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Evaluation of Physiochemical, Sensory and Microbial Qualities of Mixed Fruits Juice from Watermelon and Lime Fruits

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ABSTRACT

This study investigated the evaluation of physiochemical, sensory and microbial qualities of mixed fruit juices from blends of watermelon and lime fruits. The mixed fruit juices were extracted using juice extractor, blended and mixed in the ratios of 90:10,85:15,80:20,50:50 and 100% respectively. The juice samples were pasteurized at 85^{o}C for 5 minutes. All the analyses were carried out using standard methods for physiochemical parameters which included pH, titratable acidity, brix(%) crude protein, crude fiber, moisture content, ash, fat, carbohydrate, vitamin C and some mineral elements such as calcium, potassium, iron and magnesium. The results showed that mixed fruit juices are rich in carbohydrates, vitamin C, magnesium and potassium. Significant difference existed (p <0.05) in terms of color, taste, flavor, aroma and general acceptability of the various juice blends when compared with control sample. Sample A (100%) had the highest acceptability in terms of taste, color and flavor, while sample E (50:50%) had the least acceptability. Microbial count result showed no growth because the count was below the acceptable limit of < 10/cfu/ml for pasteurized fruit juices, for total aerobic viable cells, coliform and fungi counts. However, the biochemical test revealed some microbial flora such as Bacillus spp, Escheria coil and Salmonalla spp. Thus, from this study it can be concluded that the development of new products where two or more kinds of fruit juices are blended to obtain a new product that combines the nutritional value of both fruits with the benefits of a pleasant taste, safe and accepted by consumers could be encouraged by the food industry.

1.0 INTRODUCTION

Fruits are highly perishable, non-staple foods which make up about 39% of the food intake (fresh state or processed form) of people living in developing countries of Africa (Akusu *et al.*, 2016). Fruits and its juices constitute one of the most important foods for man and their regular consumption maintains health and makes up for the losses in the human diet (Okwori *et al.,* 2017). Consumption of fresh juices is increasing all over the world due to their freshness, high vitamin content, low caloric consumption and ability to reduce risk of many diseases (Rathnayaka, 2013), such as diabetes, heart diseases and cancer. Fruit juice contains antioxidants, vitamins and minerals that are essential for human beings (Aneja *et al* 2014).

The high potassium and low sodium characteristic of most juices help in maintaining a healthy blood pressure. Vitamin C is naturally present in juices which are essential for the body to form collagen, cartilage, muscle, and blood vessels. It also helps in the absorption of iron (International Federation of Fruit Juice Union, 2011).

Fruit juice is defined as a "non-fermented and non-sparkling fruit or vegetable beverage, obtained by dilution in potable water of the juice, pulp or vegetable extract of the fruit of origin, with or without sugar". These are the unfermented, but fermentable, liquids obtained from the edible part of sound, appropriately mature and fresh fruits or fruits maintained in fresh condition by physical means or other suitable treatments. Juices can be obtained by mechanical extraction processes or by reconstitution of concentrated fruit juice with clean water. Juices can be cloudy or clear and have the essential characteristics typical of the juice of the fruit from which it comes. Diluting and/or blending are common practices as many fruit juices are either too acidic or too strongly flavored to be pleasant for consumption.

Watermelon (*Citrullus lanatus*; family: Cucurbitaceae), also known as the sweet desert watermelon, is believed to have originated in North Eastern Africa over 5,000 years ago and is cultivated for water and food (Paris, 2015). Watermelon consists of approximately 93% water, is highly nutritional, especially the rind and seed (Erhirhie and Ekene, 2014).

Lime (*Citrus aurantifolia*) a citrus fruit is a household essential ingredient in numerous food or in cuisine worldwide sequel to its distinctive sour taste. Its juice can be directly squeezed into food during cooking (Cruz-Valenzuela *et al*., 2016). Lime juice contains organic acid which is majorly citric acid that can serve as a natural preservative. Good antimicrobial agents can be gotten from major citrus family such as lime, lemon, orange and another genus in the group (Ezeigbo *et al*., 2015).

Mixed fruit juices are liquid, non-alcoholic drink produced from the blends of fresh fruit juice such as orange, tangerine, banana, watermelon, and pineapple among others (Onwuka, 2014). In Nigeria, there is an availability of suitable fruits which could be exploited for juice making such as passion fruit, watermelon, pineapple, banana, and orange among others. These fruits are highly perishable in nature (Fish and Davis 2003). Large quantities of the fruit are traditionally and commercially processed into the different products such as wine, fruit juice, soft drink, carbonated beverages, and alcoholic drinks which help to prevent post-harvest loss.

Studies conducted on pre-cut watermelon in the northern (Kano), eastern (Imo and Abia), and western (Oyo and Ogun) parts of Nigeria revealed a high level of either pathogenic or spoilage organisms such as *Salmonella spp., Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Aspergillus Niger, Rhizopus stolonifer* and *Lactobacillus spp.,* which are a reflection of the sanitary conditions and habits involved with handling the fruits (Chukwu *et al*., 2010; Ijah *et al.,* 2015 and Titilayo and Salome, 2014). However, little information is available on the microbiome of the whole watermelon.

Watermelon consumption can be useful in maintaining acid–base balance in the body that has a major role in normal physiology, maintaining appetite and normal digestion (Choudhary *et al*., 2015). Hence, consuming contaminated juice of the fruit may give rise to infection of digestive systems like diarrhea (Gry *et al*., 2016). Watermelon fruit juices processed under hygienic conditions could an play important role in enhancing consumer's health through inhibition of breast cancer, congestive heart failure (CHF) and urinary tract infection (Bello *et al*., 2014). The fruit supplies an excellent medium for the growth of both pathogenic and spoilage microorganisms thus, watermelon mixed fruit juices when pasteurized could prevent possible infection routes of these pathogens when investigated and possible measures outlined so as to maintain the nutritional component of mixed fruit juices.

Thus, the objective of this work was to determine the physicochemical, sensory properties and microbial qualities of pasteurized mixed fruit juices produced from blends of watermelon and lime fruits.

2.0 MATERIALS AND METHODS

2.1 Materials

The raw material that was used in this study was purchased from new market in wukari, Taraba state, Nigeria. They were conveyed to Food Science and Technology laboratory for analysis.

2.2 Methods

2.2.1 Preparation of Sample

The method as described by Ijah *et al*., (2015) was used to prepare mixed fruit juice (watermelon and lime). The fruits were washed, in clean water, sliced and extracted using juice extractor (JEX328 UK). The fruit juices were divided into portions in ratio of 90:10, 85:15, 80:20, and 50:50. Thereafter, the juices were dispense into sterile plastic containers of 100mls each, and pasteurized at 85°C for 5 minutes.

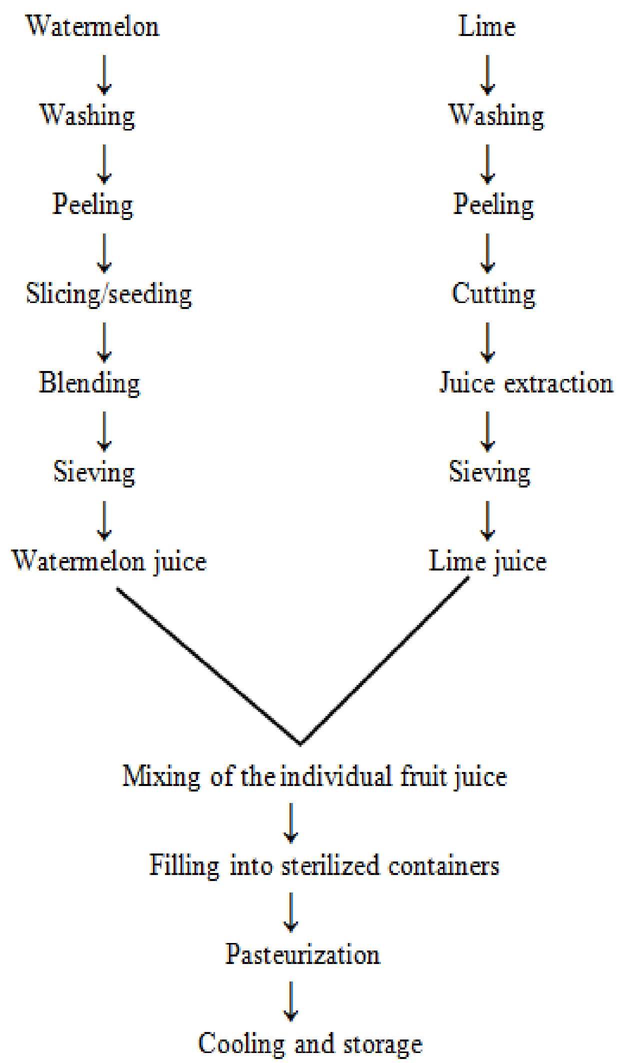

Fig 1: Production of watermelon lime juice
Source; (Ijah *et al*., 2015).

2.3 Analytical Methods

2.3.1 Physiochemical Analysis of Mixed Fruit Juices

2.3.1.1 Determination of pH

The pH of the samples was determined using digital pH meter (JENWAY 3510) according to the method reported in AOAC (2010). 10ml of the juice sample blends each were used for the calibration of the pH using standard buffer solution of pH 4.0 and 7.0.

2.3.1.2. Determination of titratable acidity (%TTA)

The method as described by AOAC (2010) was used to determine titratable acid value of the samples. 10 ml of the mixed fruit juice was diluted to 250 ml using distilled water and titrated with standardized 0.1 N sodium hydroxide (NaOH) solution using 0.3 ml phenolphthalein indicator for each 100 ml solution titrated to a pink end point, which persisted for 30 seconds and the result were expressed in terms of NaOH/100 ml of the sample.

2.3.1.3 Determination of Sugar content (°Brix) :

Sugar content (°Brix) was determined using a hand refractometer (Bellingham and Stanly, Model A85171) at 20 °C according to the method of (AOAC,2010) and the value obtained from the reference standard table was expressed as percentage sucrose by weight (°Brix).

2.3.2 Determination of Vitamins

2.3 .2.1 Determination of vitamin C

The vitamin C (Ascorbic acid) was determined according to the procedures of AOAC (2010). 20 ml of the fruit juice sample was pipette into 250 ml conical flask; 150 ml of distilled water and 1ml of starch solution indicator was added. The sample was titrated with 0.005 M iodine solution. The endpoint of the titration indicated a dark blue black colour. The amount of vitamin C in the sample was calculated in mg/100 ml.

2.4 Proximate Composition Analysis

2.4.1 Determination of moisture content

The moisture content was determined using the method described by AOAC (2010). 10mls of juice sample was measured into a crucible and heated in the oven at 105^{o}c for 4 hours until constant weight was obtained. The loss in weight from the original sample weight was calculated as the moisture content.

2.4.2 Determination of crude Fiber Content

The crude fiber was determined according to the method of AOAC (2010). Petroleum ether was used to defat 2g of sample. This was poured in a beaker containing 200 ml of 1.25 % H_2SO_4, boiled for 30 minutes, filtered through muslin cloth on a fluted funnel and washed with boiling water until it was free of acid. The residue was returned into 200 ml boiling NaOH and allowed to boil for 30 minutes. It was further washed with 1 % HCl and then with boiling water to free it of acid. The final residue was drained and transferred to silica ash crucible (porcelain crucible) and dried in the oven to a constant weight and cooled. The crude fiber content was calculated as:

% Crude fiber = $\frac{w1-w2}{w1}$ x100,

Where; W1= weight of content before ashing, W2= weight of the crucible and ash, W3= weight of dried material

2.4.3 Determination of crude protein:

One gram (1g) of the sample was introduced into micro Kjeldahl digestion flask and one tablet of Selenium catalyst was added. The mixture was digested on an electro thermal heater until a clear solution was obtained. The flask was allowed to cool after which the solution was diluted with distilled water to 50ml and 5ml of this was transferred into the distillation apparatus, 5ml of 2% boric acid was added into a 100 capacity conical flask (the receiver flask) and four drops of methyl red indicator were added. A 50% of NaOH was continually added to the digested sample until the solution turned cloudy which indicated that the solution had become alkaline. Distillation was carried out in the boric acid solution in the receiver flask with the delivery tube below the acid level. As the distillation was going on, the pink colour solution of the receiver flask turned blue indicating the presence of ammonia. The resulting solution was then titrated with 0.1 M HCl and the protein content calculated (Oyelade *et al*; 2003 AOAC., 2005).

2.4.6 Determination of total ash:

The ash content was determined from the loss in weight that occurred during incineration of the evaporated sample at a temperature high enough to allow all organic matter to be burnt off without allowing appreciable decomposition of the ash constituents. Ashing was carried out in a muffle furnace subjected to heat at 550°C for 6 hours (AOAC.,2005).

2.4.7 Determination of fat content

This was carried out using the method of AOAC (2005). 5g oven dried sample was weighed. The sample was placed in the thimble and inserted into the soxhlet apparatus and extraction under reflux was carried out with petroleum ether for 6 h. After the barrel of the extractor has been empty, the condenser and the thimble was removed, taken into the oven at 100°C for 1 h and later cooled in the desiccator and weighed again to obtain the fat content.

2.5 Determination of Minerals Content

2.5.1 Determination of Magnesium, Calcium, Potassium and iron.

Atomic absorption spectrophotometer (Model Pu 91003, England) was used to determine Mg, Ca, k, Fe contents as described (Ibitoye, and Onwuka, 2005). 1.0g of each juice sample was weighed and first digested with 20ml of acid mixtures (650ml Conc. HNO3, 80ml Perchloric acid, 20mL Conc. H2SO4) to obtain clear digest, which was made up to 100ml with distilled water. This was used for atomic absorption spectrophotometry using individual lamps and wavelength for each element. Concentration of element were determined using the calibration curve by interpolation.

2.6 Evaluation of Sensory Properties

The samples were assessed using a nine-point Hedonic Scale, where "9" represented extremely liked and "1" represented extremely disliked as described by Ihekoronye and Ngoddy (1985). A 20 - man semi-trained panelists consisting of students from the Department of Food Science and Technology, Federal University Wukari, Taraba State were used. The panelists were asked to evaluate the samples for the following attributes; flavor, color, aroma, taste, mouth feel and overall acceptability. The samples were presented in a well packaged material. It was served simultaneously to ease possibility of panelists evaluating the sample. Necessary precautions were taken to prevent bias of panelists. They were given sachets of water to rinse their mouth after each stage of sensory evaluation.

2.7 Microbiolocal Analysis

2.7.1 Media Preparation

The enumeration of bacteria cells and fungi count from the samples of mixed fruits juices from blends of watermelon and lime fruits was done using Nutrient agar, Macconkey agar, and Potato dextrose agar. .They were prepared according to the manufacturers (Titan Biotech Ltd) instruction and sterilized by autoclaving at 121°C for 15 minutes at 15 pounds per square inch (PSI).

2.7.2 Isolation and Enumeration

Total bacterial count was determined using the method as described by (Obasi *et al.,* (2019). The stock solution was prepared by dissolving 1ml of the sample each of the mixed fruits juices from blends of watermelon and lime fruits in 9ml of sterile peptone water. Serial dilution (10 fold) was carried out (1:10, 1: 100, 1:1000…10,0000). 0.1 ml of appropriate dilutions (10-2 and 10-4) was placed on various agar plates using pour plate method and incubated at 37°C for 18-24 hr for total bacteria and coliform count. For fungi 0.1 ml amount of appropriate dilutions (10-2 and 10-4) was also poured into the plates of potato dextrose agar and incubated at room temperature 28±1°C for 3 to 5 days.

All enumeration was expressed as colony forming unit per milliliter (cfu/ml).

2.7.3 Purification and Maintenance of Microbial Isolates

Bacteria isolates were transferred into fresh agar medium of isolation and incubated at 37°C for 24hr. Pure colonies of bacteria cells were picked, subcultured, purified and stored at 4°C until when needed.

2.7.4 Identification and Characterisation of the Isolates

Bacteria isolates were identified and characterized based on their cultural, morphological and biochemical tests as described by Cheesbrough, (2006) and Obasi *et al.,* (2019). Biochemical tests included: indole, catalase, citrate utilization , oxidase, hydrogen sulfide production, Triple-Sugar Iron agar (TSI) etc.

2.8 Statistical Analysis

The experimental design used was the factorial design and data obtained were subjected to analysis of variance (ANOVA) using the statistical package for Social Sciences Version 17.0. Duncan's multiple range test was used to compare the treatment mean. Statistical significance was accepted at ($p<0.05$).

3.0 RESULTS AND DISCUSSION

3.1 Physio-Chemical Analysis

The results of the physiochemical analysis of the mixed fruits juices from blends of watermelon and lime fruits are presented in the Table 1 below, shows the physicochemical properties of mixed fruit juice from blends of watermelon and lime. The pH ranged from 2.70-5.40, titratable acidity 0.10-1.28, vitamin C 34.50-39.00mg/100g and the brix(%) 3.75-6.50. Based on the result from Table 4.1, it shows that the pH of mixed fruit juice decreases significantly ($p<0.05$) as the concentration of lime juice increases. This could be due to the liberation of organic acid from lime which lowered the juice pH. The result obtained from this study is in agreement with a previous study by (Adedeji and Ezekiel, 2020), which showed a reduction in the pH of apple juices. There was a corresponding significant increase in titratable acidity (TTA) following an increase in lime juice. This aligned with the reduction of pH consequent to the elaboration of organic acid.

There was no significant difference ($p<0.05$) in the vitamin C content of the juice for every mg/100g. The result of this study is in line with the report of *Ijah, et al*; (2015). There was a significant ($p > 0.05$) increase in brix (^{o}brix) following an increase in lime juice. This could be due to the degradation of complex polysaccharides and pectin to sugars (Sharma *et al*., 2014). Adedeji and Ezekiel, (2020) also reported an increase in brix of mango juice.

Table 1: Physiochemical analysis of mixed fruit juices from blends of watermelon and lime fruits

Parameters	A(100)	B(90:10)	C(85:15)	D(80:20)	E(50:50)
pH	$5.40^b±0.10$	$4.64^b±0.47$	$3.30^b ±0.05$	$3.12^c±0.02$	$2.70^c±0.20$
TTA	$0.07^c ±0.02$	$0.10^c±0.01$	$0.09^c±0.01$	$0.95^d ±0.05$	$1.28^c±0.03$
VITC (mg/100g)	$39.00^a±1.00$	$36.75^a±1.75$	$37.00^a±1.00$	$36.50^a±0.50$	$34.50^a±0.50$
Brix %	$3.75^b±0.25$	$4.25^b ±0.25$	$4.75^b±0.25$	$5.60^b±0.20$	$6.50^b±0.50$

Results expressed in mean ± standard deviation of duplicate determination. Values are means ± standard deviation of replicates values within a column with the same superscript are not significantly different at ($P< 0.05$).

3.2 Mineral Compositions of Mixed Fruit Juices from Blends of Watermelon and Lime Fruits

Table 2 shows the result of mixed fruit juice from watermelon and lime fruit. The result obtained from the various samples ranged from A-E, as follows for calcium 0.40-0.90, iron 0.40-0.85, potassium 1.80-2.10, magnessuim 0.55-0.95 respectively. The concentration of lime lead to decrease in all the minerals, however potassium and magnesium had the highest mineral content. The result of this study is in line with the report of Ijah, *et al*; (2015) who also obtained a high value in potassium and magnesium in watermelon and orange juice samples which reported a high value in mineral composition of watermelon and orange juice sample. Natural fruits and fruits and vegetable are good sources of potassium. Inadequate intake of micronutrients (minerals) has been associated with severe malnutrition, increased disease conditions and mental impairment (Dosumu *et al.,* 2006).

Table 2 Mineral Composition of pasteurized mixed fruit juice from blends of Watermelon and Lime fruits

Samples	Calcium (PPM)	Iron (PPM)	Potassium (PPM)	Magnesium (PPM)
A (100)	0.90^{a}**±**0.14	0.50^{b}**±**0.14	2.10^{a}**±**0.14	0.95^{a}**±**0.01
B (90:10)	0.90^{a}**±**0.14	0.40^{b}**±**1.41	2.00^{a}**±**1.41	0.91^{ab}**±**0.00
C (85:15)	0.75^{a}**±**0.01	4.00^{a}**±**1.41	1.95^{a}**±**0.01	0.85^{b}**±**0.01
D (80:20)	0.65^{ab}**±**0.01	0.65^{b}**±**0.01	1.90^{a}**±**0.014	085^{b}**±**0.01
E (50:50)	0.40^{b}**±**0.14	0.85^{b}**±**0.01	1.80^{a}**±**0.14	0.55^{c}**±**0.01

Results expressed in mean ± standard deviation of duplicate determination. Values are means ± standard deviation of replicates values within a column with the same superscript are not significantly different at (P< 0.05).

3.3 Proximate Compositions of Pasteurized Mixed Fruit Juices from Blends of Watermelon and Lime Fruits

The proximate composition of mixed fruit juice samples for sample A-E is shown in Table 3. The result ranged from 3.80- 6.30% moisture content, Ash 0.03-2.05,Crude fiber 1.65-4.55,Fat 6.5-5.2%,1.65-4.55,Crude protein 1.65- 2.05%, and carbohydrate 39.56-54.85. The samples were rich in carbohydrates and moisture but low in protein, fats, crude fiber and ash. Significantly (p<0.05), there is a difference in the proximate composition. Moisture content of the juice samples was significantly low as compare to standard percentage. Vicente *et* al. (2009) reported that the moisture content of juice falls at 90%. Ash content of the juice ranges form 0.30-2.05%. The low ash content may be due to long-stored fruit. Freshly harvested fruits have higher ash content. Higher ash content implies good source of minerals. Fat content was higher in the 100% watermelon juice and decreased as the level of lime juice increases. This is in line with the report of Ijah *et al*., (2015), who had a similar result that most citrus family such as watermelon contains more fat than any other fruit. The low fat content observed in the juice samples is an indication that the juice produced can keep for long periods at right temperature and moisture without spoilage by oxidative rancidity (Adedeji *et al.,* 2014).Crude protein contents were not high in the samples of the mixed juices this is an indication that the watermelon lime juice mixed had moderate protein content which implies that the freshly made juice samples may be enough to prevent protein malnutrition. The protein content is adequately enough to meet the FAO/WHO recommended daily allowance of protein content of 0.59g kg-1b.wt., for children aged 1-10 years as reported by (Anon,1995) and also it could serve as an ideal diet for a select people with liver problems (hepatic cirrhosis, hepatitis or hepatoma) who need little or no protein in their menu and the obese or those watching weights (Adedeji *et al.,*2014) The result obtained from this study compared favorably with the result of (Ijah et al., 2015) who researched on watermelon juice and watermelon orange juice mix. After water, carbohydrates are the most abundant constituents in fruits and vegetables, representing 50% to 80% of the total dry weight. This is true as the carbohydrates content of the mixed fruit juice sample obtained in this study is significantly high.

Table 3: Proximate Composition of pasteurized mixed fruit juices from blends of watermelon and lime fruits

Parameters/sample	A(100)	B(90:10)	C(85:15)	D(80:20)	E(50:50)
Moisture content	51.00^{c}±0.05	49.70^{b}±0.20	45.00^{b}±.35	40.90^{b}±0.25	37.30^{b}±0.80
Ash	0.30^{c}±0.10	2.05^{c}±0.05	2.00^{b}±0.10	1.75^{c}±0.25	1.35^{b}±0.15
Crude fibre	1.65^{d}±0.15	1.65^{c}±0.25	1.75^{b}±0.25	1.75^{c}±0.25	4.55^{b}±0.05
Fat content	6.20^{b}±0.20	6.15^{b}±0.35	6.10^{b}±0.30	5.60^{b}±0.20	0.30^{b}±0.10
Crude protein	1.80^{d}±0.00	2.05^{c}±0.15	1.80^{b}±0.20	1.90^{c}±0.10	1.65^{b}±0.15
Carbohydrate	39.56^{a}±0.95	38.40^{a}±2.20	43.35^{a}±2.65	48.10^{a}±1.70	54.85^{a}±0.20

Results expressed in mean ± standard deviation of duplicate determination. Values are means ± standard deviation of replicates values within a column with the same superscript are not significantly different at (P< 0.05).

3.4 Sensory Evaluation of Mixed Fruit Juices from Blends of Watermelon and Lime Fruits

The result of the mixed fruits juices from blends of watermelon and lime are shown in Table 4 below. The sensory evaluation test were carried out on the five blends of juice samples in ratios of A(100), B(90:10), C(85:15), D(80:20), and E(50:50) percent respectively. The overall acceptability of any food product is one of the very important and basic criteria for the acceptance or rejection of a food product (Alim-un-Nisa *et al.,* 2012).The results showed that a significant, difference existed. (p<0.05) among the sensory attributes of the juice. The sensory evaluation result revealed that the control sample (100% watermelon juice), recorded the highest score in terms of color, taste, flavor, and general acceptability, this was followed by sample B (watermelon and lime juice),which was more preferred in terms of color probably due to the presence of lycopene which gives watermelon its natural color, (Erhaedt *et al.,*2003). Sample E was least preferred the in terms of all the parameters assessed. This study agrees with the report of Ijah*, et al* (2015).who obtained a similar results in a previous study on watermelon and orange juice blends.

Table 4 Sensory evaluation of pasteurized mixed fruit juices from blends of watermelon and lime fruits

Parameters/sample	Taste	Colour	Aroma	Flavour	General acceptability
A(100)	$7.90^{a}\pm0.22$	$7.80^{a}\pm0.24$	$7.40^{a}\pm0.28$	$7.05^{a}\pm0.29$	$6.95^{a}\pm0.34$
B(90:10)	$5.25^{b}\pm0.40$	$6.65^{b}\pm0.33$	$5.45^{b}\pm0.37$	$4.80^{b}\pm0.48$	$5.45^{b}\pm0.29$
C(85:15)	$4.60^{b}\pm0.46$	$6.55^{b}\pm0.46$	$4.85^{b}\pm0.41$	$4.55^{b}\pm0.46$	$4.50^{b}\pm0.51$
D(80:20)	$5.05^{b}\pm0.46$	$6.55^{b}\pm0.39$	$5.65^{b}\pm0.33$	$5.05^{b}\pm0.43$	$5.00^{b}\pm0.42$
E(50:50)	$3.35^{c}\pm0.42$	$4.35^{c}\pm0.44$	$4.35^{c}\pm0.56$	$4.10^{b}\pm0.54$	$3.35^{c}\pm0.56$

Results expressed in mean ± standard deviation of 20 panelist. Values are means ± standard deviation of replicates values within a column with the same superscript are not significantly different at (P< 0.05).

3.5 Microbial Load of Pastuerized Mixed Fruits Juices from Blends of Watermelon and Lime Fruits

Table 5 shows the result of the total aerobic plate count of bacterial cells. The total aerobic plate count for bacteria, coliform, and fungi counts. Results obtained from this study is recorded as not detected or no growth. This result is in agreement with the microbiological limits in fruit juices and nectars according to UNBS (2009).Which states maximum of 10^{3} cful/ml for total plate count and 30 cful/ml for unpasteurized fruit juices. Based on this standard limit, it can be deducted that microbial load of the fruit juice samples analysed is not high. The result of this study is in agreement with the work of (Ijah *et al*.,2015).

Table 5: Total aerobic plate count of bacteria cells and fungi (cfu/ml) obtained from mixed fruit juices from blends of watermelon and lime fruits

Parameter (cfu/ml)	Samples				
	A	**B**	**C**	**D**	**E**
Total aerobic plate count	NG	NG	NG	NG	NG
Coliform count	NG	NG	NG	NG	NG
Fungi count	NG	NG	NG	NG	NG

Key: A=Control (100%), B=(90:10), C=(85:15), D =(80:20), E=(50:50), NG = No growth

3.6 Isolates Identification

The result in (Fig 2) showed the microbial flora isolated from mixed fruit juices from blends of watermelon and lime fruit. The microbial flora identified and its prevalence include; *Staphylococcus aureus* (6.4%)*, Esherichi coli* (16.1%)*, Bacillus* (6.4%)*, enterobacter aerogen* (3.2%) *Staphylococcus spp* (16.1%)*, Salmonella spp* (3.2%)*,proteus vulgaris (9.6%) Klebsiella pneumonia* (12.9%) *Pseudomonas* (16.1%)*, Klebsiella spp* (3.3%). were isolated. *Esherichi coli* should not be detected (Braide *et al.,* 2012)**.** The high magnitude of *Esherichi coli* and *Staphylococcus spp* in these juices could be due to high water activity of ready-to-serve juices. Products with high water activity possess good amount of combined water molecule that support growth and survival of microorganisms. (Asha *et al.,* 2014). The result of this study is similar to the report obtained from watermelon and orange juice mix by (Ijah *et al.,* 2015).

Other species of organisms isolated from the mixed fruit juices mix include: *bacillus, staphylococcus spp* and *klebsiella spp*. as reported by Ayodele and Aranisola (2015). They stated that bacillus is a major spoilage organisms in juices. The presence of staphyloccus spp in the juice could be attributed to its wide spread in the environment. *Pseudomona spp* are commonly found on the fruit surfaces which can end up in the juice during production. The result obtained from this research is in line with the report of other reserachers (Braid *et al.,* 2012, Ijah *et al.,* 2015, Bernard *et al* 2021).

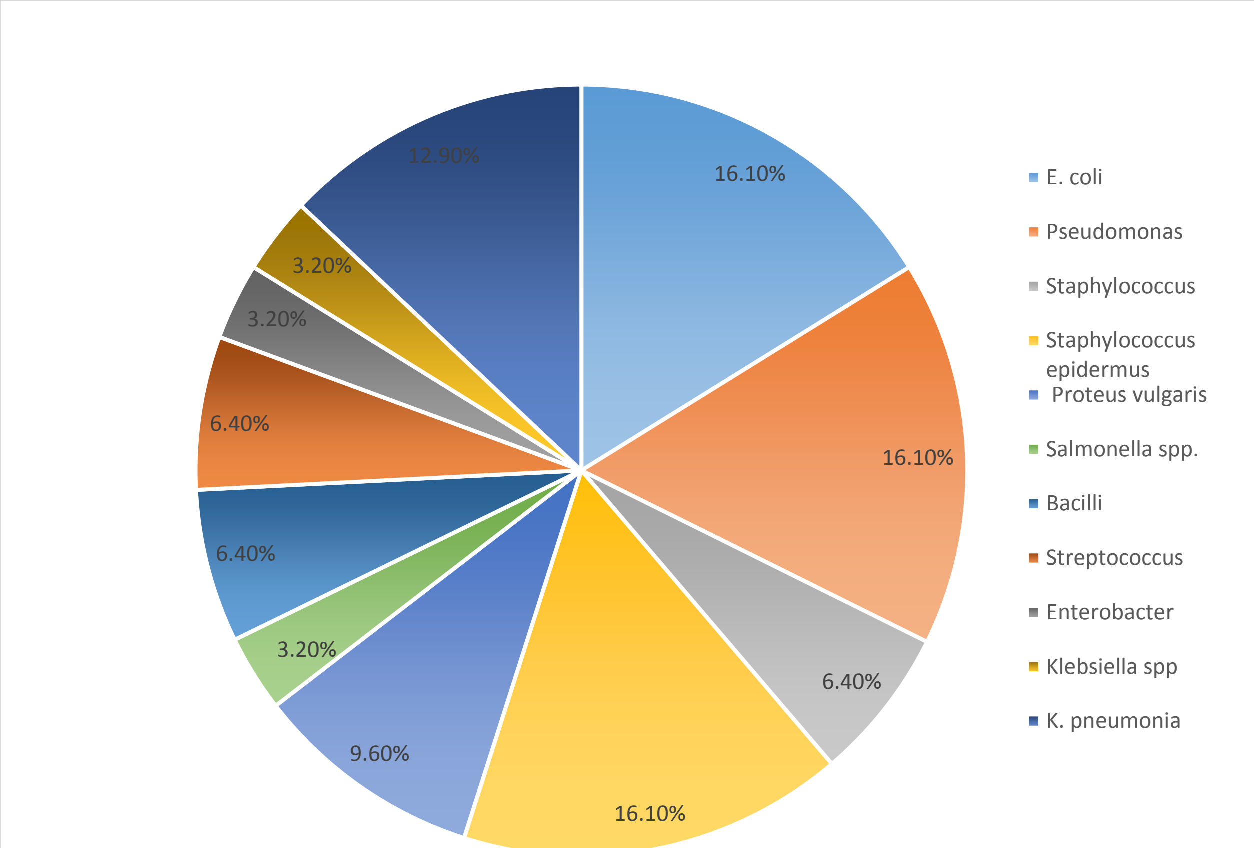

Fig 2: Prevalence of organisms isolated from mixed fruits juices from blends of watermelon and lime fruits

CONCLUSION AND RECOMMENDATION

This study showed that freshly made juice from blends of water melon and lime fruits contained high amount of nutrients and the combination increased the nutrient composition based on all parameters assessed. The result of this research revealed that mixed fruit juice blends had high amount of potassium, magnesium, calcium, carbohydrate and moisture content but low in protein, crude fibre, fat and ash content. Combining natural fruit juices could be of great health benefit to man. Pasteurized watermelon and lime have great potential in the development of healthy fruit drink as shown in this study. This could form a better alternative to the soft drinks flooding our markets which put our health at a greater risk. The microbial count was very low even beyond the allowable limit by Commission Regulation (EC) No. 2073, this showed that pasteurization had a positive effect on the mixed fruit juices. Sample B (90:10) which is the best among all the juice sample analysed should be used for pilot scale production and subsequent commercialization in the food industry.

Disclosure of conflict of interest

No conflict of interest to disclose.

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