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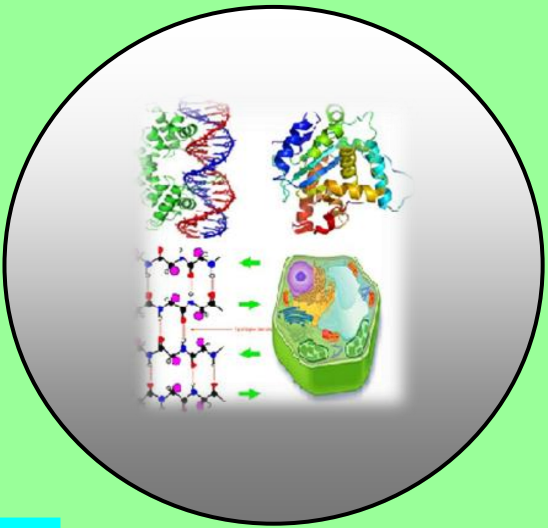

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RESEARCH PAPER

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Physico-Chemical and Nutritional Evaluation of Fruit Juice beverage Developed from Blend of Beet root (*Beta vulgaris L*) and Pineapple (*Ananas comosus*)

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ABSTRACT

This study was carried out to investigate the quality attributes of fruit juice developed from blend of Beet root (Beta vulgaris L) and pineapple (Ananas comosus). The blend was in different ratio of 100% beet root (T_1), 75 % pineapple + 25 % beet root (T_2) and 100 % pineapple (T_3). The samples were produced and stored at ambient temperature of (28±0.02). The stored samples were analyzed for proximate, minerals, ascorbic acid, acidity and pH, total soluble solids, and overall acceptability. The microbial loads were evaluated at the intervals of 7 days for the period of five weeks. The results show that the ash content of beet root-pineapple blend (T_2) was 0.78%. This is significantly higher at ($p<0.05$) than 100% beet root (T_1), and 100% pineapple (T_3) which was 0.54% and 0.11% respectively. The mineral analysis shows that the value for iron (Fe) was 0.214, 0.175 and 0.195 mg/100 ml for 100% beet root (T_1), beet root-pineapple blend (T_2) and 100% pineapple (T_3).The ascorbic acid content for (T_1) was 79.00mg/100ml which is significantly higher than (T_2) and (T_3) at ($p<0.05$). The average mean value for total viable count (TVC) at the end of fifth week of ambient storage condition for 100% beet root (T_1) was $2*10^6$ and no growth (N.G) for beet root-pineapple blend (T_2) and 100% pineapple (T_3). The result of microbial load presents each of the samples of the fruit juice fit for human consumption.
Key words: Fruit Drink, Blending, Beet root and Pineapple.

INTRODUCTION

General interest in functional food products, especially functional beverages that may be consumed as a part of a normal diet to prevent or treat cardiovascular diseases are becoming more fashionable (Berry, 2011). Fruit based Juices are a good source of vitamins minerals and valuable bioactive compounds essential for human health. Fruit beverages are well known for their medicinal properties from ancient times (Hădărugă, 2009). They have been reported to possess anti-hypertensive potential (Kondo, 2001).The health benefits associated with drinking fruit juices on a daily basis are related to the ingestion of bioactive components such as essential vitamins, minerals and polyphenolic compounds. (Ana *et–al*; 2013).The composition of a fruit juice depends on the variety, origin and growing conditions of the fruit (Imtiaz *et- al*; 2011)

Blending of two or more fruits and vegetables juices to produce delightful, delicious and more functional beverages with improve organ oleptic and nutritive value is become popular. (Deka and Sethi 2001) reported that two or more fruits juice/pulp may be blended in various proportions for the preparation of nectar, RTS beverages and mixed fruit juices. The blending of juice may also improve aroma, taste and nutrients of the beverages. Moreover, one could think of a new product development through blending in the form of a natural health drink, which may also be served as an appetizer. (Deka and Sethi 2001)

Pineapple (*Ananas comosus*) has long been one of the most popular of the non-citrus tropical and subtropical fruits, largely because of its attractive flavor and refreshing sugar-acid balance (Bartolomé, 1995). Pineapple juice is largely consumed around the world, mostly as a canning industry by-product, in the form of single strength, reconstituted or concentrated and in the blend composition to obtain new flavors in beverages and other products. Beet root on the other hand is an important root vegetable with a lot of nutritional potentials. Beet root is a rich source of dietary nitrate (NO_3^-) and a number of studies have suggested its potential for reducing blood pressure in humans. Consumption of red beets which are rich source of antioxidants can contribute to protection from age-related diseases. According to Žitňanová et *al*., (2006) red beet is one of the most potent vegetables with respect to antioxidant activity. It is rich in several vitamins and does not contain significant amount of nutritional factors like fat, hence it is an ideal vegetable for health conscious people (Deuter, 2004). However, beetroot has been described to have an 'earthy taste' which make beet root naturally unattractive and less desire to be consumed despite its numerous health potentials, hence the need to look at blending of it with other fruits and vegetables that possesses potential pleasant natural flavor and refreshing taste. Beetroot-pineapple fruit juice blend is not yet available commercially and research study has not been carried out on nutritional content and probable shelf- stability of such juice blend. The present study therefore was to produce juice blends from beet root and pineapple, determine the nutritional composition of the products and evaluate the shelf life under ambient storage condition.

MATERIAL AND METHODS

Raw Material Collection

Pineapple was purchased from Oje market which is a popular fruits collection centre in Ibadan while beetroot were sourced from Mile 12 market in Lagos, Nigeria.

Sample Preparation

The beetroot, pineapple and the blend of the two were prepared according to typical method of fruit beverage preparation as explained by (Ashurst, 1995). Pineapples were de-crowned, washed in tap water, peeled and cut into small pieces. This was followed by blanching in water at 95^{O}C for 5 min then cooled to inactivate their endogenous enzymes and soften their tissues.

They were then extracted using manual juice extractor and filtered with cheese cloth to get clear fresh juice. The Beetroot were washed with tap water, and peeled and slice into small pieces. This was followed by blanching in hot water at 95^oC for 5 min then cooled. A juice extractor (Breville, Model JE 15.USA) was used to extract the juice from the pulp with the addition of distilled water 1:2 (v/w).The Juice collected was passed through a clean cheese cloth. The pineapple and beetroot juice were then mixed in different ratio thus: 100 % beet root and 75:25 % pineapple-beet root and 100 % pineapple. The products were filled into glass bottled which has been previously sterilized at 110^0C for 10 minutes, then sealed. The bottles were pasteurized at 85^0C for 20 minutes, cooled and stored at ambient temperature for further analysis

Chemical Analysis

Proximate Analysis

Proximate Composition (Total Moisture Content, Crude Protein, Crude Fat, Crude Fiber, Ash Content, and Total Carbohydrate) of the fruit drinks were determined according to (AOAC, 2000).

Mineral Determination

The mineral content of the juice samples were determined using the methods of the (AOAC, 2000)

TTS (brix %) measurement

The prepared drinks were analyzed for total soluble solids (TSS) by Refractometer (Abbe Refractometer Model 2WAJ). A few drops of well homogenized sample were taken on prism of Refractometer and direct reading was taken by reading the scale in meter as described in (AOAC, 2000).

pH Determination

The pH of each sample was determined with digital pH meter (Ino Lab 720, Germany). A sufficient quantity (50mL) of fruit drink was taken in 100mL beaker and pH meter was used to record pH according to method explained in (AOAC, 2005).

Titratable Acidity

The acidity in each sample was determined according to standard procedure given in (AOAC,2000).10mL of fruit drink along with 100mL water was taken and then titrated with 0.1 N NaOH using phenolphthalein as an indicator (1-2 drops) till light pink color was achieved.

Determination of ascorbic acid content

The ascorbic acid was determined by iodine titration method (AOAC, 2005). 10ml milliliters of juice sample were taken in 250 mL conical flask, and then 75 mL of distilled water and 0.5 mL of starch indicator were added. The sample was titrated with 0.1 mol L^{-1} iodine solution. The endpoint of the titration was identified as the first permanent trace of a dark blue-black color due to the starch-iodine complex. The amount of ascorbic acid was expressed in mg/100 mL of juice.

Nitrate Determination

Determination of nitrate was determined by method (FAO, 1980). 10 ml of each sample was pipette into a small stoppered conical flask. 5 ml of buffer solution (Buffer pH, 9.6: 0.7M NH_4Cl) and 1g of wet cadmium was added. Stopper the flask and shake for 5 min. filter the solution through a washed filter paper into a 50 ml volumetric flask, rinse the cadmium and the filter paper with 5 ml water, to filtrate add 2 ml of arsenic acid solution. Read the absorbance at 545 nm.

Sensory Evaluation

The sensory characteristics with respect to color, taste, flavor, mouth-feel and overall acceptability of each samples was evaluated by 20 semi-trained panelists using the method described by (Larmonde, 1977). The panelists were asked to record their observations on the sensory sheet based on a 9 point hedonic scale (where 9 and 1 points showing like extremely and dislike extremely).

Microbial Analysis

Microbial loads were investigated by method of Speck (1977).Samples (0.2ml) was inoculated by spread plate methods onto Nutrient agar (Difco), Mac Conkey agar (Oxoid) and Sabauroud Dextrose agar (Fluka, Germany) for total viable count, coliform count and fungal count respectively. Plates were incubated for 24 - 48hours at 370C for colony formation, except Sabouraud Dextrose agar (SDA) that was left for 24-72 hours at 28 ± 20C. At the expiration of the incubation time, the colonies were counted using colony counter (Stuart Scientific, UK).

RESULTS AND DISCUSSION

Although the potential benefits of fruit and fruit juices are enormous, the need to evaluate their nutritional constituents and safety cannot be under estimated so as to provide information that may influence their choice and selection for human consumption. Table 2 shows the values of proximate parameters which include moisture, crude protein, crude fat, crude fiber, ash and carbohydrate obtain for the fruit juices. The crude ash content of the fruit juices ranged between 0.54±0.10 % and 0.78±0.10%. The beetroot-pineapple blend (T_2) has the highest crude ash content of 0.78±0.10%which is significantly higher ($p<0.05$) than 100% beetroot (T_1) and 100% pineapple juice (T_3) respectively. Also, crude protein value of beetroot-pineapple blend was0.12 ±0.20% significantly lower ($p<0.05$) than 100% pineapple juice. The protein content range for the products was low which is typical characteristic of a fruit and fruit juices. The ranged of crude protein values obtained are comparable to values obtained by (Tasnim, 2010) in quality assessment of industrially processed fruit juices available in Dhaka city of Bangladesh.

Table 1. Formulations

T_1	100% beetroot drink
T_2	75% pineapple at ratio+25% beetroot
T_3	100% Pineapple drink

Table 2. Proximate compositions of the fruit juice samples.

Nutrients	% composition		
	100 % beet root	Beet root-Pineapple	100% beet root drink
Moisture	96.50 ±0.10 ^{b}	89.50±0.10^{a}	88.00±0.10^{a}
Protein	0.10 ±0.10^{a}	0.12 ±0.20^{a}	0.28±0.20^{b}
Crude Fat	0.27 ±0.20^{a}	0.28±0.10^{a}	0.88±0.10^{b}
Crude Fiber	0.81 ±0.10^{b}	0.57±0.20^{a}	0.51±0.20^{a}
Total ash	0.54 ±0.10^{b}	0.78±0.10^{c}	0.11±0.10^{a}
Carbohydrate	1.78 ±0.10^{a}	8.80±0.20^{b}	11.02±0.20^{c}
Energy	9.95±0.20^{a}	37.30±0.10^{b}	45.92K±0.10^{c}cal/100ml

Data are average value of triplicate ± standard deviation. Values in the same row with different superscripts are statistically significant ($p<0.05$).

The mineral constituent of the juices was represented in Table 3. The iron (Fe) content of 100% beetroot juice (T_1), beet root-pineapple blends (T_2) and 100% pineapple (T_3) was 0.214±0.20, 0.175±0.20, 0.195±0.20 mg/100 ml. The Iron (Fe) concentration of 100% beet root which was 0.214± 0.02 mgl 100 ml is significantly higher ($p<0.05$) than the blend (T_2) and (T_3). The 100% beet root (T_1) has highest potassium (K) concentration which was 9.768 mh/100 ml followed by beet root-pineapple blend (T_2) of 5.023 mg/100 ml. The magnesium (Mg) content of the beet root-pineapple blend (T_2) is 1.987 mg/100 ml. This value is significantly higher ($p<0.05$) than 100 % beet root (T_1) and 100 % pineapple juice (T_3) respectively. Minerals are inorganic substances, present in all body tissues and fluids and their presence is necessary for the maintenance of certain physico-chemical processes which are essential to life. Minerals are chemical constituents used by the body in many ways. Although they yield no energy, they have important roles to play in many activities in the body (Malhotra, 1998; Eruvbetine, 2003).Macro-minerals are needed in large amounts and play major structural roles (such as calcium and phosphorus) and function as electrolytes (such as sodium and potassium). Micro-minerals (trace minerals), often serve as catalysts in enzyme reactions and are only needed in small amounts (Eruvbetine, 2003).

Iron functions as haemoglobin in the transport of oxygen. Iron exists in the blood mainly as haemoglobin in the erythrocytes and as transferring in the plasma. It is transported as transferring; stored as ferritin or haemosider in and it is lost in sloughed cells and by bleeding (Murray *et al*., 2000). Fe is required for making haemoglobin (Hb) and it is a pro-oxidant which is also needed by microorganisms for proliferation (Galan *et al.,* 2005).Also, Magnesium is an active component of several enzymesystems in which thymine pyrophosphate is a cofactor. Oxidative phosphorylation is greatly reduced in the absence of magnesium. Mg is also an essential activator for the phosphate-transferring enzymes myokinase, kinase, and creatine kinase. It also activates pyruvic acid carboxylase, pyruvic acid oxidase, and the condensing enzyme for the reactions in the citric acid cycle. It is also a constituent of bones and teeth (Murray *et al*., 2000). Beet root juice (T_1) and beetroot-pineapple blend (T_2) are good source of iron (Fe), potassium (K) and magnesium (Mg), which can be available for essential physiological processes in human when the juices are consumed.

Table 3. Mineral compositions of the juice samples.

Mineral	100% beetroot mg/100ml	beetroot-pineapple blend mg/100ml	100%Pineapple mg/100ml
Iron (Fe)	0.214±0.20[c]	0.175±0.20[a]	0.195±0.20[b]
Zinc (Zn)	0.038±0.10[b]	0.023±0.10[a]	0.024±0.10[a]
Calcium (Ca)	0.136 ±0.10[a]	0.182±0.20[b]	0. 253±0.10[c]
Manganese (Mn)	0.011 ±0.10[a]	0.032 ±0.10[b]	0.042 ±0.10[c]
Magnesium (Mg)	0.870 ±0.10[a]	1.987±0.10[c]	1.286 ±0.10[b]
Potassium (K)	9.768±0.20[c]	5.023±0.20[b]	4.355±0.10[a]
Nitrate mg/lNO_3-N	14.61±0.10[b]	8.21±0.10[a]	8.86±0.10[a]

Data are average value of triplicate ± standard deviation. Values in the same row with different superscripts are statistically significant ($p<0.05$).

Table 4 shows the physico-chemical characteristics obtained from the analysis of 100% beetroot (T_1) beetroot-pineapple blend (T_2) and 100% pineapple (T_3).The pH value of the juices ranged between 2.80 -4.20. The average value pH of 100% beet root (T_1) was 4.20 which is significantly higher (p<0.05) than the beet root-pineapple blend (T_2) and 100% pineapple (T_3). The TSS (brix %) value for 100% beet root (T_1) beet root-pineapple blend (T_2) and 100 % pineapple (T_3) was 4.00, 10.00 and 12.00.The TSS (brix %) of 100 % pineapple was 12.00±0.10, this value is significantly higher (p<0.05) than 100% beetroot juice (T_1).The TSS (brix %) value is a measure which usually indicate of sweetness and it influences the preference and choice of fruit juice products. The low pH observed in the juices conforms to the standard description of pH for acid foods which is between pH 3.0– 4.60 (Kirk, 1997). The pH of juices during storage affects their quality (Ukwo, 2010). The low pH may inhibit the growth and proliferation of the contaminants (Ukwo, 2010). The low pH maintained by the juices therefore may perhaps be one of the factors responsible for shelf stability of the juices under ambient condition for period of 5 weeks for which the study was conducted.

Table 4.Thephysico- chemical quality parameters of the juice samples.

Parameters	100% beetroot	beetroot-pineapple blend	100%Pineapple
TSS (brix %)	4.00 ± 0.10^{a}	10.00 ± 0.21^{b}	12.00 ± 0.10^{c}
PH	4.20 ± 0.20^{c}	3.70 ± 0.11^{b}	2.80 ± 0.12^{a}
TA	2.75 ± 0.12^{a}	6.80 ± 0.20^{b}	6.52 ± 0.10^{b}
Vit C mg/100ml	79.0 ± 00.20^{c}	44.00 ± 0.11^{a}	61.00 ± 0.21^{b}

Data are average value of triplicate ± standard deviation. Values in the same row with different superscripts are statistically significant (p<0.05)

The average score for sensory evaluation is represented in Table 5. The average score for taste of 100 % beet root (T_1) beetroot-pineapple blend (T_2) and 100 % pineapple (T_3) was 2.92, 6.32 and 7.64 respectively out of 9 points. The taste of 100 % pineapple (T_3) which was 7.64 is significantly higher (P< 0.05) than 100 % beet root. However, the addition of pineapple increases significantly the taste value of 100 % beet root at (p<0.05). This agreed with the submission that blend of two or more fruit juices could improve taste and aroma (Deka and Sethi 2001).

Table 5.The average score of Sensory evaluation of juice samples.

Oganoleptic Attributes					
Sample	color	Taste	aroma	mouth feel	Overall acceptability
100 % beet root	6.20 ± 0.21^{a}	2.92 ± 0.10^{a}	3.16 ± 0.10^{a}	3.44 ± 0.10^{a}	3.20 ± 0.10^{a}
75 % pineapple + 25 % beet root	6.80 ± 0.22^{a}	6.32 ± 0.10^{b}	6.20 ± 0.22^{b}	6.20 ± 0.10^{b}	6.80 ± 0.10^{b}
100 % pineapple	7.80 ± 0.10^{b}	7.64 ± 0.22^{c}	7.48 ± 0.22^{c}	7.00 ± 0.22^{c}	7.88 ± 0.22^{c}

Data are average value of duplicate ± standard deviation. Values in the same row with different superscripts are statistically significant (p<0.05).

The result of microbial load analysis was presented in Table-6.This was done to ascertain the safety or otherwise of the fruit juices for human consumption. Microbial load of the juices were in range of $1*10^6$– $3*10^6$ cfu/ml thus within limit for human consumption (ICMSF, 1994). The total coliform count for 100% beet root was $1*10^6$ and no growth beetroot-pineapple blend and 100% pineapple juice at the end of 5th week. The presence of the low pH of the juices could be one of the factors that accounted for keeping the microbial load in check within limit tolerable for human consumption. The few presence of microbial contaminants could be a reflection of either quality of the raw materials, processing equipment, packaging materials used in the production process (Rahman, 2001).However, the result of microbial load shows each of the sample of the juices isfit and safe for human consumption.

Table 6.Microbiological analysis of the fruit juice samples.

	100 % beet root			**beet root-pineapple**			**100 % pineapple**		
wks	TVC cfu/mol	TFC cfu/mol	TCC cfu/mol	TVC cfu/mol	TFC cfu/mol	TCC cfu/mol	TVC cfu/mol	TFC cfu/mol	TCC cfu/mol
0	$2*10^6$	N.G	N.G	$2*10^6$	N.G	N.G	$1*10^6$	N.G	N.G
1	$2*10^6$	N.G	N.G	$2*10^6$	N.G	N.G	$1*10^6$	N.G	N.G
2	$2*10^6$	N.G	N.G	$3*10^6$	$1*10^6$	$1*10^6$	$2*10^6$	N.G	N.G
3	$2*10^6$	N.G	N.G	$3*10^6$	$1*10^6$	$1*10^6$	$2*10^6$	N.G	N.G
4	$2*10^6$	$2*10^6$	$2*10^6$	N.G	$1*10^6$	N.G	$2*10^6$	N.G	N.G
5	$2*10^6$	$2*10^6$	$1*10^6$	N.G	$1*10^6$	N.G	$3*10^6$	N.G	N.G

Key:
TVC =Total viable counts.
TFC = Total fungus counts.
TCC= Total coliform count.
N.G = no growth.

CONCLUSION

This study suggests that beetroot-pineapple has some nutritive chemical constituents that can be beneficial to man. These juice blends can be stored effectively for a period of 5 weeks at room temperature. The juice blend could serves as an alternative to the industrially produced carbonated soft drink sanda good addition to varieties of the commercially produced non-alcoholic beverages found in our stores and supermarkets. However, the principles of hygiene should be followed in the production processes to prevent microbial contamination that can affect its safety for consumption.

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