

2019

KETOGENESIS

CHEMISTRY PROJECT

The survival phenomenon of the body “KETOSIS”, is studied and implemented. The observations have been reported in this project.

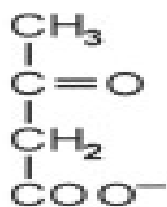
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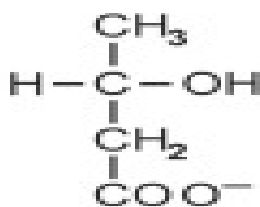
KETOGENESIS

By definition “**Ketogenesis** is the biochemical process through which organisms produce ketone bodies through breakdown of fatty acids and ketogenic amino acids.”

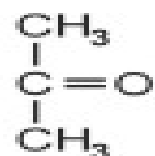
In other words, Ketogenesis, or formation of ketone bodies, is an alternative catabolic pathway for active acetates. The amount of ketone bodies is small in normal individuals, but their levels become important in certain metabolic conditions. Acetoacetate, 3-hydroxybutyrate, and acetone are all ketone bodies.



Acetoacetate



D-3-hydroxybutyrate



Acetone

The synthesis of these compounds is performed in liver mitochondria from acetyl-CoA. The process comprises several stages.

References:

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3. <https://www.healthline.com/nutrition/10-signs-and-symptoms-of-ketosis>
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5. <https://www.hsph.harvard.edunutritionsource/ketogenic-diet/>

What it is ?

The ketogenic or “keto” diet is a low-carbohydrate, fat-rich eating plan that has been used for centuries to treat specific medical conditions. In the 19th century, the ketogenic diet was commonly used to help control diabetes. In 1920 it was introduced as an effective treatment for epilepsy in children in whom medication was ineffective. The ketogenic diet has also been tested and used in closely monitored settings for cancer, diabetes, polycystic ovary syndrome, and Alzheimer’s disease.

However, this diet is gaining considerable attention as a potential weight-loss strategy due to the low-carb diet craze, which started in the 1970s with the Atkins diet (a very low-carbohydrate, high-protein diet, which was a commercial success and popularized low-carb diets to a new level). Today, other low-carb diets including the Paleo, South Beach, and Dukan diets are all high in protein but moderate in fat. In contrast, the ketogenic diet is distinctive for its exceptionally high-fat content, typically 70% to 80%, though with only a moderate intake of protein.

How it works ?

The premise of the ketogenic diet for weight loss is that if you deprive the body of glucose—the main source of energy for all cells in the body, which is obtained by eating carbohydrate foods—an alternative fuel called ketones is produced from stored fat (thus, the term “keto”-genic). The brain demands the most glucose in a steady supply, about 120 grams daily, because it cannot store glucose. During fasting, or when very little carbohydrate is eaten, the body first pulls stored glucose from the liver and temporarily breaks down muscle to release glucose. If this continues for 3-4 days and stored glucose is fully depleted, blood levels of a hormone called insulin decrease, and the body begins to use fat as its primary fuel. The liver produces ketone bodies from fat, which can be used in the absence of glucose.

When ketone bodies accumulate in the blood, this is called ketosis. Healthy individuals naturally experience mild ketosis during periods of fasting (e.g.,

sleeping overnight) and very strenuous exercise. Proponents of the ketogenic diet state that if the diet is carefully followed, blood levels of ketones should not reach a harmful level (known as “ketoacidosis”) as the brain will use ketones for fuel, and healthy individuals will typically produce enough insulin to prevent excessive ketones from forming. How soon ketosis happens and the number of ketone bodies that accumulate in the blood is variable from person to person and depends on factors such as body fat percentage and resting metabolic rate.

The diet ?

There is not one “standard” ketogenic diet with a specific ratio of macronutrients ([carbohydrates](#), [protein](#), [fat](#)). The ketogenic diet typically reduces total carbohydrate intake to less than 50 grams a day—less than the amount found in a medium plain bagel—and can be as low as 20 grams a day. Generally, popular ketogenic resources suggest an average of 70-80% fat from total daily calories, 5-10% carbohydrate, and 10-20% protein. For a 2000-calorie diet, this translates to about 165 grams fat, 40 grams carbohydrate, and 75 grams protein. The protein amount on the ketogenic diet is kept moderate in comparison with other low-carb high-protein diets, because eating too much protein can prevent ketosis. The amino acids in protein can be converted to glucose, so a ketogenic diet specifies enough protein to preserve lean body mass including muscle, but that will still cause ketosis.

Many versions of ketogenic diets exist, but all ban carb-rich foods. Some of these foods may be obvious: starches from both refined and [whole grains](#) like breads, cereals, pasta, rice, and cookies; potatoes, corn, and other starchy vegetables; and fruit juices. Some that may not be so obvious are [beans](#), legumes, and most fruits. Most ketogenic plans allow foods high in saturated fat, such as [fatty cuts of meat](#), processed meats, lard, and butter, as well as sources of [unsaturated fats](#), such as nuts, seeds, avocados, plant oils, and oily fish. Depending on your source of information, ketogenic food lists may vary and even conflict.

The research so far:

The ketogenic diet has been shown to produce beneficial metabolic changes in the short-term. Along with weight loss, health parameters associated with carrying excess weight have improved, such as insulin resistance, high blood pressure, and elevated cholesterol and triglycerides. There is also growing interest in the use of low-carbohydrate diets, including the ketogenic diet, for type 2 diabetes. Several theories exist as to why the ketogenic diet promotes weight loss, though they have not been consistently shown.

- ❖ **A satiating effect with decreased food cravings due to the high-fat content of the diet.**
- ❖ **A decrease in appetite-stimulating hormones, such as insulin and ghrelin, when eating restricted amounts of carbohydrate.**
- ❖ **A direct hunger-reducing role of ketone bodies—the body's main fuel source on the diet.**
- ❖ **Increased calorie expenditure due to the metabolic effects of converting fat and protein to glucose.**
- ❖ **Promotion of fat loss versus lean body mass, partly due to decreased insulin levels**

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Our Observation

The below measurements and observations were taken on **AMAN KUMAR GUPTA**.

- Weight before the start of the keto diet: **69.9 kg**
- For the first week carbs intake were reduced 200gms for preparing the body for carb deficit.
- After the first week keto diet begins and carbs were gradually lowered to negligible level and no direct sources of carbs were taken. All the food that has been taken was high in fat and protein content with almost no carbs and still the total calorie deficit was maintained.
- After two days fatigue and dehydration was observed, this is the phase when body gets into the ketosis and the side effects that are felt are often called “keto flu”.
- On third day the odour of sweat was observed to be fruity.
- On fourth day the weight was measured and it was **68.1 kg**. It was around **2 kg** loss in just **4 days**, but after that the weight loss slowed down and reached a plateau on 9th day where the weight loss almost stopped at **67.5**.
- After this the re-feeding starts and carbs were gradually included in the diet.

In total 2.4kg was lost in just 9 days without any exercise.

Conclusion

- ✓ The weight lost in first 4 days were due to flushing of water because the glycogen stores were getting used up by the body, so no **fat** was lost during this period.
- ✓ During the keto flu i.e. the transition period between the carb to fat as a fuel source a lot of fatigue was observed due to loss of minerals with water.
- ✓ After 4 days i.e. after the keto flu the body was in ketosis, body odour change is a symptom for that.
- ✓ In total the Fat that has been lost was 0.6 kg.

In our opinion keto diet is a very effective diet for fat loss and it gives great results in very less time without exercising.