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Production and Preservation of Fruit Juice from African Locust Bean (*Parkia biglobosa)*

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Abstract

The Parkia juice was extracted from the edible pulp of African locust bean (Parkia Biglobosa). The extraction was done by gravity in a porous medium (sieve). Some portion of the juice were preserved using three different preservatives (Sodium benzoate, Benzoic acid and Citric acid) at different concentrations while some were kept unpreserved. The juice was stored; some were stored shelved (at room temperature of 25^oC) while some were refrigerated at temperature of 4^oC for a period of 45 days to monitor the changes that might likely occur in the characteristics of the juice during storage. The result obtained showed that the Parkia juice preserved, both refrigerated and shelved had a longer shelf life compared with the unpreserved juice both refrigerated and shelved. More so, the juice preserved with sodium benzoate has a longer shelf life compared with that preserved with benzoic acid and citric acid.

Keywords*: Locust bean, Parkia Biglobosa, sodium benzoate, benzoic acid, citric acid.*

Introduction

Food in addition to air and water has from time immemorial been the most important requirement for the support of life. Food supplies the body with the nutrients such as protein, vitamins, carbohydrates and fat, which are required for the normal functioning and maintenance of the human being. A deficiency in any or some of theses nutrient that food supplies may lead to disease and sometimes death. Therefore, their importance is based more on the nutrients than the filling satisfactions they give (Dare 2004; Bender 1987).

African locust tree is a leguminous tree from which fruit juice can also be made (from the yellow edible pulp) which is rich in carbohydrates, vitamins and carotenes. It is very abundant in nature and `seasonal, hence making fruit juice from it is aimed at making use of the surplus supply of it during the season and to make it available during the off season period (Dupriez and De Leener 1989; Vickery and Vickery 1979).

Fruits and vegetables form an important part of the diet and are usually regarded as "good" foods. They are major sources of vitamin C, foliates and non-starch polysaccharides, they are not generally rich in other nutrients. The fruits, which are the succulent part of the plant, are characterised by a sweet or acid taste and a distinct flavour, which is refreshing to eat and adds colour and flavour to the diet. When the fruit is stored there is a progressive loss of Vitamin C and up to 20% of that present in citrus fruit may be lost in one month. There is usually also a loss of thiamine but as only small amounts are present initially the loss is not nutritionally significant. Small amounts of carotene may also be lost (Fellows 1990; Bender 1987; Mauron 1982).

Flavour is a more subtle property than taste, consisting as it does of a combination of taste and smell. Fruits owe its smell to the presence of a variety of volatile sweet smelling organic compounds including acids, alcohols,

esters (which are formed by reaction between acids and alcohols), aldehydes, ketones and hydrocarbons. A large number of such compounds may contribute to the flavour of a particular fruit (Erdman and Erdman 1982, Nelson and Tessler 1980; Harper 1979; Woodroof 1975). This paper present the results obtained from experimental analysis and observations of changes in smell, taste, colour, pH value, sugar concentration and to assess the rate of spoilage by carrying out microbiological analysis on the preserved and unpreserved juices.

African Locust Beans (*Parkia biglobosa*)

There are varieties of between 30-40 species mostly found in the tropical areas of South America, Africa and Asia. The *Parkias* of which these are only two species in Nigeria have very distinctive flowers hanging in large heads at the end of long stalks. The individual flowers are practically stalk less, each with a narrow spoon- shaped bracteole as long as the tubular calyx, which almost hides the corolla and a slender style longer than the ten stamens. The projecting styles and stamens are the conspicuous part of the flower head usually several elongated fruits developed from each head. Our species have large leaves usually with 10-20 pairs of pinnae and very numerous small stalk less leaflet, closely crowded, the middle one being the longest (Keay 1989; Dupriez and De Leener 1989; Vickery and Vickery 1979).

Juice Production and Preservation

The conversion of fruits into juice was originally developed as a method for making use of supplies surplus to the fresh fruits market, but, while it still fulfils this function, juice production is now firmly established in its own right. A fresh juice may be defined as the liquid expressed by pressure or mechanical means from the edible portion of the fruit. It will frequently by turbid, containing cellular components in colloidal suspension with variable amount of finely divided tissue. It may also contain only or waxy and carotene pigments derived from the skin of the fruit. Some juices, for example orange juice, are consumed in their naturally state (Dare 2004; Fellows 1990; Bender 1987). All types of juice are inherently unstable; they rapidly undergo microbiological attack by organism already present on the fruit or gaining access to the produce during processing; they are also subjected to enzymic and non-enzymic changes.

Micro-organisms are present in the air, in dust, soil, sewage and on the hands and other parts of the body. They are so widely distributed that their presence in or on food is inevitable unless special steps are taken to kill them. If food is to be kept in good condition for any length of time, it is essential that the growth of micro-organisms be prevented. This can be done either by killing them and then storing the food in conditions where further infection is impossible or by creating an environment, which slows, down or stops their growth (Bender 1987; Earle 1983; Lewis 1987; Jackson and Lamb 1981).

Experimental Procedures

The *Parkia* juice was extracted from the yellow edible pulp of the African locust bean (*Parkia biglobosa*) fruit. The method adopted was extraction by gravity. The fruit was sun dried and deshelled. 2000 ml of water was used to make a paste with 570 g of *Parkia biglobosa* fruit in a porous medium and was left for 24 hours. Water was added to it at interval and the juice was collected in a pan. Sweetening and addition of preservative, pasteurisation, sealing, cooling (natural) and packaging then followed (Fig. 1).

Results

Tables 1 to 3 show the observations made on *Parkia* juice after various days of production for both control shelved and control refrigerated samples.

Table 1. Observation on unpreserved *Parkia* Juice at day 1.

Observation	Control shelved	Control refrigerated
Colour	Yellow	Yellow
Taste	Sweet	Sweet
Odour	Nil	Nil
Flavour	Desirable	Desirable
Sugar (%)	11.80	11.80
pH	4.84	4.84

Table 2. Observation on unpreserved *Parkia* Juice at day 15.

Observation	Control shelved	Control refrigerated
Colour	Dirty Yellow	Yellow
Taste	Sour	Sweet
Odour	Sour	Nil
Flavour	Not Desirable	Desirable
Sugar (%)	10.30	11.40
pH	4.38	4.50

Table 3. Observation on unpreserved *Parkia* Juice at day 45.

Observation	Control shelved	Control refrigerated
Colour	Brown	Yellow
Taste	Not Desirable	Not Desirable
Odour	Bad	Not Desirable
Flavour	Not Desirable	Not Desirable
Sugar (%)	9.00	10.50
pH	2.80	3.20
	With Microbes suspended	

Table 4. Observation on *Parkia* Juice at day 1 with Sodium Benzoate (Shelved).

Observation	Concentration		
	0.40 mg/ml	0.35 mg/ml	0.30 mg/ml
Colour	Yellow	Yellow	Yellow
Taste	Sweet	Sweet	Sweet
Odour	Nil	Nil	Nil
Flavour	Desirable	Desirable	Desirable
Sugar (%)	11.80	11.80	11.80
PH	4.78	4.78	4.78

Table 5: Observation on *Parkia* Juice at day 15 with Sodium Benzoate (Shelved).

Observation	Concentration		
	0.40 mg/ml	0.40 mg/ml	0.40 mg/ml
Colour	Yellow	Yellow	Yellow
Taste	Sweet	Sweet	Sweet
Odour	Nil	Nil	Nil
Flavour	Desirable	Desirable	Desirable
Sugar (%)	11.80	11.80	11.60
pH	4.73	4.73	4.73

Table 6. Observation on *Parkia* Juice at day 45 with Sodium Benzoate (Shelved).

Observation	Concentration		
	0.40 mg/ml	0.40 mg/ml	0.40 mg/ml
Colour	Yellow	Yellow	Yellow
Taste	Sour	Sour	Sour
Odour	Sour	Sour	Sour
Flavour	Not Desirable	Not Desirable	Not Desirable
Sugar (%)	10.70	10.70	10.30
pH	4.48	4.48	4.48

Table 7. Observation on *Parkia* Juice at day 1 with Sodium Benzoate (refrigerated).

Observation	Concentration		
	0.40 mg/ml	0.40 mg/ml	0.40 mg/ml
Colour	Yellow	Yellow	Yellow
Taste	Sweet	Sweet	Sweet
Odour	Nil	Nil	Nil
Flavour	Desirable	Desirable	Desirable
Sugar (%)	11.80	11.80	11.80
pH	4.78	4.78	4.78

Table 8. Observation on *Parkia* Juice at day 33 with Sodium Benzoate (refrigerated).

Observation	Concentration		
	0.40 mg/ml	0.40 mg/ml	0.40 mg/ml
Colour	Yellow	Yellow	Yellow
Taste	Sweet	Sweet	Sweet
Odour	Nil	Nil	Nil
Flavour	Desirable	Desirable	Desirable
Sugar (%)	11.70	11.70	11.50
pH	4.72	4.72	4.72

Table 9. Observation on *Parkia* Juice at day 36 with Sodium Benzoate (refrigerated).

Observation	Concentration		
	0.40 mg/ml	0.40 mg/ml	0.40 mg/ml
Colour	Yellow	Yellow	Yellow
Taste	Sweet	Sweet	Sweet
Odour	Nil	Nil	Nil
Flavour	Desirable	Desirable	Desirable
Sugar (%)	11.70	11.50	11.30
pH	4.71	4.71	4.71

Tables 4 to 6 show observations made on *Parkia* juice after various days of production with Sodium Benzoate as preservatives at different concentrations of 0.40 mg/ml, 0.35 mg/ml and 0.30 mg/ml for shelved samples.

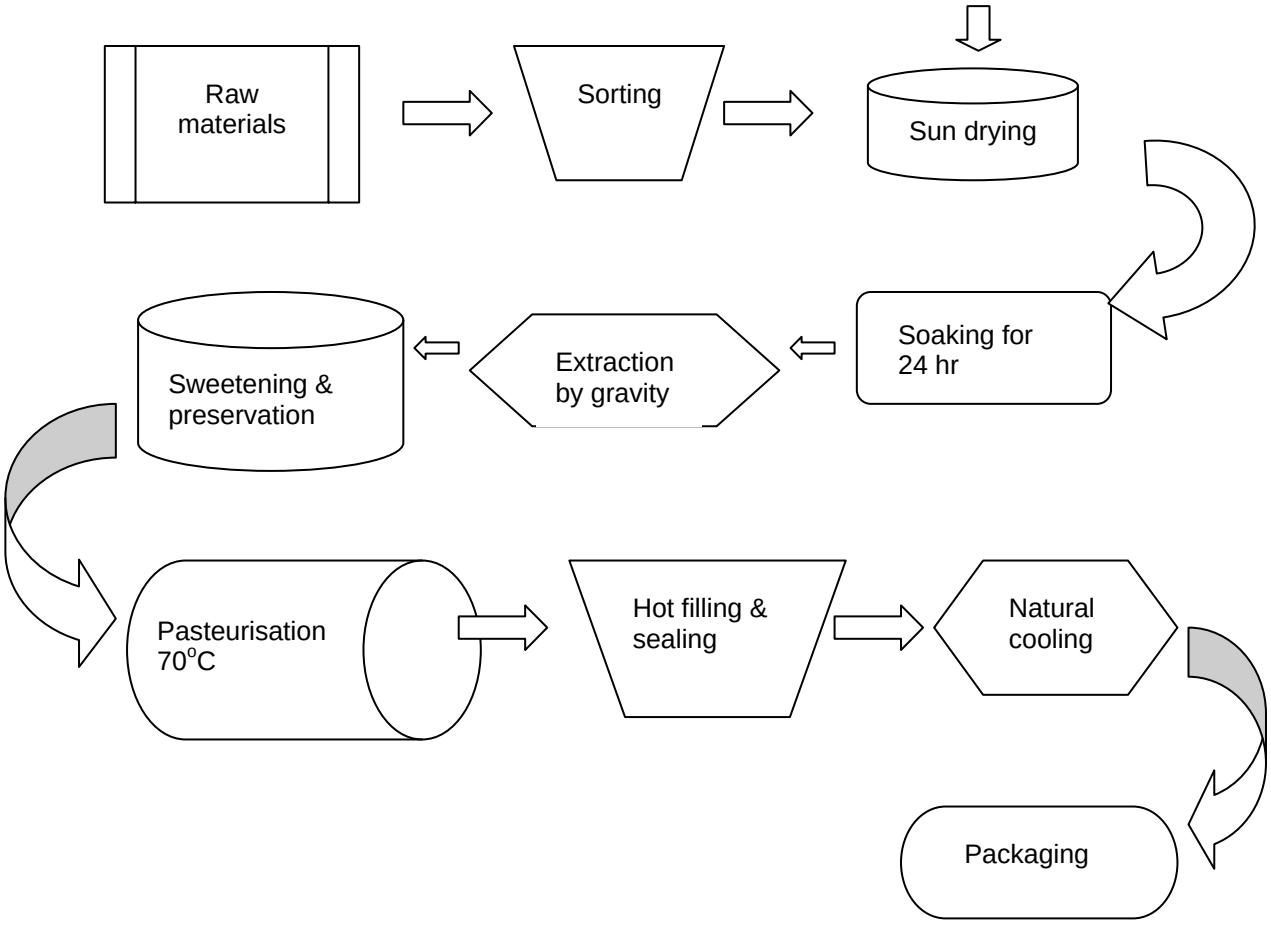

Fig. 1. Flow diagram for the extraction of juice from *Parkia biglobosa* fruit (Ajisafe 2005).

Tables 7 to 8 show the observations made on *Parkia* juice after various days of production with Sodium Benzoate as preservatives at different concentrations of 0.40 mg/ml, 0.35 mg/ml and 0.30 mg/ml for refrigerated samples. Table 9 shows the characteristics of *Parkia* juice preserved with sodium benzoate concentrations above its threshold value (0.4 mg/ml) for both the refrigerated and shelved maintained the same characteristics with the juice preserved with sodium benzoate with concentration above its own threshold value of 0.35 mg/ml.

Discussion

Tables 1 to 9 shows the characteristics of the preserved *Parkia* juice, both control refrigerated and control shelved. The control refrigerated was able to maintain its characteristics for a period of 18 days, while the control shelved was not able to maintain its own characteristics beyond 6 days. This implies that the control refrigerated had a longer shelf life than control shelved and this is because of the storage conditions. The storage condition is very important, particularly temperature and time. These mainly determine the barrier demands irrespective of the packaging condition. The rate of spoilage is faster at high temperature (Ajisafe 2005; Bender 1987; Earle 1983; Lewis 1987).

Tables 7 to 8 shows the characteristics of *Parkia* juice preserved with sodium benzoate at different concentrations for the shelved and refrigerated. The *Parkia* juice preserved at 0.40 mg/ml, 0.35 mg/ml and 0.30 mg/ml shelved, the characteristics were maintained for a period of 33, 33, and 27 days, respectively, while in the *Parkia* juice preserved at 0.40 mg/ml, 0.35 mg/ml and 0.30 mg/ml refrigerated, the characteristics were maintained for a period of 45, 45 and 42 days, respectively. From these tables, it could be observed that the characteristics were maintained for quite some time before changes started occurring and also at concentration 0.40 mg/ml and 0.35 mg/ml.

The characteristics were maintained for a period of 45 days meaning that the shelf life for the juice preserved at concentration of 0.40 mg/ml and 0.35 mg/ml has not been reached. The reason for the observations made in Tables 7 to 9 is because of the ability of preservative to inhibit the growth of micro-organism which is the major contributor to the juice spoilage. More so, the higher the concentration of preservative, the lower the rate of spoilage, because at high concentration of preservative the growth of micro-organism is limited (Jackson and Lamb 1981).

Figures 8 to 11 shows the characteristics of *Parkia* juice preserved with Benzoic acid at the same concentration and the same storage condition as in the case of sodium benzoate. The *Parkia* juice preserved at concentrations of 0.40 mg/ml, 0.35 mg/ml and 0.30 mg/ml shelved, the characteristics were maintained for the period of 30, 30, and 24 days, respectively while for concentrations of 0.40 mg/ml, 0.35 mg/ml and 0.30 mg/ml refrigerated, these characteristics were maintained for the period of 42, 42, and 36 days, respectively. It could be noted that the shelf life of *Parkia* juice preserved under the influence of benzoic acid is shorter compared with that preserved under the influence of sodium benzoate.

Figure 12 shows the characteristics of *Parkia* juice preserved with citric acid preservatives at different concentrations, shelved and refrigerated. The *Parkia* juice preserved at 5 mg/ml, 4 mg/ml and 3 mg/ml shelved. The characteristics were maintained for a period of 27, 18 and 12 days, respectively. While in the *Parkia* juice preserved at 5 mg/ml, 4 mg/ml and 3 mg/ml refrigerated, the characteristics were maintained for a period of 36, 27 and 18 days, respectively. It could also be noted that the shelf life of *Parkia* juice preserved under the influence of citric acid is shorter compared with that preserved under the influence of Benzoic acid and sodium benzoate meaning that sodium benzoate was the best preservative among the three. The colour change noted in Tables 4.1 to 4.112 mainly was a problem of long term storage in most juice at temperature higher than 12^{o}C. Flavours are also known to lead to loss of freshness and unpleasant odour and tastes not associated with juice (Ajisafe 2005; Lewis 1987; Allen and Joseph 1985; Barclay *et al*. 1984; Hammid-Samimi and Swartzel 1984; Lund 1975).

Tables 1 to 9 shows the changes that occurred in the valves of the pH during storage, the pH values decreased from 4.88 to 2.00 and 4.88 to 2.80 and 4.88 to 3.17 for control shelved and refrigerated, respectively. These are show in graph (Fig. 4 to 11) that has a negative slope. Tables 4 to 6 shows the results of juice preserved with sodium benzoate at different concentrations shelved and refrigerated. For refrigerated juice, the pH value decreased from 4.78 to 4.48 for 0.40 mg/ml, 0.35 mg/ml and 0.30 mg/ml concentrations while for the shelved juice, the pH value decreased from 4.78 to 4.70 for 0.40 mg/ml, 0.35 mg/ml and 0.30 mg/ml concentrations, respectively. These are seen from graphs (Figs. 4 to 11) to the same observation of decrease in pH was noted in the juice preserved with Benzoic acid and citric acid. The increase in acidity of the juice was due to the formation of carboxylic acid as indicated below. Juice with about 6 percent alcohol is a starting point for the acetic acid formation, which also contributes to the sour taste of the juice.

Conclusion

Based on the experiments performed and the results obtained, the following conclusions were reached. The higher the concentration of the preservations used, the longer the shelf life will be for the product. Inhibitive ability of sodium benzoate is higher than that of Benzoic acid and citric acid. The storage conditions, that is, the temperature also determines the barrier demands. Also, the chemical changes undergone by the flavour fraction of the juice during storage gradually lead to a loss of freshness and unpleasant odours and taste not associated with the juice while the browning colouration is mainly a problem of long term storage particularly at high temperature. Increase in acidity of the juice was due to the formation of carboxylic acids resulting in low pH and this low pH provides an ideal environment for micro organisms to grow. And lastly, fermentation in juice was due to the

oxidation of organic compound present in the juice by bacteria and fungi.

References

Ajisafe, M. 2005. Production and characterisation of fruit juice from locust beans (*Parkia biglobosa*). B.Eng. Thesis, Department of Chemical Engineering, Federal University of Technology, Minna, Unpublished, pp. 1-96.

Allen, J.C. and Joseph, G. 1985. Determination of pasteurized milk on storage. J. Dairy Res. 52: 469-87.

Barclay, N.F.; Potter, T.D.; and Wiggins, A.L. 1984. Batch pasteurization of liquid whole egg. J. food Technology 19(5): 605-13.

Bender, A.E. 1987. The nutritional aspects of food processing. *In*: Turner, A. (ed.). Food technology international Europe. Sterling, London, UK, pp. 273-5.

Dare F.M. 2004. Design of a plant to produce 250,000 litres per day of citrus (Sweet orange) Juice Plant. Department of Chemical Engineering, Federal University of Technology, Minna, Nigeria, Unpublished, pp. 1-2.

Dupriez, H.; and De Leener, P. 1989. African gardens and orchards. Macmillan Press Ltd., London, UK, pp. 304-5.

Earle, R.L. 1983. Unit operation in food processing. 2nd ed., Pergamon Press, Oxford, UK, pp. 24-38, 46-63.

Erdman, J.W.; and Erdman, E.A. 1982. Effect of home preparation practices on nutritive values of food. *In*: Rechcigl M. (ed.). Handbook of nutritive value of processed food. CRC Press, Boca Raton, Florida, USA, pp. 237-63.

Fellows P.J. 1990. Food processing technology: Principles and practice. Ellis Horwood Ltd., West Sussex, England, UK, pp. 35, 73, 85, 108, 210, 421.

Hammid-Samimi, M.H.; and Swartzel, K.R. 1984. Pasteurization design criteria for production of extended shelf-life refrigerated liquid whole egg. J. Food Process Preserv 8: 219-24.

Harper, W.J. 1979. Process induced changes. *In*: Harper, W.J.; and Hall, C.W. (eds.). Dairy technology and engineering. AVI, Westport, Connecticut, USA, pp. 561-8.

Jackson, A.T.; and Lamb, J. 1981. Calculations in food and chemical engineering. Macmillan, London, UK, pp. 164-74.

Keay, R.W.J. 1989. Trees of Nigeria. Oxford University Press, New York, NY, USA, p. 251.

Lewis, M.J. 1987. Physical properties of foods and food processing systems. Ellis Horword, Chichester, West Sussex, UK, and VCH, Weinheim, Germany, pp. 137-66.

Lund, D.B. 1975. Heat processing. *In*: Karel, M.; Fennema, O.R.; and Lund, D.B. (eds.). Principles of food science. Part 2. Marcel Dekker, New York, NY, USA, pp. 31-92.

Mauron, J. 1982. Effect of processing nutritive value of food: Protein. *In*: Recheigl, M. (ed.). Handbook of nutritive value of processed foods. Vol. 1. CRC Press, Boca Raton Florida, USA, pp. 429-71.

Nelson, P.E.; and Tressler, D.K. 1980. Fruit and vegetable juice processing technology. 3rd ed., AVI, Westport, Connecticut, USA, pp. 268-309.

Vickery, M.L.; and Vickery, B. 1979. Plant products of tropical Africa. Macmillan Press Limited, London, UK, pp. 1 and 25.

Woodroof, J.G. 1975. Fruit washing, peeling and preparation. *In*: Woodroof, J.G.; and Luh, B.S. (eds.). Commercial fruit processing. AVI, Westport, Connecticut, USA, pp. 78-99.

Appendix

The following graphs were generated from the results and observations on *Parkia* Juice.

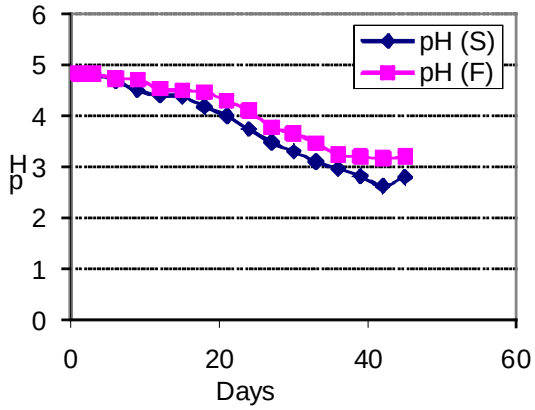

Fig. 2. pH of *Parkia* Juice for control shelved (S) and control refrigerated (F) samples.

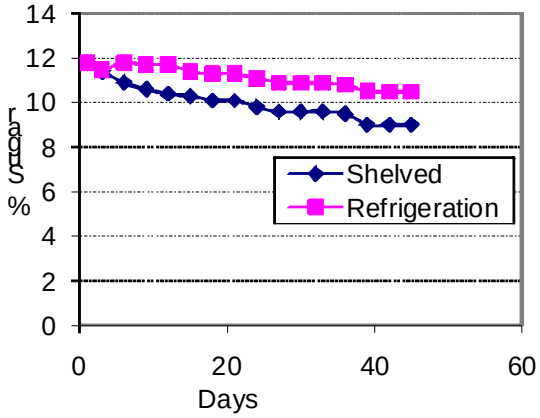

Fig. 3. Percent Sugar of *Parkia* Juice for control shelved (S) and control refrigerated (F) samples.

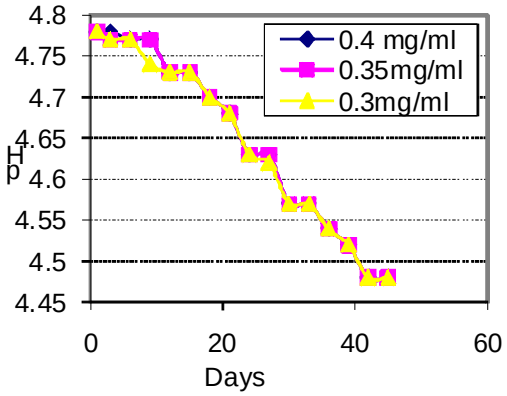

Fig. 4. pH of *Parkia* Juice using Sodium Benzoate preservative (Shelved).

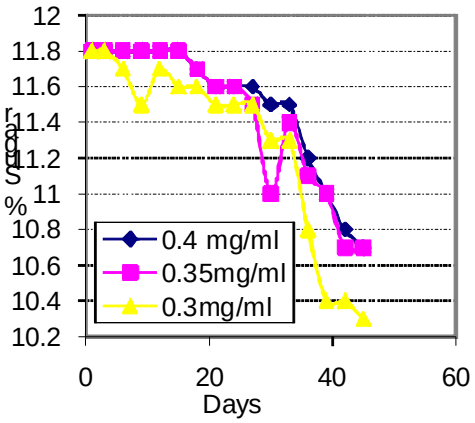

Fig. 5. Percent Sugar of *Parkia* Juice using Sodium Benzoate preservative (Shelved).

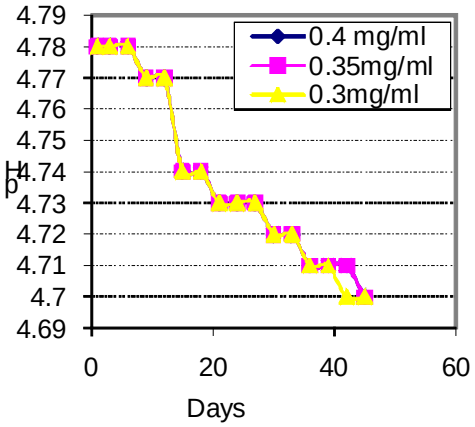

Fig. 6. pH of *Parkia* Juice using Sodium Benzoate preservative (Refrigerated).

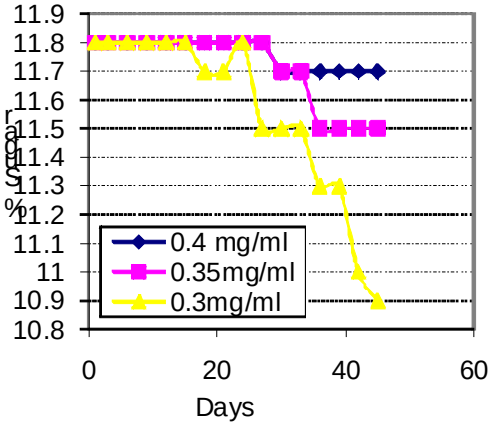

Fig. 7. Percent Sugar of *Parkia* Juice using Sodium Benzoate preservative (Refrigerated).

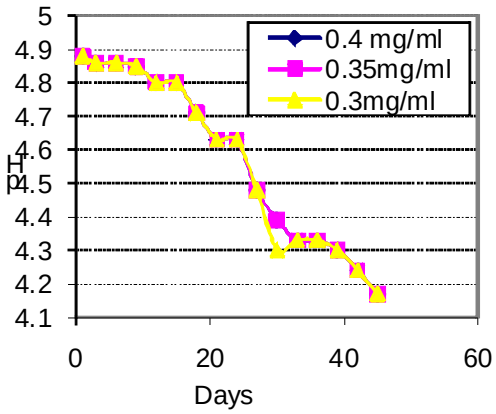

Fig. 8. pH of *Parkia* Juice using Benzoic Acid preservative (Shelved).

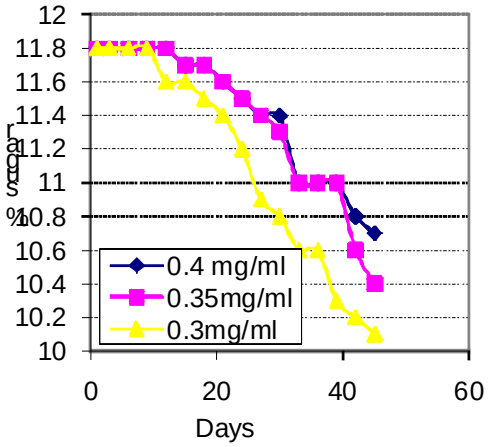

Fig. 9. Percent Sugar of *Parkia* Juice using Benzoic Acid preservative (Shelved).

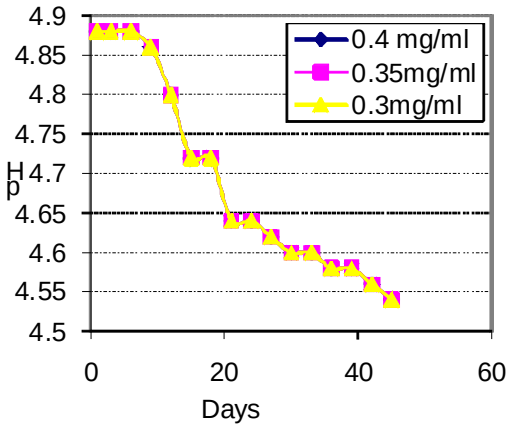

Fig. 10. pH of *Parkia* Juice using Sodium Benzoic Acid preservative (Refrigerated).

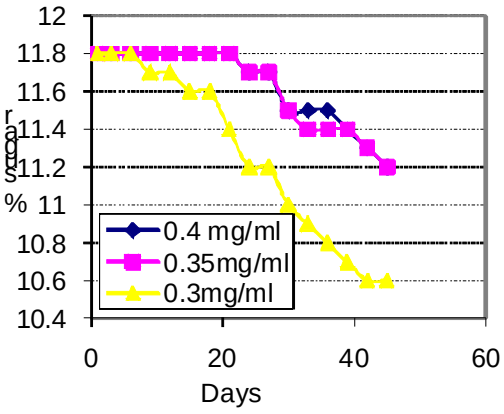

Fig. 11. Percent Sugar of *Parkia* Juice using Benzoic Acid preservative (Refrigerated).

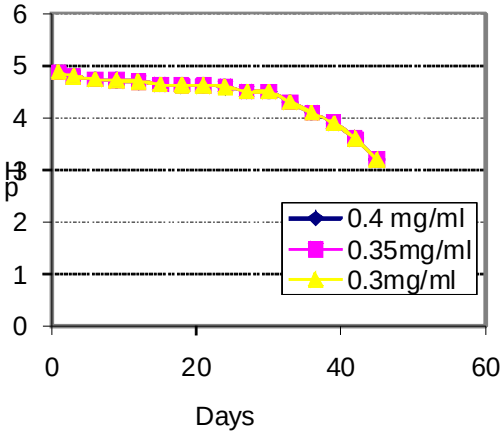

Fig. 12. pH of *Parkia* Juice using Citric Acid preservative (Shelved).