

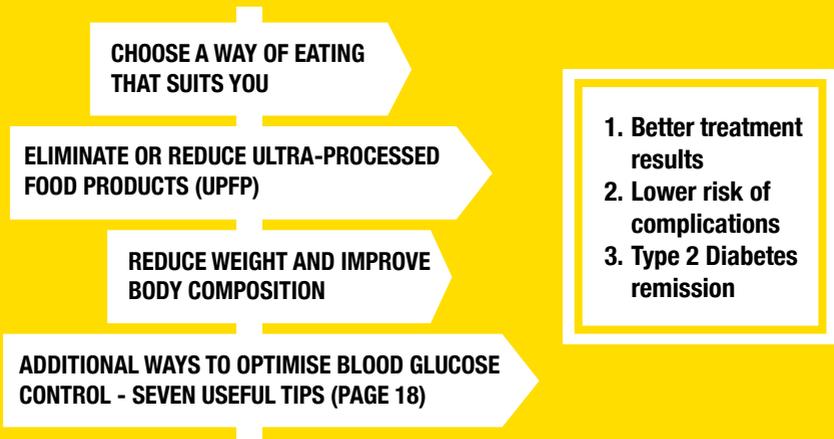


Beating Diabetes with Food

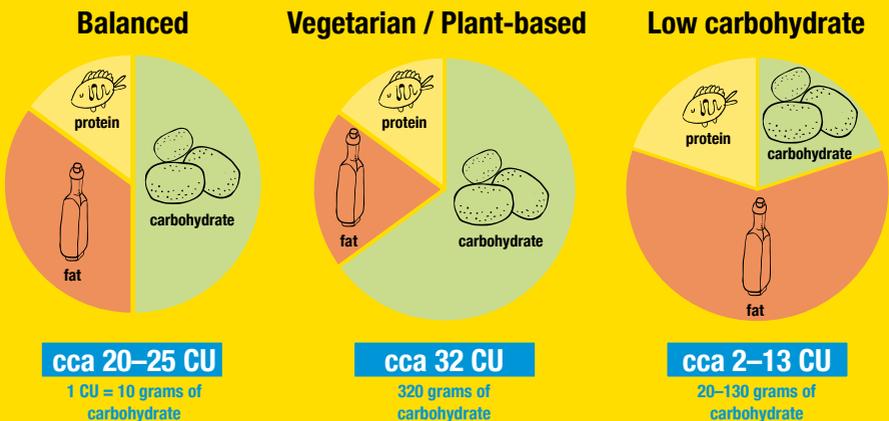


Diet plays a fundamental role in the management of diabetes. This e-book offers patients with diabetes basic information about dietary options, and also about remission of Type 2 Diabetes. This e-book does not replace individual medical care. It only serves as an overview of dietary advice to navigate diabetes and nutrition. Any dietary change - notably in patients taking diabetes or blood pressure medication - should be discussed with a medical doctor and a dietitian with experience in this area.

The journey towards better results



Main types of diet





Main types of diabetes

Type 1 Diabetes (T1D)

is an incurable autoimmune disease, involving the destruction of pancreatic beta cells. It results in loss of insulin production, and ultimately in an increase in blood glucose levels (hyperglycaemia), with a tendency towards ketoacidosis. It is most common in children and adolescents but can also develop in adults. [\(CDS 2016\)](#)

Type 2 Diabetes (T2D)

is currently the most common metabolic disorder. It is very often linked with overweight or obesity.

It is characterised by elevated blood glucose due to progressive insensitivity to insulin (insulin resistance) and eventually relative insulin deficiency [\(CDS 2017a\)](#). T2D has long been considered a chronic progressive disease. Today, there are several ways to achieve remission (see below).

Gestational diabetes (GDM)

is a glucose metabolism disorder which appears in pregnancy and spontaneously resolves within six weeks of birth. It manifests in women with a genetic predisposition to diabetes. These women also have a higher risk of developing Type 2 Diabetes later in life [\(CDS 2017b\)](#).



Diabetes



What is optimal blood glucose (glycaemia)?

The general targets below can be individually set by a medical doctor.

	T1D	T1D child	T2D	GDM	GDM+ins***
fasting (before a meal)	4,0–6,0	4,0–7,0	4,0–6,0	<5,3	<5,3
after a meal *	5,0–7,5	5,0–9,0	5,0–7,5	<7,8	5,3–7,8
before sleep	---	4,0–7,0	---	---	---
at night	---	4,5–7,0	---	---	---
HbA1c **	<45	<48	<45	<40	<40

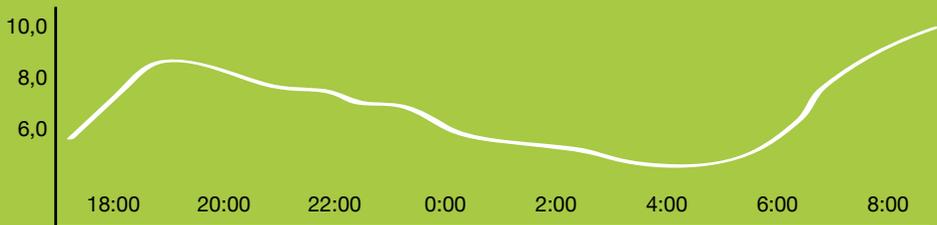
*after a meal = 60 min after the start of a meal

**HbA1c = HbA1c or glycated haemoglobin reflects the average blood glucose over the last three months. In people without diabetes below 38 mmol/mol (5.6%)

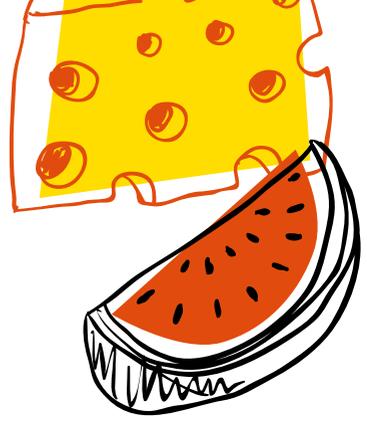
***GDM+ins = woman with GDM using insulin

It is advisable to **measure blood glucose** levels multiple times a day, for example, after waking up, before meals, one and two hours after meals (from the first mouthful) and record these in a diary. In T1D, **flash monitoring of glucose** and continuous monitoring of glucose (**CGM**) can also be useful.

Every patient will have individual responses to different foods and meals, therefore it is useful to monitor blood glucose regularly to see which foods are tolerated. If measured values do not match desired targets, it could be seen as an opportunity to consider dietary changes.



Main types of diet



There is no universal diet best for all people with diabetes. It is important, however, to consider the habits and individual preferences of the patient when selecting a dietary regimen. The primary diets that have shown good results for glycaemic control, are the following:

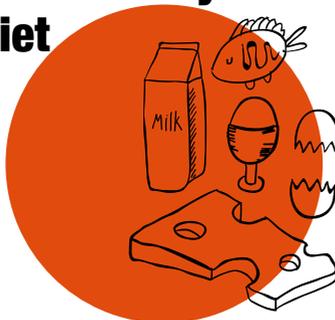
1. balanced (Mediterranean) diet



2. vegetarian / plant-based diet



3. low carbohydrate diet



All three diets have a common platform



They eliminate or significantly reduce the consumption of foods with added sugars, refined carbohydrates, refined oils and additives - so called ultra-processed food products (UPFPs), fast food, instant meals, semi-finished products and ready meals including canned products.

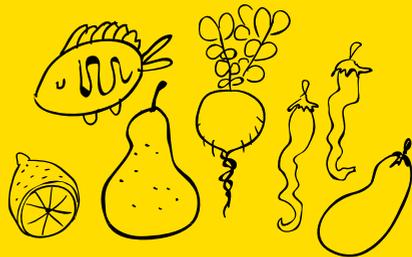


The main difference lies in the macronutrient composition of the diets, that is, carbohydrate, fat and protein in the overall energy intake. It is always useful to read food labels and know an item's exact composition, notably grams of carbohydrates per 100 grams of food.

The intake of carbohydrates can also be expressed in so called Carbohydrate Units (CUs) or exchange units (EUs),



They promote whole and minimally processed foods and homemade meals that are locally and seasonally sourced.



Each type of diet can be tailored for (A) weight maintenance and (B) weight reduction. Reducing weight significantly in overweight and obese patients is the only clinically verified therapy shown to achieve long term remission of Type 2 Diabetes, which means a return to normal glycaemia without the need to take insulin or other medications. It is a good idea to combine dietary changes with sensible resistance (muscle) training, 7-8 hours of quality sleep each night and stress reduction.

**1 unit = 10 grams of carbohydrates
(in some countries, it may be 12 or 15 grams).**

Balanced diet

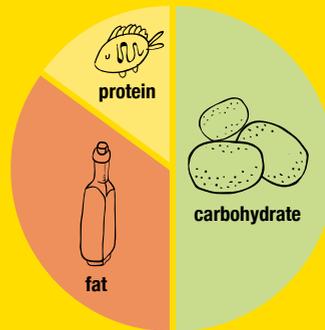
(Esposito 2014)



A balanced diet includes a wide variety of foods. In patients with diabetes, a balanced diet usually contains about 200-250 grams of carbohydrates per day which should be split into smaller portions throughout the day (at least 5 meals). In weight reduction, it is also important to keep track of the total calories eaten per day (as advised by your dietitian).

A balanced diet can be based on the so called Mediterranean Diet - typically, it includes **whole grain bread, pasta, plenty of vegetables and some fruit** based on seasonal availability. **Leafy vegetables** are very beneficial and should be part of every meal. The Mediterranean Diet is also rich in **legumes, green beans, peas**, etc. In addition, it contains **nuts (almonds, walnuts or hazelnuts) and olives**. Dairy products, notably soured or **fermented**, are eaten daily, and **fish** at least 2-3 times per week.

Eggs and meat are consumed moderately. Herbs, spices such as thyme, basil, oregano, garlic, onion and fresh lemon juice are used to add flavour. The Mediterranean Diet can contain more fat (up to 42% of calories, [Estruch 2018](#)), with **quality olive** oil being the major source. In Czech cuisine, rapeseed oil comes closest to olive oil composition.



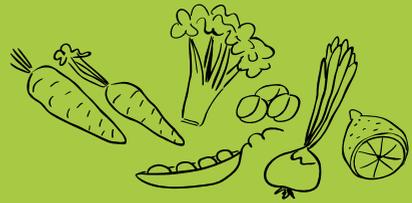
cca 20–25 CU

200–250 grams of
carbohydrate



Vegetarian diet

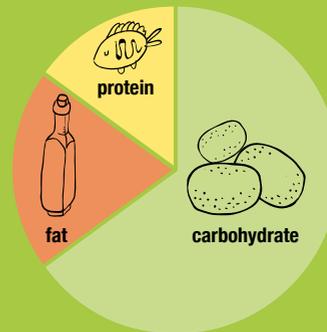
(Kahleova 2011)



Contains no meat, fresh or processed, and also excludes fish and other seafood in its stricter forms. It contains more carbohydrates and less fat (notably saturated fat) than a balanced diet. The main items include quality sources of carbohydrate and plant protein: **whole grains and legumes (soy, beans and lentils)**. It is rich in **fruits and vegetables**, however, patients with diabetes should eat fruit in moderation. It also includes **seeds and nuts** with eggs, and allows dairy and also fish in moderation.

This diet has a favourable effect on blood cholesterol but contains more carbohydrates (up to 320 grams), which patients with diabetes should split into smaller portions per day (5-7 meals). Larger portions of carbohydrates have a negative effect on blood glucose after

meals. In weight reduction, it is typically useful to keep track of daily caloric intake (as advised by your dietitian). It is important to consider sufficient intake of protein and in some scenarios (e.g., pregnant or breastfeeding women), it is wise to supplement iron, iodine, zinc and vitamin B12.



cca 32 CU

320 grams of
carbohydrate



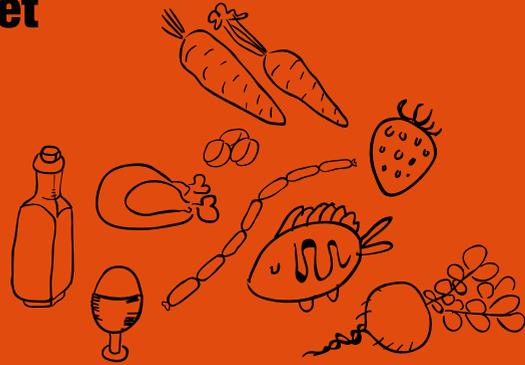
Low carbohydrate diet

([Fay 2018](#), [Athinarayanan 2019](#))

The low carbohydrate diet (up to 130 grams of carbohydrates per day) is one of the diets suitable for treatment of diabetes ([ADA 2019](#)). When intake of protein and fat is sufficient, it does not lead to malnutrition or starvation. Although it is considered a weight loss diet, that is not its only application. It has a wide variety of tasty menu options and is not a limitation for sports ([Kaspar 2019](#)).

A lower intake of carbohydrates has a beneficial effect on blood glucose (glycaemia) after meals. It leads to a significant reduction of bolus insulin requirements in patients with Type 1 and Type 2 Diabetes who inject insulin. Sufficient consumption of protein and higher intake of fat results in prolonged satiety, and so fewer (2-3) meals per day are usually eaten. The lower intake of carbohydrates does not require consumption to be split into smaller, more frequent portions.

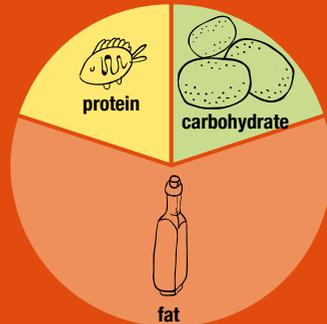
The low carbohydrate diet is different from a balanced diet in that it replaces commonly eaten food items such as bread, potatoes, rice, pasta or dumplings with vegetables (raw, fermented or cooked), which thus increases the consumption of vegetables. The diet contains animal and plant sources of protein and fat (meat, quality processed meat with high meat content, fish, eggs, dairy, nuts, seeds, butter, lard, and quality plant oils) ([Krejci 2018](#)). It is important, however, to watch for an excessive intake of protein. In adults,



protein intake should not exceed 1.5 g per kilogram of body weight. In patients with diabetes who have kidney problems, protein intake should be kept below 0.8 g/kg (or less, as per medical advice).

Low carbohydrate diets can be very low (containing up to 50 g of carbohydrates/day) or moderate (up to 130 g of carbohydrates/day) ([Feinman 2015](#)). A diet with up to 30-50 grams of carbohydrates per day is an option for treatment of overweight or obesity and achieving Type 2 Diabetes remission (see below). It can also be used in Type 1 Diabetes (so called Bernstein's approach, [Lennerz 2018](#), [Tuton 2018](#)). Other than carbohydrate restriction, this approach normally does not require calorie counting. The very low carbohydrate diet (up to 50 grams) allows small amounts of lower sugar fruit (such as strawberries, raspberries, blueberries, etc.), avocado and olives. The version up to 130 grams can also contain small portions of carbohydrate side dishes such as quality sourdough bread, whole grains and legumes.

A medical doctor should be consulted prior to the start of this diet as it requires a change in insulin dosing, and, in patients with T2D, also a change or discontinuation of some other antidiabetic or blood pressure medications that the patient may be taking. This diet is inappropriate for patients with digestive or fat metabolism disorders (e.g., chronic pancreatitis). Increased intake of fat sometimes results in a more pronounced elevation of blood cholesterol - in the event of which it may be necessary to reduce consumption of saturated fats, notably from animal foods (butter, lard, cheese, full fat dairy, fatty meats and processed meat), or, alternatively, to consider another type of diet.



cca 2–13 CU

20–130 grams of
carbohydrate





Examples of foods and meals for each of the main diet types

diet	balanced	vegetarian	low carbohydrate
breakfast	sourdough bread, cottage cheese spread/ eggs/ham, vegetables	porridge oats soaked in water, seeds, nuts, sourdough bread, legumes spread, vegetables	egg omelette with ham and cheese cooked in butter, vegetables, unsweetened (natural) yoghurt with nuts and fruit, low-carb bread with vegetables
snack	unsweetened (natural) yoghurt with nuts and fruit, vegetables, cheese, a slice of bread	vegetable salad with seeds, unsweetened (natural) yoghurt with nuts and fruit	
lunch	vegetable/legume soup or meat broth, fish/meat/ cheese/ legumes, potatoes/pasta/rice/bulgur/ millet/buckwheat/ groats, mushrooms, vegetables, fruit	vegetable or legume soup legumes, tofu, tempeh, seitan, cheese, fish potatoes/pasta/rice/ bulgur/millet/buckwheat/ groats, mushrooms, vegetables, fruit	vegetable/legume soup or meat broth, fish/meat/ cheese, mushrooms, vegetables, fruit
dinner	fish with vegetables and side dish, sandwich with vegetables, vegetable salad with cheese	whole grain pancakes / sandwich with vegetables, vegetable-legume soup, vegetable salad with cheese	fish/meat/cheese/egg, vegetable salad, low carb bread with avocado
occasional dessert	panna cotta without sugar with strawberries, 70% chocolate, fruit	panna cotta without sugar with strawberries, 70% chocolate, fruit	panna cotta without sugar with strawberries, 70% chocolate, berries, protein ice-cream



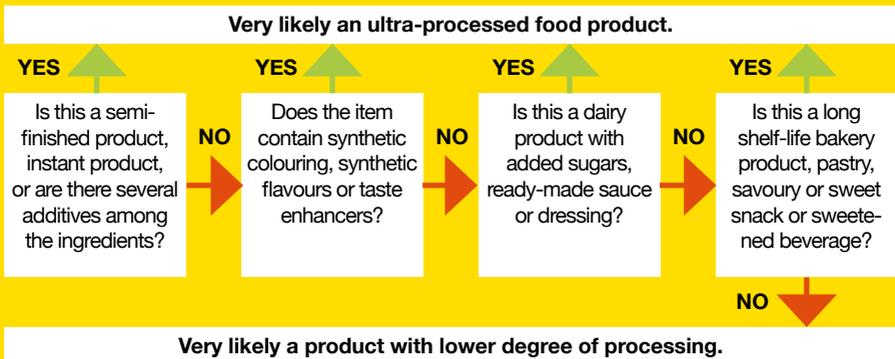
What should be avoided in any diet?

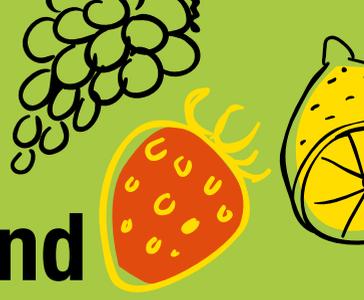
A diet high in so called **ultra-processed food products** (UPFPs) leads to a spontaneous increase of caloric intake, weight and fat stores. The main reason is that UPFPs contain a lot of unsuitable ingredients - added sugars and refined carbohydrates (white flour), which have a high glycaemic index (see below Tip 2), hydrogenated (100% saturated) and semi-hydrogenated fats (source of trans fatty acids). They can often also contain too much salt and a long list of additives. At the same time, due to the high degree of processing, they are stripped of fibre, vitamins, minerals and other biologically active substances, such as polyphenols, which are beneficial for health (Kohutiar 2019). UPFPs have detrimental

effects on the gut microbiome, which is closely linked with a number of physiological functions in the body - regulation of carbohydrate metabolism, fat stores, appetite, immunity, psychological wellbeing and stress resilience.

An example of UPFPs would be savoury or sweet snacks and bakery items, soft drinks, meat products with low meat content, dairy products with added sugar and preservatives, zero fat products with added starches, processed cheese, fish fingers, nuggets, fish and other ready made salads with many additives, canned products, ready and semi-finished meals, instant products.

How to recognise an UPFP:





Diet for fat loss and methods of achieving T2D remission

The aim of weight loss in overweight or obese people is primarily to improve health markers. As soon as weight **loss hits 10%** of baseline weight, glycaemia, lipid profile and blood pressure improve. With a **15% weight loss**, a patient can achieve T2D remission, i.e. long term normal glycaemia without medication ([Rusavy 2019](#)). Complete normalisation of BMI (Body Mass Index) is not a necessary condition for these improvements. For obese people, 10-15% weight loss could represent a step from Class 3 obesity to Class 1 obesity or overweight.

Besides dietary changes, weight loss can also be facilitated by **lower frequency of meals**, regular intermittent fasting (see Tips below) and sufficient physical activity.

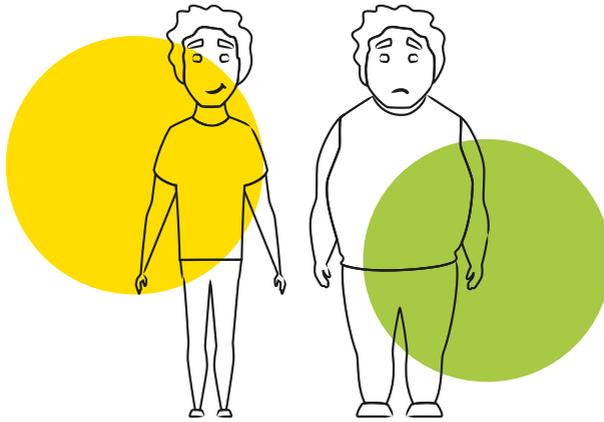
During the initial phases of the more restricted diets, it is useful to put increased physical activity on hold until one achieves 10-15% weight loss. The requirement to “eat less and move more” is often difficult to achieve in real life and results in failure. Also, in less physically

able people with severe obesity, it is important to increase physical activity slowly, ideally only after dietary changes result in initial fat loss.

Once the initial weight loss phase is completed and weight maintenance starts, a **gradual increase of physical activity** is highly beneficial. Physical activity plays an important role in maintaining the achieved weight loss and in further improvements of health markers including glycaemia.

The balanced diet typically requires an explicit reduction of caloric intake of around 500 kcal/day, or to 1500 kcal/day, predominantly from carbohydrates and fats. In contrast, low carbohydrate diets typically do not require tracking of caloric intake, because it is normally spontaneously reduced. If the patient does not lose weight, it is usually sufficient to reduce intake of added oils/fats, or prioritise lean meats and generally less fatty sources of protein.

Drinking alcohol, lack of sleep and chronic stress can significantly hamper effective fat loss.



At 15% weight loss, a complete remission of T2D can be achieved - preserved insulin secretion being a condition of remission. The expected target is fasting glucose below 5.5 mmol/l (99 mg/dl), glycated haemoglobin (HbA1c) below 38 mmol/mol (5.6%) and no medication. The likelihood of remission is greater in patients with a shorter duration of the disease and in those who are not taking insulin. A great result is

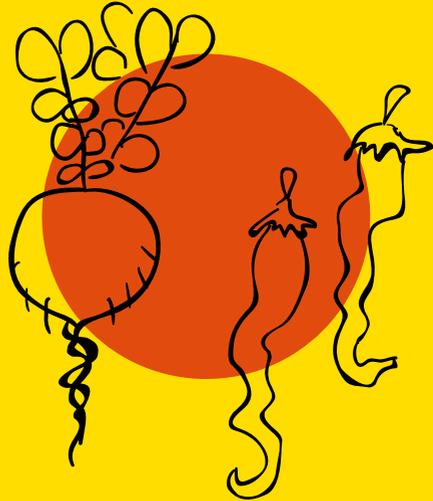
also achieving partial remission, when glycaemia drops into prediabetes range (fasting glucose between 5.6-6.9 mmol/l or 100-124 mg/dl, glycated haemoglobin 39-47 mmol/mol, or 5.7-6.5%) or achieving remission with only metformin. In any case, aiming for remission can at least help improve glycaemic control and in many cases also reduce the need for medications including insulin.



Ketogenic diet and T2D remission

(Hallberg 2018, Athinarayanan 2019)

It is important to consult this option with a medical doctor experienced in this area. A ketogenic diet is a form of low carbohydrate diet, allowing 30 grams (max 50 grams) of carbohydrate per day, 1.5 grams of protein for 1 kg of target body weight, and fat to satiety. It aims to maintain blood ketones (beta-hydroxybutyrate, BHB) between 0.5-3.0 mmol/l (so called nutritional ketosis). It is recommended to consume non-starchy vegetables in place of regular side dishes, and maintain a sufficient intake of water.



Pros: tasty varied diet with popular foods, highly satiating

Cons: not popular among the broader public and medical community, mainly due to lack of information, and, for some people, it is unacceptable due to preference for meals high in carbohydrates

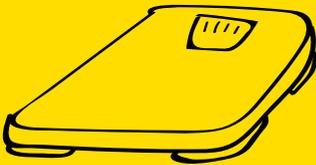




Low energy diet and T2D remission

(Lean 2017, Taylor 2018, Lean 2019)

It is important to consult this option with a medical doctor experienced in this area. The fat loss diet has two phases. In the first phase, typically 3-5 months, the patient only eats clinically tested nutritional products with 800-850 kcal/day. In the second phase (6-8 weeks), whole and minimally processed foods are gradually reintroduced. At the end of this stage, patients switch to a weight loss maintenance diet.



A whole food fat loss diet is an alternative to consuming nutritional products during a low energy diet (Morris 2019). For example, the Charvat diet contains 60 g of carbohydrate, 40 g of fat and 70 g of protein (880 kcal in total) from beef, ham, eggs, potatoes, fruit, vegetables, butter and milk.

Once target weight and glycaemic control have been achieved, these results can be maintained for example by adopting a balanced diet, vegetarian diet or low carbohydrate diet, or also using intermittent fasting (see below). Adding regular physical activity is also highly beneficial.

Pros: rapid fat loss, very easy preparation

Cons: price, temporary elimination of regular (and often favourite) foods



Seven tips to reduce glycaemia and weight

1 Food order, vinegar, fibre

It is possible to improve glycaemic control by changing the food order of any meal. All you need to do is start eating vegetables and foods high in protein and fat first, and only later (after 10 min) continue with foods containing carbohydrates. This results in lower glycaemia (Shukla 2017). In addition to protein and fats, gastric emptying can also be slowed down by adding lemon juice or unsweetened vinegar to meals. Fermented vegetables (e.g., sauerkraut) have a similar effect. These also contains fibre, another reliable “retarder” of other carbohydrates. For this reason, it is beneficial to add vegetables (not only fermented) to every meal.

2 Glycaemic index

Foods with a high glycaemic index (GI) contain carbohydrates, which are absorbed very quickly and increase glycaemia very rapidly. Sugar and white flour have high GI, whilst legumes and vegetables have low GI due to fibre. Many food products with high GI are also UPFPs, which are best avoided also for other reasons (see above). Carbohydrates with a higher degree of processing (white flour, instant and extruded products) generally have higher GI. Unsuitable drinks with a high GI include sweetened beverages, fruit juices and beer. For other foods which are commonly included in balanced or vegetarian diets (e.g., potatoes, rice, etc.), there are tricks for reducing GI.

The glycaemic index of carbohydrates is significantly increased by frying and baking - this applies to potatoes (French fries/chips, baked potatoes) as well as bakery products - toast has a higher GI than ordinary bread. Prolonged cooking also raises GI - pasta cooked “al dente” has a lower GI than overcooked pasta. Carbohydrates are quickly absorbed not just when fibre is removed, but also when blended, which destroys fibre (mashed potatoes, fruit puree, smoothies).



The process of ripening also has a role - for example, an overripe banana (brown spots) or older potatoes have a higher GI. Also, starch content affects GI, for example, basmati rice has a lower GI than jasmine or short-grain rice. Starch content is modified when the food is first cooked and then chilled. That is why a potato salad has a lower GI than other methods of potato preparation.



3 Physical activity after meals

Likewise, including a 30-min walk after a meal can significantly mitigate the increase in glycaemia (Colberg 2014). In patients using insulin, the planning of physical activity after meals requires careful reduction of bolus insulin to avoid hypoglycaemia.



4 Meal frequency

It is often recommended to eat 5-6 times per day, but as long as it suits the individual, lower frequency is just fine. Breakfast is not mandatory, if it does not suit the individual. Lower meal frequency can contribute towards weight loss and better glycaemic control (Kahleova 2014). **Warning** - patients on medications incl. insulin, especially those with T1D, must pay careful attention to doses to avoid hypoglycaemia and other undesirable effects. A diet with a higher carbohydrate content (vegetarian, balanced) must usually be split into more meals during the day. Lower meal frequency is thus feasible in weight loss versions of these two diets, and also in a low carbohydrate diet.

5 Fasting

Fasting can be particularly useful in weight reduction, but also in lowering blood glucose. There are a number of different forms, for example the 16:8 model assumes that a patient eats in an 8-hour long window (e.g., 9:00 a.m. -5:00 p.m.), and then goes 16 hours without food (5:00 p.m.-9:00 a.m.). The 5:2 model assumes that a patient reduces their caloric intake to 200-300 kcal/day for two (non-consecutive) days and eats normally for the rest of the week (Taylor 2018). Patients on medication must have their medications amended accordingly and should always consult their medical doctor. In insulin therapy, intermittent fasting can also be used to estimate the correct dose of long-acting (basal) insulin.

6 Insulin in T1D

In patients with T1D, glycaemia after meals is greatly affected by timely application of insulin before meals containing carbohydrates (with most current insulin products roughly 10-15 min). In a mixed meal which contains carbohydrates as well as more protein and fat, it is important to incorporate so called fat-protein units into the insulin dose calculations.



7 Dairy products for breakfast

It is evident that a significant number of patients see an unusual increase in glycaemia after consuming dairy products for breakfast, but not after consuming them in the afternoon. This can be picked up in self-monitoring of blood glucose, and the foods eaten at the appropriate time.





How to calculate carbohydrate content in a food?

For all patients with diabetes, it is very useful to be aware of the carbohydrate content of the diet - especially for those who are on insulin. For more practical tips and advice not just for T1D see ([Krejci 2019](#)). The two major questions are typically the following:

A) How many carbohydrates does a particular amount of food contain?

B) How much of a given food can I eat so that the portion contains a specific amount of carbohydrates?

Nutrition label (potatoes)

Nutritional values per 100 grams

Protein	1 g
Carbohydrate	16 g
of which sugars	6 g
Fats	0,08 g
saturated fats	0,04 g
cholesterol	0 mg
Fibre	2 g
Salt	0,07 g

based on
www.kaloricketabulky.cz

(A) How many grams of carbohydrates ... are in 130 grams of potatoes?

Calculation: carbohydrate content per 100 grams divided by 100 multiplied by weight of potatoes, hence

$$16 / 100 \times 130 = 20.8 \text{ grams}$$

$$130 \text{ g of potatoes} = 20.8 \text{ g C}$$

(B) What is the appropriate portion ... of potatoes, to consume 30 grams of carbohydrates?

Calculation: 30 divided by carbohydrate content per 100 grams of food multiplied by 100.

$$30 / 16 \times 100 = 187.5 \text{ g}$$

For 30 g of carbohydrates you can eat 187.5 grams of potatoes.

Summary of key points

1. Choose a type of eating which suits you, ideally in the long term.
2. Eliminate or significantly reduce added sugars, refined grains, UPFPs.
3. Give preference to whole and minimally processed foods.
4. Include non-starchy vegetables.
5. Pay attention to nutrition labels on foods and to carbohydrate content.
6. Prioritise quality sleep for at least 7-8 hours.
7. Eliminate stress.
8. Optimise body composition (reduce excessive fat stores).
9. Find a suitable form of physical activity (including also appropriate muscle strengthening) and enjoy it regularly.

Links to useful sources

Websites in Czech

www.diab.cz

www.cojist.cz

www.cukrpodkontrolou.cz

www.tehotenskacukrovka.cz

www.neslazeno.cz

Clinical guidelines

ČDS (2016) Type 1 Diabetes

ČDS (2019) Type 1 Diabetes, children

ČDS (2017) Type 2 Diabetes

ČDS (2017) Gestational Diabetes

International societies

ADA (2019) USA

ADA-EASD (2018) USA/EU

Diabetes UK (2017) UK

Diabetes Canada (2020) Kanada

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