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EVERYTHING YOU NEED TO KNOW ABOUT FAT

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Fat has become almost synonymous with negativity, but dietary fat has many different roles within the body, such as sex steroid hormone production, immunity, energy reserves and joint protection.

There are 7700 calories of energy in 1kg of body fat (not 9000, as it also contains water), and with practically unlimited potential storage, body fat is by far the largest energy reserve. Body fat also fits every criterion to be classified as an organ, so fat is not just extra weight that you carry around.

Lipids are powerful mediators of the immune system, and chronically eating below 20% of your calories from fat can have detrimental effects on immunity for a lot of people. It is also the main storage of the hormone **leptin**.

Fats can be classed into six main subgroups:

Triglycerides
Triglycerides are made from 1 glycerol backbone and 3 fatty acids. They are often found in your blood after you eat a meal high in fat or carbohydrate. They are stored for energy release in your fat cells.

Cholesterol
Cholesterol is a key component of cell membranes along with phospholipids and is required for sex steroid hormone synthesis, bile production and Vitamin D synthesis. It is carried in the body by lipoproteins, LDL, HDL and IDL.

Saturated fats
Saturated fats contain no double bonds and are very long chain triglycerides, meaning they are all very stable and hard to break down. There is a lot of controversy over the role of saturated fats and heart disease pathology.

When they make up a large part of the diet, saturated fats do raise blood cholesterol. However, this is only one factor in the complex multitude of heart disease. It appears the ratio of saturated fats to other fats, such as polyunsaturated fats, may be more important than saturated fat alone (1).

Not all saturated fats are the same. The saturated fat in red meat and butter contains a high percentage of palmitic acid, which is consistently shown to raise blood cholesterol (2). But full-fat dairy, of which almost all the fat is saturated, contains stearic and myristic acid and is negatively associated with cardiovascular disease mortality. But again, it's not as simple as **palmitic acid=bad.**

Linoleic acid is one of our essential fatty acids, and research shows that if our diet has >4.5% Linoleic acid, the hypercholesterolemic effects of palmitic acid are reduced.

A note on trans fats

Trans fats are a type of unsaturated fatty acid which can be found in certain ruminant fats and CLA. They can also be man made by hydrogenating vegetable oils adding a pair of hydrogen atoms to make a compound e.g. to increase its shelf life.

Man-made trans fats are unanimously unhealthy for human consumption and should be avoided as much as practically possible due to their increase in LDL and lowering of HDL in the body. Trans fats are often grouped together with saturated fats, which is an unhelpful way to categorise them as saturated fats do not have consistently negative effects like trans fats.

Take home: While saturated fats in isolation are likely not harmful, they have not been shown to be cardioprotective, and they do raise blood cholesterol in the vast majority of people. Excessive consumption of animal fats should probably be minimised, in favour of monounsaturated and polyunsaturated.

Sources : Animal fats, butter, cheese, full-fat dairy, coconut oil and palm oil.

Monounsaturated fats

Monounsaturated fats contain the same structure as saturated fats with the inclusion of one double bond. This means they are still fairly stable but easier to break down than saturated fats.

Monounsaturated fats like olive oil and avocados are high in the fatty acid oleic acid, which is a type of omega 9 fatty acid. A high monounsaturated fat diet is now being recommended to prevent cardiovascular disease, as olive oil is a major constituent of the Mediterranean diet which is well known for being cardioprotective. Since polyunsaturated fats are more prone to oxidative damage and lipid peroxidation (the oxidative degradation of lipids), monounsaturated fats should be the choice for cooking.

Take home: Monounsaturated fats should make up a large portion of the fat content of your diet, due to their cardioprotective quality and stability in cooking.

Sources : Olive oil, avocados, peanuts and rapeseed oil.

Polyunsaturated fats

Polyunsaturated fats contain more than one double carbon bond (hence 'poly'). They are the least stable fatty acid, due to more double bonds being susceptible to oxidation, electron transfer and peroxidation (free radicals stealing electrons from within the cell membrane).

The two main types of polyunsaturated fat found in our diet are omega 6 and omega 3 fatty acids.

Omega 6 – Linoleic Acid (LA), Arachidonic Acid (AA) and Gamma Linoleic Acid (GLA).

Linoleic acid (LA) being the primary omega 6 fatty acid, is involved in the synthesis of AA and must be consumed in the diet, as it is not able to be synthesised by the body. It is also heavily involved in inflammatory regulation. It is thought that 1-2% of total dietary intake should be from linoleic acid.

Arachidonic acid (AA) is a major regulator of inflammation and is essential to initiate this process. AA is not a bad thing as often touted in the media. Inflammation is a natural part of homeostasis. Acutely, it is very useful as it serves to protect and repair the body. Chronic inflammation, on the other hand, is a very different matter and can lead to disease.

Gamma linoleic acid (GLA), unlike AA and LA, is actually involved in suppressing polyunsaturated fatty acid (PUFA) desaturation and is needed in the conversion of LA to AA (3). It is important to consider that certain things like smoking, stress, diabetes and ageing inhibit this transfer. Emerging evidence is showing anti-inflammatory benefits similar to that of fish oil in the elderly.

Polyunsaturated fats, in general, are very unstable when subjected to heat and oxidative damage, so oils like sunflower and safflower should not be heated to high temperatures. However, their cholesterol-lowering effects are more potent than that of polyunsaturated.

Sources : Sunflower oil, nuts, sunflower and pumpkin seeds.

Omega 3 - Alpha Linoleic Acid (ALA), Ecosapentanoic Acid (EPA), Docosahexaenoic Acid (DHA) and Docosapentaenoic Acid (DPA).

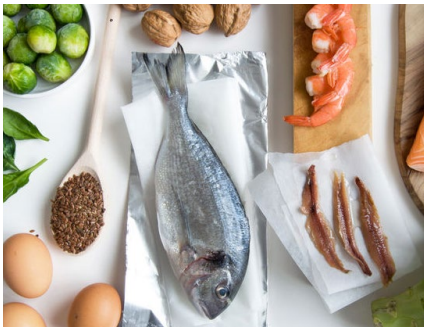
Alpha Linoleic Acid (ALA), like linoleic acid, is also an essential fatty acid that must be consumed through the diet, as it cannot be endogenously produced. ALA must be converted into EPA and DHA. The body has the enzymes to facilitate this, but the process only yields about 4% EPA and DHA from 100% ALA. This is why we must consume direct sources of both EPA and DHA.

Ecosapentanoic Acid (EPA) is a major regulator in anti-inflammatory processes within the body. It is key in producing resolvins which are responsible for initiating the resolving phase of chronic and acute inflammation (4). It aids in lowering triglycerides, is antihypertensive and can improve mood in certain populations.

Docosahexaenoic Acid (DHA), a major brain phospholipid makes up 8% of the total of your brain weight and is involved in neurogenesis, retina formation and memory (5). It is very important in pregnancy and early years of cognitive development in children. Supplementation of DHA during pregnancy and breastfeeding is linked to improved memory recall at 5 years of age in children.

DHA is a proposed natural supplement to reduce the pathogenesis of Alzheimer's. DHA reduces the production of the β-amyloid peptide, which is commonly believed to worsen Alzheimer's (6). DHA reduces neuroinflammation and brain oxidative damage which exacerbate the loss of function in the brain in patients with dementia (7). A decrease in DHA concentration in regard to AA compromise how fluid the membranes in our brain are, this makes them more rigid and can lead to dysfunction in the neurotransmitters that send messages in our brain, otherwise known as synaptic dysfunction.

Omega 3 has also been shown to improve the anabolic response to protein feedings, specifically in older populations. This is known as anabolic resistance.



By re-sensitising the elderly to protein, this will aid in the maintenance of lean muscle tissue, which can reduce the risk of falls.

Take home: Diets high in saturated fat and low in omega 3 can lead to impaired memory and an increase in LDL cholesterol. Skewing the ratio of omega 6 to 3 can result in increases in inflammation if other factors in the diet such as weight maintenance and adequate micronutrient status are not met. Almost everyone could probably benefit from eating more oily fish or taking an omega 3 supplement.

Does fat make you fat?

Since fat contains 9 calories per gram, it has over double the calories of both carbohydrate and protein. Does this mean fat is more likely to cause weight gain?

The short answer is NO.

In periods of overfeeding dietary fat is preferentially stored in adipose tissue, and carbohydrate oxidation will increase via gluconeogenesis (a process which occurs during periods of fasting, starvation, low carbohydrate diets or intense exercise).

Fat calories can add up quickly in a diet, 10ml of oil will contain almost 100 calories, and other foods like nuts, seeds, butter and certain meats can be very easy to over consume. This is why knowledge of calories is so important, eating fat will not necessarily lead to weight gain unless it leads to an energy surplus, there are hundreds of randomised controlled trials diets high in fat and high in carbohydrate, and under isocaloric conditions, weight loss is practically identical (8). If anything there is more evidence to suggest a diet lower in carbohydrate would be the better choice in weight loss diet (9).

The danger in overconsumption is when fat and sugar is combined in foods. No food will naturally contain this combination, the brain treats these foods as hyperpalatable and is more likely to increase consumption (10).

This is why messages like "sugar is bad" and "fat is bad" are very poor public health messages. Neither sugar or fat are solely responsible for the obesity epidemic. Overconsumption of calories and a lack of activity are. Obviously, it is far more nuanced than this and there are other very important factors such as genetics, relationship with food and hunger cues, but no macronutrient should be demonised in the fight against obesity.

The Ketogenic Diet

The Ketogenic diet or 'keto' diet has become increasingly popular in the last decade as the media look to blame something else for obesity, the current target being carbohydrate.

Ketogenesis is a state in which there is a lack of exogenous glucose in the diet, so the liver has to start creating ketone bodies such as beta-hydroxybutyrate and acetate to act as an alternate fuel source.

Your brain needs approximately 120g glucose per day to function, but this can be created endogenously by gluconeogenesis. So theoretically the need for carbohydrate is very small.

The main arguments for a keto diet are:

1. By keeping insulin low, free fatty acids (FFA) will be constantly liberated from adipose tissue and the body will become a fat burning machine
2. The need for dietary carbohydrate is not essential
3. Better appetite control
4. Curing of various diseases
5. Reversal of diabetes
6. Improved endurance.

Let's break down each of these claims with a critical approach:

1. Lipolysis is a transient process from the effects of insulin, so yes insulin does inhibit the release of free fatty acids from adipose. There is a difference between the FFAs being released and beta-oxidation (when they are actually burnt). We have hundreds of studies showing that even with repeated spikes in insulin (up to 9 times daily), if calories are controlled weight loss still occurs. Insulin's role is to take glucose out of the blood and transport it somewhere, by inhibiting lipolysis it makes sure the glucose doesn't go straight into adipose

2. Essential, what about optimal? By eliminating dietary carbohydrate, the variety of fruits, vegetables, whole grains and legumes is severely restricted. This means micronutrient targets will be more challenging to achieve, due to a lack of diversity. Resistant starch is also devoid from a ketogenic diet, which has been shown to negatively affect gut microbiota diversity. While not essential, dietary carbohydrate can confer significant benefits to health

3. While this is often reported in many studies, the mechanism is not fully understood. Insulin is actually linked with higher levels of satiety due to it being anorexigenic and signalling a positive energy status. Possibly in people with poor blood glucose control, keeping insulin and blood glucose lower, leads to fewer symptoms of reactive hypoglycemia which can aid in appetite control

4. The only pathology in which ketogenic diets have significant evidence is drug-resistant epilepsy, to which ketogenesis is able to markedly reduce seizures. There is a theory that because cancer cells can only feed on glucose, that ketosis acts as a way of starving them, but this has only been shown in vivo and not in vitro

5. There is very sound evidence for ketogenic diets improving insulin sensitivity, reducing body weight and improved blood glucose control. However, adherence to the ketogenic diet specifically is very low in comparison to moderate and higher carbohydrate approaches. You can achieve improvements in all the above markers by eating some carbohydrate

6. So this is perhaps the only claim with robust scientific evidence. By restricting carbohydrate and training for endurance, you will naturally upregulate mitochondrial biogenesis, gene transcription and AMPK activity. All of these pathways will increase the rate of fat oxidation. However, when you eat carbohydrate, you will increase carbohydrate oxidation and lower fat oxidation. The opposite is true for keto.

Carbohydrate is by far the most metabolically efficient fuel for high intensity exercise, as it can yield 10 times the amount of ATP through glycolysis. So if all your training consists of low intensity running (below 80% VO2 max), then yes maybe keto might work, but you can get the same results by just training with low carbohydrate availability, and then eating carbohydrate after your session.

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