Extraction of caffeine from tea leaves

Three teabags with weight 6. Egg ere boiled with water and then extracted with 60 ml DC; extract was dehydrated with anhydride Nassau then was collected by decanting to an evaporating dish where it was evaporated to dryness. Crude caffeine with a weight of 0. Egg gave out a 0. 7116% yield; after sublimation, the sublimate weigh O . Egg with a percentage yield of 0. 0144%. Melting point determination was the last step where the sublimate was compared to a standard caffeine, where both gave out the temperature range of CGI – 236 c.

Introduction Caffeine is a bitter substance found in coffee, tea, soft drinks, chocolate, kola nuts ND certain medicines. It has many effects on the body metabolism, including stimulating the central nervous system. This can make one more alert and give a boost of energy. [l] Most people have high tolerance for caffeine and this can be manifested with the cups of coffee one can consume in a day. However, too much caffeine intake can make one restless, anxious, uneasy, and irritable. It may also keep one from sleeping well and cause headaches, abnormal heart rhythms, or other problems.

Age and body size can make a difference in effect. A child or a smaller person may feel famine’s effects more strongly than an adult or a heavier, taller person. [2] Caffeine in tea leaves comprises about 5% of its weight. Extraction is a very common laboratory procedure used when isolating or purifying a product. The principle of extraction depends on the concept of miscibility between two phases to separate a solute from the other phase. Extraction of caffeine is basically the isolation and purification of caffeine from mixtures like that of tea leaves.

Most common extractions in organic chemistry are solid-liquid, liquid-liquid and acid-bases. In this experiment, 2 of these extractions re used; first the solid-liquid, followed by the liquid-liquid extraction. Solid-liquid extraction is an extraction process by which compounds that are dissolved or suspended in a liquid mixture are separated from other compounds in the mixture according to their physical and chemical properties. It allows soluble components to be removed from solids using a solvent. 3] In this case the soluble component is the caffeine; the solid, tea leaves and the solvent, water. It is afterwards followed by a liquid-liquid extraction. Liquid-liquid extraction also known as Solvent extraction or Partitioning is a teeth to separate compounds based on their relative solubility in two different immiscible liquids usually water and an organic solvent. It is an extraction of a substance from one liquid into another liquid phase. It is performed in a separators funnel. In this case the water is the water with caffeine extraction and the organic solvent, DC.

After the extraction steps, purification, the process of separating a substance of interest from foreign or contaminating elements called impurities; was necessary to produce from crude caffeine, a pure caffeine. Sublimation is one of the purification processes. It is a physical change in which a old sample is allowed to be converted to its vapor state directly without passing the liquid state. At a point where the vapor pressure equals the atmospheric pressure before melting stage is reached, a compound may vaporize directly without passing the liquid state.

Compounds with high vapor pressure are good candidates to sublime under normal atmospheric pressure. As a criterion for purity, melting point

identification was used. A sharp melting point range of ; 2 C constitutes good evidence for accepting a substance to be pure. But exceptions to the rule are eutectic mixtures that behave like pure impounds. Wide melting point ranges typically indicate that a substance is not pure, except if it decomposes on heating. With cases like these, the decomposition products become the impurities.

Another case is the opposite, wherein the presence of impurities will cause lowering of the melting point of a pure sample. This experiment deals with the extraction of caffeine from Lipton tea leaves. It aims to: * To isolate caffeine using multiple extraction * To purify caffeine using sublimation * To determine the purity using melting point determination * To calculate the percent yield of the crude and purified caffeine Results and Discussion Table 1. Summary of results of extraction and purification process. Tea Leaves 6. 2674 g I Volume of DC | 60 ml I Crude Caffeine | 0. 446 g I | 0. 7116% | I Shiny, yellow-green, powder like Sublimate (Pure Caffeine) | 0. 0009 g | 0. 0144% | I White, crystal-like I This experiment is a series of extraction and purification steps to extract and purify caffeine from Lipton tea leaves. The table above shows a summary of the extraction process and purification process. Also, the physical characteristics and quantities of the products after every process were recorded For the initial process, solid-liquid extraction, 3 teabags of Lipton tea with weight of 6. 2674 g based from the table were boiled in water for 5 minutes.

Water was used to extract the caffeine from the tea leaves for the reason that caffeine is soluble in water. But to increase the efficiency of the extraction of caffeine, the water should be boiling during the extraction

process. Another factor is that water is less likely to react with the other components of the tea leaves. Unlike Cacao, which is also used in caffeine extraction; if calcium carbonate, a base, is used, calcium salts of these acid form in these solutions. It will react with the tannins and Gaelic acid to form insoluble calcium salts of these acids. 4] After boiling for 5 minutes, the water with the caffeine was decanted but in this experiment, filtering the tea leaves from the water with caffeine extract was necessary because the tea bags burst. After which, the water with caffeine was transferred in a separators funnel to where the next extraction process was performed, the liquid-liquid extraction.

A liquid-liquid extraction, which is extraction of a substance from one liquid into another liquid phase, was essential because the mixture of water and caffeine was till accompanied by foreign components such as tannins. Tannins are polyphonic compounds (having OH on aromatic ring… With molecular weights of 50-20, 000. Tea tannins are soluble in water and therefore extracted from the leaf and responsible for the typical bitter taste of tea [5]. So basically, while the caffeine was extracted from the leaves, the tannins are extracted with it. The liquid-liquid extraction involves the addition of DC in the separators funnel in 3 20 ml components. The table above shows a total of 60 ml addition of DC. Caffeine is more soluble in DC than in water while tannins are more slightly lobule to DC than water, that is why after the liquid-liquid extraction, the caffeine dissolves in the DC and the tannins remain in the water.

The addition of Noah is based on Lee Chatterers principle by adding a base to a base so the equilibrium is shifted to the unprotected reactant side and

this reactant is neutral caffeine which is allophonic and insoluble in water. Adding Noah to the coffee prevents caffeine to be propionate. Without adding Noah you would only extract the unprotected fraction of caffeine. After treatment of Noah, the solution was treated with anhydride Nassau. This was to dry the solution, that is free from any traces of water which are considered as impurities.

In this point, after letting the solution evaporate to dryness, the product is called crude caffeine. The weight of the crude was recorded which is 0. 0446 g based from the table. Based from this, the percentage yield was computed using the formula: % yield? weight of crude caffeinated of sample x 100% which gave out a result of 0. 7116 % based from the table. After extraction and evaporation, the product that is collected still contains considerable amounts of impurities. One method of purification is based on the ability of caffeine to sublime.

Sublimation is the ability to pass directly from solid state to the vapor state and condense back to a solid form without passing through liquid phase. Since the impurities in crude caffeine extract do not sublime under the same condition as caffeine, sublimation will result in pure caffeine. During the process, the temperature was carefully monitored so as to minimize the decomposition of caffeine. The “ cold-finger” in the sublimation set-up served as the condensation site where the vapor is instantly converted to solid form. Also, after the process, it is in the “ cold-finger” where the sublimate clinger.

The weight of the sublimate cased inside a previewed vial was then recorded; which based from the table is, 0. 0009 g. And from this, the % yield of the sublimate was calculated using the formula: % yield? weight of substitutability of sample x 100% which gave out the result of 0. 0144%. Table 2. Results for melting point determination. I Temperature 1 | Temperature 2 | Capillary 1 (Standard caffeine) 1 CGI 1 FCC I Capillary 2 (Standard caffeine and sublimate 1 CGI 1 FCC I Subsequent the extraction and purification processes, there is nothing more to do UT to test the purity of the substance.

Melting point determination as a criterion for the purity of caffeine involved the comparison of the melting points of a standard caffeine and a 1: 1 ratio mixture off standard caffeine and the sublimate. A pure substance sill show a temperature range of ; C. True enough, from the table, both capillaries showed a temperature range of CGI – FCC. This range qualified for a pure substance. Meaning, the sublimate is now a pure substance of caffeine. In the procedure, the standard caffeine and the sublimate are packed inside 2 micro capillaries. Tight packing, maintaining a fixed level in the fill is also a very important requirement.

Taller samples take extra heat to completely melt and usually display larger melting ranges than their shorter counterparts. Well-packed substances in the capillaries can be achieved through repeated passing of the capillaries in a long glass tubing. Experimental Three teabags were opened and the combined weights of the tea leaves were recorded. The tea leaves then were returned in the bags; a string stapled to the teabag was used to secure the

teabags. In 100 ml water, the tea bags were boiled for 5 minutes. Fluted filter paper was used since the teabags burst, to filter the leaves.

The side of the flask was cooled in running tap water for 2 minutes. One ice cube was mixed in the tea extract to cool to room temperature. The tea extract was transferred to a separators funnel which contained 20 ml of DC. The tea extract and the DC were mixed thrice; and the pressure released before the extraction of the caffeine. The aqueous lower layer was drained into a clean flask. The extraction was performed again for two times. All aqueous lower layers were discarded and DC proportions were retained in the separators funnel. It was washed with 20 ml MM Noah solution.

The Noah layer was discarded. The DC layer was drained into a clean, dry flask then half spatula of anhydride Nassau was added. It was swirled then the Nassau was allowed to settle. The DC was decanted to a evaporating dish then was allowed to dry. The weight of the solid was recorded . This solid was called the crude caffeine. The crude caffeine was transferred in a filter tube with a fitted inner test tube which served as a “ cold finger” and into a hot air bath for 35 minutes. The inner tube was carefully removed. The caffeine which clinger in the cold finger was scraped-off ND weighed into a vial.

The percent yield was calculated. One end of a micro capillary was sealed by heating from the blue portion of a Bunsen burner flame. Using the open end of the micrometer, the pulverize caffeine crystal was scooped. The height of the caffeine sample should not exceed 3 mm. The micro capillary 1 contained standard caffeine while the micro capillary 2 contained a mixture

of the standard caffeine and sublimate. The crystals at the bottom of the tube were packed by letting the micro capillary fall inside a glass tubing and letting it bounce up and down.

The 2 micro capillary were attached side by side a thermometer and were boiled in cooking oil until the crystals inside melted. The temperature range of each micro capillary was recorded. References [1] retrieved from http://www. Ml. NIH. Gob/midlines/caffeine. HTML [2] retrieved from www. Ml. NIH. Gob/midlines/drugging/caffeinesystemic202105. HTML [3] retrieved from http://www. Gung. De/download/extraction_English. PDF [4] retrieved from http://www. Polaris. Nova. Due/? shanghai/chemistry/cool labs/caffeine. PDF [5] retrieved from http://chem.-courses. Scuds. Due/Courageous/Gulags/AAA_Whizzed/ expect_AN. PDF