**Average Urine Specific Gravity and Urine Flow Rate**

**Affected by Different Fluid**

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**Introduction:**

Throughout the day, our bodies have to eliminate waste through urine. This waste is composed of substances our body can't use or store when metabolizing food. Each person has two kidneys that produce urine and play an important role of achieving homeostasis. In order to achieve this, the kidneys have five basic functions such as hormone production, excretion of wastes and toxins, regulating pH levels, regulating the quantity of plasma in the blood, and maintaining ion concentrations like sodium, potassium, and calcium. All of these functions occur in three steps such as glomerular filtration, tubular reabsorption, and tubular secretion.

Glomerular filtration is a process of filtering blood through a nephron which has a small filter called glomerulus. Inside the kidney, exists 1 million nephrons which are the basic units of structure for the kidneys. Blood enters the glomerulus which consists of blood capillaries. These capillaries have very small pores in their walls. The glomerulus is located between two arterioles such as the afferent arterioles and efferent arterioles. The afferent arterioles transport blood into the glomerulus and are bigger in diameter to the efferent arterioles while the efferent arterioles transport the blood away. The different sizes of the arterioles ensures the blood pressure remains stable as blood flows from a wide tube(afferent arterioles) and goes into a narrower tube(efferent arterioles). In addition, the two arterioles can either expand or constrict to adjust the blood pressure. With this, water and nitrogenous waste will be extracted from the blood and enter the bowmans capsule while the remaining substances flow through the efferent arteriole and back into the blood stream. As water and nitrogenous waste is extracted, it will accumulate inside the Bowmans capsule and become a product called glomerular filtrate. However this filtrate may not solely be composed of nitrogenous waste but may contain glucose, amino acids, and salts. All of which are important to the body and need to be reabsorbed thus leads to the next process tubular reabsorption.

Tubular reabsorption. The Tubular reabsorption occurs when the peritubular capillary is reabsorbing 75% or more of the filtrate from the renal tubule. In the Sodium Glucose Secondary Active Transport (SGLT), 100% amount of glucose is being reabsorbed by the proximal convoluted tubule. In the Loop of Henle, the descending limbs reabsorb H2O. As for the ascending limb in the loop of henle, it reabsorbs the Na+, K+, and Cl-. In the distal convoluted tubule, the aldosterone and the atrial natriuretic peptide can make an impact on the reabsorption rate of Na+ and H2O. In the Aldosterone, the rate of Na+ reabsorption is increase. As for the atrial natriuretic peptide, the rate of H2O reabsorption is increase and the Na+ reasbsorption rate is decrease.

In the third process of the kidney regulation of the human body, Tubular secretion occurs when the peritubular capillary emits the materials in the proximal convoluted tubule and distal convoluted tubule. This type of development preserves the plasma pH level and water/ion level. In the distal convoluted tubule, Na+, H+, HCO3-, toxins, and wastes are being secreted by the peritubular capillaries. As for proximal convoluted tubule, only Na+, H2O, and H+ are secreted from the peritubular capillaries.

In kidney regulation, there are three hormones that can cause certain change in it. The first hormone is the aldosterone which is produce and secreted by the adrenal cortex. The aldosterone is acted on the distal convoluted tubule and collecting duct for homeostasis in the blood. This hormone can make an impact on the blood pressure, affect the blood pH, affect the electrolytes, and affect water absorption (Scott and Dunn, 2017). With that being said, this hormone can alter the amount of the blood pressure by the increase or decrease amount of the sodium in the extracellular fluid. As for the blood pH, the pH level can be alter by amount of potassium. This hormone can also enhance the blood volume by creating a blood flow with water reabsorption and sodium.

The second hormone that can change the kidney regulation is the anti-diuretic hormone (ADH). The anti-diuretice hormone contains a lifespan about 18-20 minutes in the kidney. The ADH was made in the hypothalamus and was transferred in the posterior pituitary gland. The anti-diuretice hormone plays a certain role in the distal convoluted tubule and the collecting duct. In the kidney, the ADH provides aid to control the blood pressure and the blood volume by the amount of H2O release in the urine configuration (“Vasopressin”). If water is permeable in the renal collecting duct, this causes to decrease the urine formation which causes to increase the blood volume and blood pressure in the human body.

The third hormone that was produce and secreted in the cardiac atrial cells that is able to affect the kidney regulation is known as the atrial natriuretic peptide (ANP). In physiological, ANP reduces the plasma volume in three ways: 1.) increase the flow of salt and water in the renal, 2.) form the vasodilation in the blood stream, and 3.) increase the vascular permeability (Curry, 2005). This suggest that ANP is to able to reduce rate of Na+ reabsorption that contain Na+ and H2O excretion when engaging in the distal convoluted tubule. In addition, this causes ANP to inhibit other hormones like ADH, rennin, and aldosterone secretion.

The first purpose of this lab is to observe how the kidney in the human body was able to sustain the fluid equilibrium by the osmotic regulation. The second purpose was to investigate and contrast the urine flow rates and specific gravity after consuming different type liquid from each group except the non-drinking group. Finally, the third purpose is to use Labstix to examine the urine for blood, ketone, glucose, protein, and pH. In the lab, there are four different groups which were non-drinking, gatorade, coke and water groups. In the experiment Gatorade was part of the procedure because the plasma is isoosmetic and has the level of pH is 2.5-3. For Coke, it is hyper-osmotic to plasma, the level of pH is 2-2.5, contain low level of Na+, and high level of glucose than Gatorade. In water, the plasma is hypoosmotic and the level pH is 6.5-7. After carefully analyzing and comparing the entire group, my hypothesis there are certain changes in the average urine flow rates and the corrected urine specific gravity. In the average urine flow rate, Gatorade, water, and coke group will increase rate while the non-drinking group doesn’t change. As for the corrected urine specific gravity, all drinking group will decrease and the non-drinking group will still remain the same values. In the Labstix, the urine sample contain no blood, ketone, protein, or glucose and the level of pH is 6.5-7.

***Method:***

In the lab procedure, we were told to avoid exercise and to start fasting five hours on the day before the experiment can start. On the next day of the experiment, we were separated into four different groups: the Gatorade group, Coke group, Water group, and the non-drinking group. After assigning into groups, each individuals in a group has two cups that need to be filled with urine during fasting which was T=0. After filling the cup with urine, we had to measure the time we start urinated, the amount of urine in the cup, the corrected specific gravity, and the urine flow rate in the experiment. After the calculation, we had to use one Labstix reagent strip to dip in the urinary cup and to find any trace of blood, ketone, glucose, or protein by seeing if there are any changes on the color of the strip. With Labstix, we are able to measure the level pH and find if any substance were positive in the urinary cup at T=0. In 15 minutes, we had to calculate the amount of fluid we need to ingest by using the equation:

**\*volume of fluid intake (mL) = [body weight (lbs) x 7 mL/lbs] x 0.80**.

Once we are able to calculate the amount of fluid intake, we use different cups to gather the fluid we need to consume. After consuming the fluid we need to take, we begin to urinate in the urinary cup four times for every thirty minutes. After urinating, we record the amount of urination in the cup, the time we urinated, measure the urinated flow rate, measure the temperature of the urine, urine specific gravity, and corrected specific gravity.

In our next experiment, we had to calculate the urine specific gravity by filling the cylinder halfway with the urine sample and place the urinometer into the graduated cylinder. In the urinometer, we find the bottom of the meniscus and read the number it touches. In order to find the measurement of the corrected specific gravity, first: take the temperature of the urine sample and second, add 0.001 for every three degree above 15 degree Celsius. For example for the correct urine specific gravity:

**36°C – 15°C = 21°C**

**21°C / 3°C= 7°C**

**7 x 0.001 = 0.007**

**1.026 + 0.007 = 1.033 (correct specific gravity)**

As for the urine flow rate, we take the total volume of the urine output and divide by the time since the last void. Using the formula:

**\*Flow Rate (mL/min) = Volume Voided (mL)**

**Duration of time since**

**last void (min)**

***Result:***

This graph represents the average urine flow rate for all the groups: Non-drinking group, coke group, Gatorade group, and water group. From highest to lowest, the water group has the highest urine flow rate and the non-drinking group has the lowest urine flow rate. In the average urine flow rate, the water group, the Gatorade group, and the coke group will be able to increase from T=30 to T= 90. After T=90 to T=120, the average urine flow rate from those group will decrease. As for the Non-drinking group, it would slightly increase, then decrease, and remain constant on the same values.

In the average corrected urine specific gravity, the non-drinking group has the highest amount and Gatorade group has the lowest amount. From T=0 to T=90, the water group, the coke group, and the Gatorade group decreases in the average correct urine specific gravity graph. From T= 90 to T=120, only the coke and the water group will slightly increase, but the Gatorade group slightly decrease. From T=0 to T=90, the non-drinking group would steadily increase and slightly decrease from T=90 to T=120.

In the Labstix Results:

|  |  |
| --- | --- |
| **Test Reagent** | **Results** |
| Blood | Negative |
| Ketone | Negative |
| Glucose | Negative |
| Protein | Negative |
| pH | 5.0 |

In the Labstix table, the entire test reagent is negative meaning that there are no tracing of blood, ketone, glucose, or protein in the urine sample. In addition the pH level of the urine sample is 5.

***Discussion:***

In this experiment, my hypothesis suggests the water group, Gatorade group, and coke group would increase in the average urine flow rate. In addition, the groups would increase from the T=30 to T=90 and from T=90 to T=120 would decrease. As for the non-drinking group, the average urine flow rate would increase from T=0 to T=30, slightly decrease and remain constant value from T=30 to T=120. In this graph show that my hypothesis was a failure due the fact that the average flow rate didn’t increase the whole entire time in the experiment. In the corrected urine specific gravity, my suggestion is that the entire drinking group, except the non-drinking group, are decreasing from T=0 to T= 90 and increase from T= 90 to T=120. As for the non-drinking group, the average corrected urine specific gravity will increase from T=0 to T=90 and slightly decrease from T= 90 to T=120. After examining the graph, my hypothesis was rejected because the average corrected urine specific gravity value did not decrease all the way to T=0. In the Labstix procedure, my hypothesis was that there were no traces of blood, ketone, protein, or glucose in the urine sample but the pH level was lower than normal. Usually the normal rate of pH level is 6.5-7 but the result pH found in my experiment was 5. This mean that my hypothesis was yet again reject due to the low pH level which is 5.

In the experiment, there was an increase in ADH secretion at starting point T=0 from the water group, Gatorade group, and coke group. In the average urine flow rate, the water group had an increase in ANP secretion and decrease in ADH secretion which cause to have low level of water secretion from T=30 to T=90. In addition after T= 90, the water group had encounter a decrease of ANP secretion and increase of ADH secretion. In the UFR, the water group’s blood volume had increase and the plasma osmolarity decrease when it reach to T=90. However when it goes towards T= 120, the blood volume decrease and the plasma osmolarity increase. In the Gatorade group, there was an increase level of ANP secretion and decrease in ADH secretion from T=30 to T=90. From T=90 to T=120, Gatorade group experience decreases in the blood volume and the plasma osmolarity. As for the coke group, it is very