

Original Research Article

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Microbial Quality, Physicochemical and Sensory Properties of Mixed Fruit Juice Subjected to Different Preservation Methods

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ABSTRACT

Microbial, physicochemical and sensory properties of mixed fruit juice produced from pineapple, orange, apple and lime was investigated using standard methods. The fruits were sliced, pulped using an electric blender and filtered separately with a clean muslin cloth. The individual fruit juices were blended in ratios, divided into three samples and preserve using high temperature pasteurization at 80°C for 15 minutes (HPS), Low temperature pasteurization (LPS) at 60°C for 30min (LPS) and the third samples was preserve with sodium metabisulphite (SFS). The total viable count ranges from 3.2×10^3 to 4.5×10^3 cfu/ml. Coliform count ranges from 1.0 to 2.8×10^3 cfu/ml, fungal count ranged from 1.5×10^3 to 2.6×10^3 cfu/ml there was no *Salmonella* count in all the samples. The pH, titratable acidity, total soluble sugars and vitamin C content ranged from, 3.4 to 4.1, 1.34 - 1.35 (lg/100g), 3.4 to 10.32%, 4.33 to 7.2 (lg/100g) respectively. Sensory evaluation of the samples revealed that there was significant difference at ($p < 0.5$) in colour, taste and overall acceptability among the mixed fruit samples. Sample HPS (High pasteurized sample) was found to be the most acceptable from all the other samples. However the pH, titratable acidity, vitamin c and microbial counts recorded lower values. Thus, high temperature pasteurization is encourage for longer shelflife of fruit juice samples.

Keywords

Microbial, Quality,
Physicochemical,
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Introduction

Juices are aqueous liquids expressed or otherwise extracted usually from one or more fruits (Bello *et al.*, 2014). Juices are prepared mechanically by squeezing or macerating the pulp of fresh fruits or vegetables without application of heat or solvent to give an unfermented clouded, unclarified and untreated juice ready for consumption. Diluting or blending is a common practice as many fresh juices are either too acidic or too

strongly flavored to be pleasant for consumption (Asha *et al.*, 2014). Fruits are parts of plants that houses seeds or flesh covering of nuts or succulent, they are pulpy in character, often juicy and since the develop from flowers of plant. Fresh fruit and vegetable juices are an important part of modern day diet in many parts of the world as they are rich source of nutrients such as vitamins, minerals and other naturally occurring phytochemicals which are of health and therapeutic benefits (Ukwo *et al.*, 2011).

The consumption of fruit juices could have both positive and negative effects on the part of consumers. Fruit juices processed under hygienic conditions could 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). However, freshly extracted juices may not always be safe owing to the heavy load of microbes. Major ingredients of juices such as water, sugar, natural fruit pulp, etc may also carry some microbial contaminants which may cause spoilage of drinks or gastrointestinal disorders to consumers (Asha *et al.*, 2014).

Fruit juice is a ready and rich sources of vitamins, fiber and mineral salt for human consumption due to its uses as medicine, food and appetites (Ashurst, 1991). Fruits are difficult to keep for a considerable length of time. Thus, ripe fruits are utilized either as fresh fruit or processed into juice and specially product (Fraternale, 2011). 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 *et al.*, 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 nature (Fish *et al.*, 2002). 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. Fruit and vegetable supply more than 90% of vitamin C in human diet (Erentuk *et al.*, 2005). Most fruits are perishable in their natural state after harvest, deterioration sets in almost immediately due to metabolic activities which continue even after harvest. The perishable nature makes it difficult to

store and preserved fruit, hence there is gradual loss of flavor and nutritional values. The conversion of fruit juice was originally developed as a result for making use of supplies surplus to the fresh fruits market but while it still fulfill this function. There are also different kinds of tropical fruit available for the production of fruit juices and they are pineapple, orange, apple, lime. All these are used for the different purposes depending on the types of drink that is desired (Tambekar, 2009).

Orange (*Citrus sinensis*) belong to citrus family from *Rutaceae* (USDA,2000). Orange are rich in vitamin C powerful natural antioxidant, folate, dietary fiber, and bioactive compound like carotenoid and flavonoids that prevent cancer and degenerative diseases (Ejaz *et al.*, 2006). Apple fruit is notable for its impressive list of phyto-nutrients, and antioxidants, studies that its components are essential for optimal growth, development, and overall wellness. Apples are rich in dietary fiber, which helps prevent absorption of dietary in the gut. Apples are rich antioxidant phyto-nutrient flavonoids and polyphenolics, the total measured anti-oxidant strength and procyanidin B2. (Crandall, 2001). Fresh pineapple is low in calories, nevertheless it is a store house for several unique health promoting compounds, minerals and vitamins that are essential for optimum health. Pineapple fruits contain a proteolytic enzyme bromelain that digests food by breaking down protein. Pineapple is an excellent sources of antioxidant vitamin; vitamin C It contain small amount of vitamin A and beta-carotene levels (Dull, 2000; Hossain, 2011). All types of juice are inherently unstable, they rapidly undergo microbiological attack by microorganism already present on the fruit or gaining access to the produce during processing, they are also subjected to enzymatic and non – enzymatic changes (Fernandes, 2008). Most

fruits are seasonal crop and must be either part processed for temporary storage or a success with crops must be processed as they come into season (Mc gee; 2004). In Nigeria, most of the fruit drinks are imported. Locally processed fruit drinks are highly needed in order to reduce foreign exchange for importation (Nwachukwu and Aniedu 2013).

The objectives of this research is to produce mixed fruit juice from orange, pineapple, apple, lime subjecting to different treated methods and to determine the microbial, physicochemical and sensory qualities of the mixed fruit juice.

Materials and Methods

Sources of materials

The fruits used for the production were purchased from sayedero market Ilaro, Ogun State, Nigeria. All other material/ items were gotten from Food Technology laboratory of Food Technology Department, Federal Polytechnic Ilaro.

Preparation of mixed fruit juice

The fruits were sorted for wholesomeness, washed in clean water to remove contaminants reduced microbial load. They were peeled, squeezed to extract the juice, sieved to obtained pineapple, orange, apple and lime juice. Apple was washed, peeled, deseeded, blended and sieved to obtained juice. Juices extracted from the three fruits, blended in different proportion of (40:25:25:10) to obtain the pineapple, orange, apple and lime mixed fruit juice as in Fig1.

Treatment of fruit juice

Pasteurization was done for the first and second samples. Sample (HPS) High pasteurization temperature low time at 80 C

for 15 minutes, Sample (LPS) Low pasteurization temperature high time at 60⁰C for 30. Third sample (SMS) Chemical preservative (sodium metabisulphite) 0.1% was incorporated into the fresh mixed fruit juice filled into bottles and capped immediately. All the samples cooled and stored in the refrigerator at 4⁰C.

Microbiological analysis

The different media used to inoculate the samples were Nutrient Agar (Oxoid) for total viable count (TVC), Potato Dextrose Agar (Oxoid) (supplemented with chloramphenicol to prevent bacterial growth) for total fungal count (TFC), Salmonella-Shigella agar (Antec) for *Salmonella* count (SC) and Eosin Methylene Blue Agar (Oxoid) for coliforms. The media were prepared according to the manufacturer's instruction. Aten-fold serial dilution of each of the sample was carried out and one (1) ml from the appropriate dilutions was placed in sterile Petri plate before pouring 20 ml of pre sterilized unsolidified agar medium. The sample was properly mixed in the unsolidified agar medium. The agar plates were allowed to solidified and then incubated at 37⁰C for 24 to 48hrs for bacterial count and at 28⁰C for 3-5 days for fungal count (Lynne, 2003; Cheesbrough, 2005). Count of sample was performed on two plates of each medium and the mean value recorded as colony forming unit per ml (cfu/ml).

Determination of pH

The ph of the juice was determined using a digital ph meter (pHs-2f harris, England) according to AOAC 2005 method. 50ml of the juice was transferred into a beaker and the pH was determined after the meter was calibrated using standard buffer solution of pH 4.0 and 7.0. Sufficient time was allowed for equilibration before readings were taken.

Determination of the total sugar content

The hand held sugar refractometer was used. The prism of the refractometer was cleaned and a drop of juice was placed on the prism and closed. The total sugar content (brix) was read off the scale of the refractometer when held close to the eye according to the method of (AOAC 2005).

Determination of Titratable Acidity (TTA)

10ml of the juice was pipette into a conical flask and 25ml of distilled water was added as described by (AOAC 2005). Two hundred meters (200ml) of 0.1m NaOH was poured into a burette and was titrated against the sample in the flask using 3 drops of phenolphthalein as indicator. It was titrated until a pink coloration was observed and the corresponding burette reading was taking.

Results and Discussion

The result of the microbial, Physicochemical and Sensory analysis of the mixed fruit juice are represented in the table 1,2 and Fig 1

Table 1 shows the microbial count (cfu/ml) of the various mixed fruit juice from Pineapple, oranges, apple and lime samples. Total viable count ranged from 3.2×10^3 to 4.5×10^3 cfu/ml, Samples HPS (Sample with High pasteurization temperature) has the lowest counts of 3.2×10^3 , sample LPS (samples with Low pasteurization temperature) has 4.0×10^3 and 4.5×10^3 cfu/ml in sample SMS (Sample with Sodium metabisulphite), the coliform count range from 1.0×10^3 to 2.8×10^3 cfu/ml and no growth of *Salmonella* count in all the samples. The yeast and mold count of the sample range from Nil to 2.6×10^3 cfu/ml from sample HPS – sample SMS respectively. Total viable count analysis of the sample showed HPS has the least total viable count in the range of 3.2×10^3 cfu/ml

while sample SMS showed the highest count of 4.5×10^3 cfu/ml in all the attributed analysed. The total viable counts recorded in the three juice samples were lower counts. This is in agreements with the findings of Nwachukwu and Aniedu (2013), The fungi count shows no growth for the sample HPS and LPS showed the least count of 1.5×10^3 cfu/ml while sample SMS showed the highest count of 2.6×10^3 cfu/ml. The high pasteurize sample had the least microbial count than other samples. This confer that juice can be best preserve with high temperature to have a lower microbial counts. There were no microbial standard set for juice in Nigeria. However, the recommended specifications for fruit juices served in gulf regions indicated that the maximum count permitted for aerobic bacteria was 5.0×10^4 cfu/ml and yeast or moulds was 1.0×10^3 cfu/ml while total coliforms was 100/ml (Ahmed *et al.*, 2009). On the basis of the gulf standards the microbial load in this study is within permissible level. A number factor is responsible for contamination of fruit juice. Most fruit contain bacterial count, due to improper handling, washing of fruits before use can add bacterial and microorganism to the juice been produced and leading to contamination. Properly pasteurized fruit juices are generally considered as safe and very rarely associated with foodborne disease outbreaks. To reduce the use of heat, weak acid preservatives (citric acid, benzoic acid, sulfur dioxide or their combination) are generally added. In addition, refrigeration at 5°C or lower has to be applied to control spoilage microorganisms that survive pasteurization.

The physicochemical analysis of the mixed fruit juice are presented in Table 1. It shows that the fresh sample had the highest vitamin C, pH, titratable acidity, total sugar content. The pH value of the fruit juice range from 3.4 to 4.1 This falls within the range of 3 – 5 for

fruit and vegetable juices (Akusu *et al.*, 2016; Owolade *et al.*, 2017). This result is also in agreement with the research reports of 3.23 – 4.08 for different brands of orange juice has was observed by (Ndife *et al.*, 2013), The pH is a measure of the degree of acidity or Alkalinity of a product. The pH value of 3 to 4 may give juice a good potential of inhibiting the growth of pathogenic bacterial (Jay 2000).

There was a slight increase in the TTA from the sample with high pasteurization temperature to the sample preserve with sodium metabisulphite. Titratable acidity is a measure of the predominant acid present in the juice of fruits. Food acids dictate the dominant microflora in foods and to a large extent will determine the shelf stability of the juice; the more acidic the juice, the less

susceptible to bacterial action (Ndife *et al.*, 2013).

The total sugar content decreased from 10.34 to 3,4 °Brix, with the sample with sodium metabisulphite having the least value. Akusu & Emelike (2018) reported the total sugar content in watermelon and pineapple blends to be 4.50 – 5.00 % and 6.90 – 7.70%, respectively Also value recorded by Akusu *et al.*, (2016), were the total sugar content range from 10.20 to 13,00%. These are quite similar to results obtained in the current study. It may be suggested that the increase in the sugar present may be ascribed to the amount of sugar present in the pineapple and apple fruit while the preservative may have been the cause of the reduction of total sugar in sample juice SMS.

Table.1 Microbial analysis of the mixed fruit juice from pineapple, oranges, apple and lime

Sample	Total viable count cfu/ml	Coliform count cfu/ml	Salmonella count cfu/ml	Fungi (mold and yeast) cfu/ml
HPS	3.2x10 ³	1.0x10 ³	Nil	Nil
LPS	4.0x10 ³	1.6x10 ³	Nil	1.5x10 ³
SMS	4.5x10 ³	2.8x10 ³	1.0x10 ³	2.6x10 ³

Key: Mixed fruit juice produced from (Pineapple, orange, apple and lime in ratio (40;25;25;10)
 HPS: High temperature pasteurized sample at 80°C for 15min
 LPS: Low temperature pasteurized sample at 60°C for 30min
 SMS: Sodium metabisulphite fresh sample

Table.2 Physicochemical analysis of the mixed fruit juice from pineapple, oranges, apple and lime

Sample code	p ^H	TSC	TTA	Vitamin C
HPS	3.4±0.01 ^{ab}	10.32±0.14 ^c	1.34±0.01 ^{bc}	4.33±2.25 ^a
LPS	4.1±0.5 ^{ab}	10.30±0.10 ^b	1.35±0.7 ^a	5.18±0.34 ^a
SFS	3.5±0.1 ^b	3.4±0.01 ^a	1.35±0.3 ^a	7.21 ± 1.3 ^b

Values are means of duplicate determinations. Means in the same column with different superscripts differ significantly (P<0.05)
 Key; TSC :Total soluble content TTA: Totaltitratable acidity

Fig.1 Flow chart for the production of mixed fruit juice

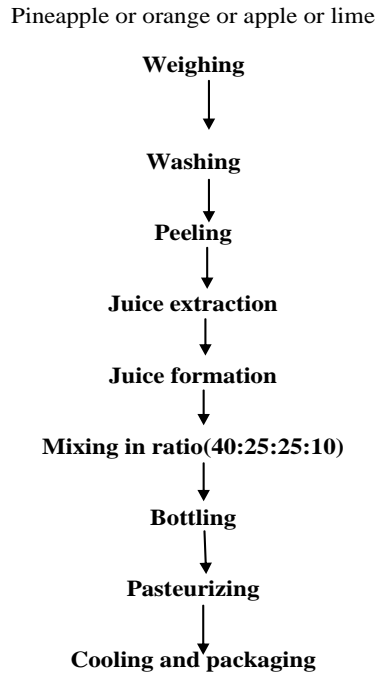
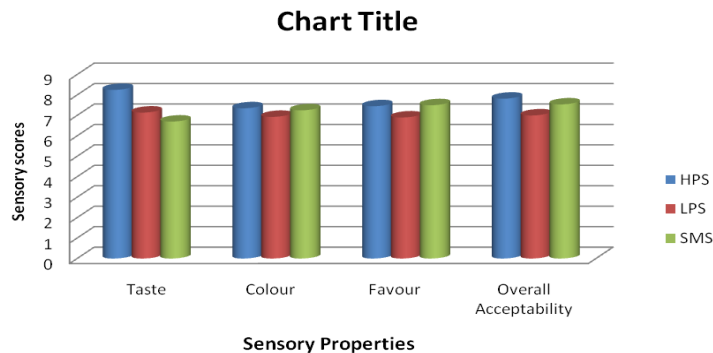


Fig.2 Sensory evaluation of mixed fruit juice from pineapple, oranges, apple and lime



The Vitamin C content of the samples range from 4.33 to 7.27mg/100mg. Sample SMS has the highest value while sample HPS has the lowest value. This is due to the heat treatment which reduces the Vitamin C content.

The sensory evaluation result are presented in Fig 2. The sensory taste shows significant differences ($P < 0.05$), sample HPS has highest

score of 8.85 while sample SFS has the least score of 6.7. The colour evaluation result showed that the high pasteurized was highly accepted by the panelist. In terms of the colour, sample HPS has the highest scores while the least score recorded was sample LPS. There was no significant difference in flavours. Sample HPS has the highest scores while LPS has the least score of 6.9. In terms of overall acceptability sample HPS (sample

with high pasteurization temperature) has the best overall acceptability

In conclusion from the research work of the microbial analysis of mixed fruit juice, sample HP5 had the least microbial counts, highest total sugar content though with low vitamin C content, which is still in the range of fruit juice and had the best overall acceptability of the samples. Thus, high temperature, pasteurization is encourage for longer shelf life of juice samples.

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