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QUESTION

WRITE A SHORT NOTE ON THE CHARACTERISTICS AND COMPONENTS OF URINE

Urine color is an indicator for hydration.

Urine pH is often influenced by diet.

Urine smell indicates age of the urine and may indicate the presence of glucose and ketones.

Urinalysis is the process of analyzing and detecting chemicals excreted in urine.

Urine: A liquid excrement consisting of water, salts, and urea, which is made in the kidneys then released through the urethra.

Urinalysis: A urinalysis (UA), also known as Routine and Microscopy (R&M), is an array of tests performed on urine, and one of the most common methods of medical diagnosis.

Urine, a typically sterile liquid by-product of the body, is secreted by the kidneys through a process called urination and excreted through the urethra. Urine is often used as a diagnostic feature for many disease conditions. These may be based on either physical or chemical components that may give insight to processes within the body, often through urinalysis, a common clinical analysis of urine.

PHYSICAL CHARACTERISTICS

Physical characteristics that can be applied to urine include color, turbidity (transparency), smell (odor), pH (acidity – alkalinity) and density. Many of these characteristics are notable and identifiable by vision alone, but some require laboratory testing.

- Color: Typically yellow-amber, but varies according to recent diet and the concentration of the urine. Drinking more water generally tends to reduce the concentration of urine,

and therefore causes it to have a lighter color. Dark urine may indicate dehydration. Red urine indicates red blood cells within the urine, a sign of kidney damage and disease.

- Smell: The smell of urine may provide health information. For example, urine of diabetics may have a sweet or fruity odor due to the presence of ketones (organic molecules of a particular structure) or glucose. Generally fresh urine has a mild smell but aged urine has a stronger odor similar to that of ammonia.

The pH of normal urine is generally in the range 4.6 – 8, with a typical average being around 6.0. Much of the variation occurs due to diet. For example, high protein diets result in more acidic urine, but vegetarian diets generally result in more alkaline urine (both within the typical range of 4.6 – 8).

- Density: Density is also known as "specific gravity." This is the ratio of the weight of a volume of a substance compared with the weight of the same volume of distilled water. The density of normal urine ranges from 0.001 to 0.035.
- Turbidity: The turbidity of the urine sample is gauged subjectively and reported as clear, slightly cloudy, cloudy, opaque or flocculent. Normally, fresh urine is either clear or very slightly cloudy. Excess turbidity results from the presence of suspended particles in the urine, the cause of which can usually be determined by the results of the microscopic urine sediment examination. Common causes of abnormal turbidity include: increased cells, urinary tract infections or obstructions.

Abnormalities in any of these of physical characteristics may indicate disease or metabolic imbalances. These problems may seem superficial or minor on their own, but can actually be the symptoms for more serious diseases, such as diabetes mellitus, or a damaged glomerulus.

Normal Chemical Composition of Urine

Urine is an aqueous solution of greater than 95% water, with a minimum of these remaining constituents, in order of decreasing concentration:

Urea 9.3 g/L.

Chloride 1.87 g/L.

Sodium 1.17 g/L.

Potassium 0.750 g/L.

Creatinine 0.670 g/L.

Other dissolved ions, inorganic and organic compounds (proteins, hormones, metabolites).

Urine is sterile until it reaches the urethra, where epithelial cells lining the urethra are colonized by facultative anaerobic gram-negative rods and cocci. Urea is essentially a processed form of ammonia that is non-toxic to mammals, unlike ammonia, which can be highly toxic. It is processed from ammonia and carbon dioxide in the liver.

Abnormal Types of Urine

There are several conditions that can cause abnormal components to be excreted in urine or present as abnormal characteristics of urine. They are mostly referred to by the suffix -uria. Some of the more common types of abnormal urine include:

Proteinuria—Protein content in urine, often due to leaky or damaged glomeruli.

Oliguria—an abnormally small amount of urine, often due to shock or kidney damage.

Polyuria—an abnormally large amount of urine, often caused by diabetes.

Dysuria—Painful or uncomfortable urination, often from urinary tract infections.

Hematuria—Red blood cells in urine, from infection or injury.

Glycosuria— Glucose in urine, due to excess plasma glucose in diabetes, beyond the amount able to be reabsorbed in the proximal convoluted tubule.

Regulation of Urine Concentration and Volume

Antidiuretic hormone (ADH) is produced by the pituitary gland to control the amount of water that is reabsorbed through the collecting ducts.

Urine Composition

Over 99 percent of urinary solutes are composed of only 68 chemicals which have a concentration of 10 mg/L or more. 42 compounds are actually involved. They may be classified as follows:

Electrolytes such as sodium, potassium, calcium, magnesium and chloride

Nitrogenous chemicals such as urea and creatinine

Vitamins

Hormones

Organic acids such as uric acid

Other organic compounds

Total Dissolved Solids

Total dissolved solids in urine constitute between 24.8 to 37.1 g/kg. Urinary solids are primarily made up of organic matter, largely volatile solids. Urine has large amounts of nitrogen, phosphorus, and potassium. Nitrogen content in urine is high, mostly in urea, which makes up more than 50 percent of the total organic acids. This includes urea from protein metabolism, sodium and potassium both of which come from food. Dry solids thus comprise 14-18 percent nitrogen, 13 percent carbon, and 3.7 percent each of potassium and phosphorus. The largest excretion of these substances from the body is through urine.

Nitrogen Excretion

Nitrogen in urine is excreted mostly as urea, with about 11 g per day being the average excretion of nitrogen. It is most significantly affected by dietary protein intake, with a correlation of 0.91 existing between protein in diet and urinary nitrogenous components. About 80 percent of the dietary intake of nitrogen is balanced by the urinary excretion of nitrogenous compounds. Urinary urea concentration ranges from 9 to 23 g/L.

Creatinine is another important nitrogenous compound in urine, and its level depends on the body mass and muscle mass, as well as age. Gender differences may be correlated with these. On average, creatinine production in the body is about 1.6 g/day.

Nitrate is a third nitrogenous compound in urine, with increased concentrations if the person has a high protein diet.

In addition to causing alterations in urinary nitrogen concentrations, protein in diet also affects the levels of other minerals such as phosphorus and potassium. Additionally, an extremely low intake of protein may affect calcium levels.

Calcium in Urine

Calcium excretion is affected by protein intake, as above, and is heavily influenced by sodium excretion. A low sodium diet, therefore, will decrease calcium excretion and vice versa.

A normal urinary sample from an adult collected over 24 hours should receive a calcium level of 100 to 250 mg.

Other Ions

Other less common ionic groups in urine include ammonium, sulfates from amino acids, and phosphates depending on parathyroid hormone levels.

Overall Solute Concentrations

The concentration of the following constituents in urine may be regarded as a careful approximation:

Urea: 9.3 g/dSL

Creatinine: 0.670 g/ L

Sodium: 1.17 g/L

Potassium: 0.750 g/L

Chloride: 1.87 g/L