Urinalysis

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Introduction

Previously, we learned how the digestive system processes the food we consume in order to absorb nutrients and create energy used for the functions of the body. However, many chemical waste products are still left behind after the metabolism process is finished. The major organ system that plays a role in the filtration of this waste is the urinary system. The urinary system, specifically the kidney, maintains homeostatic balance by regulating water volume, pH, and salt levels as well as controlling blood pressure. It also filters out toxic leftovers from our blood using specialized capillaries called glomeruli shared by both kidneys. The glomerulus is attached to the nephron, which is connected to tubules that are responsible for the final composition of urine. In the same period, urinary output, which contains by-products of metabolism and excess ions, is 0.8 to 1.8 liters (Marieb, pg 617). So by looking at our urine, urinalysis, we can trace abnormalities in our body and treat these pathological changes.

There are many factors that can affect the characteristics of urine such as exercise, water intake, diet, medications, and many other things. Immediate physical characteristics such as color and odor can reflect hydration levels and diet. Normal urine color is generally between transparent to light yellow, however, water intake may not immediately change the color of urine. For example, athletes will have to consume more water as their urine will generally be darker after high activity levels. The color of urine is largely due to the breakdown of hemoglobin into bile and then indirectly into the urine, producing a yellow pigment called urochrome. Certain foods like beets and medication such as iron supplements can also produce concentrated yellow urine. Dark or “cola” like urine may be the first indication of renal disease or even bile drainage obstruction, which is why urinalysis is so important for disease and illness prevention. Normal urine is generally odorless, but some odor may be produced due to decreased

hydration levels and possible infections. We commonly associate most urine smells with that of ammonia, but there is rarely ever ammonia detected in actual urine due to its toxicity levels. Ammonia is produced from protein breakdown and then converted into urea by the liver. Once out of the body, urea can degrade back into ammonia by bacteria in the environment, producing that ammonia smell. There have also been distinctive odors associated with the consumption of foods like asparagus and fish. Regarding urine output, the normal range is one to two liters per day. Levels below this may indicate anything from dehydration to renal disease, and abnormally low levels are called oliguria. Inversely, polyuria is excessive output and can be affected by medications, alcohol, and caffeine as well as indicate diabetes and kidney disease. In diabetes patients, glucose may appear in the urine. Diet largely affects the pH levels of urine, and chronically low or high pH levels can indicate kidney stones. Leukocytes in urine will indicate a urinary tract infection. In this lab, we will be using dipsticks to perform chemical tests on three different urine samples to determine normal values as well as identify abnormal urinary components.

Materials and Methods

In this experiment, we looked at three artificial urine samples, Sample 1 with “normal” characteristics and Samples 2 and 3 with “abnormal” characteristics. The experiment was divided into two parts; physical and organic components. Disposable gloves were donned to prevent contamination and safety control. For the physical component analysis, we first conducted a physical assessment by noting color, transparency, and odor. These descriptions we recorded in the chart below. Then, a pH test was conducted using Dipsticks and wide-range pH paper, using a fresh piece of paper for each test and dipping it two or three times into each sample to be compared to the chart on the dispenser. To determine specific gravity, a urinometer

cylinder and float were used. The cylinder was filled to about two-thirds full, and then markings read according to the chart. The number lines indicated the first two decimal places, and the lower edge of the meniscus determined the third decimal place.

For the organic component of the experiment, we looked at specifically glucose, bilirubin, ketone, blood, protein, urobilinogen, nitrate, and leukocytes. Using several different Dipsticks, we conducted the testing for each organic component. Clinistix was used for the glucose test, Albustix for protein, Kestostix for ketones, Hemastix for blood, and finally combination dipsticks for testing bilirubin, leukocytes, and urobilinogen.

Activity 1: Urinalysis Results

Physical Characteristics	**Normal Values**	**Normal Urine-Sample 1**	**Abnormal Urine-Sample 2**	**Abnormal Urine-Sample 3**
Color	Pale yellow	Pale yellow	Medium Yellow	Pale-Medium Yellow
Transparency	Clear	Clear	Clear	Clear
Odor	Aromatic	Aromatic	Aromatic	Aromatic
pH	4.5-8.0	6.5	6	8.5
Specific Gravity	1.001-1.030	1.025	1.030	1

Type of Urine Sample	Glucose	Bilirubin	Ketone	Blood	Protein	Urobilinogen	Nitrate	Leukocyte
Normal Urine- Sample 1	Negative	Negative	5mg	Negative	Negative	Normal 0.2	Negative	Negative
Abnormal Urine- Sample 2	Positive	Negative	15mg/dl	Trace	2000+	Normal 0.2	Negative	Negative
Abnormal Urine- Sample 3	Positive	Negative	5mg/dl	Large	2000+	Normal 0.2	Negative	Negative

Discussion/Conclusion

Based on the findings from all testings, we can conclude that Sample 1 would indicate someone in good health while Sample 2 and 3 may have some underlying health conditions. Sample 1 had a pH value of 6.5 and Sample 2 had a pH value of 6 which is within normal values, but Sample 3's alkaline pH of 8.5 may indicate kidney-related conditions like kidney stones or a urinary tract infection. A person can also have a higher urine pH due to prolonged vomiting. This rids the body of stomach acid, which can make body fluids more basic (Medical News Today). None of the three samples tested for positive bilirubin. A positive bilirubin test would indicate liver disease. Both abnormal samples also showed higher levels of blood and protein. Blood in the urine is called hematuria and can be found in the urine of those who are menstruating. Otherwise, hematuria may indicate serious conditions like kidney stones or disease, cancer, or an enlarged prostate. Protein in the blood can indicate kidney disease or pregnancy. Glucose was also found in the abnormal samples, indicating that those patients may have diabetes. This would

also explain the presence of ketones in both samples. Ketones are produced when the body uses fats instead of glucose to produce energy.

A serious condition determined by the elevation of both glucose and ketone levels is called diabetic ketoacidosis, or DKA, which is when the blood becomes too acidic and may result in a coma or death. Although more common with Type I diabetes patients, they can also occur in type II diabetes patients. DKA develops very slowly, so it's important for diabetes patients to be aware of the early signs and symptoms to prevent further progression. Early signs are excessive thirst and urination. Progression of the condition would exhibit itself with a fruity-smelling breath, nausea, vomiting, fast breathing, frequent headaches, and being very tired. Immediate intervention is needed to prevent fatality, and some treatments may include insulin, replacing fluids and electrolytes, and antibiotics if an infection caused the DKA.

In conclusion, urinalysis is extremely important in healthcare and used for disease prevention and detection for early treatment. Many diseases occur without symptoms until they are much further into progression, so it's important that people get routine checkups to make sure they are in good health as well as monitor any conditions they currently have.

References

Marieb, E. Smith, L. (2018) Human Anatomy & Physiology Laboratory Manual: Fetal Pig Version. 13th Edition.

Lumen Learning (2020). Chapter 13: The Urinary System. *Physical Characteristics of Urine.* Retrieved from https://courses.lumenlearning.com/atd-herkimer-biologyofaging/chapter/physical-characteristics-of-urine/

Medical News Today (2018) What is the normal pH range for urine? Retrieved from https://www.medicalnewstoday.com/articles/323957#normal-ph-level

Centers for Disease Control and Prevention (2021) Diabetic Ketoacidosis. Retrieved from https://www.cdc.gov/diabetes/basics/diabetic-ketoacidosis.html#:~:text=Diabetic%20ketoacidosis%20(DKA)%20is%20a,cells%20for%20use%20as%20energy.