THE EFFECT OF HIGH AND LOW GLYCEMIC INDEX DIETS ON THE FASTING BLOOD GLUCOSE LEVELS IN NON-DIABETIC, POSTMENOPAUSAL, OBESE, CAUCASIAN WOMEN.

A THESIS

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BY

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To the Associate Vice President for Research and Dean of the Graduate School:

I am submitting herewith a thesis written by Deana Brittain entitled "The effect of high and low glycemic index diets on the fasting blood glucose levels in non-diabetic, postmenopausal, obese, Caucasian women." I have examined this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science with a major in Nutrition.

Betty B. Alford
Major Professor

We have read this thesis and recommend its acceptance:

Audie M. Howell

V Turnham

Accepted

Leslie M Thompson
Associate Vice President for Research and Dean of the Graduate School

Dedication

This thesis is dedicated to

my husband, Steve
my daughter, Lindsey
my son, Jared
my sisters Barbara and Cathy, and
my dad, Fred Kellow.

who always give me love and encouragement

In Memory

This thesis is also dedicated in memory of my parents

Richard Dininger and Phyllis Dininger Kellow.

ABSTRACT

THE EFFECT OF HIGH AND LOW GLYCEMIC INDEX DIETS ON THE FASTING BLOOD GLUCOSE LEVELS IN NON-DIABETIC POSTMENOPAUSAL, OBESE, CAUCASIAN WOMEN.

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AUGUST 1998

The purpose of this study was to compare the initial fasting blood glucose (FBG) to the final FBG from two groups of non-diabetic, postmenopausal, obese, Caucasian women, to ascertain whether there was a significant difference in FBG after following a high or low glycemic index (GI) diet.

Twenty five data files from studies done in 1990 and 1992 were analyzed for this study. Thirteen women followed the low GI diet, and twelve women followed the high GI diet over a four week period. Three days from the last week of the diet were analyzed to obtain a mean GI for each subject. The initial FBG and the final FBG were compared using a two tailed, two sample t-test to determine whether there was a significant difference.

The results of this study revealed that there was not a significant difference in the initial FBG and the final FBG in either diet group. The GI diet did not affect the final FBG. Problems with the study included a small sample size, the files were not randomly selected due to the use of pre-existing data, and no involvement in the original collection of the data. The subjects were also free living which allowed for the possibility of inaccurate selection and measurement of foods. Using a controlled environment would improve the validity of the data.

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Chapter 1

Introduction

The glycemic index (GI) is the measurement of the blood glucose response to a carbohydrate. It is expressed as a percent of the response of an equal amount of carbohydrate from a standard food, white bread. There have been a number of foods tested on individuals. The GIs recorded give another dietary tool which may be used by a person diagnosed with diabetes (1-6). An individual's food intake may be high in carbohydrates which can elevate blood glucose, insulin, and triglyceride concentrations, yet it has been found to be beneficial to use low GI carbohydrates to keep the blood glucose, insulin and triglyceride concentrations under control (7). Other factors which can affect the GI response to foods are fiber, fat, and protein (8-14). These factors will affect the digestion process from the stomach, but not the GI of the food itself, or the rate it is metabolized. Foods with a low GI include pasta, some breads, some rice, and especially legumes (5,15-16). One study by Wolever et al, evaluated 102 complex carbohydrate foods in patients with diabetes (2). The results of this study increased the number of food GIs available for patients to use for monitoring their food intake choices.

Fasting blood glucose (FBG) is used to measure how well the body is utilizing glucose. A goal for incorporating the GI as a dietary tool is to normalize the FBG and the postprandial glucose (17). Low GI foods have been found to improve the FBG and long term glycemic response (18-20). The importance of controlling glycemic responses when a person has other risk factors may be more apparent when looking at the criteria for diagnosing type 2 diabetes. The normal FBG levels are between 80 mg/dl -115 mg/dl or

less (21). The guidelines for diagnosis is a FBG greater than or equal to 140 mg/dl, or a two hour post challenge blood glucose level of 200 mg/dl or greater. This appears to be an inadequate guideline for those with pre-existing complications; therefore, an expert panel was appointed by the American Diabetes Association to revise the diagnostic criteria (22). The panel lowered the diagnostic threshold to 126 mg/dl. A normal FBG will be considered 110 mg/dl or less, and an impaired FBG will be 110 mg/dl or greater, but less than 126 mg/dl. The goal for persons with type 2 diabetes is to achieve a FBG less than 120 mg/dl. The diagnostic levels, and goals for persons with type 2 diabetes are getting lower. The importance for early awareness and good control over time to avoid any major complications with the disease is becoming more evident. It may be possible for an individual with other risk factors for developing type 2 diabetes, to avoid the disease by becoming aware of their FBG levels over time, and minimizing foods which tend to elevate the blood sugar levels.

Postmenopausal, obese Caucasian women who regularly follow a high GI diet, may be increasing their risk for type 2 diabetes. Risk factors for type 2 diabetes include family history, obesity, and age (23-25). Obesity is especially a problem when it occurs in the mid-section of the body. The waist-hip ratio (WHR) is used to measure the centrally distributed body fat. Abdominal fat is positively associated with hyperinsulinemia and insulin resistance, hence glucose intolerance. Aging is associated with decreasing glucose tolerance. The age for increased risk in women is after menopause, and in looking at obese, postmenopausal women, another possible red flag to an increased risk for type 2 diabetes may be a high GI diet. Studies have shown that a low GI diet may be a possible choice for persons with diabetes in their quest to control their blood sugar levels (26-27). Studies may eventually reveal a positive benefit for those who do not have

diabetes, but may have other risk factors which predispose them to the disease.

Purpose of the Study

The purpose of this study was to use data files existing in the Department of Nutrition and Food Science at Texas Woman's University, Denton, Texas, to compare the initial FBG to the final FBG from two groups of non-diabetic, postmenopausal, obese, Caucasian women following a high or low GI diet for four weeks. If following a low GI diet results in lower FBG, women with other risk factors for type 2 diabetes may benefit from choosing low GI foods.

Hypothesis

The null hypothesis of this study was that there is no significant difference in the initial FBG and final FBG of subjects following a low GI diet or a high GI diet.

Chapter 2

Literature Review

Glycemic Index

Different carbohydrate foods produce different glycemic responses. The glycemic response can be defined as "the incremental area under the blood glucose response curve"(28). Otto and colleagues were the first to study the systematic classification for carbohydrates according to glycemic responses. Their early studies focused on individual foods in 50 g carbohydrate portions, which helped establish the GI tables.

Wolever and Jenkins have been leaders in the research of the GI. A study released in 1980 in the British Medical Journal tested foods including cooked beans and peas, cereal grains, breads, pasta, breakfast cereals, biscuits and tuberous vegetables (15). Groups of 5-10 healthy individuals from a pool of 25 (15 men, 10 women) were given 50 g carbohydrate portions of single foods. Test meals were eaten over 10-15 minutes after a 10-12 hour overnight fast. Finger pricks were taken with an Autolet lancet at 0, 15, 30, 45, 60, 90, and 120 minutes. Areas under the two hour glucose curve were calculated. The student's t-test revealed that there were significant differences between many of the foods tested. The researchers focused on the benefits of legumes, which overall, were found to have the lowest GI.

In March, 1981, The American Journal of Clinical Nutrition published an article "Glycemic index of foods: a physiological basis for carbohydrate exchange", by Jenkins et al (1). This study included groups of 5 -10 healthy non-diabetic volunteers drawn from a pool of 34 (21 male, 13 female: 29 $\pm$ 2 yr.) who were fed 62 foods and sugars in random

order after overnight fasts. The meals were eaten over 10 - 15 minutes. Blood samples were taken using finger pricks. Results showed variations within most of the food groups except dairy. A significant negative relationship existed between fat and protein. The fat delays gastric emptying and the protein stimulates insulin secretion. No relationship was seen between the GI and dietary fiber. The insoluble fiber in wheat products had little effect on the blood glucose. The cereal group showed variations in the GI with wholemeal bread at 72% and wholemeal spaghetti at 42%. Root vegetables such as parsnips have a GI of 97%, while sweet potatoes were at 48%. Another aspect discovered in the study was that a simple increase in meal size did not invalidate the GI table which was based on 50 g carbohydrate portions. When the dose of 50 g was exceeded, the increase in GI was smaller than expected. The conclusions of this study led the authors to believe that the classification of foods according to the measured response of the blood glucose can be used to prescribe a diet with low GI foods for persons with diabetes, especially for post-gastric surgery patients who suffer from hypoglycemia after large rises in blood glucose & insulin after meals, and for patients with carbohydrate-induced hyperlipidemia.

Another study evaluated 15 foods tested on 12 volunteers with diabetes (4). There were 6 men and 6 women, aged 67 $\pm$ 2 years who participated in the study. Eleven volunteers had type 2 diabetes, and one had type 1 diabetes. 50 g portions of foods were tested using groups of 5-7 volunteers. Foods included spaghetti, All-bran, rice, beans, Cornflakes, bananas, and breads. The authors began exploring mixed meals by adding cottage cheese, and substituting part of the carbohydrate with marmalade which did not appear to significantly alter the GI. The mean peak rise of the legumes was 23-28% lower than that of the other foods tested. There was not a significant trend seen in body

weight, FBG levels and the glycemic response to the standard test meal.

The "International tables of glycemic index" were published in 1995 by Kaye Foster-Powell and Janette Brand Miller in the *American Journal of Clinical Nutrition* (6). There are approximately 600 entries taken from all the published data on the GIs of individual foods. Many ethnic foods have been studied and added to the GI tables (29-30). Different sweeteners have been evaluated. Fructose has a GI of approximately 32% as compared to sucrose with 92%, glucose at 138%, and lactose at 65%. Fructose is found in fruits, berries, vegetables, and roots, and may be a good alternative sweetening agent for a low GI diet if used in moderation (1,31-33). The "International Tables" are a valuable resource for those who wish to use the GI as a tool, as well as a good resource for studies on the GI. The number of subjects in the study, and the actual study are also referenced. The GI studies performed have included subjects with normal glucose tolerance, type 1 diabetes, and type 2 diabetes. Some diabetic education centers already utilize the GI as part of their diabetic education (6).

Objections to the Glycemic Index

Objections to the use of the glycemic index as a tool for classifying carbohydrates in the diet according to their effect on blood glucose response include large individual variation in responses due to the presence and type of diabetes, age, sex, body weight, and race. In their studies, Jenkins et al (34) observed each volunteer with diabetes demonstrating a mean GI value for foods tested that was similar to or below predicted mean GI values for those foods; therefore, they believe the GI concept can be applied to individual diets composed of many foods. There can be significant differences between the incremental glycemic responses due to day to day variation within the same subject. When expressed as a GI, there was no difference between subjects (35). Twelve subjects

(4 males, 8 females, ages 36-83 yr.) were studied as outpatients. Three of the subjects had type 1 diabetes, and nine subjects had type 2 diabetes. They were intentionally chosen with differences in age, sex, body weight, treatment, and type of diabetes to research the differences between individuals. Each subject ate three different test meals on four different occasions, which consisted of 50 g carbohydrate portions of either white bread, polished white rice, or white spaghetti, combined with cheese and tomato. Blood samples were taken at fasting and 30-min intervals for 3 hours after the start of the test meal. Analysis of variance with repeated measures with the subject and test meal as variables, was performed on all of the glycemic response areas and the GIs. The results in the comparison of glycemic responses between subjects showed highly significant differences between the incremental glycemic response areas of the different subjects, yet when the results were expressed as the GI, there was no significant difference between subjects. When the glycemic response is normalized to a standard, resulting in the GI, there was no significant difference between the mean GI of the different subjects in this study.

Hoover-Plow et al found a significant correlation between the mean total area glucose curve and a subject's body mass index (BMI), body weight, and age (36). The purpose of their study was to examine the extent of variation of glucose response to a standard mixed meal in non-diabetic individuals and determine factors of reproducibility. Age and BMI appear to be critical factors in explaining differences in the total area under the curve between subjects. Five non-diabetic volunteers (3 males, 2 females, ages 21-56) performed 3-23 trials which consisted of a standard noon meal and blood glucose samples. The meals consisted of rice, turkey, green beans, and margarine. The total area and the net incremental areas were significantly different between subjects. The authors

do not agree with Wolever and Jenkins that the variation is caused by using the total instead of the incremental area under the glucose curve. They conclude that the use of the incremental area is easily affected due to extreme sensitivity to baseline values.

Effects of Physical Form

The lack of agreement between different centers on the GI values of food tested, especially potatoes and rice, causes skepticism toward the validity of the GI values reported in previous studies. It has been noted that the differences are due to the type of potatoes, and the way they are cooked (baked have a higher GI than boiled) (28,34). The GI for rice can be different depending on the variety tested. Ripeness of fruit can also affect the resulting GI value (28). Even though these differences occur between centers, there is a lot of agreement on the relative glycemic effect of the carbohydrates tested.

Food form is thought to be an important factor relating to GI value (37). The more processed a food is, the higher the GI value (6,38-39). As the particle size of a food decreases, the GI increases (38,40-41). A study which evaluated food structures effect on postprandial blood glucose as well as the concept of mixed meals, revealed large differences in the glycemic response between durum and cereal/bean meals (42). Parboiled rice, red kidney beans and whole grain wheat bread were compared with sticky rice, ground red kidney beans, and ground wheat bread. Higher glycemic responses resulted with the ground items as compared to the whole food. Modern methods of food processing affect the rate of digestion, which is why a food such as rice can have different GI values depending on how it was processed (43). Rice has been tested and given a wide range of GI values. The differences in the proportions of starch present in different types of rice, affect the GI value. Rice with a higher proportion of amylose tends to produce lower glucose responses (44). Parboiled rice and products made from rice such

as rice cakes and brown rice pasta result in a higher GI due to the processing. The amount of starch has also been addressed and the GI was not found to be affected by the amount of the starch ingested.

The blood glucose response to a meal is also affected by the previous meal carbohydrate intake (36,45-46). A study used healthy volunteers to evaluate the effect of the prior meal (46). The lower GI carbohydrates eaten at dinner decreased both the postprandial glucose immediately following the dinner as well as the glucose response after breakfast the following morning. Responses were almost exactly as expected from the GI values of the individual carbohydrates. Results from other studies differ due to the differences in the methods of assessing the glycemic response area (total vs. incremental), failure to measure the blood glucose response to the individual foods tested, and the different GI of foods with the same name, but which differ in how processed (polished rice vs. parboiled rice).

Using soluble fibers such as guar gum or B-glucan rich cereals may slow gastric emptying which results in a flattened glucose response curve, and can affect the next meal (9-14). Enzyme inhibitors, phytates, tannins and lectins have been found to influence starch digestibility, affecting the glycemic response as well (29,47).

Glycemic Index and Mixed Meals

Mixed meals are the most criticized aspect of the glycemic index due to the effects of fat and protein on glycemic responses. Studies show that when taking into consideration the amount of fat and protein, the resulting GI is statistically proportional to the individual GI (28). Wolever and Jenkins developed a method of calculating the GI for mixed meals (48). Each carbohydrate component in a mixed meal is evaluated for the grams of carbohydrate for that food. The total meal carbohydrate is then figured by

adding these together. The proportion of carbohydrate is calculated by dividing the component carbohydrate into the total meal carbohydrate. This value is then multiplied by the GI for that food from the GI food table. The component GIs are then added together to get the total meal GI. A study using 8 volunteers with type 2 diabetes given four test meals incorporated this calculation (48). The authors demonstrated that glycemic responses to mixed meals can be accurately ranked. Their results to a study using 6 participants (1 male, 5 females, ages 31-81yr) with type 2 diabetes who consumed 5 mixed meals in random order, demonstrated that the mean glycemic response of a mixed meal could be predicted from the individual GIs (49). The consideration of three factors appears to be important when utilizing the GI in mixed meals. These include, using the incremental glucose areas instead of the total area, recognizing all carbohydrate sources in mixed meals by estimating the total meal GI from the GI of each carbohydrate, and to consider the individual variations in glucose response.

A study by Chew et al tested meals of six ethnic origins combining foods to evaluate the GI in mixed meals (50). They used the calculation of summing the percent carbohydrate of each component in the meal and multiplying this by the published GI value for the single foods. The result was a positive correlation between the observed GI and the predicted GI.

There is a question as to whether studies evaluating a single mixed meal are beneficial. The purpose of a study by Hollenbeck et al released in 1988, was to evaluate the effects of day-long glycemic response when all three meals focused on the GI as a means of controlling the glycemic effect (51). Their subjects were 9 volunteers (6 males, 3 females) with type 2 diabetes ranging in age from 42-70 yr. Three meal plans were developed which included a high GI (71%), an intermediate GI (48%), and a low GI

(34%) plan. Three test meals were provided daily, and within a 2 week period all the subjects received all the daily meal plans in random order. The only significant difference in the glucose response and GI level occurred after lunch, and only when the participants consumed the low GI meal. The authors do not believe that this is significant enough to recommend a diet modification using the GI. Their studies do not have the same outcome as Wolever and Jenkins have had for mixed meals (51-53). Their findings show the individual differences between the GIs of foods such as potato, lentils, and spaghetti are lost when these foods are in mixed meals . Their view is based on comparison of their results to the published GI values, which they do not see as useful in mixed meals. They concede that there is a possibility that an individual, with their own set of GI values resulting from testing different carbohydrates, may benefit from choosing those foods which control their individual glucose response. The feasibility of each individual testing these foods is unlikely.

The addition of fat and/or protein to a meal may or may not have some effect, depending on the carbohydrate. One study found that the glycemic response to a potato with fat ingestion was 70% of the potato by itself, demonstrating that adding fat decreases the glycemic response of the potato (8). Protein only slightly reduced the blood glucose response of the potato meal. The glucose response of spaghetti, which is a low glycemic food, was not affected by the addition of fat or protein.

The Continuing Controversy

Presently, studies on the glycemic index are not as numerous. There is still controversy over the benefits of using the GI value of carbohydrates as a guide to selecting foods to incorporate into a dietary regimen. The American Diabetic Association

(ADA) does not include any reference to using the GI as a dietary tool when making recommendations to individuals with diabetes. In the 1998 Clinical Practice Recommendations Position Statement, the ADA recognized different carbohydrates as having different glycemic responses, but for clinical purposes, emphasis is placed on the total amount of carbohydrate, rather than the source of carbohydrate (54). Recommendations for the amount of carbohydrate depends on the individualized diet based on eating habits. These have been the recommendations for the past several years. The ADA feels that using the GI as a guide limits the food choices an individual has when following a diet plan. A commentary by Thomas Wolever defends the use of lower GI foods as a response to the ADA's recommendations to consider the total carbohydrate in the diet (55). Wolever stated that the only foods to be avoided are the ready-to-eat breakfast cereals, instant mashed potatoes, and polished rice. Higher GI foods can also be worked into the diet but emphasis should be placed on the lower GI foods.

Two researchers from the Stanford group, Ann M. Coulston, MS,RD, and Gerald M. Reavens, MD, responded to Dr. Wolever's commentary (56). Their opinion on the utility of the glycemic index coincides with the ADA. Their recommendation to Dr. Wolever was to provide more substantial reasoning to prescribe the use of the GI in diet planning. A multicenter study with investigators who have no prior opinion on the clinical utility of the GI, use similar diet at all the sites, and carry the study out long enough to prove clinical relevance, may help to substantiate Dr. Wolever's view. Coulston and Reavens state that even if this is proven to have valid clinical utility, they question burdening the patient who has diabetes with having to watch for the glycemic index in their daily food pattern. More details complicate their diet regimen which may hard to adhere to already.

Glycemic Index as a Risk Factor

The choices made each day in an individual's diet will somehow affect that person's health either positively or negatively over a period of time. An additional tool for healthy individuals with other risk factors for diabetes may be beneficial in their quest to avoid diagnosis, and other health problems associated with diabetes. A 12 year cross-sectional study of 1,462 women in Sweden began in 1968 (57). Their nutrient intakes and incidence of diabetes were evaluated, and then the women were restudied in 1974-75 and 1980-81. This study looked at the dietary habits in general. There were no significant differences in the consumption of the carbohydrates as a whole between those women who developed diabetes and those who did not develop diabetes.

Two studies on diet and risk of type 2 diabetes were performed using participants and data from a 1986 national longitudinal study of diet and lifestyle factors in relation to chronic disease (58-59). A total of 42,759 men (ages 40-75 yr.) and 65,173 women (ages 40-65 yr.) were followed during 1986 - 1992. Initially, using validated semiquantitative food frequency questionnaires, 131 food items were analyzed and the average dietary GI value was derived. Follow up questionnaires were mailed every 2 years (1988, 1990, 1992) to ascertain if type 2 diabetes had been newly diagnosed. If type 2 diabetes was reported, the researchers provided a supplementary questionnaire for more detailed information. During the 6 years, 523 men and 915 women reported newly onset type 2 diabetes. The results revealed that total carbohydrate was not related to risk, yet the GI was positively associated when an adjustment was made for cereal fiber intake. Cereal fiber had a definite significant inverse association with type 2 diabetes risk. These results suggest there is an additional risk for type 2 diabetes when the diet has a high glycemic load and a low cereal fiber content, independent of other known risks for type 2 diabetes.

Just looking at the total carbohydrate as the ADA suggests, limits the overall picture of the effects on the blood glucose. Taking into account the glycemic effect of the carbohydrate allows more control over the blood glucose response. The authors used a "global dietary glycemic load" which is calculated similarly to the GI except this is not divided by the total carbohydrate intake. Using this takes the quantity as well as the quality of the carbohydrate into consideration. Their conclusion shows a positive relationship between the intake of high glycemic carbohydrates and the risk of type 2 diabetes.

CHAPTER 3

METHODOLOGY

Existing data files from studies performed during the fall semester 1990, and the fall semester 1992, in the Nutrition and Food Science Department of Texas Woman's University in Denton, Texas, were used in this study (60-61). The subjects were participating in weight loss studies and were randomly assigned into a low GI diet or a high GI diet. The subjects were aware that an adjustment was made in the carbohydrate content of the diets, but did not know which GI diet they were following in the study. Both studies were approved by the Human Subjects Review Committee of Texas Woman's University, Denton, Texas. Consent forms were signed by each of the participants. Criteria for acceptance into the studies included postmenopausal (70 years of age and under), Caucasian women with a WHR of > 0.80, with no personal history of diabetes or cardiovascular disease, and who were not taking medicine which interfered with lipid or carbohydrate metabolism. Health questionnaires were reviewed and discussed with the subjects to ascertain if there was a pre-existing disease, what medications were being taken, and the date of the last menses. The data for the two studies was combined due to the similarity of the subjects and methodology of the studies, and to allow for a larger sample size.

Data collected in 1990 for a four week weight loss study (60) using high and low glycemic index diets (Table 1), initially included 24 postmenopausal, obese, Caucasian women. The volunteers were recruited through newspaper advertisements, fliers distributed on campus and in Denton, Texas, in addition to interpersonal communication

with potential participants. The first screening of volunteers was by telephone to ensure basic criteria for the study were met. The second screening included anthropometric measures, signing of consent forms, and filling out questionnaires. Abdominal obesity was classified according to a waist-to-hip ratio (WHR) of greater than 0.80. Sixteen of the 24 recruited completed the study. Participants were randomly assigned to 2 equal groups. Group 1 was the control group which was assigned a 1200 - 1250 kcal high glycemic index diet. Group 2 was assigned a 1200 - 1250 kcal low glycemic index diet. All the meals contained an average of 57% carbohydrate, 18% protein, and 25% fat. The average daily GI values were 89.63 for the high GI diet and 59.07 for the low GI diet. Counseling sessions were provided weekly for verification of compliance to the diet. Weight was taken using a beam balance scale. Blood was drawn at week 0, and at the end of week 4 following an overnight fast. The four weeks of dietary intake, initial FBG, and the final FBG were used for this study. Fifteen of the participants records were available for this study.

Data files obtained in 1992 for an eight week weight loss study (61) using high and low glycemic index diets (Table 2) were included in this study. Recruitment was accomplished using the Denton newspaper, fliers distributed at Denton grocery stores and campus mail, as well as recruitment assistance at the Harris Methodist Outpatient Clinics of Ft. Worth. Initial screening was over the telephone for eligibility. The second screening included anthropometric measurements, signing consent forms, and filling out questionnaires. Subjects were randomly assigned to 1 of 2 diet groups. One group followed a 1200 kcal high GI diet for four weeks, the second group followed a 1200 kcal low GI diet for four weeks. The subjects then switched diets during the fifth through the eighth weeks. All the test meals contained approximately 43% carbohydrate, 38% fat,

Table 1

1990 Study (60)
Example of One Day Meal Plan for Low and High GI Meals

Low GI Meal	High GI Meal
Breakfast	
1/2 cup oatmeal	2/3 cup shredded wheat
1 cup skim milk	1 cup skim milk
1/2 grapefruit	1/2 banana
1 Tbsp diet margarine	coffee, tea
coffee, tea	
Lunch	
1 Tbsp natural peanut butter	1 Tbsp natural peanut butter
1 Tbsp diet Fruit Spread	1 Tbsp diet Fruit Spread
2 slices pumpernickel bread	2 slices whole wheat bread
Supper	
2 oz. chicken strips	2 oz ham
1-1/4 cup cooked pasta shells	1 baked potato
1 cup fresh /frozen broccoli	1 cup broccoli
1 Tbsp diet margarine	1/2 cup corn
1 Tbsp lemon juice/clove garlic	2 Tbsp diet margarine
1 tsp. olive oil	2 Tbsp diet margarine
1 cup skim milk	1 cup skim milk
Snack	
1 sm. apple	1/2 cup orange juice or sm. orange
1 sl pumpernickel toast	1 sl pumpernickel
1 tsp. diet margarine	1 tsp. diet margarine

Table 2

1992 Study (61)
Example of One Day Meal Plan For Low and High GI Meals

Low GI Meal	High GI Meal
Breakfast	
1/2 cup oatmeal	2/3 cup shredded wheat
1 cup skim milk	1 cup skim milk
1 cup apple juice	1/2 cup ORANGE JUICE
1 slice pumpernickel	1 slice whole wheat bread
1 Tbsp diet margarine	1 Tbsp diet margarine
Lunch	
1 egg	1 egg
1 Tsbp. mayonnaise, low calorie	1 Tbsp. mayonnaise, low cal.
1 tsp. pickle relish	1 tsp. pickle relish
1 Tbsp onion	1 Tbsp onion
2 slice pumpernickel	2 slice whole wheat bread
1 cup skim milk	1 cup skim milk
Supper	
2 oz. hamburger, lean	2 oz. hamburger, lean
1 cup macaroni	1 bun or roll
1/3 c red kidney beans	1/2 cup corn, frozen
1 tomato	1 tomato
2 Tbsp onion	1 Tbsp. catsup
Snack	
1 orange	1/2 banana

and 19% protein. Weekly meetings were included for nutritional counseling, and diet evaluation. Twenty individuals completed the study and were evaluated for this study. The FBG was obtained at week 0, week 5, and the end of week 8, following an overnight fast. In both studies the diet consisted of a 7 day menu cycle. The final four weeks of dietary intake, initial FBG, and the final FBG were used for this study.

Three days of diet records consisting of two weekdays and one weekend day were randomly selected for this study. An alternate weekday and weekend day were selected to be used in case an individual was not able to follow the prescribed diet due to a possible sick day or other unforeseen circumstances. The alternate day was also used if there were GIs unavailable for foods eaten which were not on the study diet. The three days randomly selected were Monday, Friday and Sunday. Wednesday and Saturday were selected as the alternate days. The last week's food diary for each individual was used for the study since it was the closest intake to the final FBG. The foods included in these three days were analyzed for glycemic index ratings by calculating the glycemic index for each carbohydrate food using the "International Tables of Glycemic Index" (6). A copy of these tables can be found in Appendix A. In calculating the GI for the sample days, the GI was based on mixed meals (Table 3). By taking a food's percent of the total meal carbohydrate and multiplying this by the GI for that food, a meal GI results (62,7). The carbohydrate content of the participants diet intake was calculated using *Bowes and Churchs Food Values of Portions Commonly Used* (63). The mean GI for that individual's three day intake was then calculated. Calculations were double checked for errors.

Statistical Analysis

To determine whether a significant difference existed between the initial FBG and the final FBG from the two diet groups, a two-sample t-test was computed. Descriptive statistics were also figured for the two groups. The level of statistical significance was set at $p < 0 .05$.

Table 3

Calculation of GI for Mixed Meals (48)

Food	GI	CHO(g)	Proportion	Food GI
A	GI(A)	g (A)	P(A)	FGI(A)
B	GI(B)	g (B)	P(B)	FGI(B)
C	GI(C)	g (C)	P(C)	FGI(C)
Total		g	1.0	MGI

The total meal carbohydrate in grams (g) equals the sum of the three carbohydrate components:

$$g = g(A) + g(B) + g(C)$$

The proportion (P) of carbohydrate from each food is calculated:

$$P(A) = (g(A) / g)$$

This is multiplied by the GI for the food to give the GI contribution of that food to the total meal glycemic index:

$$FGI(A) = P(A) \text{ X } GI(A)$$

The GI contributions of each food are then added to give the total meal glycemic index (MGI).

GI = glycemic Index
CHO = carbohydrate
FGI = food glycemic index
MGI = meal glycemic index

Table 3A

Sample Calculation of GI for Mixed Meals (48)

Food	Food GI	CHO (g)	Proportion	Food GI
1/2 c oatmeal	93	12	23.3	21.7
1 c. skim milk	46	11.9	23.1	10.6
1 c apple juice	58	27.6	53.6	31.1
	Total CHO	51.5 g	Total Meal GI	63.4

GI = glycemic index
CHO = carbohydrate in grams

Chapter 4

Results and Discussion

Thirty-five data files were available for evaluation. Only 25 of these data files qualified for use in this study, with 10 files disqualified for the following reasons: one subject had incomplete food records, one did not have an initial FBG, two subjects dropped out of the studies, four subjects had no final FBG, two subjects had eaten some carbohydrates which had not been previously tested and assigned a GI.

A total sample of 25 subjects was included in this study. There were 12 subjects who followed a high GI diet, and 13 subjects who followed a low GI diet. Data included age, height, weight, mean GI, initial FBG, and final FBG (Table 4). The program Minitab was used for the statistical analysis of data in this study. All statistical values reported in the study are means ($\pm$ Standard Error Mean).

The total sample of 25 subjects had a mean age of 56.9 $\pm$ 1.53 with age ranging from 44 - 70 years (Table 5). The mean height was 63.8 in $\pm$ 0.45, ranging from 59 - 67 inches. The mean weight was 195.7 lb. $\pm$ 6.97, with a range of 147 - 275 lb.

The high GI diet group had a mean average GI of 92.2 $\pm$ 2.63 while the low GI diet group's mean average GI was 57.8 $\pm$ 0.936. Individual mean GIs can be seen in Appendix B. These characteristics reflect the expected average GI levels for each diet group.

The mean initial FBG for the high GI diet group was 102.5 mg/dl $\pm$ 3.43 while the final FBG was 109.8 mg/dl $\pm$ 11.6. The low GI diet group had a mean initial FBG of

Table 4

Subject's Age, Height, Weight, Initial and Final FBGs

High GI Diet Subjects

Subject	Age yr	Height in.	Weight lb.	Initial FBG mg/dL	Final FBG mg/dL
01	55	63	188	94	89
02	53	62	200	86	83
03	58	66	207	102	90
04	68	63	181	133	113
05	57	66	174	106	102
06	58	63	244	103	109
07	55	66	170	90	86
08	53	64	224	110	233
09	70	63	147	102	99
10	70	60	161	96	95
11	61	62	210	106	116
12	70	66	197	102	102

Low GI Diet Subjects

Subject	Age yr	Height in.	Weight lb.	Initial FBG mg/dL	Final FBG mg/dL
13	64	65	275	128	109
14	52	64	187	115	94
15	64	66	182	83	93
16	45	62	175	91	102
17	53	59	165	116	127
18	51	64	214	98	98
19	55	65	264	77	87
20	47	67	248	105	94
21	46	65	161	90	82
22	57	67	222	99	104
23	44	60	152	96	93
24	60	68	178	94	91
25	56	62	166	124	111

FBG = fasting blood glucose
GI = glycemic index

Table 5

Mean Age, Height, Weight, Initial FBG, Final FBG, and GI of High and Low GI Diet Groups

Diet Group	High GI Diet	Low GI Diet
Mean Age	60.7 ± 1.99	53.4 ± 1.88
Mean Height (in)	63.7 ± 0.569	64.0 ± 0.707
Mean Weight (lb)	191.5 ± 7.93	199.2 ± 11.5
Mean Initial FBG (mg/dl)	102.5 ± 3.43	101.23 ± 4.31
Mean Final FBG (mg/dl)	109.8 ± 11.6	98.95 ± 3.28
Mean GI	92.2 ± 2.63	57.8 ± 0.936

FBG = fasting blood glucose
GI = glycemic index

101.23 mg/dl $\pm$ 4.31 and a final FBG of 98.9 mg/dl $\pm$ 3.28.

A 2-tailed two sample t-test compared the initial and final FBG for both study groups. The resulting p-value was 0.51 for the high GI diet group, and 0.47 for the low GI diet group, which indicated that there was no significant difference between the initial and final FBG results in either group. The level of significance was $p < 0.05$. The GI diet did not significantly influence the subject's FBG in this study.

The results of this study agree with the authors Hollenbeck et al (51) who reported that when a carbohydrate was incorporated into mixed meals, the GI value did not significantly affect the glucose response. The physical form of a food item was a "confounding variable" which modified the response. The authors were unable to support the use of the GI as a clinical tool for meal planning for patients with type 2 diabetes, but they supported the idea of continuing research with more emphasis on the effects of the physical form, and other factors which may affect the mixed meals. A more thorough understanding of this effect may bring more support to modifying the type of carbohydrate used in meal planning in relation to the GI value.

Coulston and Reavens supported the ADA recommendations to concentrate on the total carbohydrate, and not limiting the carbohydrate choices. The results of this study support this recommendation (51,53,56). There is no evidence that the use of the GI when used in a realistic diet which consists of mixed meals will be a beneficial dietary tool. The Swedish study from 1968 also did not show a significant difference in carbohydrate intake between those women who developed diabetes and those who did not develop the disease (57).

Unlike this study, the national longitudinal studies of both men and women did find

a positive relationship between the intake of high glycemic carbohydrates and the risk of type 2 diabetes, but only when the low cereal fiber content intake was factored into the analysis (58-59). Soluble fibers which have been studied include guar gum, and B-glucan rich cereals, which do have a flattening effect on the glucose response curve. The soluble fibers slow gastric emptying, which indicates a factor other than the low GI food, contributing to the overall meal GI (9-14).

The glycemic index as a measurement of glucose response in single foods has been accepted by the majority of authors, but the mixed meal responses continue to be controversial. The studies need to be applied to a greater sample size, with more agreement between the facilities on procedures, and how the response curve will be calculated. The many factors which affect the glucose response are the physical form of the food item, ripeness of fruits and vegetables, addition of fat and protein, soluble fiber, as well as the effect of enzyme inhibitors, such as phytates, tannins, and lectins. Further studies which take these factors into consideration are needed before the glycemic index can be recommended as a clinical tool in meal planning for people with diabetes as well as those with risk factors for the disease.

Chapter 5

Summary

The purpose of this study was to compare the initial FBG to the final FBG from two groups of non-diabetic, postmenopausal, obese, Caucasian women, to ascertain whether there was a significant difference in FBG after following a high or low GI diet.

Twenty five data files from studies done in 1990 and 1992 were analyzed for this study. Thirteen women followed the low GI diet, and twelve women followed the high GI diet over a four week period. Three days from the last week of the diet were analyzed to obtain a mean GI, verifying in which diet group the women had participated. The initial FBG and the final FBG were compared using a two tailed, two sample t-test to determine whether there was a significant difference.

The results of this study revealed that there was not a significant difference in the initial FBG and the final FBG in either diet group. The GI diet did not affect the final FBG. Problems with the study included a small sample size, the files were not randomly selected due to the use of pre-existing data, and no involvement in the original collection of the data. The subjects were also free living which allowed for the possibility of inaccurate selection and measurement of foods. Using a controlled environment would improve the validity of the data.

The results of this study do support the null hypothesis. It is recommended that future studies include larger sample sizes.

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APPENDICES

APPENDIX A

International Tables of Glycemic Index

International tables of glycemic index

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Sponsors

Australian Sugar Industry
Kellogg Australia
Goodman Fielder Ltd
Mead Johnson Nutritional Group
Ricegrowers Cooperative Ltd

International tables of glycemic index[1,2]

Kaye Foster-Powell and Janette Brand Miller

ABSTRACT The glycemic index (GI) is a ranking of foods based on their glycemic effect compared with a standard food. It has been used to classify carbohydrate foods for various applications, including diabetes, sports, and appetite research. The purpose of these tables is to bring together all of the published data on the GIs of individual foods for the convenience of users. In total, there are almost 600 separate entries, including values for most common Western foods, many indigenous foods, and pure sugar solutions. The tables show the GI according to both the glucose and white bread (the original reference food) standard, the type and number of subjects tested, and the source of the data. For many foods there were two or more published values, so the mean ± SEM was calculated and is shown together with the original data. These tables reduce unnecessary repetition in the testing of individual foods and facilitate wider application of the GI approach. *Am J Clin Nutr* 1995;62:871S–93S.

KEY WORDS Diabetes, diet, glycemic index, blood glucose

INTRODUCTION

The glycemic index (GI) is a ranking of foods based on the postprandial blood glucose response compared with a reference food. In 1981 Jenkins et al (1) published the first list of GI values for 62 foods. They proposed that a GI of foods was needed to supplement tables of nutrient composition in prescribing diets for individuals with diabetes. The work stimulated hundreds of other studies aimed at determining the GI of individual foods and testing the clinical usefulness of the GI concept. Despite early controversy, most studies have found the GI concept to be reproducible, predictable within the context of mixed meals, and clinically useful in the dietary management of diabetes and hyperlipidemia (2–4). Position statements of dietetic associations in some countries have recommended that consideration be given to the GI of carbohydrates in the dietary treatment of diabetes (5–7).

The GI concept is already being used to educate patients in diabetes education centers. In some instances it has been more successful than standard dietary advice in lowering the fat and increasing the fiber content of the diet (8). The International Diabetes Institute (9) in Melbourne has produced printed educational material describing the differences between foods in terms of their GI. New editions of many textbooks of nutrition and dietetics now devote a section to the subject (10).

The purpose of these tables therefore was to bring together all the published data on the GI of individual foods for the convenience of users. In total, there are almost 600 separate entries, including values for most common Western foods, many indigenous foods, and pure sugar solutions. The list gives values for both a white bread and glucose standard to remove some of the confusion associated with having two reference foods. The number and type of subjects tested and the original source of the data are also given. For many foods there were two or more published values, so the mean ± SEM was calculated and is shown together with the original data. In this way the user can appreciate the variation for any one food, and if necessary, use the value relevant to his or her own country.

One of the most reassuring aspects of compiling the tables was to see the degree of consistency in values for the same food. For example, apples vary between only 32 and 40 (using glucose as the reference food) in four separate studies. Despite this consistency, we should not expect a food to have a precise GI. Small differences of < 10–15 units are within the error associated with the measurement of GI (3). There are, however, instances of wide variation and the reason may not be readily apparent. For example, porridge varied from as low as 42 to as high as 75 (using glucose as the standard) in eight separate studies. Differences in the methods of cooking and processing and in the molecular and physical characteristics of the starch in the final product markedly influence the GI (11–13). Hence, the extent to which oats are compressed between the rollers and the degree of precooking influences the final GI of porridge.

It is clear that particle size has a marked effect: as particle size decreases, the GI increases (14–16). Furthermore, the greater the degree of gelatinization of the starch granules, the higher the GI (17). Differences in particle size and gelatinization help to explain the wide differences in the GIs of pasta and bread (18, 19). Some differences in GI can be directly related to genetically determined differences in the composition of the starch granule (20). Rice is a good example of a food that varies markedly in its GI depending on its amylose content (21). Processed foods such as packaged breakfast cereals that have been manufactured under standard conditions show less variation than does raw horticultural produce that is prepared and cooked under varying conditions.

Apart from diabetes, the GI concept has been applied to sports performance and appetite research. Low-GI foods eaten before prolonged strenuous exercise were found to increase endurance time and provided higher concentrations of plasma

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fuels toward the end of exercise (22). In contrast, high-GI foods led to faster replenishment of muscle glycogen after exercise (23). In other studies, low-GI foods were found to produce greater satiety than did foods with high glycemic and insulin responses (24, 25).

The GI approach has been criticized because some foods have been rated as good or bad simply on the basis of their GI, although it was never intended that the GI be used in isolation. The total amount of carbohydrate, the amount and type of fat, and the fiber and salt content of a food are also important considerations in the dietary management of diabetes (26). The insulin response to a food may also be relevant. In general, insulin responses follow the rank order of the glycemic responses (21, 24), but protein foods elicit an insulin response without a commensurate glycemic response (27). The clinical significance of differences in insulin responses to foods is not clear, but it may mean that an insulin index of foods is eventually needed to supplement tables of GI.

GUIDE TO THE USE OF THE TABLES

The figures shown in the tables represent good-quality data produced according to standardized methodology and published in refereed journals. The foods are described as unambiguously as possible using all descriptive data about the food given in the original publication. Sometimes this was extensive, including the variety or the manufacturer's details, plus the cooking and preparation procedure. In other cases, the only description was a single word, eg, potatoes. For grains and pasta, preparation involved boiling until cooked unless otherwise specified. If cooking time was stated in the original reference, the details are given. The user should bear in mind that English-speaking countries often have different names for the same item or the same name for different items. Biscuits, muffins, and scones have different meanings in North America and Europe. We have tried, nonetheless, to be as international in our naming as possible.

In some instances, we calculated the GI ourselves because data were expressed only in the form of the area under the glucose-response curve. If required, the area was recalculated to include the area above fasting only to conform to the standardized methodology (3). When 25- or 75-g carbohydrate portions were used or where the methodology differed from that recommended for GI testing (3), we indicate this with a footnote. If the values had been corrected for added milk and carbohydrate portion size in the original publication, this is also indicated in a footnote.

When glucose was given as the standard food, the GI against a bread standard was calculated by multiplying the GI values by 1.42 (100/70, GI of white bread = 70 when glucose is the standard). Where bread was the standard food, the GI value was calculated by multiplying by 0.7.

Foods have been grouped as follows: bakery products, beverages, breads, breakfast cereals, cereal grains, cookies, crackers, dairy foods, fruit and fruit products, legumes, pasta, root vegetables, snack foods and confectionery, soups, sugars, vegetables, indigenous foods, and miscellaneous. Within each section, foods are arranged in alphabetical order by common name.

The classification of the foods is on a practical rather than scientific basis. For example, we put pizza with the bakery products and we put green peas with vegetables rather than legumes. ■

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International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
73. Whole-meal flour	75 ± 9	107	Normal, 8	Glucose, 2 h	(39)
74. Whole-meal (Tip-Top Bakeries, Sydney, Australia)	77 ± 9	110	Normal, 8	Glucose, 2 h	(17)
75. Whole-meal (Tip-Top Bakeries, Sydney, Australia)	78 ± 16	111	Normal, 7	Glucose, 2 h	(38)
76. Whole-meal flour	71	102 ± 6	NIDDM, 6	Bread, 3 h	(40)
mean of twelve studies	69 ± 2	99 ± 3			
77. Whole-wheat snack bread (Ryvita Co Ltd, Poole, Dorset, UK)	74	105 ± 8	NIDDM, IDDM, 11	Bread, 3 h	(28)
78. Pita bread, white	57	82 ± 10	NIDDM, IDDM, 7	Bread, 3 h	(28)
79. Semolina bread	64	92 ± 7	NIDDM, 10	Bread, 3 h	(71)
Bulgur bread					
80. 75% cracked wheat kernels	48	69 ± 4	NIDDM, 6	Bread, 3 h	(31)
81. 80% wheat kernels	51	73 ± 6	Normal, 10	Bread, 1.5 h	(32)
82. 50% cracked wheat kernel	58	83 ± 4	NIDDM, 6	Bread, 3 h	(31)
mean of three studies	52 ± 3	75 ± 4			
Mixed grain bread					
83. Bürgen Oat Bran & Honey Loaf with Barley (Tip-Top Bakeries, Sydney, Australia)	31 ± 3	44	Normal, 8	Bread, 2 h	(44)
84. 50% kibbled wheat grain	43	61 ± 7	Normal, 8	Bread, 2 h	(33)
85. Ploughman's Loaf (Fielders Bakeries, Sydney, Australia)	47	67 ± 4	Normal, 8	Bread, 2 h	(33)
86. Vogel's Roggenbrot (Stevns & Co Sydney, Australia)	59 ± 5	84	Normal, 8	Bread, 2 h	(44)
mean of four studies	45 ± 7	64 ± 10			
87. Fruit loaf, wheat bread with dried fruit	47 ± 6	67	Normal, 8	Bread, 2 h	(29)
BREAKFAST CEREALS					
All-Bran					
88. All-Bran (Kellogg, Sydney, Australia)	30	43 ± 3	Normal, 7	Bread, 3 h[2]	(24)
89. All-Bran	38	54	Normal, 8	Glucose, 3 h[3]	(45)
90. All-Bran	50	72 ± 5	NIDDM, 6	Bread, 3 h	(40)
91. All-Bran	51 ± 5	73	Normal, 6	Glucose, 2 h	(1)
mean of four studies	42 ± 5	60 ± 7			
92. Bran Buds (Kellogg Canada Inc, Ontario)	58	83 ± 11	NIDDM, IDDM, 8	Bread, 3 h[4]	(28)
93. Bran Buds with psyllium (Kellogg Canada Inc, Ontario)	47	67 ± 4	NIDDM, IDDM, 13	Bread, 3 h[4]	(28)
94. Bran Chex (Nabisco Brands Ltd, Toronto)	58	83 ± 6	NIDDM, IDDM, 10	Bread, 3 h[4]	(28)
95. Cheerios (General Mills Canada Inc)	74	106 ± 9	NIDDM, IDDM, 10	Bread, 3 h[4]	(28)
96. Cocopops (Kellogg, Sydney, Australia)	77 ± 8	110	Normal, 8	Bread, 2 h	(29)
97. Corn Bran (Quaker Oats Co of Canada, Ontario)	75	107 ± 6	NIDDM, IDDM, 10	Bread, 3 h[4]	(28)
98. Corn Chex (Nabisco Brands Ltd, Toronto)	83	118 ± 11	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)
Corn flakes					
99. Corn flakes (Kellogg, Sydney, Australia)	77	110	Normal, 6	Glucose, 2 h	(13)
100. Corn flakes	80 ± 6	114	Normal, 6	Glucose, 2 h	(1)
101. Corn flakes	86	123 ± 5	NIDDM, 7	Bread, 3 h	(40)
102. Corn flakes	92	130	NIDDM, 9	Glucose, 3 h[5]	(30)
mean of four studies	84 ± 3	119 ± 5			
103. Cornflakes, high-fiber (Presidents Choice, Sunfresh Ltd, Toronto)	74	105 ± 6	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)
104. Cream of Wheat (Nabisco Brands Ltd, Toronto)	66	94 ± 4	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)
105. Cream of Wheat, Instant (Nabisco Brands Ltd, Toronto)	74	105 ± 8	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)
106. Crispix (Kellogg Canada Inc, Ontario)	87	124 ± 5	NIDDM, IDDM, 12	Bread, 3 h[4]	(28)
107. Golden Grahams (General Mills Canada Inc, Etobicoke, Ontario)	71	102 ± 12	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)

[1] All mean values listed are $\bar{x} \pm SE$.

[2] GI calculated from glucose area-under-curve (AUC) data.

[3] Values based on 0.5 g carbohydrate/kg body wt.

[4] AUC measured over 3 h but includes only five time points (0, 30, 60, 120, and 180 min).

[5] Values adjusted (for added milk and to correct for 50-g carbohydrate portion size).

International tables of glycemic index (GI)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
BAKERY PRODUCTS					
Cake					
1. Angel food (Loblaw's, Toronto)	67	95 ± 7	NIDDM, IDDM, 9[2]	Bread, 3 h	(28)
2. Banana, made with sugar	47 ± 8	67	Normal, 8	Bread, 2 h	(29)
3. Banana, made without sugar	55 ± 10	79	Normal, 7	Bread, 2 h	(29)
4. Flan (Weston's Bakery, Toronto)	65	93 ± 6	NIDDM, IDDM, 10	Bread, 3 h	(28)
5. Pound (Sara Lee, Canada)	54	77 ± 8	NIDDM, IDDM, 10	Bread, 3 h	(28)
6. Sponge	46 ± 6	66	Normal, 5	Glucose, 2 h	(1)
7. Croissant (Food City, Toronto)	67	96 ± 6	NIDDM, IDDM, 13	Bread, 3 h	(28)
8. Crumpet (Dempster's Corporate Foods Ltd, Ontario)	69	98 ± 4	NIDDM, IDDM, 13	Bread, 3 h	(28)
9. Doughnut, cake-type (Loblaw's, Toronto)	76	108 ± 10	NIDDM, IDDM, 10	Bread, 3 h	(28)
Muffins					
10. Apple, made without sugar[3]	48 ± 10	69	Normal, 8	Bread, 2 h	(29)
11. Apple, made with sugar[3]	44 ± 6	63	Normal, 8	Bread, 2 h	(29)
12. Bran (Culinar Inc, Grandma Martin's Muffins, Ontario)	60	85 ± 8	NIDDM, IDDM, 14	Bread, 3 h	(28)
13. Blueberry (Culinar Inc, Grandma Martin's Muffins, Ontario)	59	84 ± 8	NIDDM, IDDM, 10	Bread, 3 h	(28)
14. Carrot (Culinar Inc, Grandma Martin's Muffins, Ontario)	62	88 ± 12	NIDDM, IDDM, 11	Bread, 3 h	(28)
15. Corn, low-amylose	102	146	NIDDM, 9	Glucose, 3 h[4]	(30)
16. Corn, high-amylose	49	70	NIDDM, 9	Glucose, 3 h[4]	(30)
17. Oatmeal muffin mix (Quaker Oats Co of Canada, Ontario)	69	98 ± 15	NIDDM, IDDM, 9	Bread, 3 h	(28)
mean of eight studies	62 ± 6	88 ± 9			
18. Pastry	59 ± 6	84	Normal, 5	Glucose, 2 h	(1)
19. Pizza cheese (Pillsbury Canada Ltd, Ontario)	60	86 ± 5	NIDDM, IDDM, 12	Bread, 3 h	(28)
20. Waffles, Aunt Jemima (Quaker Oats Co of Canada, Ontario)	76	109 ± 6	NIDDM, IDDM, 10	Bread, 3 h	(28)
BEVERAGES					
21. Cordial, orange	66 ± 8	94	Normal, 8	Bread, 2 h	(29)
22. Lucozade	95 ± 10	136	Normal, 5	Glucose, 2 h	(1)
23. Soft drink, Fanta (Coca Cola Bottlers, Australia)	68 ± 6	97	Normal, 7	Bread, 2 h	(29)
BREADS					
24. Bagel, white, frozen (Lender's Bakery, Montreal)	72	103 ± 5	NIDDM, IDDM, 13	Bread, 3 h	(28)
Barley kernel bread					
25. 75% kernels	27	39 ± 7	NIDDM, 5	Bread, 3 h	(31)
26. 80% kernels, scalded	34	49 ± 10	Normal, 10	Bread, 1.5 h	(32)
27. 80% kernels	41	58 ± 10	Normal, 10	Bread, 1.5 h	(32)
mean of three studies	34 ± 4	49 ± 5			
Barley kernel bread					
28. 50% kernels	43	62 ± 4	NIDDM, 5	Bread, 3 h	(31)
29. 50% kibbled barley	48	69 ± 7	Normal, 8	Bread, 2 h	(33)
mean of two studies	46 ± 2	66 ± 3			
Barley flour bread					
30. 80% barley flour	65	93 ± 14	Normal, 10	Bread, 1.5 h	(32)
31. 100% barley flour	67	96 ± 6	NIDDM, 6	Bread, 3 h	(31)
mean of two studies	66 ± 1	95 ± 2			
32. Bread stuffing, Paxo (Campbell Soup Co Ltd, Toronto)	74	106 ± 10	NIDDM, IDDM, 10	Bread, 3 h	(28)
33. Hamburger bun (Loblaw's, Toronto)	61	87 ± 5	NIDDM, IDDM, 12	Bread, 3 h	(28)
34. Kaiser rolls (Loblaw's, Toronto)	73	104 ± 5	NIDDM, IDDM, 12	Bread, 3 h	(28)
35. Melba toast, Old London (Best Foods Canada Inc, Ontario)	70	100 ± 6	NIDDM, IDDM, 11	Bread, 3 h	(28)

[1] All mean values listed are $\bar{x}$ ± SE.

[2] NIDDM, non-insulin-dependent diabetes mellitus; IDDM, insulin-dependent diabetes mellitus.

[3] The low GI of the apple muffins may be explained by the inclusion of rolled oats in the recipe

[4] GI calculated from glucose area-under-curve (AUC) data.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
36. Oat kernel bread, 80% kernels	65	93 ± 11	Normal, 10	Bread, 1.5 h	(32)
Oat bran bread,					
37. 50% oat bran	44	63 ± 10	Normal, 8	Bread, 2 h	(33)
38. 45% oat bran	50	72 ± 10	Normal, 10	Bread, 1.5 h	(32)
mean of two studies	47 ± 3	68 ± 5			
Rye kernel bread,					
39. 80% kernels	38	54 ± 6	Normal, 10	Bread, 1.5 h	(32)
40. 80% kernels	55	78 ± 3	NIDDM, IDDM, 14	Bread, 3 h	(34)
41. Pumpernickel	41	58	Diabetic, number NS[5]	Glucose, time NS	(35)
42. Whole-grain pumpernickel (Holtzheuser Brothers Ltd, Toronto)	46	66 ± 7	NIDDM, IDDM, 9	Bread, 3 h	(28)
43. Cocktail, sliced (Kasselar Food Products, Toronto)	55	79 ± 3	NIDDM, 9	Bread, 3 h	(36)
44. Cocktail, sliced (Kasselar Food Products, Toronto)	62	88 ± 13	IDDM, 6	Bread, 3 h	(36)
mean of six studies	50 ± 2	71 ± 3			
Rye flour bread					
45. Volkornbrot (Dimpflmeier Bakery Ltd, Toronto)	56	80 ± 5	NIDDM, IDDM, 10	Bread, 3 h	(28)
46. Whole-meal rye	41	58	NIDDM, number NS	Glucose, time NS	(37)
47. Whole-meal rye	62	89 ± 6	NIDDM, IDDM, 14	Bread, 3 h	(34)
48. Whole-meal rye	63	90 ± 7	NIDDM, 9	Bread, 3 h	(36)
49. Whole-meal rye	66	94 ± 10	IDDM, 6	Bread, 3 h	(36)
50. Klosterbrot (Dimpflmeier Bakery Ltd, Toronto)	67	95 ± 6	NIDDM, IDDM, 10	Bread, 3 h	(28)
51. Dark rye, Blackbread, Riga (Berzin's Specialty Bakery, Sydney, Australia)	76 ± 14	109	Normal, 7	Glucose, 2 h	(38)
52. Dark rye, Schinkenbrot, Riga (Berzin's Specialty Bakery, Sydney, Australia)	86 ± 15	123	Normal, 7	Glucose, 2 h	(38)
53. Sourdough rye	57	83	NIDDM, 13	Bread, 3 h	(4)
54. Light rye (Silverstein's Bakery, Toronto)	68	97 ± 6	NIDDM, IDDM, 12	Bread, 3 h	(28)
mean of ten studies	65 ± 2	92 ± 3			
55. Linseed rye (Rudolph's Specialty Bakery Ltd, Toronto)	55	78 ± 8	NIDDM, IDDM, 9	Bread, 3 h	(28)
Wheat bread					
56. White flour	69 ± 5	99	Normal, 10	Glucose, 2 h	(1)
57. White flour (Dempster's Corporate Foods Ltd, Ontario)	71	101 ± 9	NIDDM, IDDM, 12	Bread, 3 h	(28)
58. White flour	71 ± 7	101	Normal, 7	Glucose, 2 h	(39)
59. White flour	71	102 ± 5	NIDDM, 6	Bread, 3 h	(40)
60. White flour	70	100	NIDDM 5, IGT 6[6]	Bread, 3 h	(41)
mean of five studies	70 ± 0	101 ± 0			
61. French baguette	95 ± 15	136	NIDDM, 3	Glucose, 3 h	(42)
Wheat bread—white, high-fiber					
62. (Dempster's Corporate Foods Ltd, Ontario)	67	96 ± 6	NIDDM, IDDM, 13	Bread, 3 h	(28)
63. (Weston's Bakery, Toronto)	69	98 ± 5	NIDDM, IDDM, 12	Bread, 3 h	(28)
mean of two studies	68 ± 1	97 ± 1			
64. Wheat bread—gluten-free Wheat bread	90	129 ± 8	Normal, 8	Bread, 1 h	(43)
65. Whole-meal flour	52	74 ± 15	NIDDM, 9	Bread, 3 h	(19)
66. Whole-meal flour	64	92 ± 11	NIDDM, 6	Bread, 3 h	(31)
67. Whole-meal flour	65	93	Diabetic, number NS	Glucose, time NS	(35)
68. Whole-meal flour	67	95 ± 7	NIDDM, 11	Bread, 3 h	(36)
69. Whole-meal flour	67	96 ± 5	NIDDM, IDDM, 15	Bread, 3 h	(34)
70. Whole-meal flour	69	98 ± 5.2	IDDM, 5	Bread, 3 h	(36)
71. Whole-meal flour	72 ± 6	103	Normal, 10	Glucose, 2 h	(1)
72. Whole-meal flour	73	104	NIDDM, 8	Glucose, 3 h[4]	(30)

[1] All mean values listed are $\bar{x}$ ± SE.
[4] GI calculated from glucose area-under-curve (AUC) data.
[5] NS, not specified.
[6] IGT, impaired glucose tolerance.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
73. Whole-meal flour	75 ± 9	107	Normal, 8	Glucose, 2 h	(39)
74. Whole-meal (Tip-Top Bakeries, Sydney, Australia)	77 ± 9	110	Normal, 8	Glucose, 2 h	(17)
75. Whole-meal (Tip-Top Bakeries, Sydney, Australia)	78 ± 16	111	Normal, 7	Glucose, 2 h	(38)
76. Whole-meal flour	71	102 ± 6	NIDDM, 6	Bread, 3 h	(40)
mean of twelve studies	69 ± 2	99 ± 3			
77. Whole-wheat snack bread (Ryvita Co Ltd, Poole, Dorset, UK)	74	105 ± 8	NIDDM, IDDM, 11	Bread, 3 h	(28)
78. Pita bread, white	57	82 ± 10	NIDDM, IDDM, 7	Bread, 3 h	(28)
79. Semolina bread	64	92 ± 7	NIDDM, 10	Bread, 3 h	(71)
Bulgur bread					
80. 75% cracked wheat kernels	48	69 ± 4	NIDDM, 6	Bread, 3 h	(31)
81. 80% wheat kernels	51	73 ± 6	Normal, 10	Bread, 1.5 h	(32)
82. 50% cracked wheat kernel	58	83 ± 4	NIDDM, 6	Bread, 3 h	(31)
mean of three studies	52 ± 3	75 ± 4			
Mixed grain bread					
83. Bürgen Oat Bran & Honey Loaf with Barley (Tip-Top Bakeries, Sydney, Australia)	31 ± 3	44	Normal, 8	Bread, 2 h	(44)
84. 50% kibbled wheat grain	43	61 ± 7	Normal, 8	Bread, 2 h	(33)
85. Ploughman's Loaf (Fielders Bakeries, Sydney, Australia)	47	67 ± 4	Normal, 8	Bread, 2 h	(33)
86. Vogel's Roggenbrot (Stevns & Co Sydney, Australia)	59 ± 5	84	Normal, 8	Bread, 2 h	(44)
mean of four studies	45 ± 7	64 ± 10			
87. Fruit loaf, wheat bread with dried fruit	47 ± 6	67	Normal, 8	Bread, 2 h	(29)
BREAKFAST CEREALS					
All-Bran					
88. All-Bran (Kellogg, Sydney, Australia)	30	43 ± 3	Normal, 7	Bread, 3 h[2]	(24)
89. All-Bran	38	54	Normal, 8	Glucose, 3 h[3]	(45)
90. All-Bran	50	72 ± 5	NIDDM, 6	Bread, 3 h	(40)
91. All-Bran	51 ± 5	73	Normal, 6	Glucose, 2 h	(1)
mean of four studies	42 ± 5	60 ± 7			
92. Bran Buds (Kellogg Canada Inc, Ontario)	58	83 ± 11	NIDDM, IDDM, 8	Bread, 3 h[4]	(28)
93. Bran Buds with psyllium (Kellogg Canada Inc, Ontario)	47	67 ± 4	NIDDM, IDDM, 13	Bread, 3 h[4]	(28)
94. Bran Chex (Nabisco Brands Ltd, Toronto)	58	83 ± 6	NIDDM, IDDM, 10	Bread, 3 h[4]	(28)
95. Cheerios (General Mills Canada Inc)	74	106 ± 9	NIDDM, IDDM, 10	Bread, 3 h[4]	(28)
96. Cocopops (Kellogg, Sydney, Australia)	77 ± 8	110	Normal, 8	Bread, 2 h	(29)
97. Corn Bran (Quaker Oats Co of Canada, Ontario)	75	107 ± 6	NIDDM, IDDM, 10	Bread, 3 h[4]	(28)
98. Corn Chex (Nabisco Brands Ltd, Toronto)	83	118 ± 11	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)
Corn flakes					
99. Corn flakes (Kellogg, Sydney, Australia)	77	110	Normal, 6	Glucose, 2 h	(13)
100. Corn flakes	80 ± 6	114	Normal, 6	Glucose, 2 h	(1)
101. Corn flakes	86	123 ± 5	NIDDM, 7	Bread, 3 h	(40)
102. Corn flakes	92	130	NIDDM, 9	Glucose, 3 h[5]	(30)
mean of four studies	84 ± 3	119 ± 5			
103. Cornflakes, high-fiber (Presidents Choice, Sunfresh Ltd, Toronto)	74	105 ± 6	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)
104. Cream of Wheat (Nabisco Brands Ltd, Toronto)	66	94 ± 4	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)
105. Cream of Wheat, Instant (Nabisco Brands Ltd, Toronto)	74	105 ± 8	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)
106. Crispix (Kellogg Canada Inc, Ontario)	87	124 ± 5	NIDDM, IDDM, 12	Bread, 3 h[4]	(28)
107. Golden Grahams (General Mills Canada Inc, Etobicoke, Ontario)	71	102 ± 12	NIDDM, IDDM, 9	Bread, 3 h[4]	(28)

[1] All mean values listed are $\bar{x}$ ± SE.
[2] GI calculated from glucose area-under-curve (AUC) data.
[3] Values based on 0.5 g carbohydrate/kg body wt.
[4] AUC measured over 3 h but includes only five time points (0, 30, 60, 120, and 180 min).
[5] Values adjusted (for added milk and to correct for 50-g carbohydrate portion size).

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
108. Grapenuts (Post, Kraft General Foods Canada Inc, Don Mills, Ontario)	67	96 ± 9	NIDDM, IDDM, 11	Bread, 3 h[v]	(28)
109. Grapenuts Flakes (Post, Kraft General Foods Canada Inc, Don Mills, Ontario)	80	114 ± 8	NIDDM, IDDM, 10	Bread, 3 h[v]	(28)
110. Life (Quaker Oats Co of Canada, Ontario)	66	94 ± 8	NIDDM, IDDM, 9	Bread, 3 h[v]	(28)
Muesli					
111. Toasted	43 ± 4	61	Normal, 8	Bread, 2 h	(29)
112. Nontoasted (Uncle Toby's, Wahgunyah, Australia)	56 ± 8	80	Normal, 8	Bread, 2 h	(29)
113. Muesli, No Name (Sunfresh Ltd, Toronto)	60	85 ± 12	NIDDM, IDDM, 9	Bread, 3 h[v]	(28)
114. Muesli	66 ± 9	94	Normal, 6	Glucose, 2h	(1)
mean of four studies					
115. Nutri-grain (Kellogg, Sydney, Australia)	66 ± 12	94	Normal, 8	Bread, 2 h	(29)
Oat Bran					
116. Raw (Quaker Oats Co of Canada, Ontario)	50	72 ± 6	NIDDM, IDDM, 11	Bread, 3 h[v]	(28)
117. Raw	59	84	NIDDM, ≤13	Bread, 3 h	(4)
mean of two studies	55 ± 6	78 ± 8			
Porridge					
118. (Uncle Toby's, Wahgunyah Australia)	42	60 ± 5	Normal, 7	Bread, 3 h[z]	(24)
119. Porridge	49 ± 8	70	Normal, 6	Glucose, 2 h[m]	(1)
120. Porridge	58 ± 4	83	Normal, 7	Bread, 2 h	(21)
121. Porridge	62	88	Diabetic, number NS	Glucose, time NS	(35)
122. Porridge	69	98 ± 9	NIDDM, 6	Bread, 3 h	(40)
123. Porridge	75	107	NIDDM, 8	Glucose, 3 h[d]	(30)
124. Quaker Quick Oats (Quaker Oats Co of Canada, Ontario)	65	93	NIDDM, 6	Bread, 3 h	(46)
125. One Minute Oats (Quaker Oats Co of Canada, Ontario)	66	94 ± 10	NIDDM, IDDM, 7	Bread, 3 h[v]	(28)
mean of eight studies	61 ± 2	87 ± 2			
126. Pro Stars (General Mills Canada Inc, Ontario)	71	102 ± 7	NIDDM, IDDM, 10	Bread, 3 h[v]	(28)
Puffed wheat					
127. Puffed Wheat (Quaker Oats Co of Canada, Ontario)	67	96 ± 7	NIDDM, IDDM, 10	Bread, 3 h[v]	(28)
128. Puffed wheat (Sanitarium, Sydney, Australia)	80 ± 11	114	Normal, 8	Glucose, 2 h	(17)
mean of two studies	74 ± 9	105 ± 13			
129. Red River Cereal (Maple Leaf Mills, Toronto)	49	70 ± 5	NIDDM, IDDM, 9	Bread, 3 h[v]	(28)
130. Rice Bran	19 ± 3	27	Normal, 8	Bread, 2 h	(21)
Rice Bubbles (Kellogg, Sydney, Australia)					
131. Rice Bubbles	95	136	Normal, 6	Glucose, 2 h	(13)
132. Rice Bubbles	81	116 ± 11	Normal, 7	Bread, 3 h[z]	(24)
mean of two studies	88 ± 7	126 ± 10			
133. Rice Chex (Nabisco Brands Ltd, Toronto)	89	127 ± 5	NIDDM, IDDM, 11	Bread, 3 h[v]	(28)
134. Rice Krispies (Kellogg Canada Inc, Ontario)	82	117 ± 5	NIDDM, IDDM, 12	Bread, 3 h[v]	(28)
Shredded wheat					
135. Mini Wheats (Kellogg, Sydney Australia)	58 ± 8	83	Normal, 8	Bread, 2 h	(44)
136. Shredded wheat	67 ± 10	96	Normal, 6	Glucose, 2 h	(1)
137. Shredded Wheat (Nabisco Brands Ltd, Toronto)	83	118 ± 6	NIDDM, IDDM, 14	Bread, 3 h[v]	(28)
mean of three studies	69 ± 6	99 ± 9			
138. Special K (Kellogg, Sydney, Australia)	54 ± 4	77	Normal, 8	Bread, 2 h	(44)
139. Sultana Bran (Kellogg, Sydney, Australia)	52 ± 7	74	Normal, 8	Bread, 2 h	(29)
140. Sustain (Kellogg, Sydney, Australia)	68	97 ± 10	Normal, 7	Bread, 3 h[z]	(24)

[1] All mean values listed are $\bar{x}$ ± SE.
[d] GI calculated from glucose area-under-curve (AUC) data.
[z] Values based on 0.5 g carbohydrate/kg body wt.
[v] Values adjusted (for added milk and to correct for 50-g carbohydrate portion size).
[m] Porridge prepared from raw oats requiring 20-min cooking time.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
141. Team (Nabisco Brands Ltd, Toronto)	82	117 ± 9	NIDDM, IDDM, 10	Bread, 3 h[v]	(28)
142. Total (General Mills Canada Inc, Ontario)	76	109 ± 6	NIDDM, IDDM, 10	Bread, 3 h[v]	(28)
Wheat biscuits, flaked wheat					
143. Vita-Brits (Uncle Toby's, Wahgunyah, Australia)	61	87 ± 14	Normal, 7	Bread, 3 h[7]	(24)
144. Wheetabix (Wheetabix of Canada Ltd, Ontario)	74	105 ± 8	NIDDM, IDDM, 11	Bread, 3 h[v]	(28)
145. Wheetabix (Wheetabix of Canada Ltd, Ontario)	75 ± 10	107	Normal, 6	Glucose, 2 h	(1)
mean of three studies	70 ± 4	100 ± 5			
CEREAL GRAINS					
Barley					
146. Barley	22	31	NIDDM, ≤13	Bread, 3 h	(4)
147. Barley	27	39 ± 6	NIDDM, 4	Bread, 3 h	(31)
148. Pearled	29	41 ± 10	IDDM, 7	Bread, 3 h	(36)
149. Pearled	22	32 ± 3	NIDDM, 12	Bread, 3 h	(36)
mean of four studies	25 ± 2	36 ± 3			
150. Cracked (Malthouth, Tunisia)	50	72 ± 7	NIDDM, IDDM, 10	Bread, 3 h	(28)
151. Rolled	66 ± 5	94	Normal, 8	Bread, 2 h	(21)
Buckwheat					
152. Buckwheat	49	70 ± 6	NIDDM, 12	Bread, 3 h	(36)
153. Buckwheat	51 ± 10	73	Normal, 5	Glucose, 2 h	(1)
154. Buckwheat	63	90 ± 8	IDDM, 6	Bread, 3 h	(36)
mean of three studies	54 ± 4	78 ± 6			
Bulgur					
155. Bulgur	46	66 ± 4	NIDDM, 6	Bread, 3 h	(31)
156. Boiled 20 min	46	65 ± 4	NIDDM, IDDM, 17	Bread, 3h	(34)
157. Boiled 20 min	46	65 ± 5	NIDDM, 12	Bread, 3 h	(36)
158. Boiled 20 min	53	75 ± 13	IDDM, 6	Bread, 3 h	(36)
mean of four studies	48 ± 2	68 ± 3			
Couscous					
159. (Near East Food Products Co. Leominster, MA)	61	87 ± 7	NIDDM, IDDM, 9	Bread, 3 h	(28)
160. Tunisian	69	99 ± 6	NIDDM, IDDM, 9	Bread, 3 h	(28)
mean of two types	65 ± 6	93 ± 9			
Maize					
161. Cornmeal (McNair Products Co Ltd, Toronto)	68	97 ± 5	NIDDM, IDDM, 12	Bread, 3 h	(28)
162. Cornmeal + margarine	69	99 ± 10	NIDDM, IDDM, 9	Bread, 3 h	(28)
Sweet corn					
163. Featherweight, diet-pack, canned	46	66	NIDDM, 20	Bread, 3 h	(47)
164. Sweet corn	48	69	Normal, 6	Glucose, 2 h	(13)
165. Sweet corn	59 ± 11	84	Normal, 5	Glucose, 2 h	(1)
166. Sweet corn	60	86	Normal, 16	Bread, 3 h	(48)
167. Sweet corn	60	85	NIDDM 5, IGT 6	Bread, 3 h	(41)
168. Sweet corn	62 ± 5	89	Normal, 7	Glucose, 2 h	(39)
169. Frozen (Green Giant Pillsbury Canada Ltd, Toronto)	47	67 ± 4	NIDDM, IDDM, 9	Bread, 3 h	(28)
mean of seven studies	55 ± 1	78 ± 2			
170. Taco shells (Old El Paso Foods Co, Toronto)	68	97 ± 9	NIDDM, IDDM, 9	Bread, 3 h	(28)
171. Millet	71 ± 10	101	Normal, 5	Glucose, 2 h	(1)
Rice, white					
172. Long-grain, boiled 15 min	50	71	Normal, 6	Glucose, 2 h	(13)
173. Gem long-grain (Dainty Food Inc, Toronto)	55	79	NIDDM, 10	Bread, 3 h	(49)
174. Long-grain, boiled 25 min (Surinam)	56 ± 2	80	NIDDM, 3	Glucose, 3 h	(42)
175. Gem long-grain (Dainty Food Inc, Toronto)	57	82	IDDM, 6	Bread, 3 h	(49)
176. Long-grain boiled 15 min	58	83 ± 5	IDDM 5, NIDDM 13	Bread, 3 h	(50)

[1] All mean values listed are $\bar{x}$ ± SE.

[7] Values based on 0.5 g carbohydrate/kg body wt.

[v] Values adjusted (for added milk and to correct for 50-g carbohydrate portion size).

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
177. Gem long-grain (Dainty Foods Inc, Toronto)	60	86 ± 6	NIDDM, 13	Bread, 3 h	(36)
178. Gem long-grain (Dainty Foods Inc, Toronto)	60	86 ± 11	IDDM, 6	Bread, 3 h	(36)
179. Long-grain, boiled 5 min	41	58 ± 4	NIDDM, 13	Bread, 3 h	(50)
180. Type NS	69	98	NIDDM, 22	Wheat chapati, 3 h[11]	(51)
181. Type NS	72 ± 9	103	Normal, 7	Glucose, 2 h	(1)
182. Type NS	48	68	Normal, 6	Wheat chapati, 2 h[11]	(52)
183. Type NS	51	73	Diabetic, number NS	Glucose, time NS	(35)
184. Type NS	56	80 ± 5	NIDDM, 6	Bread, 3 h	(40)
mean of 13 studies	56 ± 2	81 ± 3			
Rice, white, low-amylose					
185. Waxy (0% amylose)	88 ± 11	126	Normal, 7	Bread, 2 h	(21)
186. Calrose (Ricegrowers, Leeton, Australia)	83 ± 13	119	Normal, 8	Bread, 2 h	(21)
187. Pelde (Ricegrowers, Leeton Australia)	93 ± 11	133	Normal, 7	Bread, 2 h	(21)
mean of three studies	88 ± 3	126 ± 4			
Rice, white, high-amylose					
188. Doongara (Ricegrowers, Leeton, Australia)	64 ± 9	91	Normal, 8	Bread, 2 h	(21)
189. Doongara (Ricegrowers, Leeton, Australia)	54 ± 7	75	Normal, 9	Bread, 2 h	(53)
190. Basmati	58 ± 8	83	Normal, 9	Bread, 2 h	(53)
mean of three studies	59 ± 3	83 ± 5			
Rice, brown					
191. Brown	66 ± 5	94	Normal, 7	Glucose, 2 h	(1)
192. Brown	50	72	Normal, 8	Glucose[12] 3 h[14]	(45)
193. Brown	50 ± 19	72	Normal, 12–15	Glucose[11] 3 h[14]	(54)
mean of three studies	55 ± 5	79 ± 6			
194. Sunbrown Quick (Ricegrowers, Leeton, Australia)	80 ± 7	114	Normal, 8	Bread, 2 h	(21)
195. Doongara, high amylose (Ricegrowers, Leeton, Australia)	66 ± 7	94	Normal, 8	Bread, 2 h	(21)
196. Pelde (Ricegrowers, Leeton, Australia)	76 ± 6	109	Normal, 8	Bread, 2 h	(21)
197. Calrose (Ricegrowers, Leeton, Australia)	87 ± 8	124	Normal, 8	Bread, 2 h	(21)
Instant rice					
198. Boiled 6 min	87	124	Normal, 6	Glucose, 2 h	(13)
199. Doongara (Ricegrowers, Leeton, Australia)	94 ± 7	132	Normal, 9	Bread, 2 h	(53)
mean of two studies	91 ± 4	128 ± 4			
200. Boiled 1 min	46	65 ± 5	NIDDM, 13	Bread, 3 h	(50)
Parboiled rice					
201. Uncle Ben's converted, boiled 20–30 min	38	54	Normal, 16	Bread, 3 h	(48)
202. Uncle Ben's converted (Effem Foods Ltd, Ontario)	45	64 ± 7	IDDM, 5	Bread, 3 h	(36)
203. Uncle Ben's converted long-grain, boiled 20–30 min	50	72	NIDDM, 20	Bread, 3 h	(47)
204. Long-grain, boiled 5 min	38	54 ± 5	NIDDM, 13	Bread, 3 h	(50)
205. Boiled 12 min[15]	39	55 ± 10	NIDDM, 7	Bread, 2 h	(55)
206. Boiled 12 min	42	60 ± 8	NIDDM, 7	Bread, 2 h	(55)
207. Boiled 12 min	43	62 ± 9	NIDDM, 11	Bread, 5 h	(56)
208. Boiled 12 min	46	66 ± 5	NIDDM, 12	Bread, 5 h	(56)
209. Long-grain, boiled 25 min	46	66 ± 4	NIDDM, 13	Bread, 3 h	(50)
210. Long-grain, boiled 15 min	47	67 ± 5	IDDM 5, NIDDM 13	Bread, 3 h	(50)
211. Parboiled	48	68 ± 5.8	NIDDM, 13	Bread, 3 h	(36)
212. Long-grain, boiled 10 min	61	87	NIDDM, 8	Glucose, 3 h[4]	(30)

[1] All mean values listed are $\bar{x}$ ± SE.

[8] AUC measured over 3 h but includes only five time points (0, 30, 60, 120, and 180 min).

[11] GI of wheat chapati taken as 100. GI of test food calculated by direct proportion of AUC in response to test food with AUC in response to wheat chapati.

[12] GI calculated from AUC food/AUC glucose formula. The glucose formula had added protein and fat so all means tested were equivalent in macronutrients. GI of glucose formula assumed to be 100. Three-hour response curve with only five time points.

[13] 75-g carbohydrate portion of test food and standard tested.

[14] AUC measured over 3 h for only four time points (0, 1, 2, and 3 h).

[15] 25-g carbohydrate portion tested.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
213. Parboiled	72	103	NIDDM 5, IGT 6	Bread, 3 h	(41)
mean of thirteen studies	47 ± 3	68 ± 4			
214. High-amylose, Doongara (Ricegrowers, Leeton, Australia)	50 ± 6	69	Normal, 8	Bread, 2 h	(53)
215. Low-amylose, Pelde, Sungold (Rice Growers, Leeton, Australia)	87 ± 7	124	Normal, 8	Bread, 2 h	(21)
Specialty rices					
216. Cajun Style (Uncle Ben's, Effem Foods Ltd, Ontario)	51	72 ± 13	NIDDM, IDDM, 8	Bread, 3 h	(28)
217. Garden Style (Uncle Ben's, Effem Foods Ltd, Ontario)	55	79 ± 6	NIDDM, IDDM, 11	Bread, 3 h	(28)
218. Long Grain and Wild (Uncle Ben's, Effem Foods Ltd, Ontario)	54	77 ± 9	NIDDM, IDDM, 8	Bread, 3 h	(28)
219. Mexican Fast and Fancy (Uncle Ben's, Effem Foods Ltd, Ontario)	58	83 ± 7	NIDDM, IDDM, 11	Bread, 3 h	(28)
220. Saskatchewan wild rice	57	81 ± 8	NIDDM, IDDM, 9	Bread, 3 h	(28)
mean of five studies	55 ± 1	78 ± 2			
Rye					
221. Whole kernel	29	42 ± 6.7	NIDDM, 9	Bread, 3 h	(36)
222. Whole kernel	34	47 ± 5	NIDDM, IDDM, 14	Bread, 3 h	(34)
223. Whole kernel	39	56 ± 12.2	IDDM, 7	Bread, 3 h	(36)
mean of three studies	34 ± 3	48 ± 4			
224. Tapioca boiled with milk (General Mills Canada Inc, Ontario)	81	115 ± 9	NIDDM, IDDM, 10	Bread, 3 h	(28)
Wheat					
225. Whole kernel	30 ± 9	43	Normal, 12–15	Glucose,[13] 3 h[14]	(54)
226. Whole kernels	42	60 ± 8	NIDDM, 11	Bread, 3 h	(36)
227. Whole kernels	44	63 ± 6	NIDDM, IDDM, 17	Bread, 3 h	(34)
228. Whole kernels	48	69 ± 6.8	IDDM, 7	Bread, 3 h	(36)
mean of four studies	41 ± 3	59 ± 4			
229. Wheat, quick cooking (White Wings, Sydney, Australia)	54 ± 11	77	Normal, 8	Glucose, 2 h	(17)
COOKIES					
Digestives					
230. Digestives	55	79 ± 9	NIDDM, 6	Bread, 3 h	(40)
231. Digestives	59 ± 7	84	Normal, 6	Glucose, 2 h	(1)
232. Digestives, Peak Freans (Nabisco Brands Ltd, Toronto)	62	88 ± 7	NIDDM, IDDM, 13	Bread, 3 h	(28)
mean of three studies	59 ± 2	84 ± 2			
233. Graham Wafers (Christie Brown & Co, Division of Nabisco Brands Ltd, Toronto)	74	106 ± 9	NIDDM, IDDM, 9	Bread, 3 h	(28)
Arrowroot					
234. McCormick's (Interbare Foods, Toronto)	63	90 ± 4	NIDDM, IDDM, 13	Bread, 3 h	(28)
235. Milk Arrowroot (Arnotts, Sydney, Australia)	69 ± 7	99	Normal, 8	Bread, 2 h	(29)
mean of two studies	66 ± 4	95 ± 6			
236. Morning Coffee (Arnotts, Sydney, Australia)	79 ± 6	113	Normal, 8	Bread, 2 h	(29)
Oatmeal					
237. Oatmeal	54 ± 4	77	Normal, 6	Glucose, 2 h	(1)
238. Highland Oatmeal (The Weston Biscuit Co, Sydney, Australia)	55 ± 8	79	Normal, 7	Bread, 2 h	(29)
239. Highland Oatcakes (Walker's Shortbread Ltd, Aberlour-on-Spey, UK)	57	81 ± 6	NIDDM, IDDM, 12	Bread, 3 h	(28)
mean of three studies	55 ± 1	79 ± 1			
240. Rich tea	55 ± 4	79	Normal, 6	Glucose, 2 h	(1)
241. Shredded Wheatmeal (Arnotts, Sydney, Australia)	62 ± 4	89	Normal, 7	Bread, 2 h	(29)
242. Shortbread (Arnotts, Sydney, Australia)	64 ± 8	91	Normal, 8	Glucose, 2 h	(17)

[1] All mean values listed are $\bar{x}$ ± SE.

[4] GI calculated from glucose area-under-curve (AUC) data.

[13] 75-g carbohydrate portion of test food and standard tested.

[14] AUC measured over 3 h for only four time points (0, 1, 2, and 3 h).

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
243. Vanilla Wafers (Christie Brown & Co. Division of Nabisco Brands Ltd, Toronto)	77	110 ± 4	NIDDM, IDDM, 8	Bread, 3 h	(28)
CRACKERS					
244. Breton wheat crackers (Dare Foods Ltd, Ontario)	67	96 ± 4	NIDDM, IDDM, 10	Bread, 3 h	(28)
245. Jatz (Arnotts, Sydney, Australia)	55 ± 5	79	Normal, 8	Bread, 2 h	(29)
246. Puffed Crispbread (Weston's Sydney, Australia)	81 ± 9	116	Normal, 8	Glucose, 2 h	(17)
247. Rice cakes	82 ± 11	117	Normal, 6	Bread, 2 h	(21)
248. Calrose rice cakes, low-amylose	91 ± 7	128	Normal, 9	Bread, 2 h	(53)
249. Doongara rice cakes, high-amylose	61 ± 5	85	Normal, 9	Bread, 2 h	(53)
High-fiber rye crispread					
250. Ryvita (The Ryvita Co, Sydney, Australia)	69 ± 10	99	Normal, 7	Glucose, 2 h	(1)
251. (Ryvita Company Ltd, Poole, Dorset, UK)	59	84 ± 7	NIDDM, IDDM, 9	Bread, 3 h	(28)
252. (Ryvita Company Ltd, Poole, Dorset, UK)	63	90 ± 4	NIDDM, IDDM, 12	Bread, 3 h	(28)
253. Rye crispbread	63	90	NIDDM, number NS	Glucose, time NS	(37)
254. Kavli Norwegian Crispbread, (Players Biscuits Pty Ltd, Sydney, Australia)	71 ± 7	101	Normal, 8	Bread, 2 h	(44)
mean of five studies	65 ± 1	93 ± 2			
255. Sao (Arnotts, Sydney, Australia)	70 ± 9	100	Normal, 8	Bread, 2 h	(29)
256. Stoned Wheat Thins (Christie Brown & Co, Division of Nabisco Brands Ltd, Toronto)	67	96 ± 4	NIDDM, IDDM, 11	Bread, 3 h	(28)
Water crackers					
257. Water cracker	63 ± 9	90	Normal, 6	Glucose, 2 h	(1)
258. (Arnotts, Sydney, Australia)	78 ± 11	111	Normal, 8	Glucose, 2 h	(17)
259. Premium Soda Crackers (Christie Brown & Co. Division of Nabisco Brands Ltd, Toronto)	74	106 ± 5	NIDDM, IDDM, 10	Bread, 3 h	(28)
mean of three studies	72 ± 4	102 ± 6			
DAIRY FOODS					
Ice cream					
260. Ice cream	36 ± 8	51	Normal, 5	Glucose, 2 h	(1)
261. Ice cream	57	82 ± 15	Normal, 7	Bread, 2 h	(57)
262. Ice cream	62	89	NIDDM, 7	Glucose, 5 h[16]	(58)
263. Ice cream	68 ± 15	97	NIDDM, 12	Glucose, 3 h	(59)
264. Ice cream	80	114 ± 8	NIDDM, 14	Bread, 2 h	(57)
mean of five studies	61 ± 7	87 ± 10			
265. Ice cream, low-fat	50 ± 8	71	Normal, 8	Bread, 2 h	(29)
Milk					
Full-fat					
266. Full-fat	11	15 ± 8	Normal, 7	Bread, 2 h	(57)
267. Full-fat	24	34 ± 1	NIDDM, 14	Bread, 2 h	(57)
268. Full-fat	34 ± 6	49	Normal, 6	Glucose, 2 h	(1)
269. Full-fat	40	57	NIDDM, 7	Glucose, 5 h[16]	(58)
mean of four studies	27 ± 7	39 ± 9			
270. Skim	32 ± 5	46	Normal, 6	Glucose, 2 h	(1)
271. Chocolate, sugar sweetened	34 ± 4	49	Normal, 8	Bread, 2 h	(29)
272. Chocolate, artificially sweetened	24 ± 6	34	Normal, 8	Bread, 2 h	(29)
273. + 30g bran	50	35 ± 11	NIDDM, 14	Bread, 2 h	(57)
274. + 30g bran	58	40 ± 27	Normal, 7	Bread, 2 h	(57)
275. Custard, milk + starch + sugar	43 ± 10	61	Normal, 8	Glucose, 2 h	(17)
276. Tofu frozen dessert, nondairy	115 ± 14	164	NIDDM, 12	Glucose, 3 h	(59)
277. Vitari, nondairy, frozen fruit product	28 ± 6	40	Normal, 8	Bread, 2 h	(29)
Yogurt					
278. Low-fat, fruit, sugar sweetened	33 ± 7	47	Normal, 8	Bread, 2 h	(29)
279. Low-fat, artificial sweetener	14 ± 4	20	Normal, 8	Bread, 2 h	(29)

[1] All mean values listed are $\bar{x}$ ± SE.

[16] AUC recalculated as area above fasting baseline only.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
280. Unspecified	36 ± 4	51	Normal, 5	Glucose, 2 h	(1)
FRUIT AND FRUIT PRODUCTS					
Apple					
281. Golden Delicious	39 ± 3	56	Normal, 6	Glucose, 2 h	(1)
282. Braeburn[15]	32 ± 4	45	NIDDM, IGT, 15	Glucose, 3 h	(60)
283. Apple	34	48	NIDDM, number NS	Glucose, time NS	(37)
284. Apple	40	57	NIDDM, 7	Glucose, 5 h[16]	(58)
mean of four studies	36 ± 2	52 ± 3			
Apple juice					
285. Unsweetened	40	57	NIDDM, 7	Glucose, 5 h[16]	(58)
286. Unsweetened (Allens, Toronto)	41	59 ± 8.4	NIDDM, 6	Bread, 3 h	(61)
mean of two studies	41 ± 1	58 ± 1			
Apricots					
287. Canned, light syrup, Riviera, (Aliments Caneast Foods Ltee, Montreal)	64	91 ± 6	NIDDM, 9	Bread, 3 h	(61)
288. Dried	30 ± 7	43	Normal, 8	Bread, 2 h	(29)
289. Dried	32	46 ± 7	NIDDM, 9	Bread, 3 h	(61)
mean of two studies (dried)	31 ± 1	44 ± 2			
Banana					
290. Banana	46	66	Diabetic, number NS	Glucose, time NS	(35)
291. Banana	58	83 ± 7	NIDDM, 6	Bread, 3 h	(40)
292. Banana	62 ± 9	89	Normal, 6	Glucose, 2 h	(1)
293. Banana	70 ± 5	100	Normal, 8	Glucose, 2 h	(39)
294. Underripe	30	43 ± 10	NIDDM, 10	Bread, 4 h	(62)
295. Overripe	52	74 ± 9	NIDDM, 10	Bread, 4 h	(62)
mean of six studies	53 ± 6	76 ± 8			
296. Cherries	22	32	NIDDM, number NS	Glucose, time NS	(37)
297. Fruit Cocktail, canned (Delmonte Canadian Canners Ltd, Hamilton)	55	79 ± 5	NIDDM, 8	Bread, 3 h	(61)
298. Grapefruit	25	36	NIDDM, number NS	Glucose, time NS	(37)
299. Grapefruit juice, unsweetened (Sunpac, Toronto)	48	69 ± 5	NIDDM, 13	Bread, 3 h	(61)
300. Grapes	43	62	NIDDM, number NS	Glucose, time NS	(37)
Kiwifruit					
301. Kiwifruit, Hayward[15]	47 ± 4	67	NIDDM, IGT, 15	Glucose, 3 h	(60)
302. Kiwi fruit[15]	58 ± 7	83	Normal, 7	Bread, 2 h	(29)
mean of two studies	52 ± 6	75 ± 8			
Mango					
303. Mango, *Mangifera indica*[15]	51 ± 3	73	Normal, 7	Bread, 2 h	(29)
304. Mango	60 ± 16	86	Normal, 12–15	Glucose,[12] 3 h[14]	(54)
mean of two studies	55 ± 5	80 ± 7			
Orange					
305. Orange	33 ± 6	47	Normal, 6	Glucose, 2 h	(39)
306. Orange	40 ± 3	57	Normal, 6	Glucose, 2 h	(1)
307. Orange	51	73	NIDDM, number NS	Glucose, time NS	(37)
308. (Sunkist, Van Nuys, CA)	48	69 ± 11	NIDDM, 10	Bread, 3 h	(61)
mean of four studies	43 ± 4	62 ± 6			
Orange juice					
309. Orange juice	46 ± 6	66	Normal, 6	Glucose, 2 h	(1)
310. Orange juice	53 ± 6	76	Normal, 8	Bread, 2 h	(29)
311. Reconstituted from frozen concentrate	57 ± 6	81 ± 8	NIDDM, 7	Glucose, 5 h[16]	(58)
mean of three studies	57 ± 3	74 ± 4			
Paw paw					
312. Paw paw, *Carica papaya*[15]	56 ± 6	80	Normal, 7	Bread, 2 h	(29)
313. Paw paw (papaya)	60 ± 16	86	Normal, 12–15	Glucose,[13] 3 h[14]	(54)
mean of two studies	58 ± 2	83 ± 3			
314. Peach, fresh	28	40	NIDDM, number NS	Glucose, time NS	(37)

[1] All mean values listed are $\bar{x}$ ± SE.

[12] GI calculated from AUC food/AUC glucose formula. The glucose formula had added protein and fat so all means tested were equivalent in macronutrients. GI of glucose formula assumed to be 100. Three-hour response curve with only five time points.

[13] 75-g carbohydrate portion of test food and standard tested.

[14] AUC measured over 3 h for only four time points (0, 1, 2, and 3 h).

[15] 25-g carbohydrate portion tested.

[16] AUC recalculated as area above fasting baseline only.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
315. Peach, canned, natural juice	30 ± 4	43	Normal, 8	Bread, 2 h	(29)
316. Peach, canned, heavy syrup	58 ± 11	83	Normal, 8	Bread, 2 h	(29)
317. Peach, canned, light syrup (Delmonte, Canadian Canners Ltd, Hamilton)	52	74 ± 7.4	NIDDM, 11	Bread, 3 h	(61)
Pear					
318. Pear	33	47	NIDDM, number NS	Glucose, time NS	(37)
319. Bartlett (Ontario)	41	58 ± 7	NIDDM, 13	Bread, 3 h	(61)
320. Winter Nellis[15]	34 ± 4	48	NIDDM, IGT, 15	Glucose, 3 h	(60)
mean of three studies	36 ± 3	51 ± 4			
321. Canned in pear juice, Bartlett (Delmonte, Canadian Canners Ltd, Hamilton)	44	63 ± 6	NIDDM, 10	Bread, 3 h	(61)
322. Pineapple[15]	66 ± 7	94	Normal, 8	Bread, 2 h	(29)
323. Pineapple juice, unsweetened, (Dole Packaged Foods, Toronto)	46	66 ± 3	NIDDM, 13	Bread, 3 h	(61)
324. Plum	24	34	NIDDM, number NS	Glucose, time NS	(37)
325. Raisins	64 ± 11	91	Normal, 6	Glucose, 2 h	(1)
326. Rockmelon[15]	65 ± 9	93	Normal, 8	Bread, 2 h	(29)
327. Sultanas	56 ± 11	80	Normal, 8	Bread, 2 h	(29)
328. Watermelon[15]	72 ± 13	103	Normal, 8	Bread, 2 h	(29)
LEGUMES					
Baked beans					
329. Canned	40 ± 3	57	Normal, 7	Glucose, 2 h	(1)
330. Canned (Libby, McNeill & Libby of Canada, Chatham, Ontario)	56	80 ± 8	NIDDM, 7	Bread, 3 h	(63)
mean of two studies	48 ± 8	69 ± 12			
Beans, dried					
331. Type NS	20	28 ± 14	NIDDM, 14	Bread, 2 h	(57)
332. Type NS	37	52 ± 25	Normal, 7	Bread, 2 h	(57)
mean of two studies	29 ± 9	40 ± 12			
333. Beans, dried, *Phaseolus vulgaris*	70 ± 11	100	Normal, 12–15	Glucose,[13] 3 h[14]	(54)
Black-eyed beans					
334. Black-eyed beans	50	71 ± 5	NIDDM, 6	Bread, 3 h	(40)
335. Black-eyed beans	33 ± 4	47	Normal, 6	Glucose, 2 h	(1)
mean of two studies	42 ± 9	59 ± 12			
336. Broad beans[15]	79 ± 16	113	Normal, 6	Glucose, 2 h	(1)
Butter beans					
337. Butter beans	28 ± 7	40	Normal, 8	Glucose, 2 h	(39)
338. Butter beans	29 ± 8	41	NIDDM 21, IDDM 8, Normal 11	Glucose, 2 h	(64)
339. Butter beans	36 ± 4	51	Normal, 6	Glucose, 2 h	(1)
mean of three studies	31 ± 3	44 ± 3			
340. + 5 g sucrose	30 ± 13	43	NIDDM 21, IDDM 8, Normal 11	Glucose, 2 h	(64)
341. + 10 g sucrose	31 ± 12	44	NIDDM 21, IDDM 8, Normal 11	Glucose, 2 h	(64)
342. + 15 g sucrose	54 ± 21	77	NIDDM 21, IDDM 8, Normal 11	Glucose, 2 h	(64)
Chickpeas					
343. Chickpeas	31	44 ± 8	NIDDM, 6	Bread, 3 h	(63)
344. Chickpeas	33	47 ± 9	NIDDM, 7	Bread, 3 h	(40)
345. Chickpeas	36 ± 5	51	Normal, 6	Glucose, 2 h	(1)
mean of three studies	33 ± 1	47 ± 2			
346. Canned (Lancia-Bravo Foods Ltd, Toronto)	42	60 ± 7	NIDDM, 11	Bread, 3 h	(63)
347. Curry, canned, (Canasia Foods Ltd, Ontario)	41	58 ± 7	NIDDM, IDDM, 7	Bread, 3 h	(28)
Haricot (navy) beans					

[1] All mean values listed are $\bar{x}$ ± SE.
[13] 75-g carbohydrate portion of test food and standard tested.
[14] AUC measured over 3 h for only four time points (0, 1, 2, and 3 h).
[15] 25-g carbohydrate portion tested.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
348. Pressure cooked 25 min (King Grains, Toronto)	29	41 ± 5	NIDDM, 7	Bread, 3 h	(65)
349. Haricot (navy) beans	30	43 ± 5	NIDDM, 7	Bread, 3 h	(63)
350. Haricot (navy) beans	31 ± 6	44	Normal, 6	Glucose, 2 h	(1)
351. (King Grains, Toronto)	39	56 ± 16	Normal, 6	Bread, 1 h	(49)
352. Pressure cooked 25 min (King Grains, Toronto)	59	84 ± 10	IDDM, 6	Bread, 3 h	(65)
mean of five studies	38 ± 6	54 ± 8			
Kidney beans					
353. *Phaseolus vulgaris*	19	27	Normal, 6	Glucose, 2 h	(52)
354. Kidney beans	23	33	NIDDM, 8	Glucose, 3 h[4]	(30)
355. Kidney beans	23 ± 1	33	NIDDM, 3	Glucose, 3 h	(42)
356. Kidney beans, *Phaseolus vulgaris L.*	25	36 ± 6	Normal, 10	Bread, 1.5 h	(32)
357. Kidney beans	29 ± 8	41	Normal, 6	Glucose, 2 h	(1)
358. Kidney beans	42	60 ± 6	NIDDM, 8	Bread, 3 h	(63)
359. Kidney beans	46	66 ± 7	NIDDM, 7	Bread, 3 h	(40)
mean of seven studies	27 ± 5	42 ± 6			
360. *Phaseolus vulgaris L.*, autoclaved	34	49 ± 5	Normal, 10	Bread, 1.5 h	(32)
361. Canned (Lancia-Bravo Foods Ltd, Toronto)	52	74 ± 8	NIDDM, 11	Bread, 3 h	(63)
Lentils					
362. Type NS	28	40	NIDDM, 8	Glucose, 3 h[4]	(30)
363. Type NS	29 ± 3	41	Normal, 7	Glucose, 2 h	(1)
mean of two studies	29 ± 1	41 ± 1			
Green					
364. Green	22	31 ± 5	NIDDM, 11	Bread, 3 h	(63)
365. Green	30 ± 15	43	NIDDM, 3	Glucose, 3 h	(42)
366. Green	37 ± 3	53	Normal, 7	Glucose, 2 h	(66)
mean of three studies	30 ± 4	42 ± 6			
367. Green, canned (Lancia-Bravo Foods Ltd, Toronto)	52	74 ± 5	NIDDM, 11	Bread, 3 h	(63)
Red					
368. Red	18	25	Normal, 3	Bread, 1 h	(67)
369. Red	21	30 ± 4	NIDDM, 14	Bread, 3 h	(36)
370. Red	31	44 ± 7	NIDDM 7	Bread, 3 h	(40)
371. Red	32	45 ± 9	IDDM, 11	Bread, 3 h	(36)
mean of four studies	26 ± 4	36 ± 5			
372. Lima beans, baby, frozen (York, Canada Packers, Toronto)	32	46 ± 13	NIDDM, IDDM, 5	Bread, 3 h	(28)
373. Pinto beans (Lancia-Bravo Foods Ltd, Toronto)	39	55 ± 6	NIDDM, 9	Bread, 3 h	(63)
374. Pinto beans, canned	45	64 ± 6	NIDDM, 9	Bread, 3 h	(63)
375. Romano beans	46	65 ± 7	NIDDM, 6	Bread, 3 h	(40)
Soya beans					
376. Soya beans	15 ± 5	21	Normal, 7	Glucose, 2 h	(1)
377. Soya beans	20 ± 3	29	Normal, 7	Glucose, 2 h	(66)
mean of two studies	18 ± 3	25 ± 4			
378. Canned	14 ± 2	20	Normal, 7	glucose, 2 h	(1)
379. Split peas, yellow, boiled, NuPack (Caricon Importers Ltd, Ontario)	32	45 ± 4	NIDDM, IDDM, 8	Bread, 3 h	(28)
PASTA					
380. Capellini (Primo Foods Ltd, Toronto)	45	64 ± 8	NIDDM, IDDM, 8	Bread, 3 h	(28)
381. Fettucini, egg-enriched	32 ± 4	46	Normal, 7	Glucose, 2 h	(68)
382. Instant noodles, Mr Noodle (Imported by Anderson Watts Ltd, Vancouver, British Columbia)	47	67 ± 8	NIDDM, IDDM, 10	Bread, 3 h	(28)
Linguine					
383. Thick, durum	43	62 ± 11	Normal, 10	Bread, 1.5 h	(32)
384. Thick, durum	48	68 ± 13	Normal, 9	Bread, 2 h	(18)
mean of two studies	46 ± 3	65 ± 3			
385. Thin, durum	49	70 ± 9	Normal, 10	Bread, 1.5 h	(32)

[1] All mean values listed are $\bar{x}$ ± SE.

[4] GI calculated from glucose area-under-curve (AUC) data.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
386. Durum	61	87 ± 13	Normal, 9	Bread, 2 h	(18)
mean of two studies	55 ± 6	78 ± 8			
387. + egg, durum	53	76 ± 13	Normal, 9	Bread, 2 h	(18)
388. + egg, durum	45	64 ± 11	Normal, 10	Bread, 1.5 h	(32)
mean of two studies	49 ± 4	70 ± 6			
389. Macaroni, boiled 5 min (Lancia-Bravo Foods Ltd, Toronto)	45	64 ± 8	NIDDM, IDDM, 13	Bread, 3 h	(69)
390. Macaroni and Cheese, boxed, (Kraft General Foods Canada Inc, Don Mills, Ontario)	64	92 ± 5	NIDDM, IDDM, 9	Bread, 3 h	(28)
391. Ravioli, durum, meat filled	39 ± 1	56	Normal, 6	Glucose, 2 h	(68)
Spaghetti					
392. Protein enriched, boiled 7 min (Catelli Plus, Catelli Ltd, Montreal)	27	38 ± 4	NIDDM, IDDM, 13	Bread, 3 h	(69)
White					
393. Boiled 15 min (Lancia-Bravo Foods Ltd, Toronto)	32	46 ± 6	NIDDM, IDDM, 13	Bread, 3 h	(69)
394. White	33	47 ± 9	NIDDM, 6	Bread, 3 h	(70)
395. White	34	48 ± 5	NIDDM, 9	Bread, 3 h	(19)
396. Boiled 15 min (Lancia-Bravo Foods Ltd, Toronto)	36	52 ± 7	NIDDM, 7	Bread, 3 h	(36)
397. White	38	54 ± 13	NIDDM, 10	Bread, 3 h	(71)
398. Boiled 15 min	41	59 ± 11	IDDM, 4	Bread, 3 h	(36)
399. White	42	60 ± 9	NIDDM, 6	Bread, 3 h	(40)
400. White	48	68	Diabetic, number NS	Glucose, time NS	(35)
401. White	50 ± 8	71	Normal, 6	Glucose, 2 h	(1)
402. Boiled 20 min	58 ± 7	83	Normal, 6	Bread, 2 h	(21)
mean of ten studies	41 ± 3	59 ± 4			
403. Boiled 5 min (Lancia-Bravo Foods Ltd, Toronto)	32	45 ± 6	NIDDM, IDDM, 17	Bread, 3 h	(69)
404. Boiled 5 min	34	49 ± 7	NIDDM, 11	Bread, 3 h	(36)
405. Boiled 5 min	44	63 ± 9.0	IDDM, 7	Bread, 3 h	(36)
mean of three studies	37 ± 3	52 ± 6			
Durum					
406. Boiled 12 min (Starhushålls, Kungsörnen AB, Järna, Sweden)	47	67 ± 10	Normal, 10	Bread, 2 h	(32)
407. Boiled 12 min	53	76 ± 12	Normal, 9	Bread, 2 h	(18)
408. Boiled 20 min	64 ± 15	91	NIDDM, 3	Glucose, 3 h	(42)
mean of three studies	55 ± 5	78 ± 7			
Whole-meal					
409. Whole-meal	32	46 ± 7	NIDDM, 10	Bread, 3 h	(71)
410. Whole-meal	42 ± 4	60	Normal, 6	Glucose, 2 h	(1)
mean of two studies	37 ± 5	53 ± 7			
411. Spirali, durum	43 ± 10	61	Normal, 8	Glucose, 2 h	(68)
412. Star Pastina, boiled 5 min (Lancia-Bravo Foods Ltd, Toronto)	38	54 ± 6	NIDDM, IDDM, 13	Bread, 3 h	(69)
413. Tortellini cheese (Stouffer, Nestlé Co, Don Mills, Ontario)	50	71 ± 5	NIDDM, IDDM, 8	Bread, 3 h	(28)
414. Vermicelli	35 ± 7	50	Normal, 7	Glucose, 2 h	(68)
415. Rice pasta, brown[17]	92 ± 8	131	Normal, 6	Bread, 2 h	(21)
ROOT VEGETABLES					
416. Beetroot[15]	64 ± 16	91	Normal, 5	Glucose, 2 h	(1)
Carrots					
417. Carrots[15]	92 ± 20	131	Normal, 5	Glucose, 2 h	(1)
418. Carrots[15]	49 ± 2	70	Normal, 7	Glucose, 2 h	(66)
mean of two studies	71 ± 22	101 ± 31			
419. Parsnips[15]	97 ± 19	139	Normal, 5	Glucose, 2 h	(1)
Potato					
Instant					

[1] All mean values listed are $\bar{x}$ ± SE.

[15] 25-g carbohydrate portion tested.

[17] Rice pasta was prepared from low-amylose rice flour.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
420. Instant	74 ± 12	106	NIDDM, 3	Glucose, 3 h	(42)
421. Instant	80 ± 13	114	Normal, 8	Glucose, 2 h	(1)
422. Instant	86	123	Normal, 6	Glucose, 2 h	(13)
423. Instant (Carnation Foods Co Ltd. Manitoba)	86	123 ± 5	NIDDM, IDDM, 16	Bread, 3 h	(28)
424. Instant	88	126 ± 6	Diabetic, 7	Bread, time NS	(72)
mean of five studies	83 ± 1	118 ± 2			
Baked					
425. Russet, baked without fat	56	80 ± 5	Diabetic, 7	Bread, time NS	(72)
426. Burbank, baked without fat, 45–60 min	78	112	NIDDM, 20	Bread, 3 h	(47)
427. Baked without fat	94	134	NIDDM 5, IGT 6	Bread, 3 h	(41)
428. Baked without fat	111	158	Normal, 16	Bread, 3 h	(48)
mean of four studies	85 ± 12	121 ± 16			
New					
429. New	47	67	Diabetic, number NS	Glucose, time NS	(35)
430. New	54	77 ± 11	NIDDM, 6	Bread, 3 h	(40)
431. New	70 ± 8	100	Normal, 8	Glucose, 2 h	(1)
mean of three studies	62 ± 7	81 ± 8			
432. Pontiac, boiled	56	80	Normal, 6	Glucose, 2 h	(13)
433. Prince Edward Island, boiled	63	90 ± 7	NIDDM, IDDM, 12	Bread, 3 h	(28)
434. Boiled, mashed	73	104 ± 4	NIDDM, IDDM, 14	Bread, 3 h	(28)
435. Canned, Avon (Cobi Foods Inc. Nova Scotia)	61	87 ± 8	NIDDM, IDDM, 9	Bread, 3 h	(28)
White					
436. Type NS, boiled	54	77 ± 8	Diabetic, 7	Bread, time NS	(72)
437. Boiled	58	83 ± 5	NIDDM, IDDM, 16	Bread, 3 h	(28)
438. Boiled	56	80 ± 9	NIDDM, 6	Bread, 3 h	(70)
mean of three studies (boiled)	56 ± 1	80 ± 2			
439. Mashed (Ontario)	73	104 ± 5	NIDDM, IDDM, 14	Bread, 3 h	(28)
440. Mashed	67	96 ± 7	Diabetic, 7	Bread, time NS	(72)
441. Mashed	71 ± 10	101	Normal, 7	Glucose, 2 h	(39)
mean of three studies (mashed)	70 ± 2	100 ± 2			
442. Steamed	65 ± 11	93	Normal, 12–15	Glucose,[13] 3 h[14]	(54)
443. Microwaved	82	117	NIDDM, 8	Glucose, 3 h[4]	(30)
444. Baked (Ontario)	60	85 ± 4	NIDDM, IDDM, 16	Bread, 3 h	(28)
445. French fries (Cavendish Farms, Prince Edward Island)	75	107 ± 6	NIDDM, IDDM, 9	Bread, 3 h	(28)
Sweet potato					
446. Sweet potato	48 ± 6	69	Normal, 5	Glucose, 2 h	(1)
447. Sweet potato	59	84 ± 5	NIDDM, IDDM, 13	Bread, 3 h	(28)
mean of two studies	54 ± 8	77 ± 11			
448. Swede (rutabaga)[15]	72 ± 8	103	Normal, 5	Glucose, 2 h	(1)
449. Yam	51 ± 12	73	Normal, 5	Glucose, 2 h	(1)
SNACK FOODS AND CONFECTIONERY					
450. Jelly beans	80 ± 8	114	Normal, 8	Bread, 2 h	(29)
451. Life Savers (Nestlé Confectionery, Chatswood, New South Wales, Australia)	70 ± 6	100	Normal, 8	Bread, 2 h	(29)
452. Chocolate	49 ± 6	70	Normal, 8	Bread, 2 h	(29)
453. Mars Bar (Mars, Melbourne)	68 ± 12	97	Normal, 6	Glucose, 2 h	(1)
454. Muesli Bars (Uncle Tobys, Wahgunyah, Australia)	61 ± 7	87	Normal, 7	Bread, 2 h	(29)
455. Popcorn	55 ± 7	79	Normal, 8	Bread, 2 h	(44)
Corn chips					
456. Corn chips	72	103	Normal, 6	Glucose, 2 h	(13)
457. Nachips (Old El Paso Foods Co, Toronto)	74	106 ± 8	NIDDM, IDDM, 9	Bread, 3 h	(28)
mean of two studies	73 ± 1	105 ± 2			

[1] All mean values listed are $\bar{x}$ ± SE.
[4] GI calculated from glucose area-under-curve (AUC) data.
[13] 75-g carbohydrate portion of test food and standard tested.
[14] AUC measured over 3 h for only four time points (0, 1, 2, and 3 h).
[15] 25-g carbohydrate portion tested

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
Potato crisps					
458. Potato crisps	57	81	Normal, 6	Glucose, 2 h	(13)
459. Potato crisps	51 ± 7	73	Normal, 7	Glucose, 2 h	(1)
mean of two studies	54 ± 3	77 ± 4			
Peanuts					
460. Peanuts[15]	7 ± 4	10	Normal, 6	Glucose, 2 h	(39)
461. Peanuts[15]	13 ± 6	19	Normal, 5	Glucose, 2 h	(1)
462. Peanuts	23	33 ± 17	Normal 21, NIDDM 27	Bread, 3 h	(73)
mean of three studies	14 ± 8	21 ± 12			
SOUPS					
463. Black Bean (Wil-Pak Foods, CA)	64	92 ± 9	NIDDM, IDDM, 6	Bread, 3 h	(28)
464. Green Pea, canned (Campbell Soup Co Ltd, Toronto)	66	94 ± 7	NIDDM, IDDM, 10	Bread, 3 h	(28)
465. Lentil, canned (Unico, Division of Culinar Foods Inc, Ontario)	44	63 ± 6	NIDDM, IDDM, 9	Bread, 3 h	(28)
466. Split Pea (Wil-Pak Foods, CA)	60	86 ± 12	NIDDM, IDDM, 5	Bread, 3 h	(28)
467. Tomato	38 ± 9	54	Normal, 5	Glucose, 2 h	(1)
SUGARS					
Honey					
468. Honey	87 ± 8	124	Normal, 6	Glucose, 2 h	(1)
469. Honey	58 ± 6	83	Normal, 8	Bread, 2 h	(29)
mean of two studies	73 ± 15	104 ± 21			
Fructose					
470. Fructose	20 ± 5	29	Normal, 5	Glucose, 2 h	(1)
471. Fructose	21	30	NIDDM, number NS	Glucose, time NS	(37)
472. Fructose	24	34	NIDDM, 7	Glucose, 5 h[16]	(58)
473. Fructose	25	35 ± 12	NIDDM, 6	Bread, 3 h[18]	(46)
mean of four studies	23 ± 1	32 ± 2			
Glucose					
474. Glucose	85	122	NIDDM, 20	Bread, 3 h	(47)
475. Glucose	92	131 ± 13	NIDDM, 6	Bread, 3 h[18]	(46)
476. Glucose	93	132	NIDDM 5, IGT 6	Bread, 3 h	(41)
477. Glucose	96	137	Normal, 16	Bread, 3 h	(48)
478. Glucose	96	137	Diabetic, number NS	Glucose, time NS	(35)
479. Glucose	100 ± 14	143	Normal, 12–15	Glucose,[15] 3 h[14]	(54)
480. Glucose	100	143	Normal, 35	Glucose, 2 h	(1)
481. Glucose	111	158	Normal, 6	Wheat, 2 h	(52)
mean of eight studies	97 ± 3	138 ± 4			
482. Glucose tablets, Glucodin (Boots, North Rocks, New South Wales, Australia)	102 ± 9	146	Normal, 7	Bread, 2 h	(29)
483. Maltose	105 ± 12	150	Normal, 6	Glucose, 2 h	(1)
Sucrose					
484. Sucrose	58	83	NIDDM, 7	Glucose, 5 h[16]	(58)
485. Sucrose	59 ± 10	84	Normal, 5	Glucose, 2 h	(1)
486. Sucrose	60	86	NIDDM, number NS	Glucose, time NS	(37)
487. Sucrose	64	91 ± 18	NIDDM, 6	Bread, 3 h[18]	(46)
488. Sucrose	65 ± 9	93	Normal, 7	Glucose, 2 h	(39)
489. Sucrose	82	117 ± 22	NIDDM, 14	Bread, 2 h	(57)
mean of six studies	65 ± 4	92 ± 5			
Lactose					
490. Lactose	43	61	NIDDM, 7	Glucose, 5 h[16]	(58)
491. Lactose	48	69 ± 10	NIDDM, 6	Bread, 3 h[18]	(46)
mean of two studies	46 ± 3	65 ± 4			
VEGETABLES					
Peas					
Dried					
492. Dried	22	32	NIDDM, number NS	Glucose, time NS	(35)

[1] All mean values listed are $\bar{x}$ ± SE.

[15] 75-g carbohydrate portion of test food and standard tested.

[14] AUC measured over 3 h for only four time points (0, 1, 2, and 3 h).

[15] 25-g carbohydrate portion tested

[16] AUC recalculated as area above fasting baseline only.

[18] GI for sugars calculated from the glycemic response for a meal of sugar and rolled oats, less the glycemic response for the oats alone.

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
493. Dried, marrowfat	31	44	NIDDM, number NS	Glucose, time NS	(37)
494. Dried, marrowfat	47 ± 3	68	Normal, 6	Glucose, 2 h	(1)
mean of two studies	39 ± 8	56 ± 12			
Green					
495. Green, *Pisum sativum*	54 ± 14	77	Normal, 12–15	Glucose,[13] 3 h[14]	(54)
496. Frozen, boiled	39	55	NIDDM, number NS	Glucose, time NS	(35)
497. Frozen, boiled	51 ± 6	73	Normal, 6	Glucose, 2 h	(1)
mean of three studies	48 ± 5	68 ± 7			
498. Pumpkin	75 ± 9	107	Normal, 6	Glucose, 2 h	(39)
Sweet corn					
499. Featherweight, diet-pack, canned	46	66	NIDDM, 20	Bread, 3 h	(47)
500. Sweet corn	48	69	Normal, 6	Glucose, 2 h	(13)
501. Sweet corn	59 ± 11	84	Normal, 5	Glucose, 2 h	(1)
502. Sweet corn	60	86	Normal, 16	Bread, 3 h	(48)
503. Sweet corn	60	85	NIDDM 5, IGT 6	Bread, 3 h	(41)
504. Sweet corn	62 ± 5	89	Normal, 7	Glucose, 2 h	(39)
505. Frozen (Green Giant Pillsbury Canada Ltd, Toronto)	47	67 ± 4	NIDDM, IDDM, 9	Bread, 3 h	(28)
mean of seven studies	55 ± 1	78 ± 2			
INDIGENOUS FOODS					
Pima Indian foods					
506. Acorns, stewed with venison, *Quercus emoryi*	16 ± 1	23	Normal, 8	Glucose, 2 h	(74)
507. Cactus jam, *Stenocereus thurberi*	91	130 ± 19	Normal, 8	Bread, 2 h	(75)
508. Corn hominy, *Zea mays*	40 ± 5	57	Normal, 8	Glucose, 2 h	(74)
509. Fruit leather, *Stenocereus thurberi*	70	100 ± 19	Normal, 8	Bread, 2 h	(75)
510. Lima beans broth, *Phaseolus lunatus*	36 ± 3	51	Normal, 8	Glucose, 2 h	(74)
511. Mesquite cakes, *Prosopis velutina*	25 ± 3	36	Normal, 4	Glucose, 2 h	(74)
512. Tortilla, *Zea mays* and *Olneya tesota*	38	54 ± 9	Normal, 8	Bread, 2 h	(75)
513. White teparies broth, *Phaseolus acutifolius*	31 ± 3	44	Normal, 8	Glucose, 2 h	(74)
514. Yellow teparies broth, *Phaseolus acutifolius*	29 ± 3	41	Normal, 8	Glucose, 2 h	(74)
South African foods					
515. Brown beans	24 ± 8	34	Normal, 7	Glucose, 2 h	(39)
516. Gram dhal	5 ± 3	7	Normal, 7	Glucose, 2 h	(39)
517. Maize meal porridge, unrefined	71 ± 6	101	Normal, 8	Glucose, 2 h	(39)
518. Maize meal porridge, refined	74 ± 7	106	Normal, 8	Glucose, 2 h	(39)
519. M'fino, wild greens	68 ± 8	97	Normal, 6	Glucose, 2 h	(39)
Mexican foods					
520. Black beans	30	43 ± 17	NIDDM 27, normal 21	Bread, 3 h	(73)
521. Brown beans	38	54 ± 15	NIDDM 27, normal 21	Bread, 3 h	(73)
522. Nopal, prickly pear cactus	7	10 ± 17	NIDDM 27, normal 21	Bread, 3 h	(73)
Asian Indian foods					
523. Baisen chapati	27	39	NIDDM, 11	Wheat chapati, 3 h[11]	(51)
Bajra					
524. Bajra, *Penniseteum typhoideum*	55 ± 13	79	NIDDM, 6	Glucose, 2 h	(76)
525. Bajra chapati	67	96	NIDDM, 14	Bread, 3 h	(77)
526. Bajra chapati	49	70	Normal, 18	Bread, 3 h	(77)
mean of three studies	57 ± 5	82 ± 8			
527. Banana, *Musa sapientum*, unripe, steamed 1 h	70 ± 11	100	Normal, 12–15	Glucose,[13] 3 h[14]	(54)
Barley chapati					
528. Barley chapati	37	53	NIDDM, 14	Bread, 3 h	(77)
529. Barley chapati	48	69	Normal, 18	Bread, 3 h	(77)
mean of two studies	42 ± 5	61 ± 8			
530. Bengal gram dhal, chickpea	11	16	Normal, 6	Glucose, 2 h	(52)
531. Black gram, *Phaseolus mungo*	43 ± 10	61	Normal, 12–15	Glucose,[13] 3 h[14]	(54)
532. Green gram, *Phaseolus aureus*	38 ± 14	54	Normal, 12–15	Glucose,[13] 3 h[14]	(54)

[1] All mean values listed are $\bar{x}$ ± SE.

[11] GI of wheat chapati taken as 100. GI of test food calculated by direct proportion of AUC in response to test food with AUC in response to wh chapati.

[13] 75-g carbohydrate portion of test food and standard tested.

[14] AUC measured over 3 h for only four time points (0, 1, 2, and 3 h).

International tables of glycemic index (GI) (continued)

Food number and food item	GI[1] (Glucose = 100)	GI[1] (Bread = 100)	Subjects (Type and number)	Reference Food and time period	Literature source
533. Horse gram, *Dolichos biflorus*	51 ± 11	73	Normal, 12–15	Glucose,[12] 3 h[14]	(54)
534. Jowar, *Sorghum vulgare*[19]	77 ± 8	110	NIDDM, 6	Glucose, 2 h	(76)
535. Maize, *Zea mays* chapati	64	92	NIDDM, 14	Bread, 3 h	(77)
536. Maize, *Zea mays* chapati	59	85	Normal, 18	Bread, 3 h	(77)
537. Ragi, *Eleusine coracana*[19]	104 ± 13	149	NIDDM, 6	Glucose, 2 h	(76)
538. Ragi, *Eleucine coracana*	68 ± 10	97	Normal, 12–15	Glucose,[13] 3 h[14]	(54)
539. Rajmah, *Phaseolus vulgaris*	19	27	Normal, 6	Glucose, 2 h	(52)
540. Semolina, *Triticum aestivum*, steamed	55 ± 9	79	NIDDM, 30	Glucose, 2 h[19]	(78)
541. *Triticum aestivum*, black gram dhal, *Phaseolus mungo*	46 ± 12	66	NIDDM, 30	Glucose, 2 h[19]	(78)
542. *Triticum aestivum*, green gram dhal, *Phaseolus aureus*	62 ± 20	89	NIDDM, 30	Glucose, 2 h[19]	(78)
543. *Triticum aestivum*, Bengal gram dhal, *Cicer arietum*	54 ± 7	77	NIDDM, 30	Glucose, 2 h[19]	(78)
544. Semolina, *Triticum aestivum*, preroasted	76 ± 6	109	NIDDM, 30	Glucose, 2 h[19]	(78)
545. Tapioca, *Manihot utilissima*, steamed 1 h	70 ± 10	100	Normal, 12–15	Glucose,[13] 3 h[14]	(54)
546. Varagu, *Paspalum scorbiculatum*	68 ± 8	97	NIDDM, 6	Glucose, 2 h	(76)
547. Green gram dhal, *Paspalum scorbiculatum* and *Phascolus aurius Roxb*[19]	78 ± 12	111	NIDDM, 6	Glucose, 2 h	(76)
548. Whole green gram[19]	57 ± 6	81	NIDDM, 6	Glucose, 2 h	(76)
Australian Aboriginal foods					
549. *Acacia aneura* mulga seed [15]	8	11	Normal, 7	Potato,[20] 3 h	(79)
550. *Acacia coriacea* bread[15]	46	66	Normal, 6	Bread, 3 h	(79)
551. *Araucaria bidwillii*, bunya nut pine[15]	47	67	Normal, 7	Potato,[20] 3 h	(79)
552. Bush honey, sugar bag[15]	43	61	Normal, 7	Potato,[20] 3 h	(79)
553. *Castanospermum australe*	74 ± 3	106	Normal, 7	Glucose, 2 h	(66)
554. *Castanospermum australe*, blackbean seed[15]	8	11	Normal, 7	Potato,[20] 3 h	(79)
555. *Dioscorea bulbifera*, cheeky yam[15]	34	49	Normal, 7	Potato,[20] 3 h	(79)
556. *Macrozamia communis*	40 ± 2	57	Normal, 7	Glucose, 2 h	(66)
Pacific Islands foods					
557. *Artocarpus altilis*, breadfruit[15]	68	97	Normal, 7	Potato,[20] 3 h	(79)
558. *Colocasia esculenta*, taro[15]	54	77	Normal, 7	Potato,[20] 3 h	(79)
559. *Ipomoea batatas*, sweet potato[15]	44	63	Normal, 7	Potato,[20] 3 h	(79)
Chinese foods					
560. Rice vermicelli (Kongmoon, China)	58	83 ± 5	NIDDM, IDDM, 9	Bread, 3 h	(28)
561. Lungkow beanthread (China National Cereals, Oils & Foodstuffs, Qingdao & Guangdong, China)	26	37 ± 6	NIDDM, IDDM, 9	Bread, 3 h	(28)
MISCELLANEOUS					
562. Fish fingers	38 ± 6	54	Normal, 5	Glucose, 2 h	(1)
563. Sausages	28 ± 6	40	Normal, 5	Glucose, 2 h	(1)
564. Ultracal (Mead Johnson, Evansville, IN)	40.1	55.4 ± 15.5	Normal, 8	Bread, 2 h	Brand Miller (unpublished)
565. Sustagen Hospital Formula (Mead Johnson, Sydney, Australia)	44.4	61.3 ± 9.7	Normal, 8	Bread, 2 h	Brand Miller (unpublished)

[1] All mean values listed are $\bar{x}$ ± SE.

[12] GI calculated from AUC food/AUC glucose formula. The glucose formula had added protein and fat so all means tested were equivalent in macronutrients. GI of glucose formula assumed to be 100. Three-hour response curve with only five time points.

[13] 75-g carbohydrate portion of test food and standard tested.

[14] AUC measured over 3 h for only four time points (0, 1, 2, and 3 h).

[15] 25-g carbohydrate portion tested

[19] Postprandial glucose response curve measured for only two time points.

[20] GI of potato taken as 80. GI of test food calculated by direct proportion of AUC in response to test food with AUC in response to potato.

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APPENDIX B

Glycemic Index - Daily and 3 Day Averages

Glycemic Index (GI) - Daily and 3 Day Averages

Subject	Day 1 Avg GI	Day 2 Avg GI	Day 3 Avg GI	3 Day Avg
1	94.4	93.4	95.6	94.5
2	130.1	94.2	128.2	117.5
3	95.3	89.9	84.6	89.9
4	98.5	92	83.9	91.5
5	87.1	101.6	89	92.6
6	74.8	78.4	96	83
7	90.7	94.4	83.3	89.5
8	83.3	83.6	104.6	90.5
9	79.1	98	87.2	88.1
10	89.2	95.4	83.3	89.3
11	58.2	102.5	85.7	82.1
12	89.8	102.5	102.6	98.3
13	57.8	59.7	63.9	60.5
14	63.7	53.8	41.4	53
15	57.6	57.6	74.8	63.3
16	37.2	59.2	67	54.5
17	70.1	57.6	55.1	60.9
18	52.4	51.8	57.7	54
19	71.8	54.2	57.6	61.2
20	55.6	55.4	54.8	55.3
21	58.3	59.5	53.2	57
22	57.3	58.3	56.7	57.4
23	61.3	62	44	55.8
24	56.3	58.3	55.7	56.8
25	72.5	54.9	58.6	62