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Research Article

Comparism of Composite Jam Produced from Orange, Apple and Date Powder with Commercial Jam with Table Sugar

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Abstract

To live a healthy life style and be free from diseases, fruits must be incorporated in one's daily food. Fruits are of high nutritional value and provide the body with the required daily allowance. They are highly perishable, but can be made into different products to make them available all year round. They can be processed into products which includes; fruit juice, jellies, marmalades, candies, fruit bars and jams. This study analyses jam produced using date powder and compared it with commercial jam produced using table sugar. The percentage compositions of the blends considered were 50%:50%; 70%:30%; 30%:70% of orange and apple pulps respectively with constant amount of date powder (50%). In addition to the pulp blends, 2.9% commercial pectin was added together with citric acid, and date powder. The entire mixture was heated at 120°C for 25 mins to enhance the viscosity of the blends. Proximate, microbial, physico-chemical analyses, sensory evaluation and Vitamin constituents of the experimental samples and the commercial jam were evaluated. The commercial jam was found best having higher scores in all the sensory parameters. However, in respect to proximate composition, the experimental samples had the highest in protein, ash, moisture, and fibre while the commercial jam only scored high in fat, carbohydrate. In respect to microbial count minimum fungal and bacterial growth, 1.00 cfu X 10^3 g-1 and 1.00 cfu X 10^5 g-1 respectively were recorded in the experimental samples at 3 weeks after production. The control sample had the highest value in vitamin A content (130.35mg/100g) and the least in vitamin C content (1.64mg/100g).The nutritional analysis and sensory evaluation obtained proved that the orange and apple jam samples made with date powder is a promising functional product which can be consumed by both young and adults.

Keywords: Orange; Apple; Date; Jam; Composite; Nutritional properties; Sensory analysis

Introduction

Fruits are necessary composition of healthy diet due to their high nutritional value. However, their high moisture content makes them easily perishable which results in high post-harvest losses especially in developing countries. (Ogoriet al, 2021). Most fruits are abundant during their season but become scarce during their off seasons. Unless fruits are handled properly during their seasons, they result in large economic losses to farmers and vendors (Plunkett, 2006). Jams are sweet spreads made by boiling crushed fruits with sugar and pectin to a thick consistency. Jams are sweet spreads made by boiling crushed fruits with sugar and pectin to a thick consistency. It is often eaten at breakfast with bread, pies, pancakes etc. jams have reasonable shelf life and therefore can be made available round the year. (Muresan et al., 2014). Jam production has been adopted as a method of making fruits available during their off season. Apple has high nutritional benefits and it is a decent source of vitamin C, Potassium and fibre. It contains 11% sugar, 0.3%

proteins, 14% starches, 4% nutrients and minerals and remaining piece of apple contains water (Baker et al, 2001). Apple contains 84.7% water, 13.9g carbohydrates, 0.3g lipids, 0.4g protein and vitamin C 8mg per 100 from of consumable fruit (Khan et al, 2015).Orange is the most consumed fruit in Europe and around the world (Galaverna and Dall'Asta, 2014).Orange contains substantial amounts of several micronutrients such as vitamin C, folate and polyphenols (e.ghesperidin which is a flavanone) Ohrvik and Witthoft, (2008).

Date, the fruit of date palm, can be considered as an ideal food that provides a wide range of essential nutrients with many potential health benefits. Traditionally, dates have been considered as the staple food in the Arab Gulf regions (Erskine et al., 2004). The important quality criteria for consumers are the appearance including color, size and shape, physical condition and absence of defects, mouth feel or texture, flavor, and nutritional value (Wills et al., 1998). Masmoudi et al.(2010) reported that various types of jellies prepared from date fruit and lemon by-products had less quantity of sugar, decreased pH, and resulted in significantly firmer jellies, with higher adhesive-ness, chewiness, cohesiveness, and taste attributes and gave higher sensory evaluation.

The objective of the study is to produce jam from orange and apple enriched with date powder and evaluate the nutritional parameters, microbial load, sensory qualities and vitamin composition.

Materials and Methods

Materials

The fruits; oranges, apples and date were obtained Oba market in Akure, while jam (control) was purchased from ShopRite, Akure, Ondo state. Other reagents used were obtained from Paschal Laboratory Akure and were of analytical grade.

Methods

Preparation of fruits

The orange and apple used were washed under tap running water to remove dirt from the skin of the fruit prior to peeling. Each orange and apple pulp were extracted at the kilogram equivalent of its percentage of the desired formulation as shown in Table 1.

Preparation of the jam

The jam was produced with slight modification according to Bezerra et al, 2016. The fruit purees were taken for each sample formulation, poured into a big, clean stainless pot and boiled at a temperature of 120°C using a thermometer for 25 mins. Once the fruit started boiling, date powder, pectin and citric acid were added into the mixture and stirred continuously. This was done for 30 minutes until, a homogenous mixture was observed. The date powder was added primarily to cause gelatinization of the fruit mixture and to serve as sweetener. After this, the jam produced was allowed to cool to 40°C before been poured into already sanitized jars and sealed instantly. The jars were filled to about 60 % leaving a headspace of about a quarter inch to avoid contamination. The jam in a sanitized jar was then stored in a refrigerator prior to carrying out analyses.

Samples	*Apple(g)*	*Orange(g)*	*Date(g)*	*Pectin(ml)*	*Citric acid(g)*
J245	86(20%)	108(25%)	215(50%)	-	-
A472	500(50%)	500(50%)	500(50%)	5.8	0.18
M978	210(30%)	490(70%)	350(50%)	4.06	0.126
E363	490(70%)	210(30%)	350(50%)	4.06	0.126

Table 1: Composition ratio of the various jam samples.

Mean ± standard deviation

Values are means of three replicates ± standard deviation. Mean values followed by different subscripts within columns are significantly different by Duncan's multiple range tests ($p< 0.05$).

Keys: J245=Control (commercial jam), A472 = 50% Apple, 50% Orange, M978 = 30% Apple, 70% Orange, E363 = 70% Apple, 30% Orange.

Analyses

Proximate composition (protein, ash, fibre, fat, moisture and carbohydrate) of the jam samples were carried out according to the method of AOAC, 2011. Vitamins A and C were determined according to Pearson, 1975 and Benderitteret al., 1998 respectively. The total titratable acidity was determined according to the method of Ishiwu and Oluka (2004). The total soluble solid content was determined according to Babatuyi et al., 2019, with the aid of hand-held refractometer and the results were expressed in the unit ° Brix. The jam samples produced were microbiologically examined for bacterial and fungi count according to the method described by Babatuyi et al., 2019. Sensory evaluation was performed using the modified method of Larmond, 1997.

Statistical Analysis

All the analyses were carried out in triplicates. One-way analysis of variance (ANOVA) was carried out and mean separation was done with Duncan's Multiple Range Test (DMRT) with significant ($p<0.05$) difference on all the samples.

Result and Discussion

Proximate Composition of Orange and Apple Jam Made with Date Powder

The results of proximate composition of fruits are an important index in assessing the nutritional potential of fruits. The result of the proximate composition of the jam produced from different formulations of orange and apple is shown in Table 2. There was a significant difference of $p < 0.05$ in all the measured parameter. The presence of sugar molecules reduces the amount of water available. This is shown in the moisture content of the jam samples made with date powder and the control which was made with sucrose. The moisture content varied between 19.03 % and 43.06 % with sample J245 having the lowest moisture content. The results were lower to what Anjumet al, 2020 reported. Anjumet al, 2020 reported 77% moisture content in jam produced from apricot jam. Ash refers to the inorganic residue remained after burning of the organic material and it is a measure of the mineral element in the blends Ashaye and Adeleke, 2009. The ash content of the samples showed that the experimental and the control sample(s) were in the range of 0.67% to1.00%. The ash content of the composite jam samples were higher compared to the data obtained for prickly pear jam (Atefet al, 2013). The fat content of the samples ranged from 0.49% to 8.99% with sample M978 having a significantly low-fat content and J245 having the highest fat content. The results were higher than what Nafisah Salam et al, 2020 which produced jam form apple, watermelon and apple reported.

Samples	*Moisture (%)*	*Ash (%)*	*Fat (%)*	*Fiber (%)*	*Protein (%)*	*Carbohydrate (%)*
J245	19.03 ± 8.29^{c}	0.67 ± 0.29^{a}	8.99 ± 1.25^{a}	Nil	0.88 ± 0.03^{d}	70.44 ± 7.59^{a}
A472	41.23 ± 1.33^{a}	0.83 ± 0.58^{a}	7.67 ± 0.57^{ab}	1.20 ± 0.02^{a}	3.08 ± 0.03^{c}	45.99 ± 0.18^{c}
M978	28.80 ± 0.70^{b}	0.67 ± 0.29^{a}	0.49 ± 0.50^{c}	1.02 ± 0.03^{b}	7.17 ± 0.28^{b}	61.85 ± 0.98^{b}
E363	43.06 ± 0.99^{a}	1.00 ± 0.50^{a}	6.40 ± 1.77^{b}	0.99 ± 0.04^{b}	7.47 ± 0.03^{a}	41.08 ± 0.38^{c}

Table 2: proximate composition of orange and apple jam made with date powder.

Mean ± standard deviation

Values are means of three replicates ± standard deviation. Mean values followed by different subscripts within columns are significantly different by Duncan's multiple range tests ($p< 0.05$).

Keys: J245= Control (commercial jam), A472= 50% Apple, 50% Orange, M978= 30% Apple, 70% Orange, E363= 70% Apple, 30% Orange.

Vitamin Composition of orange and apple jam made with date powder

The results of vitamin A (beta carotene) and vitamin C (ascorbic acid) are presented in Table 3. Vitamins A and C especially are some of the most important enzymatic antioxidants in the body that produce health beneficial effects through the scavenging of free radicals. Vitamin C functions as a water-soluble antioxidant and is good in the scavenging of reactive oxygen species (ROS) and reactive nitrogen species (RNS). Recommended Dietary Allowance for vitamin C is 75 mg per day for women and 90 mg per day for men that do not smoke (Annette, 2002). From the results obtained, vitamin C content was highest in sample M978 which could be as a result of the high percentage of orange used compared to the other samples. All experimental samples contained more vitamin C compare to the control. This could be attributed to the vitamin C content of the date powder used in their production. The results were in accordance with the report of Annette, 2002.

Vitamin A, also known as retinol is needed by humans for proper functioning of the sight and vision. The Recommended Dietary Allowance for vitamin A is 700 µg of retinol activity equivalents (RAE) per day for women and 900 µg per day for men (Annette, 2002). The result obtained showed that sample J245 had the highest vitamin A content. However, among all experimental samples, sample M978 had the highest vitamin A and C content. This could be as a result of the high content of these vitamins in orange fruit compared to apple fruit. The results were in accordance with the report of Annette, 2002.

Samples	*Vitamin A (IU)*	*Vitamin C (mg/g)*
J245	130.35 ± 1.84^{a}	1.64 ± 0.06^{d}
A472	95.86 ± 3.90^{b}	4.24 ± 0.14^{c}
M978	105.27 ± 1.10^{b}	7.46 ± 0.03^{a}
E363	96.42 ± 12.36^{b}	4.61 ± 0.00^{b}

Table 3: Vitamin Composition of Orange and Apple Jam produced with Date powder.

Mean ± standard deviation

Values are means of three replicates ± standard deviation. Mean values followed by different subscripts within columns are significantly different by Duncan's multiple range tests ($p< 0.05$).

Keys: J245= Control (commercial jam), A472= 50% Apple, 50% Orange, M978= 30% Apple, 70% Orange, E363= 70% Apple, 30% Orange.

Physicochemical Quality of orange and apple jam made with date powder

Alternating the proportions of the orange and apple affected the quality features of the formulated jam. Each jam sample was evaluated for pH, Brix, and total titratable acidity. The physicochemical attributes of the jam produced from orange and apple are presented in Table 4. The pH value of a food product determines what microorganism can survive and grow in the medium. Products with lower than 7.0 pH are acidic foods and are prone to spoilage by moulds, yeasts and certain acid tolerant bacteria. Pathogenic bacteria may survive but very few are likely to grow. Control of pH is very key to ensuring safety of the jam product (Prescott et al., 2005; Silva et al., 2011).

The pH of the samples was measured using pH meter and the data gathered showed that the pH of the jam produced was acidic ranging from 3.50 to 4.00. The experimental jam samples were less acidic compared to the control (2.50). The acidity of the jam samples had an inhibitory effect on microorganism growth and increasing the shelf life of the jams produced.

Brix measures the content of sucrose or sugar in the aqueous solution. It is generally acknowledged that the higher the brix value, the better the taste or sweetness and the better the resistance to spoilage or the higher the nutrient density of the food. Brix ranged from 4.00 ^{0}Brix to 6.10 ^{0}Brix with the control having the highest ^{0}Brix. The total titratable acidity ranged from 1.85% to 3.21% with sample M978 having the highest TTA. Higher values were observed in the study conducted by Caitano et al. (2012) which presents the same analysis of soluble solid jam made with pulp of acerola juice found the value of 66 ° Brix.

Samples	*PH*	*TTA (%)*	*Total soluble solids (^{0}BRIX)*
J245	2.50±0.10^d	2.00±0.02^b	6.10±0.10^a
A472	4.00±0.10^a	1.85±0.01^d	4.00±0.10^c
M978	3.50±0.10^c	3.21±0.02^a	4.63±0.15^b
E363	3.70±0.10^b	1.90±0.02^c	4.00±0.15^c

Table 4: Physico-Chemical Properties of Jamorange and apple jam produced with date powder.

Mean ± standard deviation

Values are means of three replicates ± standard deviation. Mean values followed by different subscripts within columns are significantly different by Duncan's multiple range tests ($p< 0.05$).

Keys: J245=Control (commercial sample), A472 50% Apple, 50% Orange, M978 30% Apple, 70% Orange, E363 70% Apple, 30% Orange.

Microbial composition of orange and apple composite jam made with date powder

Microbiological study is a very important tool for ensuring the ability of food product to withstand microbial growth or spoilage and also to determine the storage conditions required to keep microbial growth or spoilage at bay (Ellin, 2007).

The microbial load of the jam produced from orange and apple with date powder after 3 weeks of production is shown in Table 5. The results shows that the microbial load of the jam was minimal due to the level of aseptic condition engaged throughout the production, handling and storage. The control sample had no microbial count for all microorganisms. The experimental samples however contained general bacteria, yeast and mould all within the acceptable amount. The results were in accordance with the report of Babatuyi et al, 2019 which produce jam from pineapple, pawpaw, grapefruit and beetroot.

Sensory Evaluation of orange and apple jam made with date powder

Sensory evaluation is a measure of the attributes of food samples. Mean scores of sensory evaluations of orange and apple jam made with date powder are presented in Table 6. The mean scores for the sensory parameters of the jam products varied with varying proportions of the orange and apple. From the three experimental samples, sample A472 had the highest values in all sensory parameters when compared to samples M978 and E363.The control (commercial sample) scored the highest value in acceptability (8.15) compared to the experimental samples with scores ranging from 6.20 to 8.15.

Samples	*Staphylococcus aureus (cfu/g)*	*Salmonella (cfu/g)*	*General Bacteria (cfu/g)*	*Coliform (cfu/g)*	*E. Coli (cfu/g)*	*Yeast and mould (cfu/g)*
J245	Nil	Nil	Nil	Nil	Nil	Nil
A472	Nil	Nil	1×10^3	Nil	Nil	9×10^3
M978	Nil	Nil	5×10^3	Nil	Nil	3×10^3
E363	Nil	Nil	7×10^3	Nil	Nil	1.08×10^5

Table 5: Microbial composition of orange and apple composite jam produced with date powder.

Mean ± standard deviation

Values are means of three replicates ± standard deviation. Mean values followed by different subscripts within columns are significantly different by Duncan's multiple range tests ($p< 0.05$).

Keys: J245= Control(commercial sample), A472= 50% Apple, 50% Orange, M978= 30% Apple, 70% Orange, E363= 70% Apple, 30% Orange.

Sample A472 was the most preferred among the experimental samples while sample M978 was the least preferred sample. Similar results was observed in a study conducted by Lake et al. (2006) with the sensory evaluation of jam produced with jambolan pulp.

Samples	*Appearance*	*Texture*	*Taste*	*Aroma*	*Spreadability*	*Overall Acceptability*
J245	8.35 ± 0.88^a	7.90 ± 0.35^a	8.15 ± 1.14^a	7.45 ± 1.43^a	8.10 ± 0.97^a	8.15 ± 0.67^a
A472	6.45 ± 0.69^b	6.90 ± 0.85^b	7.25 ± 1.25^b	6.05 ± 1.19^b	6.70 ± 1.17^b	7.05 ± 0.94^b
M978	5.75 ± 0.91^b	5.75 ± 1.29^c	6.40 ± 1.70^b	5.95 ± 1.28^b	5.00 ± 1.49^c	6.20 ± 1.06^c
E363	$6.25\pm1.16b^c$	6.05 ± 1.32^c	6.35 ± 1.31^b	6.05 ± 0.89^b	6.00 ± 1.41^b	$6.55\pm0.89b^c$

Table 6: Sensory Evaluation of Orange and Apple Jam produced with Date Powder.

Mean ± standard deviation

Values are means of three replicates ± standard deviation. Mean values followed by different subscripts within columns are significantly different by Duncan's multiple range tests ($p< 0.05$).

Keys: J245= Control (commercial sample), A472= 50% Apple, 50% Orange, M978= 30% Apple, 70% Orange, E363= 70% Apple, 30% Orange.

Conclusion

The orange and apple jam samples made with date powder had a relatively higher nutritional quality which makes it a healthy and acceptable fruit jam that can be consumed by both young and adults. The microbial load of jam made with date powder was safe for consumption. The experimental samples scored above average for all sensory parameters. However, Commercial jam was more preferred especially due to the less desirable appearance and spreadability of jam made with date powder. Vitamin compositions of the jam were within the range of the recommended daily intake required for proper body functioning.

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