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Glycemic index and glycemic response: modulating attribute of diabetes mellitus

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Abstract

When a meal containing carbohydrate is consumed, there is a characteristic rise and fall in the levels of blood glucose over a period of about 3 hours. This is known as glycemic response. The measurement of the post prandial blood glucose response has been placed on a firm quantitative footing, using the concept of GI.

The GI was proposed as a method of assessing and classifying the glycemic response to foods. GI is expressed as the rise in blood glucose relative to fasting levels produced by a given amount of available carbohydrate in a standard drink or meal in the form of glucose solution or white bread.

Keywords: Glycemic response, glycemic index, postprandial

Introduction

Glycemic response

There are various carbohydrate foods which have different absorption pattern and these are reflect by differences in glycemic response.

The glycemic response forms a bell shaped curve which is affected by the opposing factors:

- a) the initial rise in blood glucose from its fasting levels reflect entry of glucose from the gut liver into peripheral blood circulation.
- b) the subsequent fall to fasting levels is due to action of insulin, secreted by pancreas in response to various meal related stimuli including glucose, amino acids, gut hormones and neurotransmitter. Insulin produces hypoglycemia by allowing glucose to enter respiring cells and tissues from blood.

glycemic response is the net result of a series of processes which include digestion, absorption, and hepatic metabolism of carbohydrate intake and he release of glucose into the peripheral blood stream.

Glycemic index (GI)

By calculating the specific glycemic indices of foods, diet can be used effectively to control glycemic responses and insulin requirement in diabetic diet. The GI was proposed as a method of assessing and classifying the glycemic response to foods. GI is expressed as the rise in blood glucose relative to fasting levels produced by a given amount of available carbohydrate in a standard drink or meal in the form of glucose solution or white bread.

The systematic classification of carbohydrate foods according to their glycemic response was first done by. They tested foods and allowed their incorporation into the diabetic diet in proportion to their glycemic response. The purpose was to keep the glycemic impact of the diet constant regardless of the variety of carbohydrate food used.

Generally, cereals like wheat and rice and root vegetables such as potato, beetroot, carrots have high GI (65 to 75). Fruits have an intermediate GI (45 to55). Legumes and dairy products have low GI (30 to 40).

Low GI diet has been found to be useful in lowering body weight, serum cholesterol, fasting blood glucose, glycosylated haemoglobin and urinary C- peptide to creatinine ratio. Inclusion of low GI food into diets of patients with diabetes may be an additional measure that favorably influence carbohydrate metabolism without increasing insulin demand.

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Factors affecting Glycemic response

Protein and Fat

Protein and fat decrease the blood glucose response and enhance insulin secretion when added to a carbohydrate rest meal. In normal and NIDDM subjects protein stimulates insulin secretion and thus reduces the blood glucose response. When 10, 30 or 50 g protein was added to 50 g glucose load in NIDDM, insulin secretion was significantly increased only after 30 and 50 g and the glycemic response was significantly reduced only after the addition of 50 g protein. It has been found that a negative relationship between protein content of food and the GI.

Fat delays gastric emptying. Delayed gastric emptying has the effect of decreasing glycemic response to a meal. Also after a fat meal, gastric inhibitory polypeptide level increases, which potentiates glucose induced insulin secretion initially. However after 4 hours fat may reduce insulin secretion, possibly due to presence of chylomicrons or increased FFA levels. Hence, the protein and fat in diet affects the glycemic response.

Carbohydrate and Fibre

complex carbohydrates and sugars like fructose and sucrose which have reduced rate of digestion are inversely related to GI. The high fibre, especially soluble fibre has been found to lower the GI.

Antinutrients

Antinutrients such as lectins, phytates and polyphenols, α amylases and tannins reduce the rate of digestion, improves glycemic response, insulin response and blood lipids in diabetics and hyper lipidemic subjects.

Nature of starch

Only two polysaccharides are able to be hydrolyzed in human small intestine : amylase and amylopectin.

Starch granules rich in amylase are thought to have more extensive H- bonding and hence more crystallinity in their structure. Consequently they are digested slowly and result in lowered blood glucose and insulin responses.

Food processing or cooking

studies have shown that ingestion of raw starch as compared to cooked form cause much flatter glycemic and insulin response. Cracking or milling of cereal grains increases glycemic response.

Rate of meal ingestion

When high- glycemic, carbohydrate containing foods ingested slowly the post prandial glucose excursion is blunted. It reduces post prandial insulin and glucose response, LDL cholesterol and hepatic cholesterol synthesis.

The effect of one meal on subsequent meals

Slowly digested carbohydrates reduce not only the glucose responses following the meal during which the carbohydrate is ingested, but carbohydrate tolerance to subsequent standard meals is also improved.

Organic acid

It has been established that the presence of certain organic acids such as those produced sour dough fermentation may reduce glycemia either by reducing gastric emptying rate or by reducing the rate of digestion.

Need of commercial diabetic food

in all modern societies, snacking is becoming a way of life. In Europe and Australia a large area of development is in snacks sector. Many recipes of the traditional Chinese medicated diet are ready to be transformed to western type health snacks. Millet has been one of the important cereals used as medicinal food or edible Chinese drugs. The worldwide trend of 'work alcoholics' and snacking habits continue to promote the universal popularity of convenience food. Also, there is a new global awareness of the concept of functional foods beyond simple nutrition, as people in the developed western and newly developed Asian countries are becoming more health conscious.

Food manufacturers should consider that opportunities available to increase market share through commercializing traditional recipes into convenience foods, fast foods and prepared meals through modern food processes.

It is estimated that over 10 per cent of total expenditure incurred in the household for foods is spent for snack foods. The total expenditure on snack foods in India is around Rs. 13,200 crores. Data has shown that one fourth to one third daily calorie intake of 75 per cent adolescents is met by snacks.

Bakery products especially biscuits in India using wheat have gained consumer acceptance and are marketed in India amongst people of all age groups. Some of the reasons for such wide popularity are low cost among all processed food, varied taste and textural profiles, easy availability in attractive packaged form and longer shelf life to suit easy marketing.

Millets have not been used much in the production of biscuits in India. Some efforts were made to study the application of millets in biscuit preparation. Researchers had prepared high protein biscuits with malted finger millet flour and oilseeds flour (groundnut) blends 70:30 ratio. In addition finger millet and legume based biscuits and reported a high protein quality of biscuits.

Millets also have been used in preparation of chapattis mixed with wheat and better quality was reported. Some food companies are looking for ways of lowering the GI of their products in the interests of both marketing advantage and public health. However, in UK, some breakfast cereal packets already have been shown in GI curves which will be highly beneficial for customers.

The development of low GI foods for specific applications not only in diabetic diet but also in sports, health and weight reduction have also been advocated. The challenge to food industry is to formulate low GI palatable foods because there is no doubt that many people see low GI foods as less acceptable than the high GI alternatives.

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