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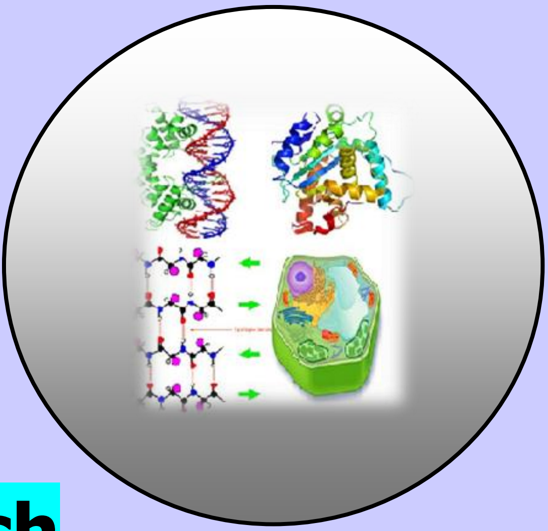

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Owolade samuel olufemi
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RESEARCH PAPER

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Effects of Packaging Materials on Quality Attributes of Fruit Beverage made from Blend of Pineapple (*Ananas comosus*) and Beetroot (*Beta vulgaris)* under ambient Temperature Storage

Owolade, S.O*[1], Akinlabi, A.A [2], Ayorinde, J.O[3] and Akinrinola, A.O[1]
[*1]Product Development Program, National Horticultural Research Institute
P.M.B. 5432, Idi-Ishin, Jericho, Ibadan
[2]Department of Food Technology, University of Ibadan
[3]Department of Food Science and Technology Kwara State University, Malete, Nigeria

ABSTRACT

The effects of different packaging materials (glass bottle, plastic bottle and polythene sachet) on quality attributes of fruit drink prepared from Pineapple (Ananas comosus) and beetroot (Beta vulgaris) were evaluated. Production of drink blend from pineapple and beetroot could serve as means of utilizing their synergetic nutritional advantages since no single fruit can adequately provide the needed nutrients that body system required. The fruit blend from pineapple and beetroot was prepared under hygienic condition by using standard method. The fruit materials were extracted, blend together, pasteurized at 85^{o}c for 10 minutes and then hot-filled into the packaging material that have been previously sterilized. The drinks were cooled and stored under room temperature storage (27$\underline{+}$2^{o}c) for further analysis. The samples were analyzed for Physico-chemical properties (pH, TA, TSS), total carotenoids and vitamin C. The microbial and sensory qualities were also determined. The results showed that pH values ranged between (3.80-3.90), total soluble solids (TSS) was between (8.0-9.0) .The total carotenoid value range between 0.19mg/mL to 1.07mg/mL and the values for vitamin C was between (17.96-18.28mg/mL) for glass bottle, (6.33-11.36mg/mL) for plastic and (1.58-11.36mg/100mL) for polythene sachet. The Sensory evaluation indicated there were changes in organo leptic characteristics as affected by each of the packaging material. The results show that glass and plastic bottle provides better packaging and retention properties than polythene sachet.

Key words: Beetroot, Pineapple, Fruit Drink, Blend and Packaging Material.

INTRODUCTION

Over the last decade, demand for healthy foods and beverages has increased in many parts of the world (Ozen *et al.*, 2012). Fruits and vegetables are among the most important foods of mankind as they are not only nutritive but are also indispensable for the maintenance of health (Wong *et al,* 2003)

Fruit drinks are regarded as non-alcoholic extract from fruits that can be consumed in one form or another (Anderson and Blackmore 1991). They are popularly consumed for their refreshing characteristics and nutritional qualities expressed in their richness in vitamins and minerals which have regulatory functions in the body systems. It is one of the most popular drinks to go with breakfast in the morning (Franke *et al*., 2005). Fruit drinks are appreciated amongst consumers, being considered as a healthy option that is also natural (Caswell, 2009).Fruit blends can be produced from various fruits, this usually gives a better quality nutritionally and organoleptically (Akande and Ojekemi 2013). Fruits such as pineapples and oranges have been used as raw materials in the making some fruit beverages (Osuntogun and Aboaba, 2004).

Fruit beverages play a very important role in the diets of people in both developed and developing countries. It has been reported to contribute to the prevention of degenerative processes, particularly lowering the incidence and mortality rate of cancer and cardio-cerebro-vascular diseases (Mannay and Shadaksharaswany 2005). They contain phytochemicals which act against oxidative reactions in the human body (Okwu and Emenike 2006).Fruit beverages are usually packaged to preserve its quality, freshness, and add appeal to consumers. Packaging is one of the most critical considerations in the value-addition chain of activities in the food or agro processing industry. Packaging materials function to contain, protect and preserve products throughout their distribution, storage and handling chain. They are also used to communicate to potential users as far as product usage and nutritional content are concerned (Robertson 1993). For the majority of food products, the protection afforded by the package is regarded as the primary function of the package and is an essential part of the preservation process (Robertson 2006). This study was to evaluate the effects of glass bottle, plastic bottle and polythene sachet as a packaging material on quality attributes of pineapple and beetroot blend under room temperature storage.

MATERIAL AND METHODS

Collection of raw materials

Matured Pineapple fruits were bought from Oje market, a popular fruit collection center in Ibadan. Beetroot was purchased from a grocery store in Ibadan, Oyo-State.

Pineapple and beetroot processing

Pineapples were de-crowned, washed with tap water, peeled and cut into small pieces. The pineapple pieces were steam blanched for 3-5 min to inactivate enzymes and soften their tissues. The pineapple was extracted with juice extractor (Breville, Model JE 15.USA).

The beetroot were washed with tap water, peeled and slice into small pieces. It was steam blanched for between 3-5 min. A juice extractor (Breville, Model JE 15.USA) was used to extract the juice from the pulp with the addition of distilled water1:2 (v/w). The extracts obtained from pineapple and beetroot were then mixed.

The blend was pasteurized at 85^{0}c for 10mins and hot filled packaging materials (glass bottle, plastic bottle and polythene sachet). The samples were cooled and stored at ambient temperature (27$\underline{+}$2^{o}c) for analysis for period of 60 days.

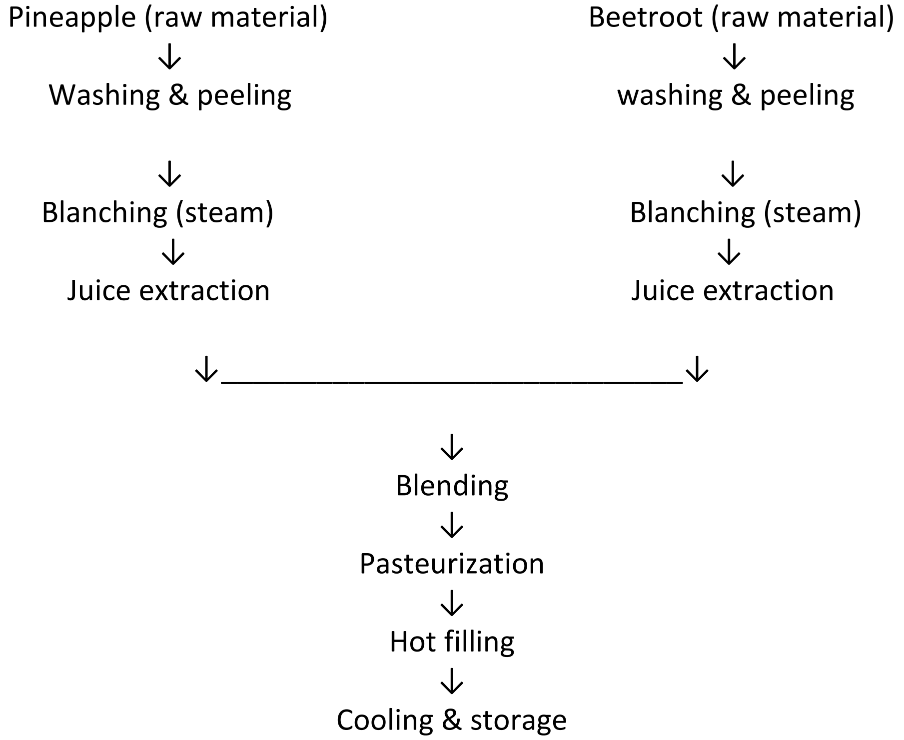

Fig. 1: Flow diagram of pineapple- beetroot blend production

Chemical analysis

Total soluble solids (TSS)

Total soluble solids(TSS) were assayed using the refractometric method, Total soluble solid (TSS) was determined using hand refractometer (ATAGO - ATC1, Atago Co. Ltd., Tokyo, Japan).Total acidity (as % citric acid) was determined by titrimetric method (Ranganna 1986).

Titratable acidity (TA)

Titratable acidity was determined by titrating samples with 0.01M NaOH solution up to pH 8.2, and was expressed as malic acid per 100 mL juices.(AOAC 2000).

$_P$H Determination

The pH of each sample was determined with digital pH meter (InoLab 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).

Ascorbic acid content (Vitamin C)

The ascorbic acid was determined by iodine titration method (AOAC 2005). Ten 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/100mL of juice.

Carotenoids determination

Carotenoids content was carried out according to Rodriguez-Amaya (2001). 2ml of each sample were mixed three times with 50ml of acetone. The mixture obtained was filtered and total carotenoids were extracted with 100 mL of petroleum ether. Absorbance of extracted fraction was then read at 450 nm by using a spectrophotometer. Total carotenoids content was subsequently estimated using a calibration curve of β-carotene (mg/mL) as standard.

Sensory Evaluation

Sensory evaluation was according to method of Larmond (1982). The samples were evaluated on colour, flavour, taste, mouth-feel and general acceptability. Twenty-five (25) semi-trained panelists consist of Staff of National Horticulture Research Institute (NIHORT) Ibadan, were used. A descriptive seven point hedonic scale, where 7 and 1 represent highest and least scores. The samples were coded and served randomly in white disposable cups one at a time. The panelists were told to taste one sample at time and record their responses.

Microbial load evaluation

The fruit drink samples were cultured by employing spread plate method described by Uriah (2004) as the best for bacterial enumeration of food samples. The plates were incubated at 37°C for 24-48 hours before observation for Total Viable Count (TVC) on Nutrient Agar and total conforms on Mac Conkey Agar and were incubated. All inoculated plates were maintained at the requisite time and temperature. Total bacteria counts were done with Gallenkamp digital colony counter (Pelczar and Chan, 1977). The mean number of colonies counted was expressed as Colony Forming Units (CFU)/ml.

RESULT AND DISCUSSION

Physico-chemical determination

The result showing the effect of the packaging materials on the physico-chemical properties of the fruit blends are shown in Fig 2-5. The pH result is presented in fig 1. The value ranged between 3.85 and 3.90. Food acids dictate the dominant microflora in fruit drink and by extension may affect its shelf-life (Ezeama, 2007). The pH is a contributing factor in assessing juice quality and the stabilization of its color (Okorie *et al* 2009). The fruit drink with high acidity (low pH) may confer longer keeping quality (Nzeagwu and Undugwu, 2009. And they are likely to have an improved shelf life (Demir *et al.*, 2004). The result of total soluble solid (TSS) is presented in fig 3. The (^{o} brix) value was between 8.0 and 9.0 for the products. The (^{o} brix) value of drink in polythene sachet decreased from 9.0 to 8.5 which represent (5.5%) at the end of 60th day of storage. The Total soluble solid (^{o}brix) is the sugar content of an aqueous solution (Zoecklein *et al.*, 1999) .The total sugar in a fruit drink to an extent determines its sweetness. The sugar in drink can be used for masking the possible astringency that can come from organic acids (Adeola and Aworh, 2010).The of this study indicated that sugar is more stable in glass and plastic bottle than polythene sachet. The result of total titratable acidity (TTA) is represented in fig 4.

Titratble acidity is a measures the ionic strength of a solution. Food acids dictate the dominant microflora in fruit drink (Ezeama, 2007). The more acidic the fruit juice or drink is the less susceptible to bacterial action (Jay, 2000). It was reported by Anvoh *et al.,* (2009) that fruit acids influence colour and flavour characteristics of the juice products. The result showed that there is no significant change in the acidity value during the storage time.

Ascorbic and carotenoid determination

The effect of the packaging material on the ascorbic content is represented in fig 5. The value for ascorbic acid was between (17.96mg/100mL-18.28mg/100mL) for glass bottle, (5.59mg/100mL - 11.36mg/100mL for plastic and (1.59 -2.11mg/100mL) for polythene sachet. There was a significant reduction ($p<0.05$) in ascorbic content of drink content in polythene sachet while compared with glass and plastic bottle. The result shows that glass and plastic bottle present a better retention of ascorbic acid than polythene sachet during storage of pineapple-beetroot fruit blend. Ascorbic acid also known as vitamin C is a naturally occurring organic compound with antioxidant properties. Ascorbic acid is important in the proper function of the immune system. As an antioxidant, it reacts with compounds like histamines and peroxides to reduce inflammatory symptoms. Its antioxidant property is associated with the reduction of cancer incidences (Lupulescu, 1990).

The result showing change in carotenoid concentration as affected by different packaging material is presented in fig 6. The carotenoid concentration of fruit drink in glass bottle ranged between (0.403 - 1.022mg/mL) for glass bottle, (0.339-1.022mg/mL) for plastic bottle and (0.183-1.021mg/mL) for polythene sachet. There was a marked decrease in the carotenoid concentration of drink in polythene sachet compared with glass bottle. The result shows that polythene sachet show poor retention of carotenoids content for beetroot-pineapple blend under room storage. Carotenoids are a family of pigmented compounds that are synthesized by plants. They are very efficient quenchers of singlet oxygen and scavengers of other reactive oxygen species. Fruits and vegetables constitute the major sources of carotenoid in human diet (Agarwal, 2000). They are thought to be responsible for the beneficial properties of fruits and vegetables in preventing human diseases including cardiovascular diseases, cancer and other chronic diseases. They are important dietary sources of vitamin A (Paiva, 1999).

Sensory evaluation

The result showing the effect of packaging material on sensory properties of pineapple-beetroot blend under room temperature storage is presented in Table- 1. Sensory analysis offers a good tool in providing quick assessment of quality of fruit drink beverages (Masniza *et al.,* 2010). The statistical analysis revealed that there is a significant difference ($p\leq0.05$) in the sensory characteristic of fruit drinks as affected by the packaging materials. The mean score for colour assessment of drink in glass bottle was 5.70, 5.55 for plastic bottle and 3.35 for polythene sachet. The mean score for taste was 5.60, 5.55 and 4.50 for glass bottle, plastic and polythene sachet respectively. The result shows that the over acceptability of polythene sachet is significantly lower at ($p<0.05$) compare to glass and plastic bottle.

Microbial determination

The result of microbial analysis is presented in Table 2. The microbial load evaluation is to ascertain the safety or otherwise of food for human consumption. The result indicated there was no growth of coliform (N.G) found.

The presence of coliform in food is not allowed by safe food consumption standard (Andres *et al*., 2004). The total viable count was between ($1*10^{4}$¯$2*10^{4}$) for glass and plastic bottle, while it was ($2.0*10^{4}$-$2*10^{5)}$ for polythene sachet. The total viable count observed in glass and plastic bottle are within the bacterial load of $1.0*10^{4}$ permissible standards for fruit juice and nectar as reported by Gulf (2000). The results show that the product as preserved by glass, plastic and polythene sachet is good for human consumption. However, glass and plastic bottle present a better keeping quality.

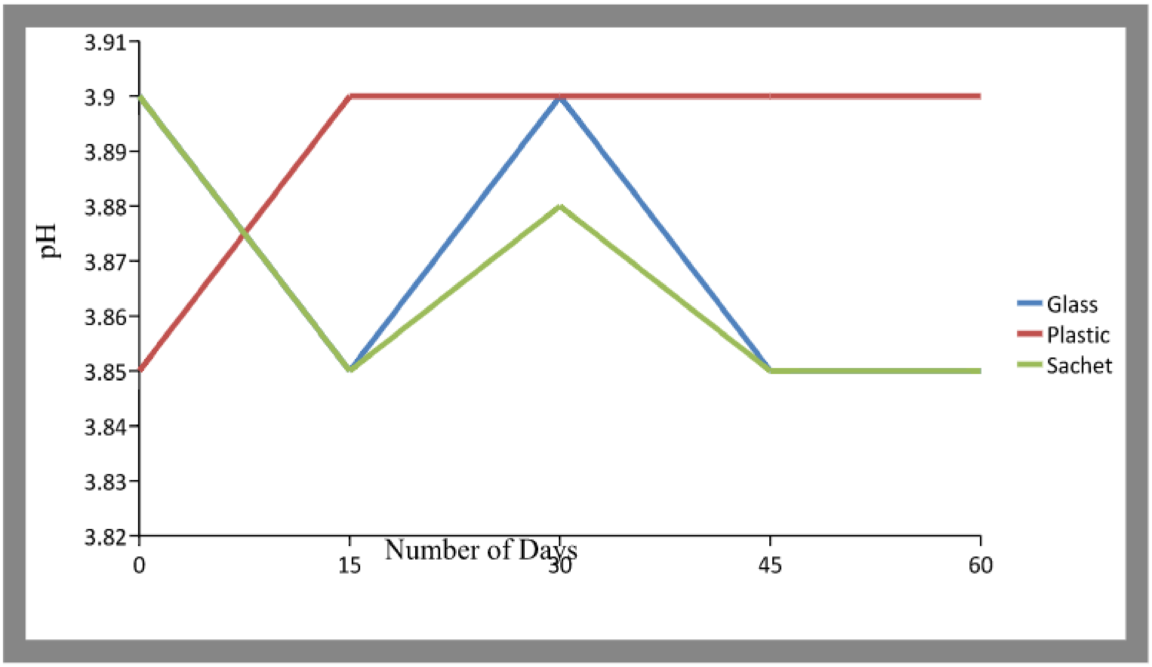

Figure 2. Changes in pH of pineapple -beetroot blend using Different Packaging.

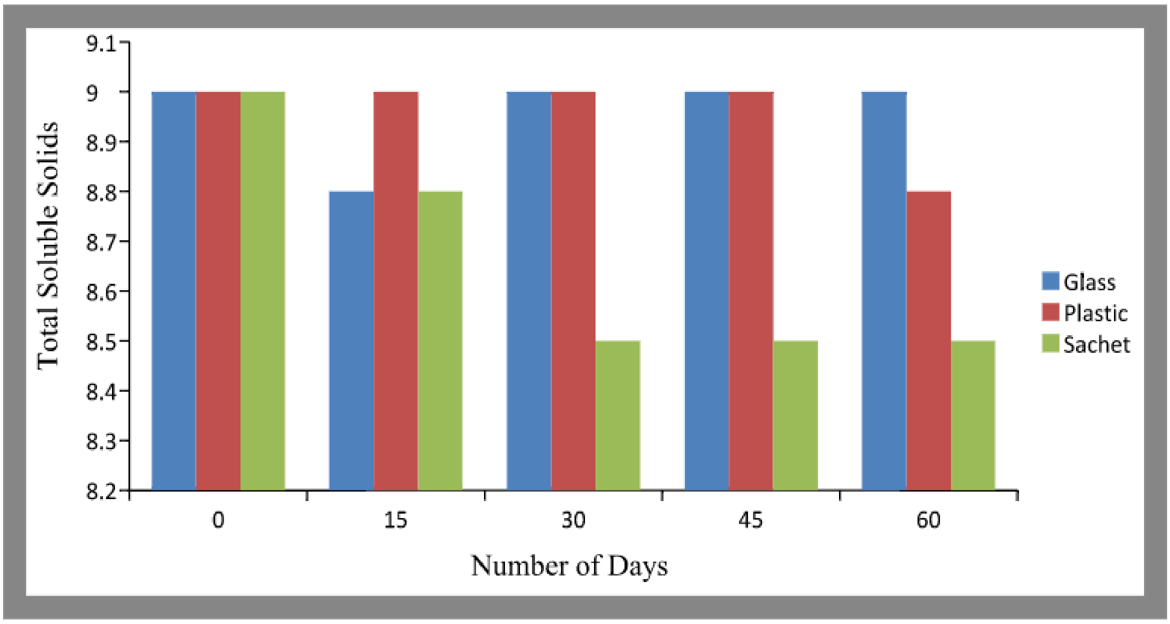

Figure 3. Changes in Total Soluble Solids (^{o}brix) of pineapple–beetroot blend using Different Packaging Materials.

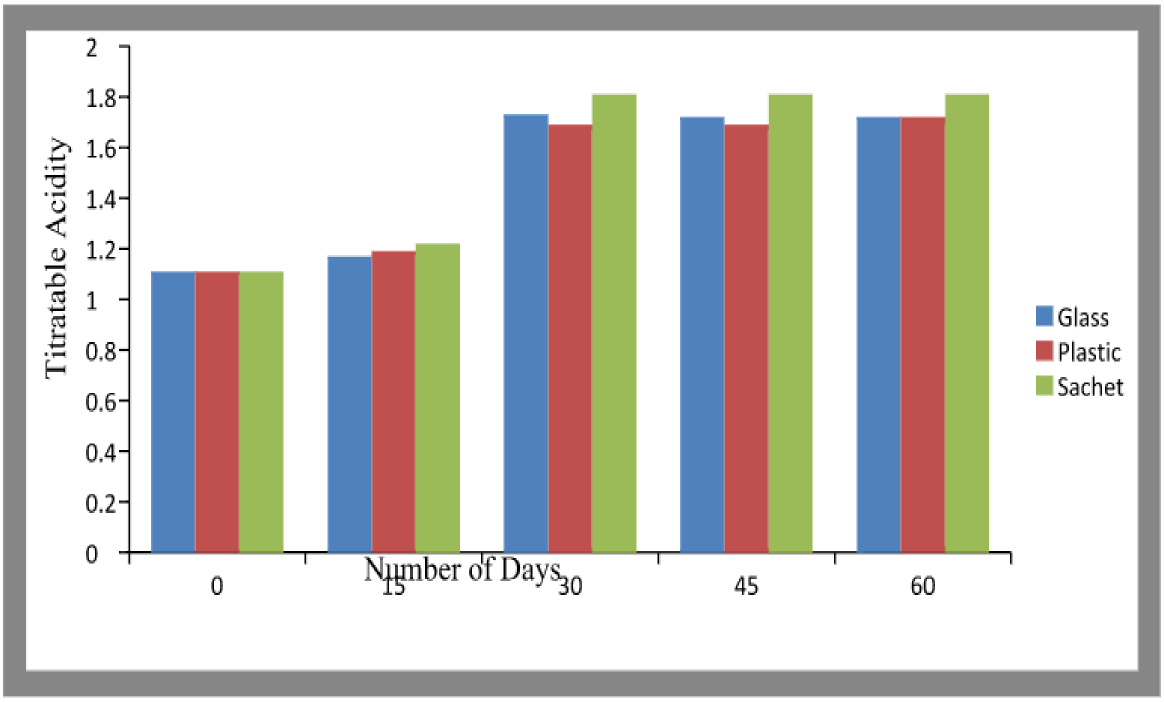

Figure 4.Changes in Titratableacidity (%) of pineapple –beetroot blend using Different Packaging Materials.

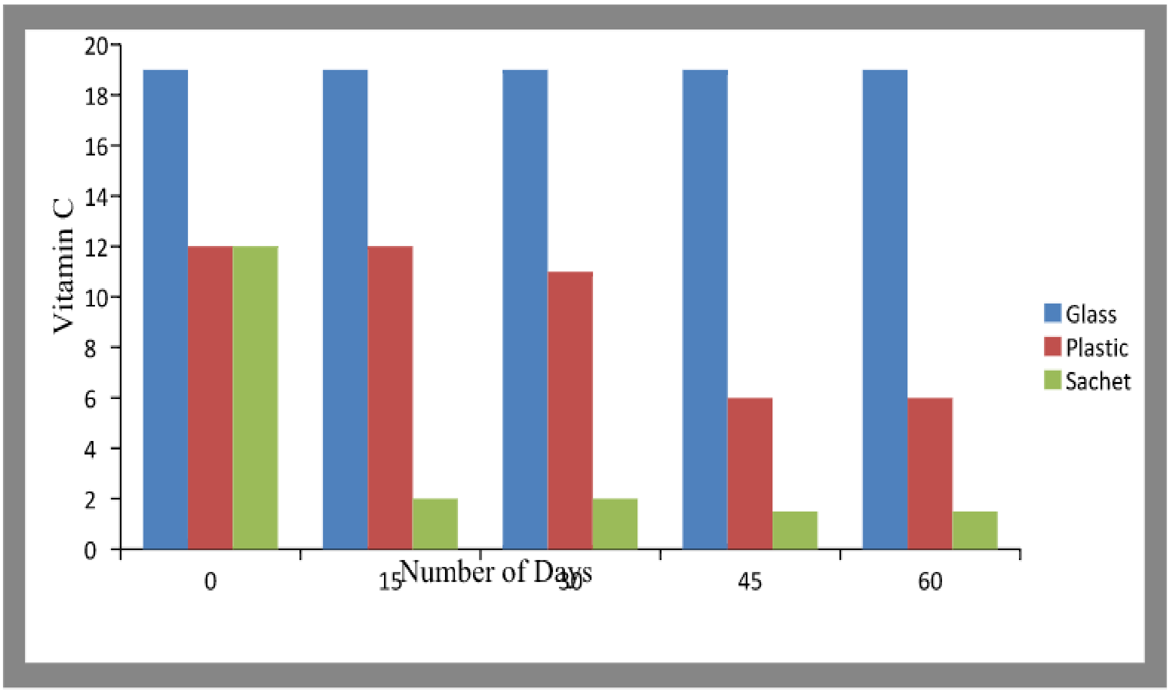

Figure 5. Changes in Vitamin C (mg/mL) of pineapple- beet root blend using Different Packaging Materials.

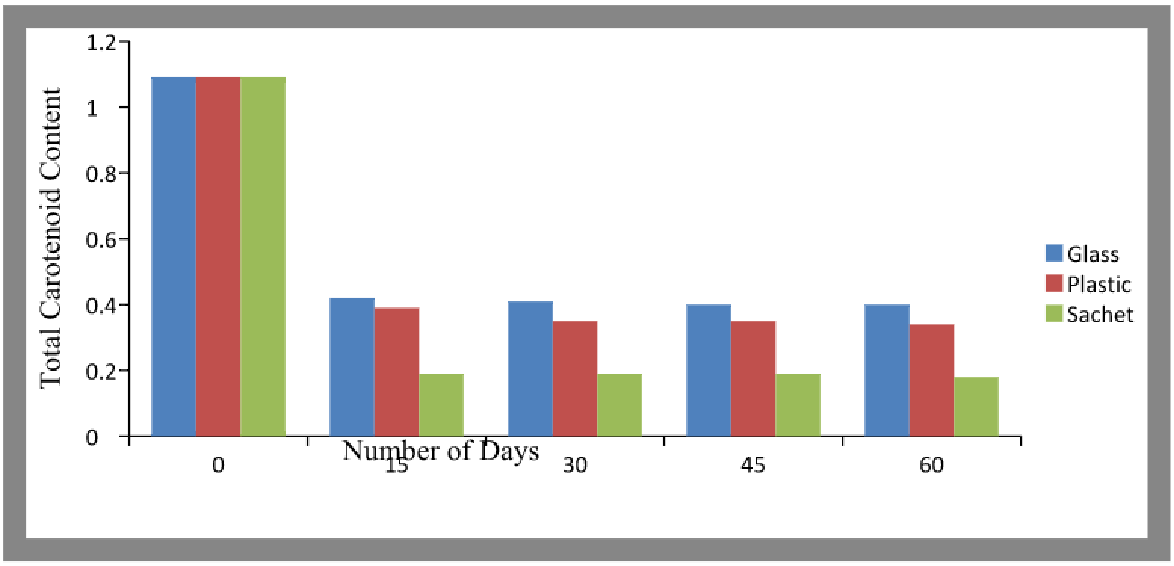

Figure 6.Changes in Total Carotenoid (mg/mL) Content of pineapple- beetroot blend using Different Packaging Materials.

Table 1. Effect of different packaging material on sensory attributes of beet root-pineapple Blend.

Packaging Materials	**Colour**	**Taste**	**Flavour**	**Mouth Feel**	**Overall Acceptability**
Glass Bottle	5.70 ± 0.71 ^{a}	5.60 ± 0.52 ^{a}	5.35 ± 0.89 ^{a}	5.45 ± 0.59 ^{a}	5.75 ± 0.50 ^{a}
Plastic Bottle	5.55 ± 0.71 ^{a}	5.40 ± 0.52 ^{a}	5.30 ± 0.89 ^{a}	5.25 ± 0.59^{ab}	5.75 ± 0.50 ^{a}
Sachet	3.35 ± 1.00 ^{b}	4.50 ± 1.00 ^{b}	4.60 ± 1.00 ^{b}	4.60 ± 0.08 ^{b}	4.00 ± 1.00 ^{b}

Data are a mean ± standard deviation of triplicate determination. Values in the same column with different superscripts are statistically significant ($p<0.05$).

Table 2.Effect of different packaging material on microbial load of pineapple-beetroot blend.

	Glass bott[le		**Plastic bottle**		**Polythene sachet**	
days	**TVC**cfu)/ mL.	TCC cfu)/mL.	**TVC** cfu)/mL.	**TCC** cfu)/mL.	**TVC**cfu)/mL .	**TCC**cfu)/ mL.
0	1.0 x 10^{4}	N.G	1.0 x 10^{4}	N.G	2.0 x 10^{4}	N.G
15	1.0 x 10^{4}	N.G	1.0 x 10^{4}	N.G	2.0 x 10^{4}	N.G
30	1.0 x 10^{4}	N.G	1.0 x 10^{4}	N.G	2.0 x 10^{4}	N.G
45	1.0 x 10^{4}	N.G	1.0 x 10^{4}	N.G	2.0 x 10^{4}	N.G
60	2.0 x 10^{4}	N.G	2.0 x 10^{4}	N.G	2.0 x 10^{5}	N.G

TVC: total viable count
TCC: total coliform count
N.G: No growth

CONCLUSION

The use of glass bottle, plastic bottle and polythene sachet as packaging material could impact on quality attributes of product preserved in them over period of time. Also, this findings show that glass bottle and followed by plastic bottle provides a protective property for quality retention than polythene sachet for keeping of fruit based beverage under ambient storage.

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Corresponding author: Owolade, S.O., Product Development Program, National Horticultural Research Institute P.M.B. 5432, Idi-Ishin, Jericho, Ibadan
Email address: obfem@yahoo.com
+2348035619552