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PRODUCTION AND QUALITY EVALUATION OF JAM PRODUCED FROM APPLE AND PAWPAW BLENDS

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Abstract

Jam production from fruits is an effective means of ensuring availability of fruits at off-seasons. The study aimed at formulating an acceptable jam from apple and pawpaw blends. The Jams were produced from blends of apple and pawpaw in the ratio 50:50, 60:40, and 70:30 respectively. The proximate composition shows that moisture content ranged between 40.30-54.20 %, ash content of 0.29-0.51 %, fat content of 0.05-0.17 %, protein content of 0.25-0.68 % and carbohydrate content of 34.0-58.9 %. Total Soluble Solids (TSS (°B)) ranged between 63.0 to 66.0 %. The pH of the jam ranged from 3.00 to 3.09, the ascorbic acid composition of the formulated jam ranged from 5.28 to 6.00

Keywords:
Pawpaw, Apple, Jam, Sensory, Proximate Composition.

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while the total sugar of the formulated jam ranged from 55.70 to 60.80 % and pectin ranged from 5.00 to 5.88 %. The sensory properties of the jam revealed that 50 % apple and 50 % pawpaw blend was rated best in term of colour, taste, aroma, texture, spread-ability, and overall acceptability. The findings reveal that apple and pawpaw could be used in the preparation of a quality jam without any adverse effect on the nutritional quality.

INTRODUCTION

Jam is a shelf-stable food product from fruit pulp, pectin and sugar cooked to form a gel. Jam is a mixture of fruit boiled with sugar and allowed to congeal (Dianne, 2011). It is often spread on bread, biscuit and ice cream. Fleshy or pulpy fruits such as pineapple, pawpaw, orange, apple, banana and mango etc or combination of these fruits are usually employed. Good jam has a soft even consistency without distinct part of fruit, a bright colour, good fruit flavour and jam jellied texture that is easy to spread but has no free liquid (Awolu *et al*., 2016). Jam is a form of fruit preservation through the use of high concentration of sugar, hence jam can be classified as sugary food, and however their quality characteristics may be more easily determined from their relationship with fruit rather than with sugar. It is the product made by cooking fruit pulp to a suitable consistency. Jams are thick; sweet spreads made by cooking crushed or chopped fruits with sugar. They tend to hold their shape, but are generally less firm than jellies (Awolu *et al.,* 2017).

Fruits such as lemon, apple, cranberries, bananas, pineapple, and orange have been used for producing jam. Apple fruit is one of the most popular and favourite fruit among the health-conscious individuals. Apple fruits are packed with rich phyto-nutrients, which in the true sense is indispensable for optimal health (Javanmard and Endan, 2010). Certain antioxidants in apple have several promoting and disease preventive properties and thereby truly justifying the adage, "an apple a day keep the doctor away" (Boyles, 2000). Availability of fruits is seasonal and therefore, jam production from fruits helps the availability of fruits at off-seasons. Jam enjoys substantial shelf life and thus can be made available round the year. Pectin is important to the jam' set, low pectin fruit like

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Prof. A.S. Hossein [Saskatchewan]

strawberries need extra pectin (from peel of unripe lemon or pectin enriched sugar) to attain a spreadable consistency. Composite jam i.e. combination of two or more fruits to produce jam such as mango, pawpaw, pineapple, etc improve the nutritive content of the final product and as well create food variety for breakfast menu. Although producing of composite Jam requires careful handling and good technical knowhow which in the long run is a beneficial and worthwhile venture.

It has been discovered that fruits contained bioactive compounds which have enormous health benefits (Ogundele *et al*., 2016). Functional fruits from blends of fruits have been developed (Ogundele *et al*., 2016). It was established that the blend of fruits consisting pineapple, orange juices, carrot, and *Hibiscus sabdariffa* extracts have high antioxidants properties in addition to high vitamin C and carotenoids contents (Ogundele *et al*., 2016). Some wastes products from fruits especially pomace had also been used to enhance the nutritional quality, in particular the antioxidants properties of composite flours. Specifically, apple pomace was added to a wheat-based composite flour to enhance its antioxidant properties and minerals composition (Awolu *et al*., 2016). Fruits are important foods with excellent nutritional and functional properties. Populations that consume diet rich in fruits and vegetables have significantly lower rates of many types of cancers (Fila *et al*., 2013). The objective of this study is to produce composite jam using apple and pawpaw fruits and to evaluate its nutritional properties, physicochemical and sensory properties of the formulated jam.

MATERIALS AND METHODS

Source of raw material

The pawpaw, apple, sugar and salt for the production and formulation of jam were purchased from Osogbo market, Osun State, Nigeria.

Sample preparation

Samples of green apple (*Malus domestica*) and pawpaw were sorted, washed with potable water to remove adhering soil, and peeled manually with stainless steel knife and sliced.

EDITOR-IN-CHIEF
Prof. A.S. Hossein [Saskatchewan]

Sample formulation

Three different blends were produced and coded as AP1, AP2, and AP3. Two and half cups of each fruit were crushed separately and blended in different proportion: 50:50, 60:40, 70:30 of apple to pawpaw. One hundred grams (100 g) of sugar was added to 400 g of the heated fruit blends and heating of the mixture continued until the sugar was completely dissolved. Twenty grams (20 g) of lemon juice and 0.05 g of salt was added to the mixture to enhance gel formation colour improvement and flavour of the jam and then boiled for about 5-10 minutes to form gel. The mixture was hot filled into sterilized glass jars, cooled under ambient conditions and stored. AP1, AP2, and AP3 represented 50 % apple, 50 % pawpaw; 60 % apple, 40 % pawpaw; 70 % apple, and 30 % pawpaw respectively.

Analysis

Proximate composition analysis of the jam was carried out at Food and Nutrition Science Lab, IITA, Ibadan, Nigeria. The overall content of moisture, ash, fat, protein, and carbohydrate of jam samples were determined according to AOAC, (2013). Physico-chemical Composition of the jam such as pH, acidity, ascorbic acids, reducing sugar, total sugar, non-reducing sugar, and pectin content of the formulated jam samples were determined according to AOAC, (2013).

Sensory evaluation

The jam samples along with bread serving as a carrier was presented to 15 trained panellists from Osun State College of Education, Ila-Orangun, Osun State, Nigeria. Five (5) points hedonic test was used and the panellists were asked to indicate their observations and rate the samples parameters; flavour, colour, taste, texture, spread-ability and overall acceptability (where 1= dislike very much, 2= dislike moderately, 3= neither like nor dislike, 4= like moderately, 5=like very much). The analysis was carried out on the four (4) samples. Strawberry jam was bought from supermarket and serves as control.

Statistical Analysis

Results were subjected to statistical analysis using statistical package for social scientist (SPSS) (Version 17.0) for analysis of variance (ANOVA). Duncan's multiple

range tests and mean standard deviation were used to determine any significant difference among the samples.

RESULTS AND DISCUSSION

Sensory evaluations of the formulated Jam

Table 1 showed the results of sensory evaluation of apple and pawpaw blends. The result showed that AP1 and AP2 recorded the best sensory evaluations. The high value of AP1 could be as a result of equal amount of apple and pawpaw present. Apple fruits are an excellent source of pectin and when adequate amount is blended with other moderate pectin fruits it comes out to form good gel and spread well (Awolu *et al.*, 2013). Colour ranged from 3.20 - 4.50, taste ranged from 3.20 - 3.83, while aroma ranged from 3.20 - 3.80 with sample AP3 having the lowest in all the sensory parameters. Among all the sensory parameters, colour is an important sensory attribute on which the consumer preference depends. Texture ranged from 3.20 - 4.10 with sample AP3 having the lowest value while AP1 had the highest. Spread-ability ranged from 3.39 - 4.45 with the sample AP3 having the least when compared with the control while sample AP1 had the highest. Overall acceptability ranged from 3.11-4.20. The results revealed that there was a significant difference ($p \geq 0.05$) in the panelist's preference for sample AP1 when compared with sample AP2, AP3 and the control in term of colour, taste, aroma, texture, spread-ability, and overall acceptability. There was no significant difference between AP2, AP3 and the control sample.

Proximate composition of the formulated Jam

The result of the proximate analysis of the composite jam is presented in Table 2. The moisture content ranged from 40.30 to 54.20 %. The control sample had the lowest moisture content of 40.30 %. However, the moisture content may also be as a result of boiling temperature and the variation of ingredients used. Sample AP3 had highest moisture content which may be as a result of combination of the fruits (apple and pawpaw in high proportion). High moisture content can cause microbial infection in the jam. The results were significantly different ($p \leq 0.05$) from the findings of Salam *et al*., (2020) who worked on production and

EDITOR-IN-CHIEF
Prof. A.S. Hossein [Saskatchewan]

acceptability of jam produced from pineapple, water melon and apple blends and reported % moisture content that ranged from 63.46 - 65.21 %. The ash content of the formulated jam ranged from 0.29-0.51 %. The sample (AP3) had the highest ash level of 0.51 % when compared to other samples. The ash content of the composite jam samples was higher compared to the data obtained for prickly pear jam (Atef *et al*., 2013). Ash content gives an indication of mineral composition of food sample and has been found to be very important in many biochemical reactions that aid physiological functioning of major metabolic processes in the body (Ashaye and Adeleke, 2009). This might be attributed to the ratio of composition of the fruit pulps. There was a significant ($p \leq 0.05$) difference between the control sample and the jam blends AP1 (50 % apple and 50 % pawpaw), AP2 (60 % apple and 40 % pawpaw) and AP3 (70 % apple and 30 % pawpaw). The control sample had the highest fat content of 0.17 % followed by sample AP3 (70 % apple and 30 % pawpaw) with 0.07 % and sample (AP1 and AP2) with 0.05 %. This observation can be concluded that, the increase in percentage of fruits may cause the fall in the fat level of jams in sample AP1 and AP2 respectively. The protein content of the formulated jam ranged from 0.25 % to 0.68 %. Sample AP2, made up of (60 % apple and 40 % pawpaw) recorded high protein of 0.68 %. The protein content increased with increase in the substitution level of the fruits in sample (AP2 and AP3). This result indicated that the blend samples had low protein content which was significant ($p \leq 0.05$) different to the protein content reported by Salam *et al*., (2020) ranged from 0.97-0.99 %. There was a significant ($p \leq 0.05$) difference between the control sample and the composite jam samples AP1 (50 % apple and 50 % pawpaw) with 0.65 % and sample AP2 and AP3 with 0.67% and 0.68% respectively. The

carbohydrate content of the composite jams ranged from 34.0 % - 35.0 % for sample AP1, AP2 and AP3 respectively. The carbohydrate content of the control sample is 58.9 %. The highest carbohydrate content observed in control sample might be attributed to the high carbohydrate content in strawberry. A significant ($p \leq 0.05$) difference was observed in the control and the formulated blends.

Physico-Chemical Parameters of Jam Produced from Apple and Pawpaw

The result of the physico-chemical parameters of the composite jam is presented in Table 3. The total soluble solids (TSS) content ranged from 58.4 to 66.0 ^{o}B. The control sample had lowest TSS of 58.4 ^{o}B. However, the significant differences in TSS may be as a result of the combination of fruits used. Sample AP3 had highest TSS which may be as a result of combination of the fruits (apple and pawpaw in high proportion). The pH of the jam ranged from 3.00 to 3.09. The control sample had the lowest pH value while AP2 had the highest pH value but the pH values for all the blends are significantly different to one another due to the combination of fruits used. The pH of the samples were lower than the pH 3.6 reported by Kouadio *et al*. (2021) who produced jam from cashew and apple. The acidity composition of the formulated jam ranged from 1.10 to 1.23 %. The control sample had the lowest while the sample AP3 (70 % apple and 30 % pawpaw) had the highest acidity which might be due to high proportion of green apple used. The ascorbic acid composition of the formulated jam ranged from 5.31 to 6.00. The control sample had the highest value of 6.00 % compared to the blends, while sample AP2 (60 % apple and 40 % pawpaw) had the lowest. The total sugar of the formulated jam ranged from 55.70 to 60.80 %. The control samples had the lowest content of sugar while the sample AP3 had the highest sugar content. This may be due to the varied percentage in the combination of fruits used. The results of the total sugar of the samples are higher compared to the one reported by Kouadio *et al.* (2021). The results of the total sugar were similar to the findings of Kouadio *et al.* (2021) who reported total sugar content of 51.87 %. The pH of the samples in this research ranged from 3.00-3.09 while Kouadio *et al*. (2021) reported a higher value of 3.60. Sugar content in jam help to improve preservation and inhibit microbial growth. The pectin content of the jam ranged from 5.00 to 5.88 %. The control sample had the lowest pectin content of 5.00 % while sample AP3 had the highest pectin content, followed by AP2 and AP1 in that order. This may be due to the proportion of the fruits combination used.

CONCLUSION

The study revealed that acceptable jams could be produced from apple and pawpaw in the ratio 50:50, 60:40 and 70:30 without adverse effects on the

nutritional values. It could be observed from the result that jam consisting 50 % apple and 50 % pawpaw have overall best sensory evaluation, followed by 60 % apple and 40 % pawpaw while 70 % apple, 30 % pawpaw was the least. The use of apple and pawpaw in the production of jam will help in reducing wastage and improving the utilization of these fruits. There will also be more income for farmers and reduced pressure on the use of other fruits for jam production.

Conflict of Interest

None to declare

Table 1: Sensory evaluation of jam produced from apple and pawpaw blends

Sample	Colour	Taste	Aroma	Texture	Spread-ability	Overall Acceptability
AP1	4.50±0.60^{c}	3.80±0.03^{b}	3.80±0.50^{b}	4.10±0.30^{a}	4.45±1.12^{a}	4.20±0.20^{a}
AP2	3.62±0.81^{b}	3.40±1.11^{a}	3.30±0.41^{a}	3.70±0.05^{b}	3.51±0.21^{b}	3.58±0.29^{b}
AP3	3.20±1.11^{b}	3.20±1.31^{a}	3.10±0.31^{a}	3.20±0.11^{b}	3.39±0.39^{b}	3.11±0.16^{b}
CRT	3.41±1.20^{b}	3.49±0.30^{a}	3.12±0.47^{a}	3.39±0.30^{b}	3.43±0.32^{b}	3.35±0.82^{b}

Values represent means of triplicate reading, follow by different lowercase letter. Means within the same row with different alphabets are significantly different ($p \leq 0.05$)

KEY: AP1 is 50% apple, 50% pawpaw, AP2 is 60% apple, 40% pawpaw, AP3 is 70% apple, 30% pawpaw, CRT is strawberry (control)

Table 2: Proximate composition of composite jam produced from apple and pawpaw

Samples	Moisture %	Ash%	Fat%	Protein%	Carbohydrate%
AP1	50.40±0.31	0.41±0.01	0.05±0.01	0.65±0.22	34.0±0.39
AP2	52.01±0.10	0.48±0.02	0.05±0.01	0.67±0.41	34.5±0.17
AP3	54.20±0.12	0.51±0.03	0.07±0.02	0.68±0.40	35.0±0.17
CTR	40.30±0.30	0.29±0.02	0.17±0.01	0.25±0.13	58.9±0.50

Values represent means of triplicate reading, follow by different lowercase letter. Means within the same row with different alphabets are significantly different ($p \leq 0.05$)

EDITOR-IN-CHIEF
Prof. A.S. Hossein [Saskatchewan]

KEY: AP1 is 50% apple, 50% pawpaw, AP2 is 60% apple, 40% pawpaw, AP3 is 70% apple, 30% pawpaw, CRT is strawberry (control).

Table 3: Nutritional parameters of composite jam produced from apple and pawpaw

Parameters	**Values**			
	AP1	**AP2**	**AP3**	**CTR**
TSS (°B)	65.0	63.0	66.0	58.4
P^{H}	3.00	3.09	3.06	3.00
Acidity (citric acid)	1.20	1.19	1.23	1.10
Ascorbic acids (mg/100g)	5.31	5.28	5.88	6.00
Reducing sugar (%)	15.88	15.80	16.08	15.20
Non-reducing sugar (%)	42.18	44.30	45.45	40.50
Total sugar (%)	58.10	60.01	60.80	55.70
Pectin (% as calcium pectate)	5.48	5.70	5.88	5.00

Values represent means of triplicate reading, follow by different lowercase letter. Means within the same row with different alphabets are significantly different ($p \leq 0.05$)

KEY: AP1 is 50% apple, 50% pawpaw, AP2 is 60% apple, 40% pawpaw, AP3 is 70% apple, 30% pawpaw, CRT is strawberry (control)

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