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QUALITY EVALUATION OF JAM PRODUCED FROM MIXTURE OF ORANGE AND BLACK PLUM FRUITS

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ABSTRACT
The potential of some wild-growing indigenous fruits such as black-plum (Vitex doniana) has remained largely untapped. Jams are solid gels made from fruit pulp or juice, sugar and added pectin. The research work was aimed at producing Jam from mixture of orange and black plum fruits in different proportions. Standard methods were used for determination of physicochemical properties; pH, titratable acidity, specific gravity, total soluble solids, sweetness index. Proximate compositions; moisture, protein, lipids, ash, carbohydrate and crude fibre analyses were carried out using standard method of AOAC, Vitamin A and E were determined using UV-Visible spectroscopic method, Vitamin C was determined by iodine titration method. Mineral contents were analyzed by AAS and flame photometry. The 9-point hedonic scale questionnaire was used for sensory evaluation. Results of physicochemical analysis showed significant increase (P<0.05) in pH (4.15±0.11 and 4.53±0.11), total soluble solids (60.88±0.74 and 62.80±2.03) and sweetness index (40.68±0.05 and 47.95±0.15) of sample orange-black plum (70:30 and 55:45) respectively when compared with orange jam (100%). Significant decrease (P<0.05) was also observed in titratable acidity (1.31±0.2) and specific gravity (2.19±0.20) of orange-black plum (55:45) when compared orange jam (100%). Significant difference was observed in all the proximate parameters analyzed with the exception of crude fibre (P<0.05). Sensory evaluation indicated consumer acceptability in orange- black plum jam (55:45). Processing black plum into jam by mixing it with orange or other fruits may help in preserving as well as utilizing the numerous nutrients available in the fruit.

Keywords: Jam, Orange, Black plum, Sensory evaluation, Proximate composition

INTRODUCTION

Fruits are source of bioactive compounds (vitamins, phenolics, carotenoids and flavonoids) attributing to the antioxidant potential of the fruits (Shinwari and Rao, 2018). During period of fruit glut, considerable quantity of fresh fruits get spoilt and are thrown away due to the highly perishable nature of the commodity (Abdussalam, 2017). These fruits can be preserved for consumption during off-season, the fruits are processed into shelf-stable products like jam and jellies (Shinwari and Rao, 2018). Wild foods such as black plum are usually considered as a dietary supplement to farmers' daily food consumption, generally based on their crop harvest (FAO, 2013). They also serve to make the diet more diverse, interesting and flavourful (Harris and Mohammed, 2003). Black plum (*Vitex doniana*) is called 'Dinya' in Hausa speaking communities of Northern Nigeria (Sayuti*et al.,* 2000). It belongsto the family *Verbanaceae,* itgrows in open woodland and savannah regions of tropical Africa; it is the commonestof the *Vitex*species in West Africa (Ajenifujah-Solebo and Aina, 2011).There is a renewed national and international interest in black plum, and it has emerged as priority species for domestication in Africa (Dadjo*et al*., 2012). The fruit has potential for use in the production of wine and jam (Okigbo, 2012).

Jam can be defined as the product prepared from sound, ripe, fresh, dehydrated, frozen or previously packed fruits including fruit juices, fruit pulp, fruit juice concentrate or dry fruit by boiling its pieces, pulp or puree with nutritive sweeteners (Jain, 2017; Onwuka, 2014; Okaka and Okaka, 2001) and are mainly a source of calories (Schafer *et al*., 2021) and of nutritional value, hence the fruits are underutilized (Okigbo, 2012). Though studies were carried out on jam production from black plum fruit only (Agbede and Ibitoye, 2007), as such combining the fruit with other fruits for jam production may yield a product with improved quality. This work aimed at producing Jam from mixture of orange and black plum fruits in different proportions.

MATERIALS AND METHODS

Sample collection and Preparation

Ripe black plum fruits were harvested from Potiskum Local Government Area of Yobe state, Northern Nigeria. Orange fruits and sugar were purchased from local traders at Sheikh Abubakar Gumi Central Market, Kaduna State, Nigeria. Ripe fruits of orange and black plum were properly selected by hand picking then followed by washing them separately with running tap water. They were crushed and sieved to remove the seeds in other to obtain the fruit pulp together.

Production of Jam Samples

Jams were produced by combining pulps of orange and black plum in the ratios of 85:15 (321), 70:30 (313) and 55:45 (324). They were then cooked with addition of sugar to the desired consistency. Another batch of 100% (314) orange fruit with sugar was also produced as the control for the study.

Determination of Physicochemical Properties

The physico-chemical properties of the samples were determined by different standard methods. The pH of the samples was determined using a pH meter (HM 305, Japan). Titratable acidity was determined by titration and viscosity was determined using Ostwald Viscometer, while the specific gravity was determined using specific gravity bottle (Onwuka, 2005). The determination of total soluble solids was carried using hand refractometer (Yokananth, 2018). Sweetness index (ratio of total solids to titratable acidity) was determined according to the method of Adeboyejo *et al*. (2018).

Proximate Analysis

Moisture, protein, lipids, ash and crude fibre and carbohydrate contents determination were carried out according to the standard method of AOAC (1975).

Determination of Vitamin Content

The vitamins A and E contents were determined by UV-Visible spectroscopic method (Jadoon*et al.*, 2015), Vitamin C analysis by iodine titration method (Kirk*et al.*,1991).Thiamin, riboflavin, niacin, pyridoxine and cobalamin contents were determined by UV-Visible spectroscopic method (Bartzatt and Wol, 2014).

Determination of Minerals Contents

The levels of calcium, magnesium, iron, manganese, copper, zinc and nickel in the samples were determined by atomic absorption spectroscopy (AAS), sodium and potassium were determined by flame photometry, while phosphorus content was determined by molybdate method (Onwuka, 2005).

Sensory Evaluation

The sensory evaluation was carried out according to the method of Iwe (2010). The codes (314, 321, 313 and 324) were presented to 10 participants to indicate their preference for the samples on the basis of appearance, flavour, texture and the overall acceptability using 9-point hedonic scale questionnaire. The scale ranged from like extremely (9) to dislike extremely (1).

Statistical Analysis

Statistical package for the social sciences was used for the analysis of the results. The results were presented as Mean± Standard deviation. Where $P<0.05$ was considered to be significant.

RESULTS

Physicochemical Analysis

The results of physicochemical analysis of jam produced from orange and black plum is shown in Table 1. There was significant increase ($P<0.05$) in the pH level of orange: black plum jam (70:30) and (55:45) when compared with 100% orange jam. Titratable acid and specific Gravity value of orange: black plum jam (55:45) was found to be significantly higher than 100% orange jam. However total soluble solute and sweetness index where found to increase significantly ($P<0.05$) in all the samples when compared with 100% orange jam.

Proximate Composition

The results of proximate analysis of the samples is presented in Table 2 below. Significant increase was established in all the macro-nutrient analysed (moisture, protein, fat, ash and carbohydrates) with the exception of crude fibre in all combined orange: black plum jam (85:15, 70:30 and 55:45) when compared with 100% orange jam.

Vitamin and Mineral Content

The result of vitamin content of jam produced from orange: black plum is presented in Figure 1 below. The concentration of vitamin A and C where found to be significantly higher ($P<0.05$) in sample with high percentage of orange. Vitamin E, thiamin and riboflavin content were found to be significantly high ($P<0.05$) in 70:30 and 55:45 orange: black plum jam. Figure 2 present the results of mineral analysis of orange: black plum jam. Sodium and potassium levels decreased significantly ($P<0.05$) following an increase in the concentration of black plum.

Table 1: Physicochemical Properties of Jams Produced from Mixture of Orange and Black Plum Fruits.

Properties	314	321	313	324
pH	$3.34^{a} \pm 0.02$	$3.45^{a} \pm 0.07$	$4.15^{b} \pm 0.11$	$4.53^{b} \pm 0.11$
Titratable Acidity (mg/g)	$1.87^{a} \pm 0.01$	$1.76^{a} \pm 0.06$	$1.50^{a} \pm 0.03$	$1.31^{b} \pm 0.03$
Total soluble Solids ($°\boldsymbol{Brix}$)	$54.41^{a} \pm 1.58$	$56.17^{b} \pm 1.90$	$60.88^{c} \pm 0.74$	$62.80^{d} \pm 2.03$
Sweetness Index	$29.16^{a} \pm 1.00$	$31.92^{a} \pm 0.77$	$40.68^{c} \pm 0.05$	$47.95^{d} \pm 0.15$
Viscosity (NMS^{-1})	$3.51^{a} \pm 0.01$	$3.98^{a} \pm 0.06$	$3.51^{a} \pm 0.12$	$3.59^{a} \pm 0.04$
Specific Gravity	$2.95^{a} \pm 0.04$	$2.62^{a} \pm 0.03$	$2.51^{a} \pm 0.01$	$2.19^{b} \pm 0.20$

Results are presented as Mean ± SD. Values with the different superscript in the same row are significantly different (P< 0.05).

Table 2: Proximate Composition of Jams Produced from Mixture of Orange and Black Plum Fruits.

% Composition	314	321	313	324
Moisture	$30.12^{a} \pm 1.00$	$25.89^{b} \pm 0.23$	$23.32^{c} \pm 0.62$	$20.36^{d} \pm 0.11$
Protein	$1.38^{a} \pm 0.03$	$2.66^{b} \pm 0.01$	$3.36^{c} \pm 0.02$	$3.90^{d} \pm 0.01$
Fat	$0.03^{a} \pm 0.00$	$1.08^{b} \pm 0.01$	$2.82^{c} \pm 0.15$	$2.90^{c} \pm 0.09$
Ash	$1.43^{a} \pm 0.21$	$2.09^{b} \pm 0.01$	$2.21^{b} \pm 0.04$	$2.68^{c} \pm 0.11$
Crude fibre	$1.13^{a} \pm 0.01$	$1.08^{a} \pm 0.01$	$1.14^{a} \pm 0.02$	$1.34^{a} \pm 0.02$
Carbohydrates	$65.90^{a} \pm 1.07$	$67.20^{b} \pm 1.03$	$67.15^{b} \pm 1.73$	$68.82^{c} \pm 0.16$

Results are presented as Mean ± SD. Values bearing the same superscript in the same row are not significantly different (P>0.05);314 = 100% Orange; 321 = 85:15 Orange and Black Plum; 313 = 70:30 Orange and Black Plum; 324 = 55:45 Orange and Black Plum.

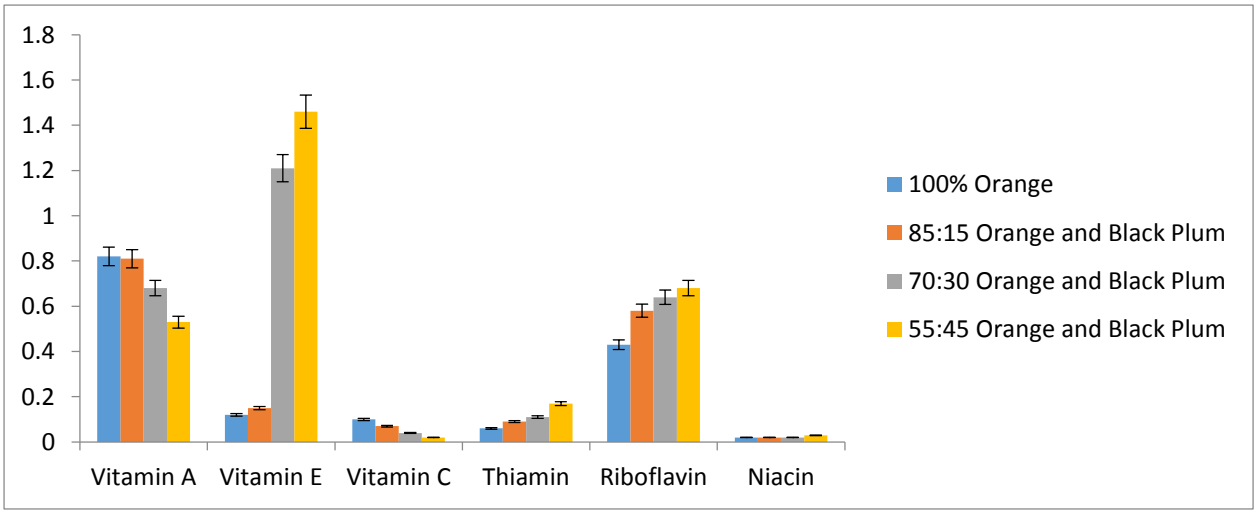

Figure 1: Vitamin Content (mg/100g) of Jam Produced from Mixture of Orange and Black Plum Fruits.

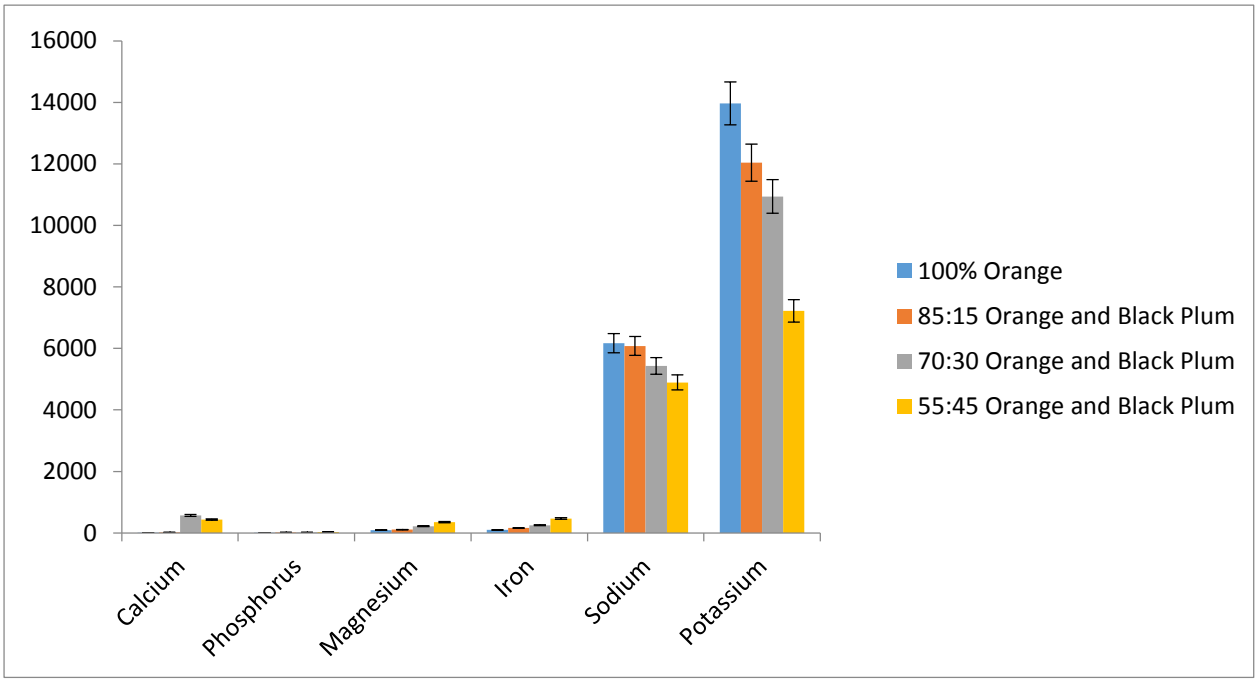

Figure 2: Mineral Content (µg/100g) of Jam Produced from Mixture of Orange and Black Plum Fruits.

Sensory Evaluation

Sensory evaluation of the orange: black plum showed that the appearance of the jam produced from 100% orange was significantly preferred (P<0.05) over jams produced from the mixture of orange and black plum fruits (Table 3). However, flavour and overall acceptability of the samples produced from the mixture of orange: black plum were more preferred.

Table 3: Sensory Evaluation of Jams Produced from Mixture of Orange and Black Plum Fruits.

Sensory parameters	314	321	313	324	LSD
Appearance	8.1^a	6.6^b	6.2^b	5.7^c	0.634
Flavour	6.2^a	6.1^a	7.0^b	7.7^c	0.589
Texture	6.1^a	6.0^a	6.2^a	5.9^a	Nil
Overall acceptability	6.9^a	7.1^a	7.3^a	7.6^b	0.557

Results are presented as Mean ± SD. Values with the same superscript in the same row are not significantly different (P>0.05); 314 = 100% Orange; 321 = 85:15 Orange and Black Plum; 313 = 70:30 Orange and Black Plum; 324 = 55:45 Orange and Black Plum.

DISCUSSION

Generally, fruits are acidic in nature, with pH ranging from 2.5-4.5 (Onwuka, 2014). However, The pH value obtained from the samples were higher than 3.42 as reported in jam produced from black plum only (Okwundulu*et al.,* 2011). This showed that the black plum decreased the acidity of the products which may be due to the low vitamin C content (Agbede and Ibitoye, 2007). Sweetness index (SI) is important for the perception of sweetness and consumer acceptance (Dadjo*et al.,* 2012). The high level of SI obtained in orange- black plum jam (70:30 and 55:45) might be as a result of lower acidity which may impart pleasant taste. The titratable acidity (TA) measures the total acid concentration in food. The level of TA was found to decrease in orange- black plum jam (55:45)

and this can be associated with the amount of ripened black plum used in producing the jam. According to James (2002) TA levels are lowered in ripened fruits.

The moisture content of the jams decreased with increase in proportions of black plum in the mixture and this can be attributed to the thick nature of the black plum pulp.It was observed that black plum contributed to the higher levels of fat, protein and carbohydrate in the jam and this is in conformity with the work of Egbekun and Bankole (1996). The Presence of fat in a food improves its palatability (Onwuka, 2014; Naeemand Rusidah, 2017) and this coincided with the overall acceptability of the jam. Ash contents, which is an indicator of the level of mineral nutrients present, increased steadily with increased black plum and this is in accordance with the work of (Ajenifujah-Solebo and Aina, 2011) which reported black plum to be a good source of minerals. High carbohydrate content combined with the fruit acidity may help in preventing microbial invasion and growth. Some variations were observed in some of the physicochemicaland proximate analyses from other authors and this could be due to the differentsources,mixture of the fruits as well as processing methods.

Vitamins and minerals are micronutrients which are needed in small amounts to meet the dietary requirements (United States Food and Nutrition Board, 2011). Minerals analysis revealed higher distributions of sodium and potassium in the orange- black plum. This showed that the product can serve as an alternative source of body electrolytes. Sensory evaluation indicated that orange- black plum jam has overall acceptability. The appearance of orange- black plum had the lowest scores and this can be associated with the black colour of the jam produced as such orange jam was more appealing. This findings are in line with that of Ajenifujah-Solebo and Aina (2011) in which black-plum jam had the lowest scores in terms of appearance.

CONCLUSION

Black plum can be used in making jam either as a single fruit or in combination with other fruits. The low gel strength of the jam produced can be improved by the addition of pectin during processing to attain the commercially acceptable gel strength or a combination of fruits rich in pectin can be used to make-up for the deficiency.

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