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Research Arfticle

Physicochemical, Anti-oxidant and Sensory Characteristics of Spiced Jam from Blends of Selected Tropical Fruits

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ABSTRACT

Fruit jams are preserved fruits and sugars normally canned for long term storage. Its processes involves the disruption of the fruit tissue followed by heating with added water and sugar to activate the pectin before being put into container. Jams were processed from two selected tropical fruits namely, pineapple and watermelon. The jam produced was spiced with ginger and turmeric at 5% level using a standard methods. The treatments are WA (watermelon 100%), WAG (watermelon 95% + ginger 5%), WAT (Watermelon 95% + turmeric 5%), WAGT (watermelon 95% + ginger 5% + turmeric 5%), PI (pineapple 100%), PIG (pineapple 95% + ginger 5%), PIT (pineapple 95% + turmeric 5%) and PIGT (pineapple 95% + ginger 5% + 5% turmeric). The proximate, physiochemical, antioxidant, total phenolic, color and sensory properties of the spiced jams were determined using standard analytical procedures. The proximate result showed that the moisture content of the samples ranged from 3.61-20.55% for watermelon jam (WA) and reference sample (CNTP); protein 0.50-5.16% for (CNTP) and watermelon-ginger jam (WAG); fat and ash contents were 0.21-2.55% and 0.38-1.53% for (CNTP) and pineapple jam (PI) respectively. The pH of the spiced jam ranged from 3.10-3.40 for (CNTP) and (WAG) while the sugar °brix ranged from 69.80-79.50° brix. The titratable acidity of the samples ranged from 1.03-1.06 g/ml for pineapple-turmeric jam (PIT) and (CNTP).The TSS/TTA ratio was 52.88 and 5.39 for (CNTP) and (WA) respectively. The antioxidant properties of the sample ranged between 31.39-50.67% for (WA) and (PIG). Total phenolic content was 0.14-0.25 MM GAE/ 100 ml for watermelon jam (WA) and (PIT). The L*, a* and b* values for the samples ranged from 23.23-33.16, 1.05-6.69 and 3.35-13.55. The result for sensory scores of the spiced jams ranged from 5.66-7.98 and 6.20-7.88 for color and taste respectively while the mouth feel was 5.05-7.46. The overall acceptability scores ranged from 6.40-7.90. Conclusively, pineapple and watermelon jams spiced with ginger and turmeric were nutritious and acceptable, however pineapple-ginger jam was most nutritious and acceptable, hence, pineapple-ginger jam can be utilized as functional food and can also contribute to the enhancement of Nigeria food composition database.

Keywords: Fruit jams; Spiced; Physicochemical; Antioxidant; Total phenolic

INTRODUCTION

Commonly consumed fruits are usually surplus in Nigeria in their various seasons however; more than 50% are lost due to the perishable nature of fruits occasioned by high moisture content, poor post-harvest handling and marketing strategies. In some countries like the Caribbean and the Pacific, transformation of fruits into juices, jams and chutneys have reduced spoilage and have formed the basis for lucrative value chains (CTA, 2012). Tropical fruits have been used to develop many products which have gained global significance over time due to their characteristic exotic aroma and colour. There are a number of these fruits readily available for utilization, including orange, grape, pineapple, banana, guava and watermelon. The

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use of these fruits depends on the intended product (juice, drink, jam etc.). Fruits possess antioxidant potentials as they often serve as scavengers of free radicals in the body system, thus preventing oxidative damage. The attention of scientists has been focused on the role of oxidative stress in development of many diseases [1]. Free radicals generation is considered to be the main cause of oxidative stress, which further leads to damage of lipids, proteins and nucleic acids. This can cause development of many degenerative diseases, such as cardiovascular and nervous system disorders, cataract, arthritis, immune system malfunction, different forms of inflammation and many malignant diseases. Antioxidants, which can inhibit or delay substance oxidation in chain reactions could be significant for prevention of these diseases [2]. Large amounts of these antioxidants could be found in different kind of fruit and vegetables, and a diet rich in antioxidants could significantly reduce the occurrence of mentioned diseases.

Watermelon (Citrullus lanatus) is a popular staple summer fruit in the world which is consumed frequently as a dessert, fruit salad and used in garnishing drinks. It is a natural source of antioxidants. Water melon is an unusual fruit source of the carotenoid lycopene and a rich source of phenolic antioxidants. It contains cucurbitacin E, a triterpene anti-inflammatory phytonutrient and unusual amounts of the amino acid citrulline. Water melon is an excellent source of immune-supportive vitamin C. It is also a very good source of vitamin A [3]. In addition, water melon is a good source of potassium and magnesium. The nutritional profile of water melon is full array of nutrients, including carbohydrates, sugar, soluble and insoluble fiber, sodium, vitamins, minerals, fatty acids, amino acids etc.

Pineapple (Ananas comosus L.) is a fruit which belongs to the Bromeliaceae family. This fruit is cultivated in most tropical and subtropical countries. Pineapple has widely been consumed as jam, jelly, juice, as a dried product, or as fresh fruit. Pineapple is a rich source of vitamin A, B, and C as well as the minerals calcium, phosphorous, and iron [4]. The bioactivity of this fruit is due to the presence of compounds such as polyphenols and ascorbic acid, which contribute to the antioxidant activity of the fruit extract. Study has shown that pineapples contain flavonoids, phenolic compounds, namely the quercetin, flavones-3-ol, flavones, p-coumaric acid and ferulic acid and vitamin C. Jam is a semi-solid food product, obtained upon cooking of fruits or vegetables pulp with sugar, citric acid and pectin. Jam can be defined as an intermediate moisture food prepared by cooking sugar with fruit pulp, pectin, acid and other ingredients to a sensibly consistency. Jams are one of the most popular food products because of their low cost, all year long availability and organoleptic properties. Traditionally, jam was produced as an effort to preserve fruits during off-season for consumption and it must consist a total soluble content of 45°C Brix and at least 40 % fruit content [5].

To our knowledge, the nutritional and antioxidant contents of fruit jam spiced with ginger and turmeric pulp consumed in Nigeria are not yet documented hence, the objective of this research work was to produce functional jam from watermelon and pineapple spiced with ginger and turmeric and determine its proximate, physicochemical, antioxidant and sensory characteristics [6,7].

MATERIAL AND METHODS

Preparation of fresh ginger and turmeric rhizome juice

Freshly harvested ginger and turmeric rhizomes were washed and cleaned by removing all the dirt and impurities. After peeling, the ginger, turmeric and rhizomes were cut into small pieces for the extraction of juice through juice extractor. The obtained juice was then filtered through muslin cloth to obtain clear juice [8].

Jam preparation

A modified method described by was adopted for this purpose. The fruits were washed with potable water to remove surface contamination, cut and peeled manually. They are immediately packaged and frozen (-18°C) until further processing into jam. The thoroughly washed, peeled fruits were separately blended in a blender (Sumeet Food Processor, Model A). Jams were prepared in laboratory conditions under ambient temperature. The jam formulation was fruits (1000 g), sucrose (470 g), methoxyl pectin (Danisco Ingredients, Denmark) (10 g) and citric acid (4 g). Citric acid was used for adjusting pH values for proper pectin gelatinisation (pH necessary for gelatinisation was 2.8-3.3). Fruit blended with larger part of sucrose, citric acid, ginger and turmeric juice at 5 % level were mixed and thermally processed at 80°C for 20 min. Pectin was mixed with part of sucrose and added at the final stage of the jam processing. Fruit jams were cooked until the final product contained 68 °brix. When the processed mass reached 68 °brix, the jams were filled into hot glass jars, capped and pasteurized at 80°C for 10 min [9]. They were allowed to cool at room temperature and stored in the dark at 20 until analysis. The blending ratio of the fruits and the spices is shown in Table 1. WA- WAG- Watermelon-ginger jam PIG-Pineapple-ginger jam

WAT-Watermelon-tumeric jam PIT-Pineapple-turmeric jam

WAGT- Watermelon-ginger-tumeric jam PIGT-Pineapple-ginger-tumeric jam

Watermelon jam PI- Pineapple jam

Samples	Watermelon	Pineapple	Ginger	Tumeric
WA	100	-	-	-
WAG	95	-	5	-
WAT	95	-	-	5
WAGT	95	-	5	5
PI	-	100	-	-
PIG	-	95	5	-
PIT	-	95	-	5

PIGT	-	95	5	5

Table 1: Watermelon-pineapple-ginger-tumeric jam blends formulation.

Determination of dry matter and moisture content

About 2 ml of each sample was measured into a previously weighed crucible, dried over water for sometimes. The crucible plus sample taken was transferred into the oven set at 1000°C to dry to a

Content weight for 24hr. After this, the crucible plus sample was removed from the oven and transfer to the desiccator, cooled for ten minutes and weighed (AOAC, 2006). The weight of empty crucible is W0; the crucible plus sample was W1while the weight of crucible plus oven dried sample was W3 [10].

Determination of carbohydrate content

Carbohydrate content of the sample was expressed as a percentage of the difference of the difference between the addition of other chemical composition and 100.

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

Determination of the physicochemical properties of the jam

Determination of pH: The pH was determined using a glass electrode pH meter (TS 625, UK). The pH meter was calibrated with buffers at pH 4.0 followed by pH 7.0. The glass electrode was placed into the filtrate to measure the pH and stabilized reading was recorded. For accuracy of the reading, the glass electrode was washed after each reading with distilled water and wiped to dry with soft tissue paper [11].

Determination of titratable acidity: The titratable acidity of jam was determined according to AOAC (2006). Ten gram of fresh watermelon jam sample was taken in a 500 ml beaker and homogenized with distilled water in a blender (MX-798S, National, Malaysia). The blender materials were then filtered and transferred to a 500 ml volumetric flask and the volume was made up to the mark with distilled water. Five milliliters of the pulp solution was taken in a conical flask. Two to three drops of phenolphthalein indicator solution was added and then the conical flask was shaken vigorously. It was then titrated immediately with 0.01N NaOH solution from a burette till the permanent pink color appeared [12].

Determination of brix: The brix content in the jams were determined using the hand held refractometer (Bellingham and Stanly, Model A85171). The prism of the refractometer was cleaned and a drop of each of the samples were placed on the prism and closed. The sugar content (soluble sugar) of each sample was read in triplicates from the scale of the refractometer at 20 when held close to the eye.

Determination of viscosity: Modified method of Awolu et al., (2013) was used to determine the viscosity of the sample. Viscosity was analyzed using Rion-viscotester, model VA-04F. The heated jam samples were poured into the viscometer cup, the rotor was suspended into the sample to rotate and the values were determined in decipascal-second unit at varying temperatures of 30, 40 and 50°C .

Determination of color parameters: Measurement of upper surface color was carried out with the use of Konica MINOLTA CM-3500d equipment (Konica Minolta Inc., Tokyo, Japan) with reference to illuminant D65 and a visual angle of 10°. The results were expressed using the CIE system (CIE, 2004). The established color parameters were as follows: (lightness) 0 is black, and 100 is white; redness (+) greenness (-); yellowness (+) blueness (-); and the color saturation value (chroma) as well as the hue angle [13].

RESULTS AND DISCUSSION

Physicochemical properties of spiced jam from blends of selected tropical fruits

The physicochemical properties of the jams is shown in Table 1. The pH value of the watermelon-ginger jam (3.40) was significantly higher that of the reference jam (3.10). This values was slightly lower than the value of (3.95) for pineapple jam as reported by Fasogbon et al., (2013). However, the values obtained in the study was within the range reported by Gonzalez et al., (2010) for Kiwi and orange marmalade (3.04-3.68). The low pH obtained from the study is desirable as low pH has been reported to retard some specific bacteria growth. There was a significant ($p< 0.05$) difference among the jam samples. Watermelon-tumeric jam (WAT) has the highest sugar brix of 79.50 °brix while the reference sample (CNTP) has the lowest value of 69.80°C brix. The sugar brix for watermelon-ginger-tumeric jams (WAGT), pineapple-ginger jam (PIG) and pineapple-tumeric jam (PIT) were 70.25, 77.27 and 72.25°C brix respectively. These values were within the range of 70.50 °brix for mixed jam of pawpaw and pineapple as reported by (Singh et al., 2009) as well as mixed jams of pawpaw and orange 72.50 °brix by Lago et al., (2006). A total soluble solid content lower than 60°C brix make the gel weak whereas a total soluble solid content higher than 70 °brix may cause crystallization of sugar which can result to undesirable changes in the texture of the jam. The total titratable acidity of the jams showed no significant ($p> 0.05$) difference. The values for total titratable acidity ranged from 1.03 to 1.06 g/ml for watermelon-ginger-tumeric jam (WAGT) and pineapple jam (PI). The value of total titratable acid for all the jam samples in the study was within the range of 1.03 g/ml for pineapple jam as reported by Fasogbon et al., (2013). The variation in the value of titratable acidity of the sample may be attributed to the difference in the acid content of the fruits used in the development of the jams. The ratio of sugar brix to the titratable acidity for watermelon-tumeric jam (WAT) was 75.71 while the reference jam (CNTP) was 66.48 [14,15] The ratio of total soluble solid to total titratable acidity is a quality index related to the sweetness of jam products. The ratio values observed in the study indicates that the products present a more pronounced sweetness which invariably affect the consumer's acceptability. The viscosity of the jams showed a reducing trend as the temperature increases. For instance, the watermelon jam (WA) showed values of 107.75, 110.11 and

90.00 cp at 30, 40 and 50°C respectively. The viscosity of jams in the present study has shown that it flowability of the jam occurred best at 50°C [16] Flow behaviour and rheological properties are associated to the quality of jam which are highly considered in commercial manufacturing. Therefore, it is important to maintain them as a quality check during manufacturing (Figure 1).

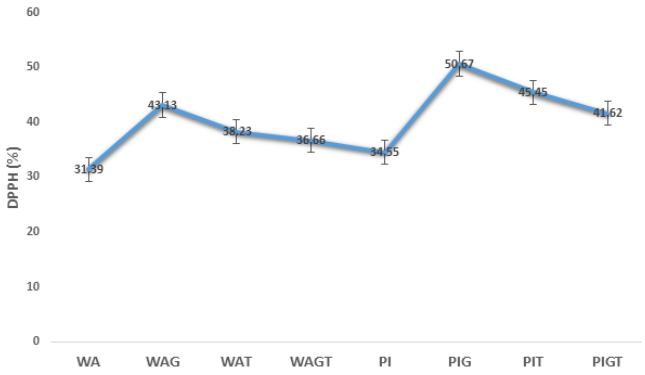

Figure 1: Antioxidant activity of the spiced jam.

WA- Watermelon jam PI- Pineapple jam

WAG- Watermelon-ginger jam PIG-Pineapple-ginger jam

WAT-Watermelon-tumeric jam PIT-Pineapple-turmeric jam

WAGT- Watermelon-ginger-tumeric jam PIGT-Pineapple-ginger-tumeric jam

Sensory properties of the spiced jam

The sensory properties of the spiced jam is shown in figure 1. Pineapple-ginger jam (PIG) has the highest preference for color with a mean score of (7.98) while the watermelon-ginger jam (WAG) with a mean score of (7.70) was the second highest. There was a marked difference between the color of other jams and the reference sample (CNTP) with a mean score of (5.60). With regards to color, the reference sample without the addition of ginger may be undesirable. Pineapple-ginger jam (PIG) and watermelon jam (WAG) has the highest preference for taste with a mean scores of (7.88) and (7.56) respectively. However, a significant ($p<0.05$) differences were observed amongst all other jam samples including the reference sample [9]. With regards to the mouthfeel, there were significant differences observed amongst the jam samples. The mouthfeel is a textural sensory attribute that describe the smoothness or generally how the samples feels in the palate of the assessor. Pineapple-ginger jam (PIG) has the highest preference with a mean score of (7.46) while watermelon-ginger jam (WAG) followed as the second highest with a mean score of (7.05) and the reference jam sample has the least mean value of (5.05). In terms of the overall acceptability, the pineapple-ginger and watermelon-ginger jam samples have a mean score of (7.9) and (7.8) respectively as compared to reference sample with a mean score of (6.4), hence it can concluded that pineapple-ginger jam was more acceptable and this has shown that it will be accepted when introduced into the market [16].

CONCLUSION

The study revealed that production of pineapple-ginger jam has more nutritional quality from the point view of the proximate, physicochemical and antioxidant composition results. It was equally generally accepted by the sensory assessors, hence, optimal utilization of pineapple and ginger for jam production would improve the health status of the consumers.

AUTHOR'S CONTRIBUTIONS

AOA- Conceptualization, supervision, methodology, data collation, writing the original draft and editing.

AAO- Conceptualization, supervision, writing the review and editing.

EOO- Sensory analysis and editing

CONFLICTS OF INTEREST

The authors declare no conflict of interest

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