

Ketogenic Handbook

A short and simple way of eating that will help you with obesity, type II diabetes and other diseases

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This text is intended to serve those who want to get started with ketogenic eating. For patients with diabetes and other diseases who want to get well and lose weight naturally, but also for those who want to avoid illnesses and health problems and want to be healthy and full of strength. I have tried to explain the principles of the ketogenic diet (ketodiet for short) and metabolism in a way that is easy to understand, but at the same time without resigning to a certain level of expertise, because I believe that only when we properly understand what is happening in our bodies, we will also find sufficient motivation to be able to eat properly in the long term.

The so-called ketodiet is essentially the oldest way our ancestors ate, even as hunters and gatherers. It is therefore not a fashionable novelty, but a return to our roots. A return to what is most natural for our bodies. By ketogenic diet I don't mean commercially prepared mixtures, various food supplements and programs. On the contrary, I recommend real food and basic ingredients.

There are three basic energy sources in food - protein, fat and carbohydrates (sugars), soluble and insoluble fibre, and then so-called micronutrients - vitamins, minerals and trace elements. The only thing we don't necessarily need that is not essential for life is carbohydrates. Yes, it's true that glucose is essential to life, as it serves as fuel for our cells along with ketone bodies, but we don't need to ingest it. The liver can make it as needed. The basic principle of ketodiet is very simple - the recommended amount of protein and fiber remains, but sugars are replaced with fats as an energy source. That's it.

The basic problem with the diet today is that the consumption of sugars, especially fructose, has increased tremendously, and at the same time we move much less in general, we are under more and more stress (e.g. We also eat a lot more industrially produced food (ultra-processed food), we are exposed to a lot of chemicals that have biological effects, called obesitogens, and all these things and more are causing us to get fatter, having more chronic diseases, and these are moving into younger and younger age groups. If we do not do something about it, then, on a personal level, we are likely to see diseases that will eventually increase and significantly shorten the period of a healthy life, but, in the sum of all of us, it will lead to the health system one day collapsing, the health system becoming unfunded, with all the consequences that this will bring.

The ketogenic diet works, I have seen it on myself, on my patients and there are already data available with large sets of patients who managed to cure their diabetes, significantly reduce their weight, adjust their blood pressure, reduce the amount of medication (e.g. Virta Health study). There are even published cases where patients have been cured of cancer thanks to ketodiet and fasting, or have significantly prolonged remission of the disease, or have significantly improved symptoms in Alzheimer's dementia, depression, anxiety, acne, polycystic ovaries, etc. The action is complex.

Everything is based on science. There are hundreds of papers and studies that confirm the positive effect of ketogenic eating on health. It is suitable for everyone, including children, except perhaps for those who have to follow special diets due to bowel diseases, and it is not recommended for pregnant and breastfeeding women (but there are women who have managed both on a ketodiet without the slightest difficulty). It is not a restrictive diet where one would suffer from starvation, but the opposite. Nor is it more expensive than the recommended way of eating (it is more expensive than the wrong way of eating).

So go ahead!

Basic concepts and principles.

What does ketogenic mean? What are ketones? And what are they good for? Our cells use **glucose** as their immediate fuel, which is produced by the breakdown of complex carbohydrates such as glycogen or starch, or by synthesis and conversion from other molecules (amino acids, glycerol, fructose). The second fuel for the cells is the so-called **ketoparticles**, which are formed by the breakdown of fats; these are beta-hydroxybutyrate, acetoacetate and acetone. Normally the body burns both at the same time in some proportion, when there is a greater influx of sugars the cells burn glucose, when we are more hungry between meals we switch more to burning fat and burn ketone bodies. With prolonged fasting, ketone particle burning dominates, but glucose is also present, which the liver synthesizes, because we have cells in the body that can't burn anything but glucose - red blood cells and some cells in the brain. The body can fully adapt to burning ketone bodies and it is even a more convenient source, less oxidative radicals are produced and the whole metabolism runs more smoothly, without significant fluctuations in insulin and glucose levels. The state where the body uses ketone bodies as an energy source is called **nutritional ketosis** and we should be in it for as long as possible. Burning ketone bodies instead of glucose is more beneficial to the body. Ketone bodies are anti-inflammatory, glucose is pro-inflammatory.

The main "switch" between these two sources is a hormone called **insulin**. Insulin is made in the pancreas and its production is stimulated by higher blood glucose levels. Hormones that are produced in the stomach and intestines - called incretins, GIP and GLP-1 - also play an important role in this and "kick-start" insulin production. Insulin serves as the key that unlocks membrane receptors for glucose to enter cells, mainly in the liver, muscles, adipose tissue and some other structures in the body, but it also has other effects in virtually every cell in the body. It causes glucose uptake into cells, glycogen synthesis (storage sugar), stimulates fat storage, protein synthesis, gene expression, DNA synthesis, amino acid uptake, stimulates the Na⁺K⁺ membrane pump, it is the main storage and growth hormone as it also blocks fat breakdown - lipolysis, the formation of new glucose - gluconeogenesis, blocks apoptosis and autophagy. Insulin is a vital hormone, when the pancreas does not produce it, type I diabetes (diabetes mellitus) develops. When cells have enough stored energy, they adjust their receptors to be so-called **insulin resistant**, not accepting additional nutrients and redirecting the flow of nutrients elsewhere. Thus, short-term insulin resistance is natural, even physiological in pregnancy and adolescence, even over a longer period of time.

But what if we have too many sugars in our diet, and repeatedly and for a long time? Insulin resistance and also hyperinsulinaemia (high insulin levels in the blood) becomes a chronic pathological condition that leads to fat storage not only where fat belongs - in the subcutaneous adipose tissue, but also where it largely does not belong - the liver, pancreas,

abdominal organs, blood vessels, tongue and upper palate, causing, for example, a disease called obstructive sleep apnoea. Insulin resistance syndrome is not necessarily associated with obesity (TOFI - thin outside fat inside, typically in Asian populations). This process leads to what is called metabolic syndrome, which is nothing but chronic insulin resistance syndrome - type II diabetes, obesity, impaired fat metabolism, hypertension, cardiovascular disease, but it also causes other pathologies that are not in the narrow definition of metabolic syndrome (sleep apnea syndrome, polycystic ovary syndrome, etc.). Insulin resistance also leads to poorer flow of other nutrients into the cells, impaired mineral transport, gene expression, and increased dysfunction of the mitochondria, those tiny cellular powerhouses, toxic products increase, glucose binds to proteins and impairs their function (glycation), and other pathological processes (methylation, oxidation, mitochondrial dysfunction, membrane dysfunction).

In different tissues, these processes manifest themselves differently. In the brain, for example, this dysfunction leads to a higher risk of neurodegenerative diseases, depression and anxiety; in children, it leads to behavioural and concentration problems; in the eyes, it increases the risk of cataracts and age-related macular degeneration, the most common cause of blindness; in the liver, it causes steatosis (fatty liver), liver inflammation and cirrhosis; it also increases the production of triacylglycerol and the synthesis of damaged lipoprotein particles (sd LDL), which in turn increase the risk of cardiovascular (heart and blood vessel disease) and cerebrovascular disease. At the level of the kidneys and blood vessels, it leads to high blood pressure - hypertension; in women it causes polycystic ovary syndrome and infertility, in men it reduces testosterone levels; it aggravates skin diseases - acne, psoriasis; it leads to ectopic fat storage and, of course, obesity, where people often fail to lose weight even with significant calorie restriction. The theory that body weight depends on the amount of calories in and out does not apply here, because it is a hormonal dysfunction.

Chronic insulin resistance, which is caused by long-term excessive intake of carbohydrates - sugars, thus has complex devastating effects on virtually all tissues in the body.

However, it is necessary to know that there are other triggers of this pathological process than just sugar. It is also **chronic stress, lack of quality sleep**, (note the vicious circle: insulin resistance - ectopic fat in the tongue and palate - sleep apnea syndrome - lack of quality sleep - high cortisol levels - increased sugar production in the liver - increased insulin - insulin resistance...and so on and so on). Another major factor is **chronic inflammatory conditions** including chronic infections (hence the horrible fatigue in chronic borreliosis) and certain **medications** (insulin, corticosteroids, diuretics, some antidepressants, etc). **Lack of healthy exercise** is also a major contributor to chronic insulin resistance and naturally increases with age, puberty and pregnancy (hence why many mothers develop gestational diabetes, gestational hypertension and the condition improves or resolves after childbirth). And also the long-term higher **intake of alcohol and fructose**, as the causative agent of hepatic steatosis, which leads to insulin resistance at the liver level. (Neither ethanol nor fructose directly raises insulin levels, only secondarily when they are converted to glucose, but it is mainly a dose-dependent mitochondrial poison.)

Symptoms of insulin resistance are: Cravings and cravings for sweets, feeling hungry even after eating or soon after eating, inability to tolerate hunger, fatigue after eating, irritability between meals, mood improves with eating, memory impairment, obesity, often unable to lose

weight even with low calorie intake, waist circumference greater than half of height, fatty liver, higher liver tests, high blood pressure, type II diabetes mellitus, high triacylglycerols and low HDL cholesterol, more frequent nighttime urination, urinating small amounts of urine, polycystic ovaries, dark skin in the neck and armpit area, small skin growths on the neck, armpits and elbow sockets, anxiety and depression, and other less common symptoms. Insulin resistance increases the risk of cancer and neurodegenerative diseases.

When we cut out carbohydrates - sugars - from our diet, which means not only sweets and sugary drinks, but also all pastries, rice, potatoes and pasta, and we significantly limit sweet and juicy fruits, which are high in fructose, we force our body to burn fat, to produce ketone bodies as the main energy source. This will decrease the amount of insulin produced (especially if we can also improve sleep, stress and move more) and we will begin to treat the cause of all the above increased chronic diseases. So we start to address the health problems at the root and not just affect the symptoms, which is what we do when we take medications for blood pressure, cholesterol, diabetes, depression, etc. The medications (except perhaps metformin) affect the symptoms, which of course is important, but we don't address the cause. That is chronic insulin resistance and other pathological processes in cells, their membranes and mitochondria, as mentioned above. It should also be noted that cancers of all kinds are also strongly associated with insulin resistance, although genetics and environmental toxins play a major role in most of them (cancer cells cannot burn anything but glucose). In autoimmune diseases, in addition to insulin resistance and genetic make-up, the gut microbiome, digestive tract and psychological state are also important contributors. All are interrelated. Our goal should not just be to lose weight. That's basically the least important thing, but to be metabolically healthy - to have a healthy gut, a rich and functional gut microbiome, a healthy, non-fatty liver and pancreas, not to have excess adipose tissue where it doesn't belong, to have normal sugar and lipid levels, unclogged blood vessels, normal blood pressure, not to lose muscle to stay active, to avoid neurodegenerative diseases, depression, sleep disorders, osteoporosis... Weight loss and maintaining a healthy weight will then come by itself.

Sugars and carbohydrates and how to get to know them

From a purely chemical point of view, these are synonyms. The words was created by naming the cumulative chemical formula of sugars $C(H_2O)$. The word sugar comes from the Latin "sacharum", meaning sugar. In general, "carbohydrate" refers to all types of sugars as well as complex sugars such as soluble and insoluble, digestible and indigestible fibre and starch. To be clear, by sugars we mean simple and easily digestible molecules - glucose, fructose, galactose and combinations of these. Glucose+fructose make up sucrose, our familiar table sugar, glucose+galactose make up lactose, which is found in milk, yogurt, and cheese (the more mature and fermented, the less lactose), glucose+glucose make up maltose - malt sugar.

Amylopectin is a digestible component of starch that consists of highly branched chains of glucose linked together, which we gradually break down during digestion. Starch is therefore a source of glucose (e.g. a serving of potatoes is energetically equivalent to 10 teaspoons of sugar, a serving of rice to 12 teaspoons of sugar).

The daily carbohydrate intake of a ketodiet should be up to 30-50 grams with as little as possible per individual serving, ideally up to 10 grams. Any food that contains carbohydrates (but we are not counting here the non-absorbable fiber that is food for our gut microbiome)

increases insulin, stops fat breakdown and abolishes nutritional ketosis. On the other hand, fibre is very important, the gut bacteria break it down to produce short chain fatty acids that are beneficial to us.

Fructose - the world's number 1 killer

Fructose is a fruit sugar, much sweeter than glucose, found in fruit, some vegetables and even honey. But mainly in sugary drinks, sweets and industrially processed foods (high fructose corn syrup). The problem is that we can't burn fructose directly. Our cells can't use fructose as an immediate source of energy, so we must first metabolize it - convert it into something else. Fructose must first be absorbed from the intestine, which costs us energy, then goes to the liver, where it is converted into either glucose or fat. Fructose is in fact somewhat toxic, or to put it another way, it is a dose-dependent mitochondrial toxin. The body tries to convert it as quickly as possible into something less harmful-glucose, which it uses as fuel, but a certain percentage of it turns into fat. And that fat is created and stored where it shouldn't be, which is in the liver. And if the amount of fat in the liver exceeds a certain threshold, it triggers the process of insulin resistance. Fructose has virtually the same metabolism as ethanol (the alcohol we drink in alcoholic beverages). Steatosis, steatohepatitis and cirrhosis of the liver are typical diseases of alcoholics. Today, twenty percent of adolescents and children have this disease (UK data). But they don't get it from alcohol, they get it from fructose, which they get in high doses in sweetened drinks and sweets generally from a young age. And it's even more complicated and pernicious. Because it turns out that fructose also affects our brains, causing what's called **leptin resistance**, which leads to the brain not being able to recognize that we're already full. We eat far more than we need and we're still hungry. Fructose is even produced endogenously in the body from glucose, with a large influx of sugars, but also with a large influx of salt, or chronic dehydration (you know the saying "hunger is thirst in disguise"). The effect of fructose in the brain seems to be one of the main mechanisms for the development of neurodegenerative diseases such as Alzheimer's dementia. And to make it even more complicated, many people, around 20% have what is called fructose intolerance. They can't absorb fructose properly, which leads to bloating, cramping, diarrhea. Very often fructose intolerance occurs together with lactose intolerance. In such affected people, another dangerous effect of fructose is the blockage of the metabolism of tryptophan, an essential amino acid from which the intestinal bacteria produce serotonin. Its deficiency leads to a higher incidence of depression, anxiety and sleep disorders. The gut is said to be a second brain. And it is.

To make matters worse, the metabolism of fructose produces large amounts of uric acid - the causative agent of gout and other pathologies. The level of nitric oxide - the main gas that causes relaxation of capillaries, blood vessels and bronchi - decreases. In addition, fructose damages the vascular lining - the glycocalyx, which makes the inner surface of blood vessels non-wetting. This is one of the reasons why people with diabetes and metabolic syndrome were the most at-risk population in the COVID 19 pandemic.

Sugar, especially fructose, can become a regular addiction and there is work suggesting that sugar/fructose, because it stimulates the dopaminergic centres in the brain responsible for craving/reward, may be a gateway drug for other addictions.

Fructose and leptin - or what helped our ancestors survive is killing us

Chronically increased fructose intake, as we discussed a few lines above, blocks the effect of leptin in the brain (especially in the hypothalamus). Leptin is a hormone that is predominantly produced by fat cells, signaling to the control centers in the brain that we are already full. The blocking effect of fructose on leptin sensitivity is demonstrable in virtually all mammals. In fact, it is one of the mechanisms that helps prepare for the fasting period, or hibernation. It causes a change in behaviour: excessive feeding, orientation towards foraging or risk-taking behaviour, fat storage, slowing of metabolism, energy conservation. It allows to gain weight quickly, not to lose reserves and to prepare for the hibernation period, or the period when there will be less food. These mechanisms help animals survive and helped our ancestors gain weight quickly by picking ripe fruits and berries. It's just that we don't have a period of starvation now, and we remain in a state of hyperleptinemia/leptin resistance and hyperinsulinemia/insulin resistance for long periods of time, causing all of the above mentioned diseases. Leptin metabolism is also related to other hormones and neurotransmitters such as melatonin and affects sleep, concentration, anxiety etc.

The flourishing of civilization was based on the development of agricultural production, the ability to grow, process and preserve food. You can say, of course, that traditional Italian or Japanese cuisine, for example, contains a lot of carbohydrates, and yet people in these countries live to a very old age. Yes, but that is only true for traditional cuisine and traditional ways of life. That means a diet with carbohydrates, but quite modest, mostly primary foods, no highly processed and industrialized foods, lots of vegetables and fish, lots of exercise, less stress, a healthy microbiome, etc. People remained insulin sensitive into old age despite the presence of carbohydrates in the diet. The ability to grow, process, and preserve starchy foods (rice, flour, pasta, potatoes) as a source of energy for a long time allowed them to survive even periods when meat and fat were not available.

What helped our ancestors to survive and led to the emergence of civilizations is now killing us.

Industrially processed food - ultra-processed food

As I wrote above, the ability to process and preserve food for a long time helped civilization develop and allowed our ancestors to survive. It was processed by cooking, baking, stewing, drying, grinding, freezing, salting, canning, etc. And it is clear that we cannot continue to do without it. But that does not mean that we have to eat everything that anyone makes and that there are no foods that are downright harmful. So what about the processing?

It can be said that only raw food is not processed. There is, for example, the NOVA system, which divides food into 4 categories according to the degree of processing. It is only grade 4 that is harmful to health.

1. Unprocessed or minimally processed foods (e.g. raw or peeled vegetables)
2. Cooking ingredients obtained from natural sources - oil, cane sugar, honey, spices...
3. Processed foods resulting from a combination of the first and second groups. This includes cooked, baked and gently prepared foods that we cook from primary sources, as well as basic baked goods, frozen fresh fish, dried foods, etc. Minimal additives and chemicals, just salt, spices, oil...

4. This group includes highly processed foods. These foods typically contain large amounts of added sugars, fats, starches, additives, various colours, flavour stabilisers, monosodium glutamate... They also include fried chips and croquettes, cakes, cookies, sweetened drinks and energy drinks, hot dogs, fast food, etc. Typically, these foods contain very little natural fibre, minerals and vitamins, and are either free of them or artificially added to them.

It's not just about what's in the food. What happened to the food before it went into our mouths is very important. It makes a big difference whether the potatoes are boiled or fried in sunflower oil, which contains omega 6 fatty acids, and at high temperatures, trans fats are produced that we cannot metabolise and are detrimental to health. Trans fats have been widely used since the 1920s (Procter and Gamble's Crisco margarine made from cottonseed oil). As early as the 1980s, information began to leak out that they were damaging health and causing cardiovascular disease and were responsible for up to 30,000 deaths a year in the US. How long do you think it took before the use of trans fats was banned and before companies like Procter and Gamble, Kraft, KFC, McDonald's were forced to change their manufacturing processes? 35 years! So we can define highly processed foods as those products that have a lot of added sugar, mainly fructose, added salt and fat, are processed by frying, whose basic structure has been interfered with and something has been removed (e.g. low-fat products) and something added - dyes, emulsifiers, stabilizers, artificial vitamins, glutamate, etc. These foods should be avoided.

Is cholesterol a killer? And is it good and bad? What are fats, anyway?

Fats are a natural source of energy and the so-called essential fats - a group of omega 3 and omega 6 fatty acids - must be consumed in the diet because we are unable to produce them. Dietary fats can be divided into saturated (butter, lard, coconut oil) and unsaturated fatty acids (olive oil, fish oil, sunflower oil, rapeseed oil, etc.) with short, medium and long chains, as well as cholesterol. The longer the chain, the slower it is absorbed from the intestine (already in the oral cavity, fats are broken down into individual amino acids and glycerol, absorbed in the small intestine and then travel further into the body via particles called chylomicrons). The fats, in the form of triglycerides, then go to fat cells where they can be stored or to the liver where they are packaged into lipoproteins and then transported into the body (VLDL and LDL particles).

Cholesterol is a vital substance. Without cholesterol, there would be no life. It is the building block of cell membranes, nerves, serves as a precursor for the production of vitamin D and various hormones. Cholesterol can be made by the liver itself. If we don't eat it, the liver makes it. When we eat it, liver synthesis is inhibited. Therefore, we don't need to limit our cholesterol intake.

Cholesterol does not float in the blood directly, but is packaged into lipoprotein particles - such transporters that are formed in the liver. Together with triacylglycerols, they travel in the blood to the tissues that need them.

There is no such thing as good and bad cholesterol. Cholesterol is cholesterol. What makes the difference are the lipoprotein particles that carry cholesterol from the liver to the tissues (LDL) and back (HDL). On a ketogenic diet, it may be that LDL cholesterol is elevated. But this may not pose any health risk. What is really dangerous to our bodies are the so-called

small dense LDLs. These are smaller particles that are disrupted, oxidized, glycated and pro-inflammatory. And because they are smaller, they can also penetrate the tiny capillaries that supply the blood vessels and deposit and form cholesterol plaques there. And yes, particles disturbed in this way are formed in insulin resistance and fatty, inflamed livers.

Unfortunately, sd-LDL levels are not yet commonly measured. The degree of insulin resistance and how bad our lipids are can be estimated from the Tg/HDL ratio, ideally it should be below 1.0. The higher the value, the greater the risk of insulin resistance and atherosclerosis. This is the most important parameter of the lipid spectrum.

And speaking of lab values. Surely we all know that fasting glycaemia is important and should be below 5.8 mmol/l. But this value alone, within the normal range, does not mean that we are metabolically healthy. In addition to this, we need to know our fasting insulin level, which should ideally be between 2-6 uIU/ml. The higher this value, the greater the risk of insulin resistance. There is also a useful calculation of the ratio of fasting insulin to fasting glucose - HOMA-IR, the result of which indicates not only insulin resistance (values above 1.5) and risk of diabetes, but also fatty liver (2.0-2.5). A calculator for HOMA-IR can be found online.

Adequate intake of omega-3 fatty acids (salmon, sardines, cod liver, flax, hemp and chia seeds, eggs, fish oil) and limiting intake of omega-6 fatty acids (sunflower oil, sunflower seeds, industrially processed foods with added fat) is very important for our health.

On a ketogenic diet, more fat is eaten as an energy source instead of carbohydrates. The amount of it depends of course on the overall activity, the amount of energy expended and also whether we need to lose weight or not. Also on our ability to produce bile. We don't have to calculate our fat intake in any particular way. If we want to lose weight, we don't add extra fat to our meals and consume it as part of our protein intake (fattier meats, buttered eggs, olive oil on salad, avocados, nuts, etc.), if we don't need to lose weight or have a higher energy expenditure, we add extra fat. We are guided by the feeling of satiety and hunger. If we are not hungry, we do not eat.

Nuts - pecans, almonds, walnuts, pistachios - are also natural and good sources of fat. Also various seeds - sunflower, pumpkin. But don't overdo it with nuts, it's easy to overeat them, especially the salted versions. They can also be poorly digestible, so it is advisable to blend them and use them in dressings, hummus, etc.

Ripe avocados are a very good source of healthy fats.

For frying we use saturated fats - lard, butter, clarified butter. If you don't like lard or are vegetarian, you can use canola oil, but don't overcook it. Olive oil, or other vegetable oils (pumpkin, sesame...) are used for cold cooking. It is also important that they are stored properly. Not only temperature but also light can lead to oxidation and degradation of the fatty acids contained in them.

What about protein?

In general, the ketogenic diet is not a very high protein diet. Especially when dealing with insulin resistance. Because every food triggers insulin to some degree. Least fats and vegetables. Protein, mostly lean meats and various protein products. That's why I don't recommend them. We opt for fattier meats and fattier fish. Also, too much protein is bad for

you. Firstly, to the kidneys, but also because the proteins we don't consume end up being metabolised into fat and stored. But beware, we normally struggle with a lack of protein in our diet, so we should make sure we get enough protein.

Daily protein intake should be between 1.2-2.2 grams per kilogram of ideal weight and 0.4 grams per kilogram per serving. Of course, the necessary consumption depends on the load (the higher the load, the more protein we need), age (in old age we need more protein, but again with respect to the kidneys), more protein is needed in puberty and pregnancy. If possible, we prefer organic sources of protein, meat from free-range animals, eggs from organic farms, free-range fish, or organic vegetable protein.

Animal proteins are complex and therefore preferred. We choose fattier meats because they are more filling and allow us to last between meals without snacking. We can also indulge to a lesser extent in secondarily processed meat in the form of bacon, sausages and ham, but pay attention to the quality and salt content, and do not overdo it with the quantity (large amounts of salt can trigger the production of endogenous fructose and burden the kidneys).

Important sources of vitamin D and omega-3 fatty acids are marine fish and seafood, such as cod liver, salmon, sardines, cod. Large fish such as tuna and swordfish can contain large amounts of heavy metals.

Eggs are a superfood, we can eat 2-4 a day. Ideally for breakfast, on butter or bacon, boiled, scrambled, etc.

Vegetable proteins: it is definitely advisable to alternate between animal and vegetable proteins, even meat is good for the body to take a break sometimes. A purely vegan diet is justified for many people for moral or religious reasons, but there are no health reasons for it. Some important amino acids (proline, creatine, taurine, carnosine), minerals (iron, iodine) and vitamins (B12, A, D) are missing or poorly absorbed in plants. A purely vegan diet that contains everything you need can certainly be put together, although it is not easy, but it will be a challenge to stay in nutritional ketosis. After all, the main sources of plant protein - legumes, soy, contain complex carbohydrates. They break down more slowly, but they can raise insulin. Plus, meat substitutes already fall mostly into the highly processed food category and can contain a lot of salt, hidden added sugars and omega-6 rich fats. Let's not forget that even super unhealthy foods-like potato chips, various cookies, and sugary drinks-are vegan. The most common problem with a vegan diet is the lack of bioavailable protein and the aforementioned amino acids, minerals and vitamins. Vegans are more at risk of anemia, osteoporosis, hair and tooth loss. Fermented soy - tempeh, tofu, legumes, mushrooms, nuts, hummus (chickpeas+tahini), yeast, seeds (sunflower, sesame, pumpkin..), spirulina, vegan protein powders from verified sources, preferably in organic quality, are also suitable as a source of vegetable protein. But beware, there are studies that state that up to 20% of organic foods have nothing to do with organic.

Pasta made from legume flour is a suitable alternative to classic pasta. However, if our main concern is to keep insulin as low as possible, we have to avoid pulses at least initially and use vegetable proteins such as tempeh.

What we don't like or what doesn't make us feel good - we don't eat.

Dairy products, are they healthy or not

Dairy products are generally a very good source of good quality fats, protein, calcium and other minerals. Rather, we should prefer forms with less lactose, such as kefir or mature cheeses, as lactose is a disaccharide - galactose and glucose. Therefore, more dairy products can also increase insulin and stop nutritional ketosis. The same applies here as with vegetables - if we don't like a certain type of dairy product, such as cream and milk in lactose intolerance, we avoid it. It is also advisable to alternate between sheep and goat products, not just cow products.

Fiber, soluble and insoluble, vegetables yes, fruits no?

The structure of plants is made up of a complex carbohydrate called cellulose. And we are unable to absorb and break it down into glucose, so it doesn't affect sugar levels. Cellulose, along with resistant starch and lignin, is an insoluble fibre. However, plants also contain mixtures of carbohydrates such as pectin and hemicellulose, which are soluble and, together with water, form a protective gel in the intestines that slows the absorption of sugars and lowers insulin levels. Although we cannot digest them, they are food for our gut bacteria. In addition, some plants contain sugar in the form of soluble starch, which we break down into glucose.

To simplify - everything above ground we can eat without restrictions, everything below ground we must eat with discretion and watch the amount of sugar contained. The most sugar is of course in sweet potatoes and potatoes (17g per 100g of food), less in parsley (13g/100g), beetroot (8g/100g) carrots (7g/100g), onions (8g/100g) and celery (6g/100g). Those who want to keep a very strict ketodiet should avoid root vegetables, at least in the beginning. We should not exceed a dose of 10g of sugar per serving and 50g for one day.

The foods that are lowest in sugars and super healthy are cauliflower, broccoli, cabbage, especially sauerkraut and kimchi, zucchini, spinach, asparagus, green beans, cucumber, eggplant. Kale, brussels sprouts and peppers have a bit more sugar (3-5g/100g), but they are super-healthy foods. And of course all leafy greens - salads of all kinds and spinach (watch out for oxalates in spinach). Let's also mention tomatoes, avocados and olives, although these are fruits. Of course, I have not listed everything. We should eat as varied a diet as possible and rotate as many types as possible in a week. Sauerkraut and kimchi is the best source of vitamin C. Vegetables in general contain large amounts of potassium, which we should have at least 4-4.5 grams a day, and other trace elements that we desperately need to live and function properly - manganese, copper, selenium.

Leafy vegetables can be eaten without restriction and ideally the main meal should start with a salad.

It is important to use a variety of spices as much as possible, many of which, such as turmeric, have antioxidant properties, use garlic, ginger, horseradish, chillies etc.

But beware, we are all different and not everyone can tolerate everything. If a food doesn't make you feel good, don't eat it. Plants contain what are called lectins - polysaccharide structures that can create an antibody response. Especially people who have gut problems - inflammatory bowel disease, leaky gut - leaky gut, SIBO, SIFO, IMO, various dysmicrobias, may find plant foods harder to tolerate especially at first. Then if after introducing more vegetables you find some intestinal problems, most often diarrhea, try to discontinue the vegetables and introduce them one food at a time. Sometimes cooking will also help to

improve digestion, but ideally at least 40% of your vegetable intake should be in the form of raw food.

And what about the fruit?

Fruits, unlike vegetables, contain large amounts of fructose. However, fructose can be utilized by the intestines to a certain extent, and fruit is high in fiber, pectin, and vitamins, which in turn is good for our intestinal bacteria. If we want to stay in ketosis, we should avoid very sweet and juicy fruits such as apples, oranges, grapes, grapes, peaches and apricots (and melons of various kinds, although they are effectively vegetables). We can have lemons without restrictions, and we can afford smaller fruits like blueberries, raspberries, gooseberries, currants, etc. I recommend drinking squeezed lemons with water every day preferably before meals. However, I definitely do not recommend drinking ciders and juices, as they contain a lot of sugar (and are often sweetened). A big issue is the quality of the fruit. Ripe fruits contain the most fructose and the least lectins, and are easy to digest and tasty. But most of the fruit we buy in the shops is picked unripe and ripens in storage. It therefore contains large amounts of lectins and the question is whether they are more likely to harm us. However, since we want to be in nutritional ketosis, we prefer vegetables instead of fruit and don't have to deal with this.

Demon alcohol.

Alcohol is a toxin. There is no appropriate or healthy dose of alcohol. However, it is safe to say that small amounts can be handled by our intestines and liver without impairing their function. But we should definitely include periods (preferably longer) without alcohol, not drinking every day and never over moderation. Ideally avoid alcohol altogether, especially if we have fatty or otherwise diseased livers. In terms of ketodiet, we can afford dry wine and unsweetened spirits in small quantities. Beer contains a lot of sugar, so it will reliably cancel out nutritional ketosis. Let's not drink at night, before going to bed, as alcohol blocks nighttime growth hormone production.

Caffeine

Caffeine is the world's most widely used legal drug. It is a relatively potent stimulant and its chronic excessive long-term intake can deplete the adrenal glands and significantly disrupt sleep. It's a substance that breaks down quite slowly, plus some of us are so-called slow metabolizers and they don't process caffeine in 24 hours. It has been proven that even if we fall asleep after an afternoon or evening coffee (but also black tea, chocolate, caffeinated beverages), the sleep is not deep and of sufficient quality. That is why we should drink coffee only in the morning and in the afternoon we should drink decaffeinated coffee, or green tea, which usually does not contain so much caffeine, and even better fruit or herbal tea. A lemon balm decoction, for example, lowers cortisol levels and is calming.

Lent

Incorporating fast days into your life is healthful. With most diets, and even ketodiets, one hits a certain plateau where the weight doesn't move further down. It is a physiological adjustment of the body, which usually resists more than 10% weight loss and rather tends to start gaining and catch up to the highest weight achieved. If we reach a point where the weight does not want to go down, or even goes up, it is high time to start fasting.

The basic rule is that we don't eat when we're not hungry. This is universally true with one exception and that is for people who tend to overeat in the evening, don't eat all day and then literally clean out the fridge. Those who suffer from this habit must instead start eating smaller portions more often each day, lots of fiber, salads and protein. Because these people don't so much need to get their insulin in order, but the stress hormone cortisol. They need to learn not to stuff themselves and they need good, quality sleep, which you can't do with a full stomach.

So how to fast.

We start by stopping eating between main meals. No more snacks or snacks. Drink only water. The next step is that we limit our intake to two meals, preferably a late breakfast around 9-10am and a late lunch around 3-4pm. And then no eating again until the morning. A regimen of not eating for 18 hours and eating for 6 hours is called intermittent fasting. It's important that we get everything we need in those two meals - protein, fat, fiber. This type of eating is sustainable in the long term because it is not nutrient deficient and yet it has beneficial effects, we remain in low insulin and nutritional ketosis for most of the day.

The next step is a 24-hour fast, eating one meal a day. For example, you have dinner on Sunday and the next meal is dinner on Monday, or breakfast on Tuesday if we want to stretch the fast for another 12 hours. Once in a while, maybe twice a year, a three-day fast is also appropriate.

Longer fasts than 5 days can slow down metabolism, so I generally don't recommend them.

Fasting is meant to bring joy and health benefits, not suffering. Those who do not tolerate fasting well, feel faint, have headaches, do not function as they would like, do not hurry with fasting. This is typical of people with significant insulin resistance, sugar addicts, and who have weak adrenals from prolonged stress or long term illness, they need to avoid anything that increases stress.

Health benefits of fasting: decrease glucose and insulin levels, increase ketones. Increase in growth hormone levels, after 13 hours of fasting, fat burning begins, inflammation in the body is reduced, energy and concentration increase, after 17 hours of fasting, cells begin to detoxify, burning unnecessary or toxic substances to the end - autophagy, cells regenerate, immunity improves, cancer prevention, after 24 hours of fasting stem cells are activated, nerve cells regenerate, the immune system heals, after 36 hours glucose and glycogen stores are practically used up, detoxification continues, fat burning increases, GABA secretion increases, testosterone levels in men increase, growth hormone increases by up to 500% after 48 hours, dopamine receptors reset, anxiety and depression levels decrease, antioxidant and anti-aging substances are produced, the process of cell autophagy peaks after 72 hours, stem cells are activated not only in the intestines, but also in muscles and bones, chronic diseases and self-healing processes improve. Throughout the fasting period, pure water, mineral water, green tea can be drunk, a tiny pinch of salt can be added to each drink. Broth can also be taken, especially in the beginning, before the body adapts to fasting.

It is also advisable to have some days outside of the fasts themselves to be purely vegan to give your body a break from meat and animal protein. Maybe every third or fourth day, or maybe one week a month, depending on preference.

Side effects of ketodiet, contraindications, adaptation

A well-conducted ketodiet is safe and is suitable for everyone with few exceptions. It is not a high-protein diet, which can put a strain on the kidneys. The problem can be the first weeks in the adaptation phase and for several reasons. Insulin retains water in the body. Once its levels drop, our kidneys start to produce more urine. Especially the first 14 days, the greatest weight loss is carried by the excretion of excess water. This is good in itself, but it carries several problems. Firstly, blood pressure can drop and this needs to be responded to by adjusting any anti-hypertensive therapy. Also, sodium, potassium and magnesium levels may drop, which manifests itself in muscle cramps, fatigue, headaches, even so-called "brain fog", sometimes heart palpitations, slow or fast heartbeat. Sometimes there are even symptoms of viruses - keto-flu. All these symptoms are caused by mineral deficiencies.

Therefore, at least in the beginning, it is necessary to salt a little more because of sodium and chloride losses and to eat more potassium-rich foods, especially salads and eggs. The daily requirement for potassium is up to 4.5 grams per day. If there is a persistent tendency to cramps or other problems mentioned above, ask for a prescription for potassium tablets (for example, Kalnormin 1.0 g and take 1-2 tbl daily). It is also advisable to buy some well absorbed magnesium, for example Magnesium citrate, Magnesium orotate. This adaptation phase usually lasts up to one month and then you will not need these drugs or more salt, or only in spurts.

What is often criticized as a side effect of ketodiet is an increase in LDL cholesterol, which is considered the so-called "bad, proatherogenic cholesterol". This effect does indeed occur in some people on ketodiet; in so-called rapid responders, LDL cholesterol levels are really high, but they do not pose a health risk. After all, it is logical that if cholesterol is the main fuel, the liver must produce more LDL cholesterol. However, someone who starts with an unfavorable metabolic profile - has higher liver tests, high triacylglycerols, higher glycemia, has a fatty liver, is under high stress...chances are that until they correct their metabolic state, their liver will also produce so-called sd-LDL, which is dangerous. Therefore, do not prescribe any cholesterol medication, possibly after talking to your doctor. However, I think that once the liver clears the fat, glycemia and liver tests are adjusted, Tg is lowered and HDL cholesterol is raised (Tg/HDL is 1.0 or lower), there is no need to treat cholesterol.

What to actually eat specifically

There are plenty of cookbooks and recipes for ketodiet in bookstores and on the Internet, there are also groups with ketodiet on Facebook, there are videos on YouTube with the preparation of keto meals. There are various mobile apps to help with diet and food choices.

This guide is not a cookbook, so just some basic advice. At least in the beginning, it's a good idea to have an app where you can enter your meals so you can keep track of how much protein, sugars and fats you eat in a day. I recommend doing the math for the first couple of weeks to get an idea and, most importantly, to keep an eye on your protein intake. We definitely don't need to count calories and restrict ourselves somehow. Once the body adapts to the ketodiet, there is only one rule - don't eat when we are not hungry. Those who need to lose weight must not overdo it with fats, the body needs to burn its own excess fats, especially from parts where fats do not belong - liver, pancreas. But you won't see that on the scale.

Breakfast should not contain carbohydrates and should not be sweet, not only with ketodiet, but also in general. For example, with ketodiet you can have eggs in butter (4 scrambled eggs have 25gr of protein and 25gr of fat), a piece of cheese (50gr of Balkan cheese has 5.6gr of protein and 10gr of fat) and instead of bread some vegetables, a bowl of sauerkraut or kimchi. You can even just finish the leftovers from your keto dinner. I really like caprese salad - mozzarella, tomatoes, basil, olive oil, or avocado. For vegans, hummus (chickpeas + tahini) in a thousand ways has an irreplaceable place.

Lunch should contain protein - meat, fish, for vegans for example tempeh (100 gr of tempeh is 20 gr of protein and 20 gr of fat), and a very large and varied salad. Don't forget nuts, seeds, balsamic vinegar, olive oil, lemon, yoghurt... to taste. Instead of a side dish, you can use cauliflower rice, zucchini spaghetti, or pasta made of lentil flour, Shirataki - noodles made from konjac tubers...

If you like to bake with flour, you can substitute wheat, corn or rice flour with almond flour, cashew flour, etc. - again I refer to cookbooks and the internet.

Let's not worry if we break the ketodiet occasionally and go out for a delicious dessert once a week, or have rice, potatoes, or pasta once in a while. Just don't stress, eat happily, well, varied and preferably with pleasant company. Rich social connections, friendships, well-being are as important for health as good food.

Let's not forget about stress management - evening walks, tai-chi, meditation, prayers, lemon balm decoction. It's terribly important to sleep well and address anything that disturbs sleep. It is also important to take care of the psyche, to learn to forgive and ask for forgiveness, not to let the sun go down on disputes, quarrels and conflicts. Write down any problems to be solved in the morning so that you don't have to keep them in your head. Love and forgiveness is more than justice.

BASIC PRINCIPLES OF THE KETOGEN DIET - a brief overview

- it is important to determine the amount of protein per day, which should be between 1.2g-2.0g/kg of reference weight) depending on physical exertion, age, stress, amount of sleep, illnesses, etc. Not too much, then the body metabolizes protein into glucose and turns that into fat. Any food that contains protein also raises insulin a bit, especially lean meats and protein powders.
- there must be sufficient intake of micronutrients - sodium, potassium, magnesium, zinc, selenium, omega3, and all the necessary vitamins, if it is difficult to ensure their intake from normal food, it is not a shame to supplement them with food supplements (e.g. good quality omega3 if salmon and cod are not a good source, in the transitional phase of adaptation to ketodiet usually necessary to substitute potassium and magnesium)
- use fats (lard, butter, olive and coconut oil, avocados, nuts...) as an energy source and not carbohydrates, limit lactose, rather use hard ripe cheeses, or sometimes

live unsweetened yoghurt, kefir, cottage cheese. But not too much, advisable to alternate goat and sheep products as well. (lactose is galactose with glucose)

- We eat under 50 grams of sugars (glucose and fructose) per day. We do not count carbohydrates in the form of fiber. All absorbable carbohydrates including starch are avoided - table and cane sugar, honey, flour and flour products, rice, potatoes and pasta, bulgur, couscous and other things of that nature. Better to limit legumes as well (except for vegans). When social or other reasons no longer allow to avoid these side dishes, try to eat them in smaller portions and grease them to reduce the glycaemic index. The sugar intake per single serving should be below 10 grams and max 50 grams per day, better up to 35 grams.
- significantly limit and fruit, a small amount of "berries" can be taken - blueberries, raspberries, blackberries, strawberries - the more colorful the better, avocado is very suitable. Completely discontinue ciders, juices, syrups, all sweetened drinks and the like.
- Alcohol rarely, and choose only those with the least amount of sugar, that is, dry wines or spirits - gin, whiskey, vodka, some rums and plums (but beware, alcohol is calorific, although it has no sugar). Definitely do not drink beer, even non-alcoholic.
- if possible, have a bowl of sauerkraut or kimchi every day - this will ensure enough vitamin C and microbiotic cultures
- eat salads every day, what is green is good, especially arugula, lettuce...spinach rather less, because it has a lot of oxalates and can make kidney stones. Broccoli and cauliflower can bloat, so depending on tolerance, but otherwise they are superfoods. Tomatoes preferably whole, purees and ketchups contain added substances. Root vegetables are possible, but carrots are limited. Don't eat corn, it's sweet. Soya as a source of protein, preferably fermented in the form of tempeh or tofu. Soya, buckwheat and red lentils as a source of protein to be interspersed with animal products.
- Prefer fattier meats, e.g. minced, neck, etc. Fatty meats are more caloric, but have a lower glycemic index. Lean meats can raise insulin. So less fatty meat if more fatty.
- from fish, prefer fatty fish, preferably salmon, as it is low in heavy metals and high in omega 3 fatty acids. Large fish - tuna, swordfish can contain a lot of heavy metals.
- at least once a week to have cod liver and cod liver oil.
- use olive oil often, especially in salads as a dressing.
- every day a tablespoon of apple cider vinegar, rather in the dressing, and drink squeezed lemon with water.
- Nuts are an excellent source of fat and protein along with other nutrients, the best being walnuts, macadamia and pecans. Include these if possible every day. Walnuts are good to soak ahead of time, they digest better, or blend into salad dressing. Almond and coconut "flour" can be used to bake keto breads and keto desserts. Chocolate can be made, but only above 75% cocoa with minimal sugars.
- eggs are one of the healthiest foods in the world. Can be 4-5 a day without any worries, preferably from home rearing.

- total ban on the use of certain vegetable oils - sunflower, soybean (large amounts of pro-inflammatory omega6), rapeseed is possible, but limited (if you hate lard). We prefer olive for cold cooking, where other virgin oils can be used. Fry and cook in lard, butter, or clarified butter if possible.
- Sufficient fluids (2-3 l/day) and more salt than usual during the adaptation phase, even 2.5 teaspoons of salt per day (5-7g) is essential. If the muscles harden, if there is muscle fatigue, headaches, etc. it is always a mineral deficiency - first sodium, then potassium and magnesium - it is necessary to supplement and increase the intake of foods containing them, e.g. avocados, kale. This occurs mainly in the first weeks when adapting to ketones and when insulin drops
- after adapting to the ketodiet, it is advisable to include fasting days when you do not eat at all. There I would limit myself to a few nuts and some leaf salad, tomato and avocado in the evening. Since it burns fat, there is no hunger.
- We eat real food as much as possible, no industrially produced food.
- Quality and sufficient sleep, healthy stress management - massage, walks, meditation, prayer..., if possible to do sports and even resistance training - building muscle is important, increases basal metabolism.
- When we need to lose weight, we limit fat to 100g per day, because the rest is burned by the body. When we don't need to lose weight in the maintenance phase, we increase the fat to 200g per day.
- Persevere and be patient. Some people's weight goes down quickly, some people's weight doesn't go down at all at first, but some metabolic factors adjust, liver tests, they feel better, energy goes up, waistline shrinks. The weight loss comes later. Insulin resistance is not only related to food, but also stress (belly fat) and chronic inflammation (it is important to have a healthy gut microbiome).
- For those being treated for type II diabetes, glucose levels need to be monitored closely after ketodiet as they may fall and hypoglycaemia may occur. This is most at risk with insulin therapy, sulphonylurea-based drugs and so-called glyphlozines. It is least likely with metformin, which we can usually leave in. In a study by Virta Health, 100% of patients discontinued sulfonylureas and 90% discontinued insulin.
- Hypertensive patients need to monitor their blood pressure as it tends to decrease. This needs to be responded to by reducing or withdrawing medication. However, in most cases, blood pressure responds more slowly than glycaemia, and it may take longer to withdraw medication. Watch out for diuretics - indapamide, hydrochlorothiazide, furosemide. In ketosis, they can contribute to rapid potassium and magnesium deficiency.
- A properly constructed ketodiet is not low calorie! It is not high protein! It must not lead to loss of muscle mass and deterioration of health! It must contain all the necessary macro and micronutrients and be affordable.

Conclusion. Ketodiet can be held for a long time. It is important to stay in nutritional ketosis as long as possible and even a small dose of simple carbohydrates will stop ketosis. But we don't have to be sad about it and we need to start again. It is possible to get a ketone monitor over the internet from abroad, it works just like a glucometer, or you can measure ketones in your breath. Once the insulin resistance rate improves as well, the muscles will have more energy to move. Not only is aerobic movement important, such as walking, running, cycling, but also resistance - weight training to build muscle mass. Those who are literally starting from scratch can begin with very simple exercises such as getting up from a chair, push-ups

against a wall or table, squeezing a foam ball, weight training with light weights, lifting on tiptoes, etc. It is important to do these exercises for at least 15 minutes a day. Do it in the kitchen while preparing breakfast or lunch, keep it as simple as possible and don't make big resolutions. It's good to include a walk after a meal, so walk to a distant restaurant for a working lunch, etc. If you know that moving around immediately after the meal will not be possible and you will be under a lot of stress, have something lighter, such as a salad.

Respect what your body is telling you and don't eat when you're not hungry (except, of course, for those with some form of eating disorder). If fat burning starts working again, the body has enough energy from burning its own fat stores. Alternatively, just put some protein and fiber in the diet and don't use too much fat unnecessarily, especially when we need to lose weight. There is no need to count calories. Fats will fill us up sufficiently and for a long time. Of course we don't overeat. Satiety is not fullness. For people who have really had a problem with overeating, binge eating, it can take a while to adapt to smaller portions. If there's a mental need to really stuff ourselves, we choose just salads and other vegetables.

Protein intake is more or less constant, as is fibre. We also try to keep carbohydrates in the range of 30-70g/d, some lean and athletic individuals can even keep 100g/d while maintaining nutritional ketosis, on the other hand in very strong insulin resistance it is better to keep carbohydrates as low as possible. So basically the only variable is fat and there it depends on energy expenditure, how, do we need or not need to lose weight.

Example: at the beginning = 80-120 g/d protein, 30-50 g/d carbs, 60-100 g/d fat -Maintenance = 80-120 g/d protein, 30-70 g/d carbs, 100-200 g/d fat.

One- to three-day fasts can be, and usually are, beneficial to health, although there are no large cohort studies to confirm this. You certainly don't have to force yourself to do them if it would put a lot of stress on you. But especially if you can't lose weight or the weight starts to lift, some form of fasting is appropriate, such as an 18/6 intermittent fast. Where we need to keep insulin levels as much as possible within a favourable range, two meals a day is optimal.

It makes a big difference who follows the ketogenic diet and in what context. An otherwise healthy person who just needs to lose weight can afford occasional trips out of nutritional ketosis and they pose no health risks. For children and younger, it will probably be quite sufficient to stop drinking sugary drinks and eating sweets, adjust protein and fiber intake, and nothing more will be needed. However, those who have insulin resistance, such as type II diabetes mellitus, and are taking medication, the fluctuations in glycaemia, insulin, blood pressure caused by ketodiet violations may be risky. In general, the sicker we are, the more we need to watch our diet. Ideally, we should find a specialist who is trained in ketodiet, but there are not many in our country. In any case, though, consult your doctor about your condition, especially any medication adjustments, blood mineral monitoring (a drop in potassium can cause heartbeat disturbances) and blood pressure checks.

eat real food - protect your liver and brain - feed your gut microbiome

