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**Ogori AF**
Department of Home Science and Management, Faculty of Agriculture, Federal University, Gashua, P.M.B.1005 Gashua, Yobe State, Nigeria

**Amove J**
Department of Home Science and Management, Faculty of Agriculture, Federal University, Gashua, P.M.B.1005 Gashua, Yobe State, Nigeria

**Evi-Parker P**
Department of Home Science and Management, Faculty of Agriculture, Federal University, Gashua, P.M.B.1005 Gashua, Yobe State, Nigeria

**Corresponding Author:**
**Ogori AF**
Department of Home Science and Management, Faculty of Agriculture, Federal University, Gashua, P.M.B.1005 Gashua, Yobe State, Nigeria

# Quality characteristics of jam from pineapple, cucumber and Jathropha

**Lilian Blanco and Thippi Thiagarajan**

**Abstract**
Production of jams is one of the preserving techniques to extend whole fruit utilization. Fruits are constituents and important sources of bioactive components, therefore their mixed Jams from various fruits, can be a proper solution against degenerative chronic diseases. In the present study, physiochemical and sensory properties of mixed jam from pineapple fruit, Jathropha leaves and cucumber fruit were evaluated. Mixed jam were prepared by sorting, washing, and blending different ratios of apple, cucumber and jathropa (T1(85:10:5), T2 (80:10:10), T3 (75:10:15), and T4(70:10:20) respectively. The obtained results on proximate includes moisture content, protein values, ash cotnent, fat content, crude fiber and carbohydrate values which ranged from 3.83-15.61% moisture content, 0.06-0.707% protein, 0.014-0.110% Ash,0.023-0.145% fat, 0.123-0.592% crde fibre and 83.25-96.14% carbohydrate value respectively. The minerals contents includes calcium, zinc, magnesium, potassium, sodium, and iron and ranged from 1.87-2.87mg for Ca, 0.03-0.10mg for Zn, 0.11-0.7mg for Mg, 0.12-0.61mg for K, 1.78-2.59mg for Na and 0.10-0.67mg for Fe respectively. Vitamin C and Beta carotene were evaluated and reported thus; 691.35-436.95mg/100g and 0.73-1.44mg/100g respectively. The results from sensory attributes and physiochemical properties reveal rich mixed jam product from pinneaple fruits, jathropha leaves and cocumber fruit. T4,sample ratio portrayed the most acceptable jam product.

**Keywords:** Mixed jam, fruit, vegetable, blends, physiochemicals, sensorial, quality

## Introduction

Prepared fruits, vegetables and sugar often canned or sealed for long-term storageare refered to as fruit preserves, Jam, a products from a whole fruit, cut in pieces or crushed. The fruit is heated with water and sugar for pectin activation within the fruit. The mixture is then put into the containers. The fruit preserves often involves the addition of pectin as a gelling agent,sugar or honey may be used as well (Afoakwa, 2006) [1].

*Jatropha tanjorensis*is popular in Mexico and originated in Central America. According to Egbon *et al*. (2013) [4], it can be grown on waste land and in local palace. The liquid extracted from it leave is drunk to quickly beef up blood volume in the body. It can also be used as alternative to lettuce in salad preparation. Olayiwola *et al*. (2004) [10] opined that the leaf of *Jatropha tanjorensis* is been used locally and alsoconsumed as food vegetable. It is popular as a natural remedy against diabetes for rural deweller in Nigeria.

Cucumber is the fruit of *Cucumis sativus* plant. Cucumbers are high in water and low in calories, fat, cholesterol, and sodium (George, 2007) [6]. They are noted for their mild and soothing taste with a high water content. Pineapples (*Ananas comosus)* are tropical fruit that are rich in vitamins, enzymes and antioxidants. Despite their sweetness, pineapples are low in calories. The fruit is actually made of many individual berries that fuse together around a central core. It is a non-toxic compound which has a number of potential therapeutic applications, including treatment of trauma, inflammation, auto immune disease, enhancement of immune response and malign (Bhaskar, 2011) [3]. Jams made from a combination of fruits and vegetables are rare. This work is aimed at producing a jam with fruits and vegetables complimenting each other resulting in higher nutritional quality, as well as an appealing, sensory and synergistic bioactive values.

## Scientific hypothesis

Mixed fruit jam from pineapple, jathropha and cucumber were produced as home preserves. The following hypothesis were tested: either that jathropha and cucumber blend rations had any effect on the chemical, vitamin, mineral and sensorial properties or not on jam preserve. Increasing or decreasing the blend ration percentage of jathropha and cucumber on pineapple derived mixed jam may improve the physicochemical properties (protein, crude fibre, ash fat) values of mixed jam preserve. Increasing or decreasing the percentage blend ratio of jathropha and cucumber in propoertional ration in making jam may improve the vitamin and mineral contents of mixed fruit jam preserve. Increasing the or decreasing the blend ration percentage may improve the sensoriall properties (mouthfeel, appearance, and general acceptability) of pineapple derived mixed jam

## Material and Methodology

### Materials

Mature and healthy pineaple and cocumber fruits were purchased from North Bank market Makurdi and selected on the basis of shape size, uniformity, color and damages. Any fruits with the injuries and disease were discarded. Fresh and leaves of jathropha also were collected from the enviroment housing the College of Food Technology and human Ecology complex of the University of Agriculture Makurdi.

### Fruit and Vegetable Preparations

Selected fruits and vegetables are sorted, washed to remove debris and adhering soils and dirts from their skin. In the next step, fruits were peeled and cut into small pieces the crushed/blended. The pulp from the three individual fruits and vegetable were extracted in the same manner to obtain three pulps. The pulp and sugar were mixed and heated. The soluble solid formations were monitored during the process until the brix of 55˚C was attaind (Kawther *et al*., 2013).

To prepare mixed Jam, pectin was use as solution base. These solutionswereprepared by the addition of pectin to hot water and heating to reach a homogenous solution mixture. The pectin solution, the fruit pulp, sugar and citric acid were added at this stage. The jam was ready when the bubbles formed at the sides of the vessels were obseved. The hot jam was poured in clean, dry, wide-mouthed jars or bottles and cooled to 35 °C in a water bath for gel formation and reducition of thermal stress. The final jam was then stored at ambient temperature for 24 H.

### Physico-Chemical Analysis of pineapple, cucumber and Jathropha blended Jam

The moisture contents, pH, ash, fat, protein and crude fibre contents of the jam was determined in accordance with AOAC (2012) [2] method.

### Determination of pH

The pH was standardized and the electrode was rinsed with distilled water, the electrode was then dipped into 5g of the sample which was dissolved in 50 mL of water.

### Determination of Moisture Content

Two gram (2g) of the prepared samples were weighed in petri dishes and covered immediately, then transferred into an oven, uncovered and heated at 130-150˚C for 3 H. After the heating the samples were removed, placed in a desiccator and allowed to cool for 15 min before weighing. This was repeated until constant weights were recorded. The loss in weight from the original (before heating) was reported as the percentage moisture content equation 1).

$$\text{Eq (1): } Moisture\ Content = \frac{\text{Weight loss} \times 100\%}{\text{Weight of sample}}$$

### Determination of Protein Content

AOAC (2012) [2] method was adopted .0.8g of the prepared samples was digested in kjedahl digestion system under a fume chamber. The digesta was allowed to cool and then distilled into boric acid containing bromocresor green indicators after it is appropriately diluted first with water, followed by sodium thiosulphate and sodium hydroxide solutions. In the next step, the samples were titrated against 0.1N Hydrochloric acid (HCL) solutions. Blank titrations were similarly carried out and the percentage protein content was calculated by equation 2.

Eq (2): %Nitrogen × 6.25(1ml of 0.1N HCL = 0.0014gN)

$$\text{Nitrogen} = \frac{\text{Titre value} - \text{blank} \times 0.0014\text{N} \times 100\% \times 25}{\text{Weight of sample} \times 5\text{ml aliquot}}$$

### Determination of Ash Content

AOAC (2012) [2] method was adopted. Five grams of the prepared sample was weigh in duplicates into ash dishes that have been previously weighed. The dishes were placed into a muffle furnace and ignited at 550 ± 10 °C for 5 H, cooled and then weighed to constant weight. The resulting ash was calculated based on equation 3.

$$\text{Eq (3): Ash Content} = \frac{\text{Weight of ash} \times 100\%}{\text{Weight of sample}}$$

### Determination of Fat Content

AOAC (2012) [2] method was adopted. Two (2g) of the prepared sample was weighed into soxhlet thimbles and fixed into extraction flask of given weight. Extraction was carried out using diethyl ether for 5 H. At the completion, the diethyl ether was removed by evaporation on an electrical bath and the remaining fat in the flask dried at 60 °C for 30 min in oven, then cooled for 15 min and weigh. Equation 4 was used to evaluate fat content.

$$\text{Eq (4): Ash Content} = \frac{\text{Weight of fat} \times 100\%}{\text{Weight of sample}}$$

### Determination of Crude Fibre Content

The AOAC (2012) [2] method was adopted. One gram of the sample was weigh. Then 100 mL of Trichloroacetic acid (TCA) digesting reagent was added. The solution was brought to boil and reflux for exactly 40min at 50-60˚C. The flask was removed from the heater, cooled a little and the solution was filtered through Whatman filter paper. The residue was washed with hot water and with methylated spirit. The filtrate was transferred to a muffle furnace and ignited at 550ºC for 30 min, cooled and weighed. The percentage crude fibre content was calculated as:

% Crude fibre = the loss in weight after incineration x 100

### Determination of Carbohydrate Content

Carbohy date value of sample was determined in accordance with the method described by AOAC (2012) [2]**.** Equation was used to calculate carbohydrate percent.

Carbohydrate percent = 100– (% Moisture + % Fat + % Protein + % Crude fibre + % Ash)

### Total Titratable Acid

Ten (10g) of the sample was dissolved in100 mL of distilled water. 10 mL eloquent of the supernatant was titrated with 0.1N NaOH and phenolphthalein as an indicator. Titrable acidity was reported based on citric acid following the below equation.

%citric acid= volume of NaOH used × 0.1N × ml equivalent of citric acid × 100

**Determination of Total Soluble Solids (TSS)**

Dry empty dishes were weighed and 5g of the samples were added. These were placed on a boiling water bath and left to stand until the water was evaporated from the samples. The samples were then placed in oven at 102 °C for 2.5 H. This was allowed to cool and readingrecords taken. Equation was used to calculate the SS percent.

$$\%\text{ total solid} = \frac{\text{Weight of residue} \times 100}{\text{Weight of sample}}$$

**Determination of Total Sugar Content (°Brix)**

AOAC (2012) [2] method was adopted. Hand held sugar refractometer instrument was used. The prism of the refractometer was cleaned and a drop of the sample was placed on the prism and closed. The total sugar Content (°Brix) was read off the scale of the refractometer when held close to the eyes.

**Determination of Minerals**

The mineral elements such as Calcium, Zinc, Magnesium, Potassium, Sodium and Iron were determined using the method by AOAC (2012) [2]. One gram of each sample was weighed into 100 mL round bottom flask, and 5 mL of perchloric acid was added and heated over an electric heater in a fume chamber until the solution becomes colourless. Each of the solution was made up to 10 mL mark with distilled water and the diluted sample set aside for further studies. The Calcium, Zinc, Magnesium, Potassium, Sodium and Iron content were analyzed using the Atomic Absorption Spectrophotometer.

**Determination of Vitamins**

The Vitamin A (β-carotene) and Vitamin C (ascorbic acid) was determined using the method by AOAC (2012) [2]. Ten grams of each sample was weigh into a 250mL flask and 50mL acetone was added. It was allowed to stand for 2 H with occasional shaking, and then filtered. The filtrate was measured and equal volume of saturated NaCL was added to wash the filtrate (carotene extract). The resulting mixture was shaked and transferred to a separating funnel to remove the layer of the extracted carotene. The supernatant was washed again with equal volume of 100% Potassium Trioxocarbonate (IV) ($K_2CO_3$), which separat and ultimately washed with 10-20 mL of distilled water. Water carotene was separated and the carotenoid extracted. The absorbance was read in a spectrophotometer at 326 nm wavelength using 50:50 acetones and low boiling petroleum ether solution as the blank.

**Sensory Evaluation**

Sensory evaluation was carried out to assess consumers' preference using a 9-point hedonic scale where 1 represented dislike extremely while 9 represented like extremely. Ten panelists were employed to evaluate the attributes of appearance or colour, odour, taste and general acceptability of the jam. The panelists were selected out of students of the Department of Food Science and Technology, University of Agriculture, Makurdi. For each sample, 10g of jam was served in white disposable plates with some slice of bread. The plates were coded with three digit random numbers undistributed randomly among panelists. The evaluation took place at 10a.m. in the sensory evaluation laboratory.

**Statistical Analysis**

Result data were expressed as the mean values and standard deviation of two determinations. Data were analysed using a one-way analyses of variance (ANOVA) using Statistical Package for Social Science (SPSS) version 20.0 software, 2011 ($p$<0.05) (Lawless and Heymann, 2010) [4].

**Results and Discussion**

Table 2 depicted the results of the proximate composition of mixed fruit and vegetable jam prepared from pineapple, cucumber and jathropha. Moisture contents of various samples differe significant lyat ($p$<0.05.The least and the most amounts of moisture content were control sample 3.82 moisture content is least and sample 75:10:15(15.61%)had the highest value respectively. The shelf life of the control sample (100% pineapple) might be stable compared to those from other samples. However, the spre-adablity of control (100% pineapple) was low due to lower moisture content observed.

Protein increased significantly from 0.061%±0.001 to 0.707% ±0.007, where control sample and sample 70:10:20depicted the least and the most amounts respectively. This increase arose from the addition of cucumber and Jathropha leaves. Similarly, it was found that control sample and sample 75:10:15had the least and the most amounts ash contents. Higher amounts of ash in sample 75:10:15 could be due to the addition of cucumber and jathropha leaves which makes mixed jam a good source of minerals as observed by Egbon *et al.* (2013) [4]. Considering the ash content results shown in Table 2, control sample A and sample 75:10:15differesignificantly at($p$<0.05), while other samples do not vary significantly from each other at ($p$<0.05).

The fat content of the mixed fruit and vegetable jam samples increased from 0.023% (control sample) to 0.145% in sample (85:10:05) and subsequently decreased. Sample 85:10:05has the highest value (0.145%), while controle sample has the lowest value (0.023%). The increase in the fat content was due to the addition of cucumber, which depicted a considerable level of fat as described by Uzuazokaro *et al*. (2018), whereas, the subsequent decrease was owing to increasing addition of Jathropha. The result also showed no significant differences between other samples at ($p$ <0.05).Crude fiber of the mixed fruit and vegetable jam samples was shown to increase from 0.123 – 0.592 %. Addition of jathropha and 10 % cucumber to the blend might be the reason for increasing crude fiber.

Carbohydrate content of the jam decreased from 96.14% (control sample) to 83.25% in sample (75:10:15).The varying values of the carbohydrate (calculated by difference) is due to uneven heat treatment given to the sample, hence an increase in the carbohydrate value of sample 70:10:20(87.58%) was reported. Results showed a significant difference ($p$<0.05) in the carbohydrate content of samples.

The mineral and vitamin contents of different blends of mixed fruit and vegetable jam prepared from pineapple, cucumber and jathropha are shown in Table 3.Calcium, Zinc, Magnesium, Potassium and Iron contents of the mixed fruit and vegetable jams were higher than control at ($p<0.05$).

The addition of cucumber and Jathropha was reported to increase the Calcium, Zinc, Magnesium, Potassium and Iron values of the mixed jam. Deficiency of zinc had been shown to aggravate carbohydrate intolerance in certain individuals (Franco *et al*., 2000) [5]. Also, an increase in calcium intake had been reported beneficial and likely to reduce osteoporosis and diabesity in older people surviving from diabetes (Iwalewa *et al*., 2005) [9].

The contents ofβ-carotene and vitamin C differed from each other at ($p<0.05$). This could become increased in the percentage addition of Jathropha leaves.

Table 4 show results from physiochemical analysis. The low and high values of TTA were reported in sample 70:10:20 (9.15%) and sample 75:10:15 (16.70%) respectively. The decrease in the TTA might be due to the increase of jathropha and addition of 10% cucumber in samples 85:10:05andsample70:10:20. The pH of the jam increased significantly (p>0.05). The samples became more alkaline because of the increase in the addition level of blended jathropha and the use of 10% blended cucumber in samples 85:10:05 to sample 70:10:20. The alkaline nature of this jam product could be an advantage against aerosol viruses (WHO,2020). No significant difference reported in decrease of pH from control sample to sample 80:10:10, whereas the increase in pH was significantly different from samples 80:10:10 to 70:10:20

The brix values of the samples decreased at (p>0.05). This reduction was due to the increase in the addition level of blended jathropha and the use of 10% blended cucumber in samples 85:10:05 to sample 70:10:20.

Total soluble solid values ranged from 84.38–96.17. It increased from control Sample with the low value to sample 70:10:20with the high value. It increased with an increase in minerals resulting from addition level of blended jathropha and the use of 10% blended cucumber.

The results of sensory evaluation tests have been summarized in Table 5. The organoleptic evaluation remains the final judge of the food quality. The appearance of the jam samples was affected by the blended fruits and vegetables. The taste for the control was ranked significantly ($p<0.05$) higher than sample 70:10:20, however shown to be the least preferred with lowest score among samples. This is probably due to the high amount of Jathropha in sample 70:10:20. The spread ability of the control sample is significantly different from the others due to high and uneven heat treatments. The overall acceptability of the samples was not significantly different at ($p<0.05$).

**Table 1:** Product Formulation of mixed fruit and vegetable jam from Pineapple, Cucumber and Jathropha.

| Samples | Pineapple | Cucumber | Jasthripha | Total |
|---|---|---|---|---|
| A(control) | 100 | 0 | 0 | 100 |
| B | 85 | 10 | 5 | 100 |
| C | 80 | 10 | 10 | 100 |
| D | 75 | 10 | 15 | 100 |
| E | 70 | 10 | 20 | 100 |

A = 100% Pineapple, B = 85% Pineapple; 10% Cucumber; 5% Jathropha, C = 80% Pineapple; 10% Cucumber; 10% Jathropha, D = 75% Pineapple; 10% Cucumber; 15% Jathropha, E = 70% Pineapple; 10% Cucumber; 20% Jathropha

**Table 2:** The proximate composition of jam from pineapple, cucumber and Jathropha

| Samples | Proximate Composition (%) | | | | | |
|---|---|---|---|---|---|---|
| PS:CF:JF | Moisture | Protein | Ash | Fat | Fibre | CHO |
| 100:0:0 | $3.82^{e}\pm0.03$ | $0.061^{e}\pm0.001$ | $0.014^{c}\pm0.001$ | $0.023^{d}\pm0.004$ | $0.123^{e}\pm0.001$ | $96.14^{a}\pm0.001$ |
| 85:10:05 | $10.17^{d}\pm0.02$ | $0.134^{d}\pm0.016$ | $0.039^{b}\pm0.0001$ | $0.145^{a}\pm0.004$ | $0.217^{d}\pm0.009$ | $89.29^{b}\pm0.009$ |
| 80:10:10 | $15.20^{b}\pm0.02$ | $0.405^{c}\pm0.008$ | $0.041^{b}\pm0.0001$ | $0.136^{ab}\pm0.001$ | $0.305^{c}\pm0.008$ | $83.90^{d}\pm0.008$ |
| 75:10:15 | $15.61^{a}\pm0.02$ | $0.506^{b}\pm0.008$ | $0.080^{ab}\pm0.002$ | $0.134^{bc}\pm0.001$ | $0.417^{b}\pm0.007$ | $83.25^{e}\pm0.007$ |
| 70:10:20 | $10.88^{c}\pm0.02$ | $0.707^{a}\pm0.007$ | $0.110^{a}\pm0.001$ | $0.124^{c}\pm0.006$ | $0.592^{a}\pm0.007$ | $87.58^{c}\pm0.003$ |
| LSD | 0.08 | 0.02 | 0.003 | 0.010 | 0.016 | 0.257 |

Values are mean and standard deviations of two replications, Values within a column with same superscript are not significantly different (p>0.05), Key: PS = Pineapple pulp; CS = Cucumber pulp; JF = Blended Jathropha leaves pulp, LSD = Least significant difference

**Table 3:** The vitamins and mineral composition of jam from pineapple, cucumber and Jathropha

| Samples PS:CF:JF | Vitamin C (g/kg) | β-Carotene (mg/100g) | Ca (*mg*/kg) | Zn(*mg*/kg) | Mg(*mg*/kg) | K(*mg*/kg) | Na(mg/kg) | Fe(mg/kg) |
|---|---|---|---|---|---|---|---|---|
| 100:0:0 | $691.35^{a}\pm0.49$ | $1.44^{a}\pm0.02$ | $0.12^{e}\pm0.004$ | $1.87^{e}\pm0.027$ | $0.03^{d}\pm0.002$ | $0.11^{e}\pm0.001$ | $1.78^{b}\pm0.001$ | $0.10^{e}\pm0.008$ |
| 85:10:05 | $680.65^{b}\pm0.21$ | $1.25^{b}\pm0.04$ | $0.34^{d}\pm0.003$ | $2.00^{d}\pm0.004$ | $0.06^{c}\pm0.001$ | $0.34^{d}\pm0.001$ | $1.79^{b}\pm0.003$ | $0.20^{d}\pm0.001$ |
| 80:10:10 | $569.35^{c}\pm0.49$ | $1.12^{c}\pm0.02$ | $0.40^{c}\pm0.001$ | $2.20^{c}\pm0.003$ | $0.07^{b}\pm0.002$ | $0.45^{c}\pm0.002$ | $1.81^{b}\pm0.017$ | $0.33^{c}\pm0.013$ |
| 75:10:15 | $477.45^{d}\pm0.21$ | $0.81^{d}\pm0.01$ | $0.55^{b}\pm0.001$ | $2.71^{b}\pm0.017$ | $0.09^{a}\pm0.001$ | $0.65^{b}\pm0.001$ | $1.87^{b}\pm0.024$ | $0.45^{b}\pm0.011$ |
| 70:10:20 | $436.95^{e}\pm0.07$ | $0.73^{e}\pm0.01$ | $0.61^{a}\pm0.016$ | $2.87^{a}\pm0.001$ | $0.10^{a}\pm0.002$ | $0.71^{a}\pm0.008$ | $2.59^{a}\pm0.140$ | $0.67^{a}\pm0.029$ |
| LSD | 0.887 | 0.056 | 0.019 | 0.037 | 0.004 | 0.010 | 0.163 | 0.041 |

Values are mean and standard deviations of two replications, Values within a column with same superscript are not significantly different (p>0.05), Key: PS = Pineapple pulp; CS = Cucumber pulp; JF = Blended Jathropha leaves pulp, LSD = Least significant difference

**Table 4:** The Physico-chemical property of jam from pineapple, cucumber and Jathropha

| Samples | Physico-chemical Properties | | | |
|---|---|---|---|---|
| PS:CF:JF | TTA (%) | pH | Brix (°brix) | TSS (%) |
| 100:0:0 | $0.1670^{a}\pm0.98$ | $3.16^{c}\pm0.09$ | $79.05^{a}\pm0.07$ | $84.38^{c}\pm0.02$ |
| 85:10:05 | $0.1270^{b}\pm0.28$ | $3.18^{c}\pm0.01$ | $73.15^{b}\pm0.07$ | $84.79^{c}\pm0.02$ |
| 80:10:10 | $0.1225^{b}\pm0.35$ | $3.23^{c}\pm0.03$ | $69.00^{c}\pm0.00$ | $87.31^{bc}\pm3.59$ |
| 75:10:15 | $0.0925^{c}\pm0.35$ | $3.41^{b}\pm0.01$ | $66.20^{d}\pm0.14$ | $89.11^{b}\pm0.02$ |
| 70:10:20 | $0.0915^{c}\pm0.21$ | $3.85^{a}\pm0.07$ | $64.10^{e}\pm0.14$ | $96.17^{a}\pm0.04$ |
| LSD | 0.0134 | 0.14 | 0.26 | 4.12 |

Values are mea and standard deviations of two replications, Values within a column with same superscript are not significantly different (p>0.05), Key: PS = Pineapple pulp; CS = Cucumber pulp; JF = Blended Jathropha leaves pulp; LSD = Least significant difference

**Table 5:** The Sensory properties of jam from pineapple, cucumber and Jathropha

| Samples | Sensory Properties | | | | |
|---|---|---|---|---|---|
| **PS:CF:JF** | **Appearance** | **Taste** | **Aroma** | **Spread-ability** | **General Acceptability** |
| 100:0:0 | $8.20^{a}$ | $7.93^{a}$ | $7.67^{a}$ | $3.87^{b}$ | $7.27^{a}$ |
| 85:10:05 | $7.07^{b}$ | $7.93^{a}$ | $7.67^{a}$ | $7.27^{a}$ | $7.73^{a}$ |
| 80:10:10 | $6.47^{bc}$ | $7.93^{a}$ | $7.27^{a}$ | $7.67^{a}$ | $7.60^{a}$ |
| 75:10:15 | $5.73^{cd}$ | $7.33^{a}$ | $6.93^{ab}$ | $7.80^{a}$ | $7.53^{a}$ |
| 70:10:20 | $5.07^{d}$ | $7.07^{a}$ | $6.47^{b}$ | $7.60^{a}$ | $6.87^{a}$ |
| LSD | 1.05 | 0.89 | 0.70 | 1.05 | 0.83 |

Values with same superscript within a column are not significantly different at (p>0.05), Key: PS = Pineapple pulp; CS = Cucumber pulp; JF = Blended Jathropha leaves pulp, LSD = Least significant difference

## Conclusions

The addition of cucumber and Jathropha leaf to pineapple for jam production increased the nutrient constituents of the jam. Jam containing 70% pineapple, 10% cucumber and 20% Jathropha leaves pulp blends were most acceptable. Based on the result of the study, production of jam from 20% Jathropha leaves, 10% cucumber blends and 70% pineapple pulp are recommended.

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