Wolkite University

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College of Engineering and Technology

Department of Food Process Engineering

Effect of preservatives (Ginger and Garlic) on the shelf life of tomato juice

A Thesis is submitted to Department of Food Process Engineering in Partial Fulfilment of the Requirement for the Degree of Bachelor of science in Food Process Engineering

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ABBREVIATIONS

CSA……Central Statistical Authority.

DOSS……...Degree of Serum Separation.

MPN……Most Probable Number.

NM……Normal Method.

TSS……Total Soluble Solid.

VM……Variable Method.

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CHAPTER ONE

INTRODUCTION

1.1 Background

The Tomato is the edible, often red, berry of plant solanum lycopersicum,(Peet, *et al.*,2009) commonly known as tomato plant .the species originated in western South America (Smith *et al.,* 1994).The word tomato comes from the Spanish tomate meaning fat water. It's consumed in diver's ways, raw or cooked in many dishes (Acquaah, *et al.,* 2002). Numerous varieties of tomato plant are widely grown in temperate climates across the world, with green house allowing for the production of tomato throughout all season of the year (Mueller, *et al.,* 2009). There are around 7500 tomato varieties grown for various purposes having been selected with varying fruit types, and for optimum growth in differing growing conditions. In 2016, world production of tomato was 177 million tonnes. The world dedicated 4.8 million hector in 2012 for tomato cultivation and the total production was about 168-177 million tonnes (Rick, *et al.,* 2009). The average world farm yield for tomato was 33.6 tonnes per hectare in 2012.In our country the production of tomato is widely growth vegetable crop. It is consumed in every household in different modes, but in certain areas such as Walo, Harrerge, Shewa, jimma and Wallaga.

It is also an important costaple food. According to the survey result about 32-40% of growers used irrigation.Supplmentery irrigation was required in most of the production regions to sustain food security and commercially viable tomato production. Since 1994 up to present tomato average increased to 5338ha with a total production of 55,635 Mg, (CSA 2011).Currently tomato is one of the regional export crops of the country.

The first record of commercial tomato cultivation is from 1980 with a production area of 80 ha (Lemma, 2006).In the upper Awash by Mertu Agro industrial for both domestic as well as export markets. The total area increased to 833 ha by the year 1993 and later on the cultivation spread towards other part of the country. There are also a preservatives which has healthfully benefit that used to process a tomato juice. A preservatives is a substance or chemicals that is added to product such as food, beverages, pharmaceutical drug and so on. In general, preservation is implemented in two modes, chemical and physical. Chemical preservation entail adding chemical compounds to the product.

Physical preservation entail processes such as refrigeration or drying (Erich luck *et al*., 2002).Preservative food additives reduce the risk of foodborne infections, decrease microbial spoilage and preserve fresh attributes and nutritional quality. Preservatives have been used since prehistoric times. Smoked meat for example has phenols and other chemical that delay spoilage. The preservation of foods has evolved greatly over the centuries and has been instrumental in increasing food security. The use of preservatives other than traditional oils, salts, etc.

In food began in the late 19th century, but was not widespread until the 20th century (Evans *et al*., 2010).The use of food preservatives varies greatly depending on the country. Many developing counties that do not have strong government to regulate food additives face either harmful levels of preservatives in foods or a complete avoidance of preservatives in foods or a complete avoidance of foods that are considered unnatural or foreign. These countries have also proven useful in case studies surrounding chemical preservatives, as they have been only recently introduced (Ashagrie *et al*., 2012).

1.2 STATEMENT OF THE PROBLEM

Tomato is perishable vegetable the water concentration of tomato is 94% (Barett *et al*., 1998).It is suitable for the growth of micro-organisms and it can easily deteriorate so, the shelf life of tomato is too short. In our country processed tomato is in adequate and not enough but, the demand is too high in the market in every year because of processed tomatoes are useful than fresh tomato it prevent cancer such as prostate, lung, and stomach cancer, with possible prevention of pancreatic, colon and rectal, esophageal, oral cavity, breast, and cervical cancer (Alias, *et al.*, 2011). Tomato juice have more bioavailable (absorbed into the blood) lycopene than fresh tomato when consumed with corn oil A tomato is a nutrient-dense super food that offers benefit to a range of bodily system. Its nutritional content supports healthful, weight loss, and heart health. But in our countries there no knowledge of using a tomato by modern (processed) rather than traditional (Albert, *et al.,* 2011).Canned tomato juices are preserved by chemical additives. Chemical additives or artificial preservatives are chemical substance that can cause health hazard so, chemical additives must replace with natural preservatives. Ginger and garlic have anti-oxidant and anti-flammatory property and they can preserve fruits for long time.

1.3 OBJECTIVE

1.3.1. General objective

- To determine the effect of preservatives (Ginger and Garlic) on shelf life of tomato juice.

1.3.2. Specific objective

- To analysis physico-chemical properties of tomato juice.
- To determine the sensory quality of treated juice.
- To analysis the microbial load of tomato juice.

1.3 Significance of the Study

This study create a major change in the perception of many individuals of how can live and enjoy while staying healthy by having sufficient knowledge on the product being processed. In addition, it will be beneficial to supplier-customer relationship by offering a new variety of a refreshing product which both can save cost and protect themselves from chemical hazard. It give more knowledge far beyond the basics of reading by doing the actual process and gathering data from different resources such as books and internet. In addition, it create job opportunity for many peoples.

CHAPTER TWO

2. LITERATURE RIEVEW

2.1. Tomato Production and Consumption

Tomato is globally cultivated for its fleshy fruit and known as protective food because of its special nutritive value and its wide spread production. It is the world largest vegetable crop after potato it tops the least of canned vegetables. Tomatoes are eaten directly as a raw vegetable or consumed in variety of processed product like ketchup, sauce, juice, soup, paste, and puree etc… (Kalloo,1991).Further more tomato is the richest source of nutrients, dietary fibers anti-oxidant like lycopene and beta carotene, the compound that protect sells from cancer(Hopson,1993) .Tomato has short generation time of about 3 to 4 months. It is well fitted in different chopping system of cereals grains, pulses and oil seeds. Hence, it is the most widely grown solanaceous vegetable crop grown worldwide under outdoor and indoor condition. Tomatoes are often classified among vegetables, and are added to vegetable recipes in order to make them colorful, delicious and nutritious. Juicing tomatoes even makes them more nutritious, and increases their utility. Scientists consider tomatoes as fruits, and recommend that tomato juice be taken alone. Nutritional facts and health benefits of tomato juice ripe tomatoes are healthy and rich in vitamins and minerals. They contain fiber, carbohydrates, protein, vitamins, amino acids and minerals. They are rich in vitamins such as Vitamin A, B6, C, thiamin, riboflavin, retinol, folate, folic acid, pantothenic acid, niacin, alpha tocopherol and vitamin E. The minerals contained in tomato juice include copper, zinc, potassium, calcium, phosphorous, potassium, sodium, iron, selenium and manganese. These nutrients help you to overcome conditions such as: Constipation, Lack of appetite, Hypertension, Poor circulation, Thirst, Bleeding gums, Poor digestion, and Blood shot eyes.

2.1.1. Taxonomy of Tomato

Tomato belongs to the family solanaceous (also known as night shade family) genus solanum, sub family solanoidaeace and tribe solaneace (Taylor, 1986). The genus includes a small collection of cultivated and wild species like S.Lycopersico milli. The tomato is native to central and South America it is a popular and versatile food. In tomato only fruit can be eaten since the leaves contain toxic alkaloids. The tomato is perennial plant but usually grown as an annual plant. It is reported that the tomato plant can reach up to 3 meter. The steams are somewhat weak and offers require stacking and support such as tomato cage.

2.1.2 Production of Tomato

Previously tomato well grown only during favorable season, but now a day tomatoes are grown round the year because of its economic importance area under cultivation is increasing every year. The estimated area and production of tomato for India about 350,000 hectares and 53, 00,000 tones respectively. Worldwide tomato production in 2005total 29.9 million metric tons. In 2016, world production of tomato was 177 million tonnes. The world dedicated 4.8 million hector in 2012 for tomato cultivation and the total production was about 168-177 million tonnes (Rick, *et al.,* 2009). The average world farm yield for tomato was 33.6 tonnes per hectare in 2012.

Table 2.1 Production tomato world wide

Country	**Production millions of tone**
China	56.3
European union	24.2
India	18.4
United states	13.0
Turkey	12.6

2.1.3 Tomato Production in Ethiopia

The existing agro processing factories in Ethiopia are very few. One of the major Industries are Merti Agro-processing. It has the capacity to produce 5,000 tons per year. It utilizes raw materials produced by its mother company, Upper Awash Farming. It exports some of the processed food. The factory has the UREGAP certificate in green been products. ELFORA one of the oldest agro-processing factories in the country produce various types and sizes of tomato squash, tomato ripped off and green beans. The factory has also the capacity to produce vegetable sauce, tomato juice. It out-sources agricultural product from its own farms as well as vicinities. The factory is constantly upgrading its capacity to meet the export demand and introducing several types of new exportable products. Above all, it is playing a significant role in saving foreign currency, replacing import trading of similar products. Among the major factories is the recent establishment, called Sebeta Agro-processing. Mostly, Ethiopia tomato juice, whose raw material come from Jimma, Shawa, and Wallaga areas. Providing high quality Ethiopia tomato juice to the local and export market. Ethiopia tomato juice, whose raw material collected from different direction of inside country. The extraction and evaporation of water content from bulk amounts of raw fruit helps boost the solidity of the juice.

The production of Ethiopia tomato juice is quite an involving process because the tomato berry has about 95% water and 5% of sugar and solid (Adda Bjarnadottir, 2019). Its requires nearly 6 kilos of the fruits to make a single kilo of the fruits to make a single kilo of tomato juice. This will have a 28% Brix, which is a term that defines the amount of solid in juice. Before the extraction can start, convey the tons of tomato in turns in to a roller that washed them. The next step is that of chopping the healthy selection in anticipation to make thick Ethiopia tomato juice. The extraction of tomato juice in two ways. The first one is the hot break method, whereby heat the chopped berries under 100^0c heat. The next method is that of cold break method whereby use and 75^0c .After the heating processes, hot or cold are over, and the pulp then passes with its whole skin, juice and fiber as well as seeds to the pulper. The latter is a high sieve that separate the solid from the juice part. The final stage is vapor below 100^0c. This is a process that remove the high water content and turns the naturally 5% solid material in to 28 to 36%solid juice.

2.1.4 Tomato Storage and Shelf life

Tomato keep best unwashed at room Temperature and out of direct sun light. It is not recommended to refrigerate them as this can harm the flavor (Parmell, *et al.,* (March 2004) Tomato safe method to store, preserve and enjoy. Tomato stored in cold tend to loss their flavor permanently(Barceloux, D.G, D.G (2009).Properly stored, unopened tomato juice that has been sold unrefrigerated will generally stay at best quality for about 18 to 24 months after the date on the package when stored at room temperature, although it will usually remain safe to drink after that. To extend the shelf life of unopened tomato juice, keep it away from direct source of heat or light and store in a cool dark area. In addition to this the shelf life of tomato juice will increase when it frozen and store in airtight container and leave at least ½ inch head space at the top. The freezer time shows is for best quality only tomato juice that has been kept constantly frozen at 0^0F will keep safe immediately (Parnell *et al.,* 1995). Tomato juice has been defrosted in the fridge can be kept for an additional 3 to 5 days in the refrigerator before using; tomato juice that thawed in the microwave or in cold water should be used immediately. If tomato juice develops an off odor, flavor or appearance, or if mold appears, it should be discarded (Vrebalov *et al.,* 2002).

2.2. Mechanism of Preservation of Vegetables

A permaculture design seeks to maximize the yield of food that grows in it.By promoting biodiversity, succession planting,stackaing systems and the efficiency of use of space permaculture plot should be able, space permitting provide a large proportion of gardener's required fruit, and vegetables and herbs (Dalton, *et al.,*2002). One of the most appealing things about growing your own food is that you can go from earth to table in the minimum amount of time ensuring your fruits and vegetable are at their freshest and most nutritious (Erich Luck *et al.,* 2002).Often, particularly the urban areas were plots are typically smaller, neighbors will grow different type of vegetables and fruits. Swapping allows each to make use of their abundant crops and increase the range of their diet (Bhatt *et al.,* 2011).

There are some methods for preserve vegetables such as drying, freezing, canning and addition of preservatives like salt, garlic and ginger.

- **Drying**: - drying dehydrates the fruit or vegetables, removing all the water along with the bacteria, yeasts and mold that live in the moisture (Evans, *et al.,* 2007). Besides altering the texture of the food, drying also modifies the taste, typically concentrating it.Dried food has the added benefit of being safe to store as is on your pantry shelf-we don't need special packaging to keep it in or to keep it in the refrigerator (Hafeez, *et al.,* 2013). In some countries solar drying of food is a part of life, and if we live in an area that receives high levels of consistent sunshine, we may able to dry food that way. More likely however, is drying in an oven (Kabra, *et al.,* 2014). The technique requires low temperature and good air circulation so use the lowest setting and crop the oven door open-this allows the air that the moisture has evaporated into to escape.
- **Freezing**:-Freezing fruit and vegetables soon after they are picked serves to lock in the flavor and freshness of the produce. Freezing and thawing a vegetable or fruit is the preserving method that will have an end product that most closely resembles the taste of fresh food (Challemaison,*et al.,* 2010). A temperature below freezing needed for effective long term storage.
- **Canning**: - Canning involves placing fruit and vegetables in airtight containers, typically glass, jars, and so prevent bacteria getting to them. Canned goods can be stored on shelves for years, if required (Titus, *et al.,* 2012). The equipment used for canning must be sterilized before being filled with product.
- **Salt**:-One of the oldest method of preserving food, salting can be used for meat and fish as well as sliced vegetables. Salting promotes the growth of lactic acid bacteria which in turn inhibits the growth of other bacterial forms that could spoil the food. It also serves to slightly pickled the vegetables (Msagati *et al.,* 2012).
- **Garlic**:- is a plant in the Allium,(onion) family. It is closely related to onions. Each segment of a garlic bulb is called a clove (Alias *et al.,* 2012). Garlic grows in the many parts of the world and is a popular ingredient in cooking due to its strong smell and delicious test. It has been used as an antibiotic to treat bacterial, fungi and parasitic infection for the last 7000 years (Riva *et al.,* 2017). Several studies have indicated an association between daily consumption of garlic and prevention of stomach and

colorectal cancer. It is said to strengthen the immunity of the body against cancer. Consuming garlic on a daily basis helps to lower cholesterol levels because of the anti-oxidant properties of Allicin (Gert-Wolfhard, *et al.,* 2002).

- **Ginger:**- is part of Zingiberaceae family alongside cardamom and turmeric (Megan, *et al.,*2017). It's a popular ingredient in cooking and it has also been used for thousands of years for medicinal purpose.it is commonly produce in India,Jamaica,Figi,Indonessia and Australia (Rajeev, *et al.,*2011). It has a possible health benefit include relieving nausea, loss of appetite, motion sickness and pain. Other possible uses include reducing cholesterol, lowering the risk of blood clotting and helping to maintain healthy blood sugar level (Barrett, *et al.,* 2007). The root or underground steam of the ginger plant can be consumed fresh, powdered, dried as a spice, in oil form or as juice.
- Ginger provides a variety of vitamin and minerals. The fresh or dried ginger can be used to flavor foods and drinks without adding unnecessary salt or sugar. There are anti-inflammatory and anti-oxidant compounds found in ginger that are beneficial to health include gingerols, beta carotene, caffeic acid (Theron, *et al.,* 2007). Store fresh ginger in a tightly wrapped plastic bag in the refrigerator or freezer, and peel and grate it before use. Add it to any suitable dish for extra flavor (Kumar, *et al.,* 2013).

There are some products of tomato known around the world such as

- Tomato juice: - A smooth liquid form of tomato available in cans or bottles. It can be included in small quantities in recipes where a tomato flavor and smooth texture are required.
- Tomato ketchup: - It is a combination of tomatoes, vinegar, sugar and spices and is available in glass or plastic bottles.
- Tomato paste: - This coarse paste made from sun dried tomatoes has a texture midway between sun drier tomatoes in olive and tomato puree.
- Tomato puree:- is a concentrated smooth paste with a very strong tomato flavor. It is available in cans, tubes and jars.
- Tomato sauce: - Is a readymade sauce made with chopped tomatoes .A variety of sauce are available, containing a range of different ingredient's including onions, garlic, herbs, olive oil, chili's and mushroom.

2.3. QUALITY CHARACTERISTICS OFTOMATO PRODUCT

The quality of the processed tomato product is dependent upon processing conditions. It is important for tomato processors to know how to obtain high viscosity products to prevent loss of flavor and nutritional quality by preventing loss and increase the bioavailability of lycopene and appropriate evaluation of the tomato products (Preedy *et al.,* 2008) .Quality of tomato juice is strongly by mechanical and thermal abuse during processing (Takada, *et al.,* 1983). The effect of processing and storage duration on the viscosity and quality parameter of tomato juice was evaluated in the present work. Tomato juice was obtained by two different method (Caradec, *et al.,* 1985). Normal Method (NM) and Variable Method (VM), and was heated by both conventional and microwave hot break treatments. Tomato juice was evaluated for various quality. Characteristics include precipitate weight ratio, degree of serum separation (DOSS), viscosity, lycopene levels, vitamin C, phenols and antioxidant activity (Barett, *et al.,* 1998). Changes observed in several quality statistically insignificant. The method and processing had the great contribution toward viscosity (Hayes, *et al.,* 1998). Ascorbic acid and lycopene content varied significantly with mechanical methods and processing conditions. However, phenolic content and antioxidant activity remained stable (Ranganna 1976)

CHAPTER THREE

3. MATERIAL AND METHODS

3.1 EXPERMENTAL SITE

The experiment was conducted at Wolkite University Food Process Engineering Laboratory.

3.2 SAMPLE, COLLECTION, TRANSPORTATION AND PEREPARATION

The sample were collect from local market in order to minimizing the time required for processing. This also uses to prevent the tomato from deterioration. The tomato were transported to food laboratory the aim is to reach the tomato to consumers without any deterioration in the quality. The tomatoes must be firm, of a fine color both inside and outside and they must have a good taste. The optimum storage temperature in the warehouse and during transport is 12^{o}C and the humidity 85-90% relative humidity.

- **Collecting and grading**:-Before processing of tomatoes it should have to collect and prepare for further processing step. Collected the tomatoes by their ripeness, size and shape. After collecting and grading, the tomatoes were ready for processing. This also use for preventing quality of process tomato. Grading is done on the basis of color and percentage of defects. Color can be determined visually by estimation of what percentage of the surface is red, or with an Electronic colorimeter on a composite raw juice sample. Defects include worms, worm Damage, freeze damage, stems, mechanical damage, anthracnose, mold, and decay were removed. The allowable percentage of extraneous matter may also be specified. Extraneous matter includes stems, vines, dirt, stones, and trash.
- **Washing:-**tomatoes should be washed before cutting. Wash tomato with water, rub its surface, rinse it with running water, and dry it with a paper towel. Washing tomatoes is in a sink filled with water is not recommended since contaminated water can be absorbed through the fruits stem scar. The washing step also serves to cool the fruit. Since tomatoes are typically harvested on hot summer days, washing remove the field heat, slowing respiration and therefore quality loss. Therefore, tomato washing can be a

separate step in a water tank or it can be built into the flume system. A water tank also serves to separate stones from the fruit, since the stones settle to the bottom

- **Sorting and Trimming**:-sorting of tomatoes according to their features is an important postharvest procedure. The purpose of sorting parameter included shape (oblong and circular), size (small and large), maturity (color), and defect. Photoelectric color sorters are used in almost every plant to remove the green and to pink tomatoes. Those sorters work by allowing the tomatoes to fall between the conveyer belts in front of the sensor. Unacceptable tomatoes are ejected by a pneumatic finger. A small Percentage of green tomatoes in tomato juice do not adversely affect the quality. Green Tomatoes bring down the pH, but do not affect the color of the final product. The trimming can be used for the preparation of tomato juice. Trimming to remove rot or green portions is not practiced in United States due to the high cost of labor. After trimming, tomatoes are cut into small pieces before boiling. Alternatively they may be crushed by means of wooden roller crusher.

3.3. PREPARATION OF TOMATO JUICE

- **Peeling**:-pulping or peeling is one of the important unit operation in tomato processing. Mostly recently, three novel tomato peeling methods were reported infrared ohmic heating and power ultrasound. Steam hot water peeling have been the most commercialized methods but compared to steam peeling, is more preferred and has gained widespread application among processors due to its association with higher product yields and better product quality. Steam peeling coupled with vacuum cooling and pinch roller is a physical alternative to hot lye peeling of tomatoes. Heating the tomatoes for few seconds to some min with pressuring steam weakens the tomato skin through the flash vaporization skin of water under the skin. It is better to select steam hot water method, in ordered to increase the yield of tomato juice at the end of this process the additives like garlic and ginger and other additional ingredients (salt and sugar) will added.
- **Cutting and chopping**: - Tomato processors generally cutting or crushing the tomatoes, prior to hot breaking to realize higher juice yields. Crushing of tomatoes prior to hot breaking often leads to more serious fragmentation and disruption of cell walls, quick

Liberation of pectolytic enzymes as well as pectin from cell walls. This makes pectin more vulnerable to attack by pectolytic enzymes, resulting in rapid degradation of pectin. The tomatoes are put through a break system to be chopped. Some break systems operate under vacuum to minimize oxidation. In an industrial plant operating under vacuum, no degradation of ascorbic acid occurs during break process (Trifiro, et al., 1998). When vacuum is not used, the higher the break temperature, the greater the loss of ascorbic acid (Fonseca and Luh, 1976).Tomatoes can be processed into juice by either a hot break or cold break method. Most Juice is made by hot break. In the hot break method tomatoes are chopped and heated rapidly to at least 80oC to inactivate the pectolytic enzymes polygalacturonase (PG) andPectin metylesterase (PME). Inactivation of those enzymes helps to maintain the Maximum viscosity.

- **Homogenization**:-juice homogenization is mostly done to create smaller fiber particles, which reduces the sedimentation velocity to a lower level. The juice is homogenized to increase product viscosity and minimize serum separation. Precipitate weight ratio, serum separation were taken as parameter for evaluating viscosity. The juice is forced through a narrow orifice at high pressure, shredding the suspended solids. The Creation of a large particle surface area increase product viscosity.
- **Heating**:- After cutting or chopping and homogenization the tomato, heating it at 90^0c for 3-5 min then added garlic and ginger in order to achieve overall commercial sterility. This process is designed to destroy the vegetative cell and the spores of bacillus spp., (Tribst *et al.,)* 2009which are the most common spoilage organisms of tomato juice.
- **Filling**: - Products can be hot filled and held, or can be processed in a retort as needed to minimize spoilage. Most tomato products undergo a retort process to ensure an adequate shelf life.
- **Cooling**: - After filling, the product must be cooled to 30-40oC to minimize quality loss. The Product may be cooled by water or air. Water cooling is more efficient than air cooling; therefore, longer retort process times are recommended when water cooling is used than air cooling.

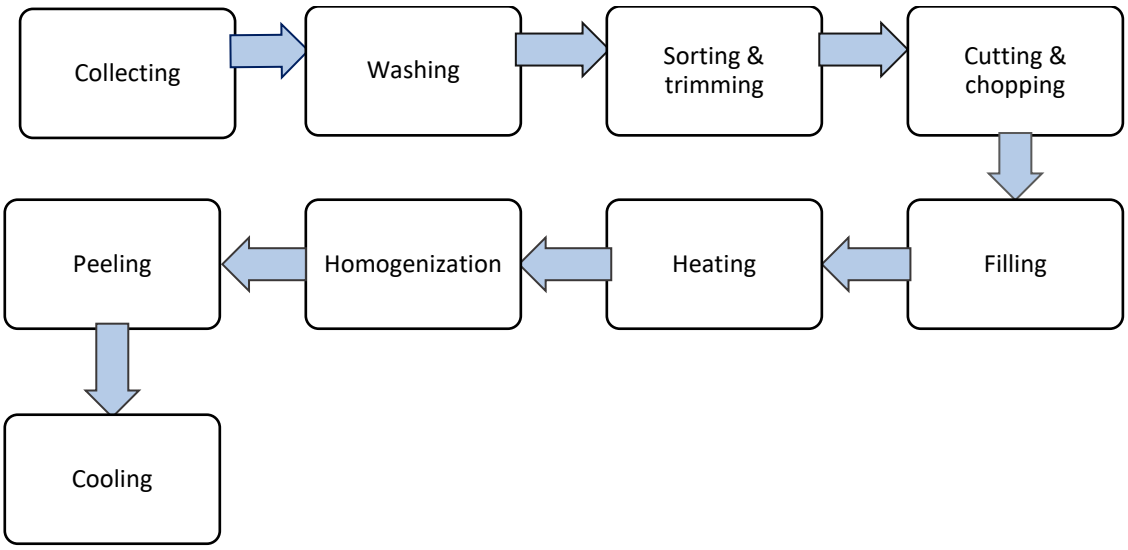

Figure 3.1 Preparation of tomato juice

3.4 ANALISIS METHODS

3.4.1 PHYSICO- CHEMICAL ANALYSIS

- **PH**

  The pH of samples was measured using Microprocessor TS pH meter. Standardization of the meter was done using buffer solution of pH 4 and 9.

- **Total Soluble Solid (TSS)**

  TSS of processed products is measured by Refractometer. Refractive index of the sample conducted by using Abbe type Refractometer for TSS.

3.4.2 MICROBIAL ANALYSIS

Using Pour Plate Method, a 46g of sample taken and serially diluted to 1:10, 1:100 and 1:1000. for yeast and mold and total plate count, one ml diluents taken from each and Put on sterile Petridis, pour potato dextrea agar and mix with the sample, then incubate At 35^0c 48hr finally count the colony (APHA, 1976).

3.4.3 SENSORY ANALISIS

Using Difference from control test method, sensory evaluate for each Tomato juice. Present to each panel a control sample plus more test samples. Ask Panel to rate the difference between each sample and the control provide a scale for this purpose. Sensory evaluation were carried out by ten up to fifteen panelists Comprised of students of the Food process engineering and lab assistants and teachers. Sensory Attributes evaluate taste, using a score scale of 1 to 9 hedonic scale (Koppmaier, *et al.*, 2018).

3.4.4 INSTRUMENTAL SENSORY ANALAYSIS

Color

Color was determined by LOVIBOND 3000 color comparator (1986) procedure.

3.5 Experimental Design and Statically Data Analysis

The experiment have single factorial design and conduct in triplicates. All data were conducted by using IBM and Statically Analysis software (SAS) for window version 9.0. the amount of Ginger to make tomato juice 80mg, the amount of Garlic is 53mg and the amount of mixed tomato prepared from 26.5 mg Garlic and 40 mg Ginger at constant temperature 90^0C.

Table 3.1 Experimental Design

Temperature	Type of preservatives		
	G1	G2	G1&G2
T	G1T	G1T	G1T
T	G1T	G2T	G2T
T	G1T	G3T	G3T

G1= Garlic
G2=Ginger
T= Temperature
G3= Garlic and ginger

CHAPTER FOUR

4 RESULT AND DISCUSSION

The tomato juice is a ready to drink juice prepare from tomato pulp, sugar, water and natural preservatives. The effect of different type of natural preservatives on acceptability and shelf life of tomato juice at room temperature was studied. The acceptability and shelf life were evaluated through physicochemical with sensory and microbiological analysis.

4.1. PHYSICO- CHEMICAL ANALYSIS

Table 4.1 Physicochemical analysis

Treatment	PH	TSS
G1	4.4133 ± 0.0153^{a}	19 ± 0.3605^{a}
G2	4.2267 ± 0.456^{a}	18 ± 0.36055^{b}
G3	4.12 ± 0.4508^{a}	17.4 ± 0.305505^{b}

Means with same letter are not significant different

G1=Garlic G2=Ginger G3=Ginger &Garlic

- **Effect of different type of natural preservatives on PH**

According to the center for food safety and applied nutrition at the U.S. Food and Drug Administration, Fresh tomatoes fall into the 4.3-4.9 range when it comes to acidity. For tomato juice the range is 4.1-4.6. The prepared of tomato juice with different preservatives had the standard range of pH observed in garlic (G1, 4.41), ginger (G2, 4.23), and mixed (ginger & garlic) (G3, 4.12) tomato juices. Observed the highest PH in G1 (Garlic) the lowest PH observed in G3 (mixed of G1 & G2 4.12) the result suggest that garlic is low acidic than ginger. The mixed tomato juice is the most acid juice than others because the amount of ginger is higher than the garlic also This variation is occurs may be from the instrument used, type of preservatives, the ripens of tomato, ingredient used and also the amount of preservative in tomato juice and so

on in addition nature of ginger is more acidic than garlic. The prepared tomato juice PH ranged between 4.12-4.2 which is within the standard range of tomato juice (Harris *et al.*, 1991)

According to results, natural preservatives have different effect on PH of tomato juice. Juice prepared with Garlic had PH value of 4.4133, varied from (3.7-4.56), the Ginger had PH value of 4.2267 varied from (3.7-4.7) and juice prepared with mixed (garlic&ginger) had PH value of 4.12 varied (4.3-4.4) at a constant temperature of 90^0 c.

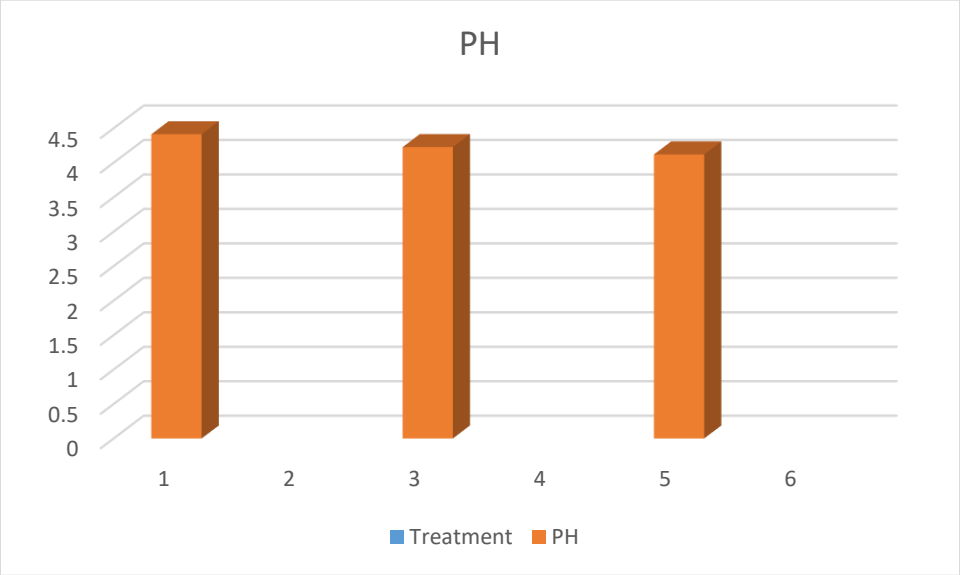

Figure 4.1 Effect of PH on tomato juice

- **Effect of different type of natural preservatives on TSS**

  It is commonly used to measure sugar content in drinks, medicines and fruits. Measuring is done scale called Brix scale. The Brix scale measures % of total soluble solids in a substance. The TSS of standard range in tomato juice is 20^0 brix. According to results, natural preservatives have different range on TSS content of tomato juices. Juice prepared with Garlic contained 19^0brix varied from (18.4-19.1), ginger contained 18^0brix varied from (17.5-18.3) and juice prepared with mixed (garlic & ginger) contained 17.4^0brix varied from (16.9-17.7)

  The result showed in the above the three samples are different from the standard range (lower than the standard). The reason of the lower result in the three sample Ginger, (G1, 19^0 brix) Garlic (G2,18^0 brix) and mixed (G1&G2) (17^0Brix).The tomato used for making

juice were in deep freezer for a week, larger round or common tomatoes in general, smaller, cherry tomatoes have a higher brix ratio and sweeter than common tomatoes .for prepared tomato juice.

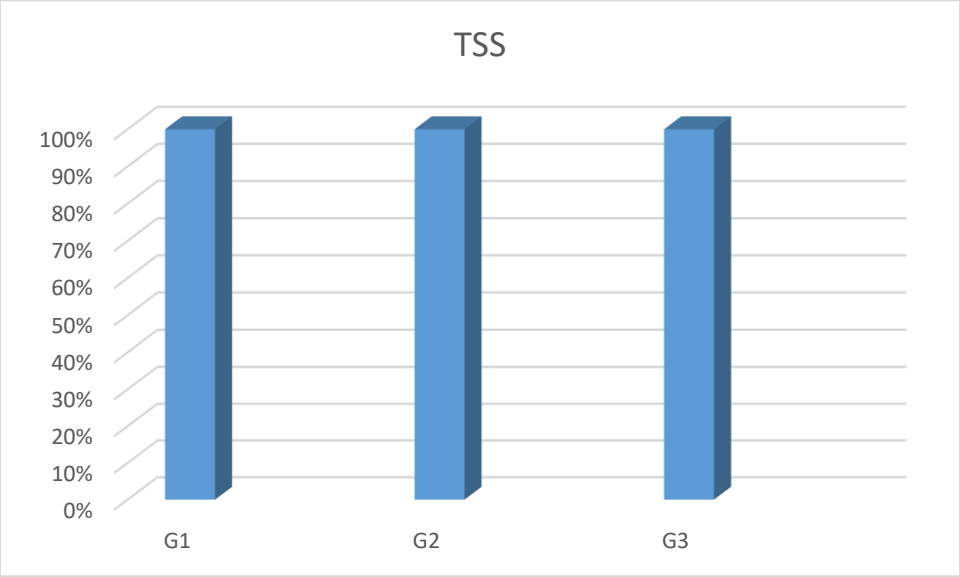

Figure 4.2 Effect of TSS on tomato juice

❖ **Effect of different type of natural preservatives on Color**

Color is characteristic of human visual perception described through color categories with names and it is the aspect of things that is caused by differing qualities of light being reflected or emitted by them. The magnitude of total color reader using colorimeter model and values. A positive value of a^*indicates the magnitude of reddish component, while its negative value shows that of greenish component. A positive value for b^*shows yellowish component while its negative indicates the bluish component. The L,*A*,B*values was be recorded according to Jangchud *et al.,(*2003)The color of tomato juice prepared with garlic is decreased from the control tomato juice and the juice prepared with Ginger and mixed juice also decreased. The reason of this variation where the addition of natural preservatives and different spices.

Table 4.2 Color of Tomato juice

Color	L	A^*	B^*	C^*	$H(^0)$	Control
G1	3.40 ± 0.34^{B}	7.29 ± 0.69^{B}	10.46 ± 1.18^{BA}	18.56 ± 1.07^{BC}	68.51 ± 0.87^{B}	10.44 ± 0.50^{A}
G2	2.68 ± 0.73^{BC}	7.59 ± 0.55^{B}	7.43 ± 0.80^{B}	17.40 ± 1.21^{C}	66.53 ± 3.02^{B}	32.81 ± 0.62^{A}
G3	2.35 ± 0.03^{C}	6.28 ± 0.25^{B}	19.43 ± 1.31^{B}	21.38 ± 0.24^{B}	42.43 ± 1.16^{C}	81.77 ± 1.61^{A}

Means with same letter are not significant different

G1= Garlic

G2= Ginger

G3= Mixed (G1&G2)

L^*=CIE lightness

A^*=CIE red (+)/green (-) color attribute

$B^{*=}$CIE yellow (+)/blue (-) color attribute

4.2 MICROBIAL ANALAYSIS

During the storage period there were countable Yeast and mould present in processed tomato juice. Tomato juice prepared with the Garlic during 0 hr null countable yeast and mould present in tomato juice, in 72 hr the total countable yeast and mold present in tomato juice were 95cfu varied from (31-159cfu) and in 144 hr the result showed there were 190cfu varied from (60-320cfu) countable yeast and mold. Tomato juice prepared with Ginger during 0 hr the total viable yeast and mold present in tomato juice were 14cfu varied from (10-17cfu),during 72 hr the result were 160cfu varied from (125-197cfu) during 144 hr the result were 206cfu varied from (143-269cfu).Tomato juice prepared with mixed (Ginger & Ginger) during 0 hr the total viable yeast and mold present in tomato juice were 10cfu varied from(7-14cfu)during 72 hr the result were 88cfu varied from (48-128cfu) during 144 hr the total viable countable yeast and mold present in tomato juice were 187cfu varied from (76-198cfu).

In addition, without microbial analysis the shelf life can determine in indirect ways by smelling and visualizing the treated juice. This result showed that, yeast and mold were count increased with time .This may occurred for Equipment that is used to process the juice, such as

presses, mills, extractors, taste tube , Petridish, and packaging materials can be sources of contamination Improper sanitation procedures will result in juice recontamination after pasteurization and the possibility of the microbes establishing themselves inside the plant Fruits, on the other hand, can be contaminated from several sources, such as the air, dust, handling, insect pests and animals like birds. The tomato juice prepared from different natural preservatives is safe in its shelf life and the countable yeast and mold were within the acceptability limit. In addition natural preservatives are better than chemical preservatives.

Table 4.3 Microbial analysis

Treatment	O hr	72 hr	144 hr
G1T1	7.333 ± 3.055^{b}	80.67 ± 16.258^{c}	160.00 ± 34.117^{b}
G1T2	10.000 ± 5.000^{b}	95.67 ± 19.858^{bac}	191.33 ± 39.7156^{ba}
G1T3	14.000 ± 6.5574^{ba}	109.67 ± 28.184^{ba}	219.33 ± 56.367^{ba}
G2T1	9.000 ± 4.000^{b}	91.33 ± 7.3711^{bac}	183.33 ± 15.535^{ba}
G2T2	14.333 ± 3.215^{ba}	100.00 ± 10.1489^{bac}	202.00 ± 17.088^{ba}
G2T3	18.667 ± 3.759^{a}	113.67 ± 18.5562^{a}	232.67 ± 29.955^{a}
G3T1	8.67 ± 2.5166^{b}	83.33 ± 16.4458^{bc}	166.67 ± 32.884^{b}
G3T2	12.33 ± 3.5118^{ba}	93.00 ± 17.349^{bac}	187.33 ± 36.896^{ba}
G3T3	11.000 ± 6.000^{b}	89.33 ± 6.506^{bac}	208.67 ± 41.585^{ba}

Means with the same letter are not significantly different

G1=Garlic T1=10^{-1}

G2=Ginger T2=10^{-3}

G3=Ginger & Garlic T3=10^{-5}

4.3 SENSORY ANALAYSIS

The processed tomato juice was evaluated for its color, flavor, viscosity, taste and overall acceptability through taste testing panel. The panelists were asked to score the sample in ascending order of 1-9 points showing their degree of preference in respect of color, flavor,

viscosity, taste and overall acceptability of the tomato juice sample. As shown in the table there was no significance difference for color, flavor and viscosity preference between sample G1,G2 & G3.In case of taste there is no significance difference between sample G2 & G3 but there was significance difference between G1 from the two sample (G2 &G3).From the above table the overall acceptability result showed that there were significance difference among the three samples.

Table 4.4 Sensory Analysis

Treatment	Color	Flavor	Viscosity	Taste	Overall acceptability
G1T	7400 ± 0.0100^{a}	7.2667 ± 0.11547^{a}	7.6667 ± 0.30551^{a}	7.4000 ± 0.20000^{b}	7.733 ± 0.50332^{b}
G2T	8.4000 ± 0.34641^{a}	7.933 ± 0.80829^{a}	7.8000 ± 0.34641^{a}	8.4000 ± 0.34641^{a}	8.2667 ± 0.11547^{ab}
G3T	8.0667 ± 0.75719^{a}	8.133 ± 0.46188^{a}	8.0667 ± 0.30551^{a}	8.400 ± 0.20000^{a}	8.667 ± 0.23094^{a}
Control	8.55 ± 0.3054^{a}	5.21 ± 0.24^{b}	7.811 ± 0.1154^{a}	6.3333 ± 0.4321^{b}	6.612 ± 0.3215^{b}

Means with same letter are not significant different

- **Effect of different type of natural preservatives on Color**

The color ranged between7-8 among all samples. The control had the highest color (8.5) and the lowest for G1 (Garlic) as compared than other sample. It showed that a tomato juice without any spices and preservatives had a good color and also preservatives and spices had an effect on color.

- **Effect of different type of natural preservatives on Flavor**

The flavor for the prepared tomato juice ranged between 5-8.The highest flavor scored in G3 (mixed (Garlic & Ginger)) and the lowest in control. This result showed that the combination of garlic and ginger gave a good flavor to the tomato juice and the control (without any preservatives) had not a good flavor or tomato by itself without any addition difficult to drink.

- **Effect of different type of natural preservatives on Viscosity**

The viscosity of the tomato juice ranged between 7.8-8.The highest flavor scored in G3 (mixed) and the lowest in G1 (Garlic).this showed that the combination of garlic and ginger had an effect on the juice. However, there were not a big difference in the viscosity between the four samples at all.

- **Effect of different type of natural preservatives on TASTE**

The taste of tomato juice ranged between 6-8.The highest tastes scored in G3 (mixed) and the lowest scored in the control sample. The result showed that addition of preservatives had their own effect on the taste of tomato juice. The result was the same with the flavor.

- **Effect of different type of natural preservatives on Overall acceptability**

The overall acceptability of the tomato juice ranged between 6-8.The highest overall acceptability scored in G3 (mixed) and the lowest in control sample. This result showed that sample G3 (mixed) were acceptable in its overall quality (color, flavor, viscosity and taste.

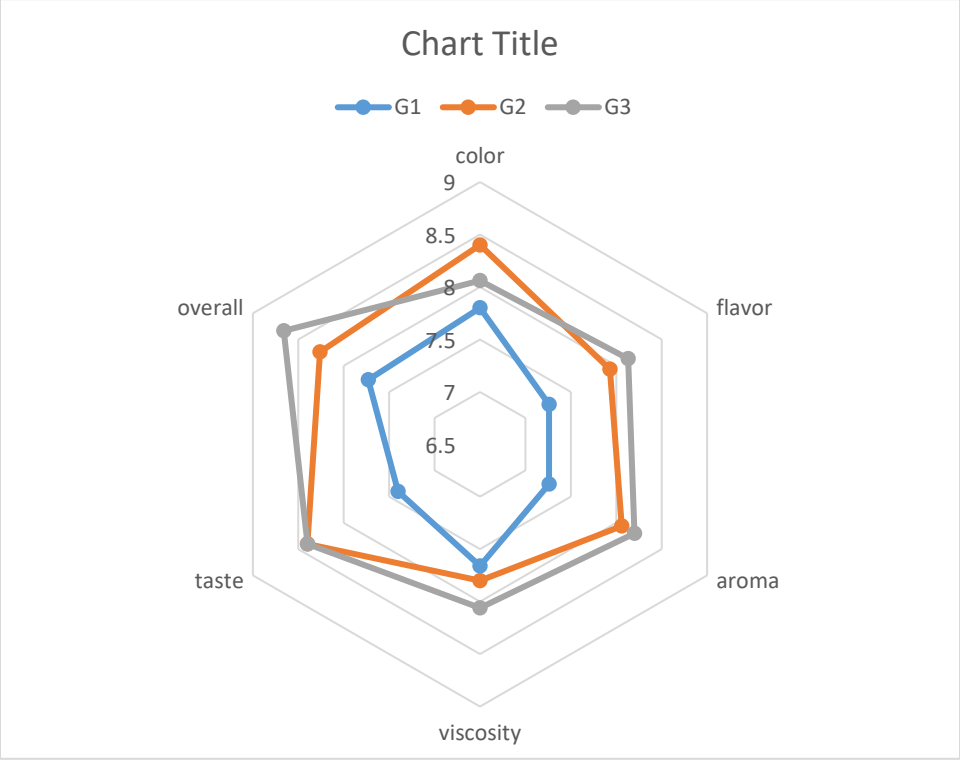

Figure 4.3 Radar plot of Sensory analysis

Chapter Five

5 Conclusion and Recommendation

5. 1 CONCLUSION

The result showed that the effect of preservatives (garlic and ginger) on shelf life of tomato juice. The impact of the preservatives is apparently more significant than control tomato juice. The processed tomato juice was acceptable in its all quality and attributes .The PH of prepared tomato juice (4.12-4.2) was within the standard range (4.1-4.6) and the TSS of the prepared tomato juice (17-19^{0}Brix) the standard range is 20^0 Brix the reason of decreasing the TSS of the prepared tomato was the tomatoes used for making juice were high in their moisture content because there were in deep freezer for a week .However, it is almost the same with the standard range. The growth of yeast and mold also within the acceptable limit and the sensory evaluation showed that the product is acceptable in its all quality. The control sample was not acceptable in its sensory test and the total countable of yeast and mold of the control were higher than other sample. This result showed that prepared tomato juice with garlic and ginger (combining garlic and ginger)was the best way to preserve tomato with long shelf life not only preserve the shelf life, the combination of the two preservatives can give the best taste and flavor to the tomato

juice. In general, natural preservatives are better than artificial or chemical preservatives. Chemical preservatives are chemical substance that can cause health hazard.

5.2 RECOMMENDATION

Tomato is a widely processed vegetable to be used as a vital ingredient in many products, Soups, sauces, juice and ketchups .Ginger and garlic have antioxidant and highly inflammatory property. Other than to use our product (tomato juice) were recommends that by mixing ginger and garlic not only tomato but also for other fruit to get better preservation and taste. We recommended that processor must replace chemical additives or preservatives by natural preservatives to protect consumer health from chemical hazard and consumers must be purchased the product produced from natural preservatives and additive. Tomato products was strongest for the prevention of prostate, lung, and stomach cancer, with possible prevention of pancreatic, colon and rectal, esophageal, oral cavity, breast, and cervical cancer. So we must take this product and more detail study is required for further improvement of quality characteristics shelf life of tomato juice.

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8. **APPENDIX**

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Color	Between Groups	1.556	2	.778	3.365	.105
	Within Groups	1.387	6	.231		
	Total	2.942	8			
Flavor	Between Groups	1.236	2	.618	2.106	.203
	Within Groups	1.760	6	.293		
	Total	2.996	8			
viscosity	Between Groups	.249	2	.124	1.217	.360
	Within Groups	.613	6	.102		
	Total	.862	8			
Tast	Between Groups	2.000	2	1.000	15.000	.005
	Within Groups	.400	6	.067		
	Total	2.400	8			
over all aceptability	Between Groups	1.316	2	.658	6.167	.035
	Within Groups	.640	6	.107		

Total	1.956	8			

The ANOVA Procedure

Dependent Variable: _0_hr__T1_ **0** hr (T1)

Source	DF	Sum of Squares	Mean Square	F Value	Pr> F
Model		**8300.296296337.53703701.960.1130**			
Error		**18345.333333319.1851852**			
Corrected Total		**26645.6296296**			

R-Square	CoeffVar	Root MSE	_0_hr__T1_ Mean
0.46512237.424824.38009011.70370			

Source	DF	Anova SS	Mean Square	F Value	Pr> F
treatment		**8300.296296337.53703701.960.1130**			

105:**21** Saturday, December **18**, **20043**

The ANOVA Procedure

Dependent Variable: _2_hr **72** hr

Source	DF	Sum of Squares	Mean Square	F Value	Pr> F
Model		**82939.407407367.4259261.290.3099**			
Error		**185136.666667285.370370**			
Corrected Total		**268076.074074**			

R-Square	CoeffVar	Root MSE	_2_hr Mean
0.36396517.7474116.8929195.18519			

Source	DF	Anova SS	Mean Square	F Value	Pr> F
treatment		**82939.407407367.4259261.290.3099**			

105:**21** Saturday, December **18**, **20046**

The ANOVA Procedure

Dependent Variable: _44hr **144**hr

Source	DF	Sum of Squares	Mean Square	F Value	Pr> F
Model	**813443.851851680.481481.310.2985**				
Error	**1823042.666671280.14815**				
Corrected Total	**2636486.51852**				

R-Square	CoeffVar	Root MSE	_44hr Mean
0.36846118.3867035.77916194.5926			

Source	DF	Anova SS	Mean Square	F Value	Pr> F
treatment	**813443.851851680.481481.310.2985**				

104:**29** Sunday, December **12**, **20049**

Nine point hedonic scale for Acceptance test

NO	Sample code	Color	Flavor	Viscosity	taste	Overall acceptability
1	G1	7	8	7	9	8
2	G2	8	9	8	9	9
3	G3(G1&G2)	7	8	8	8	8

9=like extremely

8=Like very much

7=Like moderately

6=Like slightly

5=Neither like nor dislike

4=dislike slightly

3=dislike moderately

2=dislike very much

1=dislike extremely