It was widely believed that the most important principle of the diabetic diet was to restrict carbohydrate intake. This principle was also followed in India through the 1950s. The typical diabetic diet of India in 1955 was similar to the conventional (carbohydrate-restricted) diabetic diet used in Western countries and that recommended by the American Diabetes Association. This carbohydrate-restricted diet provided about 33 percent of energy from carbohydrate, 50 percent from fat and 17 percent from protein.

The diet of an average Indian is cereal-based and consequently rich in carbohydrate which constitutes approximately 80 percent of the total calories. As early as 1958, Viswanathan noted that a marked reduction in the carbohydrate content of the diet of diabetic patients resulted in drastic changes in the usual diet pattern which could not be adhered to by the patients for long periods of time. In order to achieve better compliance, diabetic patients were instructed to follow their usual food pattern with reduction in the total caloric intake, but were prohibited the use of free sugar and sweets. This resulted in a diet which we termed the “high carbohydrate diet” with carbohydrate comprising 60 percent of the total energy (Table 1).

When our patients subsisted on this diet for periods up to 10 years, we found that, contrary to existing beliefs, the carbohydrate tolerance did not worsen. In fact, control of diabetes was better. In most patients, the requirement of oral antidiabetes drugs was low. However, the protein content of this diet was considered insufficient. In order to provide a more balanced diet, we increased the protein content of the diet by adding vegetable proteins like bengal gram, green gram and black gram. In India, even though many people use non-vegetarian foods, the average intake of the non-vegetarian items is restricted to one or two meals in a week. The amount of protein derived from animal sources is hence meagre and this was the reason why we added vegetable proteins in the form of pulses and legumes. The amino-acid profiles of proteins of cereals and pulses are such as to complement each other in a manner expected to ensure desired protein quality. Thus the diet became a High Carbohydrate High Protein Diet.

About this time there was growing interest in the subject of dietary fibre. In collaboration with Dr. J. Anderson of the University of Lexington, Kentucky, we computed the dietary fibre content of our diet. It was found that our diet provided 52 gms of dietary fibre which was double that of the American Diabetic Association’s diet. Hence we renamed our diet the “High Carbohydrate, High Fibre (HCHF) diet”. Table 2 shows the composition of the HCHF diet.

**Type of carbohydrate:** Cereals in the form of rice and wheat are the staple foods of the people of south and north India, respectively. Hence the carbohydrate we recommend for our patients in the south is in the form of whole cereals, chiefly rice.

**Fats:** The fat content of the diet is restricted to the oil used in cooking. At least 50 percent of the fat is in the form of polyunsaturated fatty acids. The cholesterol intake is reduced to less than 300 mg/day.

**Vegetables and fruits:** By prescribing non-starchy vegetables containing only three to four percent of energy as carbohydrate (eg. greens, cucumber, drumstick, bitter gourd, banana-flower, cabbage, cauliflower and ladies finger), the bulk of the meal was increased and patients’ hunger

Table 1: High Carbohydrate Diet of Diabetes Research Centre, Madras

<table>
<thead>
<tr>
<th></th>
<th>Grams</th>
<th>Calories</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate</td>
<td>265</td>
<td>1060</td>
<td>60</td>
</tr>
<tr>
<td>Protein</td>
<td>50</td>
<td>200</td>
<td>10</td>
</tr>
<tr>
<td>Fat</td>
<td>60</td>
<td>540</td>
<td>30</td>
</tr>
<tr>
<td>Total Calories</td>
<td>1800</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fibre content: As already mentioned, the use of whole cereals, pulses and leafy vegetables helps to increase the fibre content of the diet. Hence, we do not add any artificial or purified fibre to the diet except in certain special situations. A sample menu plan for a 1,800-calorie diet is given in Table 3.

**Beneficial Effects Of HCHF Diets in Diabetes**

Glycemic control: Short-term studies at our centre showed that the HCHF diet, when used in conjunction with small doses of oral hypoglycaemic agents, helps to achieve rapid control of diabetes. On long term follow-up, the effect on blood glucose level was sustained for several years.

Lipid profile: Studies at our centre showed that there was a consistent reduction in the plasma cholesterol and triglyceride levels. These effects were sustained for long periods of time. Tables 4 and 5 summarise the short-term and long-term effects of HCHF diets on plasma glucose and lipid profiles.

Improvement in insulin sensitivity: The mode of action of the high carbohydrate, high fibre (HCHF) diet in diabetes was studied by measuring the immunoreactive insulin (IRI) levels in patients at the beginning and after control of hyperglycaemia with diet therapy. The data showed that the HCHF diet did not cause hyperinsulinism, but on the other hand, the mean IRI concentration came down with a concomitant reduction in blood sugar. This suggests that the diet acts by increasing the peripheral sensitivity to insulin perhaps by improving the insulin receptor number and/or affinity at post-receptor levels.

Studies on glycemic responses of South Indian breakfast items: In a recent study, we investigated the glycemic and insulin responses to four common breakfast items, namely, idli, pongal, uppuma and bread in South Indian non-insulin dependent diabetic subjects. The breakfast provides 300 K cals of which complex carbohydrate contributed 68-81 percent, proteins 12-14 percent, fat 8-19 percent of total calories and the dietary fibre content varied from 3.8 g to 7.4 g. The results indicated that pongal, uppuma and idli were suitable for diabetics as their glycemic responses to the test foods were low. Bread was considered unsuitable as its glycemic response was as high as that of glucose. A number of parameters like the mode of cooking and processing, the form of food and the differences in food constituents which affect digestion, absorption and metabolism seem to influence the glycemic and insulin responses.

Other workers in India have also noted the beneficial effects of high carbohydrate diets for diabetic patients.