



Production and Evaluation of Jam Produced from Apple and Banana 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 banana blends. The proximate composition of the jam samples were determined. Jams were produced from blends of apple and banana in the ratio 50:50, 60:40, and 70:30 respectively. The proximate composition result of the jam produced indicated moisture content between 40.32-55.20 %, ash content of 0.33-0.53 %, fat content of 0.04-0.16 %, protein content of 0.26-0.69 % and carbohydrate content of 35.01-59.99 %. The nutritional composition of the jam produced indicated Total Soluble Solids (TSS (°B)) between 58.80 to 68.0 %. The control sample has lowest TSS of 58.8 % while sample AB3 (70 % apple and 30 % banana) had the highest TSS value. The pH of the jam ranged from 3.00 to 3.11, the ascorbic acid composition of the formulated jam ranged from 5.30 to 6.01 while the total sugar of the formulated jam ranged from 55.76 to 61.60 % and the pectin content of the jam ranged from 5.02 to 5.74 %. The control sample had the lowest pectin content of 5.02 % while sample AB3 (70 % apple, 30 % banana), had the highest pectin content, followed by AB2 (60 % apple, 40 % banana) and AB1 (50 % apple, 50 % banana) in that order. The sensory properties of the jam revealed that sample AB1 which comprises of 50 % apple and 50 % banana was rated best in term of colour, taste, aroma, texture, spread-ability, and overall acceptability, followed by sample AB2 (60 % apple, 40 % banana). The findings reveal that apple and banana could be used in the preparation of a quality jam without any adverse effect on the nutritional quality.

Keywords: Banana, apple, jam, composite ingredients, proximate composition

Introduction

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. Jam is a type of fruit preservation which can be canned, sealed for long term storage. Jam making involves the disruption of the fruit's tissues followed by

heating with addition of water and sugar to activate its pectin before being put into containers. The sugar and the fruits used in producing jam vary according to the type of fruit and its ripeness, when the temperature of the mixture reaches 104 °C the acid and the pectin reacts with sugar (Awolu *et al.*, 2017)

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Normally, jam preparation requires the addition of commercial or natural pectin as a gelling agent (Awolu *et al.*, 2016). The uses of ingredient and how the jams are prepared actually determine the type of jam produced. Jams are one of the most popular products because of their low cost, availability and organoleptic properties (Eke and Owuno, 2013). Traditionally, jams were first produced as an effort to preserve fruits during off-season for consumption. Nevertheless, processed product such as jams usually have low nutritional value when compared to fresh fruits for an example, jam normally have lower vitamin C content compared to the fresh fruits (Kamari and Dhaliwal, 2010). This is due to exposure to the heat generated during the processing (Awolu *et al.*, 2016).

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).

Banana fruit is a perennial herbaceous plant that grows from the underground Rhizome. It flourishes well under tropical, moisture-rich, humid, low-lying, farm lands. Banana fruits are composed of soft, easily digestible flesh made up of simple sugars like fructose and sucrose that upon consumption instantly replenish energy and revitalizes the body (Adejoro *et al.*, 2010). It is also one of the recommended supplement foods included in the treatment plan for under-nourished children. There is scarcity of information on the nutritional properties and product development potential of some fruits blends such as apple and banana. The objective of this study is to produce

composite jam using apple and banana fruits and to evaluate its nutritional properties, physicochemical and sensory properties of the formulated jam.

Materials and Methods

Source of raw material

The banana, 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 red banana (*Musa acuminata*) were sorted, washed with potable water to remove adhering soil, and peeled manually with stainless steel knife and sliced.

Sample formulation

Three different blends were produced and coded as AB1, AB2, and AB3. Two and half cups of each fruit were crushed separately and blended in different proportion: 50:50, 60:40, 70:30 of apple to banana. 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. AB1, AB2, and AB3 represented 50 % apple, 50 % banana; 60 % apple, 40 % banana; 70 % apple, and 30 % banana 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 panelists from Osun State College of Education, Ila-Orangun, Osun State. Five (5) points hedonic test was used and the panelists 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 banana blends. The result showed that AB1 and AB2 recorded the best sensory evaluations. The high value of AB1 could be as a result of equal amount of apple and banana 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). Color ranged from 3.23 - 4.53, taste ranged from 3.20 - 3.83, while aroma ranged from 3.18 - 3.82 with sample AB3 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 3.30 - 4.20 with sample AB3 having the lowest value while AB1 had the highest. Spread-ability ranged from 3.49 - 4.46 with the sample AB3 having the least when compared with the control while sample AB1 had the highest. Overall acceptability ranged from 3.20-4.30. The results revealed that there was a significant difference ($p \geq 0.05$) in the panelist's preference for sample AB1 when compared with sample AB2, AB3 and the control in term of colour, taste, aroma, texture, spread-ability, and overall acceptability. There were no significant difference between AB2, AB3 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 40.32 to 45.20 %. The control sample had the lowest moisture content of 40.32 %. However, the moisture content may also be as a result of boiling temperature and the variation of ingredients used. Sample AB3 had highest moisture content which may be as a result of combination of the fruits (apple and banana 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 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 0.33-0.53 %. The sample (AB3) had the highest ash level of 0.53 % when compared to other samples. The ash content of the composite jam samples were 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 AB1 (50 % apple and 50 % banana), AB2 (60 % apple and 40 % banana) and AB3 (70 % apple and 30 % banana). The control sample had the highest fat content of 0.16 % followed by sample AB3 (70 % apple and 30 %) with 0.06 % and sample (AB1 and AB2) with 0.04 %. This observation can be concluded that, the increase in percentage of fruits may cause the fall in the fat level of jams in sample AB1 and AB2 respectively. The protein content of the pineapple jam ranged from 0.26 % to 0.69 %. Sample AB2, made up of (60 % apple and 40 % banana) recorded high protein of 0.69 %.

The protein content increased with increase in the substitution level of the fruits in sample (AB2 and AB3). 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 AB1 (50 % apple and 50 % banana) with 0.67 % and sample AB2 and AB3 with 0.69%. The carbohydrate content of the composite jams ranged from 35.01 % - 35.80 % for sample AB1, AB2 and AB3 respectively. The carbohydrate content of the control sample is 59.99 %. 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 Banana

The result of the physico-chemical parameters of the composite jam is presented in Table 3. The total soluble solids (TSS) content ranged from 58.8 to 68.0 °B. The control sample had lowest TSS of

58.8 °B. However, the significant differences in TSS may be as a result of the combination of fruits used. Sample AB3 had highest TSS which may be as a result of combination of the fruits (apple and banana in high proportion). The pH of the jam ranged from 3.00 to 3.11. The control sample had the lowest pH value while AB2 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 1.12 to 1.25 %. The control sample had the lowest while the sample AB3 (70 % apple and 30 % banana) 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 5.30 to 6.01. The control sample had the highest value of 6.01 % compared to the blends, while sample AB2 (60 % apple and 40 % banana) had the lowest. The total sugar of the formulated jam ranged from 55.76 to 61.60 %. The control samples had the lowest content of sugar while the sample AB3 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 ranged from 55.76-61.60 % while Kouadio *et al* reported total sugar content of 51.87 %. The pH of the samples in this research ranged from 3.01-3.11 while kouadio *et al* 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 5.02 to 5.74 %. The control sample had the lowest pectin content of 5.02 % while sample AB3 had the highest pectin content, followed by AB2 and AB1 in that order. This may be due to the proportion of the fruits combination used.

Table 1: Sensory Evaluation of Jam Produced from Banana and Apple bends

Sample	Color	Taste	Aroma	Texture	Spread-ability	Overall Acceptability
AB1	4.53±0.66 ^c	3.83±0.09 ^b	3.82±0.60 ^b	4.20±0.33 ^a	4.46±1.13 ^a	4.31±0.32 ^a
AB2	3.69±0.85 ^b	3.45±1.14 ^a	3.36±0.51 ^a	3.77±0.09 ^b	3.621±0.31 ^b	3.69±0.33 ^b
AB3	3.23±1.16 ^b	3.20±1.41 ^a	3.18±0.41 ^a	3.30±0.19 ^b	3.49±0.41 ^b	3.22±0.19 ^b
CTR	3.46±1.26 ^b	3.54±0.39 ^a	3.19±0.51 ^a	3.46±0.34 ^b	3.54±0.43 ^b	3.45±0.99 ^b

Values represent means of triplicate reading, follow by different lowercase letter.

Means within the same row with different alphabets are significantly different (p≤0.05)

KEY: AB1 is 50 % apple, 50 % banana; AB2 is 60 % apple, 40 % banana; AB3 is 70 % apple, 30 % banana, CTR : is strawberry (control)

Table 2: Proximate Composition of Banana and Apple Jams

Samples	Moisture %	Ash%	Fat %	Protein%	Carbohydrate%
AB1	50.46±0.41	0.46±0.01	0.04±0.01	0.67±0.30	35.01±0.40
AB2	53.01±0.20	0.50±0.04	0.04±0.01	0.69±0.44	35.50±0.18
AB3	55.25±0.22	0.53±0.04	0.06±0.01	0.69±0.44	35.80±0.18
CTR	40.32±0.35	0.33±0.05	0.16±0.01	0.26±0.12	59.99±0.52

Values represent means of triplicate reading, follow by different lowercase letter.

Means within the same row with different alphabets are significantly different (p≤0.05)

KEY: AB1 is 50 % apple, 50 % banana; AB2 is 60 % apple, 40 % banana; AB3 is 70 % apple, 30 % banana, and CTR: strawberry (control).

Table 3: Physico-chemical Parameters of Composite Jam Produced from Apple and Banana

Parameters	Values			
	AB1	AB2	AB3	CTR
TSS (°B)	68.0	65.0	66.10	58.80
pH	3.01	3.11	3.08	3.00
Acidity (citric acid)	1.22	1.20	1.25	1.12
Ascorbic acids (mg/100g)	5.35	5.30	5.90	6.01
Reducing sugar (%)	15.91	15.81	16.10	15.24
Non-reducing sugar (%)	42.21	44.32	45.50	40.52
Total sugar (%)	58.13	60.13	61.60	55.76
Pectin (% as calcium pectate)	5.51	5.74	5.92	5.02

Values represent means of triplicate reading, follow by different lowercase letter.

Means within the same row with different alphabets are significantly different (p≤0.05)

KEY: AB1 is 50 % apple, 50 % banana, AB2 is 60 % apple, 40 % banana, AB3 is 70 % apple, 30 % banana, and CTR is strawberry (control).

Conclusion

The study revealed that acceptable jams could be produced from apple and banana 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 % banana and 50 % apple have overall best sensory evaluation, followed by 60 % apple and 40 % banana while 70 % apple, 30 % banana was the least. The use of apple and banana 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

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