TO FORMULA DEVELOPMENT OF READY TO DRINK TEA BY USING LOW GRADE TEA.

By
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DECLARATION

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Affectionately
Dedicated
To
My Parents
&
Teachers

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ABSTRACT

The tea plant is an evergreen of the *Camellia* family. There are two main varieties of tea: *Camellia sinensis*, and *Camellia assamica*. Tea is one of the most developed beverages in the world that drink as tea consumption is only second to water but tea industry is facing so many problems at present. One of the problems is the low prices of low grade and tea waste (refuse tea). Therefore value addition is needed to couple with other strong consumer requirements and expectations such as beneficial health to consumers, convenience and sensory satisfaction, etc.

According to the result of market survey bottled ready to drink, tea product should be available at the market which can be served in cold condition. Also ginger flavored drink was most preferred. This development was based on low grade tea such as dust, broken mixed, refuse and tea under Sri Lanka Standard and Food and Drug Administration regulations. Optimum extraction and taste was achieved by using the sensory evaluation with 7 point hedonic scale. Statistical analysis was done by using MINITAB software of Kruskal-Wallis Test. From the findings of this study the best formula for 1L of tea drink include, 100ml of tea mixture extract,ginger25g/l, aspartame25g/l and Carboxyl Methyl Cellulose 1.725g/l. This drink was developed to compatible diabetic people as a calories free drink.

0.06g/100ml of Caffeine content was quantified using ISO 10727 method per serving (180ml) ready to drink tea. 24.8g/L of ginger content (on fresh weight basis) was quantified using High Performance Liquid Chromatography method per serving (180ml) ready to drink tea. Ready to drink tea can be formulated which compatible with consumer requirement is using the low grade tea and refuse tea with a shelf life of one month. Thus this is one of the best value added quality low grade tea ready to drink from dust, broken mixed, refuse tea which can be achieved by using the above specification

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LIST OF ABBREVIATIONS

RTS	Ready To Serve
RTD	Ready To Drink
US	United States
BM	Broken Mixed
UK	United Kingdom
LTP	Lawrie Tea Processor
CTC	Crush, Tear, Curl
ADI	Acceptable Daily Intake
ISO	Organization for Standardization
HACCP	Hazard Analysis of Critical Control Point
GMP	Good Manufacturing Practices
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
SLS	Sri Lankan Standards
TSS	Total Soluble Solid
Codex	Codex Alimentarius Commission, an FAO/WHO Organization

CHAPTER 01

INTRODUCTION

1.1 Background

Tea is one of the most developed beverages in the world that drink as tea consumption is only second to water in the world but, this period tea industry is facing so many problems. The conventional tea production which caters mainly to the standard industrial tea sector, the percentage of value addition has to be gradually increased to make an impact. Therefore low grade tea have to sell very low price or some tea waste (refuse tea). It is big a problem in tea industry and thus it is important that value addition is coupled with other strong consumer requirements and expectations such as beneficial health to consumers, convenience and sensory satisfaction, etc.

In almost every form, tea has been less convenient to prepare and consume than its competitive options such as coffee, soft drinks, bottled water, flavored water, and fruit juice. Ready to Drink (RTD) tea in bottles, cans, aseptic packaging, plastic containers, and other packaging configurations now bring the ultimate in convenience to consumers. Ease of preparation had never really been viewed as a strong issue for selling of tea and, in a nation which demands convenience, has served to act as a constraint on sales. It was this same demand for convenience which caused the tea industry to introduce the teabag in 1904 and to create instant tea and iced tea mixes in the 1940s and 1950s. Closely linked to convenience is availability. Ready to Drink bottles and cans have made tea more readily available to consumers than ever before, particularly at the point of consumption (Beverage, 2008).

In 1993, many new Ready to Drink iced tea products were rolled out nationally and, even more importantly; it became apparent that consumers were readily accepting these products. It was also the year in which significantly increased levels of marketing dollars were devoted to supporting the introduction of the new Ready to drink products and to communicating the more appealing attributes of tea over other beverage options The significance of the Ready to drink teas on the overall health Not only did it make tea consumption more convenient and available for current consumers, but it also introduced tea to a great many new consumers who, prior to the advent of RTD teas, were not part of the target audience. (Beverage, 2008)

As a result of the development of Ready to drink teas has become even more the beverage of choice for a consumer. Ready to Drink teas are discovered by an increasing numbers of consumers. Today, as many experts predicted, the sales of the new ready-to-drink teas will top, in effect doubling the size of the traditional tea market. The availability of Ready to Drink teas is not the only reason why tea has become more popular. One of the most important is the continuing and increasing health consciousness of consumers. Tea is perceived to be a healthier beverage choice and part of a healthier lifestyle. This perception is likely to be reinforced as more and more scientific research studies confirm the important role which tea plays in human health. (Beverage, 2008)

Aigburth Estate and the Tea Factory are belonging to the Suriyakanda Plantation (Pvt) which produces good quality black tea to world market. During the period of 2005 to 2008 Factory, building and machinery was updated and got quality standard of certification of GMP,HACCP, ISO 9001 and 22000 requirement to win international market. Aigburth Factory has been very successful company in tea fields in Sri Lanka.

1.2 Overall objective:

Formula Development of Ready to Drink Tea by using Low Grade Tea.

1.3 Specific Objectives:

- To produce a cost effective natural tea drink with extended shelf life.
- To improve the palatable flavor and appearance (color) of the product.
- To find the best caffeine and tannin extraction methods.
- To eliminate or minimize higher amount of precipitation which occurred after the process product.
- To eliminate or minimize high degree of caramalization during the heat treatment of processing.
- To develop drink compatible for the diabetic people.

CHAPTER 02

LITERATURE REVIEV

2.1 History of tea

The Chinese have been drinking tea for 5,000 years for health and for enjoyment for thousands of years. They discovered that this brew was both delicious and refreshing. The strange brew that came in amongst the cargoes of silks and spices was not an instant success. Europeans tasted it, but preferred the flavor of coffee. The suspicious English waited until 1652 before they even began to trade in tea. The Russians were early devotees of tea. Their tea arrived overland from China. Since the British sailor, James Taylor planted the first 19 acres of tea in Sri Lanka in 1867 tea plantation has flourished in the elephant country. Tea for people in Sri Lanka is not only a valuable commercial crop, but also a lifestyle. Locals enjoy chewing betel nuts while drinking tea. With the unique advantage of tropical weather condition and different altitude of terrains, Sri Lanka produces tea that has its own aroma and flavors. (Werlehoven, 1988)

Today, it is the world third largest tea producer and teas economic value contributes to increasing accumulation of foreign exchanges. However, there is a tendency of substitution from tea plantation to rice cultivation through the years. Today, how to reach the balance between economic development and environmental preservation is crucial to Sri Lanka. (Werlehoven, 1988)

2.1.1 Tea cultivation

The tea plant is an evergreen of the *Camellia* family that is native to China, Tibet and northern India. There are two main varieties of the tea plant. The small leaf variety, known as *Camellia sinensis*, thrives in the cool, high mountain regions of central China and Japan. The broad leaf variety, known as *Camellia assamica*, grows best in the moist, tropical climates found in India, Sri Lanka and Kenya and Indonesia. The plant produces dark green, shiny leaves and small, white blossoms. There are numerous hybrids that originate from the above two species, which have been developed to suit different conditions. (Werlehoven, 1988)

The altitude and mountain mists help shield against too much sunlight and provide the proper temperature and humidity to allow the leaves to develop slowly and remain tender. As with wine, the quality and taste of a particular tea is influenced by both the environment (soil, climate, and altitude) and the tea maker (who decides when and how the leaf is plucked and how it is processed). Most tea plants have a growth phase and a dormant period usually during the winter. The leaves are plucked as the new tea shoots (flush) emerge. In hotter climates, the plants have several flushes and can be picked year round. In cooler conditions at higher elevations, there is a distinct harvesting season. Leaves from the earlier flushes usually in the spring give the finest quality teas. There are four main types of tea. green tea, black tea, oolong tea and white tea. All tea comes from the same plant. The specific variety of tea plant and the way the leaves are processed after harvesting determine the type of tea that is created. (Werlehoven, 1988)

Tea grows mainly between the tropic of growth and Capricorn, requiring up to 1000-1250mm of rain per year, as well as a temperature ideally between 10 to 30 °C. It will grow from sea level up to 2400 meters. The tea garden (tea estate) is where the flavor potential of the tea will be generated and so great care and attention is taken to ensure that the best possible growing conditions are created. This means in some cases planting trees to generate shade, or planting wind breaks, to prevent damage from strong winds, particularly on the plains of Assam. Plants are placed in rows some approximately one meter apart. The bushes must be pruned every four to five years in order to rejuvenate the bush and keeping it at a convenient height for the pluckers to pick the tea. A tea plant may happily produce good tea for 50 - 70 years, but after 50 years the plants yield will reduce. At this time the older bushes will be considered for replacement by younger plants grown on the estates nursery. (Jason, 2004)

2.1.2 Main countries of the Tea produce

From the main countries of its primary origin in south East Asia, tea has spread far and wide into tropical and sub tropical areas and adopted board characteristic corresponded to origin of the rain forest, tropical savannah and summer rain area. At present, tea is grown in more than thirty countries of which a dozen could be regarded as major tea growing countries. The area, productivity and export of tea some countries are given table (Ghosh, 2001)

Table 2.1 Main countries of the Tea produce.

Country		production export	export
Asia	China	665030	217152
	India	870410	210338
	Japan	82600	752
	sri lanka	280000	265305
	Taiwan	22640	2482
Africa	Kenya	264160	263033
	Malawi	40360	41000
	Tanzania	24333	22218
	Uganda	26425	23350
south America	Argentina	50000	41239
	Brazil	8000	3208
	Peru	2400	200
Australia	Papua new guinea	6000	5000

(Ghosh, 2001)

2.2 Harvest

Plucking rounds depend on climate new growth can be plucked at 7 - 12 day intervals during the growing season. Tea harvesting is exhaustive and labour intensive (between two and three thousand tea leaves are needed to produce just a kilo of unprocessed tea) and is a procedure of considerable skill. Tea pluckers learn to recognize the correct moment at which the flush should be removed. This is important to ensure the tenderness leaves are plucked to produce the finest teas. After plucking leaves are transported to factories for processing. The fields are normally adjacent to the factory. (Werlehoven, 1988)

2.3 Tea production

The production of tea involves several steps.

- Withering.
- Rolling.
- Oxidation. (fermentation)
- Drying.
- Packing.

Although the process is relatively simple, each step has to be controlled carefully to obtain the proper flavors and taste. (Keegel, 1963)

2.3.1 Withering

The objective of withering is to reduce the moisture in the tea leaf by up to 70% (varies from region to region). Tea is laid out on a wire mesh in troughs. Air is then passed through the tea removing the moisture in a uniform way. This process takes around 12 to 17 hours. At the end of this time the leaf is limp and flexible and thus will roll well. (Keegel, 1963)

2.3.2 Rolling

Tea is placed into a rolling machine which rotates horizontally on the rolling table. This action creates the twisted wiry looking tea leaves. During the rolling process the leaves are also broken open which starts the third process. Instead of the more traditional and gentle rolling two other methods are used for the production of mainly black tea for the finer end of the scale. Fanning and dust grades are usually destined for teabag production. (Keegel, 1963)

2.3.2.1 The CTC production method

CTC stands for crushing, tearing and curling. The withered leaf is often cut to a uniform size by machine. Then the leaves are fed into the CTC machine where they are crushed, torn and curled in a single operation by metal rollers. The extracted cell sap is collected and added to the leaves again. The crushed leaves are then oxidized, dried and sorted. (Keegel, 1963)

2.3.2.2 The LTP method

The third method of producing black tea is the LTP method, named after the inventor of the relevant machine, the Lawrie Tea Processor. In this method the withered leaves are often leveled before being processed in the LTP machine. Here they are virtually torn to pieces by blades rotating at high speed. This is followed by the usual oxidation, drying and sorting procedures. (Keegel, 1963)

2.3.3 Oxidation (fermentation)

Once rolling is complete, the tea is either put into troughs or laid out on tables whereby the enzymes inside the tealeaf come in to contact with the air and start to oxidize. This creates the flavor, Color and strength of the tea. It is during this process that the tealeaf changes from green, through light brown, to a deep brown, and happens at about 26 degrees centigrade this stage is critical to the final flavor of the tea, if left too long the flavor will be spoilt. Oxidation takes from between half an hour to 2 hours. This process is monitored constantly with the use of a thermometer along with years of experience. The tea then passes to the final stage of drying. The longer oxidized, the darker the tea. Green teas are not oxidized or for a very short period of time. Oolong teas are partially oxidized, whereas black teas are more fully oxidized. Often this step is referred to as fermentation. However fermentation requires the use of micro organisms (bacteria, moulds, yeasts, such as in bread, beer), which is not the case for the tea fermentation. Tea fermentation is a chemical oxidation process. (Numi, 2008)

2.3.4 Drying

To stop the oxidation process the tea is passed through hot air dryers. This reduces the total moisture content down to about 3% and stops the enzyme activity. The oxidation will be stopped by this process, and now the dried tea is ready to be sorted into grades before packing. (Numi, 2008)

2.3.5 Packing

Tea is normally packed in large wooden boxes and exported. It can further be packed in smaller packages, tea bags etc. (Akbar, 2004)

2.4 Tea grading and markings

The leaf grades result exclusively from the last stage of production, the sorting stage. There are four basic groups in orthodox production, leaf, broken, fannings and dust. These categories specify and indicate the different leaf sizes and associated strengths. The grading is based on the quality of the leaves. A whole leaf, broken leaves, crushed leaves (fanning) and dust. In each category the highest grades are listed first. Fannings and dust are mainly used for large scale commercial teas, especially in tea bags. (Higgins, 2002)

2.4.1 Whole Leaf Grades:

- **FTGFOP1** (Finest Tippy Golden Flowery Orange Pekoe First Grade Leaves).
- **SFTGFOP1** (Special Finest Tippy Golden Flowery Orange Pekoe First Grade Leaves).
- **TGFOP1/TGFO P** (Tippy Golden Flowery Orange Pekoe First Grade Leaves / Tippy Golden Flowery Orange Pekoe).
- **GFOP1** (Golden Flowery Orange Pekoe First Grade Leaves).
- **FOP/FOP1** (Flowery Orange Pekoe/Flowery Orange Pekoe First Grade Leaves).
- **OP sup** (Orange Pekoe Superior) Only from Indonesia.
- **OP** (Orange Pekoe)
- **BOP1** (Broken Orange Pekoe First Grade Leaves).(Higgins, 2002)

2.4.2 Broken Leaf Grades:

- **P/FP** (Pekoe/Flowery Pekoe) Mainly in Ceylon and Southern India, also produced in some parts of Kenya.
- **BOP** coarse (Broken Orange Pekoe)
- **BPS** (Broken Pekoe Souchong)
- **TGFBOP1** (Tippy Golden Flowery Broken Orange Pekoe 1)
- **GFBOP1** (Golden Flowery Broken Orange Pekoe 1)

- **GBOP** (Golden Broken Orange Pekoe)
- **FBOP** (Flowery Broken Orange Pekoe)
- **BOP** (Broken Orange Pekoe)
- **BP** (Broken Pekoe)
- **FBOPF** (Finest Broken Orange Pekoe Flowery)
- **BT** (Broken Tea) (Higgins, 2002)

2.4.3 Fannings:

- **BOPF** (Broken Orange Pekoe Fannings)
- **TGFOF** (Tippy Golden Flowery Orange Fannings).
- **GFOF** (Golden Flowery Orange Fannings)
- **FOF** (Flowery Orange Fannings)
- **OF** (Orange Fannings)
- **PF** (Pekoe Fannings) (Higgins, 2002)

2.4.4 Dust:

- **D1** (Dust 1)
- **PD/PD1** (Pekoe Dust/Pekoe Dust 1) mainly produced in India. (Higgins, 2002)

2.5 Biochemical composition of the tea flushes

2.5.1 Enzyme

Present in the tea leave, initiate the fermentation process .these enzyme are important to develop the quality of the final product.

- Leafed polyphenol oxidase: Polyphenols are oxidizing into the quinine derivatives.
- 5-dehydroshikimate reductase: biosynthesis of the polyphenolic compounds and tightly active involvement of the enzymes and during the plant growth, carry out in the living tissues.
- Leaf chlorophylase: catalyst brake down chlorophylls into the chlorophyllide.
- Alcohol dehydrogenase: important to produce volatile aroma compounds that are attributed to tea quality.

- 2-methyl transference: catalyses in synthesis of caffeine biosynthesis which important for stimulation property (astringency briskness) .in green tea .the stimulation property is comes due to this caffeine .but black there is more compounds are generated in fermentation process. (Banerjee,1993)

2.5.2 Carbohydrates

Starch, glucose, fructose, ribose, arabinose and crude fiber .carbohydrate present in tea is not nutritionally significant and no medicinal value. (Banerjee, 1993)

2.5.3 Protein

Protein is not play nutritional value .proteins are very impotent to develop aroma compounds. (Banerjee, 1993)

2.5.4 Thiamine

Thiamine is unique in tea. Important in green tea and black tea production. (Banerjee, 1993)

2.5.5 Lipids

Unsaturated fatty acid present in the tea, especially linoleic and linolenic are important for aroma production as a precursor. Depending on the oxidative condition, linoleic and linolenic produce favorable and unfavorable aroma compounds. (Banerjee, 1993)

2.5.6 Vitamins and minerals

Carotinoids .vitamin A .B,C,E, and tea is rich in vitamin K. minerals Fe, Cu, Cl, F, Na, K, Ca, P, Se, Zn, Mn. (Banerjee,1993)

2.5.7 Organic acid

Fumaric acid, succinic acid, citric acid, oxalic acid. (Banerjee, 1993)

2.5.8 Polyphenols

Polyphenols are important compound and responsible for the unique properties of the tea It can be categories of the four groups such as flavonls, flavonols, flavones, acid and despides. Polyphenols are normally in cell cytoplasmic vaccules. Polyphenolic compound are depend on the leaf age, tea process, origin, genetically condition, environmental factor (climate, soil etc) (Banerjee, 1993)

2.5.9 Chlorophyll and carotinoides

Mainly contain chlorophyll A & B .mainly four type of carotinoid; beta-carotene, lutein, vilo-xanthin, neo-xanthin. Carotinoids are oxidizing during fermentation and other subsequence produce the volatile aroma compounds. (Banerjee, 1993)

2.5.10 Xanthenes derivatives

Mainly contain the theobromine, theophylline, caffeine. (Banerjee, 1993)

2.5.11 Volatile compounds

Important for the determinations of overall aroma. Most of the volatile compounds are produced during the processing and little of the volatile compounds are produces during the growth. Some of the volatile compounds are aldehyde, lenaluin, geraniole, ketones, and the volatile aroma in green tea. In green tea low volatile compounds thus add jasmine flavor to increase the volatile aroma in green tea. (Banerjee, 1993)

2.6 Types of tea drink

- **Pure green tea drink**

Tea drink is made from tea after processing and preparing tea, which is rich in many kinds of elements good for health.

- **Taisun fruit tea drink**

Natural and fresh and release from thirsty quickly.

- **Honey Jasmine Tea drink**

Tea drink is made from tea after processing and preparing tea, which is rich in many jasmine volatile aromas compound and good for health

- **Peach black tea drink**

The idea natural and healthy has become a trend and more convenient.

- **Sosro Fruit Tea Drink**

Ready to drink fruit flavor tea with multiple flavors and good freshness.

- **Botol sosro jasmine tea drink**

The most unique popular drink.

- **Slimming tea drink**

Slimming tea is our new product to meet customers' requirements of healthy products, such as low caloric and no sugar.

- **Lemon black tea drink**

Black tea with lemon refreshes flavor.

- **Pure oolong tea drink**

Pure oolong tea with sophistication and soft scent, golden color and mellow taste.

- **Ice green tea drink**

Ice Green Tea with Honey flavor, it's soft, pure and healthy.

- **Tea energy drink**

The suitable flavor for peoples healthy.

- **Ice cool lemon tea drink**

Natural and fresh and release from thirsty quickly and healthy products.

- **Canned oolong tea drink**

The most famous brand in korea, green tea beverage.

- **Flavored Green Tea drink**

Tasty green tea catechin. Catechin is the bioactive substance in green tea that proved much health. (Beverage, 2008)

2.7 Market research for new product development

2.7.1 Introduction of market research

Market research is the collection and analysis of information about consumers, competitors and the effectiveness of marketing programs. Large scale business owners use market research to determine the feasibility of a new business, test interest in new products or services, improve aspects of their businesses, such as customer service or distribution channels, and develop competitive strategies. In other words, market research allows businesses to make decisions that make them more responsive to customers' needs and increase profits. (Blanken, 1989)

Product research includes simple, in-person research such as taste tests conducted in malls and in the aisles of grocery stores, as well as elaborate, long-term "beta testing" of high-tech products by selected, experienced users. The objective of product research can be simple; for example, a company may weak the taste of an existing product, then measure consumers' reactions to see if there is room in the market for a variation. It can also be more extensive, as when a company develops prototype of proposed new products that may be intended for market introduction months down the road. (David, 2003)

2.7.2 Research designing

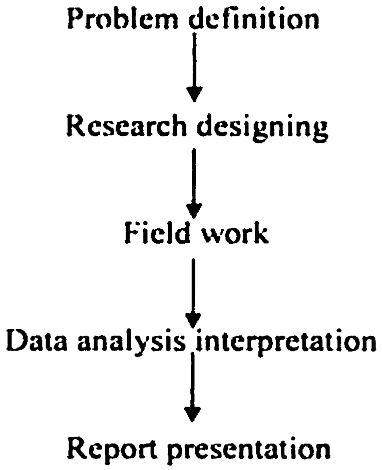

Fig: 2.1 Processes follow diagram of research designing

2.7.2.1 Problem definition

The first step in marketing search process is to define the problem chosen for investigation. This step is a very significant one since it is said a problem well define is half solved on the other hand, if problem is defined vaguely, a wrong problem is define, or the used of research are not clarified. all the aspect may not be responsible for decline in the sales. Therefore, marketing manager should have specially told the investigator that later should study product planning, pricing policies, distribution policies promotion policies, or other policies of the marketing management affect the sales. Thus before assigning if to the marketing researcher, the problem at hand must be defined clearly it may e reiterated that a well defined problem leads to a better solution. (Sharma, 1988)

2.7.2.2 Research design

Once the problem is defined the next step, that is the research design, because easier .the research design is the basis framework which provide Guidelines for the result of research process. It is map or blue print according to which research is to be conducted. The research design specified the method for data collection and data analysis. The research specially;

01) How the data would be collected

02) Which instrument would be used?

03) What sampling plane would be used?

The research has to carefully decide and make a choice from the group of different alternative available to him. (Sharma, 1988)

2.7.2.3 Data collection

There two type of data. Primary data secondary data. Secondary data refer to those data which were gathered for some other purpose and are already available in the firms' .internal record and commercial, trade or government publication. On other hand primary data not exist already in the records .and publication. The research has to gather primary data afresh. The primary data are explicitly gathered for a specific research project at hand. It is always in the fitness of things that research attempts to look into source of secondary data before collect primary data it has been observed that firm (researches) had wasted a lot of time and money on collect of the primary data, while the secondary data were already available in various records and publication. Primary data can collect by three method observation, experiment, and surveys. (Sharma, 1988)

2.7.2.4 Field work

Once the research has finalized the problem definition and research design step, researcher must collect operation .this step called the field work is most expensive all the step in research project. Also the field work is most prone to error. The research might be encountered with a number of problems during the field work. (Sharma, 1988)

2.7.2.5 Data analysis

In order to meaningful information from the data collected, the data analysis carried out. The data are fist edited; coded and tabulated .the analysis can be conducted by using simple statistical tools like percentages, average and measures of dispersion. Alternatively the collected data may be analyzed by using diagrams, graphs, charts, etc. (Sharma, 1988)

2.7.2.6 Report preparation

After collected data is analyzed and interpreted job of marketing research in the form of a systematically type or printed report. Specifically designed format must be used for research result presentation .so greater emphasize must be placed on the findings, conclusion and recommendation which interested the executives. The report prepared should be understandable and useful. (Sharma, 1988)

2.8.1 Product requirement

Product shall be uniform and characteristic color, it shall be free from extraneous mater. Flavor and odor shall have pleasant characteristic flavor .flavor and odor shall be accordance with any clime made or implied by many factors .it shall be free from scorching and caramalization. (SLS 214, 1985)

2.9 Food additives

Most of people think of preservatives, colors and food additives. However, food additives cover a wide range of ingredients used in food processing including colors, preservatives, flavors, emulsifiers, sweeteners and antioxidants etc. Each additive has a chemical name and an E number. It also has its own unique characteristic and brings to a food something it does not contain naturally. (Potter and Hotchkiss, 1996)

2.9.1 Different types of food additives

2.9.1.1 Preservatives

Soft drink preserve some times required addition of chemical preservatives to improve their storage stability .this additives should be used judiciously and only when there is clear need increase the self life prevent the spoilage or minimize the food poisoning risk (Chapman,2000)

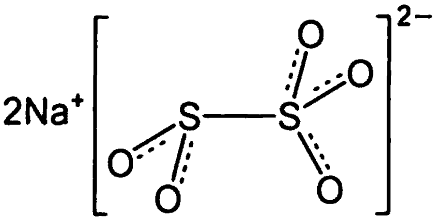

Fig: 2.2 Sodium metabisulfite.

Sodium metabisulfite (Na_2SO_5) is a white yellow wish crystallization powder with an odor of sulfur dioxide. The content of SO_2 at least 65.5%wt sulfur dioxide is able to stabilize the color of fresh and process fruits and vegetable. Sulfur dioxide also inhibits the activity of common oxidizing enzyme and has antioxidant properties. Sodium metabisufite is commonly used stable sauce of sulfur dioxide. Sulfur dioxide, SO_2 is color less with pigment odor at normal temperature and pressure sodium metabisufite added to drink inhibit the growth of bacteria, yeast and /or mold (potter and Hotchkiss, 1996)

2.9.1.2 Sweeteners

Sweeteners are generally viewed in a more positive light than many other additives. With so much attention focused on weight and health, sweeteners such as acesulfame-K, aspartame and saccharin are seen as an easy way to cut back on calories and are also safer for teeth than sugar. As with all additives, sweeteners are thoroughly assessed for safety before they are permitted for use.Aspartame is the methyl ester of the dipeptide of the natural amino acids L-aspartic acid and L-phenylalanine. Under strongly acidic or alkaline conditions, aspartame may generate methanol by hydrolysis. Under more severe conditions, the peptide bonds are also hydrolyzed, resulting in the free amino acids.

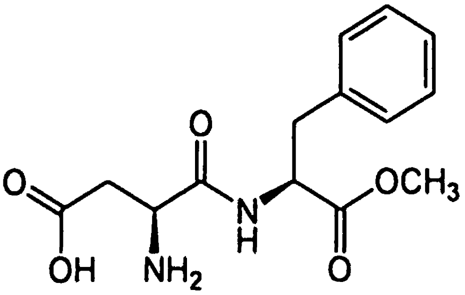

Fig: 2.3 Aspartame

Aspartame was discovered in 1969, and in 1981 was approved by the FDA for use in foods. Aspartame is produced from two amino acids aspartic acid and phenylalanine and is 180 times sweeter than sucrose. Although the FDA points to more than 100 scientific experiments that purportedly document the safety of aspartame, many consumers and scientists are not convinced that long term daily intake of aspartame is completely safe, and are concerned about the growing number of foods that contain this ingredient. Aspartame intake is known to be dangerous for persons with phenylketonuria, a metabolic disorder that results in dangerously high blood levels of phenylalanine. In addition, aspartame is not recommended for use by pregnant or lactating women. (Anthony, 2006)

2.9.1.3 Thickening agents

Carboxymethyl cellulose (CMC) is a cellulose derivative with carboxymethyl groups (-CH_2-COOH) bound to some of the hydroxyl groups of the glucopyranose monomers that make up the cellulose backbone. It is often used as its sodium salt, sodium carboxymethyl cellulose.The CMC structure is based on the β-(14)-D-glucopyranose polymer of cellulose. Different preparations may have different degrees of substitution, but it is generally in the range 0.6 - 0.95 derivatives per monomer unit.

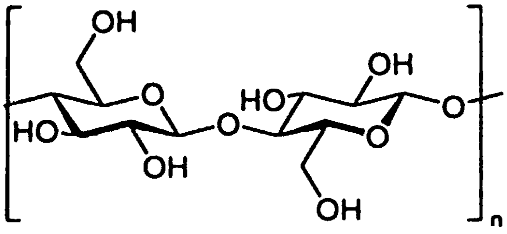

Fig: 2.4 Carboxyl methyl cellulose

Most CMC's dissolve rapidly in cold water and are mainly used for controlling viscosity without gelling. As its viscosity drops during heating, it may be used to improve the volume yield during baking by encouraging gas bubble formation. Its control of viscosity allows use as thickener, phase and emulsion stabilizer (for example, with milk casein), and suspending agent. CMC can be also used for its water holding capacity as this is high even at low viscosity, particularly when used as the Ca^{2+} salt. Thus, it is used for retarding staling and reducing fat uptake into fried foods.

2.9.1.4 Colors

Food color is mainly using for increase the attractiveness of the foods it has mainly natural color and artificial color. It means really the infused leaf. The trade attached much important to it, although sometimes it bear no relation to the properties of liquor. The color of the infused leaf and it degrease of the evenness are the criteria. A bright, even infusion is considered to be a valuable asset. A dull infusion is some fault in manufacture or an inherent property. For similar reasons an infusion may be green in color. (keegel, 1983)

The color of black-tea beverage is influenced by the hydrogen-ion concentration of the water. Thearubigins in tea brew are weak acids that ionize. The anions are highly colored. If the water used to brew tea is alkaline, the color of the beverage is deeper, and effect due to greater ionization of the thearubigins. If acid is added to tea, the hydrogen ions depress the ionization of thearubigins, which makes the beverage lighter. This accounts for the effect of lemon juice on the color of tea. Theaflavins are not involved in the change in color of tea associated with a change in acidity. (Areej, 2008)

2.9.1.5 Liquor characteristic

The appreciation of a tea liquor as the determined by teasing is mostly dome systematically according to characteristic is vary as a Color (depth, brightness), quality (good, coarse), strength (strong, weak), briskness (pungent, soft), flavor (fine, poor).As to color ,brightness is a very important attribute as a matter of fact ,the depth of color varies between all grades from the same taste .generally ,the smaller the grade the more calorie the liquid .consequently ,leaf grades make in general a lighter liquor than broken, broken a lighter liquid than fanning's , while dusts give the darkest liquor.(Werlehoven., 1988)

2.9.1.6 Caffeine

Caffeine is a color less slightly bitter compound which is present in tea leaf to the extent of 2.5% to 4.5%. It is important constituent of the beverage such as the tea, caffeine is responsible for their stimulatory properties .during manufacture it does not appear to undergo any changes of fundamental importance but it is possible, indeed probable, that it forms an association with the desirable intermediate product of the oxidation, and may protect a part of them by precipitation, so that they don't undergo further changes to complex polymers. The product of association between oxidation products and caffeine is soluble in hot water, but separate out on cooling of tea liquids as cream. A heavy cream on the cooling is a sign of a high of the aseptic of tea manufacture requiring further investigation. Due to its well known stimulating effects,caffeine also has an influence on breathing and on the ability of the cardiac muscles to contract, as well as the heart rate it has a stimulating effect on the central nervous system and speeds up cardiac activity. Caffeine has a stimulating effect on the organism and ensures adrenaline release, so that more glycogen (energy reserves) and fats can be absorbed. Caffeine leads to stimulation of the metabolism and of blood pressure. (keegel, 1983)

2.9.1.7 Ginger

Ginger is a spice which is used for cooking and is also consumed whole as a delicacy or medicine. It is the underground stem of the ginger plant, *Zingiber officinale*.The ginger plant has a long history of cultivation, having originated in Asia and is grown in India, Southeast Asia, West Africa and the Caribbean Young ginger rhizomes are juicy and fleshy with a very mild taste. They can also be stewed in boiling water to make ginger tea, to which honey is often added as a sweetener; sliced orange or lemon fruit may also be added. Mature ginger roots are fibrous and nearly dry. (Govindarajan, 1982)

2.9.1.8 Medicinal uses of ginger

- The medical form of ginger historically was called Jamaica ginger. It was classified as a stimulant and carminative, and used frequently for dyspepsia and colic. It was also frequently employed to disguise the taste of medicines. Ginger is on the FDA generally recognized as safe' list, though it does interact with some medications, including warfarin. Ginger is contraindicated in people suffering from gallstones as the herb promotes the release of bile from the gallbladder. Ginger may also decrease joint pain from arthritis, though studies on this have been inconsistent, and may have blood thinning and cholesterol lowering properties that may make it useful for treating heart disease. The increasing world demand for quality products of added value such as the oleoresin and volatile oil show prospects for their production in the growing countries. The chemistry of the components which contribute aroma and pungency that characterize ginger is critically reviewed. The second part deals with evaluation of quality. The physico-chemical parameters prescribed as a measure of quality for ginger and its products in the existing standards can assure only hygienic quality and purity, and possibly the source, when new parameters such as GC-fingerprints are included. The importance of sensorily evaluating flavor quality is emphasized to understand the variation in flavor quality required by the industrial and retail markets. (Govindarajan, 1982)

- Diarrhea: Ginger compounds are active against a form of diarrhea which is the leading cause of infant death in developing countries. Zingerone is likely to be the active constituent against enterotoxigenic Escherichia coli heat labile enterotoxin induced diarrhea.

- Nausea: Ginger has been found effective in multiple studies for treating nausea caused by seasickness, morning sickness and chemotherapy, though ginger was not found superior over a placebo for post operative nausea.
- Folk medicinal uses: A variety of uses are suggested for ginger. Tea brewed from ginger is a folk remedy for colds. Ginger has also been historically used to treat inflammation.
- Local uses In the West, powdered dried ginger root is made into capsules and sold in pharmacies for medicinal use.
- Ginger and a local sweetener made from palm tree juice are boiled together and taken to prevent the flu.
- Drinks made with sliced ginger cooked in sweetened water or a cola is used as a folk medicine for the common cold.
- Ginger is crushed and mixed with mango-tree sap to make tangawisi juice, which is considered as a universal panacea.
- Ginger is applied as a paste to the temples to relieve headache and consumed when suffering from a cold, people use ginger for making tea, in food etc. a type of ginger known as Jahe is used as an herbal preparation to reduce fatigue, reducing winds in the blood, prevent and cure rheumatism and controlling poor dietary habits.
- Traditional health drink called salabat is made for breakfast by boiling chopped ginger and adding sugar; it is considered good for a sore throat. (Govindarajan, 1982)

2.10 Packaging

2.10.1 Introduction

Packaging has been defined in several ways;

01) A coordinated system of the preparing goods for trance port, distribution, storage retailing and ensued.

02) A mean of ensure the safety delivery to the ultimate consumer in sound condition of minimum overall cost.

03) A techno economical functional aimed at minimizing cost or delivery while maximize the sales.

Packaging material used for food liquid should maintain the good hygiene and have significant mechanical strength to prevent the leakage and contamination from the outside. They should also be inert and provide barriers to light .seal are important and low gas permeability is required. (Paine and Paine, 1992)

2.10.2 Glass bottles

Glass bottle, the older industrial packaging still have a high share of the packaged juice produce: they are use mainly for long shelf life. glass bottle are seen as a quality pack and have technical advantages where distribution peace special demand on the package , as in long distance travel and also proved many advantages in particular inertness , easy to clean ,durability and rigidity .glass is not susceptible to mould growth and is impermeable to odor ,vapors and liquid. (Paine and Paine, 1992)

2.10.3 Spoilage and Metal Contamination

The characteristic indicating spoilage of concentrated syrup are extreme change in the taste and flavor e.g.: musty, sour, putrid, fermentation of the sediment, cloud on turbidity, fermentation o0f slime, changes in odor and excessive forming or constant bubbling. (Harry et al, 1991)

2.11 Microbiological spoilage

Microbiology spoilage cause by yeast, mould and bacteria .yeast is major cause of deterioration. inflection with mould and bacteria are less common .yeast are mainly responsible for spoilage in drink .different kind may predominant in juice, and there growth also depends upon the temperature spoilage of row juice at room temperature result in an alcoholic fermentation, flowed by the oxidation of the acid by yeast and mould, growing on the surface .to prevent the spoilage every living cells must be removed or suppressed by pasteurization, filtration and preservatives. (Harry et al, 1991)

2.12 Shelf life evaluation

2.12.1 Introduction

Foods are perishable by nature .Numerous changes took please in food processing and food storage food may adversely influence the quality attribute in food .upon storage e for a certain period one or more quality attribute of food may react an undesirable state. At the food is considered undesirable for consumption and it is said to react of selflife.
Self life is an important feature of all foods .all those who involved in the handling of food should aware of those factor. These may include grower, ingredient, supplier, manufacture, wholesaler, retailer sellers and customers. Self life of the product may be defined as the time between product and packaging of the product and point which it becomes unacceptable under the defined environmental condition. (Manoranjan, 2000)

2.12.2 Major molds of food deteriorations

During storage and distribution of food, they are exposed to a wide range of environmental conditions. Environmental factor such as temperature, humidity, oxygen and light can trigger several reactions. Mechanism that may lead to food degradation as a consequences of these mechanism , food may be altered to such extend so that the consumer either rejects them .or they may become harmful to the portion .it there for imperative that a good understanding of the deferent reaction that cause food deterioration is gain period to developing .specific procedure for the environment of the shelf life of the product .chemical .physical and microbiological changes are the leading cause of food deterioration. (Manoranjan, 2000)

2.13 Sensory evaluation

2.13.1 Introduction

A sensory evaluation system med by the sense of the test, smell, touch and hearing when food ids eaten. Complex sensation that results from the interaction of our sense is used to measure food quality in program for quality control and new product development
Sensory evaluation panel can be grouped into tree type, high train experts, laboratory panel and large consumer panel .highly train expert evaluate quality lager consumer

panels are used to determine consumer reaction to a product .a sensory department may interact with many other department in a food or consumer product company. Their primary interaction is in support of research and development, such as marketing research support to the company marketing effects. However they may also interact with quality control marketing research, packaging and design group and even large services over issues such as clime, substantiation and adversely challenge. (Anna, 1998)

2.13.2 Preparing for the test

- Testing area: for sensory evaluation special testing area is that distraction can be minimized and condition can be control. The preparation area should be separate from the testing area as they might gain information they would influence their judgment. Foreign odors and odor from food preparation should be kept from the testing room .smirking should not be permitted at any time and cosmetic odors should be avoid. (Anna,1998)

- Testing setup: for must type f testing except profile method, the panelist are required to make independent judgment .in order to eliminate distraction and prevent communication among the panelist, individual booth area used .this arrāngement is really preferable because the product it be tested can be passed through the preparation area to the panelist and operators do not have to serve sample in the testing room. (Anna,1998)

- Light: light should be uniform and influence the appearance of the product to be tested .the type of the light used should be carefully choose .color and appearance are important factor to be judgment, since May fluorescent light distort color. To eliminate difference in color between samples colored lights are some time used. (Anna,1998)

- Testing schedule: the time of the day that is run influence the result, although this cannot be control it number of large. Late morning and mid afternoon are generally the best time for testing. (Anna,1998)

2.13.3 Methods for sensory testing

Several deferent sensory evaluation methods have been developed. The experiment should thoroughly familiar with the advantage and disadvantage of each method. The most practical and efficient method should be selected for each situation .no one method can be used universally. The experimenter must precisely define the purpose of the test and the information he want to require. There 3 fundamental type of sensory test. Preference /acceptance test, discriminatory test and descriptive test.

- Preference /acceptance test: These tests are effective test based on a measure of preference or a measure from which relative preference can be determined. The personal feeling of a panelist toward the product directs his response. Preference test include the paired comparison test the hedonic scale and ranking.
- Discriminating test: these tests are used to determine whether a difference exists between the samples. The panelist does not allow his personal like and dislike influencing his response. Laboratory deference panels can be used to determine if there is deference among the sample.
- Descriptive test: These tests are used to determine the nature and intensity of the deference. (Anna,1998)

2.14 New product development

2.14.1 Introduction

A sample definition for a new product might be a product not previously marketed or manufactured by a company. however this breaks down if one include new packaging (shape or size) or if one enter a product into a new market niche the food service sector. for example; the definition of new product development and introduction of a products not previously manufactured by a company into the market place or the presentation of an old product into a new market not previously explode by a company. (Gordon and Fuller, 1994)

2.14.2 Classification and characterization of new products

New food products fail into the classification.

- Line extension.
- Repositioned existing product.
- New form of existing product.
- Reformulation of existing product.
- New packaging of existing of product.
- Innovative or added value products.
- Creative products. (Gordon and Fuller, 1994)

2.14.3 Why go into food product development

If new food product development is fraught with so much difficulty, it is so costly, and if it is has a high rate of familiar, why go into? Would it not be simple to coast along with the existing product. This certainly would be simple but it would not be profitable for very long. Food companies must grow to make money and service. New food products are the major avenues open to a food company to be profitable and survive.

The need for new product development can be seemed to be driven by five dominate forces:

- All products have life cycle. That is they enter e marketplace, flourish for an indeterminate time .then die, and must be replaced.
- A company is management may adopt a policy that requires an aggressive grow the program satisfy long run business goals.
- The marketplace may change, requiring new product mare suited to respond to the changes.
- New technology may make new product available and new knowledge may tailor new product may more suited to the life styles of today's consumer.
- Changes in government legislation, health programs, agricultural policy, or agricultural support program may dictate that development of new food product be pursued. (Gordon and Fuller, 1994)

CHAPTER 3

MATERIAL AND METHODOLOGY

3.1Material

3.1.1 Material for extraction of low grade tea juice.

Raw material: low grade tea

Apparatus:

- Electronic balance.
- Measuring cylinder.
- Plastic jug.
- Stainless steel spoon.
- Stainless steel sauce pan.
- Gas cooker.
- Thermometer.

3.1.2 Material for extraction of ginger.

Apparatus:

- Electronic balance.
- Measuring cylinder.
- Plastic jug.
- Stainless steel spoon.
- Stainless steel sauce pan.
- Gas cooker.
- Thermometer.

3.1.3 Material for tea drinks preparation.

Raw material:

- Extracted ginger and tea juice.
- Portable water.
- Carboxymethyl cellulose (CMC).
- Sodium metabisulfite (SMS)

Apparatus:

- Electric balance.
- Small measuring cylinder.
- Plastic jug.
- Stainless steel sauce pan.
- Gas cooker.
- Thermometer.
- Bottle.
- Lids.
- Refractometer.

3.1.4 Material for sensory evaluation.

Apparatus:

- Sensory evaluation ballet paper.
- Code sample white glass.
- Portable water.

3.1.5 Material for microbiology analysis.

Apparatus:

- Incubator.
- Pipettes (10ml +0.05ml).
- Small conical flask (250ml).
- Conical flask (1000ml).
- Measuring cylinder (50ml).
- Petridis.

3.2 Methodology

3.2.1 Market research for new product development

Market research was conducted at various places and 30 people were randomly selected. They were participated to fill the quaternary ballet sheet (see app I and II). Data were collected and analyzed by using statistically method. Finally data were summarized and concluded in order to find what type of product should be developed.

3.2.2 Preparation and sterilization of laboratory wares

3.2.2.1 Washing and cleaning of used glassware

Glassware were washed with normal water then washed with hot water to loosen the dirt. The glassware was soaked for 30 minutes. Thereafter water was used to remove soda and teepol completely. Then they were dried, before sterilizing in hot air oven.

3.2.2.2 Sterilization of glassware

The glass wares were sterilized in hot air oven at 180° C for 2 1/2 hours.

3.2.3 Preparation of media

- Standard method agar

23.5g of medium was suspended in 1L of distilled water and boiled to dissolve completely. Then it was sterilized by autoclave at 121^{0}C for 15 minutes.

- Peptone water

15g of sample was added into 1L of distilled water. Then it was sterilized by autoclave at 121^{0}C for 15 min.

- MacConkey broth

35g of sample was suspended in 1L of dissolved water and boiled to dissolve completely Then it was sterilized by autoclave at 121^{0}C for 15 min.

3.2.4 Extraction ginger juice

Ginger was ground to small pieces and put into the 1L of water. Mixture was boiled for 30min. Solution was filtered and separated out juice.

3.2.5 Extraction tea juice.

The Equal weight of 3 low grade tea samples were measured and mixed .1L of ginger extracted water was boiled at 100^{0}C. 60g of low grade tea mixture was added into boiled water & kept for 5min. Finally tea juice extraction was filtered separate out the juice.

3.2.6 Development of formula

Three different recipes were developed with the range of carbonated beverages standard by varying aspartame content, ginger content, and extracted tea content.

Table 3.1 Formula for a ready to use tea drink

INGREDIENTS	523	638	712
Ginger	20g/l	25g/l	30g/l
Aspartame	20mg/l	25mg/l	30mg/l
CMC	0.10%	0.15%	0.20%
SMS	0.03%	0.03%	0.03%
Tea mixture	75ml	100ml	125ml
Water	1000ml	1000ml	1000ml

Ingredient were mixed and stirred until they completely dissolved and juice was filtered through a net cloth.

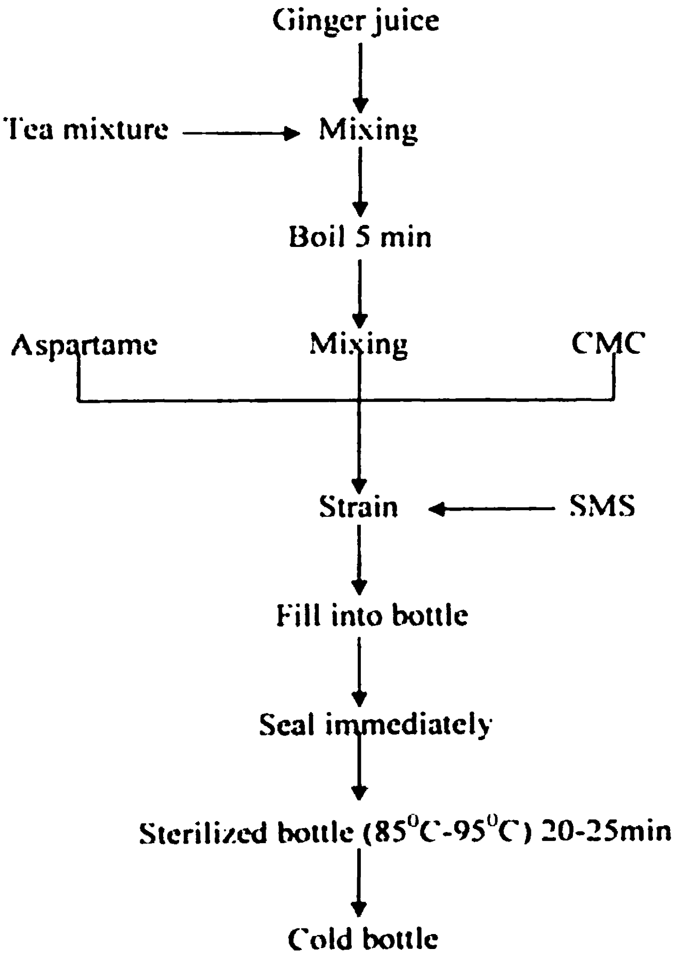

Fig: 3.1 processes follow diagram of tea drink

3.2.7 Filling and sealing

Tea drink was filled into a clean and washed bottle and it was sealed air tightly by a hand sealer.

3.2.8 Pasteurization

The sealed bottle was pasteurized at 85^{0}C-95^{0}C, 20-25min in a water bath and it was cooled into room temperature.

3.2.9 Sensory evaluation test

The sensory evaluation test was conducted one week after the preparation of ready to drink tea for three samples. 40 untrained panelists were participated for the sensory evaluation test.

A hedonic scale rating test was used to measure the degree of the pleasurable and unpleasurable experience of panelist with the scale of 7 points from like very much to dislike very much.

Sensory evaluation was conducted for testing the following sensory attributes on flavor of sweetness/taste, texture /mouth feel, color, smell, overall acceptability

3.2.10 method of caffeine and ginger content determination

- Caffeine content

  ISO 10727 method.

- Ginger content.

  High performance liquid chromatography using gingerol as standard.

3.2.11 Microbiological quality evaluation

Microbiological count (total plate count, colifroms) was taken after 1 month from the stored sample.

3.2.11.1 Preparation the serial dilution

- First dilution

  1ml of original sample was measured and mixed with 9ml of peptone water and shaken well. It was liable as 10^{-1} solution.

- Second dilution

  From the first dilution, 1ml was transferred into the second dilution tube contain 9ml of peptone water. It was labeled as 10^{-2} solution. This was repeated in until .10^{-4} dilution.

3.2.11.2 Microbial quality of the product

- **Coliform test**

  This test is called 9 tube test macConkey broth was used as the culture media .p^{H} was adjusted to 6.6 and 10ml of macConkey broth were put into each of the 9 tube and Durham tubes were introduced to all the tubes and they were sterilized after filling of culture media without air bubbles. Test tubes were covered with cotton plugs and aluminums foil. All tube were sterilized in a autoclave at $121^{0}C$, 15psi pressure for 15min.

  After that 1ml of original sample was taken into a pipette & it was put into 3 separate tubes, which were contained 10ml quantities of the macConkey broth with durum tube. Tubes were labeled as 10^{0} 1ml was pipetted from the serial decimal dilution solution (10^{-1}) and introduced into 3test tube of 10ml of macConkey broth with Durham tubes. It was labeled as a10^{-1} .After that 1ml of 10^{-2} Solution was pipetted into the remaining tube 3 test tube with 10ml of macConkey broth and Durham tube. Tube was label as 10^{-2}. After that each tube was incubated at $37^{0}c$ and was estimated for the gas formation in the Durham tube after 24hrs and 48hrs. Number of tubes out of each set of 3 were recorded, which gave positive result for particular orgent and was calculated using MPN (see app.X). (SLS 516: PER 3, 1991)

- **Pour plate method**

  The distribution serial 10^{-1},10^{-2},10^{-3},10^{-4} solutions were prepared with15ml of the prepared standard 15ml of the prepared standard method agar medium was pour into the Petri dish as $45 \pm 0.5^{0}C$ .Then 1ml from each sample of serial dilution was pipetted out and introduce aseptically into the serial dilution pleats .it were label as a 1ml was pipetted out and introduce aseptically into sterilized plates. It ware label as a 10^{-1} 10^{-2},10^{-3},10^{-4} 1ml was pipetted out from the original sample and it was introduced into Petri dish with 15ml of prepared standard method agar medium It was labored then lid was closed immediately and shaken gently for even distribution of media on plate. After that plates were kept invented on a clean horizontal surface for few minutes to solidify the nutrient agar then dishes were surface and incubate at 35 ± $1^{0}C$ for 72 ± 3hrs after the specified period of incubation, colonies were counted in each Petridis using the colony counter (SLS 516 part I, 1991)

CAPTER 04

RESULTS AND DISCUSSION

4.1 Results

4.1.1 Market research for new product development

- **Preference of product type**

Among the selected population, preference of processed product and semi process product were 63.33% 36.67% respectively.

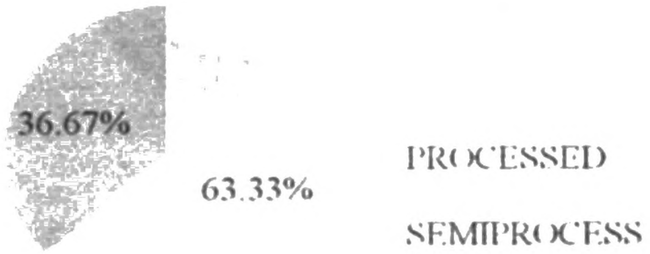

Fig.4.1 Preference of product type

- **Consumption pattern of this type of product(RTS)**

Consumption pattern of this product was ranged between 3 categories. Among these categories, weekly consumed category showed highest percentage 53.33% and most daily usage was 16.67% while rarely usage was 30.00%.

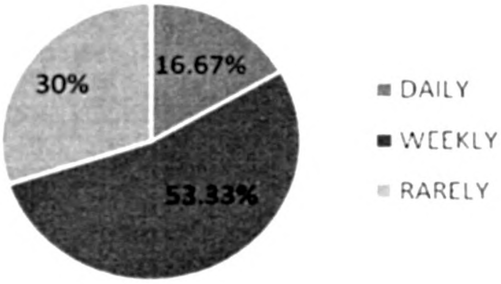

Fig.4.2 consumption pattern of this type of product

- **Final product serving method**

Final product serving method was categorized in to 2 different methods. Among those 2 methods, Cold serving method was highly preferred 56.67% and hot serving method condition 43.33%.

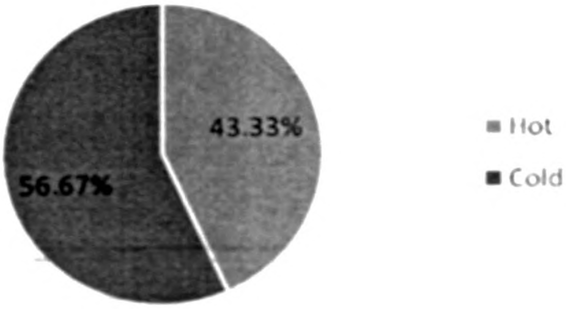

Fig. 4.3 Final product serving method

- **Carbonated /non carbonated**

73.33% was preferred to non carbonated product among selected population while 26.67% percentage was preferred to carbonated product.

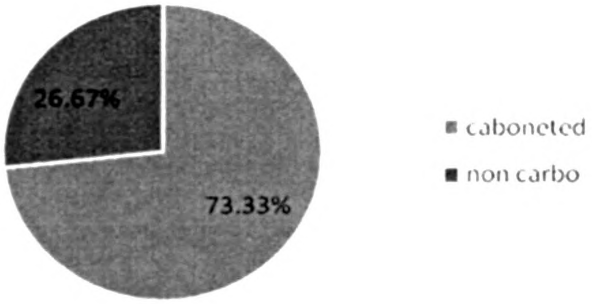

Fig.4.4 Carbonated / Non carbonated

- **Preference of flavor type**

3 flavor types were used to determine the preferred type of the product. Product flavored with ginger showed most preferred type with 53.33%. Acid and cinnamon flavored product was preferred with 36.67%, 16.67% respectively.

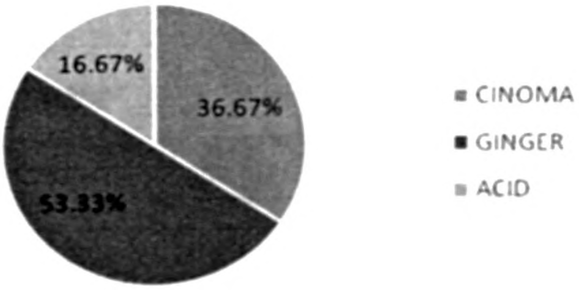

Fig.4.5 Preference of flavor type

- **Package type**

3 types of packages were used to package the product as bottle, cane and satche. Most preference type of package was bottle with 56.66%, caned preferred by 26.66% and satche packet was preferred 16.66% with lowest deman

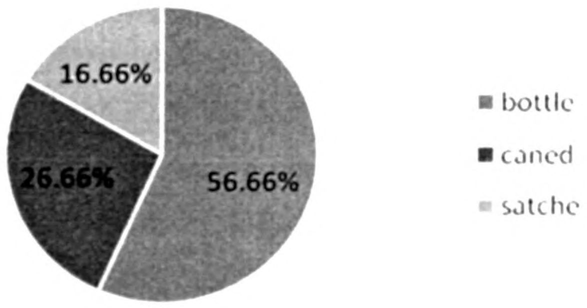

Fig.4.6 Package type

4. 1.2 Results of sensory evaluation

After statistically analyses of the result of the sensory evaluation test, following results were obtained for each characteristic features of the sample.

- **Result of effect on the sweetness of the low grade tea drink**

Tea drink is showing the highest rank for the product ,which contain 25mg of the aspartame in the formula .According to data analysis there is a significant difference between the 3 samples, since probability value P=0.000 of the test is less than minimum probability P=0.05. According to data sample with 25mg aspartame gain the highest sum of rank value with the highest estimated median for sweetness. Therefore this sample come under the category of like very much according to the 7-point hedonic scale (see app.iv)

5

Table 4.1 Result of sensory evaluation test on sweetness

sample code	N	Median	Ave rank	z
543	40	5	54.9	-1.25
638	40	7	91.5	6.9
712	40	4	35.1	-5.66

- **The result of effect on the texture of tea drink**

Result of effect on the texture of the low grade tea drink show the highest rank for the product, which contain 0.15% of the CMC in the formula .According to data analysis there is a significant difference between the sample since probability value P=0.000 of the test is less than minimum probability P=0.05.According to data sample with 0.15% CMC gain the highest sum of rank value with the highest estimated median for texture. There for this sample come under the category of like very much according to the 7-point hedonic scale (see app.v)

Table 4.2 Result of sensory evaluation test on texture

sample code	N	Median	Ave rank	z
543	40	4.000	36.9	-5.25
638	40	7.000	93.4	7.33
712	40	5.000	51.2	-2.07

- **Result effect of extracted tea juice content on the color of tea drink.**

Result of effect on the extracted tea juice of the low grade tea drink show the highest rank for the product ,which contain 100ml of the extracted tea juice in the formula .according to data analysis there is a significant difference between the sample since probability value P=0.000 of the test is less than minimum probability P=0.05.According to data sample with100ml extracted tea juice gain the highest sum of rank value with the highest estimated median for color . There for this sample come under the category of like very much according to the 7-point hedonic scale (see app.vi)

Table 4.3 Result of sensory evaluation test on color

sample code	N	Median	Ave rank	z
543	40	5.000	33.8	-5.96
638	40	7.000	88.1	6.13
712	40	6.000	59.7	-0.18

- **Result effect of extracted ginger juice content on the ginger flavor of tea drink**

Result of effect on the extracted ginger juice of the low grade tea drink show the highest rank for the product ,which contain 25g /l of the extracted ginger juice in the formula .according to data analysis there is a significant difference between the sample since probability value P=0.000 of the test is less than minimum probability P=0.05.According to data sample with25g/l extracted tea juice gain the highest sum of rank value with the highest estimated median for ginger flavor . There for this sample come under the category of like very much according to the 7-point hedonic scale (see app.vii)

Table 4.4 Result of sensory evaluation test on ginger flavor

sample code	N	Median	Ave rank	z
543	40	5.000	54.6	-1.32
638	40	7.000	92.0	7.01
712	40	4.000	34.9	-5.69

- **Result effect of extracted tea juice content on the smell of tea drink**

Tea is main component effect to the smell ;the result of effect on the extracted tea juice of the low grade tea drink show the highest rank for the product ,which contain 100ml of the extracted tea juice in the formula .according to data analysis there is a significant difference between the sample since probability value P=0.000 of the test is less than minimum probability P=0.05.According to data sample with 100ml extracted tea juice gain the highest sum of rank value with the highest estimated median for smell . There for this sample come under the category of like moderately according to the 7-point hedonic scale (see app.viii)

Table 4.5result of sensory evaluation test on smell

sample code	N	Median	Ave rank	z
543	40	4.000	47.7	-2.85
638	40	6.000	78.6	4.02
712	40	5.000	55.2	-1.17

- **Result effect of all the ingredient on the overall acceptability of tea drink**

Result of effect on the overall acceptability of the low grade tea drink show the highest rank for the product ,which contain 25g of ginger ,25mg of aspartame, 0.15% of CMC,75ml of extracted tea mixture the formula .according to data analysis there is a significant difference between the sample since probability value P=0.000 of the test is less than minimum probability P=0.05.According to data sample with code no gain the highest sum of rank value with the highest estimated median for overall acceptability. There forthis sample come under the category of like very much according to the 7-point hedonic scale (see app.ix)

Table 4.6 Result of sensory evaluation test on overall acceptability

sample code	N	Median	Ave rank	z
543	40	5.500	51.2	-2.08
638	40	7.000	94.3	7.53
712	40	5.000	36.1	-5.44

Formula of the low grade tea drink formulation was done by conducting number of trails and sensory evaluation .Finally the formulation was completed for commentated low drade tea drink with ingredient of formulated low grade tea drink.

4.1.3 Caffeine and ginger content

- Caffeine content (See app. XI)

  Caffeine content, 0.06 g/L

- ginger content (See app. XII)

  Ginger content (On fresh weight basis) 24.8 g/L

4.1.4 Self life evaluation

A) Coliforms test : After 24hrs and 48hrs the observations were taken to determined the presence of the colifroms .There was no gas formation in Durham tubes inverted in the test tube ,which were kept in incubator .It was confirmed that the product does not containing any coliforms. Presence of coli form indicates generally poor sanitation condition.

B) Total plat count: After the 24hrs incubation, number of the colonies appeared in Petridis standard method ager .All colonies were counted in Petridis and TPC was counted an according to the SLS standards, as follows.

Number of microbial cell per ml = number of colonies *dilution factor
Colonies per plate =X
Dilution factor = 10^{Y}
Volume of distribution added to the plate =1ml
So microbial content =X*10^{Y} cell / 1ml

Table 4.7 shows the amount of colonies appeared in the Petridis after 24hrs

Microbial count	Added dilution to plate	No of colonies per pleat	Microbial count 1g of sample
10^{-1}	1ml	3	$3*10^{1}$
10^{-2}	1ml	No detected	-
10^{-3}	1ml	No detected	-
10^{-4}	1ml	No detected	-

The total plat count of the product can be identified as $3*10^{1}$ cells per 1ml which shows least number of viable cells among the slandered method Petridis.

4.1.5 Cost evaluation

Table 4.8 Cost evaluation.

INGREDIENTS	AMOUNT	PRICE(RUPEACE)
Ginger	25g/l	7.50
Aspartame	25g/l	50
CMC	1.725g/l	1
SMS	0.03%	1
Tea mixture	100ml	5
Total price	-	63.50

Cost per one bottle of ready to use tea drink = 63.50 / 6
= 10.50

4.1.5 Final Formula of ready to use tea drink.

Formulation was done by conducting number of the trails and sensory evaluation .Finely the formulation was completed for the conducted ready to use tea drink.

Table 4.9 Final Formula of ready to use tea drink.

INGREDIENTS	AMOUNT
Ginger	25g/l
Aspartame	25mg/l
CMC	0.15%
SMS	0.03%
Tea mixture	100ml
Water	1000ml

Fig.4.7 Final product of the ready to use tea drink

4.2 Discussion

Finally result of the market survey tea drink product should be processed form, cold condition serving method, ginger flavor included and package type as a bottle most of people like this type of product.

Concentrated low grade tea drink was prepared by using dried three verities of low grades such as a dust, mixed broken, refuse tea and incorporation with aspartame, water, CMC, SMS and ginger amount of sample best relationship for time and amount of water was detected by conducting trails preparation drinks. Small preference test was conducted to determine the best tea flavor. Extracted tea juice gained the highest rank for appearance, flavor, color and smell but it could not be detected how many amount flavors extracted. That could be considered as a major problem. High quality tea has better flavor profiles but low grade tea has less amount of flavor profile. These factors are creating bit difficulty to flavor extraction process.

When the fermentation process starts the color of the fermentation material changes from green through olive green to light brown. Fermentation is normally stopped when the brown or orange color is brightest .It is continued ,however, the color change through dark brown to chocolate .Tea make at this stage are strong ,but have no brightness .the development of liquor with progressing fermentation is quantitative linked with the changes in the polyphenol content of the extract. There color development and thus the course of fermentation can be measured by colorimetric method. When considering the brewing of tea; it has been maintained that just boiling water must be used for making brew eater boil at 100°C (212°F) at sea level, at end of 5minutes the temperature may have cut down to 74°C (160°F) .Since at high attribute water boil at low temperature e.g. amount of soluble solid (polyphenol, caffeine, sugar gums, amino acids and mineral water) will decrease with increasing attitudes. This factor will lead again to difference in testers response .Oxidation condensation and precipitation the soluble mater in made black tea may be only about 41% of dry weight .when tea infuse by adding boiling water and allowed to cool down for 5minuts, only 60% of total soluble matter and 80% of the caffeine are extracted with both a large brew and second brew up to 85% of the soluble matter may be removed. Thus at end of a double brew or of longer single brew 15% soluble solid is still life in the conventionally processed leaf, which all the caffeine has been extracted. Therefore tea gives tea flavor and color to tea drink. That need not add additional natural or synthetic color.

Sodium metabisuphete (SMS) is used as a permitted preservative agent .It inhibit the growth of yeast, mould and anaerobic bacteria .The equilibrium of SO_2 depends both on the P^H the food and other reactive species present in food, such as a disulphide group in proteins the antimicrobial activity of SO_2 is due to undissociated HSO_3^{1-}

Most of food drink company used Carboxymethyl cellulose as a thickening agent increase the mouth feel. CMC is a cellulose derivative with carboxymethyl groups ($-CH_2-COOH$) bound to some of the hydroxyl groups of the glucopyranose monomers that make up the cellulose backbone. The CMC structure is based on the β-(14)-D-glucopyranose polymer of cellulose. Most CMCs dissolve rapidly in cold water and are mainly used for controlling viscosity without gelling. As its viscosity drops during heating, it may be used to improve the volume yield during baking by encouraging gas bubble formation. Its control of viscosity allows use as thickener, emulsion stabilizer, suspending agent and improves the palatability of the drink.

Ginger is used in more ways than any other spice. Comprehensively reviews production, trade, processing, chemistry, and evaluation of quality Derived products such as ginger powder, syruped ginger, volatile oil, and oleoresin are discussed in greater detail. The increasing world demand for quality products of added value such as the oleoresin and volatile oil show prospects for their production in the growing countries. The chemistry of the components which contribute aroma and pungency that characterize ginger is critically reviewed. The physico chemical parameters prescribed as a measure of quality for ginger and its products in the existing standards can assure only hygienic quality the importance of sensory evaluating flavor quality is emphasized to understand the variation in flavor quality required by the industrial and retail markets (Govindarajan, 1982)

Two kinds of sweeteners are widely used to replace sugar in diet. Some are classified as nutritive, because they provide calories, others are nonnutritive, because they don't provide calories. When artificial sweeteners were introduced, everyone thought that people would eat less sugar but evidence now suggests that people simply add the sweeteners to their diets. Most nutritive sweeteners used as replacements for sugar have as many calories as sugar. Refined sugars, high fructose corn syrup, crystalline fructose, glucose, dextrose, corn sweetener, honey, lactose, maltose, invert sugar, and concentrated fruit juice are examples of nutritive sweeteners. Saccharin, aspartame, acesulfame potassium, sucralose, and cyclamates are the most commonly used nonnutritive sweeteners in world. They help add sweetness to foods for people who need to limit their intake of sugar, such as those with diabetes, and they also aid in the prevention of dental cavities. Although these no calorie sweeteners may seem like a dream come true.

Finally tea drink is preserved by pasteurization, it is relatively high heat treatment. Usually perform below 100^{0}C ,which is used to extend the selflife of tea drink .It preserves tea drink by destruction of relatively heat sensitive micro organism (non spore forming bacteria ,yeast, mould).but course minimal changes in sensory characteristic or nutritional value of food.

After statistical analysis of the result of sensory evaluation test, sample (638) highest sensory quality comparing to other two sample .it contains as CMC 0.15%, aspartame 25mg/l, ginger 25g/l, extracted tea 75ml.Sample(543) show intermediate sensory quality comparing to other two sample . It contains CMC 0.10%, aspartame 20mg/l, ginger 20g/l, extracted tea 50ml.Sample (712) show lower sensory quality comparing to other two samples. It contains CMC 0.20%, aspartame 30mg/l, ginger 30g/l, extracted tea 100ml. considering above result that the sample (638) is most suitable and consumer acceptable among the three samples.

The selflife of the result revealed the product is acceptable for 1 month Generally tea drink available in market level shelf life around one year

Total plate count of product was $3*10^1$ per 1ml .it was below the maximum acceptable level .presence of the bacteria due to contamination during preparation by air, water, equipment, and person involvement. The sample is free from coliform bacteria.

CHAPTER 05

CONCLUSION AND RECOMMENDATION

5.1 Conclusions

According to the observation and results from beginning to end of the research, final conclusions can express as follow;

01) Low grade tea cannot be sold at high price in the market but low grade tea drink can be sold as value added healthy drink to consumers especially for diabetic people.

02) This product comes under the Ready to serve drink, it does avoid the time for preparation.

03) Cost effective product.

04) Very good sustainable usage of refuse tea for tea drink, as its transport or selling is prohibited.

5.2 Recommendations

01) Shelf life of the product should be further studied.

02) Evaluate the changes of sensory attributes of low grade tea drink during the expected storage period is needed.

03) Chemical changes occurred in the low grade tea drink which leads to color variation should be further studied

04) Quantity of active component (antioxidant.) in the drink should be evaluated.

05) Carbonation is highly needed for this product.

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APPENDIX I

Sabragamuwa University of Sri Lanka

Faculty of applied science

Department of food science & technology

<u>Market survey ballet paper</u>

Product: Formula development of ready to drink tea by using low grade tea.

01) Which type of product do you prefer?

RTS (processed) ☐

Concentrated scathe (semi process) ☐

02) Consumption pattern of this type of product?

Daily ☐

Weekly ☐

Rarely ☐

03) Which serving method do you prefer?

Hot ☐

Cold ☐

04) If you prefer the cold product .indicate your preference.

Carbonated ☐

Non carbonated ☐

05) Which type of flavor do you prefer?

Cinnamon ☐

Ginger ☐

Acidic flavor ☐

06) Which type of package do prefer?

Bottle ☐

Canned ☐

Satche packet ☐

Comments..

APPENDIX II

වෙළඳපොළ සමීක්ෂණයක් සඳහා වන ප්‍රශ්නාවලිය

01 කුමන වර්ගයේ නිෂ්පාදනයකට කැමැත්තක් දක්වන්නේ ද?
- ඔබට සුදුසු නම් කළ ☐
- සන්ධානය කළ ☐

02 ඔබ මෙම වර්ගයේ නිෂ්පාදන පරිභෝජනය කරන්නේ
- දිනපතා ☐
- සතිපතා ☐
- කලාතුරකින් ☐

03 ඔබ පරිභෝජනය කිරීමට කැමති ආකාරය
- උණුසුම්ව ☐
- සිසිල්ව ☐

04 ඔබ සිසිල් නිෂ්පාදන අලුත්ම රසයි නම් ඔබ කැමැත්තක් දක්වන්නේ
- පාස්චරීකරණය කළ ☐
- පාස්චරීකරණය නොකළ ☐
- ☐

06 ඔබ කැමති රස වර්ගය කුමක් ද?
- කුරුඳු ☐
- ඉඟුරු ☐
- දෙහි ☐

06 ඔබ කැමැත්තක් දක්වන්නේ කුමන වර්ගයේ ඇසුරුම්කරණ ද?
- පැකට් ගත කළ ☐
- බෝතල් ගත කළ ☐
- කුඩා පැකට්ටු වශයෙන් ☐

විවේචන

APPENDIX III

SABRAGAMUWA UNIVERSITY OF SRI LANKA

Faculty of applied science

Department of food science & technology

Quaternaries for sensory analysis

Product: formula development of ready to drink tea by using low grade tea.

Date:.......................... Time:.............................

- Asses the sample number.
- Indicate how much you preferred each sample after testing.
- Rinse you mouth with water after testing each sample.
- Give numerical values ranking from the like very much to dislike very much according to the given scale.

point scale	points
like very much	7
like moderately	6
like slightly	5
neither like or dislike	4
dislike slightly	3
dislike moderately	2
dislike very much	1

sensory aspects	sample code		
	543	638	712
sweetness/taste			
texture /mouth feel			
color			
smell			
overall acceptability			

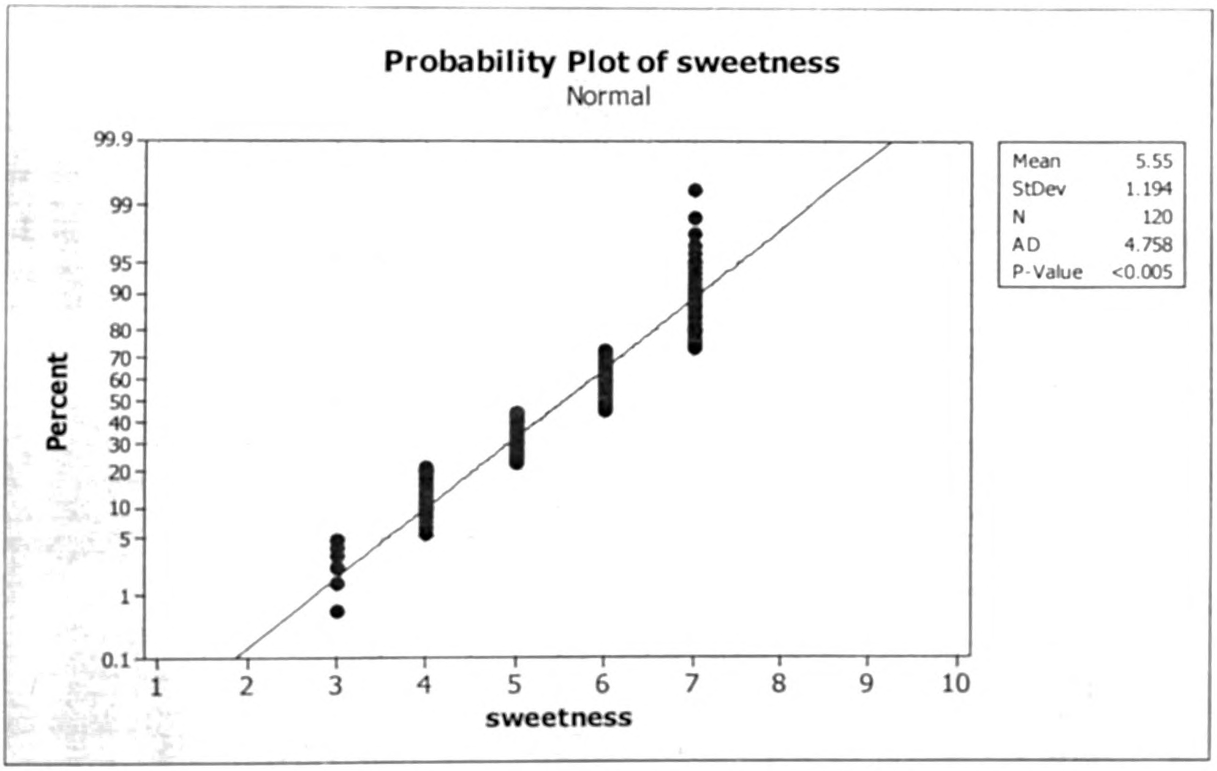
Comments:...
....

....

Thank you Signature

APPENDIX IV

NORMALITY TEST FOR SWEETNESS



P-value of normality test is 0.05 significant level 0.05 > 0.005, there for data is not normally distributed.

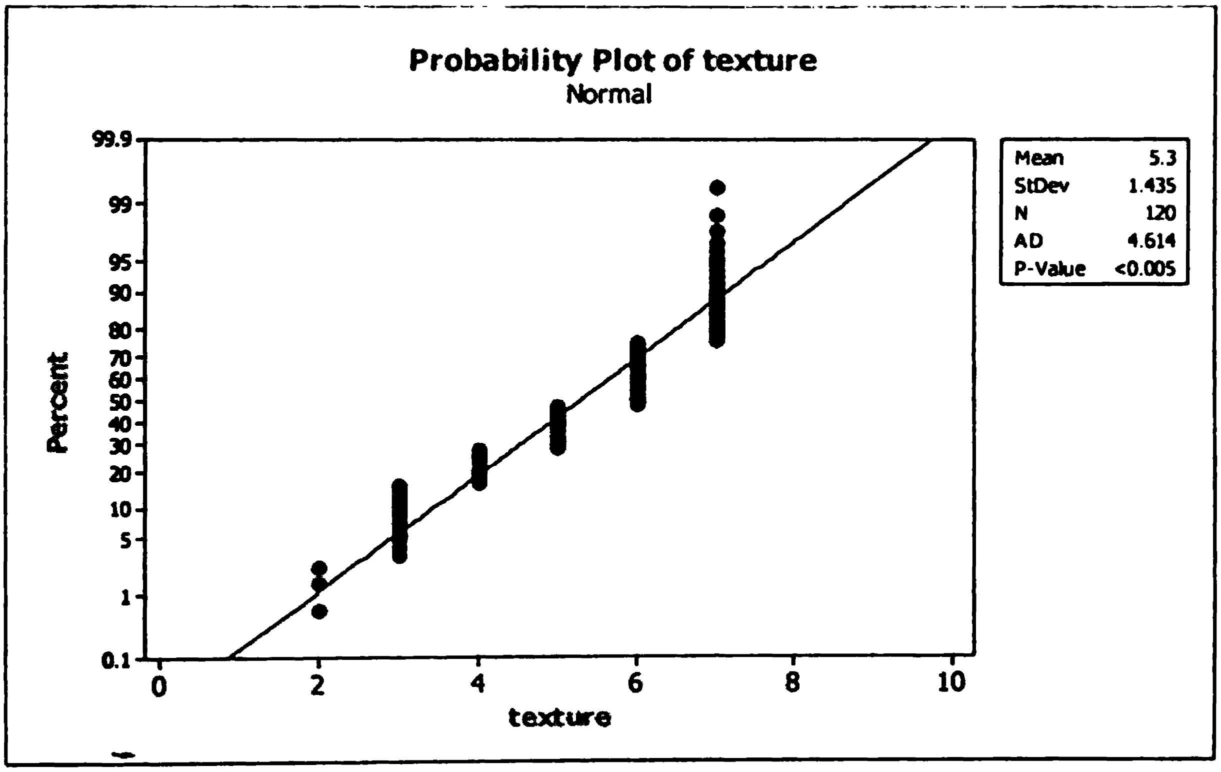
Kruskal-Wallis Test: sweetness versus code

```
Code     N  Median  Ave Rank      Z
543     40  5.000     54.9    -1.25
638     40  7.000     91.5     6.90
712     40  4.000     35.1    -5.66
Overall 120           60.5

H = 54.13  DF = 2  P = 0.000
H = 57.53  DF = 2  P = 0.000  (adjusted for ties)
```

APPENDIX V

NORMALITY TEST FOR TEXTURE



P-value of normality test is 0.05 significant level 0.05 > 0.005, there for data is not normally distributed

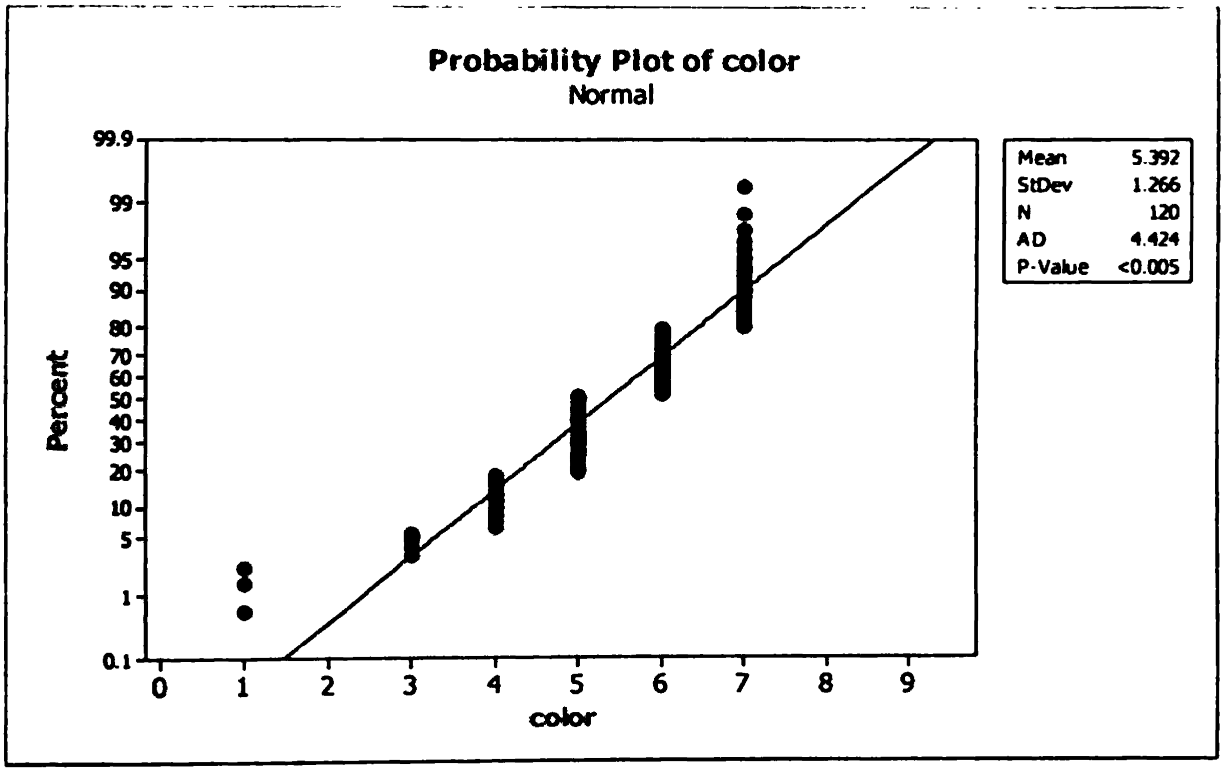
Kruskal-Wallis Test: texture versus code

```
Code      N  Median  Ave Rank    Z
543      40  4.000    36.9     -5.25
638      40  7.000    93.4      7.33
712      40  5.000    51.2     -2.07
Overall 120           60.5

H = 57.04  DF = 2  P = 0.000
H = 59.93  DF = 2  P = 0.000  (adjusted for ties)
```

APPENDIX VI

NORMALITY TEST FOR COLOR



P-value of normality test is 0.05 significant level 0.05 > 0.005, there for data is not normally distributed

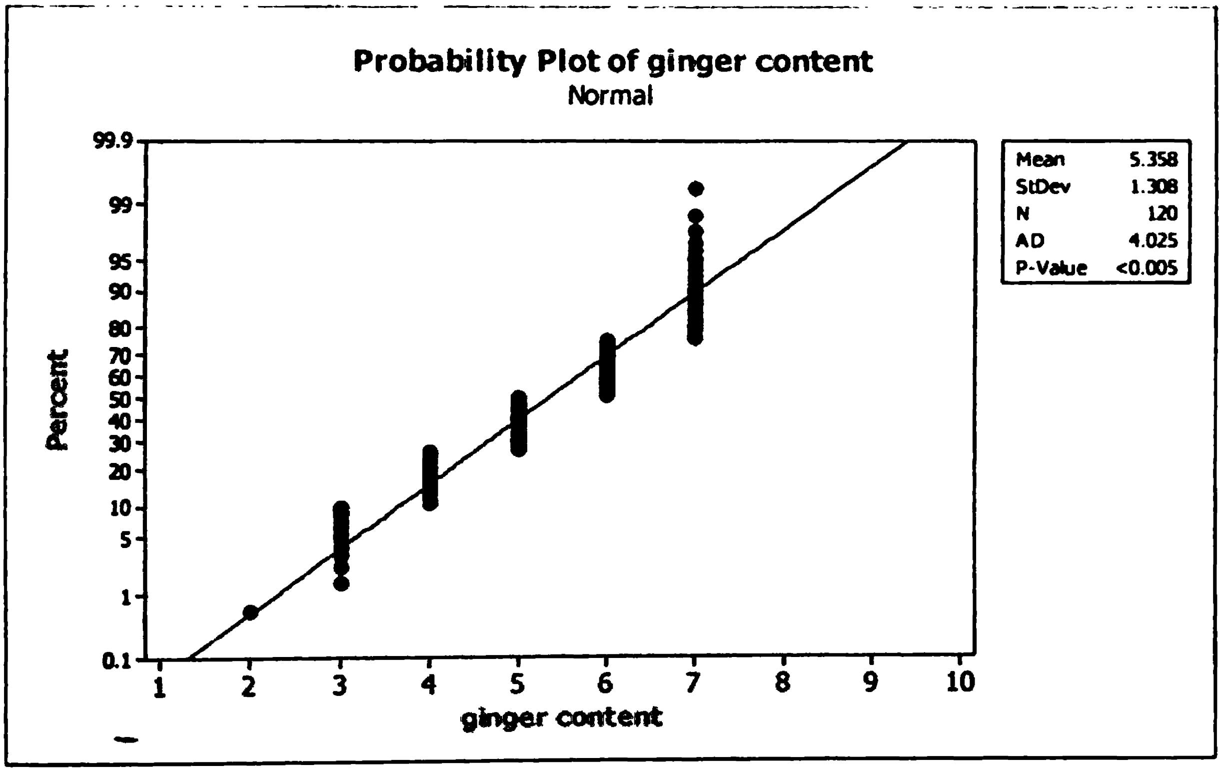
Kruskal-Wallis Test: color versus code

```
Code      N  Median  Ave Rank     Z
543      40  5.000     33.8    -5.96
638      40  7.000     88.1     6.13
712      40  6.000     59.7    -0.18
Overall 120            60.5

H = 48.77  DF = 2  P = 0.000
H = 52.42  DF = 2  P = 0.000  (adjusted for ties)
```

APPENDIX VII

NORMALITY TEST FOR GINGER CONTENT



P-value of normality test is 0.05 significant level 0.05 > 0.005, there for data is not normally distributed

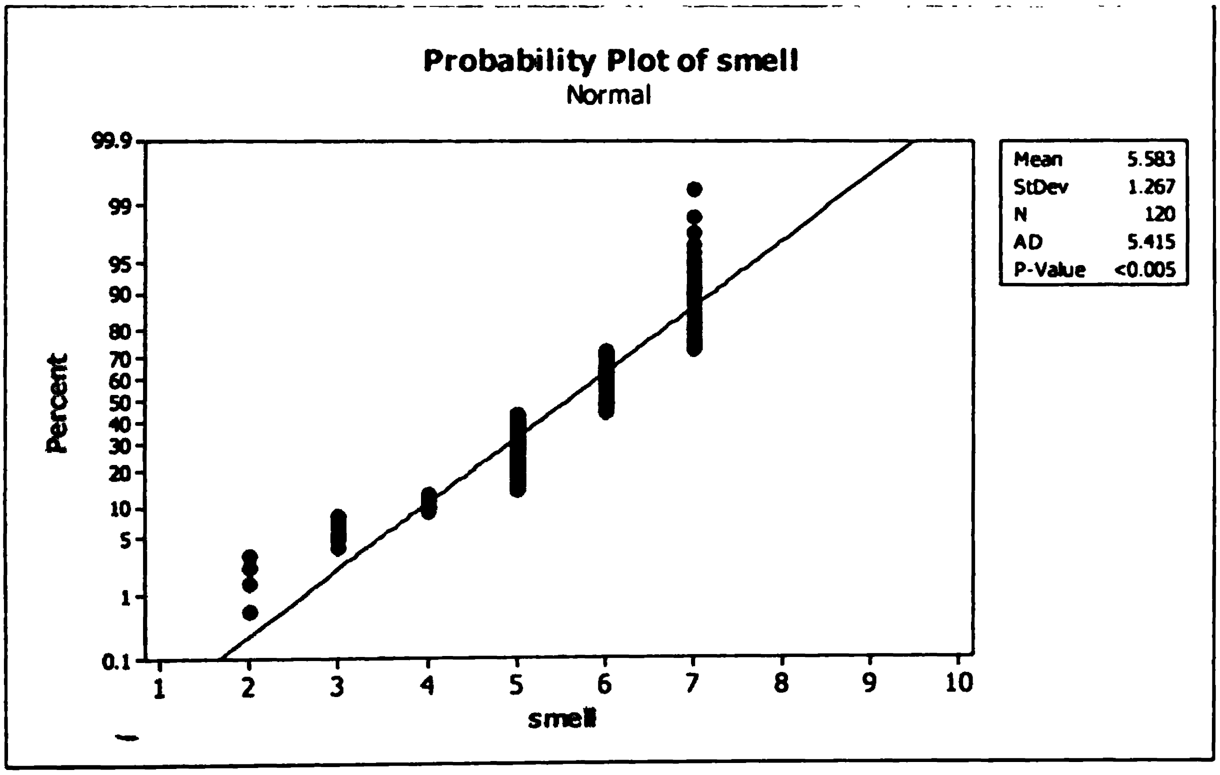
Kruskal-Wallis Test: ginger content versus code

```
Code     N  Median  Ave Rank      Z
543     40  5.000     54.6     -1.32
638     40  7.000     92.0      7.01
712     40  4.000     34.9     -5.69
Overall 120           60.5

H = 55.54  DF = 2  P = 0.000
H = 58.41  DF = 2  P = 0.000  (adjusted for ties)
```

APPENDIX VIII

NORMALITY TEST FOR SMELL



P-value of normality test is 0.05 significant level 0.05 > 0.005, there for data is not normally distributed

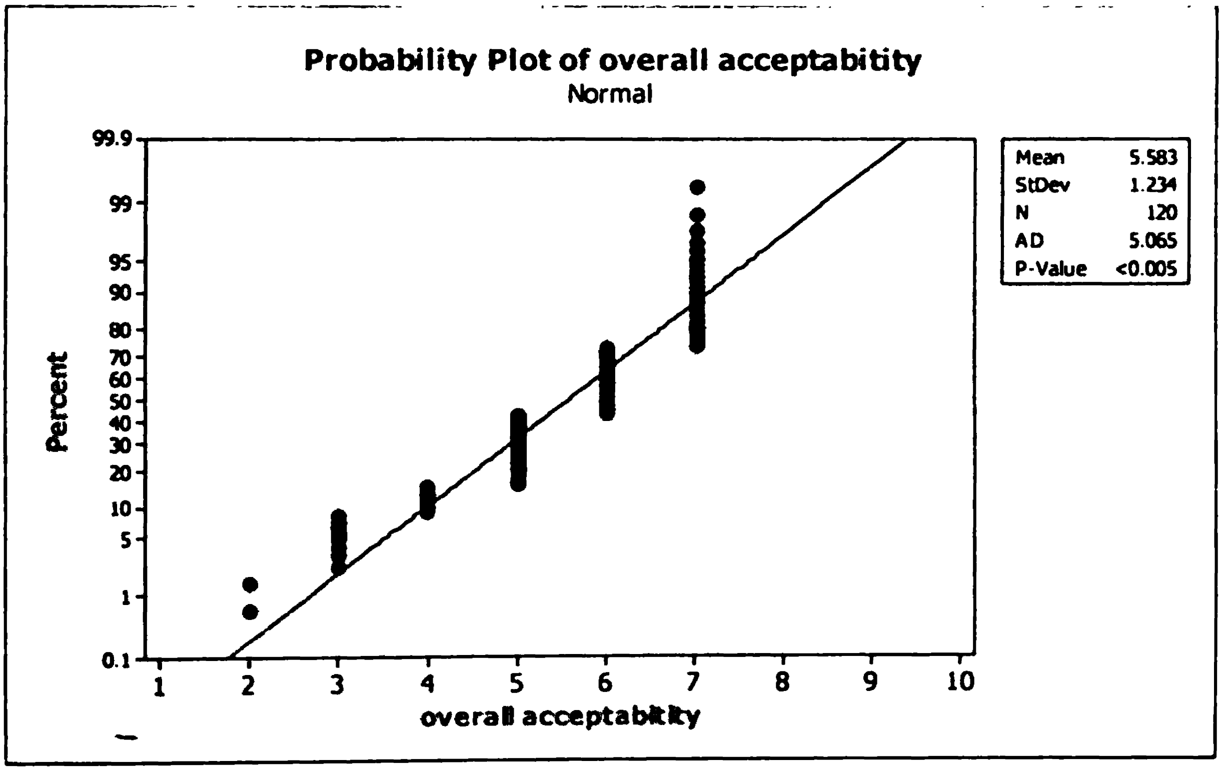
Kruskal-Wallis Test: smell versus code

```
Code     N  Median  Ave Rank     Z
543     40  4.000     47.7     -2.85
638     40  6.000     78.6      4.02
712     40  5.000     55.2     -1.17
Overall 120           60.5

H = 17.14  DF = 2  P = 0.000
H = 18.49  DF = 2  P = 0.000  (adjusted for ties)
```

APPENDIX IX

NORMALITY TEST FOR OVERALL ACCEPTABILITY



P-value of normality test is 0.05 significant level 0.05 > 0.005, there for data is not normally distributed

Kruskal-Wallis Test: overall acceptability versus code

```
Code     N  Median  Ave Rank      Z
543     40   5.500      51.2  -2.08
638     40   7.000      94.3   7.53
712     40   5.000      36.1  -5.44
Overall 120             60.5

H = 60.42  DF = 2  P = 0.000
H = 64.91  DF = 2  P = 0.000  (adjusted for ties)
```

APPENDIX X

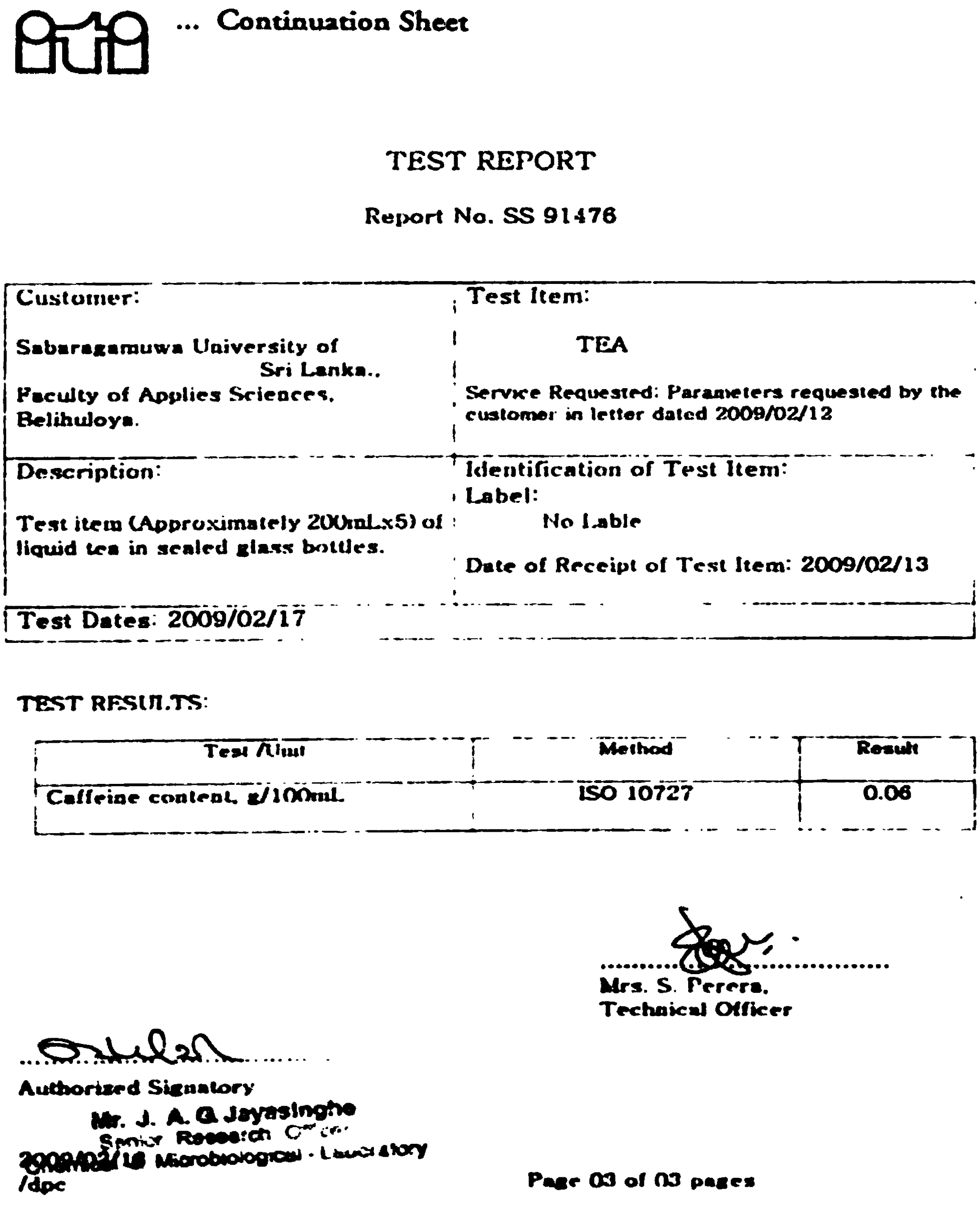
MPN TABLE

Table 1. For 3 tubes each at 0.1, 0.01, and 0.001 g inocula, the MPNs per gram and 95 percent confidence intervals.

Pos. tubes			MPN/g	Conf. lim.		Pos. tubes			MPN/g	Conf. lim.	
0.1	0.01	0.001		Low	High	0.1	0.01	0.001		Low	High
0	0	0	<3.0	--	9.5	2	2	0	21	4.5	42
0	0	1	3	0.15	9.6	2	2	1	28	8.7	94
0	1	0	3	0.15	11	2	2	2	35	8.7	94
0	1	1	6.1	1.2	18	2	3	0	29	8.7	94
0	2	0	6.2	1.2	18	2	3	1	36	8.7	94
0	3	0	9.4	3.6	38	3	0	0	23	4.6	94
1	0	0	3.6	0.17	18	3	0	1	38	8.7	110
1	0	1	7.2	1.3	18	3	0	2	64	17	180
1	0	2	11	3.6	38	3	1	0	43	9	180
1	1	0	7.4	1.3	20	3	1	1	75	17	200
1	1	1	11	3.6	38	3	1	2	120	37	420
1	2	0	11	3.6	42	3	1	3	160	40	420
1	2	1	15	4.5	42	3	2	0	93	18	420
1	3	0	16	4.5	42	3	2	1	150	37	420
2	0	0	9.2	1.4	38	3	2	2	210	40	430
2	0	1	14	3.6	42	3	2	3	290	90	1,000
2	0	2	20	4.5	42	3	3	0	240	42	1,000
2	1	0	15	3.7	42	3	3	1	460	90	2,000
2	1	1	20	4.5	42	3	3	2	1100	180	4,100
2	1	2	27	8.7	94	3	3	3	>1100	420	--

(Lynne, 2003)

APPENDIX XI



... Continuation Sheet

TEST REPORT

Report No. SS 91476

Customer: Sabaragamuwa University of Sri Lanka., Faculty of Applies Sciences, Belihuloya.	**Test Item:** TEA Service Requested: Parameters requested by the customer in letter dated 2009/02/12
Description: Test item (Approximately 200mLx5) of liquid tea in sealed glass bottles.	**Identification of Test Item:** **Label:** No Lable **Date of Receipt of Test Item:** 2009/02/13
Test Dates: 2009/02/17	

TEST RESULTS:

Test /Unit	Method	Result
Caffeine content, g/100mL	ISO 10727	0.06

Mrs. S. Perera,
Technical Officer

Authorized Signatory

Mr. J. A. G. Jayasinghe
Senior Research Officer
Chemical & Microbiological Laboratory

2009/02/18
/dpc

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APPENDIX XII

... **Continuation Sheet**

Report No. SS 91477

TEST RESULTS

Test/Unit	Result	Method
Ginger content (on fresh weight basis)	24.8 g/L	High Performance liquid Chromatography using Gingerol as Standard.

Analysis was carried out by Mr Hasitha Weeratunga, Research Officer and Mr. T.C.N. Peiris, Technical Assistant

Supervising Officer

Mr K.R Dayananda
Senior Research Officer
Herbal Technology Section

Authorized Signatory

Dr.G.A.S Premakumara
Head
Herbal Technology Section

2009.02.26
/sf

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