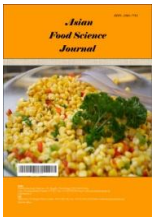

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Extraction of Mango Juice with Pectinase Influences Quality

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Authors' contributions

This work was carried out in collaboration among all authors. Author OEA supervised and wrote the manuscript. Author AOAO conducted the practical. Author MOO analyzed the data statistically and author EAA read through the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The production of mango juice is usually characterized with high percentage of pulp which is conventionally reduced with enzymatic treatment in processing. The use of pectinase in fruit juice processing however has not been fully explored in Nigeria. Therefore, this study investigated the effect of pectinase on the yield and some quality attributes of juice produced from mango varieties. Two varieties of mango (Ogbomoso and Sherry) fruits were locally procured. Juices were produced from each of the fruits and pectinase powder or liquid was added at three different concentration levels (0.25, 0.5 and 0.75 g – powdered; 1, 2 and 4 ml - liquid) while juices without pectinase served as control. The yield, physicochemical composition and microbial analyses were carried out. Sensory evaluation was also carried out on the juice. The study showed that 0.75 g pectinase addition increases the yield of mango juice, with improved physicochemical composition and with high acceptability.

Keywords: Pectinase; mango juice; physicochemical composition.

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1. INTRODUCTION

Although, mangoes have high nutritional values but they are highly perishable. Preservation and production into juice helps to reduce their post-harvest loss. The production of mango juices is characterized with high percentage of pulp and post-harvest loss. According to [1], by-products of industrial mango processing may amount to 35-60% of the total fruit weight, while the edible pulp makes up 33-85% of the fresh fruit [2].

In Nigeria, adequate preservation is one of the greatest problems which are militating against local juice processing. However, efficiency of crude enzymatic extract in the extraction of mango juice has been evaluated, with improving yield up to 79% [2]. Hence, there is a need for such investigation of mango fruit juice in Nigeria. The challenge is getting an acceptable product which will add value to mango in order to increase its usability and to reduce production losses. In general, enzymes have a disadvantage in that they are deactivated due to heat-induced structural changes or, in the case of proteolytic enzymes, due to decomposition by themselves. It is therefore desirable to distribute and use enzyme preparations in the form of solids, such as powders and granules, instead of liquids [3]. Use of liquid enzyme (pectinase) has been employed in the processing of juice, but the use of powdered pectinase is yet to be fully exploited for juice clarification in Nigeria.

Traditionally, mango juice is produced by extracting the pulp and blending with water to make juice. Although mango juices produced this way have delicious and appealing taste, but they are pulpy in nature. However, clarification of mango juice using pectic enzymes is another alternative. The traditional simple pressing or centrifugation techniques involve use of excessive amounts of energy and results in meagre juice yield [4]. Recently as an alternative, enzymatic processing is being employed particularly pectinolytic enzymes which are effectively utilized in fruit processing industry. Because it makes the juice not only clear by breaking down the pectin and allowing the suspended particles to settle down, but also eliminate undesirable changes in colour, bouquet and stability [5]. Thus, this research investigated the use of pectinase (powdered and liquid) for production of two different varieties of clarified mango juice and evaluated the physicochemical qualities and sensory attributes. By employing the use of pectinase for mango juice in Nigeria, consumption of mango and its juice can be increased and the rate of deterioration reduced drastically. Also, availability of the juice all year round will be greatly enhanced.

2. MATERIALS AND METHODS

2.1 Materials

Two varieties of (2) of mango (Ogbomoso and Sherry) used in this study were obtained from Nigeria institute of Horticultural Research (NIHORT) Jericho, Ibadan, Nigeria. Pectinase enzyme used (liquid) was obtained from Federal Institute of Industrial Research Oshodi (FIIRO), Lagos, Nigeria. Also, the powdered pectinase enzyme was purchased at Amazon.com. Portable and sterilized water was obtained and the processing and analysis was carried out at Food Science and Engineering Departmental Laboratory, LAUTECH Ogbomoso, Nigeria.

2.2 Production of Mango Juice

Two varieties of mango (sherry and Ogbomoso mango) fruits were obtained and sorted based on colour and blemish. The fruits without blemish were thoroughly rinsed with water. The cleaned fruits were peeled manually using knives. These peeled fruit were rinsed again with mild solution of meta-bisulphate solution (75 ppm). The mesocarp was then removed off the seed manually using knife. The removed mesocarp was sliced, diced, blended and later poured into a clean bowl. The obtained pulp was sieved using muslin cloth and a clear solution of juice was obtained. Each fruit juice was divided into portion, and different concentration of liquid or powdered pectinase was introduced to each portion (Table 1). Each juice produced was packed in sterile plastic bottles of 30 ml in high tensile stretchable strength that can with stand pasteurization at 80^{o}C for a period of 7 minutes. The juices were allowed to cool and subjected to analysis (Fig. 1).

2.3 Analysis

2.3.1 Chemical analysis of samples

The pH value of the each sample was measured using a pH meter and the titratable acidity (TTA) was determined using the standard methods. Both pH and TTA were determined by the methods as described in AOAC [7]. The total soluble solids was carried out by using the glass slide of the refractometer (Atago hand

Table 1. Experimental design

Sample	Treatment					
	Liquid pectinase(ml)			Powdered pectinase(g)		
Ogbomoso	1.0	2.0	4.0	0.25	0.5	0.75
Sherry	1.0	2.0	4.0	0.25	0.5	0.75

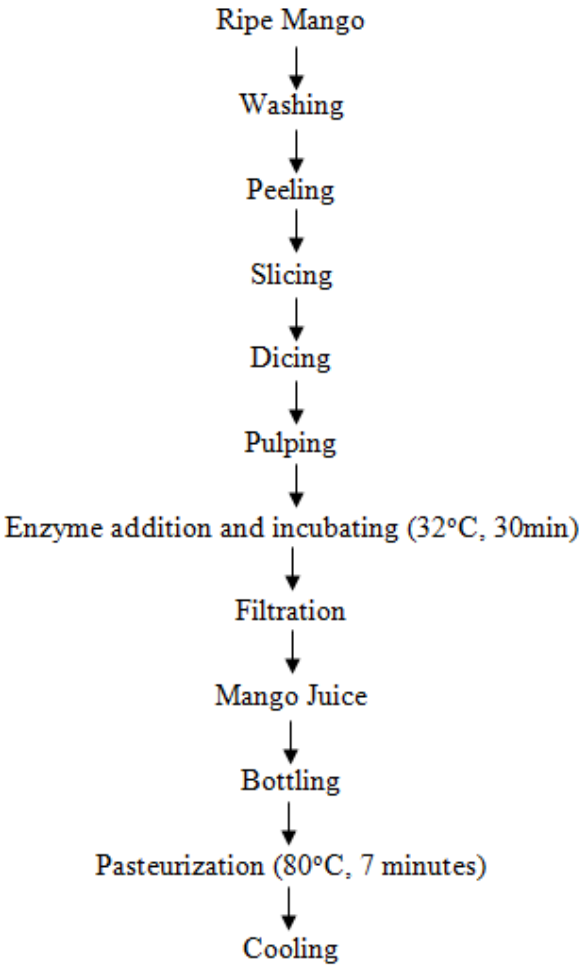

Fig. 1. Flow chart of mango juice production with enzyme [6]

refractometer N_1, 0-32%) and this was recorded in degree brix (^{o}brix) [6]. The reducing sugar was determined using phenol sulphuric acid as modified from McCready [8] and Dubois et al. [9]. The vitamin C content of the samples was extracted with 0.5 per cent oxalic acid and measured by titration with 2, 6-dichlorophenolindophenol [10] while vitamin A content of the sample determined by the method of Anthony and Egbuon [11]. Colour was determined with colorimeter after an initial standardization using distilled water at a wavelength of 600 nm [12]. All analyses were done in triplicates and readings were expressed as average values.

2.3.2 Microbiological analysis

Microbial analyses were Total viable count, yeast count, mould count and Escherichia coli. Total viable count (TVC) was determined using nutrient agar media and distilled water as the diluent by pour plate method, while yeasts and molds count was done in potato dextrose agar [13]. Escherichia coli was enumerated in MacKonkey broth according to AOAC [7] method.

2.3.3 Sensory evaluation

Sensory evaluation was performed by nine point hedonic scoring test by panelists which consists of the staff and students of the Department of Food Science and Engineering, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria to check the qualities like sweetness, appearance, flavor, texture aroma colour and general acceptability. The nine point hedonic scale ratio employed was from 0 to 9 where (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 data was subjected to the test and analysis of variance to check for significance difference between the samples [14].

2.4 Statistical Analysis

The results of the experiment was subjected to analysis of variance (ANOVA) and the mean was separated with the use of Duncan's multiple range test to detect significant difference ($p<0.05$) among the sample values using the statistical package for the social science (SPSS).

3. RESULTS AND DISCUSSION

3.1 Physicochemical Results of Juices Produced from Pectinase Enzyme

The chemical properties of both Ogbomoso and sherry mango juice samples are presented in Table 2. These include the pH, Total Titratable acidity, Brix, Reducing Sugar, Colour, Vitamin A and Vitamin C.

3.2 pH and Total Titratable Acidity (Ogbomoso and Sherry Mango Juice)

The pH value is used to measure the hydrogen ion concentration of a sample. It is defined as a measure of the acidity or alkalinity of the solution of a sample [15]. In this work, the pH of the juice samples of Ogbomoso is ranged from 2.89 - 3.77 while the pH of sherry mango juice is ranged from 3.24 - 3.74. Significant differences ($P<0.05$) were observed in all the samples. It also showed that the pH of Ogbomoso and sherry mango juices increases significantly ($P<0.05$) with increasing level of enzyme addition for both liquid and powdered enzyme. The acidity is important factor in determining the quality of fruit juice, it contributed to the development of flavor by maintaining proper sugar-acid ration, and it provides a thirst generating effect by encouraging saliva formation in the mouth [16]. The ogbomoso and sherry mango juice with liquid enzyme at higher concentration gave the highest pH.

Table 2 presents total titratable acidity (TTA) values of both Ogbomoso and sherry mango juice. The values for Ogbomoso mango juice ranged from 2.84 – 5.63%, while that of sherry mango ranged from 3.19 – 5.84. The ogbomoso mango juice with the highest concentration powdered pectinase recorded the lowest value of 2.84% while both variety of mango juice with highest concentration of pectinase enzyme gave the highest values. They however did not follow a particular pattern of increases or decreases with enzyme addition.

3.3 Brix

Brix was taken up by the hand refractometer to achieve the desired consistency. Usually, it is defined based on juice weight. Brix is important in juicing and consistency of products as well as juice application. In this study, the brix (Table 2) of mango juice samples of liquid enzyme of both Ogbomoso mango and sherry mango ranged between 11.08 - 12.88; and 11.58 - 13.27, respectively. However, the Brix value of Ogbomoso mango juice without enzyme is 11.08 while that of sherry mango juice without enzyme is 11.58. It was observed that Brix value increased with the addition of different enzyme concentration for both the liquid and powdered enzyme. This increase may be due to the different enzyme concentration as reported by Vishal et al. [17].

According to Rane et al. [18] the higher brix means higher nutrient density (assumption), better taste (widely acknowledged), resistance to rotting, resistance to disease, resistance to frost, that is higher quality. Hence the higher the enzyme concentration the better the quality of juice produced in all cases [18].

3.4 Reducing Sugar

The contents of reducing sugars were high in the Ogbomoso mango juice when compared with both sherry mango juice and without pectinase enzyme ($P \leq 0.05$). The mean of reducing sugar content of Ogbomoso mango juice were ranged from 1.28µg – 4.78µg while the sherry mango juice ranged from 2.53 - 4.85µg at the three concentration levels. However, the increases observed in both varieties with increasing level of

enzyme addition show that the sucrose might have been hydrolyzed, and it mainly depends on the conversion of sucrose in the presence of citric acid or any other organic acid [17].

3.5 Vitamin C and Vitamin A Content

Fruits are valuable chiefly for their vitamin and mineral contents and almost all fruits contain significant amount of vitamin C [19]. As shown in Table 2, the vitamin C of the Ogbomoso mango juice ranged from between 125.00 to 191.98 mg/100g with sample without enzyme recording the highest value of 191.98 mg/100g while sample of 0.5 g of powdered pectinase had the lowest value of 125.00 mg/100g. It was observed that the vitamin C decreased slightly with increased addition of enzyme concentration. For instance, the sample with lowest value which is ogb-P-2 still retained about 65% of the vitamin C while sample treated with enzyme that had the highest vitamin C content (ogb-L-2) retained about 88% of its vitamin C content from the control. This decrease may be due to the different enzyme concentration of enzyme used [20]. Ascorbic acid stability in fruit processing has been reported to depend on several factors like pH, Oxygen availability and also the presence of catalyst. In other words, ascorbic acid degradation could be possible due to light and enzymatic activity to which product is exposed [10]. The oxygen, which is present in the hand space of the packed product, might have dissolved in the juice or juice concentrate can cause ascorbic acid degradation. The other factor for the degradation of ascorbic acid is the influence of temperature exerted at the time of processing and also the storage temperature of product [21].

For the sherry mango variety, the juice vitamin C content ranged from 184.38 - 111.26 mg/100g. It was observed that sherry mango had lower vitamin C content when compared with Ogbomoso mango variety. Similar trend was noticed with the increasing level of enzyme concentration treatment, that is, the higher the enzyme concentration, the lower the vitamin C content. However, more than 60% was retained for all the treated samples. Therefore, the addition of enzyme at different concentrations had impact on the juice produced from both Ogbomoso and sherry mango. From Table 2, values of vitamin A observed in Ogbomoso mango juice value ranged from 20.22 µg/100g to 52.84 µg/100ml while that for sherry mango ranged from 18.89 – 42.77 µg/100ml. All the juice samples at different concentration of enzyme had lower vitamin A content compared with the control.

3.6 Colour

The colour was measure using spectrophotometer method and the colour quality in Ogbomoso and Sherry Mango juice is as shown in Table 2. The range values of Ogbomoso mango juice were 1.13-1.89 while that of Sherry mango were range from 1.18-1.51. There were significant differences ($P \leq 0.05$) among samples. The control samples (juice without enzyme) had higher colour readings which decreased in values with enzyme addition and in concentration. Colour had been reported to be influenced by natural enzymes, oxidation of ascorbic acid and the maillard reaction, which depends on the content of reducing sugars, proteins, and temperature [22]. Differences in colour observed might probably be due to some changes in the pigments as influenced by the addition of enzyme for clarification of the juice and the presence of oxygen which enhances the conversion of phenols to quinines [23].

3.7 Microbial Load of Ogbomoso and Sherry Mango Juice Samples

Table 3 shows microbial load of all the mango juice samples. Total viable count for the juice samples were found to range from $1.1x10^6$ - $4.2x10^6$ and $1.29x10^6$ - $1.64x10^6$ Cfu/ml for Ogbomoso and sherry mango juice respectively. The values for yeast ranged from $2.0x10^6$ - $9.2x10^6$ and $1.0x10^6$ - $2.0x10^6$ Cfu/ml while those for mould ranged from $1.45x10^6$ - $8.0x10^6$ and $1.0x10^6$ - $5.2x10^6$ Cfu/ml for Ogbomoso and sherry mango juice respectively. Some of the samples showed no growth for total viable count (Ogb– P – 1, Ogb– P – 3, Sh – P – 1, Sh – P – 3); yeast (Ogb– L – 2, Ogb– P – 3, Sh – L – 1, Sh – P – 3), mould (Ogb– L – 2, Ogb– P – 3, Sh – N, Sh – P – 1, Sh – P – 2). Generally, none of the samples had E.coli which means they are all free from faecal contamination and safe for consumption.

3.8 Sensory Evaluation of Mango Juice

Samples of the mango juice Ogbomoso and Sherry with liquid, powdered enzymes and without enzyme were subjected to sensory evaluation as presented in Table 4. The evaluation were done for, colour, Aroma, texture, taste, sweetness and overall acceptability.

Table 2. Effect of enzyme treatment on some chemical properties of Juices produced from Mango fruits

Treatment		pH	Total titritable acidity (%)	Brix (^oC)	Reducing sugar (µg)	VitaminC (mg/100ml)	Vitamin A(µg/100ml)	Colour
Mango	**Conc**							
Ogb - N	0	3.74±0.07^{f}	4.72±0.11^{d}	11.08±0.03^{a}	1.28±0.06^{a}	191.98±1.58^{g}	44.89±0.07^{h}	1.89±0.08^{f}
Ogb– L – 1	1ml	3.42±0.13^{d}	4.80±0.02^{d}	11.68±0.41^{b}	3.19±0.03^{e}	156.27±6.04^{d}	30.56±1.10^{e}	1.71±0.04^{e}
Ogb– L – 2	2ml	3.55±0.05^{de}	5.09±0.02^{ef}	12.88±0.02^{f}	2.11±0.11^{b}	168.32±1.23^{e}	24.04±1.28^{cd}	1.58±0.03^{d}
Ogb– L – 3	4ml	3.77±0.03^{f}	5.63±0.03^{g}	12.82±0.07^{f}	4.50±0.10^{i}	132.30±0.79^{c}	20.22±0.28^{a}	1.50±0.06^{c}
Ogb– P – 1	0.25g	2.89±0.14^{a}	5.20±0.08^{f}	11.58±0.08^{b}	2.83±0.10^{d}	133.71±2.20^{c}	52.84±0.60^{j}	1.18±0.02^{a}
Ogb– P – 2	0.5g	3.06±0.02^{b}	4.13±0.06^{c}	12.14±0.02^{c}	3.42±0.05^{ef}	125.00±2.50^{b}	48.73±1.14^{i}	1.14±0.01^{a}
Ogb– P – 3	0.75g	3.71±0.09^{f}	2.84±0.01^{a}	12.44±0.02^{de}	4.78±0.15^{h}	166.76±4.10^{e}	42.47±1.99^{fg}	1.13±0.02^{a}
Sh - N	0	3.66±0.07^{ef}	4.77±0.05^{d}	11.58±0.08^{b}	2.53±0.12^{c}	184.38±1.10^{f}	42.77±0.61^{g}	1.51±0.03^{c}
Sh – L – 1	1ml	3.55±0.01^{de}	5.06±0.02^{e}	12.14±0.02^{c}	4.39±0.02^{h}	134.63±2.23^{c}	40.36±1.17^{f}	1.41±0.04^{b}
Sh – L –2	2ml	3.68±0.08^{ef}	4.84±0.01^{d}	12.44±0.02^{de}	4.02±0.11^{g}	159.44±1.35^{d}	22.47±2.00^{bc}	1.35±0.05^{b}
Sh – L – 3	4ml	3.74±0.09^{f}	5.84±0.04^{h}	12.57±0.03^{e}	4.44±0.10^{h}	123.80±1.51^{b}	21.04±1.81^{ab}	1.37±0.04^{b}
Sh – P – 1	0.25g	3.24±0.12^{c}	3.31±0.17^{b}	12.22±0.22^{cd}	3.49±0.36^{f}	125.59±3.68^{b}	40.36±1.28^{f}	1.14±0.03^{a}
Sh – P – 2	0.5g	3.47±0.07^{d}	3.19±0.07^{b}	12.87±0.14^{f}	3.66±0.20^{f}	114.46±2.06^{a}	26.06±1.76^{d}	1.17±0.02^{a}
Sh – P – 3	0.75g	3.64±0.06^{ef}	3.22±0.18^{b}	13.27±0.16^{g}	4.85±0.12^{i}	111.26±0.94^{a}	18.89±0.25^{a}	1.18±0.03^{a}

Values are expressed as mean ± standard deviation of duplicate determination. Mean with the same superscript along the same column are not significantly different (p>0.05)
Ogb - N = Ogbomoso mango + No Enzyme; Ogb – L – 1 = Ogbomoso mango + Liquid enzyme at 1 ml; Ogb – L – 2 = Ogbomoso mango + Liquid enzyme at 2 ml Ogb – L – 3 = Ogbomoso mango + Liquid enzyme at 4 ml; Ogb – P – 1 = Ogbomoso mango + Powdered enzyme at 0.25 g; Ogb – P – 2 = Ogbomoso mango + Powdered enzyme at 0.5 g; Ogb – P – 3 = Ogbomoso mango + Powdered enzyme at 0.75 g; Sh - N = Sherry mango + No Enzyme; Sh – L – 1 = Sherry mango + Liquid enzyme at 1 ml; Sh – L – 2 = Sherry mango + Liquid enzyme at 2 ml; Sh – L – 3 = Sherry mango + Liquid enzyme at 4 ml; Sh – P – 1 = Sherry mango + Powdered enzyme at 0.25 g; Sh – P – 2 = Sherry mango + Powdered enzyme at 0.5 g; Sh – P – 3 = Sherry mango + Powdered enzyme at 0.75 g

Table 3. Microbial load of Ogbomoso and Sherry mango juice produced with liquid and powdered Enzyme (cfu/ml)

Treatment		TVC	Yeast	Mould	*E. coli*
Mango	**Conc**				
Ogb - N	0	$1.1x10^6$	$6.0x10^6$	$4.2x10^6$	NG
Ogb– L – 1	1ml	$1.16x10^6$	$6.6x10^6$	$1.45x10^6$	NG
Ogb– L – 2	2ml	$1.86x10^6$	NG	NG	NG
Ogb– L – 3	4ml	$2.60x10^6$	$9.2x10^6$	$4.0x10^6$	NG
Ogb– P – 1	0.25g	NG	$2.0x10^6$	$8.0x10^6$	NG
Ogb– P – 2	0.5g	$4.2x10^6$	$2.0x10^6$	$2.16x10^6$	NG
Ogb– P – 3	0.75g	NG	NG	NG	NG
Sh - N	0	$1.9x10^6$	$1.46x10^6$	NG	NG
Sh – L – 1	1ml	$1.64x10^6$	NG	$2.16x10^6$	NG
Sh – L –2	2ml	$1.29x10^6$	$1.00x10^6$	$5.2x10^6$	NG
Sh – L – 3	4ml	$1.85x10^6$	NG	$1.00x10^6$	NG
Sh – P – 1	0.25g	NG	$2.0x10^6$	NG	NG
Sh – P – 2	0.5g	$2.0x10^6$	$2.0x10^6$	NG	NG
Sh – P – 3	0.75g	NG	NG	$3.2x10^6$	NG

NG=No growth; TVC =Total viable count; Ogb - N = Ogbomoso mango + No Enzyme; Ogb – L – 1 = Ogbomoso mango + Liquid enzyme at 1 ml; Ogb – L – 2 = Ogbomoso mango + Liquid enzyme at 2 ml; Ogb – L – 3 = Ogbomoso mango + Liquid enzyme at 4 ml; Ogb – P – 1 = Ogbomoso mango + Powdered enzyme at 0.25 g; Ogb – P – 2 = Ogbomoso mango + Powdered enzyme at 0.5 g; Ogb – P – 3 = Ogbomoso mango + Powdered enzyme at 0.75 g; Sh - N = Sherry mango + No Enzyme; Sh – L – 1 = Sherry mango + Liquid enzyme at 1 ml; Sh – L – 2 = Sherry mango + Liquid enzyme at 2 ml; Sh – L – 3 = Sherry mango + Liquid enzyme at 4 ml; Sh – P – 1 = Sherry mango + Powdered enzyme at 0.25 g; Sh – P – 2 = Sherry mango + Powdered enzyme at 0.5 g; Sh – P – 3 = Sherry mango + Powdered enzyme at 0.75 g

Table 4. Sensory evaluation of juice produced from Ogbomoso and Sherry mango varieties

Treatment		Colour	Aroma	Texture	Taste	Sweetness	Overall Acceptability
Mango	**Conc**						
Ogb - N	0	7.58±1.24^{d}	8.33±0.89^{a}	8.1 +0.79^{f}	8.0 ±1.0^{b}	7.67 ±1.15^{b}	5.67 ± 2.38^{a}
Ogb– L – 1	1ml	7.5± 1.39a	7.5+1.25^{c}	7.33 ± 1.17^{c}	7.42±2.1^{a}	8.33 ± 0.9^{c}	7.75 ± 1.65^{a}
Ogb– L – 2	2ml	7.17±1.15^{c}	7.42±1.51^{c}	7.67 ± 1.44^{c}	7.25±2.0^{a}	8.0 ± 1.85^{c}	7.41 ± 1.16^{a}
Ogb– L – 3	4ml	6.5 ± 1.0^{b}	7.08±1.16^{e}	7.0 ± 1.27^{c}	7.17±1.2^{a}	7.92 ± 1.08^{c}	6.42 ± 1.31^{a}
Ogb– P – 1	0.25g	7.08±1.24^{c}	8.17±1.19	7.5 ± 1.17^{d}	7.5 ±0.9^{g}	8.17 ± 1.03^{f}	7.08± 1.62^{d}
Ogb– P – 2	0.5g	7.25±1.22^{c}	8.17±0.84^{d}	8.0 ± 0.74^{d}	7.5 ±0.9^{g}	7.58 ± 1.03^{f}	7.66 ± 1.43^{d}
Ogb– P – 3	0.75g	7.0 ±1.21^{c}	8.33±0.89	6.67 ± 0.89^{d}	7.92±0.9^{g}	8.17 ± 1.03^{f}	7.25 ± 1.71^{d}
Sh - N	0	7.83±1.11^{d}	8.08±0.79	7.33±1.50^{f}	8.25±1.2^{b}	8.17 ± 1.11^{b}	5.67 ± 1.83^{a}
Sh – L – 1	1ml	6.83±1.03^{b}	7.25±1.14^{f}	6.17 ± 1.27^{b}	6.83±1.3^{c}	7.67 ± 1.57^{e}	6.75 ± 1.60^{c}
Sh – L –2	2ml	7.0 ±0.95^{b}	7.0 ± 1.76^{f}	6.83 ± 0.94^{b}	6.66±1.2^{c}	7.50 ± 1.31^{e}	6.83± 1.85^{c}
Sh – L – 3	4ml	6.91±1.37^{b}	6.18±1.54	6.82± 1.33^{b}	6.18±1.9^{c}	7.18± 1.17^{e}	6.18± 1.77^{c}
Sh – P – 1	0.25g	7.25±1.22^{a}	8.17±0.83^{c}	8.42 ± 0.67^{e}	7.5± 0.9^{h}	7.58 ± 1.08^{g}	6.92 ± 2.15^{e}
Sh – P – 2	0.5g	7.5 ±1.24^{a}	8.17±0.94^{c}	8.25 ± 0.62^{e}	7.75±0.9^{h}	8.17 ± 1.03^{g}	5.75 ± 2.34^{e}
Sh – P – 3	0.75g	7.75±1.14^{a}	8.17±0.94^{a}	8.17 ± 0.72^{e}	7.5 ±0.9^{h}	7.58 ± 1.08^{g}	5.25 ± 1.71^{e}

Values are expressed as mean ± standard deviation of duplicate determination. Mean with the same superscript along the same column are not significantly different (p>0.05) Ogb - N = Ogbomoso mango + No Enzyme; Ogb – L – 1 = Ogbomoso mango + Liquid enzyme at 1 ml; Ogb – L – 2 = Ogbomoso mango + Liquid enzyme at 2 ml; Ogb – L – 3 = Ogbomoso mango + Liquid enzyme at 4 ml; Ogb – P – 1 = Ogbomoso mango + Powdered enzyme at 0.25 g; Ogb – P – 2 = Ogbomoso mango + Powdered enzyme at 0.5 g Ogb – P – 3 = Ogbomoso mango + Powdered enzyme at 0.75 g; Sh - N = Sherry mango + No Enzyme; Sh – L – 1 = Sherry mango + Liquid enzyme at 1 ml; Sh – L – 2 = Sherry mango + Liquid enzyme at 2 ml; Sh – L – 3 = Sherry mango + Liquid enzyme at 4 ml; Sh – P – 1 = Sherry mango + Powdered enzyme at 0.25 g; Sh – P – 2 = Sherry mango + Powdered enzyme at 0.5 g; Sh – P – 3 = Sherry mango + Powdered enzyme at 0.75 g

Sensory scores showed that the value of colour for the Ogbomoso mango juice ranged from 7.58 – 6.5, with untreated sample having highest value and sample with highest concentration of liquid enzyme had lowest. Sherry mango juice sensory scores for colour however ranged from 7.83 (Sh-N) – 6.83 (Sh-L-1). Aroma values ranged from 8.33 – 7.08 and 8.17 – 6.18 for Ogbomoso and sherry mango juice respectively. It was observed that the values of texture ranged from 8.1 – 6.67 and 8.42 – 6.17 for Ogbomoso and sherry mango juice respectively, while the values for the taste and sweetness ranged from 8.0 – 7.17 and 8.25 – 6.18 for Ogbomoso and sherry mango juice respectively. Scores for sweetness however ranged from 8.33 – 7.58 for Ogbomoso mango juice and 8.17 – 7.18 for sherry mango juice. It was observed that Ogbomoso juice had range of 7.66 – 5.67 for overall acceptability while value of sherry juice range from 6.92 - 5.25. Generally, Ogbomoso mango juice was more acceptable by the panellist than the sherry mango juice.

4. CONCLUSION

The study revealed that a good functional drink, a product of juice from mango could be produced from ripe mango which may possess health benefits to individuals when consumed as either appetizer and or dessert in developing countries like Nigeria. This study showed that the use of powdered enzyme in the production of mango juice is the best alternative to facilitate smooth juice extraction with high quality.

The mechanism of the action is that pectinase degrades the polysaccharides materials present in the pulp, causing them to be broken down into smaller fractions and thus facilitating filtration. This process could also make juice to be available all year around.

The microbial stability of both ogbomoso and sherry mango juice revealed that all juice sample are free from feacal microorganism, which suggested that all samples are fit for consumption.

The sensory analysis revealed an overall acceptability of all the juices most especially Ogbomoso enzyme treated samples. Therefore, by employing the use of powder pectinase for mango juice in Nigeria, consumption of mango and its juice can be increased, the rate of deterioration and post- harvest losses reduced, increase utilization and improve cultivation of mango. Also, availability of the juice all year round will be greatly enhanced.

Production of juice from mango using Ogbomoso variety is recommended for juice production due to large amount of fleshy mesocarp for juice producing companies. Also, the use of mango juice production in Ogbomoso and Sherry juice up to 0.5 and 0.75g level of substitution with powder (pectinase) enzyme should be encouraged.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Larrauri JA, Ruperez P, Borroto B, Saura-Calixto F. Mango peels as a new tropical fibre: preparation and characterization. Journal of Food Science and Technology. 1996;29(3):729-733.
2. Buenrostro – Figueroa J, Garza – Toledo H, Ibarra – Junguera V, Aguilar CN. Juice extraction from mango pulp using an enzymatic complex of trichoderma *sp.* produced by solid – state fermentation. Journal of Food Science and Biotechnology. 2010;19(5):1387–1390.
3. Pilosof AMR, Sanchez VE. Drying of Enzymes: In Handbook of Industrial Drying. Taylor & Francis Group, LLC. Chapt 42; 2006.
4. Litz RE. The Mango: Botany, Production and uses CABI Publishing Wallingford, UK. 1997;592.
5. Filiz U, Asiye A, Erdal A. Effects of Different Enzymes and Concentrations in the Production of Clarified Lemon Juice. Journal of Food Processing. 2014;1-14.
6. Adebayo-Oyetoro AO, Ogundipe OO, Adeyemo IG, Ogundipe FO, Bamidele FA, Adeyeye SAO. Chemical, Sensory and Shelf life study of pawpaw juice-milk blend. Journal Cogent food and Agriculture. 2016;2(1):45-56.
7. A.O.A.C. Official Methods of Analysis of the Association of Analytical Chemists, 18th edition, Washington, D.C.,U.S.A; 2005.
8. Mccready RM. Determination of starch and dextrin and methods in Food Analysis, Academic Press Walthan, MA. 1970;541–563.
9. Dubois M, Gilles KA, Hamilton JK, Roberts PA, Smith F. Colorimetric method for

determination of sugar and related substances. Journal of Analytical Chemistry. 1956;28(1):350–356.
10. Vasant KG, Ajay KK, Raghupatel GR, Manjappa S. Determination of vitamin C in some fruits and vegetables in Davanagere city, (Karanataka)-India. International Journal of Pharmacy and Life Sciences. 2013;4(3):2489-2491.
11. Anthony CC, Egbuon. Comparative Assessment of Some Minerals, Amino acid and Vitamin Compositions of water melon (*Citrullus lanatus*) rind and seed. Asian Journal of Biochemistry. 2015;10:230-236.
12. Aurelia MP, Andrei FD, Slawomii K. Ascorbic Acid Determination in Commercial fruit juice samples by cyclic voltamentry. Journal of Automated methods and Management in Chemistry. 2008;2:1-5.
13. Aneja KR. Experiments in Microbiology, Plant Pathology and Biotechnology, 4th ed., New Age International (P) Ltd Publishers, New Delhi. 2007;66-73.
14. Ihekoronye AI, Ngoddy PO. Integrated Food Science for the Tropics. London: Macmillan Publishers Limited. 1985;293–307.
15. Balami YA, Bolji HF, Bahago EJ, Komolafe G, Onyeiwu SC, Hassan A. Practical manual on food technology, nutrition and dietetics for school and industries. National Science and Technology Forum, College of Science and Technology, Kaduna Polytechnic, Kaduna. 2004; 209–212.
16. Taylor B. Acids, colour, preservatives and other additives in beverages and beverage technology. Journal of Food Technology. 2004;2:70–60.
17. Vishal BN, Chauhan AS, Rekha MN, Negi PS. Quality evaluation of enzyme liquefied papaya juice concentrate stored at various temperatures. Food and Nutrition Sciences. 2015;3(1):90-97.
18. Rane R, Halhangadi D, Jadhav P, Kundalwal S, Chotalia C, Suthar A. Significance of brix reading in determination of quality of oral syrup and semisolid formulations. European Journal of Pharmaceutical and Medical Research. 2016;3(2):245-251.
19. Makanjuola OM, Adepegba AO, Ajayi A, Makanjuola JO. Effect of different preservation methods on the quality attributes of some tropical fruit juices. Journal of Advances in Bioresearch. 2013;4(4):74-78.
20. Youssef KA, Hammad AI, Abd El-Kalek HH, Abd El-Kader RM. Ensure Microbial Safety and Extending Shelf-Life of Tomato Juice by γ Irradiation, Nature and Science. 2011;9(11):154-164
21. Reddy LVA, Reddy OVS. Production and characterization of wine from mango fruit (*Mangifera indica L*), World Journal of Microbiology and Biotechnology. 2005;21:1345–1350.
22. Mackay G, Brown J, Torrence C. The processing potential of tubers of the cultivated potato, Solanum tuberosum L. after storage at low temperatures. Potato Research. 1990;33:211-218.
23. .Kgatla TE, Howard SS, Hiss DC. Colour stability of wild cactus pear juice, World Academy of Science, Engineering and Technology. 2011;80: 249-255.

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