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An Investigation Into Organoleptic Evaluation and Phytochemical Screening of Dried Powdered Peel, Pulp of Ripped Pawpaw, Production Fresh Pawpaw Juice and Sensory Evaluation of the Pawpaw Juice

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Abstract

Organoleptic evaluation and phytochemical screening were carried out on dried powdered pawpaw peel, pulp of ripped pawpaw. Organoleptic characters investigated were size, colour, odour, taste and texture of the dried powdered pawpaw peel, pulp and the pawpaw drink. Phytochemical screening involved testing each of dried powdered pawpaw peel and pulp for different classes of secondary plant metabolites. The methods used for detection of the various phytochemicals include qualitative chemical tests to give general idea regarding the nature of constituents present in the different solvent extracts of the powdered Pawpaw peel and pulp. The powdered peel was found to be brown in colour, sticky and tasted bitter indicating that the peel contained alkaloids. The sweet taste of the pulp indicates the presence of carbohydrates. The results of phytochemical screening indicated that the dried powdered peel of ripped pawpaw fruit tested positive for starch, glucose, proteins, sterols, Alkaloids, tannins, flavonoids and phenolic compounds, fats and oils, glycosides and saponins while the driedpulptested positive for starch, glucose, glycosides and saponins. The dried Powdered peel of ripped pawpaw fruit contains more secondary plant metabolites than the dried pulp. It is therefore suggested that the peel should be included in the future formulation of the Pawpaw Juice. The results of the sensory evaluation of the Pawpaw Juice served to 40 semi-untrained panellists randomly selected from the various Departments of the Eastern Technical University of Sierra Leone indicated that the colour (75%), taste (87.5%), aroma (80%) and texture (60%) were general acceptable and good. It can therefore be used as food supplement for children.

Keywords: Alkaloid, Metabolites, Taste, Flavonoids, Supplement

1.0. Introduction

This research was geared towards the investigation into the production of Pawpaw juice as food supplement for under-five children in Sierra Leone.

A lot of Fruits grown in Sierra Leone do not have adequate storage facilities and hence generates a large amount of waste or by products such as peels, pulp, seeds or fibrous materials. It has been reported that by-products are important sources of sugars, minerals, organic acids, fibre, and phenolic compounds that have a wide range of pharmacological activities, which include

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antitumor, antiviral, antibacterial, cardio protective and ant mutagenic activities **(Claudia *et al.*, 2014; Djilas *et al.*, 2009).**

Pawpaw is a fast-growing fruit tree with edible fruits which are consumed in many countries of the world. It has been reported that fruits are edible in its unripe and ripe forms such as in salads, juices, smoothies, soups and for therapeutic purposes. Other uses include in medicine and cosmetic industries were the fruits as well as other parts of the tree are used in the production of drugs and several cosmetic items. Pawpaw fruits are rich in several nutrients especially vitamins and minerals however its consumption is low when considered to other popular fruits**(Feng, 2014; Dagerman et. al. 2020).**

Figure 1.Labelled diagram of Ripped pawpaw fruit

The fruit is an excellent source of calcium, pro-vitamin A, and vitamin C (ascorbic acid); thus, it is widely used in diets (**Serrano and Cattaneo, 2010; O'Neil, et al, 2011; Nyambo et al., 2005**).

Pawpaw is the fruit of *Carica papaya* which belongs to the genus Carica. In recent years, attention is been directed to this fruit by researchers due to its nutritional and medical properties. Pawpaw fruits are a good source of carbohydrate, vitamins C and A and minerals (copper and magnesium) (**Wall, 2006**). Pawpaw latex is released from laticifers in both female and hermaphrodite plants (**Feng, 2014**). The latex contains at least four cysteine and peptidases and other constituents including hydrolase inhibitors and lipase, which has been widely applied for food industries, pharmacy, papain which is a major component of papaya latex and as direct treatment for paediatric burns in some African countries, such as Gambia **(Azarkan*et al.*, 2006; Chen and Tsai, 2005; Maria *et al.*, 2006; Morcelle*et al.*, 2006; Nitsawang*et al.*, 2006; Starley*et al.*, 1999, Duke 1996;Oyoyede, 2005, Bari *et al.* 2006).**

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Figure 2. Raw pawpaw fruits on the tree

Research work has shown that pawpaw contains vitamin C (51.2 mg/100g), vitamin A precursors including β-carotene (232.3 µg/100g), and β-cryptoxanthin (594.3 µg/100g), as well as magnesium (19.2-32.7 mg/100g) (Wall, 2006). Pawpaw seeds contain balance nutrients which consists of protein (24.3%), fatty oil (25.3%) and total carbohydrate (32.5%) (**Feng, 2014**,**Oyoyede, 2005, Bari *et al.* 2006, Nyambo *et al*., 2005; Zahir *et al*., 2009, Krishna, Paridhavi& Patel, 2008, Huskisson *et al*., 2007; Wall, 2006)**also reported pawpaw fruit to be rich in carbohydrates (42.28% starch and 15.15% sugar in pulp), but deficient in protein and fat. About per 100 g of the fruit provides 39 kcal (163 kJ) energy and it is a very important food source in some developing countries (**Feng, 2014**). Pawpaw juice had been reported to be in used in some developing countries for cooking (**Feng, 2014**). **Duke, (1996)** reported the fruit to be high in protein (7.0 g), calcium (334 mg), phosphorus (142 mg), sodium (16 mg), vitamin B and vitamin E (136 mg). In recent years, papaya latex and its commercial products have been widely applied in baking, beverage industries, pharmacy and chemicals synthesis (**Feng, 2014, Krishna, Paridhavi& Patel, 2008,Nyambo et al., 2005; Zahir et al., 2009. Branca& Ferrari, 2002; Thiong'o, Kingori&Jaenicke, 2002, MoPHS& SCUK, 2011**).

It has been also reported that Pawpaw juice prevents many nutritional disorders because they provide hundreds of naturally occurring substances such as dietary fibres, water, easily digestible sugars and antioxidants, and have a high nutrient and low energy density

2.0. Research Method

2.1. Description of Research Area

The research was conducted at both the Chemistry and the Food Science and Consumer Education Departments of the Eastern Technical University of Sierra Leone, Kenema Campus. The campus University is located at 154 Combema road, Nongowa Chiefdom Kenema city. The people of Kenema are predominantly Ko-Mende, although there are other ethnic groups. Most of

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the inhabitants in Kenema and its environs are farmers engaged in growing many varieties of rice, cassava and potatoes.

The study area was selected because of the presence of The Sierra Leone Agricultural Research Institute in Kenema City and provide technical assistance to farmers for the growing and cultivating vegetables mainly consumed by people in this area. Ripped pawpaw fruits are cultivated as food supplements to their meals.

The Sierra Leone Agricultural Research Institute, Kenema as part of its Foods Security activities, cultivates different varieties of vegetables and supervises the Department of Crop Production at the Eastern Technical University farm.

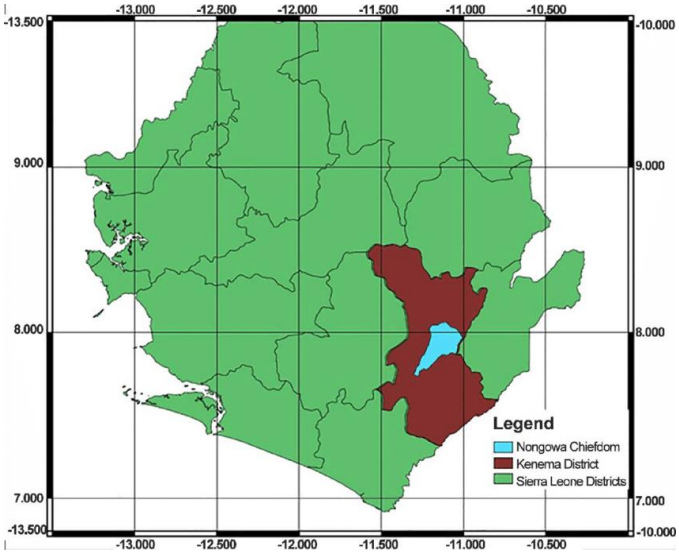

Figure 2. Map of Sierra Leone showing Kenema District

2.2. Preparation of Pawpaw Plant Materials

The Pawpaw fruits were harvested from the University Agricultural Farm, washed thoroughly and pealed. Both the pawpaw peel and pulp were reduced in size by crushing them separately into smaller pieces using the hand and knife, dried under the shade and not the sun so as to protect the thermo-labile components if present from being chemically transformed. After the plant material had been dried, they were grounded separately using a mortar and pestle. The powdered plant materials of both the powdered pawpaw peel and pulp to be investigated were kept in specially sealed containers in a refrigerator.

The powdered plant materials were used for the following analyses;

- Organoleptic evaluation
- Phytochemical analysis
- Production of pawpaw juice and sensory evaluation of the Pawpaw Drink produced

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2.3. Organoleptic Characters

Organoleptic evaluation was carried out on dried powdered pawpaw peel, pulp and the pawpaw drink by means of sense organs, which provided the simplest as well as quickest means to establish the identity and purity to ensure quality of the plant organ.

Organoleptic characters investigated (**Siddiqui, 1995**) were size, colour, odour, taste and texture of the dried powdered pawpaw peel, pulp and the pawpaw drink.

2.4. Phytochemical Screening

Phytochemical screening involved testing each of dried powdered pawpaw peel and pulp for different classes of compounds secondary plant metabolites. The methods used for detection of the various phytochemicals include qualitative chemical tests to give general idea regarding the nature of constituents present in the different solvent extracts of the Powdered pawpaw peel and pulp. (**Khandelwal, 1995; Trease et el. 1978; Sazada et el. 2009; Kokate et el. 2006; Nayak, 2007**).

2.5. Test for Carbohydrates

A small quantity of each the dried powdered pawpaw peel and pulp (5mg each) was dissolved in 5 ml distilled water and filtered. The filtrate was subjected to the following tests to detect the presence of carbohydrates.

- **Fehling's Test:** - 1ml of the extract filtrate was treated with 1ml Fehling's solution A and 1ml Fehling's solution B and the mixture boiled for 5-10 minutes on a water bath. The formation of reddish-brown precipitate (cupper (I) oxide) indicates the presence of reducing sugar.

- **Benedict's Test:** - 1ml of the extract filtrate was treated with Benedict's reagent in a test tube. The mixture was boiled for 5-10 minutes on a water bath. A change in colour of the solution from blue to green, to yellow or brick-red precipitate depending on the amount of test sample present indicates the presence of reducing sugar.

- **Iodine Test**: 2 drops of iodine solution were added to 1ml of the solvent extract. The formation of blue-black colour indicates the presence of starch.

2.6. Test for Proteins

Biuret Test: Each of the Solvent Extracts was treated with 1 ml 10% sodium hydroxide solution and heated. 2-3 drops of 0.7% copper (II) tetraoxosulphate (VI) solution was added to the mixture stirred and allowed to stand for few minutes. The formation of purplish violet colour indicates the presence of proteins

2.7. Test for Fats and Oils

5mg of each the dried powdered pawpaw peel and pulp was put into a beaker and 20 ml of water added and stirred. 5 ml of Sudan III Solution was added to the mixture and boiled for few minutes and filtered when hot. The formation of red specks of residue on the filter paper indicate the presence of Fats and Oils.

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2.8. Test for Saponin Glycosides:

- **Froth Test**: - Each the dried powdered pawpaw peel and pulp was treated with water in a semimicro tube and shaken well. The appearance of a persistent froth on top of the mixture indicates the presence of glycosides.

2.9. Tests for Sterols and Triterpenoids

Libermann-Burchard Test

The dried powdered pawpaw peel and pulp was treated with few drops of acetic anhydride and then boiled for few minutes. The mixture was cooled and concentrated tetraoxosulphate (VI) acid added down the side of the test tube. The appearance of a brown ring at the junction of the two layers with the upper layer turning green is indicative of the presence of sterols and formation of a deep-red colour indicates the presence of triterpenoids.

Salkowski's Test

The dried powdered pawpaw peel and pulp was treated with chloroform and few drops of concentrated tetraoxosulphate (VI) acid. The mixture was shaken well and allowed to stand for some time. The appearance of a red colour in the lower layer indicates the presence of sterols while formation of a yellow-coloured lower layer indicates the presence of triterpenoids

2.10. Tests for Tannins and Phenolic Compounds

Ferric Chloride Test: A small amount of each of the dried powdered pawpaw peel and pulp solventextract was shaken with water and warmed, followed by addition of 2 ml of 5% ferric chloride solution. The formation of green or blue colour indicates the presence of phenols.

Iodine Test: Each of the dried powdered pawpaw peel and pulp solventextract was treated with dilute iodine solution. The appearance of a transient red colour indicates the presence of tannins and phenolic compounds.

2.11. Test for Alkaloids

About 0.5 mg of each of the dried powdered pawpaw peel and pulp solventextract was stirred with about 5 ml of dilute hydrochloric acid and filtered. The following tests were conducted on the filtrate:

- **Hager's Test**: Few drops of Hager's reagent (saturated aqueous solution of picric acid) was added to each filtrate and observed. The formation of yellow precipitate indicates the presence of alkaloids.

- **Wagner's Test**: Few drops of Wagner's reagent (solution of iodine in potassium iodide) was added to the filtrate and observed. The formation of reddish-brown precipitate indicates the presence of alkaloids.

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2.12. Tests for Flavonoids

• **Alkaline Reagent Test**: Dilute ammonia solution was added to a small quantity of each of the dried powdered pawpaw peel and pulp solventextract and observed. The appearance of a yellow-coloured precipitate after few minutes indicates the presence of flavonoids.

Figure 3. Phytochemical Screening of the Pawpaw solvent extract

2.13. Developing Pawpaw Fruit Juice

Materials	**Quantity**
Fresh Pawpaw Fruit	300g
Honey	50g
Distilled water	1000ml
Equipment	
Electric Blender	2
Beakers (500ml, 1000ml)	4(two each)
Measuring cylinder (500ml)	2
Digital balance	1
pH meter	1
Sieve wire	2
Teaspoons	5
Thermometer (0 – 100^{o}C)	2
Magnetic stirrer	2
Spatula	2
Glass rod	4

2.14. Production of Juice from Ripped Pawpaw pulp

The fresh ripped pawpaw fruits were washed peeled, weighed and the pulp placed in an Electric Blender.

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500 ml of distilled water was added and then blended until uniform mixture was produced.

The mixture was filtered with a filter cloth and the filtrate was mixed with 50 grams of honey.

The mixture was re-heated through a temperature of 80^{o}C for 10 mins, allowed to cool and subjected to sensory evaluation.

Figure 4. Pawpaw Fruit Juice

2.15. Sensory Analysis

The Pawpaw Juice coded **FPJ01**was served to 40 semi-untrained panellists who were randomly selected from the various Departments of the Eastern Technical University of Sierra Leone to sensory evaluation in terms of the flavour, taste/mouth feel, colour and general acceptability, using a set of prepared evaluation sheet based on a nine (9) point hedonic ranking scale.

The nine (9)- point hedonic scale is listed below:

1= like extremely
2= like very much
3= like moderately
4= neither like nor dislike
5= dislike extremely

The panellists identified their acceptance of characteristics (colour, taste, aroma, and texture) using a score sheet. The acceptability test results were used to obtain the best formulations using the Effectiveness Index Method.

The responses to the nine (9)- point hedonic scale were grouped as shown below;

Like extremely/very much/moderately (**LVK**)
Neither like nor dislike (**NLD**)
Dislike extremely (**DE**)

The results of the sensory evaluation are presented using statistical tools (Respondents and percentages) and interpreted in simple tables.

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3.0. Result and Discussion

The results of Organoleptic evaluation, Phytochemical screening and sensory evaluation of the Pawpaw fruit organs are reported below;

3.1. Organoleptic Evaluation of Dried powdered pawpaw peel and pulp

The results of Organoleptic evaluation involving the colour, odour, taste, texture and particle size of the powdered plant organs carried out on thedried powdered pawpaw peel and pulp are reported in Table 1 below and their photos shown in Figure 4.

Table 1. Results of Organoleptic Evaluation of the powdered pawpaw peel and pulp

Plant Species	**Plant Organ**	**PROPERTY TESTED**				
		Colour	**Odour**	**Taste**	**Texture**	**Particle Size**
Ripped Pawpaw Fruit powders	peel	Brown	Characteristics	Bitter	Sticky	100 gauge
	pulp	Dark Brown	Characteristics	sweet	Smooth	Large

The bitter taste indicates that the powdered Pawpaw peel contain alkaloids while the sweet taste of the powdered pulp indicates the presence of glucose.

Figure 4. Showing the photos of the powdered plant materials investigated

The colour of the powdered plant material shown in Figure 4, above will also help who so ever wish to buy and use the powdered plant material for food and medicine. It helps prevent adulteration.

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Table2.The Results of Food Tests and Phytochemical screening carried out on Peel and pulp of Ripped Pawpaw

Reagent	Property tested	Dried powdered peel		Dried Powdered pulp	
		Observation	Inference	Observation	Inference
Iodine Test	Starch	Blue-black colour	++	No Blue-black colour seen	-
Biuret test	Protein	Violet colour	+++	Violet	+
Benedict's Test	Glucose	Brick red precipitate	++	Brick red precipitate	+++
Fehling's Test	Glucose	Brick red precipitate	++	Brick red precipitate	+++
Sudan III test	Fats	Few red stains on the filter paper	++	No Translucent mark	-
Hager's Test	Alkaloids	Formation of yellow precipitate	+++	No visible reaction	-
Wagner's Test	Alkaloids	Yellowish precipitate	+++	No visible reaction	-
Alkaline Test	Flavonoids	Intense yellow colour	+++	No visible reaction	-
Iron (III)Chloride Test	Tannins and Phenolic	Formation of blue colour	+++	No visible reaction	-
Libermann-Burchard Test	Sterols/ Triterpenes	layer turned green	+++	No visible reaction	-
Froth Test	Glycosides and Saponins	Persistent froth	+++	Persistent froth	+

Key: + = slightly positive, +++ intensely positive, - = Negative

The dried Powdered peel of Ripped pawpaw tested positive for starch, glucose, proteins, sterols, Alkaloids, tannins, flavonoids and phenolic compounds, glycosides and saponins while the dried powdered pulp tested positive for glucose, glycosides and saponinsas shown in Table2. The dried Powdered peel contains more phytochemicals than the dried powdered pulp. It is therefore suggested that the peel should be included in the future formulation of the pawpaw juice.

Figure 5. Showing the colours of the Pawpaw flesh/pulp during food test

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3.2. Production of Pawpaw Juice and Sensory Evaluation of the Product

The results of the processed developed sample of Fresh Pawpaw juice served to (40) semi-untrained panellists randomly selected from the various Departments of the Eastern Technical University of Sierra Leone for sensory evaluation are shown in **Tables 3 – 6.**

Table3. Respondent's Sensory Evaluation of the Colour of Sample Products

Sensory Evaluation Attribute	**Fresh Ripped Pawpaw Fruit Juice**	
	Respondents	**Percentage**
Like extremely/very much/moderately **(LVK)**	30	75.0
Neither like nor dislike**(NLD)**	8	20.0
Dislike Extremely **(DE)**	2	5.0
TOTAL	**40**	**100.0**

From Table 3, and Chart 1, indicates responses to the sensory evaluation made on the colour of the Fresh Pawpaw juice. The results indicated higher percentages 30 (75%) in favour of the colour of the juice produced.

Chart 1. Showing the sensory evaluation made on the colour of the Pawpaw juice

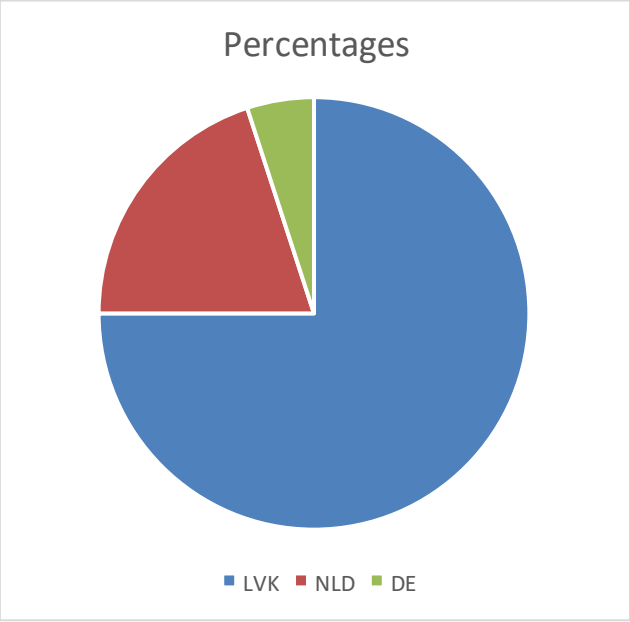

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Table4. Respondent's Sensory Evaluation of Tasteof the Product

Sensory evaluation attribute	**Pawpaw Juice (FPJ1)**	
	Respondents	**Percentage**
Like extremely/very much/moderately **(LVK)**	35	87.5
Neither like nor dislike**(NLD)**	4	10.0
Dislike Extremely **(DE)**	1	2.5
TOTAL	**40**	**100.0**

From Table 4, and Chart 2, indicates responses to the sensory evaluation made on the taste of the Fresh Pawpaw juice. The results indicated higher percentages 35 (87.5%) in favour of taste of the juice produced.

Chart 2. Showing the sensory evaluation made on taste of the Pawpaw juice

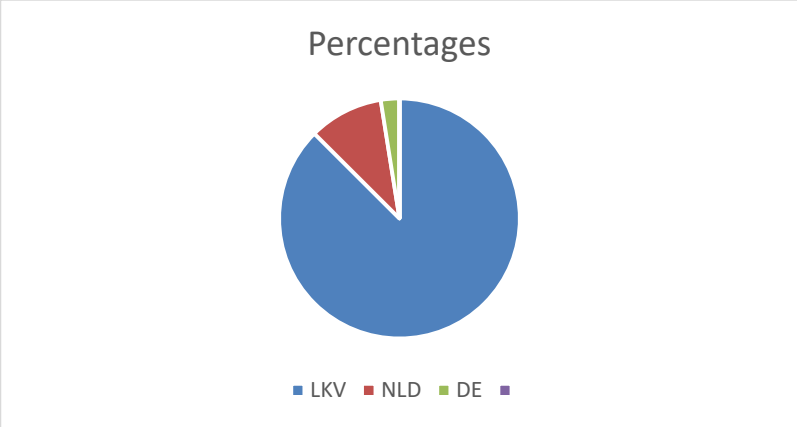

Table5. Respondent's Sensory Evaluation of Aromaof Product

Sensory evaluation attribute	**PawpawJuice (FPJ1)**	
	Respondents	**Percentage**
Like extremely/very much/moderately **(LVK)**	32	80.0
Neither like nor dislike**(NLD)**	5	12.5
Dislike Extremely **(DE)**	3	7.5
TOTAL	**40**	**100.0**

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From Table 5 and Chart 3, indicates responses to the sensory evaluation made on the aroma of the Fresh Pawpaw juice. The results indicated higher percentages 32 (80.0%) in favour of aroma of the juice produced.

Chart 3. Showing the sensory evaluation made on aroma of the Product

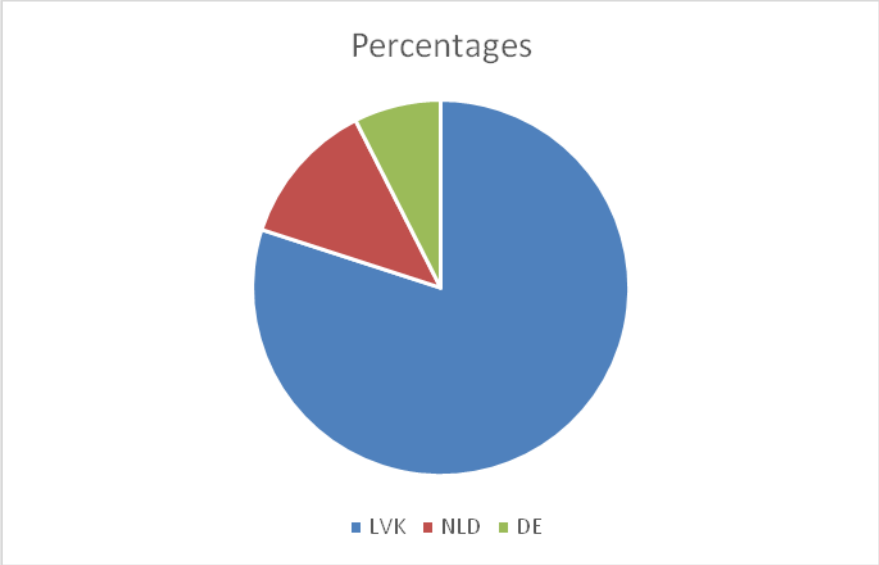

Table6. Respondent's Sensory Evaluation of the Texture of Product

Sensory evaluation attribute	Pawpaw Juice (FPJ1)	
	Respondents	**Percentage**
Like extremely/very much/moderately **(LVK)**	24	60.0
Neither like nor dislike**(NLD)**	12	30.0
Dislike Extremely **(DE)**	4	10.0
TOTAL	**40**	**100.0**

From Table 6 and Chart 4, indicates responses to the sensory evaluation made on the texture of the Fresh Pawpaw juice. The results indicated higher percentages 24 (60.0%) in favour of the texture of the product

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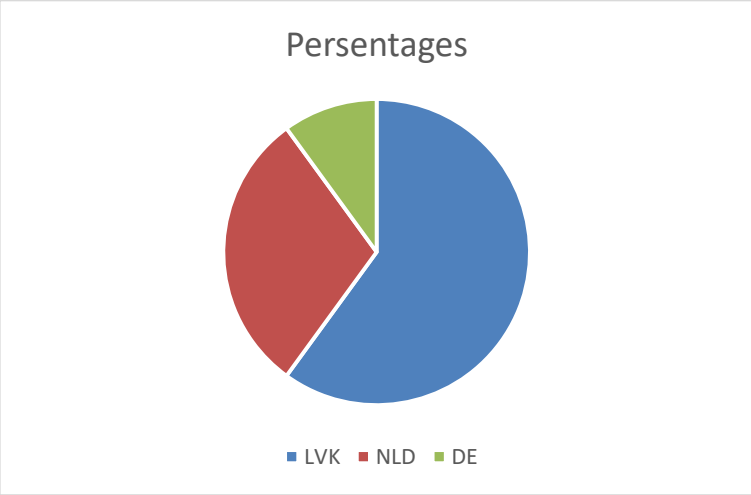
Chart 4. Showing the sensory evaluation made on the texture of the Product



4.0. Summary. Conclusions and Recommendations

4.1. Summary of the results

Organoleptic evaluation involving the colour, odour, taste, texture and particle size of the powdered plant organs carried out on the Dried Powdered peel and pulp of ripped pawpaw fruit. The powdered peel was found to brown in colour, sticky and tasted bitter indicating that the peel contained alkaloid. The sweet taste of the pulp indicates the presence of glucose.

The results of phytochemical screening indicated that the dried powdered peel of ripped pawpaw fruit tested positive for starch, glucose, proteins, sterols, Alkaloids, tannins, flavonoids and phenolic compounds, fats and oils, glycosides and saponins while the dried pulp tested positive for starch, glucose, glycosides and saponins.

The dried Powdered peel of ripped pawpaw fruit contains more phytochemicals than the dried pulp. It is therefore suggested that the peel should be included in the future formulation of the Pawpaw Juice.

The results of the sensory evaluation of the Pawpaw Juice served to (40) semi-untrained panellists randomly selected from the various Departments of the Eastern Technical University of Sierra Leone indicated that the colour (75%), taste (87.5%), aroma (80%) and texture (60%) were general acceptable and good.

4.2. Conclusions

The powdered peel was found to dark-brown in colour, sticky was tasted bitter indicating that the peel contained alkaloid. The sweet taste of the powdered tubers indicates the presence of carbohydrates. The colour of the powdered plant material will also help who so ever wish to buy and use the dried plant material as food. It helps prevent adulteration.

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The dried powdered peel of ripped pawpaw fruit tested positive for starch, glucose, proteins, sterols, Alkaloids, tannins, flavonoids and phenolic compounds, fats and oils, glycosides and saponins while the dried powdered pawpaw pulp tested positive for starch, glucose, glycosides and saponins.

The dried Powdered peel of ripped pawpaw contains more phytochemicals than the dried pulp. It is therefore suggested that the peel should be included in the future formulation of the Pawpaw Juice.
The results of the sensory evaluation of the Pawpaw Juice served to 40 semi-untrained panellists were general acceptable and good.

Literature search for the nutritive value of pawpaw juice indicated that it contained diverse micronutrients. They provide a range of important minerals such as phosphorus, magnesium, potassium, iron, calcium and zinc which play a role in macronutrient metabolism, growth and development of children (**Huskisson et al., 2007; Wall, 2006).** They also contain vitamins, enzymes, polysaccharides, proteins, alkaloids, glycosides, fats and oils, lections, saponins, flavonoids and sterols (**Krishna, Paridhavi&Patel, 2008**). In addition to the micronutrients, fruits contain dietary fibre and a broad spectrum of phytochemicals such as ascorbic acids, phenolic compounds and carotenes which have various health benefits (**Liu, 2004**).

4.3. Recommendations

It is therefore recommended from the results of this research work that the whole ripped Pawpaw fruit with the peels be used for consumption and preparation for Papaw Juice for children under five years of age.

The Government of Sierra Leone and Non-Governmental Organizations should commit themselves to the cultivation of Pawpaw Fruits instead wasting our foreign reserves to purchase Vitamin A supplements.

It is also recommended that both the Chemistry and the Food Science and Consumer Education Departments of the Eastern Technical University of Sierra Leone, Kenema Campus develop flour from purple sweet potatoes and its drink that can readily be sold in the market.

4.4. Acknowledgement

The authors are grateful to Mr. Gbondo, Laboratory Technician, Department of Chemistry for carrying out organoleptic evaluation and phytochemical screening on the dried powdered peel and pulp of ripped pawpaw fruit and the Technicians of the Food Science and Consumer Studies Department for carrying out the Sensory analysis.

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