Vishwendu Vidya Prasarak Mandal's
(Regd. No: MAH 1906 / F-1614; Dt.5/3/1987)
Abhinav Vidyalay & Junior College
(Govt. Regd. No. Prim.Edu. 6-970,90-91 Dtd:16-8-90; Index No: Sec:16.17.019 / 020; H.Sec: J16.17.24)
Contact: +91(0)251 2472232 admin@abhinav.ac.in; www.abhinav.ac.in

B12_Ph123_Urine_ Analysis

Normal urine in humans is usually a transparent, yellow liquid. The average person eliminates from 1,134 to 1,700 g (40 to 60 oz), or about 1.4 liters (2.4 pt), of urine daily. Normal urine contains 96 per cent water and 4 per cent solids in solution. About half of the solids consist of urea, the main product broken down in the metabolism of protein. The remainder includes nitrogen, chlorides, ketosteroids, phosphate, sulphur, ammonia, creatinine, and uric acid.

Composition of Human urine -

Analysis of urine is often used in diagnosis of disease. Excessive urination is characteristic of diabetes insipidus and occurs to a lesser extent in diabetes mellitus. High or continuous fever produces some dehydration and an abnormally low output of urine. In patients suffering from hepatitis, the colour of urine is dark because of bile pigments in the urinary system. The quantity of urea is increased in feverish conditions and diabetes mellitus and is decreased during inflammation of the kidney or disturbance of the body's acid-base balance. Abnormally large amounts of uric acid are present in the urine of leukemia patients and gout sufferers.

The urinary systems of reptiles and birds are designed to conserve water; the urine of these animals is a solid or semi-solid mass. Instead of producing urea as a product of protein metabolism, they produce uric acid, which is almost insoluble in water. In some fish, water is conserved by the build-up of high concentrations of urea, which causes the body to absorb water by osmosis.

Analysis of urine For abnormal substances -

The appearance of abnormal substances in the urine is even more important than changed quantities of substances normally present. In a kidney disease known as albuminuria, serum albumin escapes into the urine. In diabetes mellitus, glucose appears in the urine. Pus and bacteria are present in the urine of those suffering from infectious diseases of the urinary system. Red blood cells indicate possible haemorrhage or cancer in the urinary tract, or cystitis (inflammation of the bladder). Crystals of sulpha drugs indicate deposition of these drugs in the kidneys. Crystals of various substances also appear in the urine when stones form in the urinary system. A urinary stone may be passed with the urine, causing severe pain and sometimes haemorrhage

Glucose

It is a monosaccharide sugar, $C_6H_{12}O_6$. It is found in honey and the juices of many fruits; the alternative name grape sugar is derived from the presence of glucose in grapes. It is the sugar most often produced by hydrolysis of natural glycosides. Glucose is a normal constituent of the blood of animals. Glucose is a white crystalline solid, less sweet than ordinary table sugar. It occurs in three different forms, a-glucose, b-glucose. Glucose can act as a monomer. Molecules of its alpha form can be joined by glycosidic bonds to form the polymers of starch and glycogen, while molecules of b-glucose can also polymerize to form long chains of cellulose. The subtly different positioning of the side groups in b-glucose means that this molecule and the cellulose polymer cannot be "recognized" by the human enzyme a-amylase and so they cannot be digested by humans. Glucose itself is formed by the hydrolysis of many carbohydrates, including sucrose, maltose, cellulose, starch, and glycogen. Fermentation of glucose by yeast produces ethyl alcohol and carbon dioxide. Glucose is made industrially by the hydrolysis of starch under the influence of dilute acid or, more commonly, under that of enzymes. It is chiefly used as a sweetening agent in the food-processing industries. It is also used in tanning, in dye baths, and in medicine for treating dehydration and for intravenous feeding.

Sugar Metabolism

It is a process by which the body uses sugar for energy. Carbohydrates, one of the three principal constituents of food, form the bulk of the average human diet. The end product of the digestion and assimilation of all forms of carbohydrate is a simple sugar, glucose, commonly called grape sugar when found in food, or blood sugar when

found in the human body. Glucose is the principal fuel that the muscles and other portions of the body consume to produce energy. It is present in every cell and almost every fluid of the body, and its concentration and distribution are among the most important processes in human physiology. A few other sugars are of comparatively minor importance in human physiology, notably lactose, or milk sugar, which is formed in the mammary glands of all lactating animals and is present in their milk.

Carbohydrates such as starch, dextrin, glycogen (animal starch), sucrose (cane sugar), maltose (malt sugar), and lactose are broken down in the digestive tract into simple, six-carbon sugars that pass easily through the intestinal wall. Fructose (fruit sugar) and glucose are unchanged in the digestive tract and are absorbed as such. Cellulose, a common constituent of many foods, is an important nutritional element for some animals, notably cattle and termites, but although important to digestion as a whole, has no value in human nutrition.

The digestion of carbohydrates is performed by various enzymes. Amylase, found in saliva and in the intestine, breaks starch, dextrin, and glycogen into maltose, a 12-carbon sugar. Other sugar-converting enzymes in the small intestine break 12-carbon sugars into 6-carbon sugars. Maltase breaks maltose into glucose; sucrase, or invertase, breaks cane sugar into glucose and fructose; lactase breaks milk sugar into glucose and galactose.

The six-carbon sugars, which become the end products of carbohydrate digestion, pass through the wall of the small intestine into minute blood vessels and thence into the portal vein, which carries them to the liver. They are then converted into a single compound, glycogen (see Starch), which is stored there. This glycogen is available at all times and is converted to glucose and released into the bloodstream as required by the body

The uptake of glucose by cells is stimulated by insulin. Before glucose is used it is converted to glucose-6-phosphate (by hexokinase), which may be metabolized or (in the liver and in muscle) converted to uridine diphosphate glucose. From the latter compound glucose is transferred to glycogen, in a reaction catalyzed by glycogen synthetase and stimulated by insulin. By as yet unknown mechanisms, cortical and pituitary hormones as well as thyroxin are also involved in the control of carbohydrate metabolism. If the body produces too much pituitary hormone or too little insulin, the amount of sugar in the blood rises abnormally, producing a condition known as hyperglycaemia. In hyperglycaemia the blood may contain as much as four times the normal amount of sugar. Hyperglycaemia in itself is not lethal, but it is a symptom of a serious disease, diabetes mellitus. Diabetes is sometimes caused by a tumour or other condition in the pancreas that prevents the formation of insulin. Diabetic patients do not die of hyperglycaemia, but if they are not given injections of insulin they may die from such causes as the accumulation of poisons in the body, produced by altered metabolism of fats; the body of the diabetic consumes fats as a substitute for the sugar that it cannot use.

If an excessive amount of insulin is injected into the body, the amount of sugar is reduced to a dangerously low level, a condition known as hypoglycaemia or insulin shock. Controlled insulin shock is sometimes used in the treatment of certain types of mental illness.
In a normal individual, if the amount of sugar in the blood rises abnormally, the excess is removed from the blood by the kidneys and excreted in the urine. The presence of sugar in the urine is called glycosuria, and although it is an important symptom of diabetes, it is not always found in diabetic patients; moreover, glycosuria may appear in normal individuals immediately after a large meal. The critical test for diabetes is neither hyperglycaemia nor glycosuria, but blood-sugar tolerance: after ingesting sugar, both normal and diabetic individuals show an increased percentage of blood sugar; the percentage remains high in the diabetic, whereas in the normal individual the excess glucose is rapidly converted into glycogen.

All sugars (glucose, lactose, fructose, and pentose) reduce copper sulphate in alkaline solution to insoluble yellow red cuprous oxide; Special tests are required for identification of different sugars occurring in urine. The hexose sugars glucose & fructose are monosaccharide possessing 3 to 7 number of carbon atoms. These are main sources of energy in cells. The pentose sugars ribose & deoxy ribose are the components of nucleic acid

Simple monosaccharides are the reducing agents. This property is useful in detecting &estimating percentage of glucose in blood & in urine in diagnosis of diabetes mellitus

Albumin

It is one of a class of simple proteins, composed of carbon, hydrogen, oxygen, nitrogen, and a small percentage of sulphur. Albumin is coagulable by heat, mineral acids, alcohol, and ether, and is soluble in water and in a weak salt solution. An important part of the diet, albumin is present in animal tissues such as egg white, milk, and muscle and is found in blood plasma; it also occurs in plants, especially in seeds.

Methods used for qualitative examination are based on precipitation of proteins by chemical agents. The proteins (Album, globulin) in Urine precipitate i.e. become insoluble due to precipitation (denaturing) agent like Sulpho-salicylic acid, Alcohol etc.

Nephrities or inflammation of the kidney, is one of the commonest kidney diseases. Its chief characteristics are the appearance in the urine of such elements as albumin, a condition known as albuminuria; red and white blood cells; and hyaline or granular casts, all revealed by microscopic examination of the urine. It is much more common in childhood and adolescence than in middle age.

Nephrosclerosis, or hardening of the small arteries supplying the kidney, is a disorder characterized by the presence of albumin, casts, and occasionally white or red blood cells in the urine (haematuria); it usually accompanies hypertensive vas cular disease. Its fundamental lesion is a sclerosis of the small arteries of the kidney, with secondary atrophy of the glomeruli and pathological changes in the interstitial tissue.

Ascites (accumulation of fluid in the peritoneal cavity of liver), is caused because of the increased pressure in the portal vein and the lack of albumin in the plasma (albumin is normally made by the liver).
The first stageof yellow fever is also characterized by nausea, vomiting, and presence of albumin protein in the urine.

Urea,

It is colourless, crystalline compound, CO(NH2)2, with melting point 132.7° C (270.9° F), also known as carbamide. It is found abundantly in the urine of humans and other mammals .In lesser quantities, it is present in the blood, liver, lymph, and serous fluids and is found in the excrement of fish and many other lower animals. Urea is produced mostly in the liver as the end product of protein metabolism. The nitrogen in urea, which constitutes most of the nitrogen in the urine, is produced main ly from food protein, but part comes from the breakdown of body cells. Urea is also present in various fungus moulds as well as in the leaves and seeds of numerous legumes and cereals. The compound is soluble in both water and alcohol and is slightly soluble in ether. Urea is prepared synthetically by the Wöhler synthesis, which was devised in 1828 by the German chemist Friedrich Wöhler.

Because of its high nitrogen content, commercially prepared urea is used in the manufacture of agricultural fertilizers. Urea is also employed as a stabilizer in nitrocellulose explosives and is a basic constituent of synthetically prepared resins.

The urea cycle (also known as the ornithine cycle) is a cycle of biochemical reactions occurring in many animals that produces urea from ammonia (NH3). This cycle was the first metabolic cycle discovered (Krebs and Kurt Henseleit, 1932). In mammals, the urea cycle takes place only in the liver.

Organisms that cannot easily and quickly remove ammonia usually have to convert it to some other substance, like urea or uric acid, which are much less toxic. Insufficiency of the urea cycle occurs in some genetic disorders (inborn errors of metabolism), and in liver failure. The result of liver failure is accumulation of nitrogenous waste, mainly ammonia, which leads to hepatic encephalopathy.

Uric Acid, is white, tasteless, and odourless nitrogenous compound, $C_3H_4N_4O_3$, formed in the body as a result of protein metabolism. It is present in small amounts in human urine, and in large amounts in the urine of birds and reptiles. Uric acid is only slightly soluble in water and is insoluble in alcohol and ether. When heated, the acid forms urea, ammonia, and carbon dioxide. Gout is a result of a disturbance in uric acid metabolism. Kidney stones formed by salts of uric acid occur in people with high levels of uric acid in the urine.