What carbohydrate foods should diabetics eat?

Before the days of insulin and oral hypoglycaemic agents little could be offered to diabetic patients other than dietary advice. Drug treatment heralded an era of diminishing enthusiasm for the role of diet in the management of diabetes—to the extent that in the early 1970s standard medical textbooks devoted no more than a few paragraphs to diet and many hospitals did not have a dietician to advise diabetic patients. Around that time West reviewed the attitudes of diabetic patients in North America towards the dietary advice they had been given. Some 22% claimed not to have received any advice, and 25% said that they had received some advice but had made no attempt to follow it. Only about half of all American diabetics claimed to be following a prescribed diet, and much the same was true in Britain.

During the mid- to late 1970s attitudes began to change. Epidemiological evidence suggested that the standard diabetic diet, low in carbohydrate and relatively high in fat, might actually increase the risk of cardiovascular disease, the most frequent cause of death among diabetics. Furthermore, several studies suggested that diets relatively high in fibre rich carbohydrate reduced hyperglycaemia in diabetic patients. Though there remains some disagreement about the precise quantity of carbohydrate which should be included in the diabetic diet, the diabetic associations of many Western countries, including the United States, Britain, Canada, Australia, and Finland, have affirmed the importance of diet in the management of diabetes and recommended an increase in unrefined carbohydrate (especially fibre rich carbohydrate) with a reduction in the fat intake. Nevertheless, restriction of monosaccharides and disaccharides remains a cornerstone of diabetic dietary policy and clear advice is needed on which carbohydrate foods are the most suitable for diabetic patients.

Two approaches may be used to answer this question: short term experiments examining the response of the blood glucose concentration to various foods and longer term studies. Most investigators have used the first approach. The greatest number of foods has been studied by Jenkins and his colleagues, who are particularly well known for their work showing the reduction of postprandial glycaemia by the gel forming fibre guar. In a comparison of 15 carbohydrate containing foods they found that dried leguminous seeds—for example, kidney beans, red lentils, black eyed peas, and chick peas—produced a glycaemic response substantially lower (44% to 71%) than that of wholemeal bread. These findings are not surprising since longer term studies have shown a substantial improvement in diabetic control when gel forming fibres from such leguminous sources have been added to the diabetic diet in substantial quantities. Glycaemic responses for rice, spaghetti, and All Bran were in an intermediate category, being higher than those for beans but below those for bread. Surprisingly there was no difference between white and wholemeal bread. In these circumstances All Bran appeared to be a relatively "good" food despite the fact that one third of its total carbohydrate is made up of disaccharides.

The work of Crapo and his colleagues has aroused interest because they found that potato has a glycaemic response similar to that of dextrose—both worse than bread; white rice and corn were better than bread. In the light of these observations and others in non-diabetics and the recent report by Bantle and coworkers should not have caused much surprise. In a well conducted study they found that sucrose, fed as part of a mixed meal, did not produce higher plasma glucose concentrations than when carbohydrate was derived chiefly from the unrefined sources of potato and wheat. Meals containing fructose resulted in lower glycaemic excursions.

Nevertheless, taken together these studies raise some questions concerning two fundamental aspects of the new dietary recommendations. Firstly, are all starchy carbohydrate foods rich in dietary fibre suitable for diabetics? Secondly, is restriction of sugar really of crucial importance?

On the first issue undoubtedly foods rich in gel forming fibre (found particularly in various types of cooked dried beans) are especially useful in the diabetic diet. The results of long term studies have confirmed those of the shorter experimental reports. Furthermore, these foods provide a useful source of protein, allowing the diet to contain less animal protein, which is so often high in saturated fat, and they also lower serum cholesterol concentrations. The main reason for this beneficial effect of beans compared with all other carbohydrate foods seems to be delayed digestion. Malabsorption of carbohydrate may occur, but not to any great extent, and it does not appear to produce any long term problems.

Advice about other starchy carbohydrate foods is, however, less clear cut. The results of test meal studies suggest that the amount of dietary fibre is not the only determinant of the glycaemic response: the response to wholemeal (high fibre) and white (low fibre) bread is the same, and wheat in pasta elicits a lower response than wheat in bread. Whole rice also results in a much flatter blood glucose curve than rice flour, and glucose and insulin responses to whole apples or apples as puree differ, which suggests that particle size and integrity of structure may be important. The results of laboratory studies of digestion with human digestive enzymes show that the rate of starch hydrolysis correlates well with the biological response to ingested food, and such techniques might therefore be used to predict physiological response to food. Does this mean that wholemeal bread and potato (already identified according to their glycaemic responses as less satisfactory than several other foods in the test meal experiment) should be eliminated from or at least discouraged in the diabetic diet, or that suitability of foods for the diabetic may in future be determined in the laboratory?

The answer to both questions must be no, at least in the light of present knowledge. Wholemeal bread and potatoes have formed a substantial part of several experimental diets which have over weeks or months shown an appreciable improvement in diabetic control. Furthermore, a recent...
study compared diabetic control in insulin dependent diabetes in which the only dietary intervention consisted of replacing low fibre white bread with bread enriched with either wheat bran or guar gum: the mean blood glucose concentrations improved to an appreciable and similar extent.29

What is the explanation for the difference between the test meal experiments and the longer term (and essentially more relevant) feeding studies? Apparently the benefits of a diet high in starchy carbohydrate are not necessarily conferred by a reduction in postprandial glycaemia. Indeed, in studies in which diurnal blood glucose profiles have been examined, the main benefit seems to be a reduction of background blood glucose concentrations with little change in postprandial excursions giving a resultant overall decrease in average blood glucose concentrations, possibly via an effect on insulin sensitivity.31 Even starchy carbohydrates low in fibre appear to confer some benefit.32 Thus although the test meal and laboratory digestion experiments are of interest, they cannot replace longer term feeding studies in determining the best foods for diabetics. At present cooked dried leguminous seeds seem to be the best bet, with foods containing rice and pasta a good option too, but there seems no good reason for not including wholemeal bread, potato, and indeed other cereals or vegetables in a sensible diabetic diet.

What about sugar? Sucrose is not an essential food, and the overweight diabetic will need to restrict energy intake from sucrose as well as fat. Bantle and his colleagues concluded that in non-obese diabetics sucrose in controlled amounts as part of nutritionally balanced meals may enhance palatability and so increase overall dietary compliance without ill effect.20 Given as part of a mixed meal, sucrose does not produce a greater glucose response than comparable amounts of potato or wheat starch. In this study, however, glucose concentrations were unacceptably high after all the test meals, which were low in dietary fibre. Mixed meal studies, such as those carried out by Bantle and colleagues, are undoubtedly preferable to tests of individual foods because of the likely effects of protein and fat on absorption and insulin secretion, but definitive advice concerning sugar can be given only once the longer term effects have been examined. The same reservation applies to the suggestion that fructose might be preferable to sucrose.

Finally, every commentary on dietary advice for diabetics should restate the most important principles: energy intake should be adjusted to maintain the ideal body weight and in the insulin dependent diabetic a regular meal pattern should be established to match the injected insulin.

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