DRF-268
[1-7]

RESEARCH ARTICLE Asian Journal of Dairy and Food Research, Volume Issue : ()

Quality Characteristics and Acceptability of Jam Produced from Pineapple (*Ananas comoscus*) and Carrot (*Daucus carota* L.) Blends

A.M. Nkansah
10.18805/ajdfr.DRF-268

ABSTRACT

Background: Pineapple and carrot as composite ingredients in jam making will improve the nutritional values and general acceptability. Even though these fruit and vegetable are grown in large quantities in Ghana, yet remain unpopular due to their unusual flavour. Combining carrots with pineapple will help create a variety of jams which in the end will offer consumers a range of affordable jam products. The present work aims to determine the nutritional quality and sensory evaluation of blended pineapple-carrot jam at different blending ratios.

Methods: Five (5) different jam samples were produced from the following formulations, 100% Pineapple (control), 90% pineapple with 20% carrot, 80% pineapple with 20% carrot, 75% pineapple with 25% carrot and 25% carrot with 75% pineapple. The determination of moisture, ash, protein, fat, crude fiber and carbohydrate were carried out using the AOAC method. Twenty trained panelists performed the sensory analysis using a 9 point hedonic scale of the developed jam. The results were statistically analyzed using the SPSS statistics software (Version 17.0). Data were analysed using ANOVA and Duncan's multiple range tests was used to determine significant differences between the samples

Result: The results revealed a significant difference ($P<0.05$) in mean hedonic score between composite jam and control. Proximate analysis of the jam showed moisture (36.87-45.69%), ash (0.60-0.81%), protein (0.31-0.48%), crude fat (5.29-10.67%), crude fibre (0.13-3.85%) and carbohydrate (33.95-49.58%). Pineapple-carrot jam blends at a blending ratio of 75:25 revealed better qualities in terms of aroma, taste, spreadability and overall acceptability. Based on the data gathered from the study, it can be concluded that pineapple-carrot jam has good sensory qualities and can be utilised to make jam and other processed products to add value to the fruit and vegetable.

Key words: Carrot, Fruits and vegetables, Jam, Pineapple, Post-harvest losses, Preservation.

INTRODUCTION

Jams are thick sweet spreads produced by combining sugar and crushed or chopped fruits in a boiling liquid (Barbara, 2008). Because fruit is seasonal, a jam produced from it helps to ensure fruit availability during the off-season. Since jam has a long shelf life, it can be made available all year. The right proportions of the right ingredients, such as fruits, acid, pectin and sugar, must be employed to obtain the desired effect. Fruits and vegetables are becoming more important as part of a balanced diet. They include minerals, phytochemicals and vitamins in addition to being key parts of a balanced diet (Babajide *et al*., 2013; Hoejskov, 2013; Timothy *et al*., 2019). The consumer's understanding of the health advantages of fruits and vegetables is growing due to the advice of health professionals, educational programs, the media and public awareness campaigns (Timothy *et al*., 2019; Silva *et al*., 2017). However, a shortage of availability and high post-harvest losses impede both consumption and processing of fruits and vegetables (Timothy *et al*., 2019). Fruits and vegetables are important foods that provide mankind with a variety of nutritional and functional benefits. Many types of cancer are significantly reduced in people who eat a diet rich in fruits and vegetables (Fila *et al*., 2013). Fruit and vegetables are eaten raw or cooked into purees or jams (Marjan and Johari) (2010).

The pineapple (*Ananas comoscus*) is a tropical South American plant that is said to have originated from southern Brazil and Paraguay (Morton, 1987). Pineapple is often utilized in the production of jams, crisps and canned foods (MOA, 2016). The fruit is high in dietary fiber, vitamins and minerals, with vitamin C and manganese being particularly high (Ackom *et al*., 2012). It enhances the dining experience by adding a variety of colours, flavours and textures (Othman, 2011). Despite the enormous output of pineapple in Malaysia, this could be owing to its strong acid flavour (Jan and Masih, 2012; Shamsudin *et al*., 2014). Several studies have already combined pineapple juice with carrot and orange (Jan and Masih, 2012), guava juice and grapefruit juice in jam making (Tripathi *et al*., 1992).

Presbyterian College of Education, P.O. Box 27, Akropong-Akuapem, E/R-Ghana.

Corresponding Author: A.M. Nkansah, Presbyterian College of Education, P.O. Box 27, Akropong-Akuapem, E/R-Ghana.
Email: maureennkansahasante@gmail.com

How to cite this article: Nkansah, A.M. (2022). Quality Characteristics and Acceptability of Jam Produced from Pineapple (*Ananas comoscus*) and Carrot (*Daucus carota* L.) Blends. Asian Journal of Dairy and Food Research. DOI: 10.18805/ajdfr.DRF-268.

Submitted: 19-02-2022 **Accepted:** 22-04-2022 **Online:** 12-05-2022

Carrots (*Daucus carota* L.) are root vegetables grown around the world. They are nutritionally important vegetables because of their high vitamin, bioactive pigment and fiber content (Arscott and Tanumihardjo, 2010) and they are used to make carrot jelly (Kang *et al*., 2017; Nho *et al*., 2013). Carotenoids, polyphenols and vitamins in carrots act as antioxidants, anti-carcinogens and immunological boosters, as well as being healthy and validating the adage that carrots are good for the eyes. Carrots were originally used as a medicine before being adopted as a food (Dias, 2014). Because of its high raw and processed consumption, carrots might be a good carrier of microelements in the human diet. Furthermore, this healthy vegetable contains carbohydrates (10.6%), dietary fiber (1.2%), proteins (0.9%), lipids (0.2%) and minerals (1.1%), primarily calcium, iron and phosphorus (Sharma *et al*., 2011).

Apples and grapes are not grown locally due to unfavourable climatic conditions. However, to meet the need of industries that use fruits in making jam, carrots and pineapple are plentifully produced in Ghana. There is the need for sustainable development of such products by expanding utilization of indigenous farm products and decreasing pressure on the country's economy and sparing rare assets spent on jam importation. Industries in Ghana are attempting to be inventive by producing food products using local ingredients to meet the nutritional requirements of the country's increasing population. Unconsumed carrots and pineapples are lost due to the absence of post-harvest storage facilities. These indigenous raw materials are one of the under-used crops in the country regardless of their high nutritional values. Carrot and pineapple farmers are not encouraged because of their lack of patronage from industries that are supposed to be the strength of the carrot and pineapple market. Producing jam using local raw materials will therefore cut down the cost of importing jam and foreign fruits, enhance the incomes and livelihoods of individuals in the food production industry and promote the use of indigenous fruits and vegetables in the production of jam for consumption. This study looked at how different blends affected the functional and sensory qualities of pineapple and carrot composite jam. The sensory evaluation included features like colour, aroma, taste, spreadability and overall acceptability, whereas functional study focused on proximal factors. The research objective was to evaluate the quality characteristics and sensory attributes of the blended jam made of pineapple and carrot composites.

MATERIALS AND METHODS

The experiment took place in the Mycotoxin and Food Analysis Laboratories, Department of Food Science and Technology, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana, in March, 2020. Pineapple (*Ananas comoscus*) and carrot (*Daucus carota* L.), sugar, lemon, ginger and other ingredients were purchased from Asante Mampong main Market.

Jam blends formulation and preparation

Five distinct jam samples were made in the following ratios: 100:0, 90:10, 80: 20, 75: 25 and 25:75. Sample A was used as a control and was made entirely of pineapple (Table 1). Samples B, C, D and E were 90% pineapple and 10% carrots, 80% pineapple and 20% carrots, 75 % pineapple and 25% carrots and 25 % pineapple and 75% carrots, respectively. Pineapple (*Ananas comoscus*) and carrot (*Daucus carota* L.) flesh were combined to make the pulp. For blending, the fruits were washed, dried, peeled and chopped into smaller pieces. They were immediately chilled until further use after mixing. To prepare the jam, the pulp and sugar were mixed according to normal protocols. The Heat was applied to the pulp and sugar mixture. During the process, the soluble solid forms were monitored until 55°C was reached (Sulieman *et al*., 2013). Pectin was dissolved in boiling water and heated until completely dissolved. The fruit pulp, sugar and citric acid were added to the pectin solution at this point. The jam was then cooked until a coating of bubbles formed around the edges of the pot. The hot jam was then put into clean, dry wide-mouthed bottles and chilled in a water bath to 35°C until gelation began. The composite jam was now ready for proximal and sensory evaluation.

Proximate analysis

The determination of moisture, ash, protein, fat, crude fibre and carbohydrate were carried out using AOAC (2000) methods.

Determination of moisture

With minor changes, the moisture content of the sample was determined using the AOAC (1990) technique. 2 g of

Table 1: Percentages of ingredients used in jam formulation.

Ingredients	A	B	C	D	E
Pineapple (g)	100	90	80	75	25
Carrot (g)	0	10	20	25	75
Sugar (g)	100	100	100	100	100
Lemon (ml)	10	10	10	10	10
Water (ml)	500	500	500	500	500
Ginger (Grated) (g)	2	2	2	2	2
Pectin (g)	1	1	1	1	1

A(100% pineapple), B(90% pineapple and 10% carrots), C(80% pineapple and 20% carrots), D(75% pineapple and 25% carrots), E(25% pineapple and 75% carrots).

the samples were weighed on Petri dishes, then placed in an oven, uncovered and cooked for 3 hours at 130-150°C. The samples were removed from the oven and placed in a desiccator to cool for 15 minutes before being weighed. The operation was repeated until the mass remained consistent. Using the calculation, the weight loss was reported as a % moisture content loss:

$$\text{Moisture content} = \frac{\text{Weight loss} \times 100\%}{\text{Weight of sample}}$$

Determination of crude protein

The crude protein content of the samples was assessed using a modified version of the AOAC (1990) technique. In the Kjeldahl digestion technique, approximately 0.8 g of each sample was digested in a fume chamber. After diluting with water and then sodium thiosulphate and sodium hydroxide solutions, the digestion was allowed to cool before being distilled into boric acid containing bromocresor green indicators. After that, 0.1N hydrochloric acid (HCl) solutions were used to titrate the samples. The %age protein content was estimated using the equation after blank titrations were carried out in the same way:

$$\text{Crude protein} = \text{Nitrogen} \times 6.25$$

(1 mL of 0.1N HCl = 0.0014 gN).

Determination of ash

With minor adjustments, the AOAC [1990] method was used to determine the ash content of the sample. Approximately 5 g of sample was weighed into previously weighted ash dishes, placed in a muffle furnace and ignited for 5 hours at 550 10°C. It was weighed to a consistent mass after cooling. The ash (%age) that resulted was computed as follows:

$$\text{Ash content} = \frac{W2\text{-}W3 \times 100}{W2\text{-}W1}$$

Where

W1 is the weight of empty crucible; W2 is the weight of crucible + weight of sample before ashing and W3 is the weight of crucible + weight of sample after ashing.

Determination of crude fat

The crude fat content of the samples was determined using a modified version of the AOAC [1990] method. 2 g of the prepared material was weighed into Soxhlet thimbles and placed into an extraction flask of a specific weight. Diethyl ether extraction lasted 5 hours. Evaporation on an electrical bath was used to remove the diethyl ether at the end. The leftover fat in the flask was dried in the oven at 60°C for 30 minutes before being weighed after cooling for 15 minutes. The fat content (%age) was determined as follows:

$$\text{Fat content} = \frac{\text{Weight of fat} \times 100\%}{\text{Weight of sample}}$$

Determination of crude fiber

The crude fiber content of the samples was determined using a modified version of the AOAC (1990) method. One gram (1 g) of the sample was weighed and 100 mL of trichloroacetic acid was used as a digesting reagent. The solution was heated to a boil and then kept at 50-60°C for around 40 minutes. After removing the flask from the heater and allowing it to cool somewhat, the solution was filtered through Whitman filter paper. The residue was cleaned with methylated spirit and hot water. The filtrate was placed in the muffle furnace and heated to 550°C for 30 minutes before being cooled and weighed. The following formula was used to determine the %age of crude fiber content:

$$\text{Crude fiber} = \text{The loss in weight after incineration} \times 100$$

Determination of carbohydrate

The AOAC (2005) method was used to determine the carbohydrate % of the samples, which was computed using the equation:

Carbohydrate = 100 - (% Moisture + % Fat + + % Protein + % Crude fiber + % Ash)

Sensory evaluation

A group of 20 panelists (10 females and 10 males) who had previously been trained in descriptive analysis for jam were chosen for the evaluation. The colour, taste, aroma, spreadability and overall acceptability of each jam were determined using a hedonic scale from 9-1 (9 = like extremely, 8 = like very much, 7= like moderately, 6= like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, 1 = dislike extremely). The panelists were shown all of the jams at room temperature and under normal illumination, which included transparent plastic glass with alphabets from A to E coded on it. On white disposable plates, participants were offered 10 g of each jam with a slice of bread from the same loaf. The samples' colour, aroma, taste and spreadability were rated on a nine-point hedonic scale, with 1 representing "severe dislike" and 9 representing "intense like." The samples were evaluated in individual booths with mouth rinse water. Following the tasting, the participants completed the score sheets.

Statistical analysis

The results were statistically analyzed using the SPSS statistics software (Version 17.0). To find any significant differences between the samples, ANOVA, Duncan's multiple range tests and mean standard deviation were used (Rattanathanalerk, 2005)

RESULTS AND DISCUSSION

Proximate composition of composite jam

Table 2 displays the results of the composite jam's proximal analysis. The control (A) had a higher moisture content than the jam blends, which ranged from 36.87 to 45.59%. Because of the heating technique used during preparation, the difference in moisture is to be expected. Moisture has a significant impact on product shelf life (Eke-Ejiofor and Owuno, 2013). Water was removed from jams during processing, resulting in a higher concentration of food components (Saka *et al*., 2007). The moisture content of any food material is a measure of the food's lifespan or life span. It specifies how long food can be stored before turning rotten (Fellows, 2007). Based on this, the produced jams made with pineapple and carrot moisture content were the best jams for a longer shelf life in storage. These moisture values are within the range of numerous fruit and vegetable jams, jellies, marmalades and conserves (36.87-40.52%) (Pomeranz, 2013). The jams have a long shelf life due to their low moisture content. The results of the study are in line with the suggested jam values for preventing microbiological development and preserving quality (Moyls *et al*., 1962; Aina and Adesina, 1999; Malcolum, 2000). There was a significant difference ($p \leq 0.05$) between the control sample (100% pineapple) and the composite jam B(90% pineapple and 10% carrots), C(80% pineapple and 20% carrots), D(75% pineapple and 25% carrots), E(25% pineapple and 40% carrots).

The composite sample had an ash level of 0.60 to 0.8%. The ash content of the control jam sample (100 % pineapple) was the lowest, while the ash content of the composite jam (75% pineapple and 25% carrots) was the highest at 0.81%. In comparison to the findings obtained for prickly pear jam, the ash concentration was greater (Atef *et al*., 2013). The mineral composition of food samples is indicated by ash content, which is critical in many biochemical reactions that aid the physiological functioning of major metabolic processes in the body (Ashaye and Adeleke, 2009). These results are similar to those published by Eke-Ejiofor and Owuno (2013) for jackfruit jam (0.27%) and fresh jackfruit (0.43%), respectively. Goswami *et al*. (2011) also reported ash levels of different fresh jackfruit (A. heterophyllus) kinds (0.98, 1.04, 1.11, 0.88 and 0.70). Fresh fruit jam ash concentrations ranged from 0.053% to 0.902%, according to Haque *et al*. (2009). Although most minerals have little volatility at high temperatures of 5000C, ash content is a measure of the entire amount of minerals contained in a food; some minerals are volatile and may be partially lost.

In terms of nutrition, ash is crucial since it indicates how concentrated the minerals in a given food sample are. In general, low ash content implies that the food being examined is deficient in minerals. The crude protein value of the jam samples ranged from 0.11-0.48%; composite jam sample D(75% pineapple and 25% carrots) was the lowest (0.11%) compared to the other blends (0.31, 0.36, 6.9, 0.48% respectively and the control 0.34%). This result indicated that the blend samples C(80% pineapple and 20% carrots) and D(75% pineapple and 25% carrots) had higher protein content than the control (100% pineapple), which was lower than a study on prickly pear pulp by Atef *et al*., 2013), which found that the protein content of the blend samples C(80% pineapple and 20% carrots) was higher than the protein content of the control (100% pineapple) (7.02-8.51%). All of the composite jams developed had a significant difference (p0.05). The difference between the control sample (100% pineapple) and samples B (90% pineapple and 10% carrots), C and D was not significant (p0.05) (80% pineapple and 20% carrots). These findings were similar to those of Watt *et al*. (1963), who found protein content in the edible section of jackfruit jam, pineapple jam and raw jackfruit to be 1.3%, 0.46%, 0.19% and 1.12%, respectively. The most prevalent ingredients in jam are fruits, sugar, pectin and citric acid, according to nutritional labeling. Because none of the components utilized are high in protein, jam has a low protein level (Mohd Naeem *et al*., 2015). Because of the heat generated during processing, most processed products, such as jams, have reduced nutritional contents when compared to fresh fruits (Jawaheer *et al*., 2003).

The crude fat level of the jam samples ranged from 5.29% to 10.67%, with the control sample (100 % pineapple) having the lowest fat content (5.29%) and jam sample D (75% pineap1e fat content of many foods influences the overall physical features of the food, such as flavor, texture, mouth feel and appearance (Muhammad *et al*., 2009). According to Norman (1976), the fat content of many fruits is usually less than 1%. Haque *et al*. (2009) also discovered that the lipid content of several fruits varied between 0.0084% and 1.27%.

The fiber level of the jam mixes ranged from 0.1 % to 3.86%, with the lowest fiber content of 0.13 % in the control sample (100% pineapple) and the greatest fiber content of 3.86% in sample E (25% pineapple and 7% carrots) (3.86%). It was discovered that when the carrot's fiber content increased, so did the carrot's fiber content. The fibre content of the control (100 % pineapple) and composite sample B did not differ significantly (p0.05) (90% pineapple and 10% carrots). However, there was a significant difference ($p<0.05$) between sample C (80% pineapple and 20% carrots), D (75% pineapple and 25% carrots) and E (100 % pineapple)

Table 2: Proximate composition of pineapple-carrots jam.

Sample	Moisture (g/100 g)	Ash (g/100 g)	Protein (g/100 g)	Fat (g/100 g)	Fibre (g/100 g)	CHO (g/100 g)
A	45.69±0.58^{a}	0.60±0.00^{b}	0.34±0.03^{a}	5.29 ± 0.00^{c}	0.13±0.03^{d}	48.05±0.61^{b}
B	40.52±0.46^{b}	0.64±0.00^{b}	a0.31±0.02^{a}	5.98 ± 0.00^{c}	0.16±0.01^{d}	46.60±0.53^{c}
C	38.73 ±0.37^{c}	0.68±0.00^{b}	0.36±0.03^{a}	6.74 ± 0.00^{c}	1.22±0.02^{c}	45.13±0.43^{d}
D	38.69±0.24^{c}	0.81±0.00^{a}	0.11±0.00^{a}	10.67 ±0.03^{a}	2.56±0.07^{b}	49.52±0.28^{a}
E	36.87±0.32^{d}	0.71±0.03^{a}	0.48±0.04^{a}	7.33 ± 0.10^{b}	3.85±0.07^{a}	33.95±0.28^{e}

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different ($p>0.05$). Keys: A(100% pineapple), B(90% pineapple and 10% carrots), C(80% pineapple and 20% carrots), D(75% pineapple and 25% carrots), E(25% pineapple and 75% carrots).

Table 3: Sensory attributes of the composite jam.

Sample	Colour	Aroma	Spreadability	Taste	Overall acceptance
A	9.64±0.68^b	9.70±0.80^a	9.38±1.17^b	9.40±0.36^b	10.49±0.73^b
B	9.50±0.6.4^d	9.80±0.80^a	9.40±1.00^b	9.30±0.30^c	10.47±0.70^d
C	9.35±0.74^a	9.76±0.76^b	9.45±0.82^a	9.38±0.26^b	10.46±0.78^c
D	9.30±0.50^e	9.78±0.72^a	9.48±0.82^a	9.55±0.18^a	10.54±0.67^a
E	8.56±0.69^c	8.81±1.02^c	8.40±1.07^c	8.60±0.26^d	8.64±0.82^e

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different (p>0.05). Keys: A(100% pineapple), B(90% pineapple and 10% carrots), C(80% pineapple and 20% carrots), D(75% pineapple and 25% carrots), E(25% pineapple and 70% carrots).

(25% pineapple and 75% carrots). This Fig. is slightly higher than the 3.06% revealed by Singh *et al*. (1991). It's possible that the discrepancy is related to the proportions of substances utilized. Carrot fiber protects the colon mucous membrane by adhering to cancer-causing substances and removing them from the colon.

The jam's carbohydrate content ranged from 33.95% to 49.52%. The lowest carbohydrate content (33.95%) was found in sample (25% pineapple and 75% carrots), while the maximum carbohydrate content was found in jam blends sample D (75% pineapple and 25 % carrots) (49.52%). The carbohydrate content of the control sample (100% pineapple jam) was 48.05%. The control sample (100% Pineapple jam) and the composite jam samples B (90% pineapple, 10% carrots), C (80% pineapple, 20% carrots), D (75% pineapple, 25% carrots) and E (90 % pineapple, 10% carrots) (25 % pineapple and 75 % carrot) showed a significant (p0.05) difference. Sample D's high carbohydrate content (75% pineapple and 25% carrots) could be due to the high carbohydrate content of carrots (Franz Augstburger *et al*., 2001). The carbohydrate levels in this study are higher when compared to Emelike *et al*., (2015) carbohydrate values for beetroot jam.

Sensory attributes of the jam samples

Sensory evaluation takes into account things like appearance, scent, taste and so forth and it all adds up to show total liking. In most cases, flavour has a significant part in overall acceptance (Nafisah *et al*., 2020). The sensory characteristics of pineapple and carrot composite jam are shown in Table 3. In terms of colour, taste, texture and general acceptability, the experimental samples appeared to be substantially different (P<0.05). The color of the jam samples ranged from 8.56 to 9.64, with the greatest mean score (9.64) going to the control sample (100% pineapple) and the lowest mean score going to sample E. (25% pineapple and 70% carrots). The color obtained a slightly diminishing tendency with decreasing pineapple and increasing carrot proportions: 90:10> 80:20> 75:25 > 25:75 is a ratio of 90:10> 80:20> 75:25 > 25:75. The fragrance score of the control (100:0) sample did not differ substantially from the scores of samples B (90:10), C (80:20) and D (P>0.05). (75:25). The control sample (100% pineapple) and the composite jam sample E (25% pineapple and 70% carrots) showed a significant difference (P<0.05). With the exception of jam sample E (25% pineapple and 70% carrots), the control scored much lower than the composite jam samples in terms of spreadability: 90:10, 80:20 and 75:25. Carrot integration can be responsible for the differences in colour, aroma, taste and spreadability when compared to the control. Furthermore, decreasing the pineapple or increasing the carrot amounts had no effect on the spreadability (P>0.05). The taste of the composite samples was unlikely to be affected by the corresponding increases and declines in carrot and pineapple quantities. Furthermore, there were significant differences in overall liking (P<0.05) between the composite samples and the control. Given the higher scores for aroma, spreadability, taste and overall acceptability compared to the other samples, the sample produced with 75% pineapple and 25% carrots proved to be more preferable based on consumer acceptability.

CONCLUSION

Carrot and pineapple can be combined to make jam for consumption. Generally, consumers preferred the composite jam with 75:25% pineapple and carrot integration. The addition of other fruits could help the jam's sensory characteristics, such as colour, taste and spreadability to improve. When compared to the composite samples, the proximate components (ash, fat, fiber, moisture and carbohydrate) of the control differed considerably (P<0.05). All the factors evaluated in the study showed significant differences (P< 0.05). The sensory results showed that 75% pineapple and 25% carrot can be used to make an acceptable jam without an adverse effect on the nutritional values. The study concludes that pineapple-carrot jam has good sensory qualities and can be used to make jam and other processed products to add value to the fruit and vegetable.

Conflict of interest: None.

REFERENCES

Ackom, N.B. and Tano-Debrah, K. (2012). Processing pineapple pulp into dietary fibre supplement. African Journal of Food, Agriculture, Nutrition and Development. 2(6). DOI: 10.18697/ajfand.54.11075.

Aina, J.O. and Adesina, A.A. (1999). Suitability of frozen indigenous tropical fruits for jam processing. Advances in Food Sciences. 2: 15-18.

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

Association of Official Analytical Chemists (2005). 18th ed. Washington.

AOAC (2000). Official Methods of Analysis, Association of Official Analytical Chemists. 17th edition, Gaithersburg. M.D. Association of Official Analytical Chemistry International (19901) 5th edition. Arlington.

Arscott, S.A., Tanumihardjo, S.A. (2010). Carrots of many colors provide basic nutrition and bioavailable phytochemicals acting as a functional food. Compr. Rev. Food Sci. Food Saf. 9: 223-239.

Ashaye, O.A. and Adeleke, T.O. (2009). Quality attributes of stored Roselle jam. International Food Research Journal. 16: 363-371.

Atef, A., Abou-Zaid, M., Nadia, I., Ibrahim, R., Mostafa, T. and Nadir, A. (2013). Quality evaluation of sheets, jam and juice from prickly pear and melon blends: Life Science Journal. 10(2): 200-208.

Babajide, J.M., Olaluwoye, A.A., Taofik Shittu, T.A., Adebisi, M.A. (2013). Physicochemical properties and phytochemical components of spiced cucumber-pineapple fruit drink. Nigerian Food Journal. 31(1): 40-52. https://doi. org/ 10.1016/S0189-7241(15)30055-2.

Barbara, H.I. (2008). Making Jams, Jellies and Fruit Preserves. Wisconsin Safe Food Preservation Series.

Dias, J.C.S. (2014). Nutritional and health benefits of carrots and their seed extracts. J. Food and Nutrition Sciences. 5: 2147-2156.

Eke-Ejiofor, J., Owuno, F. (2013). The physico-chemical and sensory properties of jackfruit (*Artocarpus heterophilus*) jam. International Journal of Nutrition and Food Sciences. 2 (3): 149-152.

Emelike, N.J.T, Hart, A.D. and Ebere, C.O. (2015). Influence of drying techniques on the sensory properties, physicochemical and mineral composition of beetroot juice. IOSR Journal of Environmental Science, Toxicology and Food Technology. 9(12-2): 20-26. DOI: 10.9790/2420-091222026.

Fellows, P.J. (2007). Food Processing Technology, Principles and Practice. Wood Head Publishing, Cambridge. 591pp.

Fila, W.A., Itam, E.H., Johnson, J.T., Odey, M.O., Effiong, E.E., Dasofunjo, K. and Ambo, E.E. (2013). Comparative proximate compositions of watermelon, squash and rambutan. International Journal of Science and Technology. 2(1): 81-87.

Franz, A.F., Jörn, B., Udo, C., Petra, H., Joachim, M., Christine, S. (2001). Bananas Organic Farming in the Tropics and Subtropics. Naturlande. V, 2nd edition, pp 1-21.

Goswami, C., Hossain, M.A., Kader, H.A. and Islam, R. (2011). Assessment of Physicochemical Properties of Jackfruit (*Artocarpus heterophyllus* Lam) pulps. Journal of Horticulture, Forestry and Biotechnology 15(3): 26-31.

Haque, N.M., Saha, K.B., Karima, R.M. and Bhuiyanb, H.M. (2009). Evaluation of nutritional and physico-chemical properties of several selected fruits in Bangladesh. Bangladesh Journal of Science Industry Research. 44(3): 353-358.

Hoejskov, P.S. (2013). Importance of fruit and vegetables for public health and food safety. Nadi, Fiji: PROFAV.

Jan, A. and Masih, E.D. (2012). Development and quality evaluation of pineapple juice blend with carrot and orange juice. International Journal of Scientific and Research Publications 2(8): 1-8.

Jawaheer, B., Goburdhun, D. and Ruggoo, A. (2003). Effect of processing and storage of guava into jam and juice on the ascorbic acid content. Journal of Plant Food Human Nutrition. 58: 1-12.

Kang, H.S., Kim, M.J., Rho, J.O., Choi, H.I., Han, M.R., Myung, J.H., Kim, A.J. (2017). Quality characteristics of care food (jelly) prepared with wild carrot (*Daucus carota* L.) juice. J Korean Diet Assoc. 23: 337-349.

Marjan, J. and Johari, E. (2010). A Survey on Rheological Properties of Fruit Jams. International Journal of Chemical Engineering and Applications. 1(1): 31-37.

Malcolum, D. 2000. Science and technology of making preserves. Ministry of Agriculture and Agro-based Industry (MOA). (2016). Agro-food Statistic. Malaysia: MOA.

Mohd Naeem, M.N., Mohd Fairulnizal, M.N., Norhayati, M.N., Zaiton, A., Norliza, A.H., Wan Syuriahti, W.Z., Mohd Azerulazree, J., Aswir, A.R. and Rusidar S. (2015). The nutritional composition of fruit jams in the Malaysian market. Journal of the Saudi Society of Agricultural Sciences. 2:1-8 [http:/ /www.sciencedirect.com/science/article/pii/s1658077x15000119] site visited on May 2015.

Morton, J. (1987). Jackfruit: Fruits of warm climates. By Morton Julia F., Miami FL. pp 58-64. [http://www.hort.purdue.edu/ newcrop/morton/jackfruit_ars.html] site visited on 23/3/2015.

Moyls, A.W., Strachan, C.C. and Atkinson, F.E. (1962). Making jam commercially. Canada Dept. of Agric. Ottawa, Pub. 114pp.

Muhammad, S., Saghir, A.S. and Nizamani, S.M. (2009). Determination of Nutritive Values of Jamun Fruit (Eugenia jambolana) Products. Pakistan Journal of Nutrition 8 (8): 1275-1280.

Nafisah, S., Konadu, L., Kafui, S.E. (2020). Production and acceptability of jam produced from pineapple, watermelon and apple blend. EAS Journal of Nutrition and Food Sciences. 2(6): 321-325.

Nho H.J, Jang S.Y, Park J.J, Yun H.S, Park S.M. (2013). Browning prevention of black carrot extract and the quality characteristics of jelly supplemented with black carrot extract. J Korean Soc Food Cult. 28: 293-302.

Norman, N.P. (1976). Food Science, 2nd edition, Avi publishing company, INC-Westport, Connecticut. 640 pp.

Othman O.C. (2011). Physicochemical Characteristics and Levels of Inorganic Elements in Off-vine Ripened Pineapple (*Ananas comosus* L.) fruits of Dar es Salaam, Tanzania KIST. Journal of Science and Technology. 1(1): 23-30.

Pomeranz, Y. (2013). Food Analysis: Theory and Practice. Springer Science and Business Media. 778 pp. ISBN: 1461569 982, 9781461569985.

Rattanathanalerk, M., Chiewchan, N. and Srichumpoung, W. (2005). Effect of thermal processing on the quality loss of pineapple juice. Journal of Food Engineering. 66(2). 259-265.

Saka, J., Rapp, I., Akinnifesi, F., Ndolo, V. and Mhango, J. (2007). Physicochemical and Organoleptic characteristics of *Uapacakirkiana*,*Strychnoscocculoides*, *Adansoniadigitata* and *Mangiferia indica* fruit products. International Journal of Food Science and Technology. 42(7): 836-841.

Shamsudin, R., Adzahan, N.M., Yee, Y.P. and Mansor, A. (2014). Effect of repetitive ultraviolet irradiation on the physico-chemical properties and microbial stability of pineapple juice. Innovative Food Science and Emerging Technologies. 23: 114-120.

Sharma, K.D., Karki, S., Thakur, N.S., Attri, S. (2011). Chemical composition, functional properties and processing of carrot- A review. J. Food Sci. Technol. 49: 22-32.

Silva, O.O., Ayankogbe, O.O., Odugbemi, T.O. (2017). Knowledge and consumption of fruits and vegetables among secondary school students of Obele Community Junior High School, Surulere, Lagos State, Nigeria. Journal of Clinical Sciences.14(2): 68-73. https://doi.org/10.4103/jcls.jcls-60-16.

Singh, A., Kumar, S. and Singh, I.S. (1991). Functional properties of jackfruit seed flour. Lebensm-Wissu Technology. 24: 373-4.

Sulieman, A.M.E, Khodari, K.M.Y and Salih, Z.A. (2013). Extraction of pectin from lemon and orange fruit peels and its utilization in jam making. International Journal of Food Science and Nutrition Engineering. 3(5): 81-84.

Timothy, B.O., Olalekan, A.S.A., Rasheedat, A.F., Fatmata, F.J. (2019). Physicochemical, rheological and sensory attributes of honey sweetened jam produced from blends of carrot and cucumber. Journal of Food Stability. 2(2): 1-14.

Tripathi, V.K., Lyndgoh, K. and Singh, S. (1992). Studies on blending of pineapple juice with different ratios of guava juice for preparation of RTS beverage. Progressive Horticulture. 24(1-2): 60-65.

Watt, B.K., Merrill, A.L., Pecot, R.K., Adams, C.F., Orr, L. and Miller, D.F. (1963). Composition of Foods: Raw, Processed, Prepared. Revised Agriculture. Hand book 8. U.S.D.A. Washington. 907 pp.