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EVERYTHING YOU NEED TO KNOW ABOUT CARBOHYDRATES

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Everything You Need To Know About Carbohydrates

Carbohydrates, love them or hate them, have been a topic of controversy in the last few years, as the media and public health look to find another nutrition bad guy. The 80's advocated low fat diets and now carbohydrates are public enemy number one.

Carbohydrates are separated into 3 different types: monosaccharides, disaccharides and polysaccharides.

- **Monosaccharides**: Glucose, fructose, galactose
- **Disaccharides**: Sucrose (table sugar), maltose
- **Polysaccharides**: Starch, glycogen, cellulose

Glucose is the main fuel source for the brain and the body, and even during periods of fasting or carbohydrate restriction, the body can synthesise glucose from certain amino acids, **glycerol** and **lactate**. So even though glucose is an essential fuel source, dietary carbohydrates are not necessarily essential to consume.

Fructose is commonly known as fruit sugar and like glucose is a monosaccharide. The only difference is the arrangement of the molecules as both glucose and fructose contain 6 carbons, 12 hydrogens and 6 oxygens. This different structure does however mean fructose is digested very differently to glucose. Fructose must be metabolised by GLUT4 instead of GLUT5 and must go through the liver. This makes fructose lower GI than glucose, as it requires more digestion.

There is much controversy around fructose consumption and liver disease, diabetes and liver cancer. Research often looks at **free fructose consumption**, rather than fructose contained within fruit. When consumed in large amounts in free forms, for example, fizzy drinks and processed foods, fructose has the potential to cause fatty liver disease and cirrhosis.

***Take home* – Advising to avoid fruit because of fructose is not evidence based to improve health, but avoiding free fructose consumption is a prudent dietary strategy.**

When frustose is combined with glucose you get sucrose, which is otherwise known as table sugar.

Contrary to popular belief, it is very rare for carbohydrates to be stored as body fat. When you ingest glucose, it is preferentially oxidised or stored in muscle as glycogen and in periods of overfeeding, dietary fat is stored and carbohydrate oxidation is increased to compensate for increased energy intake.

This is part of the science behind a client refeed day, keeping carbohydrate high and fats and protein low aid in replenishing muscle and liver glycogen, while minimising the amount of fat that will be stored.

How many carbohydrates should I be eating?

This is a very specific question that there is no one answer to. Glycogen is the human body's way of storing multiple chains of monosaccharides (in plants known as starch). The body has three ways in which it can store glycogen; **in the liver, the blood and in muscle**.

The liver can hold up to 100g of glycogen, the blood approximately 0.9g per litre and depending on how much muscle mass you have, skeletal muscle can hold up to 800g of glycogen.

Why is this relevant?

Firstly, we need to understand a bit about energy systems. When we are at rest or doing light exercise, our bodies will mainly be using aerobic respiration, higher intensities lasting 10 seconds to 3 minutes. The body will be anaerobically metabolising glycogen or available carbohydrate, and under 10 seconds we will be using stored phosphocreatine.

Fructose is far more effective at restoring liver glycogen than glucose. Glucose is more effective at restoring muscle glycogen

How much carbohydrate you need should be tailored to the amount of time you spend using each energy system. If you are a football player doing lots of sprinting, stopping and running, or a cyclist doing prolonged medium to high-intensity exercise, you may need the upper recommendation of carbohydrate.

Here is a rough guideline for different activity levels:

- **Stay alive:** 0g per kg
- **Optimal health:** 1-4g per kg
- **Muscle gain:** 2-6g per kg
- **Fat loss:** 1-3g per kg
- **Performance:** 3-10g per kg

Now 10g per kg for a 70kg male would be the equivalent of 66 slices of bread, which is why it is so important to know your body and your own activity, preferences and sports specific goals.

There is much debate on the use of carbohydrates for sports like powerlifting and bodybuilding. If we look at basic biochemistry, carbohydrates fuel high-intensity exercise (anaerobic glycolysis), the body cannot metabolise ketones into ATP anywhere near as effectively as glucose and the process is expensive for the body, and gluconeogenesis (creating glucose from non-glucose stores) requires 6 ATP to produce 2 ATP.

For aerobic exercise, there is some interesting research into ketogenic diets, which are practically carbohydrate free. By restricting carbohydrate to such a degree, the body learns to spare muscle glycogen at a more effective rate than if dietary carbohydrate were available, and often performance can be maintained.

But why is this useful if you are not a marathon runner?

Well, periods of low carbohydrate availability can improve the body's ability to switch between different fuel systems, often known as "metabolic flexibility." With periods of carbohydrate restriction through the diet or fasting, the body can aerobically metabolise adipose tissue more easily, and when carbohydrates are ingested for sport-specific needs the body is more primed to produce ATP.

Does this supercede energy balance? No.

Can it be a useful way to improve overall health and energy efficiency? Probably yes.

All calories are created equally, but not all carbohydrates are created equally.

Even though carbohydrate is a broad term to describe different foods, the matrix in which they are contained can vary massively.

Amylose and **amylopectin**, **fibre**, **fructose**, **glucose**, **resistant starch**, and **glycemic index** are all words used when talking about carbohydrates. But what do they mean? And what do I need to know?

Amylose/Amylopectin: Amylose is straight and easily broken down, amylopectin is branched and harder to break down.

***Take home* – low amylopectin foods may be beneficial pre-workout or for GI issues**

Examples of low amylopectin foods:

- Long-grain rice
- Oats
- Quinoa
- Sweet potatoes
- Bananas
- Whole wheat
- Barley
- Beans
- Legumes

Fibre: Insoluble fibre (doesn't dissolve in water) e.g. wheat bran, cereals, nuts and certain seeds. Soluble fibre (attracts and is soluble in water) e.g. oats, barley, rye, fruit, vegetables, golden linseeds.

***Take home* – Insoluble adds bulk to stool and acts as roughage for the gut. Soluble can be fermented by the microbiota to form short-chain fatty acids such as butyrate and propionate.**

Resistant starch: Stored plant monosaccharides that resist digestion in the small intestine and make their way into the large intestine and can be fermented. There are 4 different types. Interestingly, type 3 resistant starch, such as cooked and cooled potatoes, contain fewer calories when prepared this way.

***Take home* – This could be a useful tool if you are on a low calorie diet or if you have a very large appetite.**

The blood sugar roller-coaster

High glycemic (GI), low GI, complex, simple, refined carbohydrate all have a different effect on the rate in which they raise blood glucose.

The Glycemic Index

SNACKS	GI	STARCH	GI	VEGETABLES	GI	FRUITS	GI	DAIRY	GI
Pizza	33	Bagel, Plain	33	Broccoli	10	Cherries	22	Yoghurt, Plain	14
Chocolate bar	49	White Rice	38	Pepper	10	Apple	38	Yogurt, Low Fat	14
Popcorn	55	Sweet Potato	44	Mushrooms	10	Grapes	46	Soy Milk	31
Energy Bar	58	White Bread	49	Onions	10	Kiwi	52	Skim Milk	32
Fizzy drink	72	Brown Rice	55	Green Peas	48	Banana	56	Chocolate Milk	35
Doughnut	76	Pancakes	67	Carrots	49	Pineapple	66	Yoghurt, Fruit	36

Lower GI carbohydrates tend to be higher in fibre and more satiating. However, the rise in blood glucose followed by the drop doesn't necessarily make you hungry. Low GI foods like vegetables, sweet potatoes, beans and oats not only contain fibre but also contain large amounts of water which aid in filling the stomach up and delaying gastric emptying, so the food is actually in your stomach longer.

As you can see, pizza and chocolate are both low GI. Does this make them healthy? Unfortunately not. So it's important to bear in mind that low GI does not always mean healthy, and high GI does not always mean unhealthy.

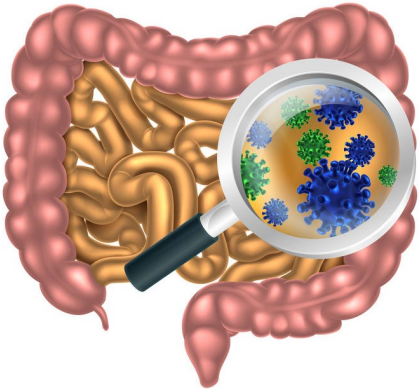
High GI doesn't necessarily mean that a carbohydrate won't fill you up. White potato is one of the highest GI carbohydrates, yet ranks highest on the satiety index, which is a measure of how filling a food leaves you.

The take home here, is that high GI carbohydrates are not inherently bad, neither are refined carbohydrates. Simple and high GI carbohydrates become more useful under certain circumstances, especially for active individuals. In the Peri-Workout window, high GI carbohydrates enable the body to ingest large amounts of carbohydrate with less fibre and overall food volume. So in the context of active individuals, high GI carbohydrates certainly have their place around the exercise window, for GI stress and speed of carbohydrate availability.

Fibre has a host of other benefits including bowel health, cholesterol management and weight management. So the bulk of carbohydrates in the diet should be whole grain and minimally processed, as this will have benefits on appetite, bowel, gut health and cholesterol. By eating higher fibre carbohydrates, the rise in blood glucose will occur more gradually and leave your blood glucose less erratic. Some scientists hypothesise that chronic elevation of postprandial (after eating a meal) blood sugar, especially in the context of a caloric surplus, will have negative health outcomes such as insulin resistance and diabetes.

Fibre also feeds your gut microbiome helping to maintain a healthy diverse gut flora. The gut houses 70% of all our immune cells so having a healthy gut is so important for staying healthy and warding off depression. There are several links between gut bacteria status and depression, and 90% of the hormone serotonin is actually made in the gut.

To maintain a healthy gut microbiome, studies show that including lots of variation in the diet is key. '*Eat the rainbow*' fits nicely here – purples, greens and oranges should be a staple in daily food intake. Resistant starch, as mentioned earlier, is fermented in the large intestine as a fuel source for the friendly bacteria.



The art of specificity

Some people may thrive with 50%+ of their calories from carbohydrate, and some may actually prefer little to no carbohydrate. Not everyone's blood glucose control, insulin sensitivity and metabolic rates are identical, so consider talking to a personal trainer, experiment with what intake works for you, and importantly, monitor your gym performance, satiety and overall how much you are actually enjoying your diet.

Adherence comes before all other factors in regards to fat loss because without it, a calorie deficit cannot be sustained.

Macronutrient splits are not the be all and end all in your diet or progress. Unless you are a bodybuilder deep into prep, or a competitive time trial or performance athlete, the composition of carbohydrate in the diet is completely variable. This is why there is no such thing as an optimum macronutrient split to follow. Carbohydrates in particular should be tailored to the activity and preferences of the individual.