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Full Length Research Paper

Processing and Shelf-life Assessment of Mixed-fruit Juice from Pineapple *(Ananas comosus)* Orange *(Citrus sinensis)* Paw-Paw *(Carica papaya)* and Guava *(Psidium guajava)*

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Abstract
A mixed fruit juice was produced with pineapple (40%), orange (30%), paw-paw (20%) and guava (10%). Different samples of the product were treated (preserved) with different levels (0.04%, 0.06% and 0.08%) of sodium benzoate, pasteurized and stored on ambient shelf for 3 months. The pH, titratable acidity, soluble solids, ascorbic acid and total microbial count were analyzed for the freshly produced and stored samples at one and three months respectively. The pH of all the samples significantly (P < 0.05) decreased with added benzoate during storage. Mixed juice with 0.04% benzoate decreased from (3.96 - 3.85) while the titratable acidity increased from (0.57 – 0.62) after three months. The total soluble solids (brix) decreased but not significantly (P 0.05) with storage and addition of benzoate, while the brix/acid ratio significantly (P < 0.05) decreased with added benzoate and storage period, decreasing from 18.60 in fresh sample (with 0.04% benzoate) to 15.0 for sample (with 0.08% benzoate) and from 16.0 to 13.86 after three months storage, for juice with 0.06% benzoate. The ascorbic acid content also showed significant decrease in all samples. The sample preserved with 0.8% benzoate retained highest ascorbic acid content, though decreasing from (38.71 - 12.00mg/100ml) after 3 months storage. This sample maintained the lowest microbial count among all the stored samples and the micro-organism identified in it were mainly Saccharomyces cerevisiae and lactobacillus species. Staphylococcus Aureus and Penicillum species were identified in the control sample and the sample preserved with 0.04% benzoate. The overall acceptability result showed no significant difference between the fresh and stored samples.

Keywords: *Fruit juice; Shelf-stability; Preservative, physico-chemical, microbial. Pineapple, Citrus, Pawpaw , Guava*

Introduction

A mixed fruit juice is the unfermented, though fermentable liquid extracted from two or more sound ripe fruits intended for direct consumption as obtained by a mechanical process (Bates *et al.*, 1997). Fruit juices are good sources of certain vitamins especially vitamin C and thus do supplement for the deficiency of these vital nutrients in our starch-loaded diet. Incidentally, Nigeria is endowed with many indigenous tropical fruits, most of which such as orange, mango, pineapple, guava and cashew have great potential for commercial juice production (Akinwale *et al.,* 2001). The availability of these raw materials notwithstanding, so much is spent on importation of fruit products. Okonkwo *et al*, (2005) lamented the alarming rate of importation of fruit products and the wastage associated with its low level of industrial utilization in developing countries. Unfortunately, most of what Nigeria imports as fruit juices can only qualify for nectars looking at their contents. Apart from creating variety and convenience, blending of fruit juices offers the opportunity of adjusting flavour, colour, viscosity defects and correcting juice composition. Besides, as the consumer demand for safe, stable and fresh-like products continue to increase, it becomes necessary to develop acceptable fresh-like and shelf-stable fruit juices that will satisfy the consumer demand. Though, some research works have been done on the nutrient composition of fruit juices, there is little of no information on the shelf-life assessment of mixed fruit juices preserved with different concentration of sodium benzoate.

The objectives if this research were to produce a mixed fruit juice from these tropical fruits, determine its physico-chemical properties, microbial analyses, shelf-stability and sensory acceptability of the mixed fruits juice.

Materials and Methods

Collection of Materials

The fruits (pineapple, orange, paw-paw and guava) used for the mixed fruit juice production were purchased from Eke Ukwu main market in Owerri Municipal, Imo State.

Chemical Reagents

The chemical reagents of analytical grades used for the various analyses were obtained from the food science and microbiological lab of Federal University of Technology, Owerri.

Method of production of mixed fruit juice

The fruits were separately washed, peeled, cut and fed into a screw press. Each fruit was pressed out separately, collected and filtered through a muslin cloth. Different trials were done in mixing the pressed fruit juices in different proportions to produce different mixed juice formulations. These trial samples were presented to a ten-man production guidance panel (PGP) to assess the overall acceptability of samples.

Considering the comments of the PGP and the rating of each presented trial sample on a 7-point hedonic scale (where 7 stood for very acceptable and 1 stood for very rejectable) adjustments were made on the proportions of formulation to obtain new trial samples. These samples were represented to the PGP, who after their re-assessment recommended a particular sample. The formula (40% pineapple, 30% orange, 20% paw-paw and 10% guava) of this most acceptable sample was used in the production of the final experimental juice samples.

A trial of 10 litres of freshly mixed fruit juice was produced with this formula. Two and a half litres of this was poured into each of four transparent bottles and corked. To the juice contents of these bottles were added either 0.0%, 0.04%, 0.06%, or 0.08% of sodium benzoate as preservative. These formed the four treatment samples.

Each stock sample was filled into three sterilized 300ml plastic transparent white bottles and pasteurized at 80% for ten minutes according to Micrea (2000). They were then corked hot and cooled in cold water.

Preference/acceptability tests for mixed fruit juice

Questionnaire for acceptability tests

Name:…………………. Product:………….

Taste these samples and indicate how much you like or dislike each one

9= Extremely acceptable	
8= Very acceptable	
7= Moderately acceptable	
6= Slightly acceptable	
5= Neither acceptable nor rejectable	
4= Slightly rejectable	
3= Moderately rejectable	
2= Very rejectable	
1= Extremely rejectable	

Physico-chemical analysis

Measurement of pH

The Jenway pH meter, model 3510 was used to determine the pH of the mixed fruit juices. The pH meter was standardized with buffers 4 and 7. The meter electrode was rinsed with distilled water and then dipped into the samples. The pH of the samples was read to the nearest 0.01 units.

Determination of Total Titratable Acidity

The method described by AOAC (1990) was used. Twenty-five milliliters of each sample was introduced into a conical flask. Three drops of phenolphthalein indicator was added into each flask and the contents titrated with standardized 0.1N NaOH to a definite pink colour. The titratable acidity was calculated as citric acid.

Determination of Total Soluble Solids

The soluble solids of the samples were measured with the aid of hand refractometer. One drop of the sample was dropped on the screen of the refractometer prism and the readings were taken (AOAC 1990).

Determination of Total Soluble Solids

Brix / Tiratable acidity = Brix/ Acid ratio

Chemical Analysis

Determination of Ascorbic Acid Content

The method as described by Onwuka (2005) was used. 10ml of the undiluted juice was pipetted into a 250ml conical flask. 10ml of 1% oxalic acid was added to it as a stabilizing agent and 2ml of acetone was added to the mixture. This was titrated with standardized indophenol solution to a faint pink colour that persisted for about 15 seconds. The volume of the standard dye used was recorded and the vitamin C content (Ascorbic acid) was calculated in mg per 100ml juice.

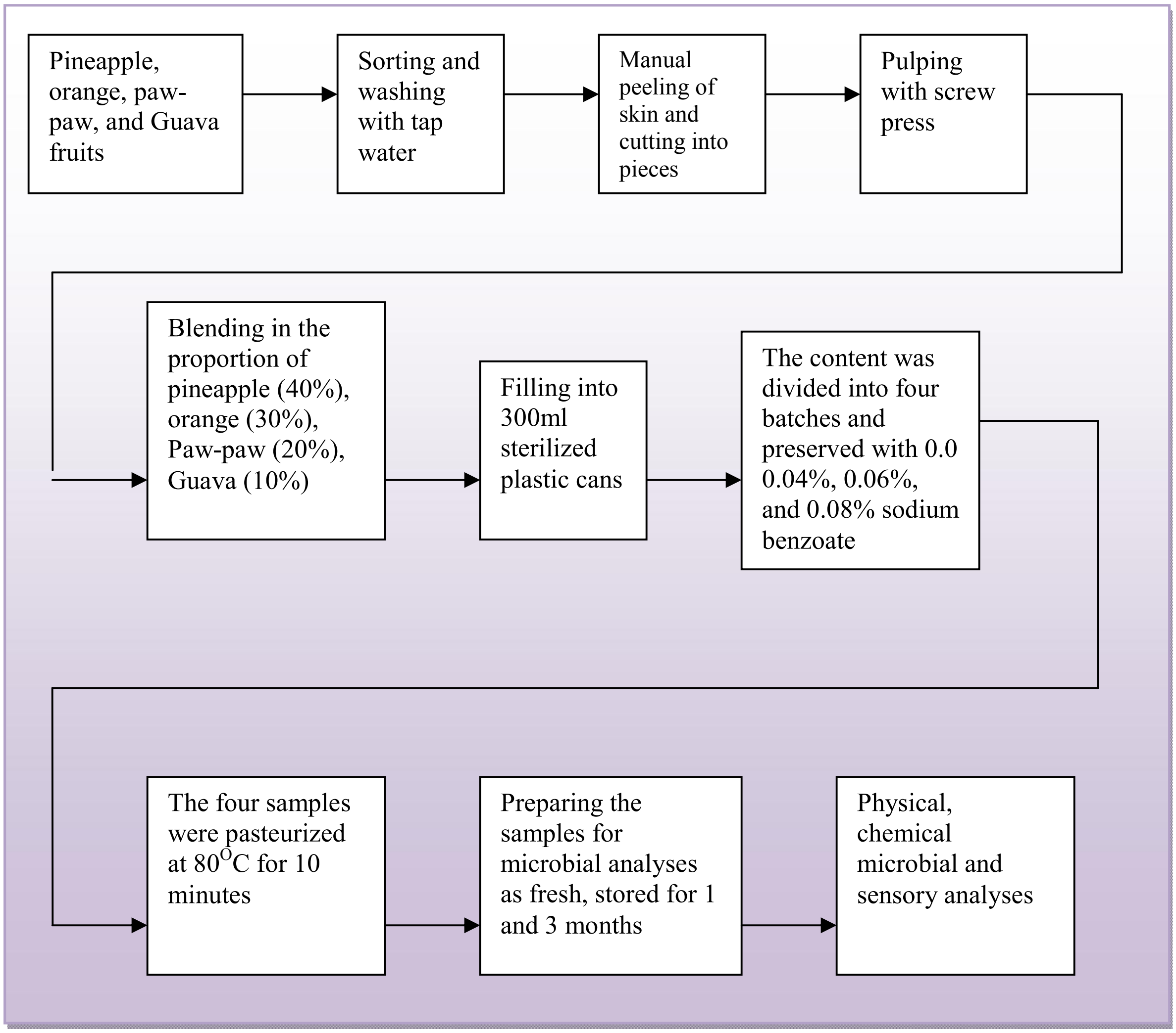

Fig 1: Flow diagram for methodology and treatments applied to mixed fruit juice

Microbiological analysis of samples

Microbiological analysis included enumeration and identification of microbes in the samples. The fruit juice samples were cultured using the spread plate method described by Uriah (2004) as the best for bacterial enumeration of food samples. The plates were incubated at $37^{O}C$ for 24 – 48 hours before observation for total viable count on nutrient Agar and total coliform on MacConkey Agar. The potato Dextrose Agar plates for yeast and moulds were incubated for 5 days. These plates were maintained at required temperature and time.

Total bacterial counts were done with Gallenkamp digital colony counter. The mean number of colonies counted was expressed as Colony Forming Units (CFU)/ml. Subculture was carried out to obtain pure isolates and discrete colonies. Identification of organisms was done based on morphological, biochemical and cultural characteristics. Bacterial isolates were analyzed for Gram character and their motility and various biochemical tests were performed by inoculating small portion of well-isolated colony into a series of media such as sugar fermentation, catalase test, coagulase test, citrate test, oxidase and indole tests (Uriah, 2004). Fungi isolates were characterized on the basis of pigmentation, sporulation, mycelia arrangement and microscopically (Abbey, 2007). The identities of the isolates were confirmed with reference to standard bacteriological and mycological manuals (Barnett and Hunter, 1987).

Sensory Evaluation of Mixed Fruit Juice

The mixed fruit juice samples were presented to a twenty-man panel at different keeping periods. The freshly prepared mixed juices were also compared with juices stored for one month and three months respectively, based on their color, flavor and overall acceptability. A nine-point hedonic scale was used for these tests. The scores obtained were analyzed statistically to determine any significant difference between the mixed-juice products. Statistically, the least significant difference method was used to separate the means and identify differences in the color, flavor and overall acceptability of the fresh and stored samples.

Results and Discussion

Effect of Preservative Concentration on pH values of mixed Fruit Juice

The freshly produced mixed fruit juice samples produced from Pineapple, Orange, Paw-paw and Guava had pH values in the range of 3.70 to 3.96 (table 1). The significant (P<0.05) variation in the pH, understandably was due to the added sodium benzoate, which is an acidulant. After one month of storage at ambient temperatures, all samples except the mixed juice preserved with 0.04% sodium benzoate decreased significantly (P<0.05) in pH, compared to their original fresh samples. The insignificant change in pH value (3.96 – 3.93) in the sample preserved with 0.04% sodium benzoate after one month could be due to lower concentration of the added acidulant un that sample. There were significant (P<0.05) decreases in pH in other samples after three months of storage. For instance, in mixed juice with 0.06% sodium benzoate, the pH decreased from a value of 3.90 to a value of 3.80 after three months storage.

Table 1: Mean pH values of mixed fruit juice samples

Samples	Storage Period		
	Not stored	1 month	3 months
Mixed juice with 0.04% sodium benzoate	**3.96_a**	**3.93_a**	**3.85_b**
Mixed juice with 0.06% sodium benzoate	**3.90_c**	**3.86_d**	**3.80_e**
Mixed juice with 0.08% sodium benzoate	**3.70_f**	**3.64_g**	**3.61_g**

Means on the same column with different subscripts are significantly different at (P< 0.05) and Means on the same row with different subscripts are significantly different at (P< 0.05).

Effect of preservative concentration on the titratable acidity of mixed fruit juice samples

Expectedly, the titratable acidity of the freshly mixed juice and stored samples increased with the amount of added benzoate. The variations in titratable acidity in the juice samples were significant (P< 0.05) (table 2). The decrease in pH is reflected in the increases in titratable acidity values. Similar results were obtained in some previous studies. Garry et al (2001) reported a pH of 3.63 with titratable acidity of 0.52 for fresh mixed apple-blue berry juice and a pH of 3.61 with titratable acidity value of 0.54 after three months of ambient shelf storage for the same mixed juice. This indicated that the trend of decrease in pH with increase in titratable acidity as observed in this study is in agreement with the results of previous studies.

Table 2: Mean titratable acidity values of mixed fruit juice samples

Samples	Storage Period		
	Not stored	**1 month**	**3 months**
Mixed juice with 0.04% sodium benzoate	**0.57_a**	**0.59_b**	**0.62_c**
Mixed juice with 0.06% sodium benzoate	**0.65_d**	**0.68_e**	**0.70_f**
Mixed juice with 0.08% sodium benzoate	**0.70g**	**0.75_h**	**0.77_i**

Means on the same column with different subscripts are significantly different at (P< 0.05) and Means on the same row with different subscripts are significantly different at (P< 0.05).

Effect of preservative concentration on soluble solids (brix) of mixed fruit juice samples

The total soluble solids (measured in degree Brix) of the freshly produced mixed juice, with preservative were between 10.40 to 10.60 ^{O}Brix (table 3). Considering the recommendation of Bates et al (2001), fruit juice should not be higher than 18^O Brix or less than 6 ^{O}Brix. Beverage less than 6 ^{O}Brix were deemed weak or watery. The samples in this study, though moderate in soluble solids, were suitable for commercial fruit juice products, with regards to soluble solids contents, more so when more consumers are avoiding very sweet beverages. Higher soluble solids for fruit juices may result to higher degree of sweetness when the acid is constant. The values of soluble solids (^{O}Brix) decreased with addition of sodium benzoate and increased in storage period, though the decrease was not significant (P>0.05), lowering from a fresh juice value of 10.60 to 10.40 after one month of storage, to a value of 10.0 after three months of ambient shelf storage for the sample with 0.04% sodium benzoate.

Table 3: Mean soluble solids values of mixed fruit juice samples

Samples	Storage Period		
	Not stored	1 month	3 months
Mixed juice with 0.04% sodium benzoate	**10.60_a**	**10.40_a**	**10.0_a**
Mixed juice with 0.06% sodium benzoate	**10.40_a**	**10.30_a**	**9.70_a**
Mixed juice with 0.08% sodium benzoate	**10.40_a**	**10.10_a**	**9.80_a**

Means on the same column with different subscripts are significantly different at (P< 0.05) and Means on the same row with different subscripts are significantly different at (P< 0.05).

Effect of preservative concentration on the brix/acid ratio of mixed fruit juice samples

The Brix/Acid ratio of all the mixed juice samples decreased significantly at (P< 0.05) with increasing concentration of sodium benzoate and storage period, (table 4). Realizing that the more the amount of preservative or acidulant (added or synthesized) in the juice, the less the Brix/Acid ratio, then a lower Brix/Acid ratio indicates lower level of juice sweetness, tending to sourness. The Brix/Acid ratio is an important quality factor for the flavour of juices and some other beverages (Namutebi *et al*., 1998), and since the soluble solid contents (brix) of the samples were relatively stable, the significant variation in Brix/Acid ratio could be attributed to the added acidulants.

Table 4: Mean brix/acid ratio values of mixed fruit juice samples

Samples	Storage Period		
	Not stored	1 month	3 months
Mixed juice with 0.04% sodium benzoate	10.60_a	17.63_b	16.13_c
Mixed juice with 0.06% sodium benzoate	16.00_d	15.15_e	13.86_f
Mixed juice with 0.08% sodium benzoate	15.40_g	13.47_h	12.73_i

Means on the same column with different subscripts are significantly different at (P< 0.05) and Means on the same row with different subscripts are significantly different at (P< 0.05).

Effect of preservative concentration on ascorbic acid contents (mg/100ml) of mixed fruit juice samples

The ascorbic acid content of the freshly produced mixed juice samples ranged from 38.68 – 38.71mg/100ml but the figures did not indicate real increases. What was observed might be an acidulant effect on the stability of the vitamin. After one month and three months of storage at ambient temperatures, the ascorbic acid contents of all the mixed juice samples decreased significantly (P< 0.05). The ascorbic acid content decreased from 38.68mg/100ml to 28.63mg/100ml after one month and to 10.50mg/100ml after three the ascorbic acid contents of all the mixed juice samples decreased significantly (P< 0.05). The ascorbic acid content decreased from 38.68mg/100ml to 28.63mg/100ml after one month and to 10.50mg/100ml after three months storage in the sample preserved with 0.04% sodium benzoate. It was also observed that the sample preserved with 0.08% sodium benzoate retained more ascorbic acid than other concentrations. It decreased from 38.71mg/100ml in freshly produced sample to 29.85mg/100ml after one month storage to 12.00mg/100ml after three months storage, which showed that the sample preserved with 0.08% sodium benzoate retained about 31% of its ascorbic acid content while that preserved with 0.06% acidulant retained 29% of its ascorbic acid after three months of ambient storage. Though this is low, it can still serve as a source of vitamin c in our starch-loaded diet. The degradation of ascorbic acid was reported by Naggy and Shaw, (1993), to be caused by oxidation, high temperature and other uncondusive storage conditions.

Table 5: Mean ascorbic acid values of mixed fruit juice samples

Samples	Storage Period		
	Not stored	1 month	3 months
Mixed juice with 0.04% sodium benzoate	38.68_a	28.63_b	10.50_c
Mixed juice with 0.06% sodium benzoate	38.70_a	28.76_c	11.39_d
Mixed juice with 0.08% sodium benzoate	8.71_a	29.85_c	12.00_b

Means on the same column with different subscripts are significantly different at (P< 0.05) and Means on the same row with different subscripts are significantly different at (P< 0.05).

The total microbial counts for the mixed fruit juice samples stored for three months.

The total bacterial counts for the freshly prepared samples (with preservative) ranged from 1.2 X 10^3 to 2.9 X 10^3 cfu/ml. See table 6 below. These variations in values could not be explained besides equipment/handling contamination, though all the fresh samples had very acceptable level of microbial load. The samples with 0.04% sodium benzoate, had higher rate of microbial growth, with bacterial count increasing from 2.9 X 10^3 to 2.6 X 10^4 at one month storage period and to 3.5 X 10^5 at 3 months storage period as compared to the samples preserved with 0.08% sodium benzoate whose bacterial count was relatively stable, increasing from 1.2 X 10^3 to 3.8 X 10^3 at one month storage period and to 4.8 X 10^3 at 3 months storage period. It was observed that the 0.08% level of sodium benzoate effectively checked fungal growth for the storage period studied. These samples maintained the total fungal load of 1.0 X 10^1 CFU/ml up to 3 months storage period. Thus, this preservative level should be recommended for the preservation of this product for its effectiveness in controlling both total bacterial and fungal growth in the product. This view was held because the maximum total microbial count recommended for single strength and mixed juice samples is 1.0 X 10^5 Cfu/ml, (Hatcher *et al*, 1992). The control sample which had no added preservative (sodium benzoate) had the highest microbial load among all the samples as fresh and at periods of storage. It increased from 3.5 X 103 in the freshly produced mixed juice to 7.5 X 10^5 at one month storage to 9.8 X 10^6 at 3 months storage. This showed that the freshly produced mixed juice can be taken without preservative within few hours of production, but becomes unsafe when stored since the values are above the acceptable microbial load level (1.0 X 10^5cfu/ml) in fruit juices. The bacteria identified in the freshly produced mixed fruit juice samples for all levels of treatment (preservative) were *lactobacillus specie* (table 7). *Staphylococcus aureus* was identified in the control and 0.04% benzoate treated samples stored for 1 and 3 months. While lactobacillus is a common bacteria used in lactic acid fermentation, the incidence of *Staphylococcus Aurues* in these other samples is considered a safety risk since it had been associated with food borne illnesses (Peng et al, 2001). Penicillum which is considered a food spoilage organism (Mathew and Monthville 2000) was identified in all the stored samples except the one preserved with 0.08% sodium benzoate. This suggests that the fruit juice product for storage, required up to 0.08% sodium benzoate (as preservative) to be shelf-stable and wholesome for the storage period of three months The non-identification of any coliform or pathogens in the mixed juices preserved with 0.06% and 0.08% sodium benzoate was not surprising since, Hatcher et al (1992) reported that the pH of most fruit juices (< 4.0) is usually too low for the growth of pathogenic bacteria. *Saccharomyces cerevisiae* was identified in all the samples and the only fungi in the samples preserved with 0.08% sodium benzoate (table 8). This confirmed a report by Ray (1996) that varieties of *Saccharomyces cerevisiae* were the most common yeasts in fermented foods and beverages based on fruit and vegetables. The fungi identified in the stored control samples were *Saccharomyces cerevisiae, Penicillum,* and *Candida* species. The isolation of *Saccharomyces cerevisiae, Penicillum, Rhodotorula* and *Candida* species in fruit juices was reported by Mathews and Monthville (2000). They stated that *Candida and Penicillum were* responsible for spoilage of apple under study. This could also be responsible for the off flavor observed in the stored control samples. of the mixed fruit juice.

Table 6: The total microbial count for mixed juice samples

Samples	**Fresh (Not stored) (Cfu/ml)**		**1 month (Cfu/ml)**		**3 months (Cfu/ml)**	
	Bacterial	**Fungal**	**Bacterial**	**Fungal**	**Bacterial**	**Fungal**
Mixed juice with 0.0% sodium benzoate	3.5 X 10^3	4.0 x 10^1	7.5 X 10^5	7.6 x 10^2	9.8 X 10^6	8.0 x 10^2
Mixed juice with 0.4% sodium benzoate	2.9 X 10^3	3.1 x 10^1	2.6 X 10^4	4.2 x 10^2	3.5 X 10^5	5.6 x 10^2
Mixed juice with 0.6% sodium benzoate	1.6 X 10^3	2.0 x 10^1	4.2 X 10^3	3.5 x 10^1	6.0 X 10^4	4.8 x 10^1

Table 7: Bacteria identified in the mixed juice samples

Samples	**Fresh**	**1 Month**	**3 Months**
Mixed juice with 0.0% sodium benzoate	*Lactobacillus species*	*Lactobacillus species Staphylococcus aurues*	*Lactobacillus species Staphylococcus aurues*
Mixed juice With 0.04% sodium benzoate	*Lactobacillus species*	*Lactobacillus specie Staphylococcus aurues*	*Lactobacillus specie Staphylococcus aurues*
Mixed juice with 0.06% sodium benzoate	*Lactobacillus specie*	*Lactobacillus species*	*Lactobacillus species*
Mixed juice with 0.08% sodium benzoate	*Lactobacillus species*	*Lactobacillus specise*	*Lactobacillus specise*

Table 8: Fungi identified in the mixed juice juice samples

Samples	**Fresh**	**1 Month**	**3 Months**
Mixed juice with 0.0% sodium benzoate	*Saccharomyces cerevisiae*	*Saccharomyces cerevisiae Penicillum Candida species*	*Saccharomyces Cerevisiae Penicillum Candida species*
Mixed juice With 0.04% sodium benzoate	*Saccharomyces cerevisiae*	*Saccharomyces cerevisiae Penicillum species*	*Saccharomyces Cerevisiae Penicillum specise*
Mixed juice with 0.06% sodium benzoate	*Saccharomyces cerevisiae*	*Saccharomyces cerevisiae Penicillum species*	*Saccharomyces Cerevisiae Penicillum species*
Mixed juice with 0.08% sodium benzoate	*Saccharomyces cerevisiae*	*Saccharomyces cerevisiae*	*Saccharomyces cerevisiae*

Sensory acceptability of the mixed fruit juice samples

All freshly produced samples irrespective of the level of preservative added were moderately acceptable (score = 7) in color, (table 9a), and flavor (table 9b) but very acceptable in overall acceptability (table 9c). For all samples, the color of the mixed fruit juice deteriorated with increased storage period. Specifically all samples stored for 3 months had slight acceptance (score: 6). There were significant differences (P< 0.05) between the color of the freshly processed mixed juice and the color of three months stored samples. There were no significant differences between the flavor scores (6.8 to 7.2), moderately acceptable) for all fresh and stored samples. In overall acceptability (table 9c), the freshly produced samples were preferred to the stored sample having the highest scores (7.5 – 7.6). Among the scored samples, 0.08% level of sodium benzoate was more effective in preserving the quality of the mixed fruit juice at 3 months period of storage having the highest scores for all quality parameters considered (tables 9a, 9b, & 9c) at all storage periods.

Table 9a: Mean sensory scores for the color of the mixed fruit juice samples

Samples	Storage period		
	Not stored	1 month	3 months
Mixed juice with 0.04% sodium benzoate	7.3_a	6.5_a	6.0_b
Mixed juice with 0.06% sodium benzoate	7.2_a	6.8_a	6.2_b
Mixed juice with 0.08% sodium benzoate	7.3_a	6.9_a	6.4_b

Table 9b: Mean sensory scores for the flavour of the mixed fruit juice samples

Samples	Storage period		
	Not stored		Not stored
Mixed juice with 0.04% sodium benzoate	7.6_a	7.0_a	6.8_a
Mixed juice with 0.06% sodium benzoate	7.5_a	7.3_a	7.2_a
Mixed juice with 0.08% sodium benzoate	7.5_a	7.3_a	7.3_a

Table 9c: Mean sensory scores for the overall acceptability of the mixed

Samples	Storage period		
	Not stored		Not stored
Mixed juice with 0.04% sodium benzoate	7.2_a	6.9_a	6.8_a
Mixed juice with 0.06% sodium benzoate	7.1_a	7.0_a	7.0_a
Mixed juice with 0.08% sodium benzoate	7.1_a	7.1_a	7.1_a

Means on the same column with different subscripts are significantly different at (P< 0.05) and Means on the same row with different subscripts are significantly different at (P< 0.05).

Fruit juice samples

Means on the same column with different subscripts are significantly different at (P< 0.05) and Means on the same row with different subscripts are significantly different at (P< 0.05).

Conclusion

Moderately accepted mixed fruit juice products was produced with pineapple, orange, paw-paw and guava at levels of 40%, 30%, 20% and 10% respectively. The samples were all acceptable to a twenty-man trained panel even after three months of storage and there was no significant difference in the flavor and overall acceptability of the freshly Prepared samples and the stored samples at (P < 0.05). All the mixed juice samples preserved with 0.06% and 0.08% sodium benzoate had microbial load within the acceptable range of 1.0 X 10^5 Cfu/ml, (Hatcher et al, 1992). The microbial load of all the samples preserved with 0.08% benzoate was lower than the ones preserved with 0.06% and 0.04% sodium benzoate. Considering the levels of sodium benzoate used, the sample preserved with 0.08% sodium benzoate is considered to be the most shelf-stable because of the type *(lactobacillus and Saccharomyces)* and load of micro-organism identified in all its samples. These microbes *Saccharomyces cerevisiae* and *lactobacillus species* are commonly found in fruit juice products and have not been reported to be harmful to human beings, (Hatcher et al, 1992).

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