Food Research 5 (4) : 93 - 98 (August 2021)
Journal homepage: http://www.myfoodresearch.com

FOOD RESEARCH

FULL PAPER

Production and evaluation of jam produced from plum and African Star apple blends

*Ogunlade, A.O. and Oluwafemi, G.I.

Department of Food Technology, The Federal Polytechnic Ado-Ekiti, P.M.B. 5351 Ado-Ekiti, Ekiti State, Nigeria

Article history:
Received: 10 January 2021
Received in revised form: 28 February 2021
Accepted: 3 March 2021
Available Online: 11 July 2021

Keywords:
African star apple,
Plum,
Blend,
Acceptability,
Sensory attributes

DOI:
https://doi.org/10.26656/fr.2017.5(4).031

Abstract

The potential of some indigenous fruits such as yellow-plum *(Spondias mombin)* and African Star Apple (*Chrysophyllum albidum*) remained largely untapped. These fruits can be processed and preserved in small-scale operations using simple techniques that could replace both expensive fruits and the lengthy operation processes usually used for jam production. Blends were produced from African Star Apple and Plum in the following proportion: 100:0%; 90:10%; 80:20%; 70:30%; 60:40% and 50:50% respectively to produce six African Star Apple and plum blends. The chemical properties and consumer acceptability of jams made from these blends were investigated using standard methods. Chemical analyses of the jam showed that vitamin A ranged between 613.09 and 686.04 (IU), sample with the highest percentage of African Star Apple had the highest value of Vitamin A; vitamin C ranged between 30.51 and 46.12 (mg/100 g); pH ranged between 4.29 and 4.58; Brix ranged between 11.00 and 14.97°Bx. There were no significant ($p>0.05$) differences in the sensory attributes of the samples. It was observed that Jam produced from African Star Apple and plum blend at 50:50% proportion had the highest Vitamin A and those at 90:10% proportion had the highest Vitamin C contents and all the samples were of high nutritional and health benefits.

1. Introduction

Fresh fruits and vegetables are known to be perishable agricultural food commodities as a result of their high moisture content due to the various readily available nutrients and growth factors that are taking place (Singh, 2007; Arah *et al.,* 2016).

Plum plant *(Spondias mombin)* is a fructiferous tree having a habitat in Nigeria and several other tropical forests in the world. It belongs to the family *Anacardiacae*. It grows in the rain forest and in the coastal area. The trunk has deep incisions in the bark, which often produces a brown resinous substance. This plant is readily common around us in South West of Nigeria (Yoruba) and is commonly used in folk medicine. Various cultures frequently maintain within their collection of traditional medicine substances valued as drugs for treating diseases (Elisabetsky *et al.,* 1992).

Indigenous tropical fruits such as African Star Apple (*Chrysophyllum albidum*) are often left unexploited and are allowed to waste due to their excess supply in their season. Due to this, rural producers are often forced to give away their produce or allow them to rot away due to the fact that the fruit has a very short life span after ripening. To prevent this loss, processing their valued products to be sold in urban areas is of importance. Processing of the gluts from these fruits has received less attention until recently where research work on the suitability of this fruit into food preserves, drinks and some other commodities are being looked into. Farm produce is often preserved in high sugar and/or salt solutions to extend their shelf-life or add variety to common food products as another means of preservation. One of such methods of preserving fruits is by processing them into Jam. Processing of fruits not only serves as a purpose of its preservation but also several other purposes such as diversification of the economy, reduction of imports and stimulate agricultural production by obtaining marketable products, generate employment, reduce fruit and vegetable losses, develop new value-added products which are also available during off-seasons (Bakshi *et al.,* 2013). The process relies on the preservative effect of sugar in high concentration that tends to make moisture unavailable (Rawat, 2015) for the proliferation of microorganisms especially bacteria and hence inhibit their growth in the food product, thereby extending the shelf life of the food.

*Corresponding author.
Email: *ayoyemi19@gmail.com*

eISSN: 2550-2166 /

Jam could be addressed as fruit preserved usually made from pulp or whole fruit. It can be defined as cooked and gelled fruit or fruit pulp packaged for storage. It could be used as bread spread and fillings. The preparation of jam involves the use of pectin as a gelling agent with sugar or honey and/or citric acid (Patten, 2001). Jam is usually hot-filled into sterilized glass jars that are inverted after capping (Adebayo and Abdusalam, 2017) and then allowed to cool and set in an upright position for subsequent storage. Subsequently, various processing methods are adopted to convert surplus fruits in time of glut into value-added products that will outlast the seasonal fruits. These techniques include the production of high-sugar preserves (jam, jelly and marmalade), fruit juice, nectar, puree, concentrate, pickle, dried chips and more advanced crystallized fruit sweets. Many of these processes can be done on a small or medium-scale level while the more advanced ones require more sophisticated machinery and setup. Jam making practices in Nigeria and the other preserves by using fruits, sugar, pectin and edible acids as one of the oldest food preserving processes known to mankind and presents a way of making food stable by increasing the total soluble solids (TSS) content (Herbstreith and Fox, 2011). High sugar content is adopted in Jam making in order to suppress microbial growth, sweeten the product, help set the pectin, and make the product glisten (Kataria *et al.,* 2016), while the pectin precipitates and helps form a matrix gel with the fruit content and sugar to yield a mixture that has a shelf-life of over 6-12 months. The act and art of Jam making is an interesting process that helps reduce post-harvest losses that are often associated with fresh fruits. The objectives of this research work are to produce and evaluate the nutritional quality of jam produced from plum and African Star apple blends.

2. Materials and methods

2.1 Materials

African Star apple (*Chrysophyllum albidum*) and plum *(Spondias mombin)* were collected from a local farm at Ado Ekiti in Ekiti state. Fresh juicy good quality African Star apple and plum were sorted for processing. The fruits were washed thoroughly under tap water followed by distilled water to remove foreign materials. The fruits were de-skin and the pulp was separated from the seeds. The pulps to be used were reduced in size for easy blending then formulated for the jam production using the open kettle method as described by DeGregorio and Cante (1992). Extracted pulp was poured into a pot and brought to boil to concentrate at atmospheric pressure and temperature of 105°C. The predetermined weight of sugar was added to the boiling pulp while stirring vigorously until it became concentrated to desired consistency. Pectin was added and further heated to remove excess water from the blend. The jam was filled while hot into sterilized jars, which had been washed properly with soap and water and sterilized by boiling (jars and lids separated) in water to 100°C for 10 mins, leaving 1/3-inch headspace and turned over. Samples of the jam were stored at ambient and refrigeration temperatures. The flow diagram is described in Figure 1.

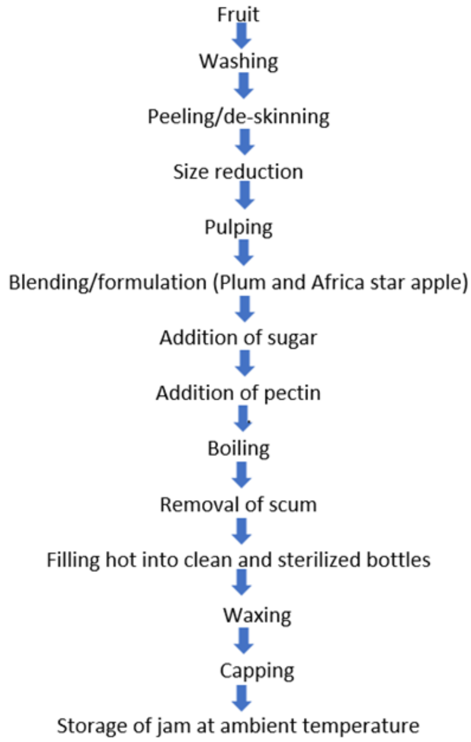

Figure 1. Production of jam from African Star apple and plum blends

2.1.1 Formulation of blends

Blends were produced from African Star apple and plum in the following proportion: 100:0%; 90:10%; 80:20%; 70:30%; 60:40% and 50:50% respectively to produce six African Star apple and plum blends. (Table 1)

Table 1. Formulation of the blends of African star apple and plum puree with other ingredients

Sample	African Star apple (%)	Plum (%)	Pectin (mL)	Sugar (g)
A1Z	100	0	15	10
B2Y	90	10	15	10
C3X	80	20	15	10
D4W	70	30	15	10
E5V	60	40	15	10
F6U	50	50	15	10

A1Z = 100% African Star Apple (ASA) + 0% Plum (PL) + 15 mL Pectin (PC) +10 g Sugar (SU), B2Y = 90% ASA + 10% PL + 15 mL PC +10 g SU, C3X = 80% ASA + 20% PL + 15 mL PC +10 g SU, D4W = 70% ASA + 30% PL + 15 mL PC +10 g SU, E5V = 60% ASA + 40% PL + 15 mL PC +10 g SU and F6U= 50% ASA + 50% PL + 15 mL PC + 10 g SU

2.2 Chemical analysis

2.2.1 Determination of vitamin A

In order to determine the vitamin A, 50 mL of 0.2 M of H_2SO_4 was added to 1 g of each sample in a test-tube boiled and cooled using a water bath as described according to (AOAC, 2012) Thereafter, 1 mL of 0.5 M of HCl was added to the solution filtered and placed in a test tube. A volume of 10 mL of each filtered sample was divided into labelled test tube A and B, 1.0 mL of distilled water was added to test tube A and 1 mL of acetic acid was added to test tube B, followed by the addition of 0.5 mL of 3% $KMnO_4$ allowed to stand for 2 mins, thereafter 0.5mL of 3% of H_2O_2 was added and the absorbance was read using a spectrophotometer at 470 nm and 525 nm.

2.2.2 Ascorbic acid (vitamin C)

Ascorbic acid was determined by the 2, 6-dichlorophenol indo-phenol titration procedure (AOAC. 2012). Ascorbic acid was extracted using acetic acid and metaphosphoric acid solution. The extracts were transferred with distilled water into a 50 mL volumetric flask and made up to the mark with more distilled water and filtered rapidly. The filtrate was run from a burette into a test tube containing one drop of dilute acetic acid and 1 mL of the redox dye, 2, 6 dichlorophenol indophenol solution. The volume of extract required to decolorize the dye was noted. The titration was repeated using standard ascorbic acid solution (1 mg pure vitamin per 100 mL) in place of the jam. Ascorbic acid per 100 g of jam is calculated as:

$$\%\ \text{ascorbic acid} = \frac{w \times 100}{100}$$

Where w = volume of dye

2.2.3 pH determination

The pH meter was calibrated by adjusting with buffers 4 and 7 solutions. pH was determined using pH meter (model BA 350 EDT instruments).

2.2.4 Soluble solid determination

The soluble solid of the jam was calculated in °Bx, this was determined using the Abbey refractometer (Bausch and Lomb). Samples were placed on the sample holder of the refractometer that had been standardized to the zero mark with distilled water. The °Bx was read from the refractometer.

2.3 Sensory evaluation of jam

Sensory evaluation of the jam was judged for colour, taste, flavour and general acceptability on a nine-point hedonic scale, varying from "dislike extremely" (score 1) to "like extremely" (score 9) according to (Iwe, 2002). An informal panellist of twenty-five untrained assessors from the polytechnic Ado Ekiti community carried out the acceptance test for the samples. The shelf life of the jam was studied in terms of sensory and chemical quality.

2.4 Statistical analysis

The difference in experimental data was tested for statistical significance $p \leq 0.05$ by Statistical Analysis of Variance (ANOVA) using SPSS 23.0 software package (Statistical Package for Social Scientist, Michigan, USA).

3. Results and discussion

3.1 Chemical composition

Table 2 shows the chemical composition of jam produced from plum and African Star apple blends. Vitamin A content ranged between 613.09 and 686.04 IU across the samples. The samples were significantly ($p<0.05$) different from one another, sample A1Z had the least value of vitamin A (613.09 IU) which could be as a result of the absence of plum in the composition while sample F6U had the highest vitamin A content (686.04 IU). The high value of vitamin A in sample F6U could be as a result of the high proportion of plum in the blends, the yellow pigment in plum is a good source of carotene which serves as a precursor for vitamin A. As the African Star apple reduces and plum increases in the blends the vitamin A content increases, except for sample B2Y.

Vitamin C (ascorbic acid) is one of the major nutrients that are obtained mainly from fruits and fruits products. Apart from the sweet sensation and flavour, the nutritional point of view of fruits and fruits products should also be of importance to consumers. The vitamin C content ranged from 30.51 mg/100 g to 46.12 mg/100 g, there were significant ($P<0.05$) differences across the samples in which the highest vitamin C content was noticed in sample B2Y (46.12 mg/100 g). Sample with a high proportion of Africa star apple had a high percentage of Vitamin C, this is an indication that Africa Star Apple is richer in ascorbic acid compare to plum fruit. However, the result obtained was higher compared to what was reported (27.06 mg/100 g) by Ajenifujah-Solebo and Aina (2011). The pH content ranged between 4.29 and 4.58, sample F6U had the highest pH value (4.58) and was significantly ($P<0.05$) higher compared to other samples, although sample A1Z and B2Y were not significantly ($P>0.05$) different likewise sample C3X and E5V were not significantly ($P>0.05$) different from each other. The high ascorbic acid content in sample F6U could be attributed to the high content of pH value in the

FULL PAPER

Table 2. Chemical composition of jam produced from African Star apple and plum blends

Sample	Vitamin A (IU)	Vitamin C (mg/100 g)	pH	°Bx
A1Z	613.09±0.02[f]	42.41±0.02[d]	4.45±0.05[bc]	12.11±0.01[b]
B2Y	674.33±0.03[c]	46.12±0.02[a]	4.48±0.03[b]	11.00±0.10[d]
C3X	638.04±0.03[e]	38.62±0.02[e]	4.30±0.00[d]	11.49±0.03[c]
D4W	656.04±0.03[d]	44.53±0.01[c]	4.41±0.03[c]	10.43±0.12[e]
E5V	682.62±1.28[b]	30.51±0.02[f]	4.29±0.02[d]	14.93±0.12[a]
F6U	686.04±0.03[a]	45.29±0.02[b]	4.58±0.03[a]	14.97±0.06[a]

A1Z = 100% African Star Apple (ASA) + 0% Plum (PL) + 15 mL Pectin (PC) +10 g Sugar (SU), B2Y = 90% ASA + 10% PL + 15 mL PC +10 g SU, C3X = 80% ASA + 20% PL + 15 mL PC +10 g SU, D4W = 70% ASA + 30% PL + 15 mL PC +10 g SU, E5V = 60% ASA + 40% PL + 15 mL PC +10 g SU and F6U= 50% ASA + 50% PL + 15 mL PC + 10 g SU. Values are presented as mean±SD. Values with different superscripts in the same column are significantly different (p≤0.05).

same sample. The pH value obtained for sample F6U was higher compared to 3.8 reported by Ajenifujah-Solebo and Aina (2011) but lower compared to 5.20 that was reported by Abu (2002). The °Bx of the various blends was in the range of 11.00 - 14.97%. There was a significant (P<0.05) difference among the samples in which the highest °Bx value was in sample F6U but not significantly (P>0.05) different from sample E5V. However, as the percentage of African Star Apple reduces in the blends with increment in that of plum, the percentage of °Bx increases. The stability of °Bx in sample E5V and F6U could be a result of the maturity of the fruits used in jam production when collected but the value obtained in this research work was lower compare to what was reported (62 -70%) by Fasogbon *et al.* (2013). This also contributed to the good palatability and acceptability of the blends which also help to prevent the growth of yeast and mould.

3.2 Sensory acceptability

Table 3 shows the mean sensory scores of jam produced from African Star apple and plum blends. The scores were analysed in terms of taste, aroma, colour, mouthfeel and overall acceptability. The result obtained from the analysis shows that the scores of the taste of the samples were not significantly (P>0.05) different from one another despite the different proportion of fruits used. Although the same percentage of sugar and pectin were used for each of the samples, this indicates that variation in the proportion of fruits used in the formulation for the jam production does not have an effect on taste but the taste score obtained were lower compared to 8.4 reported by Ihediohanma *et al.* (2014) but higher compared to jam prepared from fresh pineapple and commercial jam samples as reported by Fasogbon *et al.* (2013). The aroma scores show that there was no significant (P>0.05) difference among the samples, the aroma score obtained which ranged between 6.20 and 7.60 were lower compared to 8.4 of pineapple jam reported by Ihediohanma *et al.* (2014). Mean scores obtained for colour were not significantly (P>0.05) different from one another, this could be as a result of the same quantity of sugar used in the jam production, sugar caramelized with heat and gives colour to jam. Mouthfeel is one of the sensory attributes determined in the samples which ranged between 6.00 and 7.30 but not significantly (P>0.05) different from one another. More so, the mean scores of the overall acceptability of samples were not significantly (P>0.05) different likewise, this is an indication that varying the proportion of Africa star apple and plum during blending with a constant percentage of sugar and pectin does not have an effect on the overall acceptability of the samples.

4. Conclusion

This study demonstrated the potential use of African

Table 3. Sensory evaluation of jam produced from African Star apple and plum blends

Sample	Taste	Aroma	Colour	Mouthfeel	Overall acceptability
A1Z	6.90±1.29[a]	6.20±2.15[a]	6.30±2.36[a]	6.30±2.31[a]	7.40±1.35[a]
B2Y	6.10±2.42[a]	6.50±2.07[a]	7.20±2.20[a]	6.00±2.63[a]	6.80±2.49[a]
C3X	6.90±1.73[a]	6.50±1.58[a]	7.30±1.64[a]	7.30±1.49[a]	7.90±1.45[a]
D4W	7.20±1.93[a]	7.50±1.72[a]	7.60±1.58[a]	6.70±1.64[a]	7.30±1.70[a]
E5V	6.60±2.12[a]	7.60±1.35[a]	6.70±2.31[a]	7.30±1.70[a]	7.50±1.58[a]
F6U	6.50±2.37[a]	6.70±2.11 [a]	6.70±1.64[a]	6.90±2.23[a]	7.60±1.58[a]

A1Z = 100% African Star Apple (ASA) + 0% Plum (PL) + 15 mL Pectin (PC) +10 g Sugar (SU), B2Y = 90% ASA + 10% PL + 15 mL PC +10 g SU, C3X = 80% ASA + 20% PL + 15 mL PC +10 g SU, D4W = 70% ASA + 30% PL + 15 mL PC +10 g SU, E5V = 60% ASA + 40% PL + 15 mL PC +10 g SU and F6U= 50% ASA + 50% PL + 15 mL PC + 10 g SU. Values are presented as mean±SD. Values with different superscripts in the same column are significantly different (p≤0.05).

eISSN: 2550-2166

Star apple and plum fruits in jam production. The results obtained from the study showed that the product serves as a good source of nutritional and health beneficial chemical composition. Processing African Star apple and plum blends into jam will help in reducing post-harvest losses of fruits and also reveal the utilization potential of underutilized fruits. It also encourages the preservation of these fruits due to the seasonality which makes them abundantly available during its season and uncommon during offseason.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

The author appreciates The Centre for Research and Innovation Development (CRID) Federal polytechnic Ado Ekiti and The Tertiary Education Trust Fund (TETFUND - IBR) Nigeria, for funding the research.

References

Abu, J.D. (2002). Development of a Sweetener from Black-plum (*Vitex Doniana*) Fruit *International Journal of Food Properties*, 5(1), 153 – 159. https://doi.org/10.1081/JFP-120015598

Adebayo, F.O. and AbdusSalam, R.O. (2017). Comparative studies on mixed fruit jam packaged in different local containers. *African Journal of Food Science and Technology,* 8(4), 63-66.

Ajenifujah-Solebo, S.O. and Aina, J.O. (2011). Physicochemical properties and sensory evaluation of jam made from black-plum fruit (*Vitex doniana*). *African Journal of Food, Agriculture, Nutrition and Development,* 11(3), 4772-4784. https://doi.org/10.4314/ajfand.v11i3.66629

AOAC. (2012). Official Methods of Analysis of AOAC International, 19th ed. Gaithersburg, MD, USA: AOAC.

Arah, I.K., Ahorbo, G.K., Anku, E.K., Kumah, E.K. and Amaglo, H. (2016). Postharvest handling practices and treatment methods for tomato handlers in developing countries: A mini review. *Advances in Agriculture,* 2016, 6436945. https://doi.org/10.1155/2016/6436945

Bakshi, A.K., Joshi, V.K., Vaidya, D. and Sharma, S. (2013). Processing and Preservation of fruits of Himalayan region; food processing and preservation-Part I, p. 288-292. New Delhi: Jagmander book agency.

DeGregorio, M.L. and Cante, C.J. (1992). Fruit Preserves and Jellies. In Hui, H.Y. (Ed). Encyclopaedia of Food Technology. 1st ed. United Kingdom: Wiley-Interscience.

Elisabetsky, E., Figueiredo, W. and Oliveira, G. (1992). Spices and medicinal plants. *Journal of Herbs, Spices and Medicinal Plants,* 1(1-2), 125 – 162. https://doi.org/10.1300/J044v01n01_11

Fasogbon, B.M., Gbadamosi, S.O. and Taiwo, K.A. (2013). Studies on the Chemical and Sensory Properties of Jam from Osmotically Dehydrated Pineapple Slices. *British Journal of Applied Science and Technology*, 3(4), 1327-1335

Herbstreith and Fox (2011). Jams, jellies and marmalades. Germany: Herbstreith and Fox

Ihediohanma, N.C., Okafor, D.C. and Adeboye, A.S. (2011). Sensory Evaluation of Jam Produced from Jackfruit *(Artocarpus heterophyllus) Journal of Agriculture and Veterinary Science,* 7(5), 41-43. https://doi.org/10.9790/2380-07524143

Iwe, M.O. (2002). Handbook of Sensory Methods and Analysis. p. 40-83. Uwani Enugu, Nigeria: Rejoint Communication Services Ltd.

Kataria, R., Trivedi, D., Wadia, A. and Nina, D. (2016). Production of Nutritious Jam by using an Underutilized Fruit *Avverhoa carambola* (star fruit). *International Journal of Advanced Research* 5(1), 2852-2856. https://doi.org/10.21474/IJAR01/3081

Patten, M. (2001). Basics in Jams, Preserves and Chutneys. Handbook. London, United Kingdom: Grub Street Publishing.

Rawat, S. (2015). Food spoilage: Microorganisms and their prevention. *Asian Journal of Plant Science* and Research, 5(4), 47-56.

Singh, N.P. (2007). Fruit and vegetable preservation. 1st ed. Jaipur, India: Oxford Book Company.

