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Influence of Body Conditions on Urine Production and Identification of Abnormal or Pathological Substances in the Body

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analysis, chloride, glucose, metabolism, pH, urine

ABSTRACT
The background of this study is based on the importance of urine as a health indicator, which reflects the body's metabolic condition and can identify the presence of abnormal or pathological substances. Urine contains various organic and inorganic compounds that can change depending on a person's health condition, such as diabetes or pregnancy. The objective of this study is to analyze the influence of bodily conditions on urine production and to identify abnormal substances in urine using various chemical tests. The research method involves testing urine samples from healthy individuals, pregnant women, and diabetes patients using pH, chloride, sulfate, phosphate, glucose, and albumin tests. The results of the study showed significant differences in urine composition between normal and abnormal samples, such as more acidic pH in diabetic urine and the presence of glucose and protein in certain urine. The implications of this study contribute to early diagnosis and health condition monitoring through urine analysis, as well as providing a basis for the development of more accurate and efficient examination methods.

INTRODUCTION

Urine is formed in the kidneys, mainly from undigested food residues that end up in the large intestine (Liu et al., 2020). The urinary tract system serves to remove excess water, salt, and nitrogen waste from the body, while also keeping the bladder in a full and moist state (Zhang, 2024). Urine plays a role in maintaining a normal balance of water and electrolyte concentrations in body fluids (Balkrishna, 2018). The renal system's regulation of fluid balance is critical for maintaining homeostasis, particularly during dehydration or overhydration (Bai et al., 2021). Additionally, urine composition can serve as a diagnostic tool for detecting various health conditions, such as kidney disease and diabetes (Zhao & Li, 2021). Proper renal function is essential to the body's ability to efficiently filter and excrete waste products (Rao et al., 2020).

Maintaining the balance of glucose in the body is the main responsibility for the human body because glucose serves as the main source of energy (Martinez et al., 2020). A disturbance in maintaining glucose levels in the normal range, which is usually around 4.6 mM in the blood during fasting, can result in hyperglycemia or hypoglycemia (Kumar & Prasad, 2019). Both of these conditions are commonly associated with type 1 and type 2 diabetes (Rao et al., 2021). The regulation of blood glucose levels is mainly controlled by insulin and glucagon, which

work together to maintain homeostasis (Li & Chen, 2022). In individuals with diabetes, the body's ability to produce or respond to insulin is impaired, leading to either insufficient insulin production or insulin resistance (Zhang & Zhang, 2020). Persistent hyperglycemia can result in severe complications, including cardiovascular diseases, kidney failure, and nerve damage (Wang et al., 2021). Managing glucose levels effectively is crucial for preventing long-term complications associated with diabetes (Singh et al., 2021).

Hyperglycemia often occurs in conditions such as type 2 diabetes, where the body cannot use insulin effectively or cannot produce enough insulin. This causes the accumulation of glucose in the blood that exceeds the normal threshold. Meanwhile, hypoglycemia can occur in individuals with type 1 diabetes or in those who experience extreme hunger or fatigue, where blood glucose levels drop below normal thresholds. Both of these conditions have a serious impact on health and can result in long-term complications if left untreated. A common tool in clinical biochemistry is urine test strips, which are useful for diagnosing various diseases such as kidney, liver disease, and some metabolic disorders. These test strips allow for quick and easy testing of urine components, such as protein, glucose, ketones, blood, and pH. Through the interpretation of the test strip results, it is possible to identify abnormalities in the body that may be related to specific diseases or conditions. Urine test strips are essential in facilitating the early diagnosis and effective management of the disease. (Pohanka and Zakova, 2024)

Urine color observation is an economical and simple technique to evaluate the body's overall hydration level. The importance of this lies in the fact that hydration monitoring is a crucial aspect in maintaining optimal physiological function and performance. During physical activity, acute dehydration can cause impaired cognitive and motor performance, and can increase symptoms such as tension, fatigue, and anxiety. By observing the color of the urine, one can get clues about their body's hydration level. It is an easy-to-do method and can provide valuable information about a person's health condition quickly and efficiently. (Belasco *et al*., 2020)

RESEARCH METHODS

The research method of the influence of body conditions on urine production and the identification of abnormal substances or pathologies in the body uses various tools and materials. The research method involves testing urine samples from healthy individuals, pregnant women, and diabetes patients using pH, chloride, sulfate, phosphate, glucose, and albumin tests. The tools needed are test tubes, dropper pipettes, measuring cups, label paper, test tube racks, thermometers, beaker glass, water baths, bunsen, matches, pH paper. The ingredients needed to conduct this study are diluted HNO3, diluted AgNO3, diluted HCl, ammonium molybdate benedict reagent, glucose oxidase, normal female urine, normal male urine, pregnant urine, diabetic urine. This research was also carried out using various tests such as pH test, chloride test, sulfate test, phosphate test, glucose test, and albumin test. The pH test is carried out by inserting urine samples into each labeled test tube and then inserting pH paper which can later determine the pH level indicator in the urine.

The chloride test was carried out by inserting urine into each test tube as much as 5 ml, adding 5 drops of diluted HNO3 to each urine sample and homogenizing. Observe and record the changes that occur. Then drop 5 drops of AgNO3 into each urine sample and homogenize it, then wait for the precipitation to occur then note the color change and precipitation that appears in all samples. The Sulfate test can be done by inserting urine into each test tube as much as 5 ml, adding 5 drops of diluted HCl solution to each urine sample and homogenizing it, then observing and recording the changes that occur. After that, add 3 ml of BaCL2 solution to each sample that has been given HCL and homogenize it until evenly distributed and observe the changes.

The Phosphate Test can be done in the same way as putting urine in each test tube as much as 5 ml, then acidifying each urine sample with 5 drops of HNO3 solution and homogenizing it until evenly distributed then observe and record the changes that occur. After that, add 2 drops of ammonium molybdate solution to each sample that has been given HNO3 and homogenize. Then place each sample into a beaker glass filled with 60°C water and observe and record the changes that occur. The glucose test can be done by inserting 3 ml of benedict reagent into 4 test tubes. Then add 10 drops of urine samples to each test tube then heat each urine sample on top of the bunsen to a boil and observe the changes. The albumin test can also be done by inserting 5 ml of urine and heating the urine to a boil in the test tube, adding 2 drops of acetic acid, if cloudy in each urine. Then compare the color and precipitation from before heating and after the acetic acid is applied.

RESULT AND DISCUSSION

Table 1. pH Test

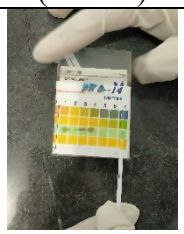
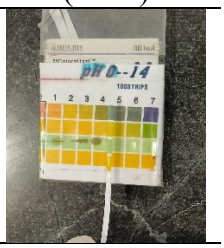
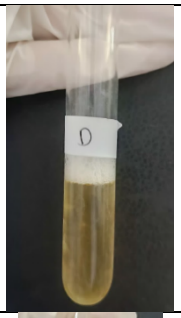
Test type	pH Test Results			
Probandus	Normal male	Normal women	Pregnant women	Diabetics
Ph	D-tube 7 (neutral)	C Tube 7 (neutral)	Tube B 6 (asam)	Tube A 5 (asam)
Picture				

Table 2. Chloride Test

Urine sample	Before (urine+HNO3)	After AgNO3 is added	Picture
Normal male urine	No deposit, slightly clear	A little bit of sediment, a little yellowish clear	
Normal female urine	No deposit, slight yellow	No deposit, slight yellow	

Urine of pregnant women	No deposit, deep yellow	No deposit, slight yellow	
Diabetic urine	No deposits, clear yellow	Foamy, no deposit, slightly yellow	

Table 3. Sulfate Test

Probandus	Color before	Treatment		Picture
		After being given HCl	After being given HCl & BaCl2	
Normal male urine	Clear yellow	Foamy yellow	Foamy yellow, there is a deposit	
Normal female urine	Clear	Clear	Slightly foamy clear	

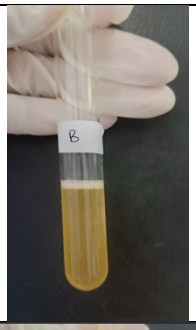
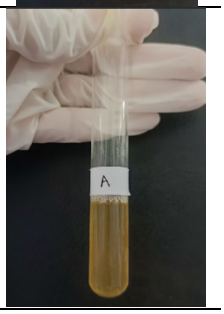
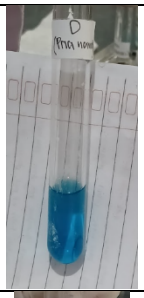
Urine of pregnant women	Cloudy yellow	Cloudy yellow	Cloudy yellow, foamy, there is sediment	
Diabetic urine	Pale yellow	Pale yellow	Cloudy yellow, there is sediment	

Table 4. Phosphate Test

Urine sample	Before color (urine+HNO3)	After added (Ammonium molybdate + heated)
Normal male urine	Yellow	There is a deposit
Normal female urine	Yellow	There is a deposit
Urine of pregnant women	Yellow	There is a deposit
Diabetic urine	Yellow	There are greenish-colored deposits

Table 5. Glucose Test

Urine sample	Before	After heating	Picture
Normal male urine	Blue	No deposits, Clear blue in color, there are white particles floating	
Normal female urine	Blue	Blue, cloudy, white particles, there are deposits	

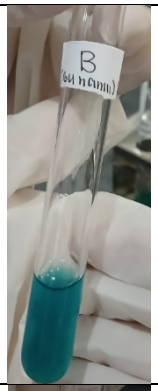
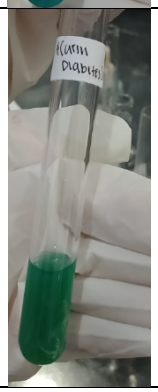
Urine of pregnant women	Blue	White particles float, blue in color there are white deposits	
Diabetic urine	Blue	It is green, has yellow deposits	

Table 6. Albumin Test

Probandus	Before	After being given acetic acid	Picture
Normal male urine	Clear yellow	Clear yellow, there are deposits, producing very little foam	
Normal female urine	Orange in color (not clear & not cloudy)	Slightly clear yellow, slightly foamy	

Urine of pregnant women	Orange clear orecity	Slightly cloudy yellow, slightly foamy	
Diabetic urine	Clear	Clear, produces a lot of foam	

Urine is a complex mixture of various organic and inorganic substances that reflect metabolic processes in the body. The composition of urine often changes along with a person's health condition. Changes in the composition of urine are often associated with certain diseases. By studying these changes, medical personnel can better identify and diagnose diseases. (Sarma and Riyat, 2007)

A healthy individual's urine contains about 150 mg of total protein in a single day, with about 20 mg being albumin, which is a type of human serum protein. (Aitekenov et al., 2021) Even clear urine does not always indicate a normal state. Abnormal levels of glucose, protein, red blood cell fractions, or white blood cells can be present in clear and seemingly negative urine. Normal urine usually has a distinctive, faint and non-pungent odor. However, if normal urine is left at room temperature and under certain circumstances, the smell of the urine can become strong and contain ammonia due to the process of converting urea to ammonia by bacteria. Naturally, the urinary tract in the body is sterile. However, when urine is excreted from the body through the urethra, it is easily contaminated with the normal bacterial flora found on the surface of the skin. (Brunzel, 2016)

Abnormal urine is an example in diabetics where the kidneys are unable to absorb glucose which is then excreted through the urine, a condition called glycosuria. In another disorder called renal glycosuria, glucose levels in the urine can be high even though blood glucose levels are normal. Thus, the function of the kidneys can only be detected through monitoring glucose levels in the urine. Diabetes Mellitus (DM) is defined as a non-communicable disease that accounts for the majority of deaths between the ages of 30 and 69. Chronic disorders caused by a combination of genetic, physiological, environmental and behavioral factors are referred to as non-communicable diseases (NCDs).

Proteinuria, which is the presence of protein in the urine that exceeds 150 mg in a 24-hour period, is an abnormal condition that often occurs in pregnant women. This can occur due to decreased kidney function, where proteins that normally dissolve in heating can cross the glomerulus and tubules, causing the protein to be detected in the urine (proteinuria). Proteinuria is one of the important indicators in the diagnosis of preeclampsia and eclampsia in pregnant

women.

Although under physiological conditions, protein in urine can be present in amounts less than 200 mg per day and is temporary. The method of determining protein levels in urine is often done by checking the turbidity of the urine. Protein deficiency during pregnancy can negatively impact the development of the fetus' brain, muscles, and organs. If this condition persists in the long term, the risk of health problems such as lack of learning ability, decreased resistance to disease, and increased risk of metabolic diseases such as diabetes and heart disease in babies can increase in the future.

The excretory system is a mechanism by which the body removes the residual substances of metabolic results that are no longer needed. These metabolic remnants often contain compounds that are toxic in nature, and if not removed, can interfere with the functioning of organs in the body. The kidneys, lungs, skin, and liver are the main organs that play a role in the excretory system. (Legiawan and Agustina, 2021)

The kidneys are a key element in the formation of urine, which is an important part of the human excretory system. The lungs play a role in the production of residual substances in the form of CO2 (carbon dioxide) and H2O (water vapor) gases through the respiratory process. The skin has the ability to produce waste substances in the form of sweat. The liver produces waste substances in the form of bile sap that come from the breakdown of red blood cells that have been damaged and broken down in the spleen.

The tool used in the chloride test practicum, namely, the test tube, functions as a testing place or mixing of urine and reagents. Drip pipettes, function to transfer urine or solution into a test tube on a small scale. Measuring cups, used to measure the amount of solution or urine needed before being put into the test tube. Label paper, used to give identity to each test tube. The test tube rack is used as a place to put the test tube so that it does not fall or break. Thermometers are used to measure temperature. pH paper is used to determine Ph. Beaker glass to mix the solution. Water cooler to heat the solution. Bunsen to heat, and matches to light Bunsen.

The material used in the chloride test practicum, i.e., diluted HNO3, is used to acidify 5ml of urine. Dilute AgNO3, used to indicate the presence or absence of chloride through an indicator of the presence of white deposits. Normal female urine, Normal male urine, Pregnant urine, diabetic urine are used as urine analysis test materials. Diluted HCl to determine the presence of white BaSO4 deposits as an indication of the presence of sulfates. Benedict reagent to confirm the glucose test in the urine. Ammonium molybdate is used to indicate the presence of phosphate. Glucose oxidase is used to test glucose in urine, but glucose oxidase is often invalid.

The pH test, based on the results of pH observations obtained from each probandus urine, was in accordance with what was expected. For normal male and normal female urine, it is appropriate, namely the acquisition of pH 7 (Neutral). For the urine of pregnant women is in accordance with the acquisition of pH 6 (acidic). For the urine of diabetics is also in accordance with the acquisition of pH 5 (acidic).

Chloride test, From the results of several urine tests, the urine that was seen to have deposits was only in normal male urine. in other urine is still not clearly visible. The presence of chloride content in urine comes from salts that enter the body through food, for example, NaCl which will then be broken down into ionic ions in body fluids. Chloride will always be present in a person's urine, this is because in filtration small molecules such as glucose and mineral salts are reabsorbed through active transport. The excess NaCl produced from the augmentation process is excreted through the urine in the form of Cl ions. In other urine whose chloride is not visible, this can possibly occur due to the fasting situation so that they do not consume much salt. Then for the urine of pregnant women, the precipitation factor is not visible

because the pregnant woman consumes very little salt, and consumes more sugar to increase the weight of the baby in the womb.

Sulfate test, in the female urine sulfate test, there should be sediment, there may be no deposits because probandus drinks too much water so the test results obtained do not contain sediment. All normal or abnormal urine contains sulfuric acid. Excessive consumption of water can cause toxins in the urine. The differentiating factors are Ph and food consumption.

The Phosphate Test, based on the results of the observations that have been obtained, shows that the results of the phosphate test are as expected. It's just that the table presented does not refer to the real results obtained. Because actually no expected reaction was found due to the unavailability of a reagent to detect the presence of phosphate in urine, namely ammonium molybdate.

Glucose Test, in the glucose test, there is a change in the color of the urine, due to the presence of a double bond reaction and the presence of glucose that causes a change in color. In the urine of normal women, normal men, and pregnant women, the color produced is clear blue and cloudy, and has white particles that float, and the presence and absence of deposits. Then diabetic urine shows a green color and yellow deposits which means it contains a lot of glucose.

The albumin test on the observation results obtained, normal male probandus urine has deposits. If there are deposits in the albumin test, probandus can be categorized as suffering from albuminuria because the protein content in the urine is too high.

CONCLUSION

Identifying normal metabolic results in urine is an important process in monitoring a person's health. Various residual substances from the body's metabolism, such as urea, creatinine, uric acid, and other metabolic products, are excreted through the urine. The amount and type of these substances in the urine can provide clues about the function of vital organs, such as the kidneys and liver. In addition, observing the normal composition of urine also helps in assessing the hydration status and electrolyte balance of the body. Abnormal or pathological substances in the urine include a variety of indicators that can provide clues about abnormal health conditions. Examples include proteinuria, hematuria, glucosuria, ketonuria, and abnormal urine pH. Urine buffer behavior is the ability of urine to maintain pH balance in the optimal range despite external or internal pH fluctuations in the body. When the pH of the urine increases, the buffer will absorb extra hydrogen ions to keep the pH within the normal range.

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