

Implementing the Glycemic Index
By John Fowlie

The Glycemic Index

The Glycemic Index (GI) is a digestion rating system for carbohydrates. Foods which have a high GI are digested and absorbed quickly into the blood stream while those with a low GI are digested and absorbed slower.

There are several benefits from basing a diet around the GI. Low GI foods can help control established diabetes, help people lose weight, lower blood lipids and improve the body's sensitivity to insulin. High GI foods can help replenish glycogen and carbohydrate stores after exercise.

The GI is based on the digestion rate of pure glucose. This is then set as the base unit of 100 for the GI. Other foods are then tested and ranked accordingly by comparing the time and rate at which the carbohydrates are absorbed into the blood stream.

The GI (Glycemic Index) Symbol program was launched in Australia on July 2nd 2002. The program's aim is to have all products disclose their GI rating on the packaging. Foods must meet specific nutritional criteria and have had their GI measured using the approved method, currently conducted by the University of Sydney. The program uses three classifications, high, medium or low.

Low 55 and Under
Medium 56 – 69
High 70 and above

Glycemic Index limited is responsible for implementing and monitoring the GI symbol program. It's a non-profit company consisting of The University of Sydney, Diabetes Australia and the Juvenile Diabetes research Foundation.

Physiology of the Glycemic Index

It is important to understand the physiology behind the GI in order to implement it correctly. Eventually all food must be broken down through digestion and a series of chemical reactions into adenosine triphosphate (ATP).

ATP

Adenosine Triphosphate (ATP) is the energy source for all biological work. Energy is released when ATP releases a phosphate and becomes adenosine diphosphate (ADP). In order to continue energy production ADP must resynthesise into ATP.

Carbohydrates

Carbohydrates are a classification of molecules that contain the atom ratio of one carbon, two hydrogen and one oxygen (CH₂O).

Glucose

Glucose is a carbohydrate with six carbon atoms. Eventually through a process called glycolysis it is broken down and resynthesises ATP. Each glucose molecule can resynthesise 36 ADP molecules into ATP. Glucose either circulates in the blood or is stored in the muscles and the liver as glycogen.

Glucagon and Insulin

Glucagon and insulin are both hormones, which control the amount of glucose in the blood stream. Glucagon stimulates the liver to oxidise glycogen and release glucose while insulin counters this and stimulates the muscle and liver to store excess glucose.

Starch

In plants glucose exists in two forms, alfa-glucose and beta-glucose. Glucose monomers (single) maintain the ability to change between the two forms until like monomers are synthesised and linked together to form polymers (multiple). Alfa-glucose forms polysaccharide starch (starch) while beta-glucose forms polysaccharide cellulose (cellulose). Many starch molecules form the starch grains that are commonly found in foods such as potatoes. Cellulose is primarily used as the structural component of cell walls in plants. It can only be used by some organisms for energy where as starch is widely utilised by higher organisms.

Factors which influence the GI

Gelatinisation (swollen from cooking) of starch: When some foods are cooked the starch in them expands. This in turn increases the surface area available for digesting enzymes and therefore increases the rate at which the food can be broken down. Gelatinisation is visible when comparing cooked and uncooked pasta.

Gain Consistency: As part of the digestion process grains are gradually broken down and processed. If the grain has been milled during the processing of the food then naturally the time taken to digest the food will decrease. This is common when comparing the GI of white bread (70) and a heavier wholegrain bread such as pumpnickel (46).

Starch Type (Amylose vs. Amylopectin): Amylose is a straight chain molecule. This limits the points where single glucose molecules can be broken away. Amylopectin has many branching points where individual glucose molecules can be separated. The branching of amylopectin allows multiple molecules to disconnect simultaneously thus increasing the GI.

Fibre Content: Fibre can act as a physical barrier between digesting enzymes and food. It can also increase the thickness in the digestion tract. In both instances digestion is slowed therefore reducing the GI.

Sugar Content: Sugar can restrict the gelatinisation of starch by binding water molecules together therefore preventing water from entering.

Fat Content: Fat slows the rate at which food is emptied from the stomach into the intestine. This gives some foods a misleading GI. An example of a food with a high fat content yet a low GI is sausages (28).

Protein, Fat and Anti-nutrients: These may either slow or inhibit starch from being digested.

Manipulation the Glycaemia Index for Increased Sport Performance

With the knowledge of how and at what rate food is digested it is possible to manipulate consumption in order to gain the maximum benefit. The three key nutritional factors that will affect swimmer's performances are:

- 1 – Ensuring adequate fuel is available prior to and during training
- 2 – The ability to recover and replenish muscle and blood glycogen stores
- 3 – Maintaining low fat consumption

The intake of foods with low GI ratings can be timed in order to ensure that glucose levels are at their peak during training and competition. They can also be manipulated so that glucose is continually released into the bloodstream during training therefore increasing performance.

Foods with a high GI (while still low in fat) can be utilised to aid in recovery after training. It is well known that cells are more receptive in the first 20 minutes after exercise. A food with a high GI will be able to release glucose into the bloodstream quickly and replenish muscle and liver glycogen stores as well as also provide the required molecules for the resynthesising of all ATP stores. This practise will reduce the effect of fatigue and allow swimmers to return to training faster fully replenished.

Sample Training Eating Plan

Wake up 5:00am

Before Training

Eat **medium** GI food (Nutri Grain 66)

WHY: Training is 2 hours long, however starts in only 30minutes from eating time. A low GI food might not start digesting in time and sit in the stomach while a high GI food won't last through training.

During Training

Drink plenty of fluid maybe have on hand a **high** GI food (rice cakes 82 and honey 87 aver 84.5) to eat during training if glucose stores become excessively depleted from high intensity training.

After Training

Eat **high** GI food within 20 minutes (breakfast bar 78) of finishing exercise.

WHY: Cells are highly receptive to glucose in the bloodstream and recovery time will be decreased.

Before School

Eat **low** GI food (toasted muesli 43)

WHY: Avoid high glucose spikes while lightly active in class. Ensure that glucose is released slowly over the course of the day. Maintain awareness and energy levels.

Recess

Eat **low – medium** GI food (Banana 55, JATZ 55)

WHY: Continue to maintain constant energy supply without large fluctuations.

Lunch

Eat **low** GI food (pita bread 57 with mixed filling)

WHY: Aim to continue gradual release of blood glucose by taking into account the lengthy time until afternoon tea. High GI foods will release glucose too fast finishing before school is done and the next meal opportunity is available.

Afternoon Tea

Eat **low – medium** GI food (2 – Minute Noodles 46)

WHY: Aim to prepare for the up coming two hour training session.

During Training

Eat **high** GI food (jellybeans 80 and Sports Drink) and drink plenty of fluid.

After Training

Eat **high** GI food (Muesli Bar 61 or breakfast bar 78 and sports drink) within 20 minutes of finishing training

Dinner

Eat **low** GI food (spaghetti 37)

WHY: Eating a high GI food may stimulate your body to store excess glucose as fat. Due to the low energy expenditure during sleep it is important for weight control to avoid eating high GI foods prior to going to bed.

Implementing the Glycemic Index

Athletes can implement the Glycemic Index by simply monitoring when they eat certain foods. Changing the times some foods such as potatoes (85) and white bread (70) are eaten will have a sudden impact on performance. With the introduction of the GI Symbol program it will become easier for athletes and swimmers to make the right decision for their personal nutritional strategy.

Glycemic Index

All Bran	42		
Angel Food Cake	67		
Apple	38		
Apple Juice (Unsweetened)	40		
Apple Muffin	44		
Apricots (fresh)	57		
Bagel	72		
Baked Beans	48		
Banana Cake	47		
Banana	55		
Barley	25		
Basmati white rice boiled	58		
Beetroot	64		
Bengal gram dahl	54		
Biscuits			
Digestive plain	59		
Gram Wafers	74		
Oatmeal	55		
Milk Arrowroots	69		
Morning Coffee	79		
Rich Tea	55		
Shredded Wheatmeal	62		
Short Bread	64		
Vanilla Wafer	77		
Black Bean Soup	64		
Black Beans, boiled	30		
Black Gram, soaked and boiled	43		
Black bread, dark rye	76		
Blueberry	59		
Bran			
Oat Bran	55		
Rice Bran	19		
Bran Buds	58		
Bran Muffin	60		
Breads			
Burgen (oat and honey)	31		
Dark Rhy	76		
French Baguette	95		
Fruit Loaf	47		
Gluten Free Bread	90		
Hamburger Bun	61		
Kaiser Roll	73		
Light Rye	68		
Linseed rye	55		
Melba Toast	70		
Pita Bread	57		
Ploughman's Loaf	47		
Pumpnickel	41		
Riga Sunflower and Barley	57		
Rye Bread	65		
Sourdough rye	57		
Vogels (honey and oats)	55		
Vogels Roggerbrot	59		
White	70		
Wholemeal	69		
Wonderwhite	80		
Bread stuffing	74		
Bread Fruit	68		
		Breakfast Cereals	
		All Bran	42
		Oat Bran	55
		Rice Bran	29
		Corn Bran	75
		Bran Buds	58
		Breakfast Bar	78
		Cheerios	74
		Coco pops	77
		Corn Chex	83
		Cornflakes	84
		Crispix	87
		Mini Wheats	58
		Muesli non-toasted	56
		Nutri-Grain	66
		Oat Bran	55
		Puffed wheat	80
		Rice Bran	19
		Rice Bubbles	83
		Rice Chex	89
		Rice Krispers	82
		Shredded Wheat	67
		Special K	54
		Sultana Bran	52
		Sustain	68
		Team	82
		Total	76
		Vita Brits	69
		Wheat-Bix	69
		Wheatbites	72
		Breakfastbar (fibre plus)	78
		Breton wheat crackers	67
		Broad Beans	79
		Buckwheat cooked	48
		Bulgur cooked	48
		Bun hamburger	61
		Butter beans boiled	31
		Cakes	
		Angel food cake	67
		Banana cake	47
		Flan	65
		Pound Cake	54
		Sponge cake	46
		Calrose white rice	87
		Capellini pasta	45
		Carrots	49
		Cereal Grains	
		Barley	25
		Buckwheat	54
		Nulgur	48
		Couscous	65
		Maize	
		Cornmeal, wholegrain	68
		Sweet Corn	55
		Taco shells	71
		Millet Ragi	71

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Lucozade	95	Pinto beans canned	45
Lungkow	26	Pinto beans soaked	39
Macaroni	45	Pizza cheese and tomato	60
Maize		Plums	39
Cornmeal wholegrain	68	Popcorn	55
Sweet corn	55	Porridge	42
Maltose	55	Potatoes	
Mars bar	68	Fries (fine cut)	75
Melba toast	70	Instant potato	83
Millet	71	New boiled	62
Mini Wheats	58	New canned	61
Morning coffee biscuits	79	Pale skin boiled	56
Muesli, cereal		Pale skin baked	85
Toasted	43	Pale skin mashed	70
Non-toasted	56	Pale skin steamed	65
Muffins		P.S microwaved	82
Apple	44	Crisps	54
Bran	60	Pretzels	83
Blueberry	59	Pumpkin	75
Noodle 2-minute	46	Rice vermicelli	58
Nutri-grain	66	Rich tea biscuits	55
Oat Bran & Honey loaf	31	Rock melon	65
Oat bran	55	Roggenbrot bread	59
Oatmeal biscuits	54	Roll Kaiser	73
Parsnips boiled	97	Romano beans	46
Pasta		Sausages fried (high fat)	28
Capellini	45	Semolina	55
Fettucini	32	Short Bread biscuits	64
Gnocchi	68	So Good	31
2-minute	46	Soya beans canned	14
Linguine (thick)	46	Soya beans boiled	18
Linguine (thin)	55	Spirali durum cooked	43
Macaroni	45	Split pea soup	60
(with cheese)	64	Sponge cake	46
Ravioli	39	Sucrose	65
Rice pasta brown	92	Sultana Bran	52
Spaghetti white	41	Swede peeled boiled	72
(wholemeal)	37	Sweet corn	55
Spirale	43	Sweet potatoes	54
Star Pastina	38	Tapioca boiled	70
Tortellini	50	Taro	54
Vermicelli	35	Tomato soup	38
Pastry flaky	59	Tortellini	50
Pea and ham soup	66	Vermicelli	35
Peanuts	14	Vitari	28
Peas green	48	Waffles	76
Pelde brown	76	Yam boiled	51

This table has been reproduced and modified from *Pocket Guide to the G.I Factor and Sports Nutrition*

BOOKS

Brand Miller J. Colagiri S. Foster Powell, *The G.I. Factor*, Hodder & Stoughton Book, Australia, 1996

Curtis H., *Biology*, Worth Publishers, New York, 1979

O'Connor H. Brand Miller J. Colagiri S. Foster Powell, *Pocket Guide to The G.I. Factor and Sports Nutrition*, Hodder & Stoughton Book, Australia, 1997

Articles

Brand Miller J. Colagiri S. Foster Powell, *The G.I. Factor*, Swimming in Australia, May-June, 1999, pages 5-13

Brand Miller J. *The G.I. Factor Part 2*, Swimming in Australia, July August, 1999, pages 7-14

Internet Resources

<http://www.indstate.edu/thcme/mwking/diabetes.htm> DATE ACCESSED 15/7/02

<http://dogwood.botany.uga.edu/~darlev/btnv1210/Sept18Fri.htm> DATE ACCESSED 15/7/02

www.glycemicindex.com DATE ACCESSED 16/7/02

www.gisymbol.com DATE ACCESSED 16/7/02

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