



Clinical Biochemistry (lab. 2)

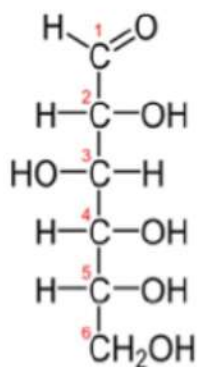


ESTIMATION OF BLOOD GLUCOSE

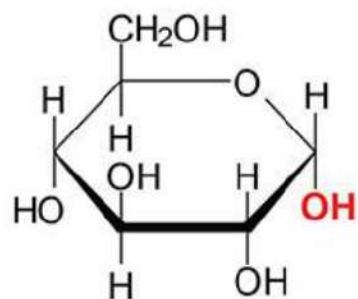


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Glucose is a simple sugar with the molecular formula $C_6H_{12}O_6$. It is referred to as an aldohexose because it contains six carbon atoms and an aldehyde group. The suffix **-ose** is used in biochemistry to form the names of sugars. Glucose is the most abundant monosaccharide, a subcategory of carbohydrates. It is the most important source of energy in all organisms and is mostly called a blood sugar. It is partially stored as a polymer, in plants mainly as starch and amylopectin and in animals as glycogen. The naturally occurring form of glucose is d-glucose, while L-glucose is produced synthetically. The glucose molecule can exist in equilibrium form in solution between an open-chain (Fischer projection) and ring form (Haworth projection).



cyclic Fischer projection



**α -D-Glucose
Haworth projection**

Biosynthesis of glucose

Glucose is produced by plants through the photosynthesis using sunlight, water and carbon dioxide and can be used by all living organisms as an energy. Excess of

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glucose does not store in its free form in the cells, but in its polymeric form such as glycogen (in animals and mushrooms) or starch (in plants). When the body needs glucose, glycogen is cleaved by specific enzyme to give free glucose in the process called glycogenolysis.

Glucose Oxidase for blood glucose estimation

PRINCIPLE OF THE METHOD

Glucose oxidase (GOD) catalyzes the oxidation of glucose to gluconic acid. The formed hydrogen peroxide (H_2O_2) react under catalysis of peroxidase (POD) with phenol and 4-aminophenazone to give a red-violet quinoneimine dye .

- $\beta\text{-D-glucose} + H_2O + O_2 \xrightarrow{\text{Glucose oxidase}} \text{D-gluconic acid} + H_2O_2$
- $H_2O_2 + 4\text{-aminophenazone} + \text{phenol} \xrightarrow{\text{Peroxidase}} \text{Quinonimine} + 4 H_2O$

The intensity of the color formed is proportional to the glucose concentration in the sample.

Glucose concentration in the sample is then calculated by using the equation below by using standard concentration (100 mg/dl or 5.55 mmol/l)

$$c = 100 \times \frac{\Delta A_{\text{sample}}}{\Delta A_{\text{STD}}} \text{ [mg/dl] or}$$
$$c = 5.55 \times \frac{\Delta A_{\text{sample}}}{\Delta A_{\text{STD}}} \text{ [mmol/l]}$$

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Normal Range of blood glucose

The normal blood glucose level (**tested while fasting**) for non-diabetics, should be between **(75 to 115 mg/dL)**.

2 hrs. **Postprandial** = **110 - 140 mg/dl**

To express the result in **mmol/L** divide by **18** (M.Wt of Glucose =180)

Hyperglycemia

Hyperglycemia is the technical term for high blood glucose (blood sugar). It occurs when the body does not produce or use enough insulin, a hormone that absorbs glucose into cells for use as energy.

Causes of hyperglycemia

A number of things can cause hyperglycemia:

- If you have type 1, you may not have given yourself enough insulin.
- If you have type 2, your body may have enough insulin, but it is not as effective as it should be.
- You ate more than planned or exercised less than planned.
- You have stress from an illness, such as a cold or flu.
- You have other stress, such as family conflicts or school or dating problems.
- You may have experienced (a surge of hormones that the body produces daily around 4:00 a.m. to 5:00 a.m.).

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symptoms of hyperglycemia

The signs and symptoms include the following:

- High blood sugar
- High levels of sugar in the urine
- Frequent urination
- Increased thirst
- Blurred vision
- Fatigue
- Headache

If hyperglycemia goes untreated, it can cause toxic acids (ketones) to build up in your blood and urine (ketoacidosis). Signs and symptoms include:

- Fruity-smelling breath
- Nausea and vomiting
- Shortness of breath
- Dry mouth
- Weakness
- Confusion
- Coma
- Abdominal pain

Treatment

While managing diabetes is an ongoing and often lifelong requirement, a person with diabetes can take steps to reduce spikes of high blood glucose.

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These include:

- **Exercise:** Physical activity can use excess glucose in the blood. However, if a person with severe hyperglycemia finds ketones in their urine, they should avoid exercise, as this breaks down more fats and might speed up ketoacidosis.
- **Moderating the diet:** Eating less during mealtimes and snacking less, as well as focusing on low-sugar foods, helps keep the amount of glucose at a level that the body can handle. A dietitian can help a person adapt their diet in gradual and healthful ways.
- **Altering medications:** A doctor may recommend changing the timings or types of medication and insulin a person is taking if they are not reducing blood sugar as they should.

Hypoglycemia

Hypoglycemia, also known as **low blood sugar**, is when blood sugar decreases to below normal levels (below **70 mg/dL**)

signs and symptoms of Hypoglycemia

signs and symptoms of low blood sugar include:

- Feeling shaky
- Being nervous or anxious
- Sweating, chills and clamminess
- Irritability or impatience

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- Confusion
- Fast heartbeat
- Feeling lightheaded or dizzy
- Hunger
- Nausea
- Color draining from the skin (pallor)
- Feeling Sleepy
- Feeling weak or having no energy
- Blurred/impaired vision
- Tingling or numbness in the lips, tongue, or cheeks
- Headaches
- Coordination problems, clumsiness
- Nightmares or crying out during sleep
- Seizures

Causes of Hypoglycemia

- Too much insulin
- Not enough carbohydrates
- kidney failure
- certain tumors
- liver disease

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- hypothyroidism
- starvation
- inborn errors of metabolism
- severe infections
- Excessive alcohol consumption
- too much exercise

Treatment of Hypoglycemia ("15-15 Rule")

The 15-15 rule—have **15 grams** of carbohydrate to raise your blood sugar and check it after **15 minutes**. If it's still below 70 mg/dL, have another serving.

Repeat these steps until your blood sugar is at least 70 mg/dL. Once your blood sugar is back to normal, eat a meal or snack to make sure it doesn't lower again.

This may be:

- Glucose tablets
- (1/2 cup) of juice or regular soda (not diet)
- 1 tablespoon of sugar, honey, or corn syrup
- Hard candies, jellybeans, or gumdrops