The Nutrition Fundamentals: Part One

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THE NUTRITION FUNDAMENTALS

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WHAT IS PROTEIN AND HOW MUCH PROTEIN DO WE NEED

The three main macronutrients are protein, fats and carbohydrates, with 'macro' simply meaning large, and these are the nutrients that are most common in our diet. On the flipside, micronutrients are those that are in much lower quantities in our diet.

This article will look at protein and provide you with an understanding of the macronutrient and its importance in human health.

Protein

Protein is ***incredibly important***, and without it our body composition and health greatly suffer as a result.

Proteins are an essential nutrient and can be broken down into 20 building blocks known as amino acids. Out of these 20 amino acids, 9 are essential as the body cannot make them itself. This means that we must obtain these from the diet, through a variety of animal and plant-based sources. And yes, it is possible to source all of these from plant-based sources. The other 11 aminos can be synthesized by the body, making them non-essential.

The table below shows how protein can be broken down into its essential and non-essential amino acids.

ESSENTIAL AMINO ACIDS	NON-ESSENTIAL AMINO ACIDS
Histidine	Alanine
Isoleucine*	Arginine**
Leucine*	Asparagine
Lysine	Aspartic Acid
Methionine	Cysteine**
Phenylalanine	Glutamic Acid
Theronine	Glutamine**
Typtophan	Glycine**
Valine*	Proline**
	Selenocysteine**
	Serine
	Taurine**
	Tyrosine**

**Branched-chain amino acids*
***Conditionally essential amino acids*

Within the 9 essential amino acids, there are 3 branched-chain amino acids (BCAA's): leucine, isoleucine and valine. These are again different to the others as they do not require metabolizing by the liver, and are therefore taken up directly by skeletal muscle. Also, these 3 aminos are the most important for the manufacture, maintenance and repair of muscle tissue as they are responsible for the "flicking on" of the muscle building process, known as protein synthesis.

Of the three, leucine has shown to be the most effective amino at stimulating protein synthesis (the process of building muscle protein and therefore growth), yet the three work better together to provide a host of benefits and even boost energy during workouts. (1) (2)

Studies show that BCAA supplementation alone can blunt the catabolic hormone cortisol and decrease delayed-onset muscle soreness. (3)

Below is a table that shows the protein quantity in many of the common foods we eat:

ANIMAL PROTEIN FOODS	1G EDIBLE PROTEIN PER 100G IN WEIGHT	PLANT & DAIRY PROTEIN FOODS	1G EDIBLE PROTEIN PER 100G IN WEIGHT
Beef Topround Lean	36.12g	Pumpkin Seeds	32.97g
Pork Bacon	35.73g	Peanut Butter	25.09g
Beef Brisket Lean	33.26g	Cheddar Cheese	24.90g
Beef Steak Lean	31.06g	Monterey Cheese	24.48g
Beef Top Sirloin Lean	30.55g	Colby Cheese	23.76g
Pork Top Loin	30.48g	Peanuts	23.68g
Bluefin Tuna	29.92g	Mozzarella Cheese	22.17g
Turkey Bacon	29.60g	Almonds	22.09g
Chicken Dark Meat	28.99g	Pistachio Nuts	21.35g
Oyster	28.81g	Flaxseeds	19.50g
Beef Tenderloin Lean	28.51g	Tofu	17.19g
Turkey White Meat	28.48g	Egg Yolk	16.89g
Beef Kidney	27.27g	Cashew Nuts	15.86g
Halibut	26.69g	Hazelnuts	15.31g

ANIMAL PROTEIN FOODS	1G EDIBLE PROTEIN PER 100G IN WEIGHT	PLANT & DAIRY PROTEIN FOODS	1G EDIBLE PROTEIN PER 100G IN WEIGHT
Cooked Trout	26.63g	Walnuts	15.03g
Veal Cooked	25.93g	Fried Egg	15.03g
Beef Liver	25.51g	Soybeans	13.63g
Cooked Salmon	25.56g	Whey	13.10g
Goose	25.16g	Cottage Cheese	12.93g
Caviar	24.60g	Ricotta Cheese	12.49g
Lamb Cooked	24.52g	Pecans	11.26g
Freshwater Bass	24.18g	Lentils	9.50g
Flounder	24.16g	Wheat Bread	9.02g
Beef T-bone	24.05g	Acorn Nuts	8.80g
Hamberger 80% Lean	24.04g	Lima Beans	7.80g
Duck	23.48g	Macadamia Nuts	7.79g
Turkey	23g	Mungo Beans	7.54g
Pork Chop	21.91g	Cranberries	5.54g
Turkey Gizzard	21.72g	Green Peas	5.36g
Turkey Heart	21.42g	Ointo beans	4.86g
Anchovy	20.35g	Kidney Beans	4.83g
Lobster	20.50g	Yogurt	3.47g
Shrimp Moist Heat	20.92g	Non-Fat Milk	3.37g
Turkey Liver	20.02g	Whole Milk	3.22g
Alaska King Crab	19.35g	White Rice	2.69g
Chicken White Meat	16.79g	Brown Rice	2.58g

Therefore, we must resort to the research that can help us make the right decisions, yet it too seems to vary from source to source.

- **The average intake**

For a healthy person of a healthy weight who is mainly sedentary and not seeking changes in body composition – then an intake of 0.4 – 0.6 grams of protein per pound body weight is sufficient.

- **When losing body fat**

Protein has a high thermic effect, which means it requires more energy just to break it down, assimilate and digest than carbohydrates and fat. It also takes longer to digest, and has been shown to reduce appetite compared to carbohydrates and fat. (5) (6)

We also need protein to build muscle, which is very important when following a fat-loss diet. The more muscle you have, the more you'll burn daily, the less stair-climber sessions you'll need to do!

Having a high protein intake during a Calorie deficit is also important, as it is an anabolic nutrient, meaning we are more likely to preserve lean body tissue, which can sometimes be broken down when dieting. (9)

- **When building muscle**

The key to building muscle is a positive protein balance. This is achieved when protein synthesis exceeds protein breakdown. A higher protein diet will upregulate protein synthesis (provided you have evenly spaced meals), which creates a net positive protein balance, resulting in that anabolic (building) environment. (10)

The studies that look at muscle mass and protein intake tend to vary from 0.8-1.0+ gram per pound bodyweight, so it's safe to say a balanced approach would be most beneficial, so around 1g per pound bodyweight is highly effective. (11) (12)

- **Active and elderly**

Body composition goals aside, you may find some clients are highly active, through their jobs or activities (such as endurance training).

The research shows a daily intake of 0.5-0.65 grams per pound bodyweight for these types of people. (13)

Elderly people can also benefit from more protein to help prevent aging diseases such as osteoporosis and sarcopenia (reduced muscle mass).

The research shows a daily intake of 0.45-0.6 gram per pound bodyweight. (14) Finally, those recovering from injuries may also benefit from a higher protein diet.

Timing & Type

We have already discussed that we assess the quality of our protein sources via the BV, therefore the type of protein we ingest will improve the results we see.

We also know that animal protein sources are more effective than most plant-based sources, at stimulating muscle protein synthesis due to their digestibility (low-fiber) and amino acid profile.

Also, proteins that contain high levels of BCAA's, particularly leucine, will produce greater protein synthesis, improve insulin signaling and spare glucose in muscle cells.

Dangers Of A High Protein Diet

Many people will try and tell us that a high protein diet is bad for us, and that it is linked to cardiovascular disease, dehydration, calcium loss and damaged liver and kidney function.

The question that must be asked is – show us the accurate research.

The small amount of research that may support these dangers appears - just like many things in the nutritional world - to have been greatly exaggerated.

Here's what you need to know:

- **There is no link to protein causing increased risk of coronary heart disease (15),**

- **There is no link to protein causing liver or kidney damage in healthy subjects (15),**

- **Recent studies show a positive relationship between protein intake and bone health. (16)**

Summary

You should now understand the importance of protein in the human diet, how it is metabolized, how to measure quality, assess daily intake for various populations, compare protein types and de bunk some of the myths that surround it.

THE NUTRITION FUNDAMENTALS

ALL ABOUT FATS

Remember the macronutrients - protein, carbohydrates and fat? We've covered protein, now let's dive into fat.

This article will look at fat and provide you with a full understanding of this macronutrient.

Fat

Our acceptance of fats has come a long way in recent years, and this has been mainly driven by a wide array of research supporting their place in a healthy diet. In just a few short years the majority of us, including fitness professionals and athletes, can usually come to some agreement that certain fat in sufficient amounts can benefit body composition and health. (1) (2) (3)

Just like we have learnt with carbohydrates, it is the amount and specific type of fat we should eat that needs to be understood. (4)

Health authorities are accepting this change too, and we are being encouraged to increase our daily intakes in place of refined carbohydrates. Yet, of all the macronutrients, fat still seems to be the least understood, and many still associate fat-containing foods with weight gain, shame and in some cases, fear!

This is to be expected, with widespread marketing of low-fat products, low-fat diets that seem to be commonplace nowadays. A lot less attention is directed toward the widespread evidence that supports, nay recommends a regular intake of fats in a healthy diet. Therefore, it's important to understand the basic chemistry of fat, its key functions, how it is metabolized and to understand the latest research.

Another term for fat is 'lipids', which provides a collective name to a wide variety of water-insoluble chemicals, including all fats and oils in the diet and body.

Similar to protein and carbohydrates, fat is made up of carbon, hydrogen and oxygen, but the main difference is that the ratio of oxygen to the other molecules is lower. This results in fat being a more concentrated source of energy for the body and 1 gram of fat provides around 9 calories (compared to 4 kcal per gram for protein and carbohydrates).

Fat Types

Fat, or lipids, can be broken down further, so let's examine the various fat types and their definitions:

TRIACYLGLYCEROL OR TRIGLYCERIDES (TG'S)

The TG's are a glycerol 'backbone' molecule composed of three fatty acid chains. This is the most nutritionally significant fat as they are the main source of ingested fat and provide the majority of energy derived from dietary lipids. 1 gram of TG's provides 9 kcal per gram of energy.

GLYCEROL (OR GLYCERIN)

A three-carbon molecule that is part of the large TG's molecule (serves as the backbone). Glycerol by itself is a three carbon 'sugar' that when released from storage, can be recycled in the liver for the creation of new blood sugar. This process is known as 'gluconeogenesis'.

FATTY ACIDS

There are three major types of fatty acids. Their molecular bonds and the number of hydrogen atoms they contain distinguish these three types from one another.

Fat may be saturated, mono-unsaturated (possessing one carbon-carbon double bond) or polyunsaturated (having two or more carbon-carbon double bonds).

We can then break this down even further:

Saturated fat: is a lipid that consists of triglycerides containing only saturated fatty acids. This means all available carbon atoms are occupied (saturated) by the hydrogen atom, unlike unsaturated fat. This makes them the most stable and least likely to turn into free radicals when exposed to heat, oxygen or light. This is why it is suggested to cook with these types of fats, so think grass fed butters or coconut oil. (5)

While nutrition labels regularly combine the various saturated fatty acids, they do appear in different proportions among food groups. Lauric and myristic acids are most commonly found in ‘tropical’ oils or dairy products. Saturated fat in meat, eggs and nuts is primarily the triglycerides of palmitic and stearic acids.

The table below shows the saturated fat profile of common foods with fatty acids as percentage of total fat:

FOOD	LAURIC ACID	MYRISTIC ACID	PALMITIC ACID	STEARIC ACID
Coconut Oil	47%	18%	9%	3%
Butter	3%	11%	29%	13%
Cashews	2%	1%	10%	7%
Palm Oil	0.1%	1%	44%	5%
Soybean Oil	0%	0%	11%	4%
Salmon	0%	1%	29%	3%
Ground Beef	0%	4%	26%	15%
Egg Yolks	0%	0.3%	27%	10%
Dark Chocolate	0%	1%	34%	43%

POLYUNSATURATED FAT

Polyunsaturated fat are triglycerides in which the hydrocarbon tails constitutes polyunsaturated fatty acids (PUFA's) i.e. fatty acids possessing more than a single carbon-carbon double bond.

'Unsaturated' refers to the fact that the molecules contain less than the maximum amount of hydrogen, thus making them more unstable compared to saturated fats. These are usually liquid at room temperature.

From what we eat, we get two types of polyunsaturated fatty acids, linolenic acid (omega 3 fatty acid) and linoleic acid (omega 6 fatty acid).

MONOUNSATURATED FAT

Monounsaturated fats are triglycerides that have one single carbon-carbon double bond in the fatty acid chain, and all the other carbon atoms are single bonded.

Monounsaturated fat has a higher melting point than polyunsaturated fatty acids and a lower melting point than saturated fatty acids. They are also liquids at room temperature and semi solid or solid when kept cold.

Below you will find a table of high fat foods that their respective fat composition:

FOOD	SATURATED	MONO-UNSATURATED	POLY-UNSATURATED
COOKING OILS			
Canola Oil	8	64	28
Corn Oil	13	24	59
Olive Oil	7	78	15
Sunflower Oil	11	78	11
Soybean Oil	15	24	58
Peanut Oil	11	71	18
Rice Bran Oil	25	38	37
Coconut Oil	86	13	1

FOOD	SATURATED	MONO-UNSATURATED	POLY-UNSATURATED
COOKING OILS			
Cheese, regular	64	29	3
Cheese, light	60	30	0
Milk, whole	62	28	4
Milk, 2%	62	30	0
Ice Cream, gourmet	62	29	4
Ice Cream, Light	62	29	4
MEATS			
Beef	33	38	5
Ground Sirloin	38	44	4
Pork Chop	35	44	8
Ham	35	49	16
Chicken Breast	29	34	21
Chicken	34	23	30
Turkey Breast	30	20	30
Turkey Drumstick	32	22	30
Fish, Orange roughy	23	15	46
Salmon	28	33	28
Hot dog, Beef	42	48	5
Hot dog, Turkey	28	40	22
Burger, fast food	36	44	6

FOOD	SATURATED	MONO-UNSATURATED	POLY-UNSATURATED
MEATS			
Cheeseburger, fast food	43	40	7
Chicken Sandwich	20	39	32
Grilled Chicken Sandwich	26	42	20
Sausage, Polish	37	46	11
Sausage, Turkey	28	40	22
Pizza, Sausage	41	32	20
Pizza, Cheese	60	28	5
NUTS			
Almonds dry roasted	9	65	21
Cashews dry roasted	20	59	17
Macadamia dry roasted	15	79	2
Peanut dry roasted	14	50	31
Pecans dry roasted	8	62	25
Flaxseeds, ground	8	23	65
Sesame seeds	14	38	44
Soybeans	14	22	57
Sunflower seeds	11	19	66

FOOD	SATURATED	MONO-UNSATURATED	POLY-UNSATURATED
SWEET AND BAKED GOODS			
Chocolate bar	59	33	3
Fruit chews	14	44	38
Cookie, oatmeal raisin	22	47	27
Cookie, chocolate chip	35	42	18
Cake, yellow	60	25	10
Pastry, Danish	50	31	14
FATS ADDED DURING COOKING OR AT THE TABLE			
Butter, stick	63	29	3
Butter, whipped	62	29	4
Margarine, stick	18	39	39
Margarine, tub	16	33	49
Margarine, light tub	19	46	33
Lard	39	45	11
Shortening	25	45	26
Chicken Fat	30	45	21
Beef fat	41	43	3
Dressing, blue cheese	16	54	25
Dressing, light Italian	14	24	58

HYDROGENATED OR TRANS FATS

Hydrogenated fats are chemically classified as unsaturated fatty acids, yet behave more like saturated fatty acids in the body.

The term ‘hydrogenated’ means manufacturers infuse the chemical structure of the fat with extra hydrogen to bond to the carbon atom. This makes the fat solid at room temperature which essentially makes it a man-made saturated fat.

Unlike processed saturated fats, hydrogenated fats are poisonous to the body. When consumed, these fats replace normal saturated fat in the cell membrane, and sometimes the essential fatty acids as well.

Hydrogenated fats have been linked to increased risk of heart disease, diabetes, certain cancers and obesity. This is because they are pro-inflammatory in the body, reducing levels of good cholesterol (HDL) and increasing the bad (LDL & VLDL). (6) (7) (8) (9)

CHOLESTEROL

Cholesterol is another group of lipids that receives a lot of bad publicity. Cholesterol is a complicated topic and will therefore be addressed in a separate article.

Cholesterol is important as it is necessary for controlling hormones and cell function. However, it is not essential to receive it through our diets, as the liver can synthesize it internally. (10) (11) (12)

The Role Of Fats

FAT IS AN ENERGY SOURCE

Fat is the most energy dense macronutrient and it is also easily stored and transported within the body. The body can store unlimited amounts of fat, and excess carbohydrates and protein can be converted into fat, but they cannot be made from fat. It therefore serves as an excellent energy reserve. (13)

FAT FORMS THE MAJOR COMPONENT OF CELL MEMBRANES

Cell membranes, the outer walls of the cells, are partly composed of a specific type of fat called phospholipids.

INSULATES THE BODY FROM EXTREMES OF TEMPERATURE

Fat can protect vital organs by providing a cushion layer in cold environments.

APPETITE SUPPRESSANT

Eating more fat greatly increases satiety levels, making it difficult to overeat when compared with a high-carbohydrate diet. Therefore, you can eat less yet feel more satisfied in the process.

Despite fats containing over twice as many calories (9kcal per gram) compared to protein and carbohydrates (4kcal per gram), they will keep you much fuller for longer, and you will not need to each as much per sitting. (14) (15)

FAT IS A KEY PLAYER IN MANAGING INFLAMMATION

Fat that is typically found in fish contains the essential omega 3 fatty acids EPA and DHA, which are known to provide a number of health and performance benefits due to their highly anti-inflammatory properties.

From a health perspective these fatty acids appear to reduce the risk of heart disease and stroke, while from a performance aspect they can help to prevent muscle breakdown, enhance joint healing, improve brain function and achieve greater fat loss. (16) (17) (18)

Reducing inflammation within the body is one of the best things you can do when seeking optimal body composition and health. It ensures you are working with the body, and not against it.

FAT CAN IMPROVE THE HORMONAL PROFILE

It has now been proven that dietary cholesterol, such as that from fat, has little to no effect on cholesterol levels in the blood. In fact, quite the opposite can occur as a range of healthy fats can actually serve to improve our good cholesterol readings (HDL) (19) (20) (21) (22)

The benefits are clear and even the health authorities are accepting that monounsaturated fats can reduce the risk of cardiovascular disease, and that essential fatty acids (Omega 3 & 6) are required for life itself.

Even the once vilified saturated fat is now being re-classified as 'not so bad after all', which is great as it's necessary for proper cell membrane function.

FAT IS HIGH IN MICRONUTRIENTS

Many fats contain high levels of fat-soluble vitamins such as A, D, E and K. These vitamins are typically seen to be lacking within a low fat diet, yet are essential for maintaining good health and performance. Fat is also required to properly digest and assimilate these fat-soluble vitamins. (23) (24)

Fat is required for optimal cell function, and is a structurally integral part of every single cell membrane within the body.

Fat Metabolism

When we eat fats they are metabolized into short, medium and long chain fatty acids and glycerol.

Fats, due to being insoluble in water, require an aqueous environment. Excess fat is stored as triglycerides and can be found in the muscles, liver or adipose tissues to serve as energy for another time.

Below is a summary of how the body uses these metabolized fatty acids and the benefits associated with them:

SHORT-CHAIN FATTY ACIDS

These have 4 to 6 carbon atoms and they're always from saturated fat. They are also antimicrobial and serve as a great source of energy as the body can easily break them down. These fatty acids do not need bile salts to emulsify them as they can be directly absorbed from the small intestine and directed to the liver for energy conversion. Butter is an example of a short chain fatty acid.

MEDIUM-CHAIN FATTY ACIDS

These have 8-12 carbon atoms and also serve as great sources of energy while having an antiviral and antimicrobial property. Coconut oil is a perfect example. These fats are often used as supplements in sports and athletics as they are rapidly absorbed and are not stored as fat.

LONG-CHAIN FATTY ACIDS

These have 14 to 18 carbon atoms and just like other fats, regular consumption seems to bring numerous health benefits. Beef, cocoa powder and chocolate are example of long chain fatty acids.

VERY LONG CHAIN FATTY ACIDS

These have 20-24 carbon atoms. These are usually sources of unsaturated fats like EPA and DHA. Vegetable oils, nuts and avocados are perfect examples.

Fat Requirements

Just as with protein and carbs, there are a number of potential factors that will determine the ideal amount of fats in a person's diet.

There's no clear definition of exactly how much fat should make up someone's diet, as what might be right for one person may not be for the next.

An individual's optimal intake depends on age, gender, body composition, activity levels, personal preference, food culture and current metabolic health.

When looking at the metabolic processes and their ability to supply energy, it is very clear that fat is an essential component of everyone's diet.

These factors will determine what percentage of dietary fat is required, but we can also look at the current research to help us in making our decisions.

THE AVERAGE INTAKE

For a healthy individual seeking a balanced macro nutrient diet, no more than 25-30% of daily caloric requirements should come from healthy fat.

This can be broken down into the three different types:

- **30% of these should be consumed from monounsaturated fat**
- **30% of these should come from polyunsaturated fat (omega 3 & 6)**
- **No more than 30% should be from saturated fat**
- **Hydrogenated (trans) fat should be avoided at all costs (and is illegal in many countries)**

This means an intake for a typical 2500kcal diet would equal 83g of dietary fat per day.

WHEN FAT LOSS IS THE GOAL

We have typically seen recommendations for reducing fat intake when seeking fat loss. (25)

Recent studies have shown that a 'higher-fat, low-carbohydrate' may promote faster rates of weight loss than a 'higher-carbohydrate, low-fat'. If fat intake is well monitored and from mostly unsaturated sources, this weight loss can be accompanied by improved risk factors for conditions like cardiovascular disease and diabetes. (26) (27) (28)

IMPORTANT: The ketogenic diet (Very low-carbohydrate diet, high-fat) has become a very popular weight loss approach in recent years. This may provide benefits to you, however, it is important to ensure you are consuming 70-80% of your fat from unsaturated, wholefood sources. Many companies and "coaches" have been exposed for providing keto plans populated with streaky bacon at breakfast, fatty beef burgers at lunch and more red meat at dinner. This will increase your saturated fat intake and risk of high cholesterol!

WHEN SEEKING IMPROVED HEALTH

Aside from body composition, there has also been a narrative perpetuated that we need to avoid dietary fat as it may be linked to cardiovascular diseases by raising bad (LDL) cholesterol in the blood. This further led to the increased adoption of a low-fat, high carbohydrate diet, despite emerging research consistently contending these ideas.

The hard, inconvenient truth is that different people thrive following different approaches, and one is not the "Be All End All". In fact, many individuals enjoy and thrive when following a lower-carbohydrate, higher-fat diet, once fat intake is not excessively high and from whole food sources.

A lower-carbohydrate diet can provide many benefits for the following groups of individuals:

- **Overweight or obese**
- **Type II diabetics**
- **Those with metabolic syndrome**

From a health perspective, here's what we see from a higher-fat, lower-carbohydrate approach:

- **Blood sugar and insulin sensitivity improvements(29) (30)**
- **Triglycerides tend to go down (31) (32) – as long as fat sources are healthy**
- **Small, dense LDL (bad) cholesterol goes down (33) (34)**
- **HDL (good) cholesterol goes up (35)**
- **Blood pressure improves significantly (36)**

Summary

You should now understand the importance of fat in the human diet, how it is metabolized, how to measure quality, assess daily intake for various populations, compare the types of fat and de bunk some of the myths that surround it.

THE NUTRITION FUNDAMENTALS

ALL ABOUT CARBOHYDRATES

Remember the macronutrients - protein, carbohydrates and fat? We've covered protein and fat now let's dive into carbohydrates, the most controversial of them all!.

This article will look at carbohydrates and provide you with a full understanding of this macronutrient.

Carbohydrates

The term 'carbohydrate' (or saccharide which means sugar) comes from carbon, hydrogen, and oxygen-based molecules that are present in our foods e.g. fruits and grains but also vegetables and legumes.

Unlike essential amino acids and fatty acids, carbohydrates are not considered 'essential' because our body can change up the energy sources it depends on. This means we can obtain everything we need nutritionally from other food sources, so carbohydrates are not necessary to maintain life.

This has brought about much debate over the inclusion and requirement of carbohydrates in our daily diets and where they should fit into it. Some experts claim we do not need them at all in our diets, while others suggest they should never be excluded. This once again, is a case that is largely dependent on the individual and their lifestyle, goals and activity levels. We cannot make any blanket statements in nutrition! As a result, we now have a number of different dietary protocols based on how they manipulate carbohydrates in the body.

Dietary carbohydrate exists in three major classes: the monosaccharides, oligosaccharides and polysaccharides. Within these three groups, we can further break down the categories into specific carbohydrate types:

MONOSACCHARIDES (ONE SUGAR MOLECULE)	**DISACCHARIDES (TWO SUGAR MOLECULES)**	**OLIGOSACCHARIDES (TWO TO TEN SUGAR MOLECULES)**	**POLYSACCHARIDES (TEN OR MORE SUGAR MOLECULES)**
Glucose	Sucrose	Raffinose	Starch
Fructose	Lactose	Stachyose	Glycogen
Galactose	Maltose		Cellulose

Note: the carbohydrates are grouped into these categories due to the variations in their molecular structure i.e. 1-10+ molecules. This is why disaccharides are typically classified under oligosaccharides as they contain 2 molecules.

MONOSACCHARIDES

This is the simplest form of carbohydrate molecule, thus the term ‘mono’, meaning they only contain one sub-unit of sugar.

The three most important monosaccharides are glucose, fructose and galactose. These are known as ‘simple’ carbohydrates and are recognized by their sweet taste.

Glucose is the simplest form and final end product of complex carbohydrates and is the preferred fuel source for our brain, organs and working muscle. This is what is measured in blood at the doctor’s office.

Glucose is therefore easily used by the body and is has the three unique characteristics –

1. Used for immediate energy,
2. Stored within muscle or liver cells, as glycogen
3. Converted to triglycerides to be stored as body fat when energy intake is higher than we need

Fructose is another monosaccharide that has to be metabolized within the liver in order for it to be converted to glucose. This is found in many natural and artificial foods and is considered the sweetest of the carbohydrates, hence the popularity in food manufacturing. Over the years, fructose has undergone a lot of debate, and it has therefore been covered in a separate article.

OLIGOSACCHARIDES

When monosaccharides join together they form disaccharides (2 molecule bonds) and oligosaccharides (2-10 molecule bonds). These then become 'complex' carbohydrates and are commonly found in 3 main carbohydrates types: sucrose, lactose and maltose.

Sucrose is also known as table sugar and is therefore the most popular oligosaccharide. This carbohydrate occurs naturally in many of our foods (fruits, vegetables, beet sugar, cane sugar) and is essentially a combination of glucose and fructose.

Lactose is another common disaccharide, yet it only exists in animal milk from lactating animals, and is a combination of glucose and galactose. The body requires a special digesting enzyme called lactase to digest this type of carbohydrate.

The last important disaccharide is maltose, which is a combination of two glucose molecules. In nature this occurs during the sprouting of seeds, but it can also be artificially induced (known as malting) by the introduction of heat. This process is usually seen in the production of alcohol, as they use this carbohydrate to provide that sweet taste in products.

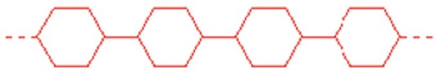
POLYSACCHARIDES

The last of the saccharide categories is polysaccharides, meaning a bonding of 10 or more molecules to form linear or complex chains.

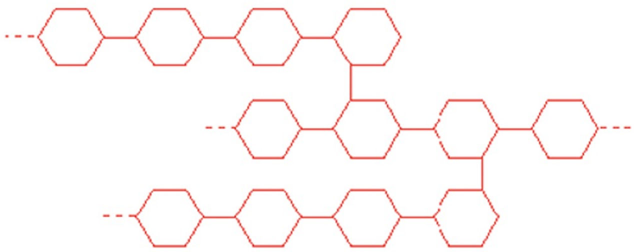
A homopolysaccharide is one that is made of 10 or more monosaccharides of the same type e.g. all glucose. A heteropolysaccharide is one that is made of 10 or more monosaccharides from two or more different monosaccharide types e.g. glucose and fructose.

When they are ‘branched’, this simply means they are bonded. The image below summarizes this information:

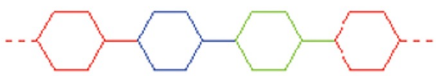
The last important monosaccharide is galactose. Just like fructose this carbohydrate molecule must be metabolized in the liver and will then be used in the same manner as glucose. Unlike the other two monosaccharides, galactose is not typically found alone in foods, but joined with other molecules to form disaccharides.



Un-branched (linear) homopolysaccharide



Branched homopolysaccharide



Un-branched (linear) heteropolysaccharide

Branched heteropolysaccharide

These types of saccharides are typically found in animal and plant sources, and the two main groups of polysaccharides are starch and fibre.

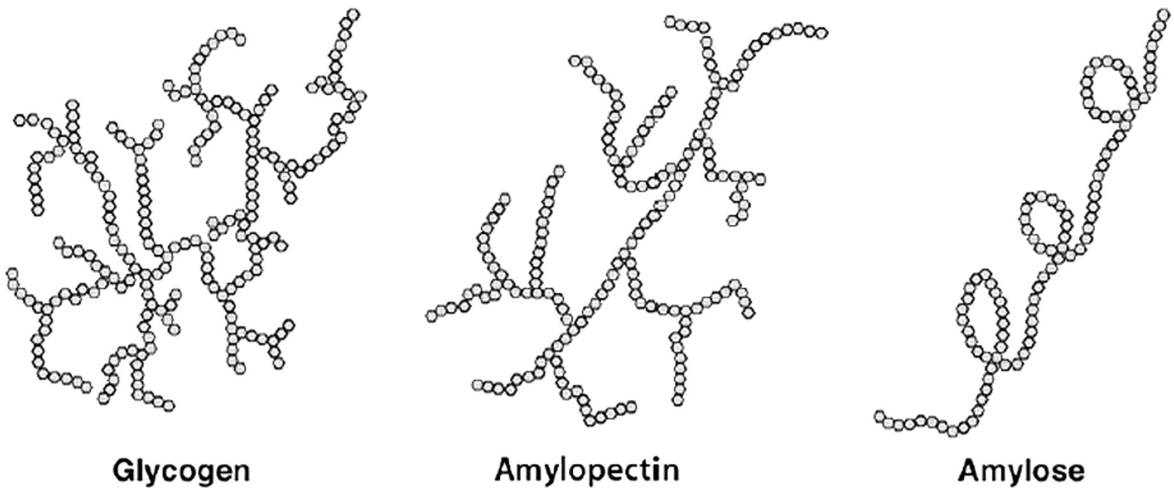
STARCHES

The starch molecule is the storage form of carbohydrates in plants e.g. grains, legumes, and potatoes. Within starch you have two forms: amylose and amylopectin.

Amylose is a linear chain containing hundreds of glucose units.

Amylopectin is a branched chain containing thousands of glucose units. Foods containing a high level of amylopectin tend to have a higher glycemic index, as they increase blood sugar levels the most due to their larger surface area (speeds up digestion – enters blood faster).

Starches that are not digested in the stomach (remain intact) are known as resistant starches, and may then be broken down in the gut to benefit gastrointestinal health. (1)



Note – Humans and animals store glucose energy from starches in the form of the very large molecules, glycogen. This is typically stored in muscle and liver cells and provides quick energy due to its highly branched nature. This process is known as glycogenolysis.

DIETARY FIBRE

Fibre is considered a non-starch, structural polysaccharide that is indigestible in the human digestive tract. Examples include pectin, gum and cellulose.

These fibres are found in plants, and despite the benefits to our health, they can only be broken down by the large intestine.

The Glycemic Index

The glycemic index or GI is a popular concept used to determine the effect of certain carbohydrates on blood sugar levels in the body. It therefore represents the metabolic response of the body to the carbohydrates we eat, and is classified into 3 groups:

1. Low GI foods = <55 GI value
2. Medium GI foods = 56 – 69 GI value
3. High GI foods = 70 or greater

Foods that have a low GI do not raise blood glucose levels as much, nor as fast as foods that have a high GI. The GI for a particular carbohydrate is primarily dependent on the rate at which the food (and carbohydrate) is digested, thus resulting in how quickly glucose appears in the blood stream.

The GI index ranking is based on a standard food such as white bread or pure glucose which is given the arbitrary GI of 100. To work out the GI of a particular carbohydrate, the carbohydrates 2-hour glucose response curve is compared with 50g of carbohydrates from the control food i.e. white bread or glucose.

There are a number of important factors that will affect the digestion rate of a carbohydrate, namely: the type of carbohydrate, the amount, fibre content and proportion of other macronutrients present.

The initial decision to create the GI was based on the studies showing that unstable (rising and falling) blood sugar responses to food are linked with poorer health outcomes e.g. insulin-resistance, prediabetes and diabetes. Recent research however, shows no correlation between the GI of a food and cardiovascular diseases but it is a great tool to highlight how various carbohydrates will impact blood sugar levels and how the body may respond based on this. (2)

Below is a table listing common carbohydrates and their respective GI:

FOODS	GI Value
LOW GI FOODS (<55)	
Apple	44
Pear	38
Banana (under-ripe)	51
Grapefruit	25
Barley	25
Navy Beans	38
Green Peas	48
Oat Bran (Quaker Oats)	50
Spaghetti (whole wheat)	37
Mashed sweet potatoes	54
Baked beans	48
Butter beans	44
Banana bread	47
Bread (sourdough)	52
Soy milk	31
Skim milk	32
Whole milk	27
Yogurt (sweetened)	33
Yogurt (plain, artificial sweetener)	14

FOODS	GI Value
MEDIUM GI FOODS (59-69)	
Apricots	57
Cantaloupe	65
Mashed Potatoes	70
Whole-Wheat Pita Bread	57
Whole-Wheat Bread	69
Couscous	65
Brown Rice	55
Cheese Pizza	60
Rye Bread	65
Hamburger Bun	61
Black Bean soup	64
Macaroni and cheese	64
Coca-cola	63

FOODS	GI Value
HIGH GI Foods (70>)	
Dates	103
Banana (over-ripe)	82
Parsnips	97
Corn Chips	72
Pretzels	83
White Bread	70
White Rice	72
Spaghetti (durum flour)	78
White rice (instant)	87
French baguette	95
Bagel	72
Bread Stuffing	74
Cheerios	74
Cream of wheat	71
Raisin bran	73
Fruit roll-up	99
Gatorade	78

Glycemic Load

The main problem with using the standard GI is that it only accounts for the type of carbohydrate and not the amount. Therefore, the glycemic load or GL was introduced to represent the glycemic index adjusted for the amount of carbohydrates, thus representing the quality and quantity.

The ranking system works similar to the standard GI, as the higher the GL, the greater the expected increase in blood sugar levels.

The GL is calculated by multiplying the GI of a food by the grams of carbohydrates per serving size. Therefore, foods with a greater amount of protein, fat or acidity, will help blunt the glucose response, improving blood sugar levels.

The glycemic load of a food can be classified into 3 groups:

1. Low GL = <10
2. Medium GL = 11-19
3. High GL = >20

Below is a table that shows some of the common foods that their respective glycemic load:

GLYCEMIC INDICES & GLYCEMIC LOADS OF COMMON FOODS		
FOODS	**GLYCEMIC INDEX**	**GLYCEMIC LOAD***
White bread	72	10
Whole wheat bread	72	8
Baked potato	111	33
Sweet potato	61	11
Carrots	35	2
Honey	69	15
Watermelon	72	4
Banana	62	16
Grapes	59	11
Apple	39	6
Cranberry juice cocktail	68	24
Yogurt (low fat)	27	9
Skim milk	32	4
Whole milk	41	5

**Glycemic load = glycemic index x carbohydrate content in 100g portions. Glucose is used as the reference and has a glycemic index of 100.*

The Role Of Carbohydrates

Carbohydrates have several important functions in the body -

1. Primary, and most efficient source of energy for the body and brain
2. Protein sparing and prevents ketosis
3. Source of B-vitamins for cholesterol metabolism
5. Type of carbohydrates chosen determine:
    - Fibre content of diet
    - Glycemic load of diet
    - Nutrient density & phytochemical content

Carbohydrate Metabolism

The metabolism of carbohydrates is a highly complex topic when examining it on a cellular level.

To simplify this, the cellular use of carbohydrates depends on their absorption from the gastrointestinal tract into the bloodstream, the activity and trained status of the individual.

In order to achieve this, all carbohydrates must be in the form of monosaccharides, so the body must break down polysaccharides and disaccharides through hydrolysis before absorption can occur.

Carbohydrates can be metabolized by 2 different pathways:

1. **Anaerobic pathway (glycolysis and glycogenolysis)**
2. **Aerobic pathway (oxidative)**

Carbohydrate Requirements

There's no clear definition of exactly how many carbs should make up someone's diet, as what might be right for one person may not be for the next. An individual's optimal intake depends on age, gender, body composition, activity levels, personal preference, food culture and current metabolic health.

When looking at the different metabolic processes and their ability to supply energy for athletic performance, it is very clear that carbohydrates are an essential component of an athlete's diet.

Therefore, people who are physically active and have more muscle mass, can tolerate and in fact, need a lot more carbohydrates than those who are sedentary. It's important as nutrition to be aware of the amounts of carbohydrates in an active person's diet, as it can have significant impact on the glycogen stores and therefore athletic performance.

Metabolic health is also a very important factor, as for those with metabolic syndrome, obesity or type II diabetes, the rules change significantly.

Those who fall into this category do not require nearly as much carbohydrates as healthier and more active individuals.

For those seeking fat loss and improved health (the majority improving their nutrition) a lower carbohydrate approach (meaning compared to the typical Western diet) appears to work well. (3) (4)

Studies show that lower-carbohydrate diets reduce appetite, which usually results in a lower energy (kCal) intake. (5) This phenomenon is in part, due to the appetite-suppressing effects of higher protein and fat intake (as they are used to replace the carbohydrates). And, because energy balance is key for fat loss, a lower-carbohydrate diet may help to increase fat loss too! (6) (7)

A lower carbohydrate diet can also improve health markers such as lowering blood sugar, blood pressure and triglycerides. (8) (9) (10).

REMEMBER: The low-carbohydrate diet is a roundabout way of reducing energy intake (kCal) by suppressing appetite, increasing the thermic effect of food (protein needs more energy to digest) and normalizing blood sugar (consistent energy). A lower-carbohydrate diet DOES NOT have magical effects that will help you lose weight when energy balance is not in check.

As mentioned, a lower-carbohydrate diet is a fantastic approach for some individuals, while for others, it is the last thing they want to do. It is important as a coach that each individual monitor how they react to this approach and to make changes if they are not enjoying it.

General Recommendations of Average Intake

Note – these recommendations are not for those who are endurance or strength training, and this is covered in a separate article.

- **HIGH-CARB DIET – 200G+ PER DAY (>5 g/kg/day)**

Some people do very well on a higher-carbohydrate diet, and some of my clients can eat 300-400g per day while still losing body fat. Most are not so lucky, and those who can, usually fall into the same category – young, lean, active individuals with high energy outputs.

If you do not tick those boxes the chances are that you will require less carbohydrates especially if weight loss is a goal.

- **MODERATE CARB DIET – 100-200G PER DAY (>3 g/kg/day)**

This is a very common daily carb range for the majority of active and healthy people looking to cut the body fat. This still allows for some starch in the diet, yet limits the amount quite significantly.

You still get all the benefits of having carbs in the diet (so we feel good and perform well), yet lower the intake and overall amount to therefore optimise fat burning (to look good).

- **LOWER-CARB DIET – <100g per day (< 3g/kg/day)**

This can be described as ketogenic diet (although it usually requires <50g/day)– one in which no starchy carbs (or very little) are consumed daily. This is when the body is forced to use fat for energy.

To do this, the person will go through a fat adaption phase, when the body releases ketones for muscle and brain fuel. This can be the most difficult part of such a diet as energy levels can significantly drop until this process is complete.

This energy slump is also common for those transitioning from, for example, a high carb diet containing high sugar and processed foods to a moderate carb diet plan.

Most people lose weight quickly on this type of plan, but it suits those who are inactive, diabetic or seeking that last bit of fat loss. A low carb diet also works better with females, as they carry much less bodyweight than men, meaning they require less energy as a result.

THE MAGIC 100

Without knowing or assessing someone, I typically suggest starting at 100g of carbohydrates (not including fibre) daily. This is a moderate amount of carbs for the majority of people and allows for ample amounts of starch too. It is in between a low and a high carb diet, and a good starting point for most to adjust as they need, based on results.

Adjustments should be gradual and calculated, unless you have greatly over/under-estimated their needs. Reduce or increase by 20-30g at a time.

Summary

You should now understand the importance of carbohydrate in the human diet, how it is metabolized, how to measure quality, assess daily intake for various populations, compare carbohydrate types and debunk some of the myths that surround it.

THE NUTRITION FUNDAMENTALS

WHAT IS DIETARY FIBRE?

Fibre is a complex carbohydrate made up of non-starch, polysaccharides, resistant starches and/or cellulose.

Dietary fibre used to be known as 'roughage', and refers to a group of substances in plant foods which humans do not possess the enzymes or digestive machinery to break down.

Previously it was considered that all fibre was completely indigestible and did not provide energy. Whilst this is technically true, we now know that some fibre types can be fermented in the large intestine by beneficial gut bacteria, which produce beneficial short-chain fatty acids (acetate, butyrate) and gases (methane, hydrogen and carbon dioxide).

It's these short chain fatty acids that can be used as an energy source if they enter the bloodstream.

Definition

Over the last number of years, a lot of attention has been given to defining dietary fibre, however this has been a challenging and controversial issue.

This is because fibre cannot be defined as either a single chemical entity or a group of related compounds. Also, different fibre types may have one or more physiological functions or health benefits, which makes it difficult to define them by health outcomes. Lastly, it is fully known whether fibre has positive effects only when it is contained within the food matrix, or whether it also functions when isolated. This has made it very difficult for authorities to truly define fibre.

In 2009, the international CODEX alimentary agreed on the following definition, and this is now recognised across Europe:

Dietary fibre consists of one or more of:

- **Edible carbohydrate polymers naturally occurring in the food as consumed;**
- **Carbohydrate polymers that have been obtained from food raw material by physical, enzymatic or chemical means and which have a beneficial physiological effect demonstrated by generally accepted scientific evidence;**
- **Synthetic carbohydrate polymers which have a beneficial physiological effect demonstrated by generally accepted scientific evidence.**

To summarize this, any edible carbohydrate polymers that occur naturally in foods should have evidence of a beneficial physiological effect, and this needs to be supported by generally accepted scientific evidence.

Up until this definition was created and accepted, the UK definition had been expressed as any non-starch polysaccharides (NSP's). NSP's are classified as the cell wall compartments of plants and include cellulose, hemicelluloses, pectins, lignin, gums, and beta glucagon.

The updated definition by CODEX highlights that there are often compounds that are not digested nor classified within the human tract. This therefore includes resistant starches, oligosaccharides and some micronutrients.

Many UK food authorities still use NSP's as a measure of dietary fibre.

Types Of Fibre

For many years, fiber was essentially separated into two classes, soluble and insoluble, both of which possess different nutritional benefits. However, recently, these have been replaced with the terms viscous and non-viscous. For simplicity, we will stick with soluble and insoluble fiber in this article.

SOLUBLE FIBRE (CAN DISSOLVE IN WATER)

This fibre type is very resistant to being broken down by the digestive enzymes in our mouth, stomach and small intestine. It is therefore partially digested in the large intestine, where good bacteria ferment it, producing butyric acid (found in butter) and acetic acid (found in vinegar). This helps the digestive system maintain its acidity and good health. (1) (2) (3)

The following types of fibre fall into this category:

1. Gums – are added to foods to help add texture and extend shelf life. Most importantly, they also slow down the absorption of glucose.
2. Pectins – are slightly acidic and aid in the absorption of certain minerals like zinc.
3. Inulin – is a prebiotic that feeds good bacteria in the stomach.

THE BENEFITS OF SOLUBLE FIBRE:

1. Reduced risk of cancer

Fibre helps remove any build up of cancer-producing compounds. As fibre is fermented into short chain fatty acids, this helps the colon maintain its pathogen killing acidity.

2. Lower LDL levels

As fibre is fermented into short chain fatty acids, this process also appears to result in a decrease in LDL (the bad) cholesterol levels. (4) (5) (6)

3. Stable blood sugar

Soluble fibre slows down the digestion time of foods, particularly starchy carbohydrates, thus reducing the release of glucose into the bloodstream.

Dietary fibre has also been shown to improve glycemic control which has an important role in managing diabetes. (7) (8) (9)

INSOLUBLE FIBRE

This is the most resistant fibre to digestion and is therefore passed through the digestive system intact. Its main role is to simply aid transport of other foods and liquids.

It does this by absorbing water and thus adding 'bulk' to our stools, making our faeces move faster through the intestines.

These types of fibre are typically lignin, cellulose or hemicellulose.

The benefits of insoluble fibre:

1. **Less constipation**

Insoluble fibre can support regular bowel movements, as it reduces transit time in the digestive tract. (10)

2. **Reduced risk of cancer and bowel disease**

By supporting regular bowel movement, it means the beneficial bacteria outnumber the harmful bacteria in our digestive tract. If this is not the case, putrefaction occurs, meaning toxic substances can build up and be reabsorbed in the body, This has been linked to bowel disease and certain cancers. (1) (2) (3)

Source Of Fibre

It's important to eat a wide variety of fibre containing foods, as the various components of dietary fibre are found in different proportions in different foods.

Below you will find a table that breaks down the various fibres into their components, further explanations and their ideal food sources. This is in line with the CODEX definition and therefore includes resistant starch, oligosaccharides and micro components:

FIBRE COMPONENT	DESCRIPTION	FOOD SOURCES
Cellulose	Polysaccharides comprising up to 10,000 closely packed units arranged linearly.	Grains, vegetables, fruit, nuts, cereal bran.
Hemicellulose	Polysaccharides containing sugars other than glucose.	Cereal grains, vegetables, fruit, legumes (peas, beans, chick peas, lentils) and nuts.
Lignin	A non-carbohydrate component associated with plant walls.	Foods with woody component, for example, celery and the outer layers of cereal grains.
Beta-glucans	Glucose polymers that (unlike cellulose) have a branched structure.	Mainly found in cell wall of oats and barley.
Pectins	A non-starch polysaccharide common to all cell walls.	Fruits & vegetables, legumes, nuts & potatoes.
Gums & Mucilage	Non-starch polysaccharides which are thick gel-forming fibres that help hold plant cell walls together.	Gums: Seeds and seaweed extracts; Mucilages: pysillium seeds. Gums and mucillages are used as gelling agents, thickeners, stabilisers & emulsifying agents.

FIBRE COMPONENT	DESCRIPTION	FOOD SOURCES
Resistant starch	Starch and the products of starch digestion that are not absorbed by the small intestines.	Legumes, potatoes, cereal grains
Oligosaccharides	Short chain carbohydrates of 3-9 monomers. These include fructo-oligosaccharides and galactooligosaccharides.	Onions, chicory, Jerusalem artichokes
Micro Components (waxes, cutin & suberin)	Micro components of the plant structures.	Cereal grains

How Much Fibre Should You Eat

The recommended average daily intake for fibre is at least 18g for adults and proportionally less for children.

Most people are not eating enough dietary fibre. The National Diet and Nutrition Survey reported that 72% of men and 87% of women were not meeting the recommended 18g of NSP's per day.

They suggested that the average intake was 15g for men and 13g for women per day.

MEASURING FIBRE

The UK food industry uses the Englyst method for determining the amount of fibre in a food. This method measures plant cell wall components of dietary fibre, referred to as non-starch polysaccharides (NSP's).

Other European and American countries use the American Association of Analytical Chemists (AOAC) method, which not only includes NSP's, but lignin and resistant starches too. Due to the additional categories, the recommended daily intake of fibre when using the AOAC is 24g.

There are current discussions at the European level to decide on the most appropriate methodology to ensure that the definition is applied consistently in the labeling of foods.

European regulations on nutrition and health claims state that, for a product to be 'source' of fibre, it should contain at least 3g of fibre per 100g or at least 1.5g per 100kcal.

A product claiming to be 'high in fibre' should contain at least 6g of fibre per 100g or at least 3g of fibre per 100kcal. (12)

Summary

Fibre is an important part of our diets, and we know high fibre foods tend to be healthier than the low-fibre alternatives.

Although we can see the benefits of including fibre in our diets, focusing specifically on the daily-recommended intake may not be required if eating a diet based around whole unprocessed foods. Reaching your daily needs for fruits and vegetables,, adding in regular intake of legume will ensure you get plenty of fibre

THE NUTRITION FUNDAMENTALS PART I **WORKBOOK**

Q1. PROTEIN CONSISTS OF HOW MANY AMINO ACIDS IN TOTAL?

Insert text here

Q2. OUT OF THOSE AMINO ACIDS, HOW MANY ARE CONSIDERED ESSENTIAL AND NON-ESSENTIAL?

Insert text here

Q3. WHAT ARE THE THREE BRANCH CHAIN AMINO ACIDS?

Insert text here

Q4. WHAT DOES THE BIOLOGICAL VALUE OF A PROTEIN REPRESENT?

Insert text here

Q5. DESCRIBE THE 3 KEY FUNCTIONS OF BODY PROTEINS?

Insert text here

Q6. A POSITIVE NITROGEN BALANCE MEANS WE HAVE HIGH LEVELS OF WHAT IN THE BLOODSTREAM/BODILY FLUIDS?

Insert text here

Q7. WHAT IS MUSCLE PROTEIN SYNTHESIS?

Insert text here

Q8. EXCESS NITROGEN IS LOST THROUGH WHICH BODILY PROCESSES?

Insert text here

Q9. WHAT IS THE RDI OF PROTEIN FOR SOMEONE WHO WANTS TO LOSE WEIGHT?

Insert text here

Q10. WHAT IS THE RDI OF PROTEIN FOR SOMEONE WHO WANTS TO GAIN WEIGHT?

Insert text here

Q11. WHICH AMINO ACID HAS BEEN SHOWN TO PROVIDE THE HIGHEST RATE OF MUSCLE PROTEIN SYNTHESIS?

Insert text here

Q12. THE MACRONUTRIENT FAT CAN ALSO BE KNOWN AS WHAT?

Insert text here

Q13. WHAT ARE THE 3 MAJOR TYPES OF FATTY ACID?

Insert text here

Q14. WHY SHOULD TRANS FATS BE LIMITED IN THE DIET?

Insert text here

Q15. NAME 7 KEY FUNCTIONS AND ROLES THAT FAT PLAYS IN THE BODY?

Insert text here

Q16. AT WHAT PERCENTAGE RATE OF TOTAL DAILY CALORIC INTAKE SHOULD FAT BE?

Insert text here

Q17. CARBOHYDRATES ARE CONSIDERED A 'WHAT' TYPE OF NUTRIENT?

Insert text here

Q18. DIETARY CARBOHYDRATES EXIT IN WHAT 3 MAJOR CLASSES?

Insert text here

Q19. THE GLYCEMIC INDEX (GI) IS USED TO DETERMINE WHAT?

Insert text here

Q20. WHAT IS THE DIFFERENCE BETWEEN THE GLYCEMIC INDEX AND THE GLYCEMIC LOAD?

Insert text here

Q21. FOR WHAT TWO DIFFERENT METABOLIC PATHWAYS CAN CARBOHYDRATES BE USED FOR?

Insert text here

Q22. WHAT KEY CONSIDERATIONS SHOULD YOU TAKE WHEN DETERMINING YOUR STARTING MACRONUTRIENT BREAKDOWN?

Insert text here

Q23. FIBRE IS A COMPLEX CARBOHYDRATE MADE UP OF WHAT?

Insert text here

Q24. WHAT ARE NON-STARCH POLYSACCHARIDES (NSP's)?

Insert text here

Q25. WHAT 2 KINDS OF DIETARY FIBRE ARE THERE?

Insert text here

Q26. WHAT IS THE RECOMMENDED AVERAGE DAILY INTAKE OF FIBRE FOR ADULTS PER DAY?

Insert text here

Q27. WHAT METHODS DOES THE UK FOOD INDUSTRY USE FOR DETERMINING THE AMOUNT OF FIBRE IN A FOOD?

Insert text here

Q28. A 'HIGH FIBRE' FOOD PRODUCT SHOULD CONTAIN HOW MUCH FIBRE PER 100G?

Insert text here

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