KOFORIDUA TECHNICAL UNIVERSITY

FACULTY OF APPLIED SCIENCE AND TECHNOLOGY

DEPARTMENT OF FOOD AND POSTHARVEST TECHNOLOGY

EFFECT OF STORAGE TIME ON QUALITY CHARACTERISTICS OF WATERMELOM-PINEAPPLE AND SOURSOP JUICE BLEND PRESERVED WITH LIME.

PROJECT WORK SUBMITTED TO THE DEPARTMENT OF FOOD AND POSTHARVEST TECHNOLOGY, KOFORIDUA TECHNICAL UNIVERSITY, KOFORIDUA, GHANA IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF B'TECH FOOD TECHNOLOGY.

BY

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STUDENT'S DECLARATION

I hereby declare that this submission is my own work toward the Bachelor of Technology and that to the best of my knowledge, it may contain materials previously published by another person or material which has been accepted for the award of any other degree of the University and where due acknowledgment has been made in the text.

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SUPERVISOR'S CERTIFICATION

I hereby certify that the preparation of this project work was supervised in accordance with the guidelines of supervision of project work laid down by the University.

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ABSTRACT

Fruit juice was developed from watermelon, pineapple and soursop blend and stored for 20 days to know the effect of storage on the quality of the juice. Physicochemical properties were assessed at day 0, day 5, day 10, day 15 and day 20. Sample A Recorded the heights pH at all storages days 5.283 at day 0 whiles sample D recorded the lowest at all storage day 3.773 at day 0. Sample C recorded highest TSS Value of 10.967 ^{o} Brix at day 20 while Sample E recorded the lowest TSS value 7.100 ^{o} Brix at day 5. Titratable acidity of the samples ranged from 0.108 to 0.688. At day 10 the highest titratable acidity was recorded in sample D 0.688 and the lowest 0.108 was recorded in sample day 20. Vitamin C content after storage observed an increasing trend as sample with watermelon, pineapple and soursop were higher. With microbial quality of the product, value for salmonella for all sample was <10. All sample were within the <10 recommended for quality of food good for consumption. Staphylococcus 1.0×10^{3} was recorded in sample C and lowest 1.0×101 was recorded in Sample B and sample E, Yeast and mold receded was in range of 1.0×101 CFU/ml to 2.0×10^{3} CFU/ml. All level of microbial recorded was within acceptable limit <10. Sensory value for taste, colour, mouthfeel, and aftertaste were higher in sample A 4.818, 4.818, 4.727 and 4.636 and lower 3.909, 4.182, 3.455 and 3.455 in sample E respectively. Flavour and aroma were highly preferred 4.727 and 4.546 in sample A and least preferred 3.909 and 4.000 in sample D respectively. Overall acceptability was rated higher 4.727 for sample A, followed by 4.636 sample D and E 4.182 and lowest in sample C 3.909. The control sample were most preferred in all sensory properties.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Fruit Juices are obtained mechanically from sound, mature fruits and are the fluid-soluble components of cells or tissues that can be consumed directly (Naz, 2018). Fruit juices are perishable, which presents substantial production and storage issues. According to Okwori et al. (2017), juices are abundant in ascorbic acids, and citrulline all of which are linked to a reduced risk of cancer and heart disease. Fruit juices' usefulness has been recognized to their antioxidative qualities.

One of the primary objectives of using chemical preservatives like acetic, lactic, sorbic, and benzoic acids is to limit microbial development and activity (Piper, 2018), they have the power to disrupt or destroy cell membranes and walls, denature proteins, and block enzymes (Hazan et al., 2004). Because consumers are more aware of the effects of consuming artificial preservatives on their health, they are currently consuming food products with fewer or no chemical preservatives (Pongsavee, 2015).

Nowadays, pasteurization is an efficient technology. Nevertheless, its high processing temperature might alter the nutritional and biochemical qualities of the juice, affecting the juice's overall quality. Due to these restrictions, it has become important to research other preservation methods that could increase fruit juice's shelf life while also maintaining its quality and posing minimal to no health risks.

Watermelon, *Citrullus lanatus (Thunb.)* is a tropical fruit that is grown in almost all parts of Africa and southeast Asia (Koocheki et al., 2007). It has large, oval, round, or oblong-shaped smooth skin that is covered in pale green stripes or a dark green rind that matures to a yellowishgreen color. According to Rolim et al., (2020), About 68% of the weight of a watermelon is made up of the flesh, 30% of the rind, and 2% of the seeds. They are an excellent source of potassium, vitamins A and C, fiber, citrulline, and non-essential amino acid, (Soteriou et al., 2014; Maynard 2001). Consuming watermelon has a number of beneficial impacts, including a decreased risk of heart disease, aging-related degenerative diseases, and numerous types of cancer because of the low sodium, saturated fat, and cholesterol levels (Choudhary et al., 2015; Romdhane et al., 2016).

Pineapple *(Ananas comosus L. Merr.)* is another tropical fruit crop grown for economic purposes and available all year. The pineapple fruit has a distinctive flavor that is pleasant, a distinct perfume, a lovely golden yellow color, and a delicious sugar acid (Nazaneen et al., 2017). The majority of pineapples are consumed as fresh or canned slices. Moreover, fruits are processed to create goods like juice, syrup, jam, jelly, and squash. Pineapples provide the body with a strong defense against free radicals that damage healthy cell slices, and pineapple juice accounts for a significant portion of all processing methods (Butu & Rodino, 2019). Moreover, it contains minerals including iron, calcium, magnesium, phosphorus, and calcium (Iwai et al., 2012). A hundred grams of pineapple pulp contains 87.3g water, 13.7 g carbohydrates, 0.54 g protein, 11 mg phosphorus, 16 mg calcium, 0.28 mg iron, 1.5mg, 12 mg magnesium, 130 IU vitamin A, 0.031 mg, vitamin B2, 24 mg ascorbic acid, and gives 52 calories of energy (Mahar, 2021).

Soursop *(Annona muricata)* is a species of the genus Annona, belongs to *Annonaceae* family of custard apple trees and is primarily noted for its delectable fruits (Chowdhury et al., 2021) Due to its mildly acidic flavor when ripe, *Annona muricata's* fruits are frequently referred to as soursops. Originally native to the Caribbean and Central America, soursop trees are now widely farmed in some regions and can be found thriving on their own in tropical conditions all over the world (Sherif et al., 2017). The soursop fruit has a rich, creamy, fruity flavor, and a hint of citrus. The fruit pulp contains substantial levels of vitamins (C, B1, and B2), minerals, dietary fiber, and good sensory qualities (flavor, aroma, and texture) (Ndife et al., 2014). It also possesses a variety of therapeutic and medical qualities, including antioxidant and anticancer characteristics (Moreno Luzia & Jorge, 2012). Although is typically eaten raw, it could be developed into other products to improve its utilization and benefit.

1.2 Problem Statement

Most people regularly eat fruits in their raw form, especially when they are in season. Fruits are perishable, yearly availability is limited and they are expensive when out of season which is due to its high postharvest loss after harvesting. Currently, consumers are more aware of the health risks accompanying with using artificial preservatives to extend the shelf life of food. Fruits like watermelon, pineapple, and soursop are common fruits grown in developing countries like Ghana. During it season, these fruits are harvested in abundance but their utilization and consumption rates are very low leading to huge postharvest losses due to their shorter lifespan. Also, there is limited utilization of these locally available crops in developing varieties of products. This background problem calls for the utilization of these fruits to produce other products such as juice as well as preserving it using natural preservatives with no health concerns.

1.3 Objective of the study

1.3.1 Main objective

The main objective of the study is to explore the effect of storage on the quality characteristics of watermelon-pineapple-soursop juice blend preserves with lime

1.3.2 Specific Objectives

The specific objectives of the study are:

i. To determine the physicochemical properties of the juice blend over a storage period of 5, 10, 15, and 20 days.
ii. To assess the sensory qualities of different blends of watermelon-pineapple-soursop juice
iii. To assess the effect of storage on the microbial quality of different juice blends over a storage period of 20 days.

1.4 Research Questions

i. What are the physicochemical properties of the juice blends over a storage period of 5, 10, 15, and 20 days?
ii. What are the sensory qualities of different blends of watermelon-pineapple-soursop juice?
iii. What is the effect of storage on the microbial quality of different juice blends over a storage period of 5, 10, 15, and 20 days?

1.5 Significance of the study

Fruits like watermelons, pineapples, and soursop are perishable by nature. Because of this, preserving the fruit's juice will help to increase its shelf life and make it available throughout the lean season. Because the amounts of nutrients in these fruits vary, the combination will result in a far more nutrient-dense product than the fruit juice made from each fruit alone.

Producing of fruit juice from these fruits will motivate farmers to produce more to generate income. The use of natural preservatives is likely to bring about a reduction in the use of synthetic preservatives in juice blends. The study will also add to already existing knowledge on juice blends and the use of natural ingredients as preservatives.

1.6 Scope of Study

This study covered areas such as the Production of fruit juice using watermelon-pineapple-soursop juice preserved with natural preservatives determination of its Physicochemical analysis, and the microbial quality of different juice blends of watermelon-pineapple-soursop before and after storage the storage period of 5, 10, 15 and 20 days.

1.7 Limitation of Study

The physicochemical properties of the juice blend were limited to pH, acidity, total soluble solids, and vitamin C. The shelf-life study was done over a period of 5, 10, 15, and 20 days and microbial quality was limited to before and after each storage period.

1.8 Organization of the Study

The research is divided into several chapters. The first chapter serves as the introduction and includes the following topics: the study's history, problem statement, aims, hypothesis, scope, significance, limitations, and organizational of the study. The review of prior research on the subject is covered in Chapter two. The study's methodology is covered in Chapter 3. Results and discussion are covered in Chapter four, and a conclusion of findings, and recommendations are covered in Chapter five

CHAPTER TWO

LITERATURE REVIEW

2.1 Juice blend

The finest ways to increase nutritional value of fruit juices is to blend the juice, depending on the type and quality of fruits used, it might increase the vitamin and mineral content. (De Carvalho et al., 2007). Blended juice can be enhanced in its interactions with other variables in addition to its nutritional quality, therefore it cannot accurately represent the overall impact of other parameters (De-Carvalho et al., 2007). Due to their distinct and delectable flavor, fruit juice blends have been heavily marketed in recent years (Jan and Masih, 2012). One of the finest ways to increase the juice's nutritious value is to combine various fruits with different physical and chemical compositions. The combination of the fundamental components found in each fruit component gives the blended juice enhanced nutritional and gustatory qualities (Akusu et al., 2016). Modern fruit beverage processing companies use blending technology as a key tool to create novel, high-quality beverages that combine the therapeutic, nutritional, and sensory benefits of two or more fruits (Dhumal et al., 2014).

2.2 Overview of Watermelon

The Cucurbitaceae family includes the watermelon (Citrulllus lanatus [Thumb]), from South Africa, where a wild variety is still cultivated today. According to Lamptey (2010). There is strong evidence that watermelons came from tropical Africa. The Cucurbitaceae family includes watermelon (*Citrullus lanatus*), which is grown in practically all warm climates across the world. Depending on the amount of lycopene and -carotene, it might be red, orange, or yellow in color. Watermelon has previously been considered a non-nutritional crop, but in recent years, a number of bioactive chemicals have been identified, and both in vivo and in vitro research have shown that it has beneficial effects (Gurukar, and Chilkunda, 2018).

2.2.1 Varieties of watermelon

More than 1,200 different watermelon types are produced worldwide, with 200 to 300 different cultivars growing in the United States alone (NWPB, 2003a). varieties have rectangular shapes, crimson meat, and dark green rinds (with or without stripes) (NWPB,2003b). The Ice-Box category includes varieties like Sugar Baby, Miniature Sweet, and Yellow Doll (NWPB,1999). These melons are round and range in size from 2.5-7 kg. They can have either red or yellow pulp and either a dark or light green rind (NWPB,2003b). There are a number of watermelon types without seeds, including Crimson Trio, Farmers Delightful, and Honey Heart. Watermelons are 4.5 to 11 kg, spherical to oval, and seedless (Creasy, 2015).

2.2.2 Distribution of Watermelon in Ghana

Watermelon is readily available across Ghana. The majority of the country's watermelon growing is concentrated in the Volta region, Ashanti region, Western region, Greater Accra region, Central region, and Eastern region, with a focus on the coastal savannah plain in the southern sector (Agbetiameh, 2006). Among of these locations include Ada, Weija, Sege, Nsakena, Kasoa, Tsopoli, Winneba, Potsin, Ningo, Afienya, Nkoranza, Todze, Sogakofe, Akatsi, and Adidome. (Lamptey, 2010).

2.2.3 Watermelon Utilization

All around the world, people have long observed the custom of consuming raw watermelon fruit on steamy summer days (El-Ramady et al., 2015; Maoto et al.,2019). According to Kim et al. (2014) and Jumde et al. (2016), watermelon juice is an alternative for preparing functional foods to increase consumption because of its lycopene-rich composition and health benefits. A variety of products, such as sauces, jams, sweets, and smoothies, have been created with it (Jumde et al., 2016).

2.2.4 Watermelon Nutrition and Health Benefits

Consumers opt to consume watermelon because it offers a variety of biological advantages, many of which are connected to the fruit's absence of fat, cholesterol, and salt and its high concentration of minerals and phytochemicals (Jumde et al., 2016). Long-term health benefits of eating watermelon include a decreased risk of developing heart disease, a reduction in blood pressure in those who have hypertension, a decrease in LDL oxidation, and a cardio-protective impact (Bianchi et al., 2018). According to Choudhary et al. (2015), watermelon has a higher antioxidant content than popular fruits like tomatoes, strawberries, and guavas. The primary nutrients found in watermelon include fiber, vitamins, and carbs. All of these components are present in their optimal arrangements. The decreased fat level of watermelon has received recent attention (Sa'id, 2014; Abourashed, 2013). Due to its low energy density as a fruit, it is advised for weight controlling (Jumde et al., 2016). According to research by Adedeji and Oluwalana (2013), watermelon is a fantastic source of vitamins and minerals. It contains vitamins including niacin, riboflavin, folate, and thiamine. Iron, calcium, phosphorus, magnesium, potassium, and other minerals are also present (Ijah et al., 2015). These characteristics make watermelon a good food to maintain the body's acid-base balance, which is necessary for normal physiology, maintaining hunger, and normal digestion (Choudhary et al., 2015). Calcium and potassium are also essential for cell control, maintaining cell shape, and the differentiation process according to Adedeji and Oluwalana (2013). Bailey et al. (2016) found that adding watermelon juice to a person's diet improves their vascular health. Vitamin-rich foods like watermelon are advantageous for keeping healthy vision and skin, lowering cholesterol, fostering appropriate appetite and nervous system function, and perhaps even assisting with proper muscle contraction (Shao et al., 2017). The World Health Organization (WHO) suggests that the best diet for everyone is one that includes low-fat, fiber-rich carbohydrates (W.H.O, 2014) Watermelon juice and pulp are both high in fiber and carbohydrates. Ijah et al. (2015) claim that watermelon is a good source of vitamin B, which the body needs to produce energy.

2.2.5 Postharvest losses in watermelon

Losses after harvest before the product reaches the consumer are referred to as postharvest losses. There are two main categories of postharvest losses for perishables like watermelons: qualitative losses and quantitative losses.

Plate 1: Watermelon

2.2.6 Physical damage

Physical injuries to watermelons include burns or scalds, bruising, cutting, chilling injuries, and cracking. These defects hasten fruit disintegration and increase the fruit's susceptibility to microbial attack. Physical damage signifies a reduction in quality because nobody will buy a watermelon with cuts or breaks. Fruits with faults are rejected due to quality control, which causes a loss (Ofosu-Anim, 2009).

Pathological disorder

Watermelon pathological disorders are the result of a variety of diseases. Fruits with the issue typically begin to decay earlier than expected. When pathogens introduce hazardous substances known as mycotoxin into fruits, they become unsafe for consumption. It should be highlighted, though, that some diseased fruits could seem healthy and attractive before senescence sets in. Fruits with diseases can occasionally be unattractive and seem odd (Ofosu-Anim, 2009).

Harvest Handling losses

Losses may occur at any point between the time the food is grown or harvested and the time it is eaten. the procedure of removing a product from the manufacturing facility. The product is dug out of the earth for roots, tubers, and bulbs. The knife or harvesting tools may nick or scratch the watermelon's surface (Ofosu-Anim, 2009).

2.2.7 Quality characteristics of watermelon

The end user's concept of quality is the most accurate, claim Knura et al. (2006). The term "quality" is widely used to describe the internal and extrinsic characteristics, features, and worth of a plant product that influence the end user's approval of the product. Yakubu et al., (2018) claimed that the flesh towards the watermelon fruit's center should have a respectable soluble solid concentration of 10% or more to be considered high-quality.

Total soluble solids concentration in the fruit flesh is an essential component of quality. Total soluble solids are important for determining maturity and are frequently connected to how delicious the fruit is. Sucrose and fructose were found to make up the majority of the soluble solids in the melon fruit when measured using a refractometer (Brix Equivalent). In general, a total soluble solid 8% or less is considered to be marginal, 10% or more is considered to be suitable, and 12% or more is considered to be exceptional (Pullanagari & Li, 2021).

While pH measures how strong these acids are, total titratable acids (TTA) is the term for the test that counts all the acids in a specific fruit. The pH scale is used to determine how acidic a food is. Neutrality is defined as a pH of 7. Acidic foods are those that have a pH of 7 or less, whereas basic or alkaline foods have a pH of 7 or more. The pH level is influenced by the type of fruit and growing circumstances, especially the soil. The pH level of the watermelon fruit juice is used to determine the fruit's maturity (Ijah et al., (2015).

The average moisture content of watermelon is 92%. (USDA, 2003). Newly picked produce is mostly made up of water, with the bulk of it having a moisture content of between 90 and 95 percent. Water loss is one of the most hazardous post-harvest situations. Further steps must be taken to retain the quality of the fruits harvested in the field at the consumer level. The watermelon fruit's crisp flesh is related to high moisture content (PerkinsVeazie et al., 2012).

2.3 Pineapple Production

The output of pineapples (Ananas comosus), which make up around 20% of all tropical fruits worldwide, is second only to that of bananas (Hess, et al 2003). Almost 50% of the world's pineapple was produced in Thailand, the Philippines, Brazil, and China, with the majority of the remaining 50% coming from Indonesia, Kenya, México, India, Costa Rica and Nigeria(FAO, 2004). (Baruwa, 2013). With an annual export into the European market of around 300,000 tonnes, Costa Rica dominated in 2008. Cote d'Ivoire was second with exports of 150,000 tonnes, while Ghana came in third with 71,000 tonnes in 2008. (Zhang, 2013).

Plate 2: Pineapple (MD2)

2.3.1 Variety of Pineapple

For a number of years, Ghana has produced modest to medium amounts of pineapples. The Sea Freight Pineapple Exporters Organization began exporting pineapple in 1985. (SPEG). West Africa's close proximity to Europe was acknowledged as a compelling benefit for Ghana's pineapple industry (Danielou and Ravry, 2005). Smooth cayenne, Sugarloaf, and Md2 are grown in Ghana (Danielou & Ravry, 2005). Only available in the neighborhood market, sugarloaf is conical in shape, has spines on the leaves, and is highly sweet. When ripe, it still has green inflorescences, the skin is hard to peel, and the fruit base releases a lot of slips. Compared to the other kinds, the MD2 is sweeter. It has a low acidity of 0.4 to 0.45% and a high brix (Sandrock et al., (2005). Unlike the bright yellow color that most people associate with good pineapples, smooth cayenne is a sweet, juicy kind. Smooth cayenne: Has a cylindrical shape, great fruit yield, huge, fresh-looking, yellow fruit; minimal slips; excellent canning; and spineless leaves (Reinhardt et al., 2002).

2.3.2 Pineapple Production, Post-Harvest Loss Management

Fresh horticulture produces postharvest losses that have been demonstrated to cause substantial economic losses throughout the commodities value chain. In contrast to the 19% (70 tons) fresh. Post-harvest losses typically ranged between 15-20% (53-75 tons on average) per farmer and between 15-22% (134-190 tons) for smallholder farmers in the Eastern and Central Regions, respectively. Rejected fruit makes up 5% of production (17 tons in the Eastern region and 35 tons in the Central region) and does not fulfill the quality standards for fresh consumption and processing.

Post-harvest loss has been found to be significantly higher at the wholesale than retail level. In Greater Accra region, each wholesaler loses 13% of the fresh pineapple fruits or an average of 640 fruits (or roughly 640 kilograms). Compared to those in the Greater Accra region, wholesalers in the Ashanti region often lose 15% more fruit, or 750 fruits (about 750 kg), every shipment per week. In general, pineapple post-harvest loss is larger at the wholesale level than in the retail market (8.9% vs. roughly 14% for pineapple). The rationale for this was that improper handling expose the wholesale fruits to a larger risk (Kuwornu et al., 2013).

Retail traders in Ashanti experience pineapple post-harvest losses that are marginally higher than those in the Greater Accra region, which are about 8.7 and 9%, respectively. The primary kind of pineapple traded in the Ashanti region is the Sugar Loaf cultivar, which has a shorter shelf life and is more susceptible to quality degradation. When fruit is not sold quickly, poor handling and inadequate packaging during transportation, combined with the physical qualities of the variety, shorten shelf life (Osae, 2005).

2.3.3 Nutritional value of pineapple

About 85% of a pineapple's total solids are made up of carbohydrates, and only 2–3% are made up of fiber. The most prevalent organic acid in pineapple is citric acid. Pineapple has extremely little ash and very little fat and protein (Hemalatha and Anbuselvi, 2013). From a dietary and medicinal standpoint, citric acid, malic acid, bromelain or bromelain are of significant. The pineapple's malic and citric acids, which give it its acidic flavor, enhance vitamin C's antioxidant properties. Although having a high acid content, pineapple serves as an antacid or an alkalizer when it comes to metabolism, as is the case with lemon and other fruits (Akotey, 2018). In the digestive tract, the protein-digesting enzyme bromalin serves to break down proteins and aid in digestion. It is frequently employed in the food business as a meat tenderizer (Hemalatha and Anbuselvi, 2013).

2.3.4 Health benefits of pineapple

Consuming pineapple is recommended for a variety of conditions, including obesity, sterility, gastric ptosis (prolapsed stomach), and hypochlorhydria (scanty gastric juice), which manifests as slow digestion and a feeling of heaviness in the stomach; these conditions are brought on by the stomach's inability to empty itself, a condition known as gastric atonia; and gastric ptosis (Jayabalan and Karthikeyan, 2013). Pineapple is a potent nitrosamine synthesis inhibitor, claim Roger and George (2008). When some dietary proteins and nitrites react chemically in the stomach, nitrosamine, a cancer-causing toxin, is created. The antiparasitic, contraceptive, detoxifying, vermifuge, and stomach-relieving effects of pineapple fruit. The fruit is linked to improved digestion, stomach acid management, and detoxification among other things (Nwaizu, and Zhang, 2011).

2.4 Soursop Overview

Certain tropical countries, like Vietnam, benefit economically from important tropical fruits like the soursop (Annona muricata). Sour fruits are prized for their sweet, subacid, fragrant, and juicy flesh (Karsheva et al., 2013). Many juice combinations, nectars, syrups, smoothies, jams, jellies, preserves, and ice cream are regularly made from soursop pulp. The soursop fruit, or Annona muricata, has witnessed an increase in demand over the past ten years in Asian nations due to its aromatic flavor and unusual taste as well as the fact that it is a great source of vitamin C.

Unfortunately, food is wasted because soursop cannot be preserved for a long time due to its high perishability. To extend the fruit's shelf life, reduce food waste, and promote the economic growth of the crops, various soursop products have been created.

2.4.1 Fruit Description

The soursop tree yields dark green, spiky aggregation fruits that are comprised of fused-together berries and related flower components (Blancke, 2016). The composite sour-sop fruit occasionally has an oval or heart-shaped shape and can weigh more than 4 kg (Allaby, 2012). White, juicy, fibrous segments that form the fruit pulp wrap an elongated container. There could be 5 seeds in a fruit, or there could be 200. The skin bears short spines and is reticulated (Patel & Patel, 2016). Its soft, pithy core is surrounded by a white, fibrous, juicy covering that can be easily removed from the inside's cream-colored, granular interior (Allaby, 2012). The seedling soursops can be generically divided into three groups: acid, subacid, and sweet. They are then divided into oblong, round, heart-shaped, or angular shapes, and finally categorized according to how hard the flesh is, which can range from moist and tender to firm and quite dry (Matsuda, 2017).

2.4.2 Compositional Characteristics of Soursop Fruit

By weight, the soursop fruit has 20% peel, 68% pulp, 4% core, and 9% seeds (Uchegbu et al., 2018). The white edible pulp contains some other nutrients in addition to having3.43% titratable acidity, 18% carbohydrates, 80–81% water, 1% protein, 24.5% non-reducing sugar, and vitamins. Refractive indices of 1.335 for the seeds and 1.356 for the pulp, pH of 8.34 for the seeds and 4.56 for pulp, and soluble solids of 1.51^0Brix for the seeds and 151oBrix for pulp were among the physicochemical properties (Gavamukulya et al., 2017).

53.1-61.3 calories, 82.8 g of moisture, 1 g of protein, and 0.97 g of fat are the energy numbers. 0.79g of fiber and 60g of ash A vitamin (-carotene) Calcium 0 10.3 mg phosphorus, 27.7 mg iron, 0.64 mg, and thiamine, 0.11 mg Vitamin C 29.6 mg, riboflavin 0.05 mg, and niacin 1.28 mg Tryptophan (11 mg), methionine (7 mg), and 60 g of lysine in soursop pulp, sugars make up between 67.2 and 69.9% of the total solids, making them the second-most common element after water (Gavamukulya et al., 2017).

2.4.3 Processing and Food Uses of Soursop

The soursop fruit is mostly utilized to manufacture juice in the tropics, and the seeds are a common byproduct of this industry (Da Silva et al., 2014). The *guanaba azucaron* (sweet), which was consumed raw and used for beverages, and *guanaba acida* (very sour), which was only used for beverages. (Tripathi at al., 2014). Thou sour is available in various countries, but its utilization in food product development is still limited. The fruit's frozen concentrates, strained soursop juice, and fresh or frozen pulp can all be purchased. These goods have been kept and used to create delicacies including ice cream, nectars, sherberts, shakes, syrups, jellies, preserves, yogurt, and jams (de Lima & Alves, 2011). With the addition of some gelatin, it can be turned into a fruit jelly, or it can be used to make drinks, sherbets, ice cream, and syrups. (de Lima & Alves, 2011). Fruit is typically mixed with water in Puerto Rico, but it is also combined with milk and sugar (champola) in Cuba and Brazil to create a delicious beverage (Pelaez, 2014). Golhani et al., (2013). invented a process for canning soursop drinks by combining them with papaya or sugar cane juice (guarapo). These drinks were made by blending 20% soursop juice and 80% sugarcane juice, heating to 1001°C, processing for 15 minutes at 1001°C, and canning. A soursop-papaya drink's recipe calls for 20% soursop pulp, and 30% papaya pulp (Sánchez et al., 2018) The soursop fruit has traditionally been ground and filtered before being combined with rum, brandy to form a drink in the subtropics. In Brazil, seeds are roasted and are consumed or used for medicinal purposes (Karsheva et al., 2013).

2.4.4 Medicinal Uses

In herbal medicine, tea made from the leaves have calming benefits, a decoction of the leaves is used to eliminate bedbugs and head lice (Wijeratne et al., 2016). For urethritis, liver issues, and hematuria, fruit juice is used orally (Akbar, 2020). A. muricata's stem bark extract have anti-stress properties. According to studies, a soursop stem bark ethanol extract significantly lowers stress levels in stressed-out rats, indicating that the extract may have adaptogenic properties (Rethinam & Sundararaj, 2016). By boosting the levels of the MAO enzyme, which was discovered to have decreased 5-HT and 5-HIAA, extract was found to diminish the rise in brain 5-hydroxytryptamine (5-HT) and 5-hydroxyindole acetic acid (5-HIAA) levels caused by stress. Additionally, it has been shown that giving the ethanol extract to rats considerably reduces the rise in lipid peroxidation brought on by the cold immobilization stress in the rats' liver and brain (Lewis & Lewis, 2012).

2.5 Preservation of juices

According to Singh (2010), preservation is the process of preserving food products by adding a natural or artificial material to prevent microbial growth-related degradation or any negative chemical change in the final product. The principal techniques for food preservation can be categorized into multiple groups according to their modes of operation. These include preventing recontamination before and after processing, killing off bacteria, yeasts, molds, or enzymes directly, and inhibiting or delaying microbial growth and chemical deterioration (Prokopov & Tanchev, 2007). While developing and producing fresh-cut and processed produce, maintaining the quality of the resulting fruit items is of utmost importance. In order to prevent the spread of illness through food items and preserve food, a push has been made for the adoption of modern food technologies, which employ a variety of procedures and agents (Okoye & Oni, 2017).

2.5.1 Types of Preservatives

Depending on where they come from, preservatives is divided into two : artificial preservatives and natural preservatives.

Artificial preservatives

These are a collection of artificial chemicals that keep microbes from spoiling or contaminating finished goods. Nitrates, sulfites, sodium metabisulphite, propyl gallate, and potassium sorbate are a few examples of these preservatives (Singh, 2010).

The most popular treatments for reducing microbial populations on fruit still involve the use of sodium metabisulphite, either before, during and pre or post-cutting processes (Gil et al., 2009). It takes 1% sodium metabisulphite solution to create 10,000 ppm of sodium metabisulphite. Moreover, 0.1% Sodium metabisulphite solution is equal to 1,000 ppm sodium metabisulphite.

Natural preservatives

These are chemical components that have been taken from natural sources and have the innate potential to shield things from microbial growth. The components of essential oils, flavonoids, phenolic compounds, antioxidants, and antimicrobials are a few of them (Singh et al., 2010).

2.5.2 Preservatives from microbial sources

By fostering an environment that is unfavorable to them, microbial preservatives are used to prevent the growth of bacteria (Singh et al. 2010). Yet, concerns exist regarding the usage of chemical preservatives. Due to the fact that many chemical food preservatives have been linked to rare allergy reactions in those with sensitivity, interest in naturally occurring antimicrobial compounds and consumer demand for natural preservatives have lately grown (Gmez-Lpez et al., 2009).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

This chapter contains the materials and methods which were adopted in conducting the research. It entails the study location, materials, source, juice production process, method for analysis, and data analysis.

3.2 Study location

The study was conducted at the Food Product Development Laboratory and Department of Food and Postharvest Technology Chemistry Laboratory, Koforidua Technical University (KTU).

3.3. Materials and sources

The materials that were used to conduct the research were watermelon, pineapple, and soursop fruit which will obtained from Koforidua Central Market.

3.4 Juice Extraction Process

3.4.1 Pineapple Juice Extraction Process

The pineapple juice was produced according to Assawarachan and Noomhorm, (2011). The pineapple fruit was washed under running tap water, peeled, and chopped into pieces using a sterilized knife. The chopped pineapple was put into a juice extractor to extract the juice. The various stages of the processes are shown in the Figure 3.1.

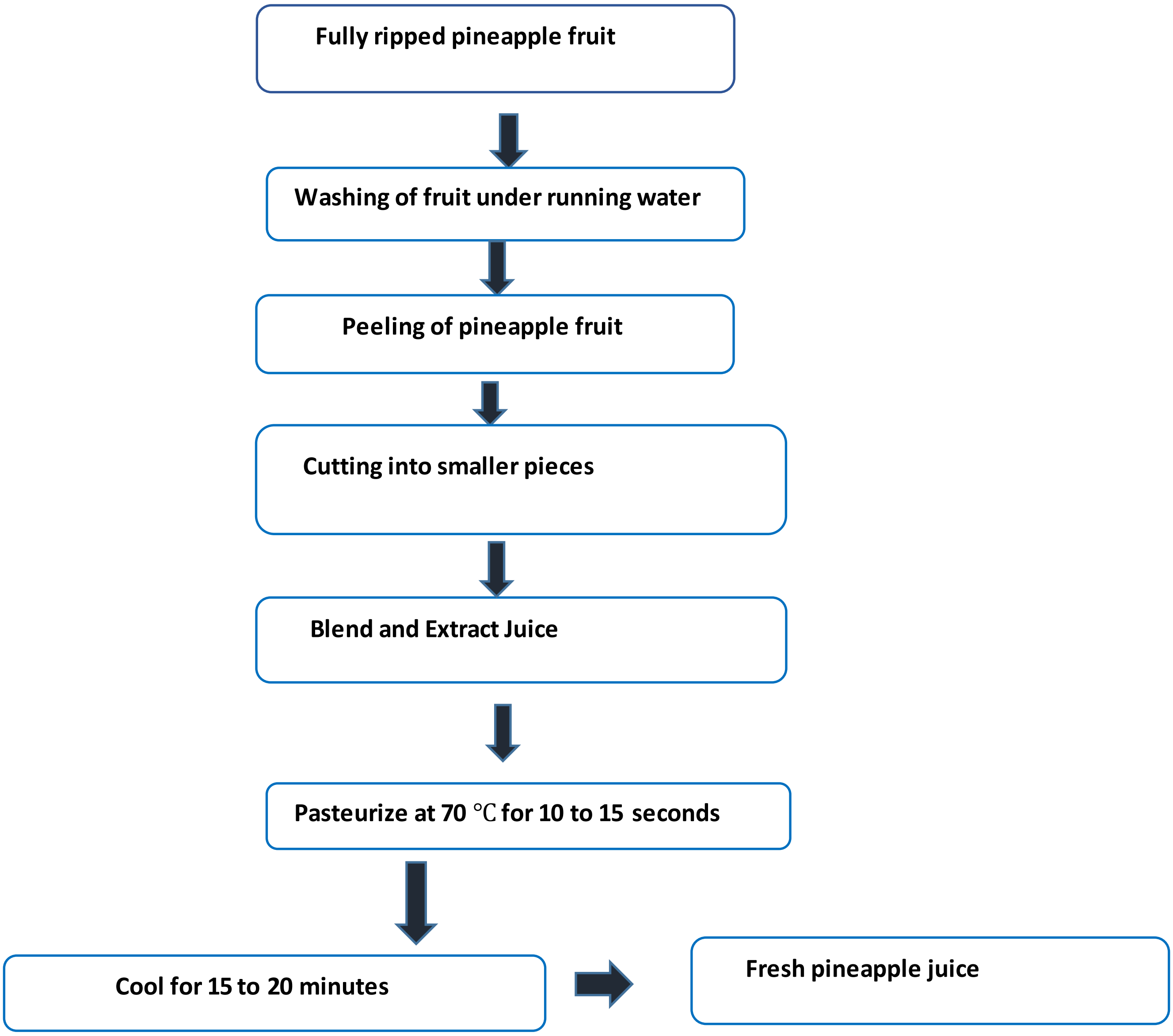


Figure 3.1: Pineapple juice extraction process

3.4.2 Watermelon Juice Extraction Process

Healthy matured Watermelon fruits were selected and washed properly to remove all dirt. The washed fruit was sliced and the pulp was removed and blended. The blended product was sieved, pasteurized, and cooled to obtain the Juice. The flow diagram of the process is shown in Figure 3.2

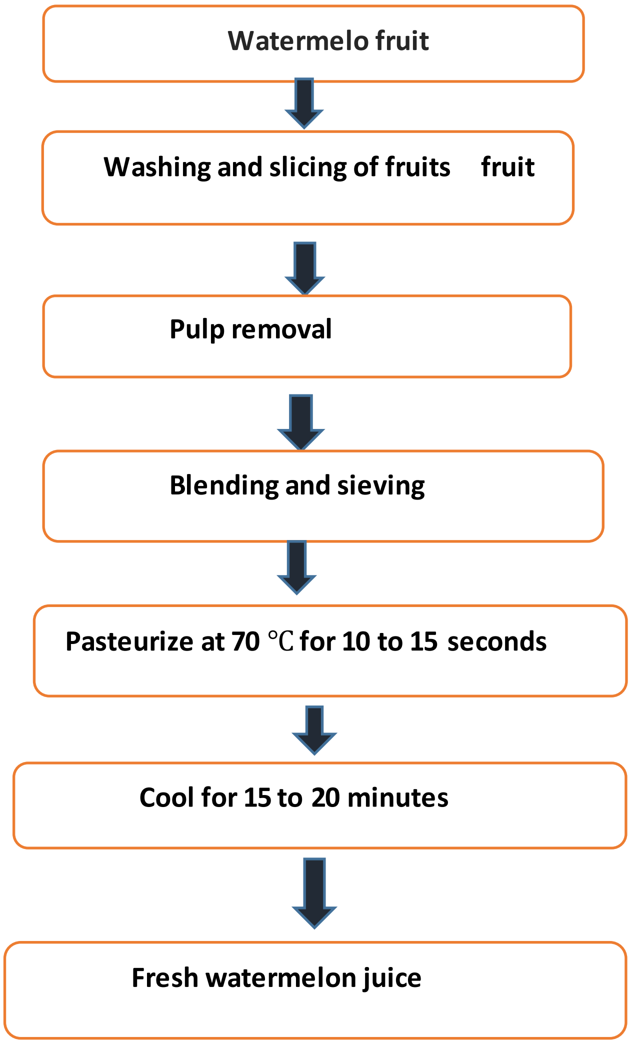


Figure 3.2: watermelon juice extraction process

3.4.3 Soursop Juice Extraction Process

Soursop was prepared according to the method by Wang et al., (2002), Soursop was sorted and washed with cold running water after which it was gently peeled using a clean knife. The fruits were cut into chunks to help them blend easily. The blended fruits were sieved to obtain the juice.

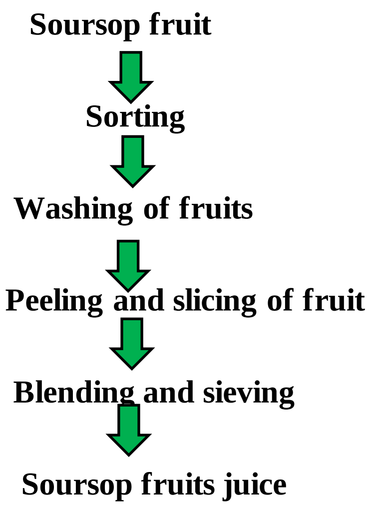


Figure 3.2: Flow chart for blended Soursop

3.5 Blending Ratios for the Juice Blend

The blending ratio that was used for the production of the various juices are shown in Table 3.1. All juice samples are made from watermelon, pineapple and soursop except Blend 1 (Control) which was produced from only watermelon.

Table 3.1: Blending ratios of the watermelon pineapple and soursop juice

Blend	Watermelon Juice (%)	Pineapple Juice (%)	Soursop Juice (5)
Blend 1 (control)	100	0	0
Blend 2	80	10	10
Blend 3	70	10	20
Blend 4	10	80	10
Blend 5	80	10	10

3.6 Determination of physicochemical properties of the Juice

3.6.1 pH determination

A digital pH meter was used to measure the pH of fruit juice. The juice blends' pH values were determined using method of AOAC, (1990). The mean value was calculated after the determination were done triplicate.

3.6.2 Total soluble solids (TSS)

The TSS for the various blend of Watermelon-Pineapple-Soursop juice was determined using a digital refractometer at a room temperature. A drop of the mixtures was placed on the refractometer's prism, and a reading was taken after the device was calibrated with distilled water. The mean value was computed after the decisions were made in triplicate.

3.6.3 Titratable acidity (TA)

The technique outlined by the Association of Official Analytical Chemists (AOAC, 1990) was used to determine the titratable acidity. One hundred milliliters of distilled water were added to a 125 milliliter conical flask containing ten milliliters of the beverage. The solution was titrated against 0.1N of sodium hydroxide (NaOH) after three drops of phenolphthalein indicator were added, and the final color turned pink. The titer values were noted, and the Mitcham et al. (1996) method will be used to compute the % of citric acid.

$$\% \text{ TA} = \frac{Mls \times Normality(NaOH) \times 0.064}{Volume\ of\ sample\ (ml)}$$

Where 0.064*= acid milliequivalent factor for citric acid.

3.6.4 Determination of vitamin C content

42 mg of sodium bicarbonate and 50 mg of 2,6-dichloroindophenol sodium salt were dissolved to create indophenol dye, which was then diluted to 200 ml with distilled water. After that, it was filtered and put in an amber bottle. The preparation of metaphosphoric acetic acid involved dissolving 7.5g of metaphosphoric acid and diluting to the 250ml mark with distilled water after 20ml of acetic acid had been diluted in 100ml of distilled water. After that, the mixture was filtered into a stopper bottle. 50 mg of ascorbic acid were weighed and then diluted to 50 ml in a volumetric flask to create the ascorbic acid standard solution. The dye, ascorbic acid, and blank will be standardized. Juice samples were titrated to a rose-pink color using an indophenol solution, and titre values were noted (Nielsen, 2003). The total vitamin C was calculated using the formular:

Ascorbic acid = $\frac{mg}{ml} = (X - B)\,\frac{F}{E} \times \frac{V}{Y}$

X = Vol. of sample for titration

B = Vol. of blank

F = Titre of dye

E = Vol. assayed (2 ml)

V = Vol. of initial assay solution (7 ml)

Y= Vol. of sample aliquot titrated (7 ml)

F = Ascorbic acid (mg) in vol. of standard solution titrated=

(Average vol. of dye used to titrate standard solution) – (average vol. of dye used to titrate blank)

3.7 Shelf-life analysis

Five milliliter of the extracted natural preservative was added to 200ml of each juice blends and the shelf life was studied over a period of 20 days. The physicochemical properties of the stored juice were determined at every five days' interval to find out the effect of the preservatives on the various parameters.

3.8 Sensory evaluation

Twenty (20) untrained panelist was used for the sensory analysis. A seven (5) point hedonic scale, where 1=like very much, 2=like much, 3=like moderately, 4 =neither like nor dislike, 5=dislike slightly, was used to assess the sensory attributes of the juice blends based on: appearance, taste, aroma, aftertaste and overall acceptability. Each blend of samples was coded with three digits and water was given to the panelists to rinse their mouths in between tastings.

3.9 Data analysis

SPSS version 25 was utilized for the analysis of the data that was acquired from the research. Three duplicates of each experiment were run. For each of the variables, a one-way analysis of variance (ANOVA) will be conducted. With $p < 0.05$, Fisher's Least Significant Difference (LSD) to identify the significant differences. In addition to being displayed in tables and graphs, the data were reported as means and standard deviations.

CHAPTER FOUR

RESULT AND DISCUSSION

This section provides detail explanation of the result obtained from the study.

4.1 Physicochemical properties of the juice

4.1.1 pH of the juice during storage

Parameter	Day 0	Day 5	Day 10	Day 15	Day 20
Sample A	5.283±0.045^{a}	4.691±0.037^{b}	5.352±0.050^{c}	4.961±0.035^{d}	4.169±0.030^{e}
Sample B	4.791±0.037^{a}	4.987±0.015^{b}	4.870±0.030^{b}	4.476±0.025^{c}	4.020±0.072^{d}
Sample C	3.962±0.040^{a}	4.043±0.031^{a}	4.172±0.030^{a}	4.301±0.021^{b}	4.148±0.044^{a}
Sample D	3.773±0.037^{a}	4.043±0.031^{b}	4.050±0.040^{b}	4.179±0.026^{c}	4.144±0.040^{c}
Sample E	4.255±0.051^{a}	4.462±0.047^{b}	4.255±0.0402^{a}	4.601±0.0210^{c}	4.202±0.053^{a}

Keys; each value is presented as mean ± standard deviation. Means within a column with the same letter superscript are not significantly different ($P>0.05$) whereas those with different superscripts are significantly different ($P<0.05$).

From the result presented in Table 4, pH of the juice ranged from 4.791 to 5.283. sample A Recorded the heights pH at all storage days 5.283 at day 0, 4.691 at day 5, 5.352 at day 10, 4.961 at day15 and 4.169 at day 20 whiles sample D recorded the lowest at all storage day 3.773 at day 0,4.043 at day 5, 4.050 at day 10, 4.179 at day 15, and 4.144 at day 20.

On the initial day of storage, all samples showed no significant difference ($P<0.05$) with pH at day 20 except for sample C 3.962 to 4.148, and sample E 4.255 to 4.202. All samples showed a decrease in Ph except sample C and Sample D which show an increase from 3.962 to 4.148 and 3.773 to 4.144 respectively. Most of the result obtained was in line with the result of 3.76 to 4.60 reported by Molva & Baysal, (2015) and 4.20 to 5.2 reported by Aderinola & Adeniran, (2015).

Since acidity and pH are inversely correlated, the notable drop in pH during storage may have resulted from variations in titrable acidity (Bhardwaj et al, 2005). Nevertheless, a significant portion of the fresh fruit's quality attributes change dramatically during processing, potentially lowering the products' worth.

The rise in pH could be caused by Juice having certain naturally occurring enzymes that might alter pH while being stored. For example, polyphenols in the juice can be oxidized by the enzyme polyphenol oxidase, which raises the pH. Juice may experience chemical interactions over time that change its pH. According to Andrés-Bello et al., (2012), juice may undergo chemical reactions over time that can alter its pH. For example, the hydrolysis of certain compounds can lead to pH changes.

4.1.2 TSS of the juice during storage

Table 4.2 TSS of the juice during storage

Parameter	Day 0	Day 5	Day 10	Day 15	Day 20
Sample A	8.837 ± 0.718^{a}	8.933 ± 0.306^{a}	9.733 ± 0.153^{b}	8.933 ± 0.252^{a}	8.133 ± 0.709^{d}
Sample B	9.800 ± 0.100^{a}	9.167 ± 0.473^{b}	10.167 ± 0.153^{c}	9.833 ± 0.208^{a}	9.400 ± 0.100^{d}
Sample C	8.800 ± 0.100^{a}	8.267 ± 0.321^{b}	9.870 ± 0.324^{c}	11.700 ± 0.361^{d}	10.967 ± 0.153^{e}
Sample D	8.100 ± 0.100^{a}	7.400 ± 1.249^{b}	14.967 ± 0.153^{c}	14.733 ± 0.252^{c}	14.833 ± 0.208^{c}
Sample E	8.200 ± 0.100^{a}	7.100 ± 0.100^{b}	10.833 ± 0.764^{c}	11.033 ± 0.153^{d}	10.266 ± 0.153^{e}

Keys; each value is presented as mean ± standard deviation. Means within a column with the same letter superscript are not significantly different (P>0.05) whereas those with different superscripts are significantly different (P<0.05).

From the result presented in table 4. 2, total soluble solids obtain ranged from 7.100 °Brix to 14.833 °Brix. The TSS value for sample A range from 8.133 recorded at day 20 to 9.733 recorded at day 10. Sample B recorded lowest 9.167 TSS at day 5 and highest 10.167 at day 10. Sample C recorded highest TSS Value of 10.967 at day 20 and lowest 8.267 at day 5.

Sample D and Sample E recorded the lowest TSS value of 7.400 and 7.100 at day 5 and highest 14.833 and 11.033 at day 20 and day 15 respectively. Between the day 0 and day 20 samples C, sample D, and sample E shows an increase in TSS from 8.800 to 10.967, 8.100 to 14.833 and 8.200 to 10.266. Sample A and sample B observed a decrease in TSS (day 0 to day 20) 8.837 to 8.133 and 9.800 to 9.400 respectively.

The total soluble solids increased during storage was in lined with study of (Riveria, 2005). One possible explanation for the rise in TSS is the hydrolysis of cell wall polysaccharides or the degradation of starch into sugars (Yashoda et al., 2012).

Since sugars and fruit acids are the main contributors, total soluble solids (TSS) concentrations are closely correlated with both; the combined effect of maturity stages and ripening circumstances considerably influences TSS content. The TSS gradually increased over the course of storage, possibly as a result of polysaccharide hydrolysis**.** Similar results 11.73 15.0 were also reported by Molva & Baysal, (2015). The range of results obtained was higher than the range of results 8 to 12.00 reported by Aderinola & Adeniran, (2015).

4.1.3 Titrable Acidity of the Juice During Storage

4.3 Titrable Acidity of the Juice During Storage

Parameter	**Day 0**	**Day 5**	**Day 10**	**Day 15**	**Day 20**
Sample A	0.151±0.003^{a}	0.166±0.023^{a}	0.299±0.012^{a}	0.398±0.521^{a}	0.128±0.003^{a}
Sample B	0.182±0.004^{a}	0.105±0.004^{b}	0.300±0.011^{a}	0.192±0.007^{b}	0.189±0.019^{b}
Sample C	0.289±0.018^{b}	0.125±0.005^{b}	0.467±0.032^{b}	0.141±0.007^{b}	0.202±0.017^{b}
Sample D	0.384±0.018^{c}	0.118±0.002^{b}	0.688±0.020^{c}	0.249±0.042^{c}	0.157±0.003^{b}
Sample E	0.166±0.005^{a}	0.098±0.002^{b}	0.402±0.007^{b}	0.119±0.091^{b}	0.108±0.002^{a}

Keys; each value is presented as mean ± standard deviation. Means within a column with the same letter superscript are not significantly different (P>0.05) whereas those with different superscripts are significantly different (P<0.05).

The titrable Acidity of the samples ranged from 0.108 to 0.688. At the initial day of storage, sample A recorded the lowest 0.151 whilst sample D recorded the highest 0.384. At day 5 sample D recorded the highest 0.166 while sample A recorded the lowest 0.098. At day 10 the highest titrable acidity was recorded in sample D 0.688 while the lowest was recorded in sample A 0.299. Sample A and C recorded the highest 0.398 and 0.202 on day 15 and 20 respectively whiles sample D recorded the lowest on days 15 and 20 0.119 and 0.108 respectively. From the result, it can generally be observed that an increase in storage day decrease the titrable acidity for all sample except for sample B which shows an increase from day 0 to day 20 (0.182 to 0.189). The decreasing trend of titratable acidity during the storage period was also reported by (Rathore et al., 2007). According to Clarke et al. (2003), respiration which consumes organic acid and reduces acidity during storage has a major impact on variations in titratable acidity. There is also evidence that respiration influences changes in titratable acidity.

Some microorganisms can consume organic acids in food products, converting them into less acidic compounds. This fermentation process can lead to a decrease in acidity. According to Krishna, (2005), chemical reactions, such as hydrolysis or degradation of organic acids, can result in a decrease in acidity, enzymes (polygalacturonase) naturally present in food can catalyze reactions that break down organic acids, causing a decrease in acidity.

4.2 Sensory Evaluation of the Product

Table 4.4 Sensory Evaluation of the Product

Parameter	Sample A	Sample B	Sample C	Sample D	Sample E
Taste	4.818 ± 0.405^{a}	4.272 ± 0.467^{b}	4.091 ± 0.701^{b}	4.000 ± 1.000^{b}	3.909 ± 1.136^{b}
Color	4.818 ± 0.405^{a}	4.455 ± 0.522^{b}	4.273 ± 0.786^{c}	4.182 ± 0.874^{c}	4.182 ± 0.874^{c}
Flavor	4.727 ± 0.647^{a}	4.364 ± 0.809^{b}	4.182 ± 0.603^{c}	3.909 ± 0.701^{c}	4.091 ± 0.701^{c}
Aroma	4.546 ± 0.688^{a}	4.364 ± 0.505^{a}	4.364 ± 0.809^{a}	4.000 ± 0.775^{b}	4.546 ± 0.522^{a}
Mouthfeel	4.727 ± 0.467^{a}	4.182 ± 0.751^{b}	4.091 ± 0.701^{b}	4.000 ± 0.775^{b}	3.455 ± 1.036^{c}
After taste	4.636 ± 0.674^{a}	4.364 ± 0.505^{a}	4.000 ± 0.633^{b}	4.182 ± 0.874^{b}	3.455 ± 0.934^{b}

Overall Acceptability	4.727±0.467 a	4.636±0.674a	3.909±0.831 b	4.182±0.874 b	4.182±0.982 b

Keys; each value is presented as mean ± standard deviation. Means within a row with the same letter superscript are not significantly different (P>0.05) whereas those with different superscripts are significantly different (P<0.05).

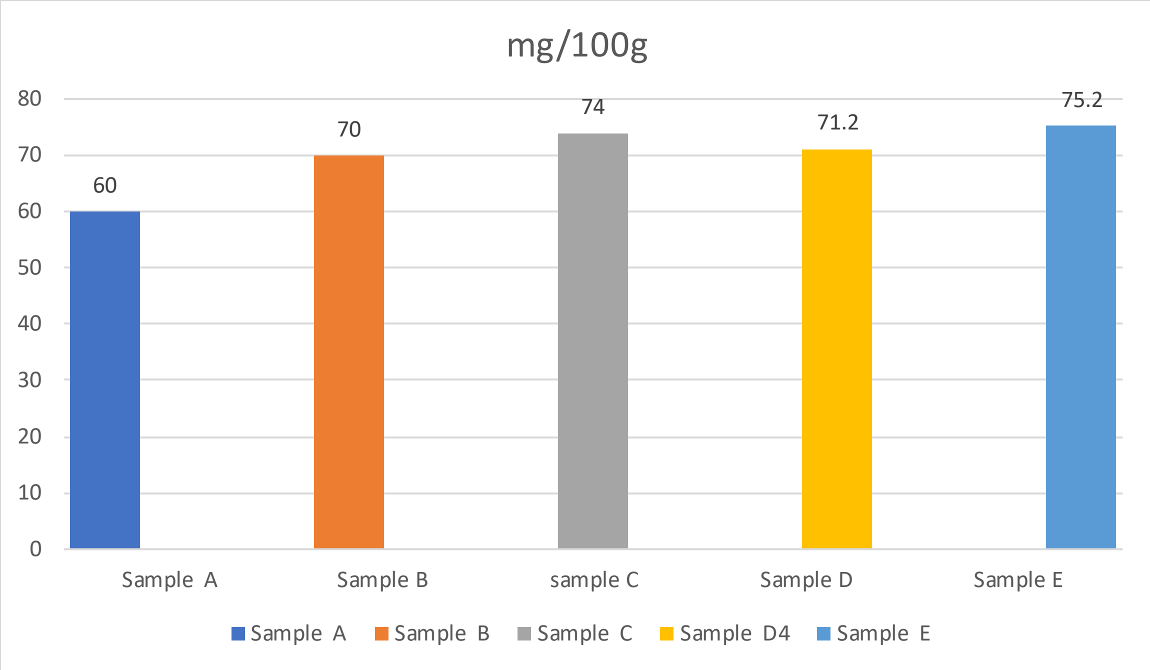
Taste of recorded for the various sample ranged from 3.909 to 4.818. The highest value was recorded for sample A 4.818, followed by sample B 4.272, sample C 4.091, sample D 4.000, and the lowest 3.909 for sample E. the reduction in the quantity of watermelon causes a reduction in the taste of the samples. The result obtained showed a significant different significantly different (P>0.05) in taste as the level of ingredient varies in the various samples. Food's flavor and aroma is a crucial component; a nice flavor and stimulates the taste receptors and gets the body ready to take the food. Food that has a "poor" flavor may be rejected outright before it has even been consumed. The influence of flavor intensity on food is an important parameter to consumers (Sampson,2020). The aroma of flavor can vary widely depending on the ingredients used, composition and processing method. From the results (table 4….), the result of flavor and aroma ranged from 3.909 to 4.727 and 4.000 to 4.546 respectively. Flavor recorded it highest value for sample A 4.727 and lowest 3.909 for sample D which shows no significant difference from sample E 4.091. Aroma was recoded highest 4.546 in sample A which shows no significant (P>0.05) from sample D and lowest in sample D 4.00. The result showed that the substitution of watermelon with pineapple and soursop decrease the value of flavour and aroma perceived by the consumer panelist. The higher preference could be due to the consumer non familiarity with sample containing all these ingredients.

Like any other food product, juice's colour is very important for a number of reasons, including marketing, consumer pleasure, and sensory appeal. Juice's visual component is among the first sensory cues that customers will experience. Juices with eye-catching looks can pique customers' curiosity and appetite, increasing their desire to sample them (Krishna, 2012). From the results colour obtained ranged from 4.182 to 4.818. Sample A recorded the maximum (4.818) value for colour whiles the lowest 4.182 was recorded in sample D and E. The result shows a significant difference ($p<0.05$) as the level of ingredient composition varies except for sample D and E which recorded mean value of colour 4.182 respectively. Again the result obtained depict consumers prefer sample A followed by sample B regarding colour compare to the other samples. The result was in line with (Potter & Hotchkiss, 2012) who claimed that adding more substitute ingredients to food manufacturing changed the juice's appearance; therefore, variations in appearance could be caused by the effect of varied ingredient composition colors.

The result of mouthfeel and after taste ranged from 3.455 to 4.727 and 3.455 to 4.636 respectively. Mouthfeel recorded highest in sample A 4.727 while the lowest 3.455 recorded in sample A. No significantly different ($P>0.05$) were observed between mouthfeel for sample B, sample C and sample D 4.182, 4.091, 4.000 respectively. After taste was prefer was higher in sample A 4.636 and lower3.455 in sample D which show no significant difference ($P>0.05$) from sample B, sample C, and D 4.000, 4.182, and 3.455 respectively.

Overall acceptability ranged from 3.909 to 4.727. The highest value of overall acceptability 4.727 was recorded for sample A, followed by sample B 4.636, sample D and E 4.182 and the lowest sample B 3.909. The result shows no significant difference ($P>0.05$) between sample C, sample D, and sample E 3.909, 4.182, 4.182. The respondents perceived all the samples to be good and preferable but preferred sample A followed by sample B the most. It was also observed that the variations in the formulation ratio vary in all sensory parameters which impact the overall acceptability. The study was in line with the study conducted by Aderinola & Adeniran, (2015) where sensory consumers prefer the control to the composite sample for watermelon pineapple juice blends.

4.3 Vitamin C after storage



As shown in the figure above, the vitamin C content of the sample ranged from 60.0mg/1000g to 75mg/100g. Sample E recorded the highest 75.0mg/100g, followed by sample C 74.0mg/100g, sample D 71.2mg/100g, sample B 75.0mg/100g, and the lowest sample A 60.0mg/100g. The addition of pineapple and soursop increases the vitamin C composition of the sample. Pineapple and soursop is known among fruit higher in pineapple and hence could be the reason. The value of vitamin C was higher than 42.13,31,50, 21.63 reported by for pineapple juice, orange, and watermelon stored for 7deays (El-Ishaq & Obirinakem, 2015).

4.4 Microbial analysis of the juice blend

Table 4.5 Microbial analysis of the juice blend

Sample Identity	**Mean Count(CFU/ml)**		
	***Staphylococcus aureus* (NMKL N0.66)**	***Samonella*(NMKL N0.125)**	**Yeast & Mould (ISO 215275-1)**
A	1.0×10^{2}	<10	2.0×10^{2}
B	1.0×10^{1}	<10	2.0×10^{3}
C	1.0×10^{3}	<10	1.0×10^{3}
D	1.0×10^{2}	<10	1.0×10^{2}
E	1.0×10^{1}	<10	1.0×10^{1}
LOD: Limit of Detection	<10	<10	<10

The mean value for salmonella for all samples was <10. All samples were within the <10 recommended by GS955:2019 for quality of food good for consumption. This indicates that all samples meet the standard in terms of salmonella. According to Zweifel & Stephan, (2012), salmonella is a leading cause of foodborne illnesses worldwide and when food products contain lower levels of Salmonella, the risk of consumers contracting Salmonella-related illnesses is significantly reduced.

The data presented in Table 4 indicate the level of staphylococcus, salmonella as well as yeast and mold. With all four samples the highest level of staphylococcus 1.0×10^{3} was recorded in sample C followed by samples A and B 1.0×10^{2}, and the lowest 1.0×10^{1} was recorded in sample B and sample E. All level of staphylococcus recorded was within the acceptable limit <10 stated by GS955:2019. The results obtained show that all samples are good to consume and are less in staphylococcus. The reason could be due to pasteurization which kills harmful microorganisms. According to Peng et al., (2017), pasteurization is a heat treatment method that kills or inactivates harmful microorganisms such as Staphylococcus aureus while preserving the product's quality. The study was in with result 1.6×10^{4} to 2×10^{2} which is (<10) reported by Farah et al., (2023) for fresh packaged fruit and milk juice.

Yeast and mold receded in the range of 1.0×10^{1} CFU/ml to 2.0×10^{3} CFU/ml. the highest was reported in sample B 2.0×10^{3} CFU/ml, followed by sample A 2.0×10^{2}, sample C 1.0×10^{3} CFU/ml, sample D 1.0×10^{2} CFU/ml, and the lowest sample E 1.0×10^{1} CFU/ml. The level of yeast recorded was lower or within the maximum limit recorded in food. This shows the juice meets the recommended level <10 set by GS955:2019. Yeast and mold grow on or in a wide range of food products and their presence and growth can be attributed to several reasons such as preparation procedures, processing methods, and storage. Rawat, S. (2015). Hence this study adopted good production, and processing methods which limited the growth of yeast and mould making the product safe for consumption. The yeast and mold count of the sample was in range of Nil (0) to $2.6x10^{3}$ cfu/ml reported by Noah, (2020) for mixed fruit juice blends.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Fruit juice can be affected by storage in a number of ways. It is essential to comprehend how food juice is stored in order to maintain its nutritional value, flavor, and quality. The physicochemical parameter showed a decrease in sample A, sample B, and sample C as the storage days increased. sample D and Sample E observed an increasing trend at day 5 and day 15. Total soluble solids were at day 10 for sample A and sample, sample C was higher at day 15, and D and E were higher on day 10 and 15 respectively. Variations in ingredients affect the total soluble solids and the titrable acidity of the samples. All samples recorded an increase in acidity compared to the initial day of storage.

With the microbial safety of the product, thou microbial level of Staphylococcus aureus, Samonella, Yeast & Mould, the quantity recorded were below the maximum level of acceptance which shows all sample are safe to consume. The sensory assessment revealed that taste, color, mouthfeel, and aftertaste were higher in sample A and lower in sample E. Flavour and aroma were highly preferred in sample A and least preferred in sample D. Overall acceptability was rated higher for sample A, followed by sample D and E and lowest in sample E. the control sample were most preferred in all sensory properties.

5.2 Recommendation

Based on the finding and conclusion made from the study

Vitamin C and percentage reduction in Vitamin C should be determine at every storage stage to know the effect of the storage period on the vitamin C composition of the juice.

Other microbial analysis should also be determined to know if it also above recommended level of acceptance.

Also different ratio should be used to for different juice development and assess consumer acceptability and preference

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APPENDIX I

Plate 3: Assessors undergoing sensory evaluation test

Plate 4:pH analysis undergoing

Plate 5: Acidity determination undergoing

Plate 6: Sample treatments