. CLIN. NUTR. 1988, 48, 255-259

The aim of this study was to compare the metabolic effects of high-carbohydrate (CHO), high-fibre diet with only moderate protein restriction with those of a low-CHO, low-fibre diet with a low protein content in six diabetic patients with moderate chronic renal failure. The high-CHO, high-fibre diet induced a significant improvement in blood glucose control, a significant improvement in blood glucose control, a significant decrease in serum cholesterol, and a significant increased in fecal nitrogen loss. Other variables evaluated were not significantly different between the two diets, except for a significant increase in serum phosphorus during the high-CHO, high-fibre diet. N balance was not significantly different from 0 at the end of either dietary period and was very similar for both diets. The high-CHO, high-fibre diet presents many beneficial metabolic effects in diabetic patients with chronic renal failure.

Effects of cottonseed dietary fiber on metabolic parameters in diabetic rats and non-insulin-dependent diabetic humans

Madar Z., Nir M., Trostler N. and Norenberg C. - J. NUTR. 1988, 118, 1143-1148

The objective of this study was to evaluate the effects of gland cottonseed dietary fibre (CSDF) containing 86% dietary fibre (mainly cellulose) on serum glucose levels in diabetic rats and in non-insulin-dependent diabetes mellitus (NIDDM) patients. A diet containing 15% CSDF given to streptozotocin-induced diabetic rats for 30 d tended to reduce the post-prandial plasma glucose level curve. Alternatively, CSDF significantly increased fecal weight (15 ± 3 vs. 5 ± 2 g; $P < 0.01$) and shortened transit time (20 ± 2.24 vs. 11.2 ± 0.8 h). CSDF had no effect on body weight and serum lipid levels. Twelve NIDDM subjects were given a meal tolerance test (MTT) with or without CSDF before and after daily supplementation of CSDF (16.5g) in pita twice a day for a month. Incremental glucose levels were significantly ($P < 0.05$) lower at 30, 60 and 180 min after the MTT containing CSDF than in subjects consuming a meal without CSDF. The insulin levels also tended to be lower. The NIDDM subjects tolerated the CSDF well. No flatulence or other side effects were exhibited. Plasma lipid levels remained unchanged. We therefore concluded that CSDF might have a potential benefit in the management of NIDDM.

Characteristics that enhance adherence to high-carbohydrate/high-fiber diets by persons with diabetes

Kouris A., Wahlqvist M. L. and Worsley A. -J. AM. DIET ASSOC. 1988, 88, 1422-1425

This study sought to characterize 40 clients with diabetes, 19 of whom adhered to a high-carbohydrate/fibre fiet and 21 of whom did not, in accordance with the adherence pattern. There would seem to be distinct differences in the characteristics of adherers and non-adherers. Dietary adherence was found to be independent for sex, age, occupation, marital status, ethnicity, and education. However, comparison of the groups' health and dietary perception showed that non-adherers, as opposed to adherers, were not concerned about reaching their ideal body weight; needed to be motivated to exercise by family or friends; did not perceive diabetes as a threat to their health; were not satisfied with their knowledge about diabetes; were not content with their nutrient status but believed they were consuming adequate amounts of carbohydrate; and believed that they did not need to change their intake of fruit, vegetables, and bread - liking/disliking of these foods being the most important barrier to dietary change. Such patients, identified in screening for potential dietary non-adherence, may benefit from the use of educational strategies different from those used with patients who are more oriented toward health.

Glucose tolerance in North Indians taking a high fibre diet

Bhatnagar D. - EUROP. J. CLIN. NUTR. 1988, 42, 1023-1027

In 249 individuals of different age groups, taking a high fibre diet naturally, glucose tolerance studies were done after a standard glucose load (1.73g/kg body weight or 100g glucose). A group of 156 of the subjects were also studied after a standardized hospital meal 258g carbohydrate, 14g fat, 47g protein and 32g fibre). Mean blood glucose values after the high fibre mixed meal were lower than after glucose load. The mean 2-h postprandial blood glucose was 2-4 mmol/l lower compared to that observed in other studies using less carbohydrate. The postprandial blood glucose pattern is likely to be the result of (a) the large amount of carbohydrate and fibre in the test meal (b) the fat and protein content of the test meal (c) the habitual intake of such a meal and (d) nature and type of fibre consumed in the meal. Among the subjects 1.2 per cent were found to have non-insulin dependent diabetes mellitus while 2 per cent had impaired glucose tolerance. This prevalence of non-insulin dependent diabetes mellitus in subject, who came predominantly from a rural or semi-rural background, is lower than that found in urban areas of Northern India. The effect of age on glucose tolerance was clearly seen after the glucose load (0.4 mol/1/decade) and after the mixed meal (0.1 mmol/1/decade). These findings suggest the potential of the constituents of a typical North Indian diet in improving glucose tolerance.

Dietary fibre enrichment, blood pressure, lipoprotein profile and gut hormones in NIDDM patients

Hagander B., Asp N-G., Ekman R. et al. - EUROP. J. CLIN. NUTR. 1989, 43, 35-44

The influence of a beet-fibre enriched diet (mean 40 Fibrex (R), 27g dietary fibre per day) on blood

pressure, plasma lipoproteins and glycaemic control was studied in 12 non-insulin-dependent diabetic (NIDD) patients. The effect of gastrointestinal hormones was also investigated. Beet-fibre and control diets were given in randomized order for 8weeks each. During the beet-fibre diet the systolic blood pressure decreased ($P > 0.05$) and the HDL-cholesterol levels increased ($P < 0.05$) compared to values before the study. There was a tendency for systolic blood pressure to be lower also in the control period, but this was not statistically significant. After both diet periods the total plasma cholesterol and triglyceride levels decreased, as well as the LDL/HDL ratio. Blood glucose levels - fasting or postprandial - and glycosylated haemoglobin were not affected during the two different period. In obese NIDD patients, however, the postprandial insulin levels were lower after the beet-fibre diet compared to the control diet. This subgroup also showed lower fasting values of pancreatic polypeptide and motilin were recorded for the obese patients after the fibre-rich period compared to before the study. Further, increased in postprandial motilin levels, 60-180 min, were found after the fibre-rich period. Investigations with reference to an entero-hormonal mechanism by measuring neurotensin and peptide YY did not show any variations between the diet periods.

Effects of guar-pasta on serum lipid levels in obese diabetic and non-diabetic women with normal lipids

Tognarelli M., Miccoli R., Giampietro O. et al. - ACTA DIABETOL. LAT. 1988, 25, 243-246

Alternative medications for hyperlipidemia management have been continuously searched for above all because currently employed drugs appear not to be effective or are poorly tolerated. Fibers, such as guar gum, seem to be able to reduce cholesterol levels, but their extensive and long-term use is beset by the high incidence of gastrointestinal side effects. In this study the administration of guar-enriched pasta has proved to reduce fasting and post-prandial cholesterol levels significantly in 15 obese normocholesterolemic women (5 diabetics and 10 non-diabetics). The women reported good palatableness of guar-pasta without any side effects.

The medium-term effect of natural or extractive dietary fibres on plasma amino acids and lipids in type 1 diabetics

Bruttomesso D., Briani G., Bilardo G. et al. DIABETES RES. CLIN. PRACT. 1989, 6, 149-155

We evaluated the effect of a diet rich in natural (NF) or extractive fibres (guar gum) on 12 male IDD (insulin-dependent diabetes) out patients. The treatment lasted for 2 months. During the first month the patients were on an isocaloric diet containing 30g of fibres and then they were randomly subdivided into two groups. One group followed an isocaloric diet rich in fibres (70g/day), the second group an isocaloric diet enriched by guar (9g or guar added to 30g of natural fibres/day). Reduced serum levels of HbA (1c) and several amino acids showed that metabolic control significantly improved under each dietary regimen.

Metabolic and nutritional effects of long-term use of guar gum in the treatment of non-insulin-dependent diabetes of poor metabolic control

Uusitupa M., Siitonen O., Savolainen K. et al. - AM. J. CLIN. NUTR. 1989, 49, 345-351

Thirty-nine patients with non-insulin-dependent diabetes on oral drug treatment were randomly allocated to either guar gum or placebo treatments for 3 mo. After 3 mo the placebo group was switched to guar gum treatment and both groups were followed for 10 mo (open trial). No significant difference occurred in the fasting blood glucose or glycosylated haemoglobin A1 levels between the two groups at 3 mo. Serum total cholesterol level decreased in the guar gum group from 6.55 ± 1.45 to 5.69 ± 1.2 mmol/L ($p < 0.001$) but no changes were observed in the placebo group 6.55 ± 1.2 vs. 6.26 ± 1.4 mmol/L, NS) during 3 mo. At the end of the open trial ($n = 33$), serum cholesterol was still ~ 7% lower than before guar gum treatment. No consistent changes occurred in serum HDL-cholesterol or triglycerdes. Serum vitamin A level was slightly lowered and Plasma zinc level elevated during the open trial. Serum vitamin E level was decreased only in the group switched to guar gum at 3 mo.

Effect of guar gum mineral balances in NIDDM adults

Behall KM; Scholfield DJ; Mclvor ME; Van Duyn S; Leo TA; Michowski JE; Cummings CC; Mendelff AI - DIABETES CARE 1989, 12, 357-64.

The self selected diet of 16 subjects with non-insulin-dependent diabetes mellitus (NIDDM) was

supplemented for 6 months with either a granola-like bar containing 35.5g carbohydrate and 6.6g guar gum/bar or placebo bar containing carbohydrate but no guar gum. Subjects consumed a mean of 4.8 bars/day. Average guar gum consumption at the end of the study was 31.7 g/day. One week before guar gum consumption at the end of the study was 31.7 g/day. One week before and at the end of the study, subjects were admitted to a metabolic ward and fed a controlled diet similar to their self-selected diet. Food, feces and urine were composited for analysis of iron, zinc, copper, calcium, magnesium and manganese. Eight subjects consuming the guar gum supplement and 6 subjects consuming the placebo bar completed collections for mineral balance. Neither consumption of guar gum nor placebo bar significantly changed apparent mineral balance for iron; copper, zinc, calcium, manganese or magnesium from prestudy levels to 6-months levels and no significant difference were observed between 2 groups. With the exception of copper, men consumed significantly more minerals than women. The authors conclude that consumption of guar gum by patients with NIDDM does not adversely affect apparent mineral balance.

The effect of diet difference in fat, carbohydrate, and fiber on carbohydrate and lipid metabolism in type II diabetes.

O'Dea K; Traianedes K; Ireland P; Niall M; Sadler J; Hopper J; De Luise M - J. AM. DIET ASSOC. 1989, 89, 1076-86

This study was designed to determine the effects of varying the proportions of carbohydrate, fibre, and fat on metabolic control in type-II diabetes. Ten man, aged 50 to 69 years, with type-II diabetes participated. Four isocaloric diets were consumed for 2 weeks each, with a break of 6 to 14 weeks between diets to ensure no carryover effects. Two of the diets were high in carbohydrate (63% to 65% energy) and low in fat (10% to 12% energy) but differed in their fibre contents (20 vs. 45 g/day). The other two diets were low in carbohydrate (23 to 27% energy) with either a low or a high fat content (15% vs. 55% energy) and high or normal protein content (62% vs. 18% energy). The composition of the subjects' usual diets in the week before each of the experimental diets did not vary significantly: carbohydrate 47% to 50% energy, protein 22% to 25% energy, fat 27% to 31% energy, and fibre 24 to 25g/day. A 75-g oral glucose tolerance test and a 12-hour metabolic profile in response to 3 meals typical of the particular diet were conducted before and at the conclusion of each 2-week dietary period. The most significant improvements in metabolic control (as assessed by the effects of the diets on fasting glucose and on lipids, and on the glucose and insulin responses to oral glucose and the mixed meals) were obtained with the high-fibre, high-carbohydrate, low-fat diet and with the low carbohydrate, high protein, low-fat diet. Metabolic control was not significantly affected by the low-fibre, high carbohydrate, low-fat diet, but it deteriorated significantly on the low-carbohydrate, high-fat diet. The results of this study confirmed the importance of high fibre and low fat in improving metabolic control in type-II diabetes. In conclusion, if high-carbohydrate, low-fat diets are to recommend to patients with diabetes, it is essential that the type of carbohydrate recommended be unrefined and high in fibre.

Long-term high fibre, low fat diet in gestational diabetes

Paisey R. B., Savage P., Marsland I. and Cooke P. - DIABETIC MED. 1985, 2, 286-287

A 30-Year-old Caucasian who developed gestational diabetes in her first pregnancy requiring 58U insulin daily and who subsequently adopted a high fibre, low fat diet and who was able to maintain normal glucose tolerance throughout a second pregnancy is reported.

Nutritional risk of high-carbohydrate, guar gum supplementation in non-insulin-dependent Diabetes Mellitus

A. S. Van Duyn, T. A. Leo, M. E. Mclvor, K. M. Behall, J. E. Michnowski and A. I. Mendeloff - DIABETES CARE, 1986, 1989, 9, 497-503

Dietary supplementation with high-carbohydrate, guar gum fibre (HCF) is effective in acutely blunting postprandial blood glucose levels. We report the effect of such supplementation on the diet and nutritional status of a group of 16 subjects with non-insulin-dependent diabetes mellitus (NIDDM) who incorporated either HCF bars (35.7 g carbohydrate and 6.6 g guar gum/bar) or placebo bars (identical except for the absence of guar gum) into the diet for 6 mo as part of a double-blind, randomized clinical trial. The HCF subjects achieved mean daily intake of 4.8 ± 0.4 bars, constituting 51.2 ± 3.1% of total calories and providing 29.7 ± 2.6g guar gum daily. Energy intakes and body weight did not change significantly in either group. Food consumption patterns and nutrient intakes did change, although

not enough to impair the nutritional integrity of the diet because the bars themselves served as a source of nutrients. The bars were rich in thiamin, B_6, folacin, phosphorus, iron, zinc, and copper, adequately replacing any decrease in nutrient intake as a result of foods being deopped from the diet. In fact, daily intakes of B_6, folacin, and copper actually increased due to contributions from the bars. Nutrients in which the bars were poor (vitamins A, C and B_{12}) resulted in suboptimal intakes (< 66% RDA). Although no significant change in nutritional status of the HCF group occurred as determined by arm muscle area, and fat area, hemoglobin, hematocrit, or serum albumin, transferrin, iron, ferritin, calcium, phosphate, B_1 and magnesium levels, these indicators of nutritional status are rather insensitive. To ensure adequate nutrient intake and thus nutritional status with HCF diets, vitamin and mineral supplementation is probably advisable over the long term.

Effects of a high-starch diet with low or high fiber content on postabsorptive glucose utilization and glucose production in normal subjects

Paul J. Nestel, Christopher Nolan, Jeff Bazelmans, and Russel Cook - DIABETES CARE. 1984, 7, 207-210

The effects of fibre, added to a high-starch diet, on glucose and insulin metabolism were studied in seven healthy men in a controlled environmental. Diets rich in starch (carbohydrate provided 62% energy) contained either 16g or 100g of fibre from several sources of food and were given for 10-day periods. Two parameters of glucose control were measured: glucose metabolism during insulin glucose infusions (seven subjects) and glucose production measured by infusing tritiated glucose tracer (five subjects). Three sets of studies were carried out in the sequence: low-fibre, high-fibre, low fibre. The respective mean values (± SE) for glucose utilization were 6.70 ± 1.4, 7.01 ± 1.02, and 6.77 ± 1.34 mg/kg min. Analysis of variance failed to show a significant effect of dietary change. Values for basal glucose production were 2.0 ± 0.1, 1.9 ± 0.2 and 2.4 ± 0.3 mg/kg min with the low-fibre, high-fibre, and low-fibre diets, respectively, which were not significantly different. The one significant response to the high-fibre diet was a lowering in plasma cholesterol, the mean values for the seven subjects during the three periods being 154 ± 12, 138 ± 10, and 156 ± 13 mg/dl ($P < 0.05$).

High-carbohydrate, high-fibre diet in children with type I diabetes mellitus

Alan N. Lindsay, Sherrie Hardy, Lucie Jarrett, and Marvin L. Rallison - DIABETES CARE, 1984, 7, 63-67

The effects of a high-carbohydrate, high-fibre (HCHF) diet on glucose control was evaluated in 12 children with type I diabetes mellitus. The children had had diabetes for an average of 5.25 yr; their mean glycosylated hemoglobinwas 12.4% (normal 5-9%), and C-peptide was virtually undetectable in all but one. They were followed on a regular diabetic diet for 10 days at home and in the hospital and then were studied on a HCHF diet for 14 days. The HCHF diet contained 60% carbohydrate and 30g of fibre per 1000 cal provided through grains, fruits, vegetables, and high-fibre crackers. Capillary blood glucose levels were monitored at home before meals and at bedtime, and venous plasma glucose levels were measured in the hospital before and after each meal and during the night. Plasma glucose was measured serially after test meals with each diet. There was no significant difference in blood glucose levels preprandially, postprandially, and while fasting on the two diets. The 24-h glucose profiles obtained during both diets were remarkably similar. We conclude that a diet high in fibre and carbohydrate has limited application in children with type I diabetes mellitus who have no residual-beta-cell function.