UNIVERSITY OF EDUCATION WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION – KUMASI

DEPARTMENT OF CATERING AND TOURISM EDUCATION

EXAMINING CONSUMER ACCEPTABILITY OF PREKESE SYRUP AS NON - ALCOHOLIC BEVERAGE

YAA ACHIAA MENSAH

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EXAMINING CONSUMER ACCEPTABILITY OF PREKESE SYRUP AS NON - ALCOHOLIC BEVERAGE

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(1074583)

A DISSERTATION SUBMITTED TO THE DEPARTMENT OF HOSPITALITY AND TOURISM EDUCATION, FACULTY OF VOCATIONAL EDUCATION, UNIVERSITY OF EDUCATION WINNEBA - KUMASI, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR AWARD OF THE MASTER OF TECHNOLOGY IN CATERING AND HOSPITALITY DEGREE.

MARCH, 2022

DECLARATION

STUDENT'S DECLARATION

I, YAA ACHIAA MENSAH declare that this project report, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for an-other degree elsewhere.

SIGNATURE:…….....…….

DATE:…….....……

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Project report as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: DR. OLU ELLEN (PhD)

SIGNATURE:…….....…….

DATE:…….....….

DEDICATION

I dedicate this work to God Almighty. I would also like to dedicate this research to Mrs Theresa Owusu, Mr. Augustine Mensah and Mr. Martin Osei Yaw, without their support and love, this work would not have been possible.

ACKNOWLEDGEMENT

My biggest thanks to Almighty God for His protection and immense assistance. It is by His grace that the idea of writing this project has come to reality.

I would like to express my appreciation to my supervisor, Dr Olu Ellen (PhD), for her guidance, advice, suggestions, and time throughout this research. I must also extend my gratitude to Charles Addai Kankam, George Kofi Asante and Eugene Opoku Duah, for their motivations and valuable assistance.

Finally, I do thank my siblings and my graduate student colleagues in the Department of Catering and Hospitality for their words of inspiration and prayers.

ABSTRACT

In recent trends, consumers seek beverages or drinks that help improve on their health status due to the increasing rate of diseases and sicknesses hence most non-alcoholic drinks on the market have an additional value of health benefits. The main objective of this project was to develop a consumer acceptability of 'prekese' syrup as non-alcoholic beverage. Consumer acceptability of prekese syrup, and the shelf life of the drink were studied. Prekese drink production includes several stages: the prekeses are selected, washed, pulps are cut from the fruits, water and leave are added to boil for 30 minutes to soften the pulp, the pulps are removed from the stock and blended, juice is extracted from the blended pulps, juice is added to the stock, stock is boiled again until it becomes sticky, leave to cool and packaged. It was found that sample PT3 of 50g prekese syrup, 100ml of water, 20g of sugar and 100ml of milk was the most appealing sample for all the sensory attributes, i.e., colour, aroma, taste, and overall acceptance during storage. The keeping quality of Prekese Syrup at an ambient temperature of 26°C and a refrigeration of 5°C for seven (7) days performed better. The rate of vitamin C degradation was also slower in the refrigerator than that under ambient temperature. The microbial analysis revealed that the total coliforms, Staphylococcus aureus, yeast/mould and total plate count indicated that there were few Staphylococci aureus and yeast/mould (<10), no total coliforms, with a total plate count of one (1) in both varieties of drink under the two storage conditions for the seven (7) day storage period). The study concludes that Prekese Syrup beverage is preferred and acceptable by consumers. Further research is needed to consider preparing Prekese Syrup by taking children into account. Studies on shelf-life beyond the seven days should and on packaging effect on storability should be carried out to determine the type of packaging that can best prevent interaction between the environment and the product.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

In West Africa, the plant *Tetrapleura tetraptera* (locally known as Prekese) is popular among the Akans of Ghana for its use as a spice, as some dietary supplement rich in vitamins and a medicine for many ailments. The 'Prekese' plant, scientifically called Tetrapleura tetraptera is from the family of Mimosaceae and commonly known as Aridan (fruit) in Nigeria. It is a single-stemmed, robust, perennial tree of about 30m. It has a grey/brown, smooth/rough bark with branches. The flower is yellow/pink and racemes white. The fruit has dark brown, four winged pods (12–25cm x 3.5–6.5cm).

It is generally found in the lowland forest of tropical Africa. The fruit consists of a fleshy pulp with small, brownish black seeds. The fruit possesses a fragrant, characteristically pungent aromatic odour, which acts as an insect repellent and a spice in foods (Aladesanmi, 2007).

The dry fruit has a characteristic aroma which makes it a popular seasoning spice in Ghana, Southern and Eastern Nigeria (Adesina, 2012; Essien et al., 2014; Okwu, 2011). The fruit shell, fruit pulp and seed contain varying amounts of nutrients such as protein, lipids and minerals which are comparable to and some are even higher than popular spices and ginger (Essien et al., 2014). It is also a source of minerals e.g., calcium, phosphorus, potassium, zinc and iron.

The plant has many traditional uses, mainly in the management of convulsion, leprosy, inflammation and rheumatic pains, schistosomiasis, asthma and hypertension (Ojewole & Adesina, 2012). The ethanol extract and saponins from the bark of the stem exerts an inhibitory effect on luteinizing hormone released by pituitary cells, suggesting its use as contraceptive agent (El-Izzi et al., 2010). It is used extensively in soups for nursing mothers to prevent post-

partum contractions (Nwawu & Akali, 2016) and gastro-intestinal disorders especially stomach ulceration (Noamesi et al., 2012) The fruit shell, fruit pulp and seed contained varying amounts of nutrients such as protein, lipids and minerals which are comparable and some are even higher than popular spices and ginger (Essien et al., 2014). Okwu (2013) reported that the proximate composition of T. tetraptera as follows: crude protein (7.44% - 17.50%), crude lipid (4.98% - 20.36%), crude fibre (17% - 20.24%), carbohydrate (43.18% - 49.06%) and food energy (234.18% - 42,379.48 gl Cal).

The fruit is also a source of minerals e.g., calcium, phosphorus, potassium, zinc and iron. In Ghana, it is used as a source of vitamins in diets (Okwu, 2013). T. tetraptera is common on the fringe of the West African rainforest belt. Trees are widespread in the forests of tropical Africa, especially secondary forest. The species is found throughout the high forest zone, in the southern savannah-woodland and in the forest outliers of the African plains (Orwa et al., 2009).

The tree is deciduous, losing its leaves in December. Flowering begins towards the end of February and ends in early April. The indehiscent pods mature and ripen from September to December. When the pods fall, their scent attracts rodents, which probably disperse the seeds (Orwa et al., 2009). According to Abii and Amarachi (2007), it was observed that the dry fruit of *tetrapleura* tetraptera contains 9% ash, 4% oil and 3% moisture.

The plant has many traditional uses, mainly in the management of convulsion, leprosy, inflammation and rheumatic pains, schistosomiasis, asthma and hypertension (Ojewole & Adesina, 2013). The ethanol extract and saponins from the bark of the stem exerts an inhibitory effect on luteinizing hormone r0eleased by pituitary cells, suggesting its use as contraceptive agent (El-Izzi et al., 2010). It is used extensively in soups for nursing mothers to prevent postpartum contractions Nwawu and Akali, (2016) and gastro-intestinal disorders especially

stomach ulceration (Noamesi et al., 2012). Phytochemical screening revealed the presence of tannins phenolic compounds, saponins, alkaloids, steroids and flavoniods which are assumed to be responsible for its varied biological and pharmacological properties (Okwu, 2013).

Traditionally, the fruits, leaves, bark and roots are perceived to have important medicinal properties (Thomas et al., 2001). Research has demonstrated how careful planting of *Tetrapleura* tetraptera in areas of high Billharzia transmission can reduce the rates of infection, offering countries with limited resource a more environmentally and financially friendly way of protecting their populations from this dreaded disease.

It was found that it had anti-ulcer and anti-convulscant properties, confirming its ethno medicinal use to treat these symptoms. The active ingredients were found to be rapidly passed through the mammalian body, with little retention in tissues. They were also found to exhibit very few toxic effects and were mutagenic only in the presence of other more dangerous chemicals which are not frequently found. (Thomas et al., 2001).

'Prekese' has many potentials uses for instance it is a potential source of raw material for the growing pole industry of Ghana, which is currently based on teak. Farmers are critical of negative environmental impact of teak therefore it is a suitable indigenous substitute which is agro-forestry and environmentally friendly (Adewunmi, 2008).

Biological study has shown that Prekese extract has some useful therapeutic action easing hypertension, and Asthma. Active constituents include Scopletin which appears to have a relaxing action on smooth muscle, helping to ease constriction in the Bronchioles of the lung, and on constricted blood vessels (Adewunmi, 2008).

Therefore, there is the need to examine the nutritional and health benefits of consuming *tetrapleura* tetraptera locally known as prekese.

1.2 Statement of Problem

Gradually there has been a paradigm shift as there is an overall increase in natural beverages consumption as an alternative to traditional caffeine and carbonated beverages (Yarkwan & Oketunde, 2016).

Food manufacturers continue to seek for product innovations geared towards the development and commercialization of functional foods. Production of beverages has become an increasing interest of the beverage industry all over the world due to their low energy value and as an important source of vitamins and minerals (Awusi & Dorcus, 2012).

Some past studies have looked at the constituents Prekese. Udourioh and Etokudoh (2014) reported forty-four compounds representing 98.5% of the essential oil from the dry pods, using gas chromatography mass spectrophotometry (GC-MS). The predominant chemical constituents of the oil were acetic acid (34.59%), 2- hydroxy-3-butanone (18.25%), butanoic acid (8.35%), 2-methyl butanoic acid (7.58%), 2- methyl buatanol (7.45%), butanol (4.30%), 2-methyl butanoic acid (3.65%), nerol (3.25%), 2-methyl butenoic acid ethyl ester (2.70%), 2-methyl butanoic acid ethyl ester (2.09%) and linalool (1.84%). The oil is dominated by carboxylic acid which gives an entirely different report from that of essential oil results obtained from other spices by Onyenekwe et al. (2007), Karioti et al. (2014), Ekwenye and Okorie (2010) and Abugri and Pritchett (2013). Terpene constituents which often dominate most essential oils as observed in other spices were detected as minor or trace constituents in *T.* tetraptera (Udourioh and Etokudoh, 2014). For example, β-caryophellene was 0.1%, α-pinene (0.1%), β-pinene (0.2 %), myrcene (0.09 %), γ-terpinene (0.2 %), whereas reports on essential oils of Piper guineense showed β-caryophellene (20.8 %), β-pinene (12.15%), α-pinene (10.6%), myrcene (1.8%) and γterpinene (4.9%) (Karioti et al., 2014; Ekwenye & Okorie, 2010; Abugri and Pritchett, 2013).

Linalool constitutes 1.8% of the essential oils and this account for the pepperish nature of the plant (Udourioh & Etokudoh, 2014).

The alarming rate of deforestation and illegal mining in Ghana put the plant at risk by disappearing. The 'prekese' plant does not do well in pure stands plantation unless there is a mixed stand plantation in other to protect its natural habitat. The fruit is being used in soups as spice, most consumers do not know the extensive use, nutritional value and medicinal aspect of the fruit which can help eradicate many ailments.

The study will help create awareness of the importance of the plant and its fruit as well as its value to our health.

1.3 Main objective of the study

The main objective of the study was to develop a consumer acceptability of 'prekese' syrup as non-alcoholic beverage.

1.4 Specific Objectives of the study

1. To determine the overall acceptability of 'prekese' syrup as non-alcoholic beverage.
2. To evaluate the sensory properties of the 'prekese'.
3. To explore individuals or caterer's selective practices of non-alcoholic beverages.
4. To determine the shelf life of the 'prekese' syrup.

1.5 Significance of the Study

The findings of this research would be of great importance to practitioners, students of the University of Skills Training and Entrepreneurial Development, Individuals., Researchers and the government in general. To the students, it will serve as a source of reference for future

studies on any topic related to food product development. The study will add to existing empirical literature on 'prekese' and contribute to academia as well. To encourage individuals to seek beverages that will help to improve the health status due to increasing rate of diseases.

To the practitioners, it will help them make informed decisions on the medicinal and nutritional benefits of 'prekese'. To the government and Researchers; the study will also generate revenue for people which will increase and provide profit for the country. Plan within the required budget by cutting down importation of non-alcoholic beverages and invest the sale of 'prekese' syrup as non-alcoholic beverages. This could earn substantial foreign exchange and reduce over dependency and importation of non-alcoholic beverage.

1.6 Scope of the Study

The main purpose of the study is to examine customer acceptability of 'prekese' syrup as non-alcoholic beverage and health benefits of consuming *Tetrapleura tetraptera* locally known as prekese. It will also seek to solve the wastage of *Tetrapleura tetraptera* when it is in abundance by promoting consumption of the fruit. The study is theoretically, empirically and conceptually limited in scope to the following research objectives including to determine the overall acceptability of 'prekese' syrup as non-alcoholic beverage, to evaluate the sensory properties of the 'prekese' syrup, assess the shelf-life of the 'prekese' syrup and to explore individual or caterer's selective practice of non-alcoholic beverages.

1.7 Organization of the Study

This study consists of five Chapters, Chapter one deals with the background to the study, the statement of the problem and objectives of the study, significance and Scope of the study and organization of the study. In Chapter two the researcher reviewed related literature whiles chapter three deals with the research methodology used in the study. Other aspects of chapter three describe the research design, the population sample and sample procedures, data gathering instruments and data collection procedures of the study, methods of data analysis. Chapter four describes the research findings, and the discussion of the main findings and chapter five presents the summary of the findings, conclusions and recommendations and suggestions for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Non-Alcoholic Beverages

According to the Eleventh Edition of the Concise Oxford English Dictionary, a drink is any liquid consumed as refreshment or nourishment. The essential components of any food drink are the water that it contains and some other components such as stimulants and aromas (Ihekoronye &Ngoddy, 2005). Food drinks commonly consumed in the tropics can be divided into two; Non-alcoholic and alcoholic drinks. The former can further be divided into non-carbonated (juices, coffee, tea, energy drinks, etc.) and carbonated (soda, coca cola, tonic water, etc.). (The European Commission on Food Safety, 1999).

2.1.1 Description of 'Prekese'

'Prekese' is a deciduous tree that sheds its leaves annually and grows approximately 20 to 25 meters in height. It is distinguished by round smallish crown that tends to flatten when old. Younger trees of *Tetrapleura tetraptera* have slender bole however, the older ones have low and sharp buttresses. The grey-brownish bark has a very smooth texture while the leaves are glabrous and hairy in appearance. It bears up to 5-10 pairs of pinnae that measure approximately 5 to 10 cm long with 6 to12 leaves on both sides of the pinna stalk. The top of the tree can be marginally notched sometimes while the base is basically hairless with slender stems (Abii & Amarachi, 2007). *Tetrapleura tetraptera* bears flowers that are sort of cream and pink in colour but they tend to change to orange colour on maturity. The flowers are in the upper leaf axils and are always in pairs with short stamens and slender stalks. The aridan fruit hangs on stout stalks at the edges of the branches and they are characteristically brownish in colour. The fruit (pod)

measures about 15 to 25 cm long and is distinguished by its 4 longitudinal ridges that are slightly curved. Two of the ridges are woody while the other two contains soft, aromatic and oily pulp. The pod contains tiny, hard seeds that measure approximately 8 mm long. The fruit is distinguished by its fleshy pulp when fresh, but this fleshy pulp tends to be very strong when dried. The inner part of the aridan fruit is characterised by tiny black-brownish seeds (Aderibigbe et al., 2010).

Plate 2.1: 'Prekese' pods

'Prekese' is highly sought after due to its high medicinal and aromatic values and as such it is used for several purposes ranging from culinary, healing, therapeutic to cosmetology. Researchers also reveal that this plant has anti-inflammatory, hypotensive, neuromuscular, cardiovascular, anti-ulcerative, molluscicidal and anti-microbial properties (Aderibigbe et al, 2010).

2.1.2 Biology and ecology of *Tetrapleura tetrapetra*

Tetrapleura tetrapetra has two varieties, namely *Tetrapleura thoningii* and *Adenonthera* tetraptera, both of which belong to the Genera *Tetrapleura* and of the family *Minosaceae.* The plant is a perennial tree, about 30 m high and found in the lowland forest of tropical Africa particularly in the West Central and East Africa.

The fruit consists of a fleshy pulp with some small brownish black seeds. The fruits are green when tender but dark, reddish brown when fully ripe. The fruit has four longitudinal wing-like fleshy ridges of about 10 cm broad with two of the ridges hard and woody while the remaining two are soft and fluffy. The fruits have fragrance, pungent aromatic odour. It is a single-stemmed, robust, perennial tree of about 30m. It has a grey/brown, smooth/rough bark with branches. The flower is yellow/pink and racemes white. The fruit has dark brown, four winged pods (12–25cm x 3.5–6.5cm).

It is generally found in the lowland forest of tropical Africa. The fruit consists of a fleshy pulp with small, brownish black seeds. The fruit possesses a fragrant, characteristically pungent aromatic odour, which acts as an insect repellent and a spice in foods (Aladesanmi, 2007).

The dry fruit has a characteristic aroma which makes it a popular seasoning spice in Southern and Eastern Nigeria (Essien et al., 2014). The fruit shell, fruit pulp and seed contain varying amounts of nutrients such as protein, lipids and minerals which are comparable to and some are even higher than popular spices and ginger (Essien et al., 2014).

It is also a source of minerals e.g., calcium, phosphorus, potassium, zinc and iron. The plant has many traditional uses, mainly in the management of convulsion, leprosy, inflammation and rheumatic pains, schistosomiasis, asthma and hypertension (Ojewole & Adesina, 2012). The ethanol extract and saponins from the bark of the stem exerts an inhibitory effect on luteinizing

hormone released by pituitary cells, suggesting its use as contraceptive agent (El-Izzi et al., 2010).

It is used extensively in soups for nursing mothers to prevent post-partum contractions (Nwawu & Akali, 2016) and gastro-intestinal disorders especially stomach ulceration (Noamesi et al., 2012).

2.1.3 Importance of *Tetrapleura* tetrapetra

The shells, pulps and seeds of both fresh and dry fruits of *Tetrapleura tetrapetra* have varying amounts of protein, lipids and minerals, all of which are comparable and, in some cases, even higher than those of popular spices such as red pepper, onion, curry and ginger ((Essien et al., 2014). Crude protein is very low in the fleshy mesocarp (2.12 %) and seed (0.51%) but is not at all in the woody mesocarp (Essien et al., 2014).

Both fresh fruits and seeds are rich in potassium, iron, magnesium and phosphorus but low in sodium. The fruits have less than 5 mg / 100 g of zinc and nickel. Sucrose and fructose occur in traces in both the fruits and seeds. The dried fruits have 7.44 % to 17.50 % crude protein, 17.0 % to 20.24 % crude fibre, 4.98 to 20.36 % lipid, 43.18 % to 49.06 % carbohydrate and 234.42 g / cal to 379.48 g / cal food energy (Okwu, 2013).

The fruit oil is a good drying oil with a few unsaturated bonds. The seeds have the amino acids L-r- methylene glutamic acid and L-r- ethyldiene glutamic acid (Gmelin & Olesen, 2007). The fruit contains cinnamon and caffeine acids (Adesina et al 2010).

The fruit also contains the essential oils saponosides triterpenes, - aessculetin, caumarins, tannins, steroids and triterpene glycosides. Also present in the fruit are the phytochemicals,

oxalates (8.14 to 16 Mg / 100 g), tannins (16.5 to 35.7 mg / 100 g) and hydrocyanic acid (hydrogen cyanide) (98 to 100 mg/100 g), saponins, alkaloids, steroids and flavonoids.

Food and medicinal uses of *Tetrapleura tetrapetra.* The fruits are used locally in Ghana and Nigeria for food flavoring, in soap and pomade preparations. The fruit is premixed with soap base made from palm kernel oil or shear butter to improve the foaming properties of the soap (Adebayo et al., 2000).

Convalescents bathe with the infusion of the fruit for healing. The bark, root and fruit of the plant are used in the management of convulsion, leprosy, inflammation and rheumatic pains (Adesina et al., 2010; Dalziel, 2008). Infusion of the whole fruit is taken as a recuperative tonic (Ojewole & Adesina, 2013). Saponin extracted from the fruits has been proven to be a potent hypotensive and non sposmolytic agent in traditional infusion (Obidoa & Obasi, 2011).

In Eastern Nigeria, the fruits are used to prepare pepper soups for mothers after labour to prevent postpartum contraction (Nwawu & Akah, 2016), and for normal cooking for its flavoring and cleansing effects. Extracts of the fruits exhibit anti-ulcer activity, confirming its use in ethnomedical medicine to treat ulceration in gastro-intestinal disorder (Noamesi et al., 2012).

The fruit shell, fruit pulp and seed contained varying amounts of nutrients such as protein, lipids and minerals which are comparable and some are even higher than popular spices and ginger (Essien et al., 2014). Okwu (2013) reported that the proximate composition of T. tetraptera as follows: crude protein (7.44% - 17.50%), crude lipid (4.98% - 20.36%), crude fibre (17% - 20.24%), carbohydrate (43.18% - 49.06%) and food energy (234.18% - 42,379.48 gl Cal). The fruit is also a source of minerals e.g., calcium, phosphorus, potassium, zinc and iron. In Ghana, it is used as a source of vitamins in diets (Okwu, 2013). According to Abii and Amarachi (2007), it

was observed that the dry fruit of *tetrapleura tetraptera* contains 9% ash, 4% oil and 3% moisture.

The plant has many traditional uses, mainly in the management of convulsion, leprosy, inflammation and rheumatic pains, schistosomiasis, asthma and hypertension (Ojewole & Adesina, 2013). The ethanol extract and saponins from the bark of the stem exerts an inhibitory effect on luteinizing hormone released by pituitary cells, suggesting its use as contraceptive agent (El-Izzi et al., 2010). It is used extensively in soups for nursing mothers to prevent post-partum contractions Nwawu and Akali (2016) and gastro-intestinal disorders especially stomach ulceration (Noamesi et al., 2012). Phytochemical screening revealed the presence of tannins phenolic compounds, saponins, alkaloids, steroids and flavoniods which are assuumed to be responsible for its varied biological and pharmacological properties (Okwu, 2013).

2.1.4 *Tetrapluera tetraptera* Availability

Tetrapluera tetraptera is common on the fringe of the West African rainforest belt. Trees are widespread in the forests of tropical Africa, especially secondary forest. The plant is found throughout the high forest zone, in the southern savannah-woodland and in the forest outliers of the African plains (Orwa et al., 2009). The tree is deciduous, losing its leaves in December. Flowering begins towards the end of February and ends in early April. The indehiscent pods mature and ripen from September to December. When the pods fall, their scent attracts rodents, which probably disperse the seeds (Orwa et al., 2009).

2.1.5 Essential Oil Composition of *T. tetraptera*

Udourioh and Etokudoh (2014) reported forty-four compounds representing 98.5% of the essential oil from the dry pods, using gas chromatography mass spectrophotometry (GC-MS). The predominant chemical constituents of the oil were acetic acid (34.59%), 2- hydroxy-3-butanone (18.25%), butanoic acid (8.35%), 2-methyl butanoic acid (7.58%), 2- methyl buatanol (7.45%), butanol (4.30%), 2-methyl butanoic acid (3.65%), nerol (3.25%), 2-methyl butenoic acid ethyl ester (2.70%), 2-methyl butanoic acid ethyl ester (2.09%) and linalool (1.84%). The oil is dominated by carboxylic acid which gives an entirely different report from that of essential oil results obtained from other spices by Onyenekwe et al. (2007), Karioti et al. (2014), Ekwenye and Okorie (2010) and Abugri and Pritchett (2013). Terpene constituents which often dominate most essential oils as observed in other spices were detected as minor or trace constituents in *T.* tetraptera (Udourioh and Etokudoh, 2014). For example, β-caryophellene was 0.1%, α-pinene (0.1%), β-pinene (0.2 %), myrcene (0.09 %), γ-terpinene (0.2 %), whereas reports on essential oils of Piper guineense showed β-caryophellene (20.8 %), β-pinene (12.15%), α-pinene (10.6%), myrcene (1.8%) and γterpinene (4.9%) (Karioti et al., 2014; Ekwenye & Okorie, 2010; Abugri and Pritchett, 2013). Linalool constitutes 1.8% of the essential oils and this account for the pepperish nature of the plant (Udourioh & Etokudoh, 2014).

2.1.6 Nutrition Facts of 'Prekese' *(Tetrapleura tetraptera)*

'Prekese' is highly valuable because it contains a high amount of essential phytochemicals and nutrients that are vital for the healthy functioning of the body. It is an excellent source of potassium, iron, calcium, zinc, flavonoids, phosphorous, tannins, alkaloids, saponins, steroids

and phenolic compounds. It also contains 234.42 to 379.48g/cal of food energy, 7.44% to 17.50% of crude protein and 4.98% - 20.36% of crude lipid (Aderibigbe, et al, 2010).

2.1.7 How to Use 'Prekese'

Prekese pods can be crushed, ground, grated or broken into tiny pieces before adding to food or using for medicinal purposes. Alternatively, the pod can be broken into two or added whole to food during preparation but in this case, remember to scoop it out from the food before serving. It is important to add this spice a lot earlier in the food while cooking so that it can infuse properly for more aromaful and aromatic smell. For herbal medicines, the stem, bark, root, leaves and pods of prekese can be infused, boiled, soaked, squeezed, extracted, crushed or transformed into concoctions.

2.2 The health benefits of consuming *tetrapleura tetraptera.*

'Prekese' or *Tetrapleura tetraplera* is a native of west tropical Africa and belongs to the pea family. The fruits of the plant have a pungent aromatic odor due to which it also possesses insect repellent properties. It is primarily used as spices. It is used as medicinal plant primarily in Ghana and Nigeria and other African countries. Some of the top diseases for which it is used medicinally are inflammation, convulsions, skin ailments like leprosy, and rheumatoid pains. Prekese is also called as Uyayak, Edeminang, Osakirisa, Osho, Dawo, Ojewole & Adewunmi, 2016) Prekese is a rich source of antioxidants and has a high concentration of vitamins, minerals, and phytochemicals. It also does have antiinflammatory properties. Its leaves bark and above all fruits contain medicinal properties (Abii & Amarachi, 2007). Over the past years, plants have become an indispensable source of food and medicine. To a larger extent, most people depend

greatly on medicinal plants as an important source of remedy and treatment for most casual and life-threatening diseases. As a result, there is a growing demand all over the world for these medicinal plants. Aside from tackling diseases, people are resorting more to these medicinal plants as a means of reducing the use of chemical (orthodox) medicines that could potentially be detrimental to human health. Interestingly, most of these plants are used in our everyday cooking as herbs, spices, seasonings and preservatives. But the truth is that we often consume most of these essential medicinal plants in the form of spices without even acknowledging what our bodies gain from them (Abii & Amarachi, 2007). Furthermore, the use of these medicinal plants as food, preservatives, spices and as instrument for preventing and tackling the development of microorganisms in human bodies has become an area of extensive studies. One of such valuable medicinal plants is Prekese.

2.3 Benefits of *Tetrapleura Tetraptera* 'Prekese'

2.3.1 Contraceptive Properties

Saponin and ethanol extract from the stem and bark of this plant has an inhibitory effect on luteinizing hormone released by the pituitary gland. This suggests why this plant equally serves as a contraceptive (Adetunji & Aladesanmi, 2016).

2.3.2 Management of convulsion

In folk medicine, both the stem, leaves and fruit of the 'prekese' are used for producing herbal concoction for managing convulsion. Studies reveal that the aqueous extract of this plant exhibits anticonvulsant activities and this confirms its inhibitory effects on the central nervous system. In traditional medicine, herbal mixture out of ingredients including stem, fruit, and leaves has a

positive effect on treating convulsions. As per a study done at University of KwaZulu-Natal it was found that aqueous extract of the fruit contains anticonvulsant properties. It is also helpful for epilepsy patients in management and control of the condition. The fruit extract can slow down the nervous system (Adetunji & Aladesanmi, 2016).

2.3.3 Management of Leprosy

Studies reveal that 'prekese' can be used for treating leprosy, which is an infectious disease that affects mainly the skin, nerves and the mucous membranes thereby causing blemishes and lumps on the skin. Severe cases of leprosy can lead to deformities and mutilation (Akah and Nwabie, 2013).

2.3.4 Anti-inflammatory Properties

The extract of this plant is known for its anti-inflammatory properties, and this suggests its inhibitory impacts against certain human pathogens. As a result, it can be used for reducing inflammation of the body, arthritic pains and rheumatoid pains (Akah &Nwabie, 2013).

2.3.5 Antimicrobial

Due to the antibacterial and antimicrobial property of the prekese, the fruit extract is used in making of soap. The soap does not only have medicinal benefits for skin, but it also improves the hardness and the foaming (Bella et al., 2013).

2.3.6 Culinary Purposes

Dried fruit is known for its distinguished aromatic and flavorful fragrance and as such used as a spice for flavoring assorted dishes such as meat pepper soup, palm kernel soup (banga soup or ofe akwu), nsala (white soup), fish pepper soup etc. To use this spice, you can either crush it before adding to food or break into smaller portions before adding in the food while cooking (Bella et al., 2013).

2.3.7 Supports the Cardiovascular System

'Prekese' supports the cardiovascular system due to its constituents of essential phytochemical and as such can be used for preventing and treating heart diseases (Bella et al., 2013).

2.3.8 Molluscicidal Properties

Studies reveal that the aqueous extracts from the stalk, leaves, stem, bark and roots of the prekese plant contain molluscicidal properties. This suggests why this plant acts as a pesticide for fighting against molluscs and pests. Prekese is normally used in gardening, planting and agriculture for offering protections and control against gastropod pests especially snails and slugs that feed on/damage crops and other valuable plants in the farmland (Effiong et al, 2014).

2.3.9 Dermatological Care

The fruit can be dried and blended into powdered form for producing dermatological products such as soap. The great attention drawn towards the use of this plant for manufacturing soap is due to its high antimicrobial and antibacterial properties. It is worthy to note that the aridan plant helps to promote soap foaming as well as its hardness. To make soap with prekese, the dried

powdered herbs can be combined with shea butter, palm kernel oil or any other bases of choice. Soaps produced with these three key ingredients have superior qualities unlike those with individual base (Effiong et al, 2014).

2.3.10 Treatment of Hypertension

In folk medicine, the stem and bark extracts of taub *(Tetrapleura tetraptera)* can be used for preventing and treating hypertension. Researchers agree that *Tetrapleura tetraptera* is effective for preventing high blood pressure and for improving the oxidative position in salt model of hypertension patients (Effiong et al., 2014).

2.3.11 Treatment of Diabetes

The stem and bark extracts of *Tetrapleura tetraptera* (Taub) can be used for preparing herbal medicines for treating diabetes (Effiong et al., 2014).

2.3.12 Supports the Immune System

Being an excellent source of key vitamins such as potassium, iron, calcium, magnesium and zinc, aridan helps to strengthen our immune system. Iron helps to regenerate lost blood, zinc offers protection against viruses especially those that can cause respiratory tract infections while calcium and potassium helps to manage, prevent and control bones and muscles disorders (Effiong et al., 2014).

2.3.13 Post-partum Care

'Prekese' pod is traditionally used for preparing special soups for newborn mothers immediately they put to bed in other to avoid post-partum contraction. Although 'Prekese' can be used alone for this sort of postnatal soup preparation however, it can be used together with piper guineese, gongronema latifolium and scotch bonnet pepper for superior action. Using this spice for post-partum care is attributed to its high constituents of calcium, iron and potassium, which are very important for new mothers.

Furthermore, it helps to restore and replenish lost blood for new mothers and promotes lactation. 'Prekese' pod is used as an additive in the soup which is served to postpartum mother to avoid contraction. The pods are rich in potassium, iron, and calcium which are the three most important ingredients required for postpartum woman. The soup also helps in the production of milk in new mothers and helps to restore the lost blood (Ekwenye, et al, 2010).

2.3.14 Wound Healing Properties

Wet fruit extract of the dry 'prekese' has very good wound healing properties. Traditionally the aqueous extract from the fruit is used for healing which is proved scientifically too. However, the low concentration (200mg/ml) of the extract proved to be more efficient than when high concentration (2000mg/ml) extract was taken.

The study was done at the University of Uyo. To have best effects always use the fruit extract in low concentration for healing wounds. 'Prekese' pods contain essential chemical compounds such as flavonoids, triterpenoid glycoside (aridanin) and phenols, which have been reported effective for healing wounds (Ekwenye et al., 2010).

2.3.15 Anti-oxidizing Properties

'Prekese' is an excellent source of antioxidants such as polyphenols, alkaloids, tannins and flavonoids. Antioxidants help to protect our body from oxidative damage by scavenging for free radicals thereby preventing peroxidation. It is important to note that free radicals and reactive oxygen species formed during oxidation process contribute immensely to diseases such as cardiovascular diseases, cancer, diabetes as well as ageing. 'Prekese' fruit has a remarkable chemo diversity due to its constituents of polyphenols. It also has a strong radical reducing and scavenging abilities (Ekwenye, et al, 2010).

2.3.16 Treatment of Asthma

Traditionally, this plant can be used for treating asthma.

2.3.17 Treatment of Schistosomiasis

Studies reveal that 'Prekese' can be used for treating schistosomiasis. This is an infection that is also known as snail fever or bilharziasis caused by parasitic flukes of the genus Schistosoma. This infection occurs mainly in the tropical regions and eastern Asia and is mostly transmitted to humans through snails or fecal-contaminated fresh water. Common symptoms of schistosomiasis include anemia, pain, fever and breakdown of the infected organs (Ekwenye, et al, 2010).

2.3.18 Treatment of Gastrointestinal Disorders

The fruit can be used for treating gastrointestinal disorders such as stomach pain, diarrhea, vomiting etc. due to its constituents of phytochemicals.

2.3.19 Antibacterial Ability

Researchers reveal that water extracts and alcoholic mixture of the 'Prekese' fruit can inhibit the growth of Staphylococcus aureus. The presence of glycosides and tannins in ethanolic and water extracts of 'Prekese' have been proven effective for inhibiting the growth of bacteria (Ekwenye, et al, 2010).

2.3.20 Analgesic Properties

In the same study mentioned above, it was also found that 'Prekese' contains strong analgesic properties. Due to this, the extract is often used to manage arthritic pain. It reduces inflammation in arthritis and rheumatism patients (Ekwenye et al, 2010).

2.3.21 Fever & Enema

A person who is recovering from a medical condition is often asked to bathe with water soaked with whole fruit. This also gives fast relief from feverish conditions. Similar infusion also helps people suffering from constipation, enema, and emetic (Ekwenye, et al, 2010).

2.3.22 Flavonoids & Phenolic Acids

'Prekese' is rich in flavonoids which possess antioxidant and anti-inflammatory benefits. These properties of the fruit help in the prevention of heart diseases. Phenolics extract of the fruit was found to be beneficial in prevention and control of hyperuricemia. This is attributed to its phenolic acids and flavonoids content (Ekwenye, et al, 2010).

2.3.23 Diabetes

As per a study done on rats, it was found that *Tetrapleura tetraptera* or Uyayak is very beneficial in controlling type 2 diabetes mellitus. It was also found that 'prekese' fruit extract was beneficial in lowering blood glucose levels in both fasting and non-fasting conditions.

2.3.24 Mosquito Repellant

The fruit has a strong smell due to which it is often used as the mosquito repellant and is effective too. This property is attributed to the presence of essential oils in it.

2.3.25 Gastrointestinal Disorders

Its uses in gastrointestinal-related ailments could be attributed to the presence of phytochemicals. The fruit extract is often used traditionally in curing problems like diarrhea, vomiting or stomach pain. 'Prekese' is often called as wonder fruit due to its immense medicinal properties and effective health benefits in curing lot of diseases (Ekwenye, et al, 2010).

2.4 The sensory characteristics of *tetrapleura tetraptera*.

Adzitey, Boateng, Dari, & Teye, (2015) carried out their research to determine the effect of "prekese" (*Tetrapleura Tetraptera*) seed powder on the sensory characteristics and nutritional qualities of pork sausage. A total of 4kg of minced pork was used. The pork was divided into four equal parts (1kg per treatment). Each treatment contains the following: (T1) control (without PSP), (T2) with 3g of PSP, (T3) with 4g of PSP and (T4) with 5g of PSP. The sausages were stuffed into casing and vacuum sealed in transparent polythene bags and refrigerated at 2oC for laboratory and sensory analysis.

The sensory analysis was conducted to determine the effect of 'prekese' seed powder on the sensory characteristics of the product. Crude fat, crude protein, moisture content and pH were determined to find out the effect of the seed powder on the nutritional qualities of the products. The results showed that, the inclusion of up to 5g of PSP has no significant effects on taste, colour, prekese aroma, aroma and overall-liking.

There were no significant differences ($P > 0.05$) in the crude fat of the products but there were significant differences ($P < 0.05$) in terms of moisture, crude protein and pH. Crude protein of T1, T3 and T4 were significantly higher ($P < 0.05$) than T2. The moisture content of T2 product was the highest followed by T4, T1 and T3. pH of the products T1, T2 and T3 were significantly higher ($P < 0.05$) than T4 (Adzitey, et al, 2015).

2.5 The shelf-life of food spiced with *T. tetraptera* pod extract on the local and international market

According to Achi, (2016), the biological active components from pods of *Tetraptera tetrapleura* Taub were analyzed by phytochemical methods and spectral analyses. The main components were tannins and glycosides. Antibacterial activity, determined with the impregnated paper disc methods, was observed against four typed bacterial strains, *Staphylococcus aureus* ATTCC 12600, *Bacillus subtilis* (ATCC6051*), Pseudomonas aeruginosa*, (ATCC10145) and *Escherichia coli* (ATCC11775). The activity was particularly high against *Staph aureus*, *P. aeruginosa* and *E. coli*, which are common foodborne bacteria. Minimum inhibitory concentrations of the extract were determined to be 250 g mL-1 against *E. coli*, *Staph aureus* and *P. aeruginosa* or 500 g mL-1 against B. subtilis. The addition of 4% (v/v) of the extract to culture broth reduced the viable counts of the test organisms from 2 to 6 log factors after incubation at 37OC for 24 h.

In general, a lower activity was observed in the presence of B. subtilis. With the increase of concentration, the antibacterial activity of the extracts also increased. These results suggest the potential use of the above extract for reducing the number or preventing the growth of pathogens in food systems and therefore, increasing the shelf life of the food spiced with *'Prekese'*. Spices and herbs have been reported to be potent sources of natural antioxidants.

Spices are known to impact flavor and improve overall organoleptic quality of foods. The use of naturally occurring materials like spices as preservatives has been proved to be a promising alternative to the use of chemicals.

2.6 Knowledge gap

Evaluation of *Tetrapluera Tetraptera* extract on the sensory characteristics and microbial quality of fresh pork (Lartey, 2016). According to T. A. Addo-Beatson (2018) Examined the use of *Tetrapluera Tetraptera* 'prekese' in meal preparation. In addition, a study on the effect of 'prekese' (*Tetrapluera Tetraptera*) seed powder on the sensory characteristics and nutritional qualities of pork sausage (Adzitey et al., 2015). Potential application of *Tetrapluera Tetraptera* and Hibiscus *Sabdariffa (Malvaceae*) in designing highly flavored and Bioactive Pito with functional properties (Adadi & N. Kanwugu, 2020).

Therefore, the study is aimed at consumer acceptability of prekese syrup in non-alcoholic beverages.

CHAPTER THREE

MATERIALS AND METHOD

3.1 Materials and method

The ‘prekese’ used for the syrup was obtained Agona in the Sekyere South District. The ‘prekese’ was sorted, washed and cut evenly then boiled for 30 minutes. The ‘prekese’ was then removed from the stock, blended and sieved to extract the chuff from added to the stock and was boiled again until it becomes sticky, cooled and packaged.

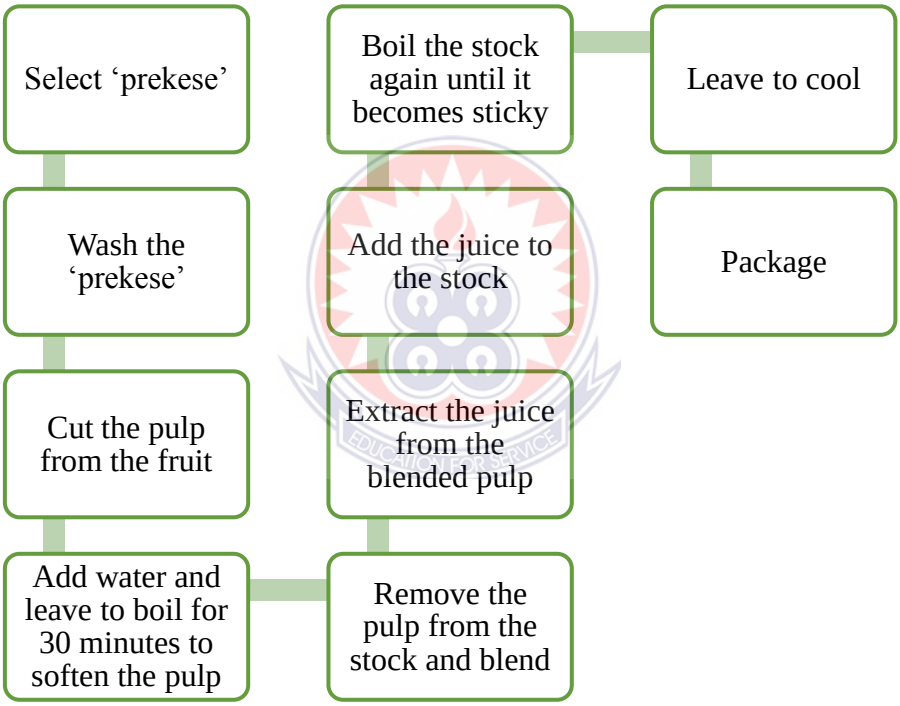

Fig 3.1. Flow chart for the production of ‘prekese’ syrup

3.2 Product formulation

Four (4) different ‘prekese’ syrup beverage formulation namely PT1, PT2, PT3 and PT4 respectfully was prepared with sugar and milk represented in percentage wise with the combination of other ingredients as shown in Table 3.1 below.

Table 3.1. Percentage composition of product sample

PRODUCT NAME	PREKESE SYRUP	WATER	SUGAR	MILK
PT1	100g	100ml	20g	100ml
PT2	75g	100ml	20g	100ml
PT3	50g	100ml	20g	100ml
PT4	25g	100ml	20g	100ml

3.3 Sensory Evaluation

As much as the objective was to develop a consumer acceptability of 'prekese syrup as a non-alcoholic beverage, the practical realities of an agreeable taste and aroma, demanded the inclusion of other ingredients were used in all the four (4) formulation of the beverage. The formulations were then subjected to panellists' assessment. The Prekese Syrup was subjected to sensory evaluation using 40 sensory panellists familiar with soft drinks and fruit juices to judge and select an acceptable drink from four (4) different formulations each of the 'prekese' beverage. Sensory acceptance of all the mixed juice samples was evaluated by 40 respondents of both genders (aged between 15 and 60 years). The criteria employed for the selection of the panellists were that (a) they will be available and willing to participate in the panel test (b) they are of sound health. The sensory attributes considered for the evaluation were colour, taste, aroma, and overall acceptance.

Panellists assessed and assigned scores to the attributes using the 9 – point Hedonic scale, which was arranged such that: 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. Organoleptic acceptance was carried out using the mixed juice

samples stored at 4 °C. The panellists were randomly served with about 30 mL of each juice mix in transparent plastic cups for evaluation. They were asked to drink water before testing the next sample. Sensory acceptance assessment was performed at day zero and after 30 days of storage period. Unsalted crackers and water were provided to panellists for rinsing of their mouth between formulations. Mean values of the responses were analysed using ANOVA and Correlation analysis.

3.4 Shelf-life Study

Samples of the acceptable Prekese Syrup were stored in a refrigerator and on a shelf (under normal room temperature) respectively for one (1) week, after which they were tested for microbial load, pH, TTA and Vitamin C.

3.5 Statistical Analysis

Data from the survey were analyzed for frequencies, percentages and Pearson's Chi-square test of association using SPSS 11.5. Data for each sensory attribute was analyzed using ANOVA. Analyses were also carried out to correlate overall acceptance with the other sensory attributes to assess the relationship between them. Finally, data from shelf-life study was also analysed using the student edition of statistics 9.0.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Socio-Demographic Data of Respondents

The Table 4.1 shows the background characteristics of respondents in terms of age, gender, and educational background.

Table 4.1 Socio-Demographic characteristics of respondents

Variables	Frequency (f)	Percentage (%)
Gender		
Male	17	42.5%
Female	23	57.5%
Total	**40**	**100.0**
Age		
15 – 25 years	2	5%
26 – 35 years	7	7%
36 – 45 years	21	52.5%
46 – 55 years	6	15%
56 and above	4	10%
Total	**40**	**100.0**
Marital Status		
Married	35	87.5%
Separated	2	5%
Divorced	0	0%
Widowed	3	7.5%
Total	**40**	**100.0**

Educational status		
None	0	0%
Basic Education	2	5%
SHS	3	7.5%
Tertiary	35	87.5%
Total	**40**	**100.0**

The characteristics of respondents' background have a crucial role to play in a research study. One such characteristic is the age distribution of respondents. In adult research, it is assumed that, the older the age distribution, the higher the reliability of the feedback. In the current study, the age distribution ranged between 15 years to 60 years with an average age of 31years. From Table 4.1, it was noted that, persons between the ages of 36-45years were the highest accounting for about 21 out of the total of 40 respondents while persons between the age ranges of 15-25 years recorded the lowest of 2. Knowing the age range and the mean age gives an impression about the categories of people used in the study in terms of their experiences which may also give credibility to the results obtained from the study.

In terms of gender, 23 of the respondents representing 57.5% were females and the remaining 42.5% were males. The implication is that, the gender dynamics in the current study reflects the national statistics of Ghana in which females have been sampled more than men in all surveys. For instance, in all the Ghana Demographic and Health Surveys (GDHS) women have been sampled more than men (GDHS, 1988, 1993, 1998, 2003, 2008, 2014 and 2020). In the 2020 GDHS, out of a total sample of 14,005 respondents, 9,396 were women as against 4,609 men. This gender dynamic is also in line with the 2020 National Population and Housing Census

report which revealed that, the sex composition of Ghana was 51.2% for women as against of 48.8% for men.

The study found that, about 87.5% of the respondents were married and about 5% separated as shown in Table 4.1. Even though there are variations in the percentage of married women and men between the results of the current study and the national data, the trends are the same. For instance, the Ghana Living Standard Survey Round 6 has equally reported that, about 39.4% of the Ghanaian population are married as against 5.6% widowed.

The educational status of respondents was analysed. No education attendance, basic education, senior high education or its equivalent and tertiary education attainments. The study found that, about 5% of the respondents had basic education, 87.5% had tertiary education, and 7.5% had Senior High School. The 2010 population and housing census reports that, about 44.6% of Ghanaians have attained education below middle school living certificate (MSLC) or Basic Education Certificate Examination (BECE). The document further mentioned that, while about 21% had attained MSLC/BECE, only about 14.7% have acquired Senior High School (SHS) or Tertiary Education. Therefore, the results of the current study are contrary to the national educational attainment statistics data.

4.2 Analyses of the Various Products samples

The scores presented by the panellists to the four products, based on their degree of liking in relation to the sensory attributes, were used to calculate the various means. The data collected from the sensory evaluation exercise were collated and analyzed using SPSS software (IBM Version 20.0). This was done to determine whether significant differences existed among the samples in terms of taste, aroma, colour and overall acceptance. Where differences existed

among the samples, Duncan's Least significant difference test was used to determine where the differences occurred.

Table 4.2: Degree of liking in relation to color attribute of Samples

Groups	Count	Sum	Average	Variance
PT1	40	256	6.4	6.041025641
PT2	40	276	6.9	5.630769231
PT3	40	344	8.6	0.451282051
PT4	40	336	8.4	0.707692308

Summary: Anova (Single Factor)

Table 4.3: ANOVA Analysis of the color attribute assessment obtained

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	142.7	3	47.56667	14.82893685	1.53E-08	2.662569
Within Groups	500.4	156	3.207692			
Total	**643.1**	**159**				

Table 4.2 displays the responses obtained from panellists on product samples in relation to color attribute. Panellists assessed and assigned scores to the attributes using the 9 – point Hedonic scale, which was arranged such that: 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. Samples PT3 and PT4 were equally ranked as "liked very much" with the mean score of 8.6 and 8.4, respectively. In comparison, PT1 and PT2 samples scored low mean values of 6.4 and 6.9, respectively. The results revealed that PT3 had

the highest mean score of 8.6 and was the most acceptable sample in terms of colour preference followed by sample PT4.

Table 4.4: Degree of liking in relation to aroma attribute of Samples

Groups	Count	Sum	Average	Variance
PT1	40	284	7.1	4.297436
PT2	40	288	7.2	3.087179
PT3	40	300	7.5	6.051282
PT4	40	276	6.9	5.938462

Summary: Anova (Single Factor)

Table 4.5: ANOVA Analysis of the aroma attribute assessment obtained

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7.5	3	2.5	0.516146	0.671758	2.662568549
Within Groups	755.6	156	4.84359			
Total	**763.1**	**159**				

Table 4.4 displays the responses obtained from panellists on product samples in relation to flavour attribute. In terms of aroma preference, the PT3 sample scored the highest mean value of 7.5, while the PT2 and PT1 samples scored 7.2 and 7.1, respectively, and the PT4 sample obtained the lowest score of 6.9. The results revealed that PT3 had the highest mean score of 7.5 and was the most acceptable sample in terms of aroma preference followed by sample PT2 and least preference by the panellists in terms of aroma is PT4.

Table 4.6: Degree of liking in relation to taste attribute of Samples

Groups	Count	Sum	Average	Variance
PT1	40	300	7.5	5.025641
PT2	40	284	7.1	6.707692
PT3	40	296	7.4	7.323077
PT4	40	272	6.8	7.497436

Summary: Anova (Single Factor)

Table 4.7: ANOVA Analysis of the taste attribute assessment obtained

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	12	3	4	0.602549	0.614284	2.662569
Within Groups	1035.6	156	6.638462			
Total	**1047.6**	**159**				

Observation from table 4.6 indicates that, in terms of taste preference, the PT1 and PT3 samples scored the highest mean values of 7.5 and 7.4 respectively while the PT2 sample scored 7.1 and the PT4 sample obtained the lowest score of 6.9. The results revealed that PT1 had the highest mean score of 7.5 and was the most acceptable sample in terms of taste preference followed by sample PT3 and least preference by the panellists in terms of taste is PT4.

4.3 Sensory Analysis properties of the prekese syrup

Table 4.2 and table 4.3 shows the mean scores for sensory evaluation in each sample stored at 4 °C for 0 day and 30 days. The sensory analyses were carried out to evaluate colour, aroma, taste,

and overall acceptability of the prekese syrup during one month of storage. The resulting responses and findings obtained from the panellists are presented in table 4.2 and table 4.3 below.

Table 4.8: Mean scores for sensory evaluation of prekese syrup at 0 day of the storage period in a fridge set at 4 °C; values with different superscripts for each sensory parameter indicate that the means are significantly different at p < 0.05.

Product	Sensory attributes			
	Colour	Flavour	Taste	Overall acceptance
PT1	6.4[a]	7.1[a]	7.5[a]	7.2[ab]
PT2	6.9[a]	7.2[a]	7.1[a]	7.0[ab]
PT3	8.6[b]	7.7[a]	7.4[a]	7.8[a]
PT4	8.4[b]	6.9[a]	6.8[a]	6.9[b]

Table 4.9: Mean scores for sensory evaluation of prekese syrup at 30 days of the storage period in a fridge set at 4 °C; values with different superscripts for each sensory parameter indicate that the means are significantly different at p < 0.05.

Product	Sensory attributes			
	Colour	Flavour	Taste	Overall acceptance
PT1	5.7[a]	6.4[a]	6.5[a]	6.8[a]
PT2	5.9[a]	6.5[a]	6.6[a]	6.7[a]
PT3	8.1[a]	7.8[a]	7.5[a]	7.6[a]
PT4	7.9[b]	6.0[a]	6.8[ab]	6.3[a]

At day zero, the colour for PT3 and PT4 samples were equally ranked as “liked very much” with the mean score of 8.6 and 8.4, respectively (Table 4.8). In comparison, PT1 and PT2 samples scored low mean values of 6.4 and 6.9, respectively. The results revealed that PT3 had the

highest mean score of 8.6 and was the most acceptable sample in terms of colour preference followed by sample PT4 (Table 4.8). This trend was also seen for all the samples during 30 days of storage, although the mean scores for the colour decreased slightly (Table 4.9). It was determined that the PT3 and PT4 samples scored mean values of 8.1 and 7.9, respectively for the colour attribute at 30 days. In contrast, the PT1 sample scored the lowest value of 5.4, followed by the PT2 sample that had 5.9 mean score. In terms of aroma preference, the PT3 sample scored the highest mean value of 7.7, while the PT2 and PT1 samples scored 7.2 and 7.1, respectively, and the PT4 sample obtained the lowest score of 6.9 at day zero (Table 4.8). After 30 days of storage, the PT3 sample scored the highest mean value of 7.8 and was ranked as "likely moderate" in terms of its aroma. The least mean value of 6.0 was found in the sample PT4, which indicates the least preference by the panellists in terms of aroma (Table 4.9). No significant difference ($p > 0.05$) in aroma was found in PT1, PT2, and PT3 samples throughout the storage time. At day zero, the PT1 sample scored the mean value of 7.8 in terms of the taste parameter and was preferred by the panellists. After 30 days of storage, the tested PT3 sample became the tastiest sample as it scored the mean value of 7.5 (Table 4.9). In addition, the PT1 and PT2 samples were observed to be significantly different ($p < 0.05$) from the PT3 sample (Table 4.9) in terms of taste attribute. The overall acceptance results indicated that the PT3 sample had the highest scores of 7.8 at day zero and 7.6 at 30 days. Therefore, these results suggested that the PT3 sample of 50g prekese syrup, 100ml of water, 20g of sugar and 100ml of milk was the most appealing sample for all the sensory attributes, i.e., colour, aroma, taste, and overall acceptance during storage.

Table 4.10. Frequency of whether respondents would like to take syrup beverage regularly

Responses	Frequency (f)	Percentage (%)
Yes	35	87.5%
No	3	7.5%
I am not sure	2	5%
Total	40	100%

Results on whether respondents would like to take the 'prekese' syrup regularly indicated that, majority of the respondents would prefer to take the 'prekese' syrup regularly. 35 respondents representing 87.5 responded yes, 3 of them representing 7.5% responded no and the remaining 5% were not sure. It can be deduced that majority of the panelists prefer to take the 'prekese' syrup regularly probably because of the health benefits associated with the syrup.

4.4 Shelf-Life Analysis of 'Prekese' Syrup

The final composite of two sample drinks (PT1, PT4) were pasteurized (62°C for 30 mins), bottled and closely monitored under two (2) different storage conditions; that is, refrigerator (5°C) and room temperature (26°C) to determine the shelf-life for seven (7) days. The following parameters were monitored during the period under consideration; ascorbic acid, Titratable Acidity (TTA), pH, alcohol and microbial content.

4.4.1 Effect of Different Storage Conditions on Vitamin C

Statistical analysis of the mean values of vitamins gave a significant different relationship between the PT1 and PT4 of Prekese Syrup, after a storage period of seven (7) days under both refrigerator and room temperature storage.

PT1 recorded 6.33mg/100g and 5.00mg/100g for both the refrigerator and ambient storage conditions, respectively, whilst PT4 also recorded 7.01mg/100g and 6.60mg/100g for the same conditions, respectively as shown in Tables 4.5 and 4.6.

Table 4.11: Effect of Refrigerator Storage on two products Drinks.

Parameter	PT1	PT4	Lsd	Cv
pH	4.17	4.67	0.089	0.54
TTA	0.26	0.22	0.057	6.45
Vitamin C	6.33	7.01	0.089	0.36

PT1 = (TN 100g: C 50g: G 50g) PT4 = (TN 66.6g: C 66.6g: G 66.6g)

Table 4.12: Effect of Room Temperature Storage on two sample products

Parameter	PT1	PT4	Lsd	Cv
Ph	4.11	4.06	0.078	0.51
TTA	0.33	0.20	0.078	7.86
Vitamins	5.00	6.60	0.969	4.45

PT1 = (TN 100g: C 50g: G 50g) PT4 = (TN 66.6g: C 66.6g: G 66.6g)

4.4.2 Effect of Different Storage Conditions on Titratable Acidity of PT1 and PT4

There were no significant differences ($p \leq 0.05$) between both sample drinks that is 0.26 in PT1 and 0.22 in PT4 when analysed for Titratable Acidity (TTA) after a storage period of seven (7) days in a refrigerator.

Meanwhile, PT1 recorded 0.33 and PT4 0.20 after being stored at a room temperature of 26°C for seven (7) days, indicating a significantly different relationship at $p \leq 0.05$ as shown in Tables 4.5 and 4.6.

4.4.3 Effect of Different Storage Conditions on Vitamin C

Statistical analysis of the mean values of vitamin C gave a significant different relationship between the PT1 and PT4, after a storage period of seven (7) days under both refrigerator and room temperature storage.

PT1 recorded 6.33mg/100g and 5.00mg/100g for both the refrigerator and ambient storage conditions, respectively, whilst PT4 also recorded 7.01mg/100g and 6.60mg/100g for the same conditions, respectively as shown in Tables 4.5 and 4.6.

4.4.4 Alcohol and Microbial Analysis

Alcohol content after the seventh day was zero (0) for both storage conditions. Microbial growth, in terms of total plate count recorded a value of one (1), total coliforms zero (0), and both *Staphylococus aureus*, and yeast / mould recorded a value of less than 10 (<10) for both storage conditions as shown in Table 4.6.

Table 4.13: Microbial Analysis of Prekese Syrup

Coliforms	Total (10-1)		Yeast and Moulds (10-1)		Staphylococcus aureus (10-1)		Total Plate Count	
Storage Condition	**PT1**	**PT4**	**PT1**	**PT4**	**PT1**	**PT4**	**PT1**	**PT4**
Refrigerator	0	0	<10	<10	<10	<10	1	1
Room Temperature	0	0	<10	<10	<10	<10	1	1

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of the study

5.1.1 Sensory Analysis

Based on the results obtained from chapter four, the four samples prepared for panellists to taste and verify according to their liking of the samples, it was found that PT3 had the highest mean score of 8.6 and was the most acceptable sample in terms of colour preference followed by sample PT4. This trend was also seen for all the samples during 30 days of storage, although the mean scores for the colour decreased slightly. It was determined that the PT3 and PT4 samples scored mean values of 8.1 and 7.9, respectively for the colour attribute at 30 days. In contrast, the PT1 sample scored the lowest value of 5.4, followed by the PT2 sample that had 5.9 mean score. In terms of aroma preference, the PT3 sample scored the highest mean value of 7.7, while the PT2 and PT1 samples scored 7.2 and 7.1, respectively, and the PT4 sample obtained the lowest score of 6.9 at day zero. After 30 days of storage, the PT3 sample scored the highest mean value of 7.8 and was ranked as “likely moderate” in terms of its aroma. The least mean value of 6.0 was found in the sample PT4, which indicates the least preference by the panellists in terms of aroma. No significant difference ($p > 0.05$) in aroma was found in PT1, PT2, and PT3 samples throughout the storage time. At day zero, the PT1 sample scored the mean value of 7.8 in terms of the taste parameter and was preferred by the panellists. After 30 days of storage, the tested PT3 sample became the tastiest sample as it scored the mean value of 7.5. In addition, the PT1 and PT2 samples were observed to be significantly different ($p < 0.05$) from the PT3 sample in terms of taste attribute. The overall acceptance results indicated that the PT3 sample had the highest scores of 7.8 at day zero and 7.6 at 30 days.

5.1.2 Shelf-Life Analysis

The rate of vitamin C degradation was lower when the drinks were stored in the refrigerator than at room temperature. The degradation under ambient temperature could be attributed to the heat to which the drinks were exposed. Wardlaw and Insel (1996) reported that water soluble vitamins like vitamins are easily destroyed by heat, exposure to light, air and cooking.

There were no detectable amounts of alcohol in the drinks under any of the storage conditions for the entire shelf-life period of seven (7) days. Indeed, the microbial analysis confirmed that there were no growths under any of the storage conditions.

The result for total coliforms, Staphylococcus aureus, yeast / mould and total plate count (Table 4.12) indicated that there were few Staphylococcus aureus and yeast / mould (<10), no total coliforms, with a total plate count of one (1) in both varieties of drink under the two storage conditions for the seven (7) day storage period.

The suppression of microbial growth could be attributed to the significant increase in the ascorbic acid content after the seven-day storage period.

5.2 Conclusion

With the objectives set for the study which was consumer acceptable, prekese syrup and broken down into develop beverages, determining consumer acceptability of the prekese syrup, and determining the shelf life of the drink. The following conclusion were drawn. In determining consumer acceptability of Prekese syrup, it was found that the PT3 sample of 50g prekese syrup, 100ml of water, 20g of sugar and 100ml of milk was the most appealing sample for all the sensory attributes, i.e., colour, aroma, taste, and overall acceptance during storage.

The keeping quality of Prekese Syrup at an ambient temperature of 26°C and a refrigeration of 5°C for seven (7) days performed better. However, almost all the quality attributes of the Prekese Syrup based drink under study were preserved after storage in the refrigerator than those stored under ambient temperature. The rate of vitamin C degradation was also slower in the refrigerator than that under ambient temperature.

5.3 Recommendation

Future researchers should consider preparing Prekese Syrup by taken children into accounts. For the conclusion drawn may not be the same for children. In order to increase reliability in the sales of the product, children must be taken into accounts. Also, future researchers should consider different panellists to ensure different views from different breed of people.

More work on shelf-life study beyond the seven days should be carried out to ascertain the keeping quality of the Prekese Syrup.

Studies on packaging effect on storability should be carried out to determine the type of packaging that can best prevent interaction between the environment and the product.

Other formulations adding different of fruits and vegetables should be carried out to improve upon the developed drinks.

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APPENDIX I

SCORE SHEET FOR SENSORY EVALUATION DATA

UNIVERSITY OF EDUCATION, WENNIBA, KUMASI CAMPUS

I am a MTECH (Master of Technology in Catering and Hospitality) student of university of Education, Wenniba, Kumasi campus, I am undertaking research on the topic: **Examining consumer acceptability of prekese syrup as non-alcoholic beverage**.

Important Note: Information supplied by you will be treated as strictly confidential. Identity of position will not be revealed. Information will be used for only academic work. I greatly appreciate your co-operation.

Sample: Prekese Syrup

SECTION A: DEMOGRAPHIC INFORMATION OF THE RESPONDENTS

1. Gender Male [ ] Female [ ]

2. Age 15-25 [ ] 26-35 [ ] 36-45 [ ] 46-55 [ ]

56 and above [ ]

3. Marital Status Married [ ] Separated [ ] Divorced [ ] Widowed [ ]

4. Educational Status

Basic Education [ ] SHS [ ] Tertiary [ ] None [ ]

SECTION B: SENSORY ASSESSMENT OF PREKESE SYRUP

Yon have been provided with Prekese Syrup and are expected to make a fair assessment based on a nine-point hedonic scale. That is;

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.

The assessment is to be done base on the following food characteristics; Taste, Colour, Aroma and overall acceptance as shown below.

Note: Please rinse your mouth after tasting each sample.

PRODUCT	TASTE	COLOUR	AROMA	OVERALL ACCEPTANCE
PT1				
PT2				
PT3				
PT4				

SECTION C: PREFERENCE

Would you like to take Prekese syrup beverage regularly?

Yes [ ] No [ ] I am not sure [ ]