

Vitamin c content in the commercial fruit juices biology essay



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Determination of Vitamin C content in the commercial fruit juices by using high performance liquid chromatography (HPLC) and spectrophotometry method.

1. 0 Introduction :

Nowadays, market is flooded with those fruit juices or syrup with the label “vitamin C enriched”. Vitamin C had become a famous compound in medical and food industry. Then what is vitamin C and its function?

Vitamin C is an essential water-soluble vitamin and it is the first vitamin being discovered by the Hungarian physician Professor Albert Szent-Györgyi from the adrenal cortex of cattle. (Davies et al., 1991). Vitamin C can be found in most of the vegetables and fruits. To measure the Vitamin C in fruits, it is significant to measure both the ascorbic acid and dehydroascorbic acid (DHAA). This is because ascorbic acid is readily oxidized to DHAA and the oxidization process is reversible and DHAA is also biological active as ascorbic acid. However, DHAA can be irreversible be converted to diketogulonic acid, which is not biologically active. (Isabel et al., 2007)

According to Institute of medicine (IOM), the Dietary Reference Intakes (DRIs) for vitamin C for adult men and women is 90 mg/day and 75 mg/day respectively. (Food and Nutrition Board, Institute of Medicine, 2004).

Deficiency of vitamin C cause scurvy, which is a disease Characterized by bleeding gums, impaired wound healing, anemia, depression and fatigue. (Phillips et al, 2010). So that, it is important to make sure that we have enough vitamin C intake.

Vitamin C plays an important role in human body. It serve as radical scavenger in vivo, this make it an important antioxidant in our body. Besides that, Vitamin C is also a cofactor in various physiological processes. Moreover, it also participates in immune system, biosynthesis and metabolism of certain compounds.

Various methods had been adapted to determine vitamin in many industry, which include spectrophotometry, titrimetry, voltammetry, fluorometry, potentiometry, kinetic-based chemiluminescence (CL), flow injection analyses and chromatography. (Arya et al, 2000). Of course, each of the methods has their strong and weaknesses.

Furthermore, due to vitamin C can oxidize easily, so the determination procedure has to be designed to avoid the loss of the vitamin. Factors including the temperature, light, pH and oxygen exposure can affect the vitamin C content. (Phillips et al, 2010).

Objective

1. To determine the vitamin C content in commercial fruit syrup.
2. To evaluate the feasibility of using HPLC method for determining vitamin C.
3. To compare the different vitamin C content in different brand of commercial fruit syrup.
4. To compare the reliability of spectrophotometric and HPLC method in vitamin C determination.

2. 0 Literature review

2. 1 Discovery and structure of vitamin C

In the year 1928, a Hungarian physician Professor Albert Szent-Györgyi was successfully to accumulate a less amount of an off-white crystalline substance from the cortex of cattle. After the discovery of this off-white crystalline compound, he had done a series of test on it. The result showed that, the substance can decolorize iodine. Next, it also lower the vapour pressure of the water, which gave the relative molecular mass of the crystal about 180 g/mol. (correct value= 176. 4 g/mol). He also did a combustion analysis on the compound, which gave 40. 7% carbon, 4. 7% hydrogen and 54. 6% oxygen. This data enable him to deduce the C₆H₈O₆ as the molecular formula for this compound. Later, he named the compound as ' hexuronic acid' but finally changed to ascorbic acid which mean prevention of scurvy. (Davies et al., 1991)

All in all, ascorbic acid is a six carbon substance with 4 OH group with relative molecular mass of 176. 14 g/mol. The melting point is 190-192oC and the specific rotation is +23o in water and +49o in methanol. (Davies et al., 1991).

2. 2 Properties and roles of vitamin C

2. 2. 1 Redox properties- an effective antioxidant

Figure (Adapted from J. Verrax et al. 2008)

Due to the unique structure of vitamin c (figure 1), it can be easilly be reversibly oxidised to dehydroascorbic acid or ascorbate and both of them can lost electro to form ascorbyl radical.(Verrax et al., 2008). This makes

vitamin C an important antioxidant and reducing agent involve in many physiological reactions such as, growth, reproduction and even immunity. (Phillips et al, 2010; Wahli et al, 2003)

2. 2. 2 Role of vitamin C in preventing diseases.

As the name ascorbic acid meaning that preventing scurvy, it plays an important role in preventing scurvy. Scurvy is the vitamin C deficiency disease which has the symptoms defection of collagen, failure of wound healing, anemia and bleeding gums.(Verrax et al., 2008; Phillips et al, 2010). If scurvy remain untreated, it can be fatal.

Next, vitamin C also involve in cancer treatment. Ascorbate enhances the activity of hydroxylase (inhibit HIF-1) by keeping the iron centre of hydroxylases in a reduced state. Hypoxia-inducible factor 1 (HIF-1) is a tumor inducing agent. (Verrax et al., 2008).

A research had been done by Wahli T. et. al. upon the influence of dietary vitamin C on the wound healing process in wounded rainbow trout. They actually feed them with different level of vitamin C and compare the wound healing process. The result had prove that, majority of the rainbow trout feed with high levels of vitamin C showed more rapid wound healing process. (Wahli et al, 2003).

2. 2. 3 Vitamin C complexes and the function.

In certain condition, ascorbic acid can deprotonate at second and third carbon OH group to form monoanion and dianion. These two anion will then react with metal to form functional ligands monodentately or chelation.. One

of the example is the complexes with iron which will improve the iron absorption in intestine. (Zümreoglu-karan, 2006). Ascorbic acid can also binds to iron centre of hydroxylases to enhance its activity in cancer treatment. (Verrax et al., 2008).

3. 0 Methodology Review

3. 1 Spectrophotometry

UV/visible spectrophotometer is one the most commonly used instrument in analytical chemistry. UV/visible spectrophotometer provide a fast, simple and reliable method for determination. However, it can be interfered by other compound such as sugars and some organic acid. The light source of the UV/visible spectrophotometer can be switched to provide the maximum absorption for the sample. The optimum absorption for vitamin c in neutral solution is at 265nm.

To start the experiment, standard solutions has to be prepared on the spot for calibration and the sample has to be diluted. Stabilizer can be added if it is needed to stabilize the vitamin C. Then by using distilled water as a reference, record a spectrum of the highest concentration standard to obtain the wavelength of the optimum absorption. Lastly is to measure the absorbance value of all the standard solutions and the sample. Then plot the calibration graph. After the result is obtain, SPSS is used to analyze the results. (Chemistry and Biology division, TAR college, n. d., p. 1-10)

3. 2 high performance liquid chromatography (HPLC)

High performance liquid chromatography (HPLC) forces the solvent through the tiny column using high pressure. This method allows smaller particles to

be used to provide a higher surface area and thus increase the sensitivity. Furthermore, all solute molecule will travel in more uniform due to small diameter of the column. This will reduces the degree of eddy diffusion and reduce the plate height.

To start the experiment, standard solutions has to be prepared on the spot for calibration and the sample has to be diluted. Stabilizer can be added if it is needed. Then test the standard solution and vitamin C by using the HPLC instrument. After the result is obtain, SPSS is used to analyze the results. (Chemistry and Biology division, TAR college, n. d., p. 57-59)