GINSENOSIDE CONTENT OF KOREAN GINSENG (*Panax ginseng C.A. Meyer*) TEA PRODUCTS

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Ginsenoside Content of Korean Ginseng (*Panax ginseng C.A. Meyer*) tea products

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GINSENOSIDE CONTENT OF KOREAN GINSENG

(*Panax ginseng C.A. Meyer*) TEA PRODUCTS

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ABSTRACT

Ginseng is one of the most highly regarded herbal medicines in the Orient. Some seemingly magical properties attributed to it are its abilities to improve psychological function, cardiovascular conditions, and immune system activities. Ginsenosides, the active constituents of ginseng, are the ones most responsible for giving ginseng products their supposed health benefits. It is important to investigate the concentrations of ginsenosides in these products, to ensure that they really deliver. BFAD (Bureau of Food and Drugs) is a regulatory agency that ensures the safety and quality of processed foods, drugs, and other substances using state-of-the-art technology. It also tests the scientific soundness and truthfulness of the products' information, for the protection of public health. Any products that will be imported, exported, manufactured or distributed must first pass the BFAD's approval. Ginseng root powder with 80% ginsenoside purity was obtained and dissolved in hot water to create the standard solution. This was then diluted into percentages: 20, 40, 60, 80 and 100. Korean Heaven Red ginseng tea was also obtained and dissolved in hot water to create the tea stock solution. Spectrophotometric analysis was carried out to determine the concentration of ginsenoside in the tea solutions. The concentrations of ginsenosides in the solutions were calculated using their absorbancies using standard addition method. The slope for the standard curve was R = 1.1163, and the resolved concentrations per 1gram sample in mol/L (M) were 1.19×10^{-4} for the Red tea and 4.40×10^{-5} for the Brown tea. Calculations for the concentrations were done using the molecular weight of Rg1 which is 801.01 g/mol. To conclude, the two ginseng teas that did not pass through BFAD approval do contain ginsenoside but in very small amounts.

Keywords:ginsenosides, ginsenoside content, standard ginsenoside, standard addition method, standard curve,*Panax ginseng*

ACKNOWLEDGEMENT

Research is one of the most important things in a Philippine Science scholar's academic life. It is not something that can be shrugged off or procrastinated upon. Therefore it requires a great deal of patience and diligence, and as such it will also sometimes require the help of people who have come before you and who are willing to support you no matter what. Luckily for us, we had these sorts of people to help and encourage us, and here we would like to acknowledge them.

Firstly, we want to thank our wonderful family members who were always very supportive towards our Research study. They contributed a great deal into making our Research goals a reality. We know they will always be there for us, and we hope to repay their loving kindness to the best of our abilities.

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And of course, the most important one we would have to thank is God. Without Him, nothing is possible. He is the one who made it all happen.

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CHAPTER 1

INTRODUCTION

A. Background of the Study

Two species of ginseng are of major importance in international trade, Asian ginseng *(Panax ginseng* C.A. Meyer) and American ginseng *(Panaxquinquefolius*L.) (Douglas and others 2000). Ginseng is one of the most highly regarded herbal medicines in the Orient; here, it has gained a reputation for improving health and general body vigor, and is also said to prolong life (Ellis And Reddy 2002; Coleman and others 2003, as cited by Yong and others 2007). The use of *P. ginseng* (Chinese ginseng) for medicinal purposes dates back over 5000 years, beginning with ancient traditional Chinese medicine. Asian ginseng may improve psychological function, immune activities, cardiovascular conditions, and prevent certain cancers (Wang and others 2006).

Because of the reported medicinal effects, many products have been made from the ginseng plant. An important thing to measure for root quality is the ginsenoside content of the root. Ginseng saponins, specifically called ginsenosides exert a variety of pharmacological actions on the central nervous, cardiovascular, endocrine and immune systems, among others (Attelle and others 1999 as cited by Kyeong and others 2003). The ginseng saponins are structurally fractionated into two groups: the panaxadiol (PD) fraction (e.g., ginsenoside Rb-1, -Rb2, -Rc, -Rd) and the panaxatriol (PT) fraction (e.g., ginsenoside-Rg1, -Rg2, -Re, -Rf) (Shibata 2001 as cited by Kyeong and others 2003). Ginsenosides are the active constituents of ginseng and are frequently used as the main index for ginseng produce evaluation (Youn and others 2002). To date, 40 ginsenosides have been identified and have numerous pharmacological effects such as immune system modulation, anti-stress, anti-oxidant and anti-cancer activities (Cheng and others 2006, as cited by Yun-Soo and others 2007). The recommended dosage for ginsenosides to take effect is 8 mg daily (Dharmananda 2002).

Because of these pharmacological effects that ginseng offers, many different kinds of ginseng products have been produced. Of all those products, ginseng tea and ginseng extract are commercially produced as instant type, and now are consumed in

is taken in, like insomnia or heart problems (Chandler 2005). There are concerns among medical professionals that ginseng products may lack purity or potency, because dietary supplements are not subject to the same regulations that pharmaceuticals are. (Harkey and others 2001)

BFAD (Bureau of Food and Drugs) is a regulatory agency that ensures the safety, efficacy, purity and quality of processed foods, drugs, diagnostic reagents, medical devices, cosmetics and household hazardous substances through state-of-the-art technology, as well as the scientific soundness and truthfulness of product information, for the protection of public health. Products what will be imported, exported, manufactured or distributed must first register with the BFAD.

In this study, the ginsenoside content of tea products that are made from Korean ginseng that are not approved by the BFAD will be measured.

B. Statement of the Problem

How much ginsenoside is present in Korean Ginseng tea?

C. Objectives

This study aims to:

1. Determine the absorbance of two brands of Korean ginseng teas
2. Compute for ginsenoside content of two brands of Korean ginseng teas

D. Significance of the Study

Ginsenosides exert a variety of pharmacological actions, which makes it the cause of the medicinal effect of the ginseng plant. Ginsenosides need to be present in the ginseng products that claim to have medicinal effects, because they are the main cause for the pharmacological effects of the ginseng plant. Ginseng products are now consumed in large quantity due to their pharmacological effects and many ginseng consumers, especially those who are using ginseng products like tea and pills, are claiming that their condition has been improving due to the supplements they took. But they are not sure if it is because of the ginsenosides present in theproduct or just due to placebo effect. This

study will ensure the consumers that they are ingesting ginsenosides, which is responsible for the medicinal effects of the ginseng.

E. Scope and Delimitations

The ginseng tea product was purchased in late November in Tagburos, Puerto Princesa City, Palawan. This study did not use real ginseng roots, instead what was used was ginseng root powder from Herbanext Inc. inBago City, Negros Occidental. This study only measured the absorbances of the solutions using a UV Spectrophotometer from the Chemistry Laboratory of the Philippine Science High School Western Visayas and measured the ginsenoside content of the ginseng teas using the Standard Addition Technique. It was conducted in the Research laboratory of the Philippine Science High School Western Visayas Campus.

F. Definition of Terms

Ginsenoside – a class of steroid glycosides, and triterpenesaponins, found exclusively in the plant genus Panax ginseng and are viewed as the active compounds behind the claims of ginseng's efficacy.

In this study, this is the one to be measured in the ginseng teas.

UV-Vis Spectrophotometer - an instrument for producing or recording a spectrum and measuring the photometric intensity of each wavelength present, esp such an instrument used for infrared, visible, and ultraviolet radiation.

In this study, this will be used to determine the absorbances of the solutions.

Absorbance - also called optical density; logarithmic ratio of the radiation falling upon a material, to the radiation transmitted through a material.

In this study, this will be measured using a UV-Vis Spectrophotometer and will be the basis for solving ginsenoside concentration.

Standard Curve - is a quantitative research tool, a method of plotting assay data that is used to determine the concentration of a substance.

In this study, this will determine the accuracy of the dilution of the solutions.

Ginsenoside Rg1 - the most prevalent active constituent of ginseng, is a potent proangiogenic factor of vascular endothelial cells.

In this study, the molecular weight of ginsenoside Rg1 was used to solve for the mass of the ginsenoside content.

CHAPTER 2

REVIEW OF RELATED LITERATURE

A. Ginseng

Ginseng (*Panax ginseng* C.A Meyer) is a member of the Araliaceae family, the genus name Panax was derived from the Greek word meaning "all-healing", which was first coined by the Russian botanist Carl A. Meyer. Ginseng is one of the most highly regarded herbal medicines in the Orient, where it has gained an almost magical reputation for promoting health and general body vigor, while also prolonging life (Ellis And Reddy 2002; Coleman and others 2003, as cited by Yong and others 2007). The use of *P. ginseng* (Chinese ginseng) for medicinal purposes dates back over 5000 years, beginning with ancient traditional Chinese medicine.Ginseng is available in a variety of forms. Many people consider the whole, dried root to be the best. However, powdered forms, slices of root and the distilled essence of the ginseng root are readily available. In addition, ginseng teas are quite common in Asian groceries. Higher quality, more expensive forms are generally thought to have more and better active ingredients Ginseng naturally grows in the mountains, and can survive for several decades (Yong and others 2007). Asian ginseng may improve psychological function, immune activities, cardiovascular conditions, and prevent certain cancers (Wang and others 2006).Ginseng is classified as an adaptogen herb, which means that it helps the body resist the negative effects of stress induced by anxiety, fatigue or trauma. It has also been reported that ginseng has many other beneficial bioactive effects on human health, such as antitumor, anti-stress, anti-aging and enhancing immune functions, although only a few of these have been clinically confirmed (Akalezi*et al*., 1999 as cited by Kim and others 2005). Until now, ginseng has been reported to contain saponins, antioxidants, peptides, polysaccharides, alkaloids, lignans and polyacetylenes. Saponins, known as ginsenosides, are the principal bioactive ingredients (Jo *et al*., 1995; Sticher, 1998, Palazon*et al*., 2003, as cited by Kim and others 2005). In recent years, ginseng has been increasingly used as a health tonic formulated into a variety of commercial health products, including ginseng capsules, soups, drinks and cosmetics, which are marketed in the Asian as well as many other countries around the world (Kim and others 2005).

A.1. Ginsenoside Content

Ginsenosides, the ginseng saponinsare the major components having pharmacological and biological activities, including antidiabetic and antitumor activities, making them the active in gradient of ginseng products that claim to improve health. More than 30 different ginsenosides have been isolated and characterized, and they have different pharmacological effects. Ginsenosides can be divided into 20(S)-protopanaxadiol (ginsenoside Rb1, Rb2, Rb3, Rc, Rd, and Rg3) and 20(S)-protopanaxatriol (ginsenoside Re, Rg1, Rg2, and Rh1) groups based on their aglycone moieties (Kim and others 2007). The pharmacological activity of ginsenosides is based primarily upon the structural aspects of the molecule, which is a glycosylated steroidal triterpene (Corbit and others 2005). There should be at least 8 mg of ginsenosides in the ginseng product for it to be considered effective.

B. Ginseng Tea

Many products from ginseng has been made because of its medicinal properties. Ginseng tea is one of them. Ginseng tea may consist of either American or Korean ginseng, both of which are members of the Panax genus of plants. Both species feature ginsenosides as the primary active agents that produce medicinal effects. There are different customs and methods in preparing ginseng tea. The Korean version involves combining slices of the ginseng root with several tablespoons of honey in a bowl, leaving it to set for about 30 minutes and then adding boiling water to the mixture to make the tea. The tea can also be made with a liquid ginseng extract; yet only a few drops should be used with this method. However, ginseng tea should be avoided if you have high blood pressure, or are taking other stimulants. Also, children and pregnant women should avoid ginseng without consulting a doctor first.

C. Principles of Methods

C.1. Standard Addition Method

The standard additions method (often referred to as "spiking" the sample) is commonly used to determine the concentration of an analyte that is in a complex matrix

such as biological fluids, soil samples, etc. The reason for using the standard additions method is that the matrix may contain other components that interfere with the analyte signal causing inaccuracy in the determined concentration. The idea is to add analyte to the sample ("spike" the sample) and monitor the change in instrument response. The change in instrument response between the sample and the spiked samples is assumed to be due only to change in analyte concentration. The procedure for standard additions is to split the sample into several even aliquots in separate volumetric flasks of the same volume. The first flask is then diluted to volume with the selected diluent. A standard containing the analyte is then added in increasing volumes to the subsequent flasks and each flask is then diluted to volume with the selected diluent. The instrument response is then measured for all of the diluted solutions and the data is plotted with volume standard added in the x-axis and instrument response in the y-axis. Linear regression is performed and the slope (m) and y-intercept (b) of the calibration curve are used to calculate the concentration of analyte in the sample.

D. Labelling

The Federal Food, Drug and Cosmetic Act (FD&C) requires five elements to appear on a food label: the name of the food, the net quantity of its contents, the name and address of the manufacturer, a statement of the ingredients and the nutrition information.

Accurate and legally complete labels make sense from the standpoints of both ethics and good business. Properly formatted labels are important because they convey specific information that will help consumers make an informed purchase.

E. BFAD

BFAD (Bureau of Food and Drugs) is a regulatory agency that ensures the safety, efficacy, purity and quality of processed foods, drugs, diagnostic reagents, medical devices, cosmetics and household hazardous substances through state-of-the-art technology, as well as the scientific soundness and truthfulness of product information, for the protection of public health. Products what will be imported, exported, manufactured or distributed must first register with the BFAD.

Related Studies

1. A study by Yong and others (2007) focused on how factors associated with a mountain-soil environment might affect the growth rate of mountain-cultivated ginseng and evaluated the physiological and chemical differences between field-cultivated ginseng and mountain-cultivated ginseng. They found out that environmental conditions at the mountain site are not as suitable for the growth of *Panax ginseng* and the growth of the ginseng slower with mountain soil. It is unclear why the growth of mountain ginseng is slower, because the total organic matter was richer in the mountain soil.

2. A study conducted in 2002 (Youn and others) aimed to compare the extraction efficiencies of ginsenosides Rg_1 and Rb_1 from ginseng by microwave and conventional solvent extraction. Microwave-assisted extraction has been shown to be an efficient method for extraction of ginsenosides Rg_1 and Rb_1 from ginseng root. Compared with the conventional heating method, the microwave-assisted extraction provided the enhanced extraction efficiency and reduction of processing time.

3. A study was conducted to show that indole-2-butyric acid combined with methyl jasmonate increased simultaneously root growth and ginsenoside accumulation in ginseng adventitious root cultures (Yun-Soo and others 2007). By histological observations, they also investigated the indole-2-butyric acid stimulated cell division in root tips of ginseng adventitious root, despite the presence of methyl jasmonate. They found out that indole-2-butyric acid with methyl jasmonate actively stimulated cell division of ginsenosides compared with methyl jasmonate alone.

4. A study by Christensen and Jensen in 2008 aimed to determine the content of bioactive ginsenosides and polyacetylenes from 50 selected roots from a 7-year old ginseng plant population grown on Denmark with root fresh weight varying from 191-490g in order to investigate the correlation between: a. root weight and the content of ginsenosides and polyacetylenes and b. ginsenosides and polyacetylenes. It was found out that the content of ginsenosides and polyacetylenes is not correlated with root fresh weight, which means that, selection for large roots may result in higher root yields without resulting in a decrease in the concentration of the bioactive compounds.

5. A study by Corbit and others (2005) aimed to test four methods of ginsenoside extraction, and to establish a simplified, yet effective protocol for the extraction of the major ginsenosides from the roots of *P. quinquefolius*with minimal sample preparation. The results showed that single extraction by refluxing ground ginseng roots with 100% methanol at 60°C for 1 hour provided a simple and efficient method of extracting R-family ginsenosides.

CHAPTER 3

METHODOLOGY

A. Overview of the Study

Ginsenoside content of ginseng teas needs to be checked for quality confirmation. The ginsenoside content of Korean ginseng teas were calculated in this study. A standard curve was made from the absorbances of the diluted solutions of the 80% ginsenoside ginseng powder from Herbanext Inc. The absorbances were all measured by UV-Visible Spectrophotometer in 405 nm. The standard addition method was used to determine the concentration of ginsenoside in the teas.

B. List of Materials and Equipments

- Electronic balance
- UV-Visible Spectrophotometer
- 80% ginsenoside Ginseng root powder from Herbanext Inc.
- Volumetric Flasks
- Pipettes
- Aspirators
- Distilled Water
- Wash Bottle
- Tissue
- Cuvettes
- Hot Water
- Masking Tape
- Cotton balls wrapped in aluminum foil
- Marker
- Ballpen
- Logbook

C. Procedures

C.1. Collection of Ginseng Teas

The Korean Ginseng teas with red and brown label were bought from a local store in Tagburos, Puerto Princesa City, Palawan. The researchers asked about the authorization of the government for this product by checking the packaging if it has marks for legal distribution here in the Philippines. The purchased ginseng teas were used for the quantity confirmation of its ginsenoside content.

Plate 1. Korean Ginseng Tea teabags with red and brown label.

Plate 2. Korean Ginseng Tea with a red label sample

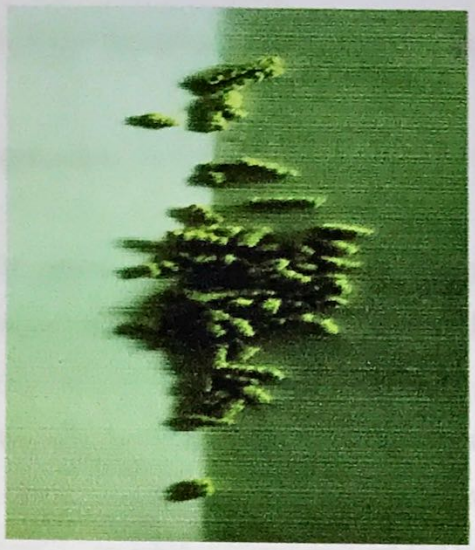

Plate 3. Korean Ginseng Tea with a brown label sample

C.2. Collection of Standard Ginsenoside

The 80% ginsenoside ginseng root powder was acquired from Herbanext Inc. at Bago City, Negros Occidental. It was sealed on an airtight plastic bag. The color of the ginseng root powder was yellow and has a pungent scent. The standard ginsenoside was used for making the standard curve.

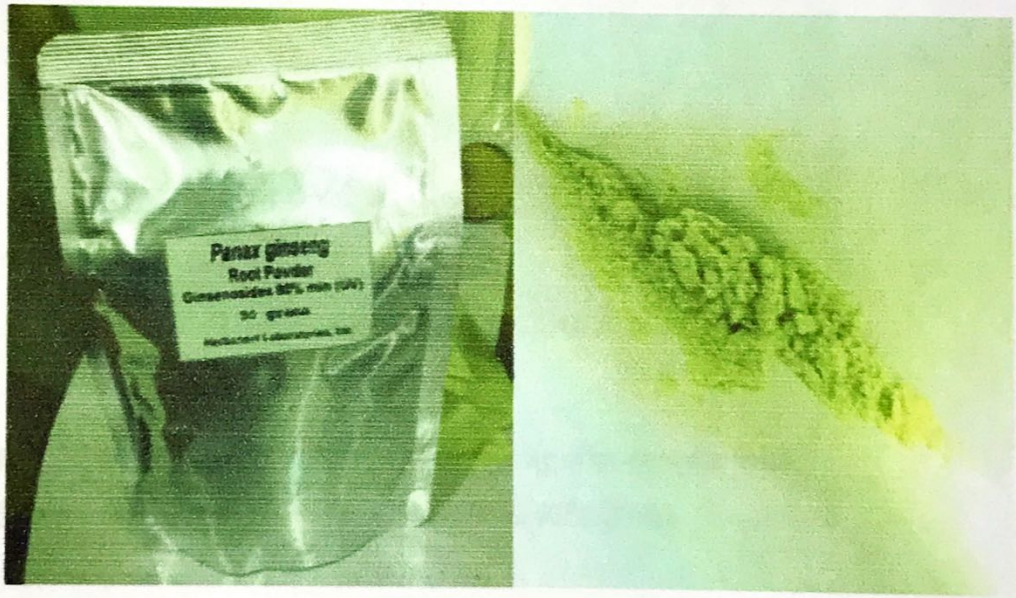

Plate 4. The *Panax Ginseng* root powder that has 80% ginsenoside.

C.3. Preparation of the Standard Curve for the Standard Ginsenoside

C.3.1. Preparation of the Diluted Solutions of the Ginseng powder

Fifty grams of 80% ginsenoside ginseng root powder was obtained from Herbanext Inc. The ginsenoside was sealed in an airtight plastic bag. An electronic balance was used to weigh five grams of ginseng root powder, later it was dissolved in 100 mL of hot water in a 100 mL volumetric flask and labeled 100%. Then 80 mL of it was transferred into another 100 mL volumetric flask and added with 20 mL water and labeled with 80%. The method is repeated to get 60%, 40%, 20 %. There is also a 0% solution which is pure water. All volumetric flasks are covered with cotton balls wrapped by aluminum foil so it will not evaporate.

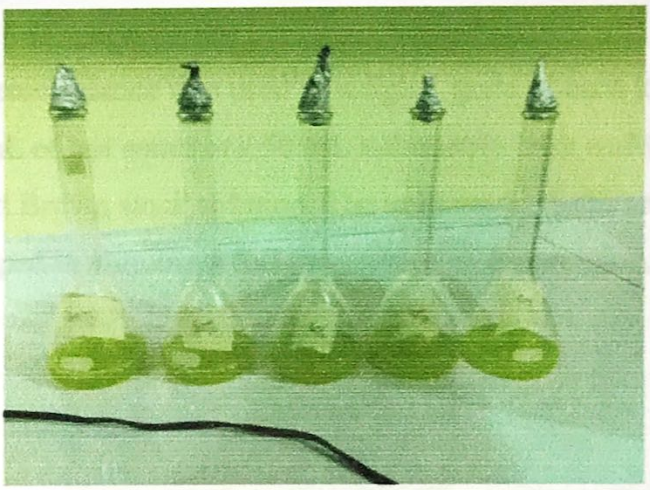

Plate 5. The diluted solutions of the ginseng root powder with differentconcentrations. (100%,80%,60%,40%,20%)

C.3.2. Determining the absorbance of the diluted solutions of the Ginseng powder

The absorbances of all the diluted solutions were measured by a UV-Visible Spectrophotometer at a wavelength of 405 nm. Using a pipette and an aspirator, a 5 mL of the 0% solution were transferred to the four cuvettes. After the machine determined the absorbances, the last three cuvettes were emptied and cleaned by distilled water and tissue. Then, 5 mL of 20% percent were transferred to the three cuvettes and their absorbances were measured. The procedure was done the same with 40%, 60%, 80%, and 100%. The absorbances in each solution were noted in the logbook. The last three cuvettes were cleaned again using distilled water and tissue.

C.4. Preparation of the Stock solution of the Ginseng Teas

An electronic balance was used to weigh 1 gram of each kind of tea. It was dissolved in 50 mL of hot water in a 50 mL volumetric flask and labeled Red stock solution and Brown stock solution. The volumetric flasks are covered with cotton balls wrapped in aluminum foil for preventing evaporation.

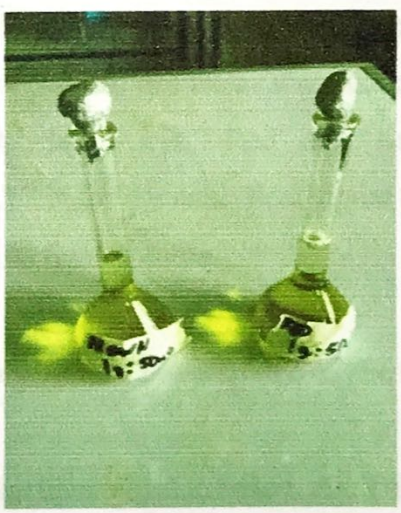

Plate 6. The Korean ginseng tea stock solutions.

C.5. Calculation of the Ginsenoside content of the Ginseng Teas using Standard Addition Method

C.5.1. Preparation of Solutions

C.5.1.1. Preparation of the Unknown Concentration Solutions

A volume of 5 mL from each Korean ginseng tea stock solution was transferred into two different 50 mL volumetric flasks using a pipette and an aspirator. Then, 45 mL of hot water was added in both volumetric flasks and it was labeled "Ax,T-Red" and "Ax,T-Brown." The label "Ax,T" is for the analytical signal for the unknown diluted to final volume.

C.5.1.2. Preparation of the Unknown Concentration Solutions with Standard

A volume of 5 mL from each Korean ginseng tea stock solution and 5 mL of 40% standard solution was transferred into two different 50 mL volumetric flasks using a pipette and an aspirator. 40 mL hot water was added in both volumetric flasks and it was labeled "Ax+s,T Red" and "Ax+s,T Brown". The label "Ax+s,T" is for the analytical signal for the unknown plus standard diluted to final volume.

C.5.2. Determining the absorbance of the unknown solutions

The absorbance of Ax,T Red, Ax,T Brown, Ax+s,T Red, and Ax+s,T Brown were all measured by UV-Visible Spectrophotometer at a

wavelength of 405 nm. The first cuvette was filled with the 5 mL of the 0% standard solution and the last three cuvettes were filled with 5 mL of a solution with unknown concentration. Then, the absorbances were measured and the procedure was done to all solutions with unknown concentration. The absorbances in each solution were noted in the logbook. The obtained absorbances for the four solutions were used in solving for the ginsenoside concentration in the Korean ginseng tea.

C.5.3. Computing for the ginsenoside concentration

The concentration of the ginsenoside in stock solutions was calculated by the standard addition method. This formula is used.

$$c_x = \frac{A_{x,T}}{A_{x+s,T} - A_{x,T}} \cdot \frac{V_s c_s}{V_x}$$

where:

Ax,T = absorbance of the unknown concentration solution.

$Ax+s,T$ = absorbance of the unknown concentration solution with 40% standard.

Vs = volume of the 40% standard added.

Vx = volume of the unknown concentration solution.

Cx = concentration of ginsenoside inside the stock solution.

Cs = concentration of the standard added.

Cs was calculated using this formula.

$$Cs = \frac{\textit{Amount of powder x concentration of the ginsenoside present in the powder x concentration of the standard solution used}}{\textit{molecular weight of ginsenoside x volume of the solvent}}$$

The molecular weight used was the molecular weight of Ginsenoside-Rg1which is 801.01 grams/mol since Ginsenoside-Rg1 is the most abundant ginsenoside found in Panax Ginseng. There is no specification what type of ginsenoside was found inside the ginseng root powder. It is only labeled 80% ginsenoside.

CHAPTER 4

RESULTS AND DISCUSSION

This study aimed to determine the concentration of ginsenoside in Korean ginseng teas that are not approved by the Bureau of Food and Drugs (BFAD).

Korean ginseng teasthat have labels with red and brown color without BFAD approval were bought in a local store at Tagburos, Puerto Princesa City, Palawan. Fifty grams of 80% ginsenoside ginseng root powder was obtained from Herbanext Inc. at Negros Occidental. Five grams of the ginseng root powder was dissolved in 100 ml hot water, and then diluted to 100%, 80%, 60%, 40%, 20%, and 0% (hot water). The standard curve was established by measuring the absorbance of the solutions using a UV-Visible Spectrophotometer. The slope of the standard curve was calculated to check if the dilution is accurate.

The teas were in granules and have a color of light brown for the Korean ginseng tea with a label in brown color and darker brown for the Korean ginseng tea with a label in red color. The stock solution of the tea samples was made by dissolving one gram of each tea in 50 ml hot water. The smell released by the dissolved teas was tea-scented. Standard Addition Technique was used to determine the concentrations of the ginsenoside in the tea samples.

A. Results

A.1 Concentration of Ginsenoside in the Red and Brown Ginseng Tea

The concentration of ginsenoside in Korean ginseng tea with a label in red color is 1.19×10^{-4} M per one gram sample which is equal to 2.86×10^{-5} mg per teabag while in Korean ginseng tea with a label in brown color is 4.40×10^{-5}M per one gram sample which is equal to 1.06×10^{-5} mg per teabag.

A.2 Slope of the Standard Curve (R)

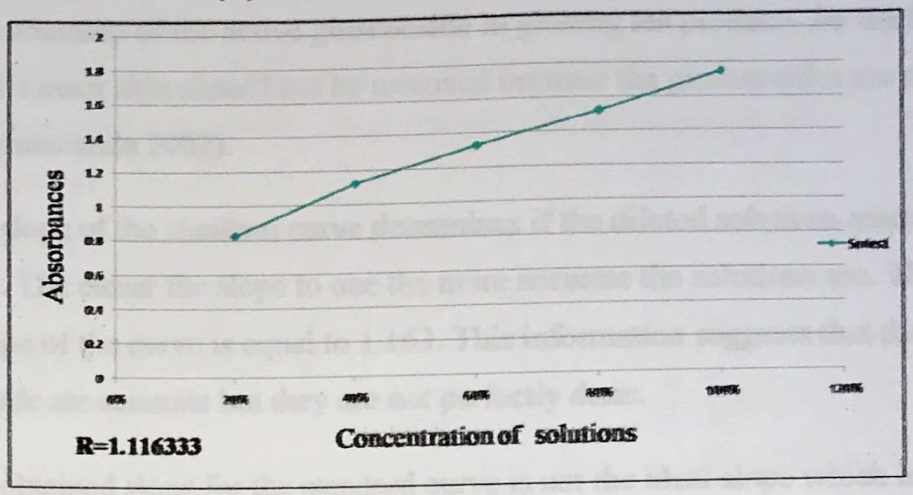

Figure 1. Standard curve for 80% ginsenoside

B. Discussion

Ginsenosides are the active constituents of the ginseng plant that gives its therapeutic effects. The ginsenoside content of the tea indicates the medicinal value of that tea(Youn and others 2002). Results of the study showed that the Korean ginseng tea contain only traces amounts of ginsenoside.

The teas are not approved by the Bureau of Food and Drugs of the Philippines (BFAD). This means that they were manufactured and licensed in Korea but not here. Consumers of this product are not guaranteed that this product is safe to take and if the drugs it contain cannot harm their health.

The Korean ginseng teas are processed from ginseng plants. The therapeutic effects of ginsenoside give the tea's main selling point. The results of the study showed that the ginsenoside content of the teas is 2.86×10^{-5} mg per teabag for the red one and 1.06×10^{-5} mg per teabag for the brown one. The different processes it undergone before it is manufactured like drying, fermenting, granulating, etc. can be the cause for it to have very small amount of ginsenoside. The additives such as flavorings and other elements added can cause a decrease or

increase of the ginsenoside content of the teas (Connor 2010). The recommended dosage for ginsenosides to take effect is 8 mg daily. It is recommended that to improve the retention of the active ginsenoside in ginseng tea products the used ginseng root's outer skin should not be removed because the ginsenosides are rich in peel (Dharmananda 2002).

The slope of the standard curve determines if the diluted solutions made are accurate. The closer the slope to one the more accurate the solutions are. The obtained slope of the curve is equal to 1.163. This information suggests that the solutions made are accurate but they are not perfectly done.

The obtained slope for the standard curve is not the ideal slope which is 1, since some errors on performing the experiment cannot be avoided like in transferring solutions. This inaccuracy can also be caused by unsuccessful dissolving of the ginseng powder. The 80% ginsenoside ginseng powder was easily dissolved by hot water but it was observed that there is something that remains.The 80% ginsenoside ginseng root powder was used because a 100% purity ginsenoside extract could not be obtained.

The fact that there is so little ginsenoside in the teas and yet they are still selling well means that either ginsenoside is a very potent substance (which may be observed since many people are praising its capabilities) or the placebo effect is taking place on all those buying it. It was also observed that there are undissolved solids from the solution of the ginseng teas.

Chapter 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This study aimed to determine whether Korean ginseng teas would contain ginsenosides and measure the ginsenoside concentrations of Korean ginseng teas.

A. Summary of Findings

Results of the study showed that:

The amount of ginsenoside in Korean ginseng tea per teabag is 2.86×10^{-5} mg for the red while 1.06×10^{-5} mg for the brown.

B. Conclusion

The ginsenoside content of the two brands of Korean Ginseng tea are 2.86×10^{-5} mg for the red while 1.06×10^{-5} mg for the brown. These amounts are very small compared to the 8 mg which is the normal suggested daily dosage. Ginsenoside must be a very potent substance to be able to achieve the expected pharmacological effects on consumers with such a low concentration in the Korean ginseng teas.

C. Recommendations

This study recommends doing further investigations on the following:

1. Use 100% extract for standard solution
2. Revise the method and use equipment like HPLC to properly quantify the ginsenosides according to type

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APPENDIX A

RAW DATA

A. Standard Curve

Concentration	Trials (absorbance)			Average
	1	2	3	
0%	0.003	0.004	0.004	0.00375
20%	0.828	0.805	0.843	0.82533
40%	1.106	1.14	1.123	1.123
60%	1.323	1.336	1.326	1.32833
80%	1.511	1.529	1.511	1.517
100%	1.723	1.763	1.748	1.74467

B. A_x T and A_{x+s} T

B.1. Red

Trials	A_x T	A_{x+s} T
1	0.06	0.161
2	0.056	0.159
3	0.059	0.15

B.2. Brown

Trials	A_x T	A_{x+s} T
1	0.028	0.139
2	0.025	0.135
3	0.02	0.13

C. Stoichiometric Calculation of the Ginsenoside Content

C.1. Calculating the concentration of the standard added (Cs)

$$Cs = \frac{\textit{Amount of powder x concentration of the ginsenoside present in the powder x concentration of the standard solution used}}{\textit{molecular weight of ginsenoside x volume of the solvent}}$$

$$Cs = \frac{5\text{ g} \times 80\% \times 40\ \%}{801.01\text{ g/mol} \times 100\text{ mL}} = 1.997 \times 10^{-5}\text{ mol/100 mL}$$

C.2. Calculating the concentration of ginsenoside per one gram tea sample(Cx)

$$c_x = \frac{A_{x,I}}{A_{x+s,I} - A_{x,I}} \cdot \frac{V_s c_s}{V_x}$$

$$Cx = \frac{0.06 \times 5\ mL}{0.161 - 0.06} \times \frac{1.997 \times 10^{-5}\ mol/100\ mL}{5\ mL} = 1.186 \times 10^{-5}\ mol/100\ mL$$

(for trial 1 only)

C.2.1. Korean Ginseng tea with red label

Trial 1	Trial 2	Trial 3	Average (mol/100ml)
1.186×10^{-5}	1.086×10^{-5}	1.295×10^{-5}	1.189×10^{-5}

C.2.2.Korean Ginseng tea with brown label

Trial 1	Trial 2	Trial 3	Average (mol/100ml)
5.038×10^{-6}	4.539×10^{-6}	3.632×10^{-6}	4.40×10^{-6}

C.3. Converting the concentration of ginsenoside to milligrams of ginsenoside per teabag

(Red) 1.189×10^{-5} mol/100 mL or 1.19×10^{-4} mol/L

(Brown) 4.40×10^{-6} mol/100 mL or 4.40×10^{-5} mol/L

} Average concentration of ginsenoside per 1 gram sample

(Red) 1.19×10^{-4} mol/L x 801.01 g/mol x 0.1 L = 9.53×10^{-3} g per 1 gram sample

(Brown) 4.40×10^{-5} mol/L x 801.01 g/mol x 0.1 L = 3.52×10^{-3} g per 1 gram sample

Since, one teabag is 3 grams, the obtain amounts were multiplied by 3.

(Red) 2.86×10^{-2} g or 2.86×10^{-5} mg per teabag.

(Brown) 1.06×10^{-2} g or 1.06×10^{-5} mg per teabag.

APPENDIX B

SPECTROMETRIC ANALYSIS

A. Calibration of UV-Visible Spectrophotometer

The machine was warmed-up for 15 minutes. The cuvettes were cleaned by distilled water and tissue. The mode was set in absorbances and the wavelength was set in 405 nm.

B. Standard Addition Method

Introduction to Standard Addition

[S]f = independent variable

Analytical methods frequently rely on methods in which the analytical signal (A) is proportional to theanalyte concentration (*cx*). Thus,

$$(1)\ Ax = kcx$$

If all the constituents in the sample (the matrix) are not known, then a standard solution with the samechemical composition cannot be prepared, and a calibration curve cannot be constructed. The method ofstandard addition provides a useful approach to measuring the analyte concentration in a complexmatrix.

Standard Addition Method A. First the analytical signal is measured for the unknown sample.

$$(1)\ Ax = kcx$$

Next a known amount of analyte (standard) is added to the unknown sample and the analytical signal ismeasured.

$$(2)\qquad A_{x+s} = k\left(\frac{c_x V_x + c_s V_s}{V_x + V_s}\right)$$

Since we have two equations and two unknowns, we can solve for *cx*:

$$(3)\qquad c_x = \frac{A_x c_s V_s / V_x}{A_{x+s}\left(\frac{V_x + V_s}{V_x}\right) - A_x}$$

In this method, the total volume of the sample changes after the addition of the standard, and as a result the matrix is not exactly the same for the measurement of *Ax* and of *Ax+s*.

Standard Addition Method B. In order for the matrix to remain constant, the total volume must remain constant for all parts of the experiment. This can be accomplished by diluting both the unknown solution and the unknown plus standard to the same final volume (*VT*). First the analytical signal (*Ax,T*) is measured for the unknown sample diluted to VT :

(4) $$A_{x,T} = k\frac{c_x V_x}{V_T}$$

Next a known amount of analyte (standard) is added to the unknown solution and the combined solution diluted to *VT* . (*VT* ._*Vx*+ *Vs*) The analytical signal, *Ax+s,T*, is measured:

(5) $$A_{x+s,T} = k\left(\frac{c_x V_x + c_s V_s}{V_T}\right)$$

Since we have two equations and two unknowns, we can solve for cx :

(6) $$c_x = \frac{A_{x,T}}{A_{x+s,T} - A_{x,T}} \cdot \frac{V_s c_s}{V_x}$$

where: *Vx*= volume of unknown whose concentration is *cx*.

Vs = volume of standard whose concentration is *cs*.

Vx+s= volume of the unknown plus standard.

Ax = analytical signal for unknown (*cx* , *Vx*).

Ax+s= analytical signal for unknown plus standard (*cxVx*+ *csVs*).

Ax,T= analytical signal for the unknown diluted to the final volume *VT* .

Ax+s,T= analytical signal for unknown plus standard diluted to the final volume *VT* .

APPENDIX C

PLATES

Plate 7. Transferring powders to volumetric flask

Plate 8. Diluting solutions

Plate 9. Dissolving tea samples

Plate 10. UV-Visible Spectrophotometer used to measure theabsorbances of the solution