

# **Developing A Green Tea Based Natural Energy Drink**

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“The effect of tea is cooling and as a beverage it is most suitable. It is especially fitting for persons of self-restraint and inner worth.”

-Lu Yü

The Classic of Tea- Origins and Rituals

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## **I. Introduction:**

The objective of this project is to develop a natural tea based energy drink with minimal and all natural sugars. When a consumer walks into a conventional grocery store, different energy drink choices are available. The one thing almost all these energy beverages have in common is the extremely high level of caffeine. There is a demand for consumers looking for a “natural” energy boost. For this reason, I have compiled a composite of 2 teas, 2 energy sources, and 2 natural sweeteners; to develop the ultimate tea based natural energy drink.

## **II. Literature Review:**

### **A. Background/Problem with Traditional Energy Drinks:**

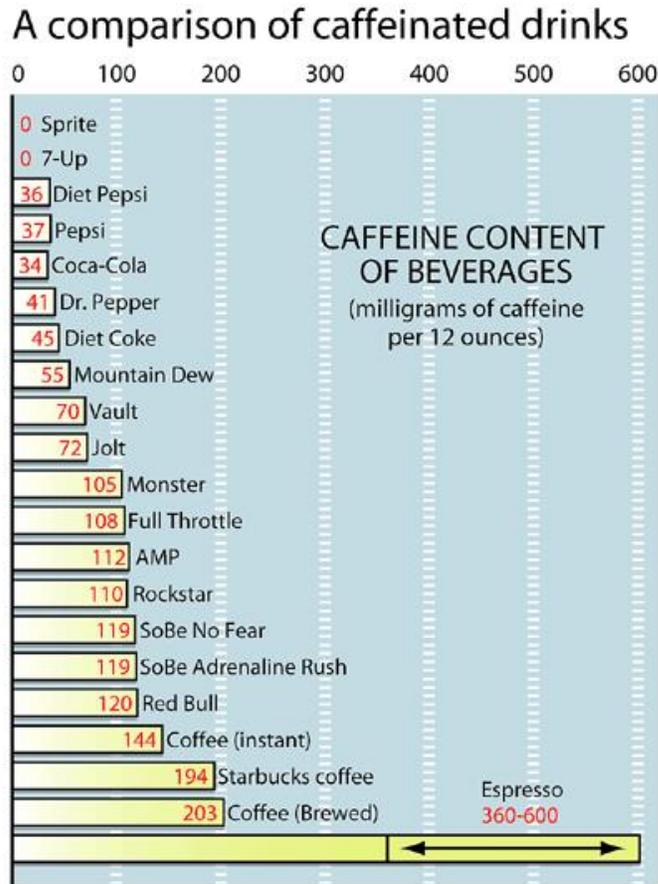
#### ***a.) Added Ingredients:***

Currently, there are several safety issues that have been associated with the traditional energy drinks available for consumers. Some common ingredients that are in nearly all of today’s traditional energy drinks are taurine, guarana, bitter orange, caffeine, and glucose. Some adverse effects that have been associated with these supplements include insomnia, restlessness, chest pain, possibility of strokes, and migraine headaches.

***b.) Caffeine Levels:***

*Figure 1.1: Different Caffeine Levels in Traditional Energy Drinks:*

*Source: Research Wikis: Energy Drink Market-Marketing Research, 2009*



The key to a safe performance energy drink is the moderation of these supplements. However, in order to achieve full consumer satisfaction, companies feel the need to increase profits and energy levels by using as much of these supplements per product as possible. The extreme caffeine levels in these energy drinks, ranging from 70 to

above 300 milligrams, have been associated with several adverse effects. Some of these possible side effects include adverse effects on the heart, increases in blood pressure, and water loss and dehydration.

*Figure 1.2: Popular Energy Drinks (2008) and their Caffeine Levels*

*Source: Reisseg, 2008*

| Energy Drink         | Ounces per bottle or can | Caffeine Concentration per bottle (mg/oz) | Total Caffeine (mg) |
|----------------------|--------------------------|---|---------------------|
| Red Bull             | 8.3                      | 9.6                                       | 80                  |
| Monster              | 16                       | 10  | 160                 |
| Rockstar             | 16                       | 10  | 160                 |
| Full Throttle        | 16                       | 9   | 144                 |
| No Fear              | 16                       | 10.9                                      | 174                 |
| Amp                  | 8.4                      | 8.9                                       | 75                  |
| Sobe Adrenaline Rush | 8.3                      | 9.5                                       | 79                  |
| Tab Energy           | 10.5                     | 9.1                                       | 95                  |

***c.) FDA Regulations:***

Although FDA does pose some regulatory aspects towards caffeine levels in energy drinks, most are neglected. The FDA states that a beverage cannot exceed 0.02% caffeine, however, this is predominately targeted towards soft drinks or similar beverages. Therefore, energy drinks are ultimately exempt from this regulation. Energy drink manufacturers continue to ignore these FDA mandated limits (Reisseg, 2008).

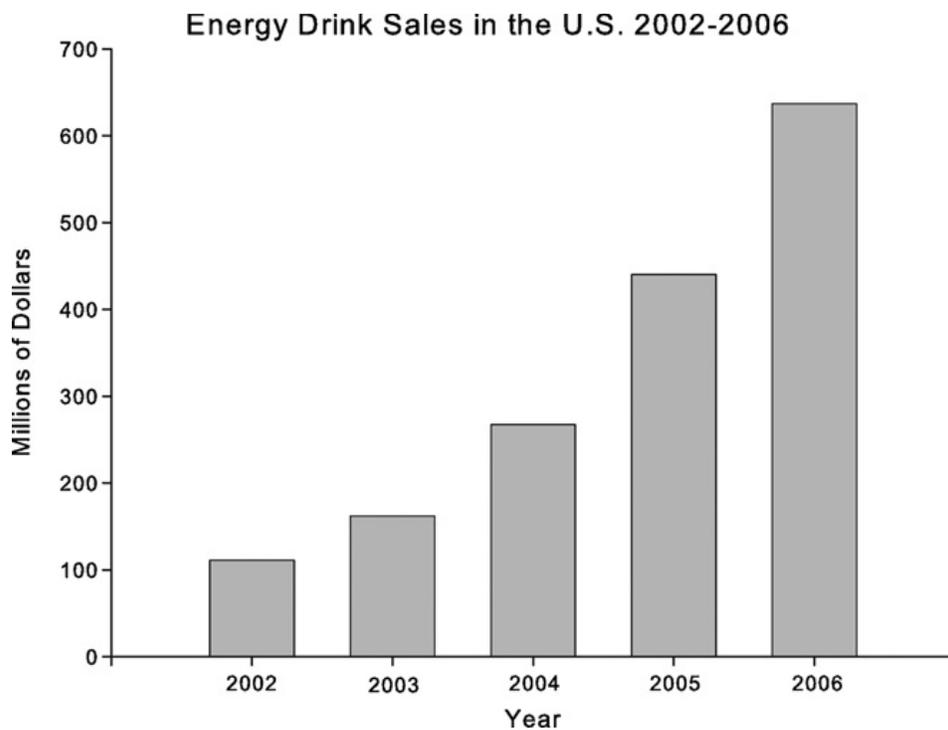
Since the introduction of Red Bull in Australia in 1987 and in the U.S. in 1997, the most recent trend toward these caffeinated energy drinks began (Reissig, 2008). By 2006, almost 500 brands had hit the market. The acute and long term effects resulting from excess of these beverages are not fully known (Reisseg, 2008).

***d.) Advertisement of Energy Drinks:***

The advertising of these energy beverages on the market are also another factor that contribute to their problem. The manufacturers claim that when consumed, these drinks promote weight loss, and increase attention, endurance, and performance (Reisseg, 2008). The main target for these energy drinks is young males. Everything from the product names to the packaging supports this demographic.

*Figure 1.3: Energy Drink Sales in millions of dollars in the United States from 2002-2006*

*Source: Reisseg, 2008*



*e.) High Sugar Levels:*

Last but not least, the high levels of sugars in energy drinks are definitely not beneficial for consumers, and can lead to weight gain and eventually obesity if abused. Except for the sugar free versions, all energy drinks contain sugars in the form of sucrose, glucose, or high fructose corn syrup, and the sugar contents vary from 21 to 34 grams per 8 ounce serving. The sugar free versions of these energy drinks bring about other possible effects regarding artificial sweeteners. The beverage industry must take initiative in developing new energy drinks that do not pose these various health threats for consumers, while still giving consumers a natural energy boost with health benefits rather than these harmful side effects. (Clauson, Shields, McQueen, and Persad, 2008).

## **B. Brief History of Tea:**

Tea has been consumed for centuries now, and is actually traced back to 2732 B.C. originally from China. Teas were primarily consumed as remedies and for medicinal purposes. The Chinese believed that teas were soul substances, which had a wide range of uses, especially targeting one's longevity and spirituality. Tea is actually the most popular drink in the world, second to water (Weiss, 2003). In today's market, not only do we have a variety of different teas and blends, but teas targeted for specific purposes as well.

## **C. Types of Green Tea: Green Power Syner Tea VS. Green Tea 50% Caffeine:**

The two green tea types with high polyphenol, EGCG, and caffeine levels that will be utilized for this energy product are Green Power Syner Tea, a recent Proctor and Gamble development, and standard Green Tea extract with a 50% caffeine level. Both samples are sourced from Amax NutraSource, Inc. The differences lie in flavor and the type of tealeaf processing. The two teas are both in the general criteria for a bold flavored green tea high in health benefits.

### **A. Green Power Syner Tea:**

Green Power Syner Tea is a green tea extract in powder patented by Proctor and Gamble, and manufactured by Taiyo Green Power in China. This product's key attributes are that it is an ultimately bitter less extract, decent clarity, yet still maintains all of the desired characteristics of green tea. By removing organic compounds and minimizing

particle size through a processing technique called nanofiltration, Proctor and Gamble produced this green tea product highlighting all its beneficial attributes.

### **B. Green Tea 50% Caffeine:**

This particular green tea extract originating from China is also from Amax NutraSource, Inc. It has a white, neutral color that is easily soluble when dispersed in liquid. By containing 50% natural caffeine from green tea, this green tea base would be suitable for an energy drink, producing pure and natural energy for the consumer.

### **D. Green Tea and its Health Benefits;**

#### ***a.) Polyphenols in Green Tea:***

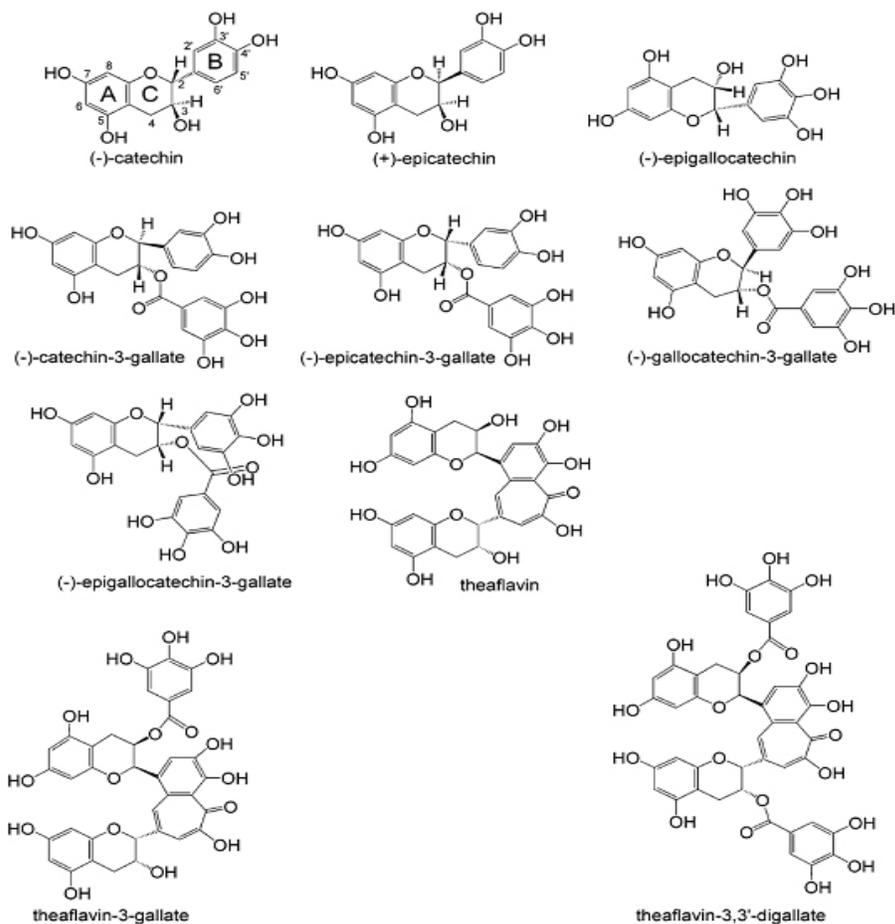
Green tea has become a tremendous health phenomenon within the beverage industry for the past two decades. Health conscious consumers seem to be generally informed about green tea and its natural health benefits. For example, antioxidants, which are mainly from the polyphenols in green tea, have a great health benefit. Antioxidants, especially in this case, have been associated with cancer prevention, therapy of hypercholesterolemia, and prevention of hypertension. (Chi Chu, Juneja, Kim, and Yamamoto, 1997). These polyphenols in green tea also have been also known to have a beneficial effect on one's intestinal micro flora as well.

One of the largest components of green tea is its polyphenols. The bitter taste associated with green tea is a result of these polyphenols. One cup of green tea usually contains about 50-100 mg of tea polyphenols. In one study, researchers reported that a daily intake of 0.5

grams green tea polyphenols resulted in both an increase of HDL-cholesterol, or the “good” cholesterol, and a decrease in blood pressure. Even when this level of tea of polyphenols was increase to 0.7 grams in the study, no adverse symptoms were observed (Chi Chu, Juneja, Kim, and Yamamoto, 1997). Currently, there is no established specific daily dosage for green tea polyphenols. Research is still taking place in determining appropriate levels of polyphenols per consumer per day in order to gain maximum beneficial results.

Figure 1.4: Variety of Polyphenols found in green tea:

Source: Institute of Science in Society (ISIS): Green Tea, the Elixir of Life, 2007



***b.) Catechins in Green Tea:***

The polyphenols found in green tea are composed of six different kinds of catechins (Yamamoto, Juneja, Chu, and Kim 13). Epigallocatechin gallate (EGCG) is the catechin found most abundantly of these green tea polyphenols. Most of the health benefits associated with green tea polyphenols are linked to this one specific EGCG catechin in green tea. EGCG is the catechin best known for its chemo protective properties and is the main bioactive component of green tea after caffeine (Weiss, 2003). For this reason, one of the “natural” energy sources that will be utilized in this innovative tea based energy drink will be matcha green tea, which is a concentrated form of this EGCG catechin.

***c.) Caffeine in Green Tea:***

Caffeine is a trimethyl derivative of purine 2,6-diol and is synthesized mainly in the leaves of the tea plant (Chi Chu, Juneja, Kim, and Yamamoto, 1997). The caffeine content of generic coffee beans is about 1.5%, whereas the caffeine levels of green tea can be extracted to achieve a maximum level of about 5% caffeine. The caffeine levels in green tea are linked to the metabolism increasing benefits of consuming green tea, which can theoretically lead to weight loss. An average cup of tea contains about 40 milligrams of caffeine (Bryan, 2007). The type, blend, and steeping time of tea will affect the desired amount of caffeine of your tea product. It takes about thirty minutes for the effects of caffeine to be recognized by the consumer. The ultimate effects of caffeine will be reached within 30 to 120 minutes after consumption (Bryan, 2007). Some beneficial effects that have been associated with caffeine from green tea are effects on mood, cognitive

performance, and increased alertness. The benefits of caffeine sourced from tea, rather than high amounts of caffeine from other sources, are its little to no “crash” effects, not leaving the consumer stripped of energy and restless. According to a journal on the nutritional review of caffeine in tea, lower doses of caffeine (in tea, for example) when compared to high levels of caffeine (in coffee and energy drinks) seem to actually be more beneficial cognitive performance over a longer period of time (Belza, 2009). Rather than having only a “burst” of energy, caffeine levels in tea actually supply the consumer with a longer, natural feeling of energy and concentration.

***d.) L - Theanine in Green Tea:***

L-theanine is an amino acid that is naturally occurring in different types of teas. It is actually found almost exclusively in green tea (Bryan, 2007). L- theanine has been associated with effecting the central nervous system and neurotransmitters. Studies on animals and L theanine have been known to increase levels of dopamine. L- theanine actually has been associated to having the inverse effects of caffeine, such as lowering blood pressure, lowering anxiety, and increasing relaxation. Janet Bryan suggests that based on several studies, a combination of both caffeine and L-theanine (which can be found in green tea) at low doses interact to produce a better ability to focus attention, while improving speed and accuracy (Bryan, 2007). For this reason, a tea based energy drink is vital for “natural” energy, due to these health benefits when compared to the artificial stimulation associated with caffeine from coffee and other artificial energy beverages.

Figure 1.5: Structure of L Theanine in Green Tea:

Source: [Hypericum.wordpress.com](http://Hypericum.wordpress.com)-“Mediation in the Bottle”, 2008.



## **E. Additional Energy Sources:**

### **a.) Caffeine in General:**

The chemical term for caffeine is methylxanthine. Caffeine is actually known to be the world's favorite legal psychoactive substance (Hohenegger, 2006). The well-liked effects of caffeine results in its wide use all over the world. Caffeine is an alkaloid found in the seeds, leaves, and fruit of more than sixty plants. The best-known sources of caffeine are most commonly known as coffee, cocoa, mate, and tea (Hohenegger, 2006).

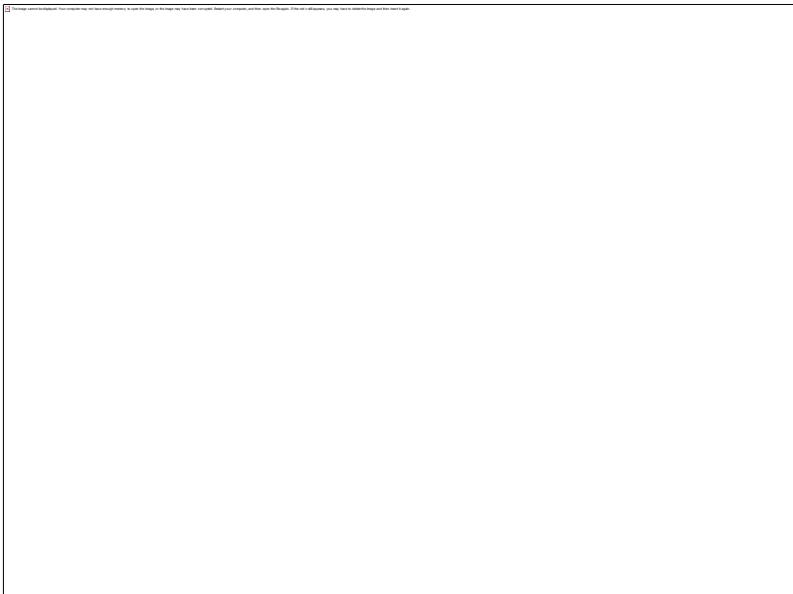
Caffeine in tea was actually referred to as “theine” until it was determined in the 1830's that caffeine and theine were in fact the same compound. The *Camellia Sinensis*, also known as the “tea bush”, grows at different climates, which results in variations in caffeine levels. The tea leaf at its final growth stage will most likely have a caffeine level anywhere from two to five percent.

After the harvesting of the tea leaves, the actual processing methods of the different tea varieties will not significantly alter the caffeine levels of the final tea product. Different classes of green tea tend to be lower in caffeine than when compared to black teas, which are about 60 milligrams of caffeine per eight ounce serving. A general range of green tea

caffeine levels fall within 25 to 50 milligrams of caffeine, dependent on the variety of factors previously discussed. Due to these reasons, tea is the alternative beverage with a gentler touch than coffee. (Chi Chu, Juneja, Kim, and Yamamoto, 1997).

*Figure 1.6: Caffeine Levels in Various Teas Compared to Coffee:*

*Source: Teavana, 2009.*



***b.) Matcha Green Tea as an Added Energy Source:***

Matcha green tea is the primary type of green tea that contains the most levels of naturally occurring caffeine. For this reason, the Japanese have been utilizing matcha green tea for centuries. Traditionally, matcha was suspended into hot water, agitated with a brush made of bamboo, and served in the typical Japanese way (Chi Chu, Juneja, Kim, and Yamamoto, 1997). Matcha accounts for only 0.6% of the total green tea consumption due to its unfamiliarity, unavailability, and price. A high-grade matcha contains about 6.5%

polyphenols, 3.85% caffeine, 2,260 mg theanine, and 5,800 mg free amino acids per eight ounce serving. When compared to other green teas, matcha green tea actually contains relatively higher components of these ingredients.

The product I will be utilizing in my beverage formulation is a concentrated form of matcha green tea, called matcha green tea powder. Matcha green tea is a special powdered green tea used in the Japanese tea ceremony. A study suggested that drinking matcha green tea and/or utilizing matcha green tea powder in a product would result in a greater intake of EGCG, when compared to consumption of other green teas (Weiss, 2003). A higher dose of the catechin EGCG will directly result to higher levels of caffeine in the desired beverage. Coming from a green tea source, these higher levels of caffeine can now be recognized as the same “natural” boost that regular green tea provides, simply in a more concentrated form.

#### ***Different Kinds of Matcha Green Tea Powder:***

There are several different varieties of matcha green tea powder product, as well as different processing methods to produce it. Matcha can basically be categorized into two different kinds, koicha and usucha, or, the thick versus thin matcha powders (Green Tea Terrace, 2008). The thin type of matcha usually contains higher levels of caffeine and a bolder flavor. The thick type of matcha, however, is more expensive, since it usually comes from older and more traditional plant sources (Green Tea Blog, 2009).

There are several different quality grades of matcha as mentioned previously. The matcha grade that will be used in this particular formulation will obviously be food grade. There is also premium grade, which is mainly sourced from Japan and is usually referred to as the

ceremonial type. In terms of quality, the finer the matcha is ground, and the greener and brighter the color is, the higher overall quality the extract will have (Greenteahous, 2004-05).

***c.) Ginseng as an Added Energy Source:***

The Chinese have been using ginseng for centuries for its health effects known to enhance stamina, memory, increase appetite, treat anemia, general weakness, nervous agitation, forgetfulness, and impotence (Tilgner, 1999). According to the Chinese, ginseng is classified as a mild medicine, a tonic that invigorates the body. These mild effects include strengthening internal organs, exerting tranquil effects, increasing resistance to infection and diseases, improving vision, mental work capacity, and one's general physical conditions, thus, prolonging life (Lee, 1992).

There are two general categories of Ginseng- Panax Quinquefolius, or the American ginseng, and Panax Ginseng, which is the Asian Ginseng. In this product development case, the American ginseng will be used, due to availability and pricing.

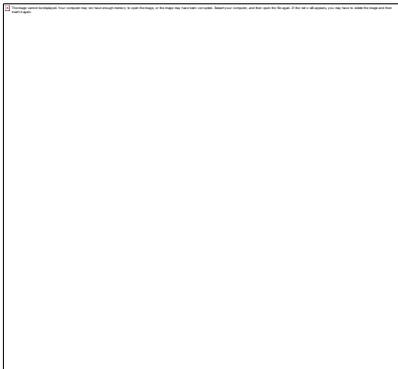
Only the root of the ginseng plant is utilized in the production of ginseng, and the amounts used vary with the concentration of the specific extract. Ginseng is unique not only for its health benefits, but also that only a little dose is needed to see results. These various beneficial effects of ginseng are due to its multi-component system. (Lee, 1992). Restored vitality is one of the many effects ginseng will bring to consumers. (Lee, 1992).

The difference of the amounts of ginseng in today's energy drinks compared to this beverage is the concentrated amounts of ginseng being added. For this reason, many have

given ginseng a negative association regarding side effects consumers may be experiencing such as fatigue, difficulty of breathing, and increased heart rates (Lee, 1992). However, due to the extreme variety of ingredients that are being added, specific associations cannot be made to a single ingredient. For this reason, ginseng, in moderation, can be readily used for its several health benefits as well as a steady increase in energy, stamina, and clarity, thus, providing a natural feeling of energy for consumers.

*Figure 1.7: Structure of Ginseng:*

*Source: Journal of Investigative Dermatology, 2003.*



## **F. Natural Sweeteners Being Utilized:**

### ***a.) Honey:***

Honey has been used as a natural form of sweetener for ages. Now that the health craze for all natural, “good-for-you” products has made a come back, the use of honey has returned within the food industry. Sourcing from the natural substance produced by honeybees, honey provided us with a subtle sweetness yet unique and pleasing flavor. Today, honey has strict regulations within the food industry, and no adulteration is allowed. The essential qualitative criteria for honey includes odor, flavor, color, HMF content, water content, pH value, diastatse, sugar spectrum, conductivity, consistency, and last but not least, viscosity (Benech, 2007). Honey contains mainly carbohydrates, without about 79% being monosaccharides. Apart from its carbohydrate content, honey contains water, a variety of acids (glucuronic and acetic), amino acids, enzymes (including diastase and saccharase), aromatic components, essential oils, natural color pigments, vitamins (insignificant amounts), minerals, proteins, dextrin’s, and pollen grains (Benech, 2007). The nutritional content honey varies a little based on the source of honey, however on average, honey contains about 32 kcal’s per 10 grams, or 320 kcal’s per 100 grams. When compared to sucrose and traditional sugars being utilized in traditional energy drinks, the caloric values do not fall much lower. However, the natural source of honey as well as its bold flavor and minimal usage will result to an overall healthier product for consumers.

***b.) Agave Nectar:***

Agave nectar has traditionally been used in Mexico for ages. However, it is a relatively new product in the United States. Agave nectar, first utilized in ancient Mexico, actually comes from blue agave, the same plant that tequila is made from. It was first identified as “honey water” among the Mexicans, due to its gentle yet original flavor characteristic.

Agave falls into a natural artisan and gourmet style sweetener category due to its natural source as well as pricy commodity regarding the growing procedure of the fragile agave plant. There are several different kinds of the agave plant. To produce agave nectar, the agave plant needs to have a life of about seven to ten years until its leaves are then cut off to produce the actual nectar. Once the leaves are cut off, the center of the plant is exposed, which is referred to as the “piña”. To produce the actual nectar, then sap is then extracted from the piña, filtered, and heated at a low temperature, which is usually below 118°F. The low temperature also adds a health benefit to the product, since it can now be recognized as a raw food, expanding to all ranges of health consumers (All about Agave, 2009).

Today, a couple health-oriented brands have brought agave nectar and made it readily available to health aware consumers. A general serving of one tablespoon of agave nectar lies between 50 and 70 calories per serving. This is most comparable to honey as an added, low calorie, all natural sweetener.

## **G. Pure Juices Utilized in Experiment:**

### ***Purpose for Ingredient:***

When looking for a happy medium of ingredients in an energy beverage, many factors are considered. The base being green tea naturally includes somewhat of a bitter after taste, as discussed previously. Since this drink is an acidic base, having a pH of less than 7, the acidity tends to increase that bitter taste in the tea. For these reasons, both a sweetener, honey or agave nectar, as well as a fresh all natural juice concentrate was utilized in product development.

### **A. Pomegranate Juice**

#### ***a.) Recent Trends:***

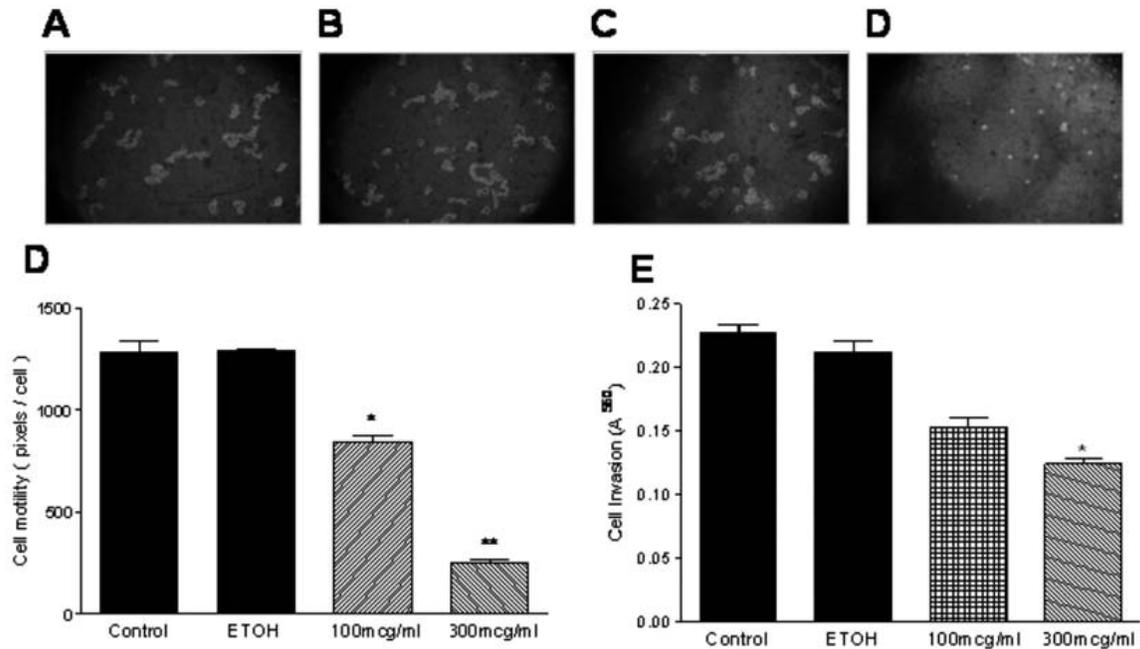
Pomegranate usage has become a recent trend in today's beverage industry due to many reasons, but primarily for its high antioxidant levels. The scientific term for the pomegranate fruit is *Prunica Granatum*. The pomegranate originated from Asia and then moved to Latin American Countries as well as Eastern Europe. Turkey actually contributes 150,000 tons of the world annual production of one million (Erim, 2008). Throughout the world, there are actually several hundred different species of the pomegranate berry. From experience, consumers are aware that the shell of the pomegranate cannot be consumed and once cut open; the pomegranate seeds are in fact the delicious fruit themselves. In addition to its high antioxidant levels, the pomegranate berry also contains quite a decent amount of both vitamin C as well as potassium.

**b.) Anticancer Effects on Various Types of Cancer Cells:**

In a recent study from Integrative Cancer Therapies this year, pomegranate fruit extracts were tested for their pro-apoptotic or ant proliferative effects (Khan, 2009). Anti-inflammatory effects were also observed in prostate, lung, and other specific types of cancer cells. Cells were examined over a period of 72 hours, and with the addition of pomegranate fruit extract, treatments lead to a decrease of motility in breast cancer cells. The pomegranate extract became aggressive on the cancer cells, and drastically decreased movement throughout the infected area.

*Figure 1.8: Functional Effects of Pomegranate Fruit Extract Treatment on Cancer Cells*

*Source: Integrative Cancer Therapies: Khan, 2009*



**B. Blueberry Juice:**

***a.) Antioxidant Levels in Blueberry Juice:***

In addition to Pomegranate Juice, Blueberry juice also contains very high levels of antioxidants and ultimately endless health benefits. Blueberries have also been known to have a very high level of polyphenolic and anthocyanin compounds, which usually lead to higher antioxidant activity, thus, leading to more anti-cancerous effects (Duffy, 2007).

***b.) Cellular Protection against Stress and Learning Impairment:***

In a recent study in 2007 by the National Institute of Aging, blueberry extract was utilized in an experiment to demonstrate its effects on cellular protection against stress and learning impairment (Duffy, 2007). Rats were pretreated with blueberry extract to determine if their learning capacities improved when compared to test rats without any pretreatments. In conclusion, the performance of the rats in mazes were increasingly improved when treated with blueberry extracts. This then leads to the association of blueberries and effects of aging. A diet rich in blueberry may also degenerate processes due to oxidative or inflammatory stressors (Duffy, 2007). Once again, the possibilities are ultimately endless.

**III. Methods and Materials:**

### **List of Entire Materials Used in Experiment:**

- Green Power Syner Tea-AMAX Nutrasource, Inc. (City of Industry, CA)
- Green Tea 50% Caffeine- AMAX Nutrasource, Inc. (City of Industry, CA)
- Panax Ginseng Extract (liquid)- Prince of Peace Co. (China)
- Panax Ginseng Extract 10% (powder)- AMAX Nutrasource, Inc. (City of Industry, CA)
- Matcha Green Tea Extract (powder)- Republic of Tea (Novato, CA)
- 100% Pure Organic Clover Honey- Trader Joes (Monrovia, CA)
- Organic Agave Nectar -Trader Joes (Monrovia, CA)
- 100% Pure Pomegranate Juice- RW Knudsen (Chico, CA)
- 100% Pure Blueberry Juice- RW Knudsen (Chico, CA)
- Filtered drinking water (no specific source)

### Lab Materials:

- (6) 600 ml beakers
- (10) Weigh boats
- (2) Metal stir rods
- (10) 1 oz. plastic tasting cups
- (6) Plastic spoons
- Weighing scale
- Conversion table
- PET 16 oz. water bottles with caps
- Refrigerator (for storage purposes)

### **Methods and Materials :**

**A (Final Desired Formulation):**

1. Convert 16 ounces (serving size of product) to milliliters with conversion table
  - a) 16 fluid ounces (fl oz) = ~473 milliliters (mL)
2. Add 473 mL filtered drinking water in a 600 ml beaker
  - a) Repeat this step to produce all 6 tea bases.
  - b) Repeat as many times as necessary

\*This formulation will be the constant base throughout entire experiment. The following variables will be added to different green tea bases to determine which is more preferred (determined by sensory evaluations).

3. Add 0.5 grams *Syner Tea* to a 600 ml water solution
4. Add 1 bottle (0.34 fl oz) *liquid Panax Ginseng*
5. Add 10 grams (g) *honey* to solution
6. Add 50 mL *pomegranate juice* to 600 ml solutions
7. Mix entire solution to ensure no solids are left and mixture is homogenous

**B:**

Repeat Steps 1-2, Then:

3. Add 0.5 grams *Green Tea 50% Caffeine* to other 600 mL water solution
4. Add 1 bottle (0.34 fl oz) *liquid Panax Ginseng*
5. Add 10 g *honey* to solution
6. Add 50 mL *pomegranate juice* to 600 ml solutions
7. Mix entire solution to ensure no solids are left and mixture is homogenous

**C:**

Repeat Steps 1-2, Then:

3. Add 0.5 grams Syner Tea to a 600 mL water solution
4. Add 1 bottle (0.34 fl oz) liquid Panax Ginseng
5. Add 10 g *agave nectar* to solution
6. Add 50 mL pomegranate juice to 600 ml solutions
7. Mix entire solution to ensure no solids are left and mixture is homogenous

**D:**

Repeat Steps 1-2, Then:

3. Add 0.5 grams Syner Tea to a 600 mL water solution
4. Add 0.5 grams *matcha green tea powder* to solution
5. Add 10 g honey to solution
6. Add 50 mL pomegranate juice to 600 ml solutions
7. Mix entire solution to ensure no solids are left and mixture is homogenous

**E:**

Repeat Steps 1-2, Then:

3. Add 0.5 grams Syner Tea to a 600 mL water solution
4. Add 0.3 grams *10% ginseng extract powder* to solution
5. Add 10 g honey to solution
6. Add 50 mL pomegranate juice to 600 mL solutions
7. Mix entire solution to ensure no solids are left and mixture is homogenous

**F:**

Repeat Steps 1-2, Then:

3. Add 0.5 grams Syner Tea to a 600 mL water solution
4. Add 1 bottle (0.34 fl oz) liquid Panax Ginseng
5. Add 10 g honey to solution
6. Add 50 mL *blueberry juice* to 600 ml solutions
7. Mix entire solution to ensure no solids are left and mixture is homogenous

**Bottling, Storage, and Shelf Life:**

*Bottling:*

1. Place 600 mL contents in 16 oz water bottle
2. Screw on plastic cap

*Storage*

1. Once bottles, place contents in refrigerator
2. Should be stored at standard refrigeration temperatures (40°F or lower)

*Shelf Life:*

This beverage will be intended for fresh use and have a shelf life of about 7-10 days. However, ascorbic and/or citric acid will be used 0.5 grams to ensure microbiological safety and shelf life.

**Sensory Evaluations:**

There will be various sensory evaluation techniques that will be taken place throughout this product formulation process. Two different green tea varieties will be tested with a preference test. This will be achieved by a traditional preference sensory evaluation. (Appendices 1-4)

Once the most popular/most liked green tea variety has been chosen, the additional energy sources will be tested for sensory evaluations as well. Two or more different combinations of the chosen green tea combined with different doses of ginseng and/or matcha will be evaluated to see which levels or thresholds can be the maximum utilization for added energy without compensating taste.

Once the ginseng and matcha levels are determined, the final sensory preferences will be tested. This is the preference choice of sweeteners at their most desired levels.

Honey and Agave nectar will both be tested for preference in the final chosen tea and added energy choice. Pomegranate and/or Blueberry Juice concentrates will also be added for antioxidant activity and enhanced flavor. This will also be accomplished by a standard sensory taste test.

**Panel:**

The panel that will be used for these various preference tests are both students and faculty from the Food Science and Nutrition Department. In addition, friends and family who are avid green tea consumers will also be chosen to give a better range of educated consumers. Some of these tests will be taken in the Food Science pilot plant, by permission. Also, a range of informal testing as “on the spot” sensory tests will also take place, due to availability in the pilot plant. There will be 10 panelists per specific preference test. Overall, a specific sensory panel will conclude the final formulations for the various tea beverages.

**IV. Results:**

**% Breakdown of Ingredients in Final Formulations:**

**Table 1.1: Trial #1: Final Chosen Product Formulation** with Syner Tea, Ginseng, Honey, & Pomegranate Juice

| Ingredient:       | % Break Down |
|-------------------|--------------|
| Water             | 88%          |
| Syner Tea         | 1.86%        |
| Ginseng           | 9.31%        |
| <b>Honey</b>      | 0.63%        |
| Pomegranate Juice | 0.21%        |

**List of Next Best Formulations in Experiment:**

**Table 1.2: Trial #2: Standard Final Formulation + Alternative Sweetener as Agave Nectar**

| <b>Ingredient:</b>  | <b>% Break Down</b> |
|---------------------|---------------------|
| Water               | 88%                 |
| Syner Tea           | 1.86%               |
| Ginseng             | 9.31%               |
| <b>Agave Nectar</b> | 0.63%               |
| Pomegranate Juice   | 0.21%               |

**Table 1.3:** Trial #3: Standard Final Formulation with Matcha Powder (Replacing Ginseng)

| <b>Ingredient:</b>          | <b>% Break Down</b> |
|-----------------------------|---------------------|
| Water                       | 88%                 |
| Syner Tea                   | 1.86%               |
| <b>Matcha Powder</b>        | 0.55%               |
| Honey                       | 0.63%               |
| Pomegranate/Blueberry Juice | 0.21%               |

**Table 1.4: Final Sensory Preference Results:**

| <b>Preference Test</b>                  | <b>% Option A</b> | <b>% Option B</b> |
|---|-------------------|-------------------|
| Syner Tea vs. Green Tea<br>50% Caffeine | 80%               | 20%               |
| Honey vs. Agave Nectar                  | 60%               | 40%               |
| Ginseng vs. Matcha                      | 70%               | 30%               |
| Pomegranate vs. Blueberry               | 60%               | 40%               |

**V. Discussion:**

The green teas that were originally going to be used were sencha and matcha green teas. The original plan was to steep both teas as if to be consumed hot, but then cooled in a refrigerated temperature to utilize in the final product. After further research, it was determined that concentrated shelf stable powder forms of green tea concentrates would be utilized instead. This will not only decrease costs but also contribute to higher levels of the beneficial antioxidant aspects of green tea such as polyphenols and catechins. The green tea powders that were specifically utilized were Amax Nutrasource's (City of Industry, CA) Syner Tea powder as well as Green Tea with a 50% Caffeine Level powder. The solubility of these powders were researched and worked as planned in the cold-water base solution.

The following step of the development process was adding the additional energy sources to achieve the goal of an energy drink-like beverage. Primarily, the two energy sources were set to be matcha green tea powder and ginseng. These two stayed consistent throughout the product development process. The matcha powder was used in one variation, where as the liquid panax ginseng was used in the other. A powder form of 10% Panax Ginseng was also experimented with, however, due to flavor and solubility issues, was easily eliminated.

Following the added energy sources, both sweeteners were utilized in the green tea formulation. Honey and Agave Nectar were both chosen due to their low caloric value (about 60 calories per tablespoon serving) as well as taste and blending characteristics concerning green tea. From the determined sensory evaluation results, honey was most proffered above agave nectar (Table 1.4).

Both pomegranate and blueberry juices were added in addition to the original formulation to enhance both flavor and antioxidant and health benefits. This was an addition that was determined later in the product development phase to cover some of the bitter flavor that was contributed from the green tea base. When added, not only did the juices add an appealing color and taste, but also completely covered all of the bitter flavor compounds. From the sensory results, tasters seemed to enjoy both the pomegranate and blueberry juices, however, the pomegranate flavor was slightly preferred (Table 1.4)

In conclusion, Table 1.4 indicates the results showing that the preferred ingredients were Syner Tea, honey, pomegranate, and liquid ginseng. The preference tests showed that the formulation that utilized all these ingredients was the best tasting green tea beverage. The Syner Tea blended well and gave a better clean taste when compared to the green tea with 50% caffeine, which left a bitter taste. The honey had more of a pleasing taste and aroma when compared to the agave nectar, which left an unusual after taste. The pomegranate and blueberry juices came in close, however, the pomegranate juice was slightly preferred, and blended well with the green tea and honey flavors. Lastly, the liquid Panax Ginseng was preferred over the powdered form, which left a bitter after taste as well.

To name a few companies that are currently being tested in the market, POM, Arizona, Honest Tea, and various others are developing similar beverages. This has been quite a recent trend in the beverage industry for about the past decade. To begin with, POM brand markets teas that include their 100% pure pomegranate juice. Most of their tea-based beverages utilize white tea, pomegranate juice, and flavors such as peach, lychee, blackberry, and others. However, POM advertises these teas as “gently brewed for a

delicious taste with less than 3 mg. caffeine” (POM, 2009). On the other hand, this green tea based energy drink that has been developed exceeds this amount of caffeine, but does not contain additionally added caffeine other than from the green tea and ginseng.

The brand Honest Tea has also come up with similar tea based products. Unlike POM brand, Honest Tea utilizes a wide range of tea varieties including flavored black teas, white teas, and last but not least, green teas. The most similar beverage to this development would be Honest Tea’s “Jasmine Green Energy Drink.” It is a blend of green and white teas, however, does not contain any additional energy sources. The name Energy from the label is in fact referring to the renewable energy that is utilized during their production process.

Arizona Iced Tea makes yet the most similar beverage to this formulation, named “Green Tea Energy Drink”. It contains only 70 calories per 8 ounce serving and has different flavors such as pomegranate, etc. The extra “energy” ingredients Arizona has added include 1,000 mg guarana, 100 mg Panax Ginseng, 35 mg milk thistle, 1,000 mg taurine, and 80 mg caffeine per serving (Arizona Iced Tea, 2009).

The intentional addition of all these ingredients listed above set this product far apart from my particular formulation. The only thing Arizona did to set this beverage apart from a traditional energy drink is use green tea as its base, rather than the conventional nutrient lacking sugar filled concentrate in regular energy drinks. In addition, the 80 milligrams of caffeine per 8 ounce serving is an unnecessary extra ingredient for additional energy.

After reviewing the several similar products available in today’s market, this innovative green tea energy drink does not nearly compare to anything in its category. The

reasons this beverage sets itself apart are due to its completely simple list of ingredients, and the caffeine originating from only green tea and ginseng. No unknown sources of caffeine will be present. The green tea combined with the ginseng extract will be enough for the generic tea drinker to get more of a “boost” than standard green tea without containing several other sources of caffeine like traditional energy drinks.

## **V. Conclusion:**

Based on the results, four main ingredients were tested with preference tests to determine which ingredients would work best together to develop an all natural green tea based energy drink. These ingredients were Syner green tea, ginseng extract, honey, and pomegranate juice.

Utilizing all natural ingredients for product formulation, the consumer will hopefully feel comfortable with the familiarity of ingredients. This is the key idea that will set this product apart from already existing energy drinks. The combination of energy drink combined with a tea beverage will enable this product for consumer interest and eventually purchases. This product will be marketed as a high-end, yet affordable all natural energy drink for an ultimately unlimited range of consumers.

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APPENDIX:

**Preference Test Forms Utilized:**

(Source: Neuhaus-Food Sensory, 2009)

**Paired Preference Test #1**

**Syner Tea vs. Green Tea with 50% Caffeine**

Tester Number \_\_\_\_\_

Date \_\_\_\_\_

Please rinse your mouth with water before starting. Please taste the two samples in the order presented, from left to right. You may drink as much as you would like, but you must consume at least half the sample provided. If you have any questions, please ask the server now.

**Circle the number of the sample you prefer**  
(you must make a choice)

\_\_\_\_\_

\_\_\_\_\_

Thank you for your participation. Please return your ballot through the window to the server.



**Paired Preference Test #2**

**Honey vs. Agave Nectar Sweeteners**

Tester Number\_\_\_\_\_

Date\_\_\_\_\_

Please rinse your mouth with water before starting. Please taste the two samples in the order presented, from left to right. You may drink as much as you would like, but you must consume at least half the sample provided. If you have any questions, please ask the server now.

**Circle the number of the sample you prefer**  
(you must make a choice)

\_\_\_\_\_

\_\_\_\_\_

Thank you for your participation. Please return your ballot through the window to the server.

**Paired Preference Test #3**

**Ginseng Versus Matcha as Energy Sources**

Tester Number \_\_\_\_\_

Date \_\_\_\_\_

Please rinse your mouth with water before starting. Please taste the two samples in the order presented, from left to right. You may drink as much as you would like, but you must consume at least half the sample provided. If you have any questions, please ask the server now.

**Circle the number of the sample you prefer**  
(you must make a choice)

\_\_\_\_\_

\_\_\_\_\_

Thank you for your participation. Please return your ballot through the window to the server.



**Paired Preference Test #4**

**Final Green Tea Combinations with Added Juices**

Tester Number \_\_\_\_\_

Date \_\_\_\_\_

Please rinse your mouth with water before starting. Please taste the two samples in the order presented, from left to right. You may drink as much as you would like, but you must consume at least half the sample provided. If you have any questions, please ask the server now.

**Circle the number of the sample you prefer**  
(you must make a choice)

\_\_\_\_\_

\_\_\_\_\_

Thank you for your participation. Please return your ballot through the window to the server.