Carbohydrates contribute 60-70% of the total energy intake with cereals occupying a major portion of the Indian meals. WHO/FAO (2003) emphasize increased intake of whole grain cereals, vegetables and fruits to promote long term good health and to prevent lifestyle related diseases. On the other hand, consumption of processed refined carbohydrate containing foods (breads, biscuits, sweetened beverages, cakes, etc), that are rapidly digestible, devoid of fiber, and energy-dense, has been blamed for obesity and obesity-related metabolic disorders. The above mentioned food products contain carbohydrates as the major macronutrient but their implications on health differ widely. This necessitates the characterization of carbohydrates to emphasize selection of carbohydrate containing foods that may be beneficial rather than having detrimental effects on health.

The type/quality of carbohydrates largely depends on the physico-chemical properties that form the basis for characterization of the carbohydrate containing foods. Physical properties of foods are reflective of the food matrix as well as type of processing. Chemical identity is determined by the sugar type, linkages present, degree of polymerization and in case of composite foods, mixture of ingredients used. Both, physical and chemical properties determine the access of endogenous digestive enzymes to the foods and thereby affecting its gastrointestinal handling and utilization (Englyst & Englyst 2005).

Structurally, carbohydrates are divided into simple and complex, on the number of individual simple sugar units, presence or absence of free reducing functional groups, amylose-amylopectin ratio, presence of resistant starch, soluble and insoluble fiber, etc. (Senray & Singhania 2011). Complex carbohydrates (e.g. whole grain cereals, legumes, vegetables, nuts) are those having a high fiber content and slower release of sugar in the blood. Kabir et
al (1998) reported that complex carbohydrates as high starch foods can be promoted for reducing glycemic and insulinemic responses.

In 1996, Lerer-Metzger et al emphasized that all starchy foods may not respond similarly and they may not be interchangeable. Various factors such as moisture content, amylose to amylopectin ratios, the extent of processing, effect of ripening, influence of co-ingredients present in the food matrix or the gastrointestinal function of the consuming individual may influence the blood glucose response to foods (Pi-Sunyer 2002, Arvidsson-Lenner et al 2004). The method of cooking, process of fermentation, germination, etc also has shown to impact the blood glucose response (Mani et al 1997). These factors formed the basis for functional classification of carbohydrates.

The functional classification of carbohydrates depends upon its postprandial glycemic effect based on rate of digestion and entry of glucose into systemic circulation (Schenk et al 2003). Postprandial glycemic response has vital implications in the normal metabolism as well as prevention, control or treatment of several metabolic disorders including obesity, diabetes with insulin resistance and insulin deficiency.

In 1981, Jenkins characterized carbohydrate quality using Glycemic Index (GI), which is expressed as the percentage increase in blood glucose produced by specific amount of available CHO (e.g. 50g of available carbohydrate) in a test food as compared to the same amount of available CHO from a reference food such as glucose, which was then replaced by white bread in order to make more meaningful comparisons with real foods.
However, in foods as consumed, there are other macro and micronutrients present with different moisture content which alter the percentage of available carbohydrates. GI denotes an absolute value and fails to respond to the changes in the amounts of carbohydrate consumed (Monro 1999).

Glycemic Load (GL), the product of the Glycemic Index and the amount of carbohydrate in a serving, is then used to determine responses to specific amount of carbohydrates. It serves as an aid to determine overall glycemic effect of a diet. But GL is still a mathematical expression derived from GI, using available carbohydrate and its practical use is limited.

GI and GL, when used in conjunction, contradict each other due to varying compositional characteristics of foods. For example, in a food like watermelon which contains 96% water (NIN 2002), GI is much higher than GL.

Glycemic Index has been used to elucidate glycemic potency of available carbohydrate in foods relative to glucose (Jenkins et al 1981). But when we consume food, we do not measure how much nutrient as carbohydrate is available from the total quantity consumed. In fact, Jenkins himself (2002) has expressed that “GI is not significant in low energy foods in which ratio of other desirable factors (e.g. vitamins, minerals, and fiber) to available carbohydrate is high”
The need for a more comprehensive concept indicative of glycemic effect of both quality as well as quantity of carbohydrates was felt. In 2003, Dr JA Monro, introduced the concept of GI\textsubscript{food} value, where postprandial glycemic effect of food as it is consumed was assessed instead of postprandial glycemic effect of available CHO which varies in different foods.

The GI\textsubscript{food} value is defined as the blood sugar response elicited by a specific quantity of test food compared with that of same quantity of a standard such as glucose or white bread to give Glycemic Glucose Equivalent (GGE) or ‘Glycemic Bread Equivalent (GBE) respectively (Monro 2003). This is also called as the Relative Glycemic impact (RGI), the terminology is used to represent acute effects of single intake (food weight) or serving (Monro 2002) expressed as GBE/ amount of food.

When GI\textsubscript{food} value is used to indicate glycemic impact of a food as a percentage of the effect of equal amount of reference food is called Relative glycemic potency (RGP) wherein the amount of bread that gives similar response as that of 100gm of test food is expressed as GBE/100g.

Food listing based on GI\textsubscript{food} expressed as GBE may facilitate selection of food groups to have comparable postprandial glycemic and insulinergetic effect in normal healthy subjects. They are presented in the same format as nutrients, with gram units. Hence, one can use it directly and independently without need for any further calculations. Also, the GI\textsubscript{food} values are direct function of food quantity and hence are responsive to changing doses of intake. It can serve
as a simple and easy to use food value that helps to characterize carbohydrate containing foods, both qualitatively and quantitatively (SenRay & Singhania 2011).

GI\text{food} value expresses the overall glycemic impact of foods under conditions in which they are actually selected and consumed without any assumptions regarding the specific food nutrient responsible and can be used as a food based reference index in food exchange list. Also, it will enable diet counseling in terms of food exchanges to know how much quantity of a particular food can be substituted with another, such that a similar glucose response is obtained (Singhania & SenRay 2012a).

The postprandial glycemic effect is also dependent on insulinergic effect of the specific food. The insulin response to foods may be independent of the glycemic response. For example, foods that contain high amounts of protein, which is an insulin secretagogue, may cause a high insulinergic effect as compared to a food that contains proteins in lesser amounts (Wolever & Bolognesi 1996). Hence, the glucose and insulin response may or may not be parallel.

The present study aims to establish the GI\text{food} values of selected carbohydrate rich foods and also for the first time, the II\text{food} was determined by comparing the insulin response elicited by a specified quantity of sample food with a standard such as white bread to give Relative Insulinemic Impact (RII) and as percentage of the effect of 100g of bread to give the Relative Insulinemic Potency (RIP). The weight of bread that would induce the same insulin response
as the given weight of food is expressed as Insulinemic Bread Equivalent (IBE) of the food (Singhania & SenRay 2012a)