

Ketones Serum

Alternative Names

Acetone bodies; Ketones - serum; Nitroprusside test; Ketone bodies - serum

Biochemistry

Acetone, acetoacetate and beta-hydroxybutyrate are ketones (or ketone bodies) generated from carbohydrates, fatty acids and amino acids in humans and most vertebrates.

Ketones are elevated in blood after fasting including a night of sleep, and in both blood and urine in starvation, hypoglycemia due to causes other than hyperinsulinism, various inborn errors of metabolism, and ketoacidosis (usually due to diabetes mellitus).

Although ketoacidosis is characteristic of decompensated or untreated type 1 diabetes, ketosis or even ketoacidosis can as well occur in type II diabetes in some circumstances.

Acetoacetate and beta-hydroxybutyrate are an important fuel for many tissues, especially during fasting and starvation. The brain, in particular, relies heavily on ketone bodies as a substrate for lipid synthesis and for energy during times of reduced food intake. Ketones are referred to as 'magic' because of their ability to increase metabolic efficiency, while decreasing production of free radicals, the damaging byproducts of normal metabolism. It has been shown that ketone bodies may treat neurological diseases such as Alzheimer's and Parkinson's disease, and the heart and brain operate 25% more efficiently using ketones as a source of energy.

- The foods you eat break down into glucose (sugar). Glucose travels in the blood and into your cells. Insulin is a hormone (or 'key') that 'unlocks the doors of your cells' to allow glucose to enter your cells where it can be turned into energy. So without insulin, glucose would not be able to get into the cells.

- Your brain (and the rest of your body) requires glucose to function. When you have not eaten for a while, or during the night when you are asleep, your liver releases stored glucose to keep you supplied with energy.
- If you do not eat for several days, the stored glucose in the liver is depleted, and your body is in a starvation state. In this situation, the body will break down stored fat to get energy, (and ketones can show in the urine, indicating that fat was burned) and also the body will create sugar out of other substances in the body in order to supply the brain with glucose.

Keep in mind that fat is burned when there is no glucose available (that is, when the body is starving) and the presence of ketones indicate that fat was burned.

Reasons for the presence of ketones:

- *A non-diabetic* can show ketones if he/she has not eaten for several days, or is on a severe weight reduction diet. In this situation the body is starving, and there is not enough available glucose, so fat will burn for energy and the by-product, ketones, may show in the urine or blood.
- *Pregnancy:* During pregnancy, you are eating for two. If you are not eating enough, your body will burn fat to get more energy. In gestational diabetes (temporary diabetes during pregnancy) and in pregnancy with pre-existing diabetes, women are advised to check ketones each morning. If the blood glucose is normal but there are ketones present, usually the mother will be advised to increase her bedtime snack (but you should first check with your healthcare professional).
- *Hypoglycemia if you are taking diabetes medication:* When no glucose is available, your body is in a starvation state and will break down stored fat to get energy. It is not necessary to check

ketones during hypoglycemia and these ketones are harmless. When the blood glucose is low, it is most important to immediately correct it with proper treatment of a fast-acting sugar such as glucose tabs, fruit juice or a regular soft drink.

- *High blood glucose:* High blood glucose means you do not have enough insulin to allow the glucose to get into the cells, so the glucose is piling up in the blood and/or being excreted in the urine. Your body needs insulin to use glucose for energy. So if you do not have enough insulin, your body will start to burn fat for energy.
- *Insulin pump malfunction or dislodged pump set:* Insulin pumps provide a continuous delivery of background insulin. If the supply is disrupted due to a pump problem or a clogged / dislodged pump set, then no insulin would be available and, as noted above under 'high blood glucose,' you will start to burn fat for energy. Insulin pump users are trained to check ketones and to check the pump connections anytime there is unexplained high blood glucose, for the ketones may indicate a pump malfunction.
- *Illness/ stress:* When you are under physical or emotional stress, your body needs extra energy to fight it. Hormones are triggered, which tell the body to release stored glucose in an attempt to give you more energy. If you do not have enough insulin to help this glucose get into your cells, your body will again burn fat for energy.
- *Exercise:* Exercise requires extra energy. If you have not eaten enough or if you do not have enough insulin available to allow the glucose to get into the cells, again the cells are starving and will turn to fat for energy.

If you do not have enough insulin available in your body, and the blood glucose rises, your body will eliminate the glucose by passing it

into your urine. As your body takes fluid from everywhere it can to help dilute the urine and pass the sugar out, you will get dehydrated. Because the glucose is passing out through the urine, the body is starving and fat will burn. If the body burns too much fat too quickly, ketones will accumulate in your bloodstream. Ketones make your body too acidic, which will upset the body's chemical balance. Your body might not be able to excrete the ketones adequately. In this setting, if your glucose is high, you are dehydrated, and your ketones are large, then your body's chemical balance is disrupted and you could develop a life-threatening condition called ketoacidosis. Usually only people with type 1 diabetes are at risk for this condition, but everyone should know the signs of Ketoacidosis.

Signs of Ketoacidosis:

- Increased thirst
- Increased urination
- Dry mouth
- Labored breathing
- Fruity breath
- Nausea/vomiting
- Stomach pain
- Loss of appetite
- Fatigue, drowsiness
- Dry, flushed skin or fatigue

Testing for serum Ketones:

- Generally you should check for ketones if you are ill, pregnant, under stress or your blood glucose is over 250 mg/dl, but first check with your healthcare professional.
- According to the ADA Clinical Practice Recommendations, blood ketone testing is now preferred over urine testing for diagnosing and monitoring ketoacidosis.
- Follow the directions provided on the package. If you show any ketones in the urine or blood, call your healthcare professional right away.

Definition

This test measures the amount of ketones (substances produced when fat cells break down) in the blood.

How to Prepare for the Test

Fast for 4 hours before the test.

Why the Test is Performed

This test is used to diagnose ketoacidosis.

A normal test result would be negative, meaning there are no ketone bodies in the blood.

Normal value ranges may vary slightly among different laboratories.

What Abnormal Results Mean

A test result is positive if ketones are found in the blood. This may indicate:

- Alcoholic ketoacidosis
- Starvation
- Uncontrolled blood glucose in diabetics

False positives

The main purpose of testing is to detect diabetic ketoacidosis. A false positive is regarded as a positive result which is not likely to signal the start of diabetic ketoacidosis or agents which give a positive result in the absence of ketones. Testing may not be helpful and can be misleading if there is a chance of false positives. This may occur in non-diabetic (as well as in diabetic patients):

- Positive test result but ‘no’ ketones:
 - Some medication:
 - Levodopa for example sinemet
 - Phenazopyrazine

- Valproic acid
 - Vitamin C
 - Dehydration
- Positive result and ketones present but not relevant to diabetic ketoacidosis:
 - High fat diets (for example the Atkins diet)
 - Some metabolic disorders and inborn errors of metabolism (ketones but low or normal blood glucose)⁷
 - Starvation (as above)
 - Poisoning
 - Ether anaesthesia
 - Alkalosis

False negatives

Most urine testing kits detect acetoacetate not the predominant ketone beta-hydroxybutyrate. It is possible for the test to be negative with high levels of beta-hydroxybutyrate and then as ketoacidosis improves and ketone levels fall the urine test becomes positive (to acetoacetate).

The blood test can check for one type of ketone that the urine test cannot detect. Therefore, a urine test that does not show any ketones may not be accurate (false-negative result).

Ketone levels will increase in your urine before they increase in your blood if you are fasting or on a very low carbohydrate diet.

Ketones can be tested at home using urine ketone test strips. A more accurate reading can be obtained by some home glucose meters that test for blood ketones.

Considerations

A diet low in carbohydrates can increase ketone bodies.

Diabetes and Ketones

The presence of ketones in the bloodstream is a common complication of diabetes, which if left untreated can lead to ketoacidosis.

Sugar is the primary fuel that the body uses for energy. Insulin, a hormone produced in the pancreas that metabolises blood sugar, is either deficient or non-existent in the blood of diabetes patients. If the body cannot burn sugar, it will burn stored fat, and ketone build up will begin. When ketone levels become too high, the risk of ketoacidosis is raised, and this emergency condition can lead to coma and even death in serious cases.

All people with type 1 diabetes should be tested for ketones, and although type 2 diabetics are less likely to suffer the complications caused by ketones, it is essential to know what the symptoms are. Finding ketones present in your urine is a sign that the management of your disease needs adjusting.

Ketone testing should also be a matter of course for pregnant diabetics and women who develop gestational diabetes.

It is generally understood that testing should take place when fasting (i.e: when food has not been consumed for eight hours or more) and any of the following occurs:

- Blood sugar is on or above 250 mg/dl for two consecutive tests
- When any illness occurs (as even the most minor can cause ketones)
- If you vomit or suffer from diarrhea
- You suffer from depression or stress
- You fall pregnant

The test will not interfere with the management of you diabetes.

The ketone test is simple and involves a dip and read urine test strip. If the colour changes, there are ketones in your urine. Ketone test strips are available over the counter in some chemists. Should the tests show very small amounts of ketones take the following actions: Drink water every hour, and continue testing after every three hours.

If you are suffering from DKA (diabetic ketoacidosis) then early signs would be likely to include: stomach pains, nausea and/or vomiting, breathlessness, breath that smells of fruit. In this instance, call your doctor as soon as possible. Ketoacidosis is an extremely severe condition.