

Full Length Research Paper

Evaluation for microbial quality, physicochemical and sensory properties of locally produced fruit-ginger drinks in Umuahia

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Microbial quality and physicochemical properties of ginger fruit drinks were investigated. Total viable count, staphylococcal count, fungal count, *Salmonella* count and total coliform were determined according to standard microbiological methods. pH, titratable acidity, total solids, total soluble sugar, water content and sensory evaluation were determined following standard procedures. The total viable count ranged from 1.0×10^3 - 4.0×10^3 cfu/ml and fungal count ranged from 1.0×10^3 - 3.0×10^3 cfu/ml. Values obtained for the total coliforms were from < 3 -14 MPN/100ml. The pH, titratable acidity, total solids, total soluble sugars and water content ranged from, 2.7 - 4.7, 0.036 - 0.504 (g lactic/100g), 10.53 - 13.09%, 2.02 - 3.93g/100g and 86.91 - 89.47% respectively. General sensory acceptability assessment indicated that the pineapple-ginger and pawpaw-ginger fruit drinks were highly acceptable while the orange-ginger was the least. Hygienic condition, holding time during the preparation of fruits and ingredients are critical factors to the quality of fruit-ginger drinks.

Key word: fruit juice, microbial quality, titratable acidity, total solids.

INTRODUCTION

Fruit juices are beverages which are commonly consumed for their refreshing attributes, nutritive values or vitamin content and health benefits. In Nigeria, most of the fruit drinks are imported. Locally processed fruit drinks are highly needed in order to reduce foreign exchange for importation. Fruit juices are easy to process and blended with other products (Bate et al., 2001). A whole fruit can be directly squeezed, macerated or crushed so as to produce a considerable amount of pulp or juice or may be extracted by water. The extracted juice could be used in their natural state or could be concentrated by evaporation or freezing and could be preserved by bottling, canning or freezing (Frazier and Westhoff, 1998).

The production of fruit juices blended with spices such as ginger has to be encouraged because of its medicinal and nutritional values. Ginger has been used in the

making of cakes, ginger ale, ginger bread and ginger biscuits. Ginger also has medicinal values (O'Hara et al., 1998; Ernst and Pittler, 2000; Pakrashi and Pakrashi, 2003; Almin et al., 2006; Afshari et al., 2007). However, in view of the processing techniques used for making local fruit juice drinks such as washing, handling and extraction as well as little or no facilities for preservation, the microbial or physicochemical evaluation of such drinks is necessary. Like other local beverages or food, the traditional method of production exposes them to microbial contamination through various means. Food borne illnesses associated with the consumption of fruit juices had been reported (Sandeep et al., 2001; Lewis et al., 2006; Chumber et al., 2007). Microorganisms in food products are influenced by characteristics inherent in the food such as moisture content, nutrient composition and pH (Frazier and Westhoff, 1998).

Therefore, the aim of this study is to characterize fruit juice drinks blended with ginger such as pineapple-ginger, orange-ginger, pawpaw-ginger juice drinks and to evaluate their microbial, physicochemical and sensory

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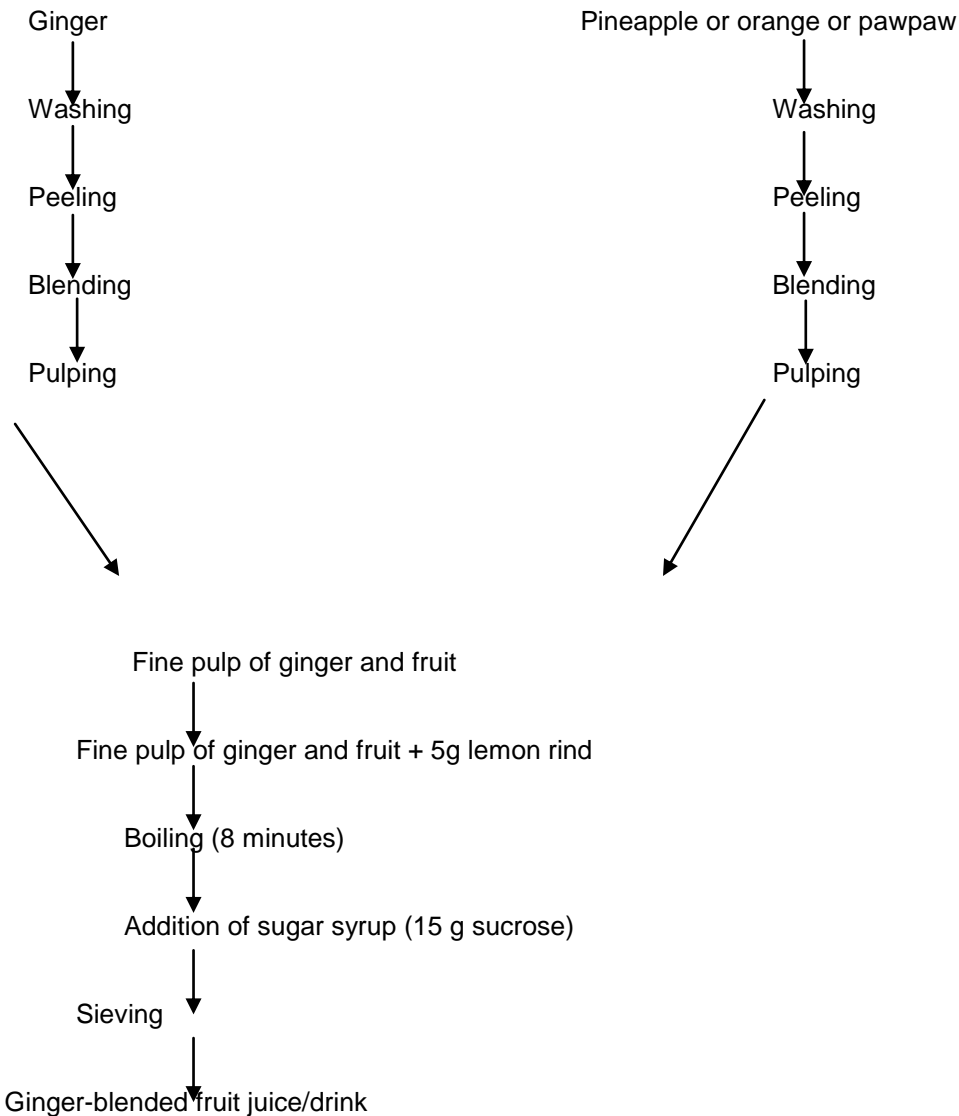


Figure 1. Flow chart for the preparation of fruit-ginger samples (Adapted from Aniedu et al. 2002).

properties.

MATERIALS AND METHODS

Collection of sample materials

The ripe pineapple, sweet orange and pawpaw fruits were purchased from a market in Umuahia, Nigeria. The ginger rhizome was obtained from the National Root Crops Research Institute (NRCRI), Umudike, Nigeria.

Preparation of samples

Two separate methods for the preparation of ginger-pineapple, ginger-orange and ginger-pawpaw fruit juice/drinks were adopted (Aniedu et al., 2002; Daramola and Asunmi, 2009) and subjected to analyses. The fruits

and ginger were washed and peeled with sterile knife. Sterile (with 70% ethanol) hand gloves were used during processing. Using Aniedu et al., (2002) processing technique, 90:10 ratio (w/w, in gram) of pineapple-ginger, orange-ginger and pawpaw-ginger were blended separately to a fine pulp. Then 5g lemon rind (thick outer skin) was added to each of the fruit-ginger mixtures and boiled for 8mins. Thereafter, syrup of 15g sucrose was added to each mixture to improve taste. A total of 500ml of boiled water was used separately for processing each fruit-ginger sample. Each mixture of fruit-ginger was sieved using a sterile muslin cloth to produce the pineapple-ginger (PG), orange-ginger (OG), and pawpaw-ginger (PPG) juice/drinks (Figure 1). The products were allowed to cool to 30°C in a conical glass container before the various analyses were carried out. Using the processing technique followed by Daramola and Asunmi, (2007), the peeled rhizomes were dehydra-

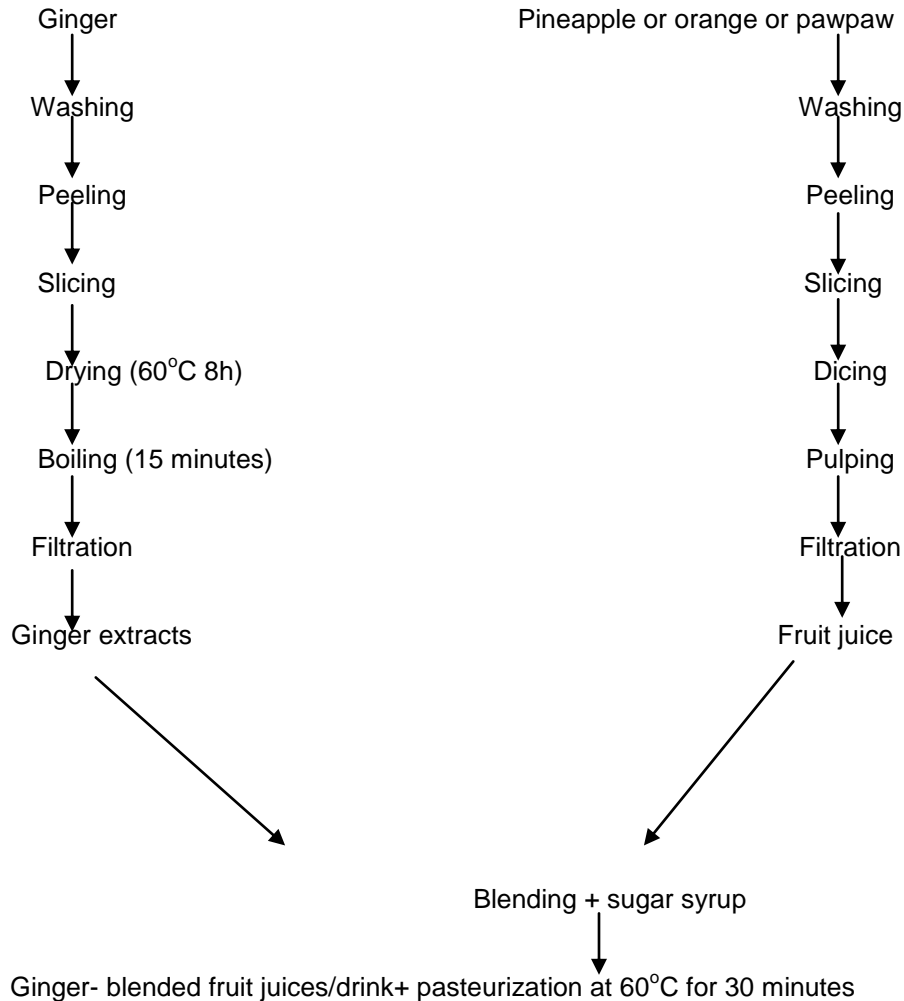


Figure 2. Flow chart for the preparation of fruit-ginger samples (Adapted from Daramola and Asumni, 2007).

ted in oven at 60°C for 8 h. Forty gram of dried ginger was placed in 3 litres of potable water and boiled for 15 minutes. The boiled mixture was then filtered using the sterile muslin cloth to obtain the ginger extract. The pineapple, sweet orange and pawpaw were sliced separately. The sliced were then diced for easy pulping necessary for extraction of their respective juices. The process is schematically represented in Figure 2. Product of ginger extract and the various fruit juices were blended separately at the proportion of 90 to 10 pineapple juice/ginger extract (PGe), orange juice/ginger extract (OGe) and pawpaw juice/ginger extract (PPGe). The samples were pasteurized at 60°C for 30 minutes, cooled and packaged in clean plastic bottles and were analyzed.

Microbiological analyses

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), Mannitol Salt Agar (Oxoid) for total staphylococcal count (TSC), 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. A ten-fold serial dilution of each of the sample was carried out and 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 37°C for 24 -48 h for bacterial count and at 26°C for 3-5 days for fungal count (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). Total coliforms (TC) of the sample was obtained by employing the multiple tubes fermentation technique (Dhawale and La Master, 2003). Lactose broth medium

Table 1. Microbial count of the fruit-ginger drink samples,

Sample	TVC (cfu/ml)	TSC (cfu/ml)	SC (cfu/ml)	TFC (cfu/ml)	TC (MPN/100ml)
PG	4.0 X 10 ^{3a}	1.0 X10 ^{3b}	0 ^b	3.0 X 10 ^{3a}	14 ^a
OG	3.0 X 10 ^{3b}	1.0 X10 ^{3b}	0 ^b	1.0 X 10 ^{3c}	<3 ^c
PPG	3.0 X10 ^{3b}	2.0 x 10 ^{3a}	0 ^b	2.0 x 10 ^{3b}	4 ^b
PGe	1.0 X 10 ^{3d}	1.0 X 10 ^{3b}	0 ^b	0 ^d	< 3 ^c
OGe	2.0 x 10 ^{3c}	0 ^c	0 ^b	0 ^d	< 3 ^c
PPGe	1.0 x 10 ^{3d}	1.0 x 10 ^{3b}	0 ^b	0 ^d	< 3 ^c

The means with the same letter are not significantly different at 95% Confidence Interval (P> 0.05).

was prepared (double strength and single strength) in tubes containing Durham tubes and inoculated with each of the samples. All the test tubes were incubated at 35°C for 48 h. After incubation, the tubes with yellow coloration signifying acid production and gas trapped in the Durham tubes were recorded as positive for coliforms. The most probable number (MPN) of coliform was determined by a standard MPN statistical table. The confirmed test was done by selecting one positive lactose broth tube and streaked on eosin methylene blue (EMB) medium. After incubation at 35°C for 24 h, dark colonies with metallic sheen revealed a positive result. Gram reactions of the colonies were also performed to determine short, non-spore forming Gram negative rods.

Physicochemical analysis

pH determination

The pH of samples were measured using the digital pH meter (model pH S-25, B. Bran Scientific Co., England). The pH meter was standardized with a buffer solution. The buffer solution was prepared with pH buffer powder of pH 4.0 at 25°C dissolved in 250ml distilled water. The electrode of the pH meter was immersed in a glass beaker containing the sample. Readings were obtained from the photo-detector of the pH meter.

Determination of titratable acidity

Standard method was adopted to measure titratable acidity. The sample (5 ml) was homogenized in distilled water (20 ml) and filtered through Watman No.1 filter paper. Two drops of phenolphthalein were added to 20 ml of the filtrate as indicator and titrated against 0.05M NaOH to the end point of phenolphthalein. Titratable acidity was expressed in g lactic acid/100g of juice (Tsige et al., 2008).

Determination of total solid and moisture content

Total solid and moisture content of the samples were obtained using weight reduction method (Daramola and Asunmi, 2007).

Determination of total soluble sugar content

Total soluble sugar content of the samples was obtained using the standard colorimetric method by Dubois *et al.*, 1956.

Sensory evaluation

Using a multiple comparison test, sensory evaluation of the different samples was carried out by ten (10) men panel. The men were randomly selected and they tested the samples independently to avoid interference. Sensory attributes evaluated were colour, taste, mouth-feel, pungency and general acceptability using a score scale of 1 to 7 where 1 indicated extremely dislike and 7 indicates extremely like (Daramola and Asunmi, 2007).

Data analysis

The means of data were evaluated with one way analysis of variance (ANOVA) at 95% confidence interval using SAS computer software.

RESULTS AND DISCUSSION

Table 1 shows the microbial count (cfu/ml) of the various fruit ginger drink samples. Total viable count ranged from 1.0 x 10³ to 4.0 x 10³ cfu/l, count of staphylococci was 1.0 x 10³ to 2.0 x 10³ cfu/l, fungal count was 1.0 x 10³ to 3.0 x 10³ cfu/l while count of total coliforms ranged from < 3 to 14 MPN/100 ml. No *Salmonella* was isolated. Samples of fruit-ginger prepared following techniques of Daramola and Asunmi (2007) generally indicated lower microbial load when compared with that of Aniedu *et al.* (2002). This could be attributed to the pasteurization technique which helped to reduce the microbial load. Statistical analysis of the microbial load of the samples revealed significant differences at P<0.05. Total viable counts recorded in this study were relatively lower than the microbial load (6.2 x 10³ – 3.1 x 10⁷ cfu/ml) reported by Tsige *et al.*, (2008) and (3.00 x 10² – 9.60 x 10⁸ cfu/ml) reported by Ahmed *et al.*, (2009). The low level of microbial loads of the ginger fruit

Table 2. Physicochemical properties of the various fruit-gingers drink samples,

Samples	Titrateable acidity (glactic acid/100g)	Water content (%)	Total Solids (%)	Soluble sugar (g/100g)	pH value
PG	0.414 ^b	88.83 ^c	11.17 ^d	2.15 ^c	3.0 ^d
OG	0.504 ^a	88.15 ^e	11.85 ^b	1.02 ^f	2.7 ^e
PPG	0.036 ^f	88.63 ^d	11.37 ^c	2.04 ^d	4.7 ^a
PGe	0.342 ^c	89.47 ^a	10.53 ^f	1.14 ^e	3.0 ^d
OGe	0.270 ^d	86.91 ^f	13.09 ^a	2.34 ^b	3.3 ^c
PPGe	0.108 ^e	89.17 ^b	10.83 ^e	3.93 ^a	4.4 ^b

The means with the same letter are not significantly different at 95% confidence interval ($P > 0.05$).

Table 3. Sensory scores of the various fruit-gingers drink samples.

Samples	Colour	Taste	Mouth-feel	Pungency	General acceptability
PG	5.80 ^a	5.40 ^a	5.20 ^a	5.10 ^a	5.90 ^a
OG	5.20 ^{ab}	5.20 ^a	4.50 ^a	4.90 ^{ab}	5.30 ^{ab}
PPG	5.70 ^a	5.30 ^a	5.30 ^a	5.40 ^a	6.10 ^a
PGe	5.00 ^{ab}	5.50 ^a	5.40 ^a	4.90 ^{ab}	6.10 ^a
OGe	4.50 ^{ab}	4.00 ^b	4.50 ^a	4.10 ^b	4.70 ^b
PPGe	5.70 ^a	5.20 ^a	5.00 ^a	5.20 ^a	5.70 ^{ab}

The means with the same letter are not significantly different at 95% confidence interval ($P > 0.05$).

drinks could be as a result of the medicinal or antimicrobial qualities of ginger (Malu et al., 2009; Shirin and Jamuna, 2010). There is no specification for the permissible level of microorganisms in fruit juices or drinks produced 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. Contamination of the fruit ginger drinks may be through water or other ingredients and utensils used during the preparation (Tambekar et al., 2009). Presence of *Staphylococcus* may be attributed to the handling of the ginger and fruits (Ghosh et al., 2004, Titarmare et al., 2009).

The data obtained for physicochemical analysis of the fruit ginger drink samples is shown in Table 2. The results of physicochemical analysis showed that the fruit-ginger drinks have relatively low pH with a range of 2.7 – 4.7. Total titrateable acidity of samples ranged between 0.036 - 0.504% lactic acid equivalents of juice. The range of total solids of the ginger fruit drink was from 10.53 - 13.09 %. The moisture content of fruit drinks was 86.91 - 89.47%. Total soluble sugars of fruit drinks ranged from 1.02g/100g to 3.93g/100g and it is relatively low compared to the total soluble sugars of most whole fruits (Chareoansiri and Kongkachuichai, 2009). The statistical analysis of the physicochemical properties of the samples showed that the means were significantly different ($P < 0.05$). The result of sensory evaluation of

the various fruit ginger drinks shown in Table 3 revealed that there was generally no significant ($p > 0.05$) difference in taste and mouth feel. Significant ($P < 0.05$) differences existed in pungency and general acceptability among the fruit ginger drinks.

The fruit ginger drinks are generally acceptable to the people. And on the basis of the medicinal and antimicrobial properties of ginger the production of fruit juice blended with ginger is highly recommended. However, good hygiene during preparation of the drinks should be adopted to avoid microbial contamination of public health significance. Further study should be carried out to determine how to improve the shelf life of the fruit ginger drinks.

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