

Identification of organic compounds



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Observations:

Table 1: The Use of Iodine Solution for Determining the Presence of Starch in Various Samples Solutions

<u>Sample:</u>	Amylose	Maltose	Sucrose	Glucose	Unknown X	Unknown Y	Unknown Z
<u>Observation</u>	Light yellow, cloudy, liquid	Transparent light yellow, liquid	Clear, colourless liquid	Clear, colourless liquid	White liquid	Orange liquid	Dark blue/black liquid
<u>Colour of Solution</u>	Dark blue/black liquid	Clear yellow liquid	Clear, dark yellow liquid	Red/brown liquid	Blue	Dark blue/black liquid	Dark blue/black liquid

Table 2: The Use of Benedict’s Solution for Determining the Presence of Sugar in Various Samples Solutions

<u>Sample:</u>	Amylose	Maltose	Sucrose	Glucose	Unknown X	Unknown Y	Unknown Z
<u>Observation</u>	Light yellow, cloudy, liquid	Transparent light yellow, liquid	Clear, colourless liquid	Clear, colourless liquid	White liquid	Orange liquid	Dark blue/black liquid

	liquid	liquid	s liquid	liquid			
<u>Colour of Solution</u>	Orange liquid	Dark orange liquid	Clear, light blue liquid	Yellowish/whitish precipitate	Beige liquid	Lime green liquid	

Table 3: The Use of Biuret’s Reagent for Determining the Presence of Protein in Various Samples Solutions

<u>Sample:</u>	Amylose	Maltose	Sucrose	Glucose	Unknown X	Unknown Y	Distilled Water
<u>Observations</u>	Light yellow, cloudy, liquid	Transparent light yellow, liquid	Clear, colourless liquid	Clear, colourless liquid	White liquid	Orange liquid	Clear colourless liquid
<u>Colour of Solution</u>	No colour change	No colour change	Clear light blue liquid	Very light blue/white liquid	Beige liquid	Yellow liquid	Clear colourless liquid

Table 4: The Use of Sudan (III) Solution for Determining the Presence of Lipid in Various Samples Solutions

<u>Sample:</u>	Amylose	Maltose	Sucrose	Glucose	Unknown X	Unknown Y	Distilled Water
<u>Observations</u>	Light yellow,	Transparent light	Clear, colourless	Clear, colourless	White	Orange	Clear colourless

	cloudy, liquid	yellow, liquid	ss liquid	liquid	liquid	liquid	liquid
<u>Colour of Solution</u>	Pinkish red on top, yellowish/ white on bottom	Light pink liquid	Light orange liquid	$\frac{1}{4}$ pinkish layer, white on bottom	Pink layer, milky/ whitish layer on bottom	Orangey on top, yellow on bottom	Clear faint when indica adde slowly away

Discussion:

The distilled water in this experiment functioned as the control sample. A control sample should be a constant variable that was not exposed to the factors being tested in the experiment. In this case, the purpose of the lab was to determine the presence of starch, lipid, protein, and sugar in various solutions. Distilled water did not contain any of these experimental factors and therefore it acted as a control sample. The distilled water played a very important role in this experiment considering that the results of the experimental samples must be compared to the control in order to form a conclusion (Rodriguez, 2013). By comparing the results of the control, the colour changes which had occurred in the experimental samples could be identified. If there was no control, one wouldn't have been able to determine any valid changes in the experimental results since there was nothing to compare them to in order to verify the changes. In this experiment, distilled water was used as the control instead of tap water because of the absence

of metals and minerals such as iron and calcium. These elements have the potential to alter the results of the experiment by creating unwanted reactions with other substances in the experiment. Therefore, in order to have an accurate control to act as a reference source for the results of the experimental samples, distilled water was used (Myers, 2013).

The Iodine solution was commonly used to test for the presence of starch in a substance. During the presence of starch, the Iodine solution would turn into a dark blue/black colour. The colour change was caused by the chemical reaction between the starch and the iodine. Amylose was a polysaccharide consisting of glucose units; it was a type of starch, in fact starch was made up of a mixture of amylose and amylopectin. Therefore in this experiment, when the iodine solution was added into the Amylose solution, the resulting solution had a deep bluish-black colour. The helix structure of amylose resembled a coiled spring. The element iodine, a non-polar molecule, on its own was insoluble in water; hence it was dissolved in an aqueous potassium iodide solution forming potassium triiodide which was soluble in water. The linear triiodide ion (I_3^-) basically slipped inside the coil of the amylose molecule resulting in an extremely blue/black colour. The transfer of charged particles (electrons) which occurred between the amylose and the iodide ion altered the spaces between the energy levels/electron orbitals. This meant that light was absorbed by the solution at a different wavelength resulting in the colour change. The presence of starch was also determined in the unknown X and unknown Y solutions. The unknown X solution had a less intense shade of blue indicating that there was a lower concentration of starch in that substance (" Iodine test for," 2012).

Benedict's solution was a clear blue liquid containing copper sulfate used to test for the presence of simple carbohydrates such as allmonosaccharides and several disaccharides like maltose. The presence of these sugars such as glucose triggered a chemical reaction between the sugar and copper sulfate (after heating which provides the energy required to initiate the reaction) resulting in a reddish-brown precipitate if there was a high concentration of sugar (2% or more). The solution could also turn greenish, yellow, or orange with lower concentrations of sugar. During this experiment, the glucose solution changed into a dark orange-red colour, while unknown X turned into a light yellow/beige colour, the unknown Y with a lime green colour and the maltose resulted in a yellowish-green colour. This suggested that the sugar content in maltose, unknown X and Y was low (less than 2%) compared to glucose ("Benedict's reagent," 2014).

Specifically, the Benedict's solution tested for reducing sugars which consisted of an aldehyde group (presence of the CHO group). In the presence of reducing sugars, the copper (II) ions were reduced to copper (I) ions forming copper (I) oxide, a reddish-brown precipitate that was insoluble in water. In this experiment, the glucose possessed accessible electrons for donation, which the blue copper (II) ions were willing to receiving/accept to become reduced to reddish copper (I) ions. When the glucose donated an electron, it became oxidized while the copper (II) was reduced. For this reason, glucose was considered to be a reducing sugar capable of initiating a chemical reaction with the copper sulfate in Benedict's solution. Similarly, maltose, a reducing disaccharide, reacted with the benedict's solution when heated to form a murky yellow precipitate. Maltose molecules have a linear

open-chain structure which made them accessible to react with the copper sulfate in Benedict's solution resulting in a dark yellowish colour indicating a low concentration of sugar (Yool, 2014).

However, sucrose, also a disaccharide, did not provide a positive test for sugar. This was because sucrose was not a reducing sugar. The bond between the two sugars which made up sucrose, fructose and glucose, was formed in a particular way which inhibited the sucrose to isomerize to aldehyde form causing it to be a non-reducing sugar. The molecular structure of sucrose was not linear meaning that it was incapable of opening; it was basically stuck in its cyclical form. This prevented the sucrose from donating electrons and reducing the copper (II) in Benedict's solution resulting in no chemical reaction, colour change, or formation of precipitate ("Benedict's reagent," 2014).

Biuret's reagent was used to test for the presence of protein. The chemical reaction which occurred in the presence of protein resulted in a violet colour solution due to the peptide bonds which made up protein. The biuret reagent contained hydrated copper sulfate; the copper (II) ions formed coordination complexes as the single electron pairs of the four nitrogen atoms in peptide bonds surrounded a central atom which was the copper (II) ion. As the metal complex was formed, the wavelength at which light was absorbed changed to violet from clear blue indicating the presence of protein. Additionally, the greater the amount the protein in a solution, the more intense the colour change considering that there were more peptide bonds present resulting in long chain peptides ("Biuret test," 2014).

Sudan III was a red reagent that detected the presence of lipids. This solution was insoluble in water, however would dissolve in lipids. It would stain the present lipid an orange-red colour. In this experiment, only the unknown Y solution presented a distinctive orangey colour on top of a yellow solution after the addition of the Sudan III reagent suggesting the presence of lipid in this unknown solution. This showed a clear separation of the lipid and water portions of the solution considering that the two did not mix; lipid molecules were nonpolar while water molecules were polar. For this reason, the staining had only occurred at the top layer of the solution ("Sudan iii," 2014).

Carbohydrates were essential nutrients to leading a healthy diet. They were important energy source for the human body. However, they were not used straightaway due to excess intake; the body would store the carbohydrates in the form of glycogen in the muscles and liver. The body used the glycogen stored in the muscles while the brain obtained energy from the glycogen stored in the liver which could only support a limited amount. Therefore, upon excess consumption of carbohydrates, the carbohydrates would be converted into fat which was stored in the fatty tissues. This would also simultaneously increase the glucose levels in blood which triggered the release of insulin in order to maintain homeostasis. Insulin was a hormone secreted by the pancreas into the bloodstream with the purpose of lowering the sugar levels. A great quantity of insulin not only triggered the body to store the extra carbohydrates as fat but also inhibited the release of the stored fat. This meant that the stored fat lost its ability to be used as energy. Additionally, high levels of insulin restrained the secretion of glucagon and

growth hormones. Glucagon was a hormone secreted in the pancreas that initiated the breakdown of fat and sugar to increase the blood sugar levels. Growth hormone was responsible for muscle development. Lastly, the excess intake of carbohydrates which increased the blood glucose levels caused the secretion of extra insulin in order to lower the sugar level at a rapid rate. This caused hunger considering that after a short amount of time; the body's blood sugar levels would be lower than normal causing the hungry sensation to convince the body to consume more carbohydrates increase the sugar levels (" The relationship between," 2008).

Cholesterol was a waxy, sterol, substance found in most body tissue such as in bloodstream and the nerves. This compound was produced by the liver in the human body and circulated through one's blood stream. Cholesterol could also be found in one's diet; foods with a great amount of saturated and trans fat such as meat and dairy products contained this substance. The presence of high level of cholesterol in the body greatly increased the risk of many heart diseases such as heart attacks and strokes. This was because when there was an excess amount of cholesterol in the blood, it could accumulate in the interior walls of arteries which provided various parts of the body the nutrients and oxygen needed to function properly. Plaque was formed as the extra cholesterol and other substances such as fat and calcium stuck to the inner walls of the blood vessel. This sticky substance would harden and decrease the circumferences and flexibility/elasticity of arteries. This health issue was known as atherosclerosis; the clotting of blood vessels due to the buildup of plaque limiting the flow of blood to several parts of the body such as the brain, the heart, and other organs. Depending

on which of the many arteries in the body was blocked, there were several potential heart diseases. If the plaques clot the coronary arteries which supplied the heart with oxygen-rich blood, heart attacks may occur and if there was a blockage in the carotid arteries which fed blood to the brain, the reduced blood flow to the brain may cause a stroke. Most of these heart diseases were serious and even deadly (" What is atherosclerosis?," 2011).

Protein could be used as an energy source for the human body; however not the most efficient method. As protein was digested by the body, it was chemically broken down into amino acid subunits. Glucose and amino acids were chemically alike with the exception of the presence of nitrogen atoms in amino acids. In the absence of nitrogen, the amino acids could be converted into glucose or fatty acids which provided energy for the body. Due to the additional steps of removing the nitrogen, proteins were a slower source of energy, but longer lasting compared to carbohydrates and lipids. Furthermore, the use of protein as an energy source could be harmful to the body due to the by-products formed from the breakdown of amino acids. The nitrogen atoms contained in all amino acids were converted into ammonia during amino acid catabolism. The substance ammonia was toxic as it accumulated in the blood causing the body to excrete it through urination. However, high levels of ammonia would damage the liver and the kidneys. Also, the presence of a large quantity of this compound was poisonous to the cells in the body (Cloe, 2012).

Errors:

During this experimental, a few errors had occurred. The test tubes filled with the experimental samples were not washed properly for the next nutrient test. This resulted in absurd colour changes. At times, not enough indicator solution was added to the samples. This might have affected the resulting colours. Lastly, during the test for sugars, after the addition of the benedict's solution into the samples, the solutions were not heated evenly for the same length of time. A few samples did not obtain enough energy for a potential chemical reaction/ colour change to occur.

Conclusion:

It was concluded that distilled water functioned as the control in the experiment due to the absence of metals and minerals in the liquid which could possibility initiate unwanted reactions. The control was used to provide a reference source for the obtained results from the experimental samples in order for the changes to be valid. The iodine solution was used to test for the presence of starch. The chemical reaction between the triiodine ions and starch molecules triggered the colour change of the solution to deep blue/black. Starch was detected in the amylose, unknown X and Y solutions. The benedict's solution was used to determine the presence of reducing sugars. The chemical reaction between the copper sulfate in the benedict's solution and the sugar molecules triggered a colour change in the samples. The sugar molecules reduced the copper (II) into copper (I) resulting in a reddish precipitate. With a lower concentration of sugar molecules, the samples turned greenish, yellowish or orangey. The presence of sugar was determined in maltose, glucose, unknown X and Y samples in this experiment. Biuret's reagent tested for the presence of protein. The copper

sulfate in the reagent formed metal complexes with the nitrogen atoms found in the peptide bonds of protein. This resulted in a colour change of the samples to violet if protein was detected. The Sudan III solution tested for the presence of lipid. Since the solution was insoluble in water and soluble in lipids, the colour change to orangey red was only found on the top layer of a few samples. The presence of lipid was determined in the unknown Y sample.

Furthermore, excess intake of carbohydrate increased the sugar level in blood. This triggered the release of the hormone, insulin, with the intention of lowering the sugar level to maintain internal balance. The release of this hormone by the pancreas caused the extra carbohydrates to be stored as fat. Also, the presence of a large amount of insulin caused the frequent sensation of hunger. This was because the insulin quickly lowered the sugar levels causing the body to want more carbohydrates to increase the sugar levels to maintain homeostasis. High levels of cholesterol in the blood resulted in the accumulation of plaque reducing the blood flow to various part of the body. This was a major risk factor of heart diseases such as heart attacks and strokes. Lastly, when the body used protein as an energy source, there would be an elevated level of ammonia in the body considering that it was a by-product of the breakdown of amino acids. The high level of this toxic compound would cause harm to the kidneys, the liver and other body cells.

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