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FLAVOUR EXTRACTION FROM *MONODORA MYRISTICA AND TETRAPLEURA TETRAPTERA* AND PRODUCTION OF FLAVOURED POPCORN FROM THE EXTRACT

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ABSTRACT: *Monodora myristica and Tetrapleura tetraptera are cherished in many Nigerian dishes. However, these spices are still of low industrial and commercial value, hence the need to incorporate them into new food products. The ground samples of both spices were evaluated for proximate composition and sugar concentrations (Sucrose, fructose, and glucose) of T.tetraptera. The proximate composition of M.myristica, was found to be 3.48±0.01% moisture, 4.52±0.07% ash, 47.09±0.33% fat, 8.38±0.09% crude fibre, 27.57±0.10% crude protein, and 8.96±0.02% carbohydrate corresponding values for T.tetraptera were found to be 6.0±0.02% moisture, 4.90±0.03% ash, 24.33±0.05% fat, 3.30±0.12% crude fibre, 18.69±0.19% crude protein, and 42.78±0.01% carbohydrate. The T.tetraptera was also found to have appreciable concentrations of the sucrose, fructose and glucose sugars. The relative abundance of oil, hence, essential oil, justifies the use of the spices as sources of flavourings. Both ground spice samples were extracted separately with water and ethanol. The flavour extracts were used to season popcorn and the acceptability evaluated using sugar flavoured popcorn as control. The water extracts of both spices were preferred compared to their ethanol extracts. The results obtained confirm that flavouring agents can be derived from M.myristica and T.tetraptera for industrial and commercial use.*

KEYWORDS: Sugar, proximate, flavor, popcorn, spices, extract

Introduction

African Nutmeg *Monodora myristica* (Ehuru) belongs to the Anonacea family. Its local (Nigeria) names include: Ehuru or Ehiri (Igbo), Ariwo (Yoruba), Jamaica nutmeg, Calabash nutmeg, and Airama (Ekeanyanwu *et al*, 2010). It is widely distributed from Africa to Asia, Central and South America and Australia (Omobuwajo *et al*, 2003). It is native to West, Central and East Africa, extending from Sierra Leone to Uganda, Kenya, Congo and Angola. It is one of the most important spice trees of the evergreen forest of West Africa and mostly prevalent in the Southern part of Nigeria (Ravindran and Kallupurackal, 2001). Almost every part of the tree has economic importance. Nutritional value of *Monodora myristica* (Ehuru) centers on its usefulness as a seasoning because of its aromatic flavour, and the seeds which are embedded in the white sweet-smelling pulp of the sub-spherical fruit, being the portion of interest (Uhegbu *et al*, 2011).

Another spice tree, *Tetrapleura tetraptera* (Oshorisho): "Aidan" fruit belongs to the Fabaceae family. It is locally known as "Aridan" in Yoruba and "Oshorisho" in Igbo. It is generally found

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in the lowland forest of tropical Africa. The fruit is pod-like with two pairs of flanges running along its whole length, opposite each other. When the pod is mature, ripe and dry, one of the pairs of the flanges opposite each other are soft, with sweet pleasant aromatic pulp, while the second pair are corky and hard as the central axis of the pod along which the brownish-black seeds are embedded. The pod is therefore used as a seasoning spice in Southern and Eastern Nigeria (Essien *et al*, 1994; Okwu, 2003; Aladesanmi, 2007).

Traditionally, herbs and spices are used in food preparations. They include whole plants or parts of plants, such as flowers, leaves, roots, bark, seeds, and parts of seeds (Fellows, 1997). Many reports are available on the use of these plants *Monodora myristica* (Ehuru) and *Tetrapleura tetraptera* (Oshorisho) as spices and in home remedies for the treatment of human illnesses (Noamesi *et al*, 1992; Akah and Nwabie, 1993; Essien *et al*, 1994; Adewunmi, 2001). Despite the long use of *Monodora myristica* (Ehuru) and *Tetrapleura tetraptera* (Oshorisho) in traditional soups and salads, their culinary use has not progressed beyond soups, salads and peanut paste. Thus, unlike Asian and Western spices, these spices have not gained industrial recognition and the commercial value remains low when compared to Asian spices. There is need to incorporate these indigenous spices; *Monodora myristica* (Ehuru) and *Tetrapleura tetraptera* (Oshorisho) into new food products. Flavours from *Monodora myristica* (Ehuru) and *Tetrapleura tetraptera* (Oshorisho) were extracted and popcorn seasoned with *Monodora myristica* (Ehuru) and Tetrapleura tetraptera (Oshorisho) flavours were produced. The acceptability of popcorn flavoured with the extracts from *Monodora myristica* (Ehuru) and Tetrapleura tetraptera (Oshorisho) also was analyzed. It is envisaged that the successful production of popcorn with *Monodora myristica* (Ehuru) *and* Tetrapleura tetraptera (Oshorisho) flavours, may result to the application of these spices in snacks and probably other foods beyond traditional soups and salad. This study may initiate the industrial production of these flavours for other food products.

MATERIALS AND METHOD

The spices; "Ehuru" (*Monodora myristica*) and "Oshorisho" (*Tetrapleura tetraptera*) were purchased from Aba new market in Abia state. Unpopped popcorn, sugar, vegetable oil, and sachet dry gin (43% alcohol) were also bought from the same source. Empty used mayonnaise bottles were purchased from Ekeonuwa market, owerri. The processing equipments were obtained from the laboratory of the Department of Food Science and Technology, Federal University of Technology, Owerri.

Preparation of the Spices

The spice, Ehuru (plate 1) was weighed with a weighing scale, toasted over fire, dehulled by cracking, and milled with Corona attrition manual milling machine (Landers YCIA, S.A. Colombia). Oshorisho (plate 2) was also weighed, washed in a bowl, and the semi-solid pulp extracted with a stainless steel knife before pounding with a ceramic mortar and pestle. Next, both spice meals were extracted separately with water and 43% ethanol. See figure 1 and 2 below. For each spice, 30ml portions of water and ethanol were used to separately extract 5g, 10g and 15g portions, to produce twelve spice extract samples. In each extraction, the weighed out spice meal was soaked in the 30ml solvent for 24hours in glass bottles with shaking (agitation) at 1hour interval for the first 4hrs. Each extract was sieved through a muslin cloth into a graduated

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measuring cylinder. These extracts were presented to a 5-member Production Guidance Panel to taste and recommend the preferred ones for use in the finished product, based on their flavour intensity (strength). Their recommended extract samples were used in the production of the pilot popcorn production (A.O.A.C.2000).

Proximate Composition Analysis of the Spices

The proximate composition analysis of the spices was conducted according to the methods of A.O.A.C, (2000).

Moisture Content Analysis

The moisture content was determined by weighing out 2g of each of the samples into a dry pan of a known mass, charged into the oven at a temperature of 105^0C for 3h. The dried samples were then withdrawn from the oven and placed in a desiccator to cool. They were weighed using the analytical balance (electronic) and the whole process was repeated until a constant mass was obtained. The difference in mass was used to calculate the percentage (%) moisture content as follows;

$$\% \text{ moisture} = \frac{(M_2 - M_3)}{(M_2 - M_1)} \times 100$$

Where M_1 – mass of dish

M_2 – mass of dish + sample before drying

M_2 – mass of dish + sample after drying

Crude Fat Analysis

A Soxhlet extraction unit with a reflux condenser and a small round bottom flask (250ml) was used. The flask was weighed after washing and drying and half filled with light petroleum ether (Boiling point 40-60^0C) and fitted back

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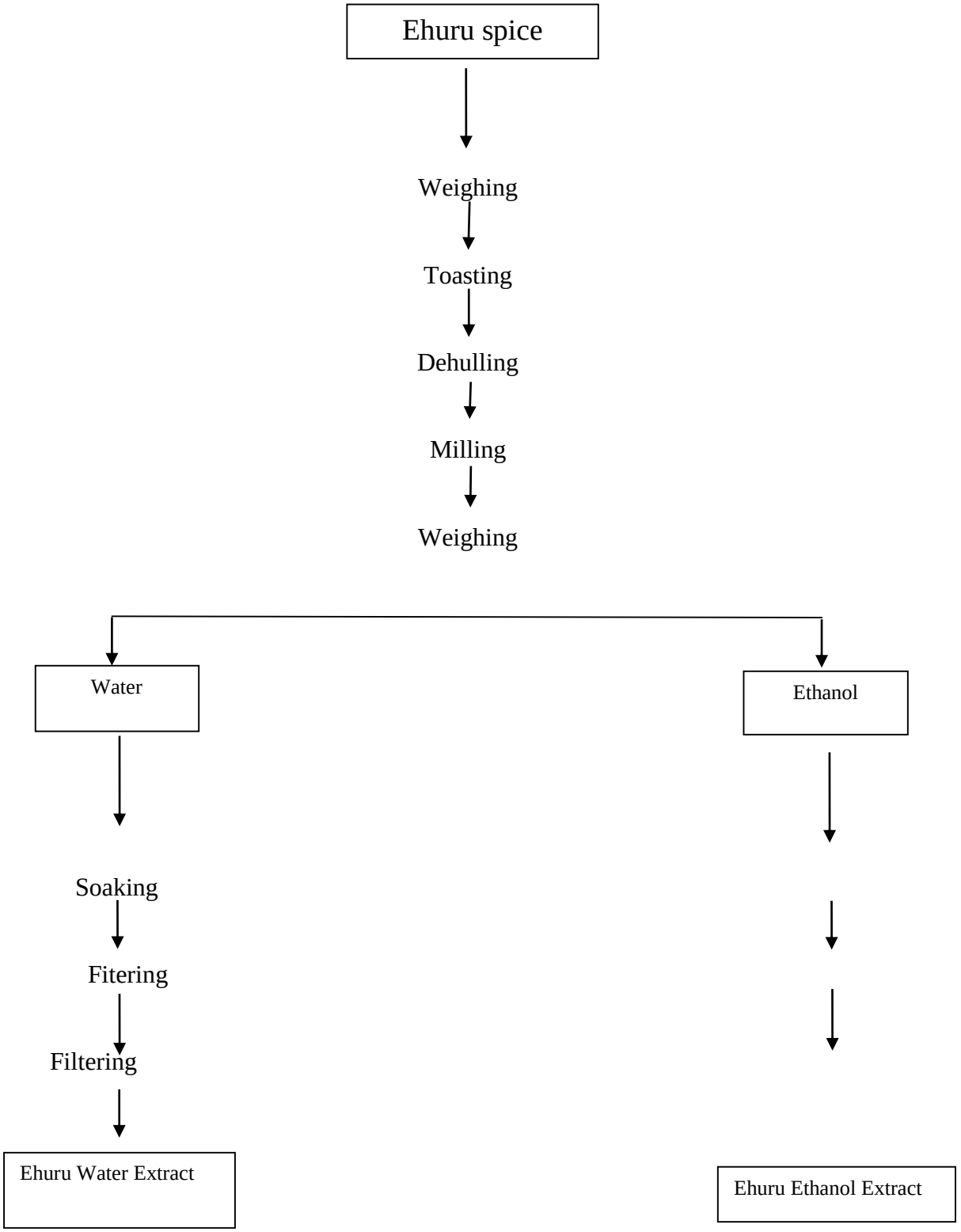

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Figure 1: Flow diagram for flavour extraction from *Monodora myristica* (Ehuru)

Plate 1: Ehuru

Plate 2: Oshorisho

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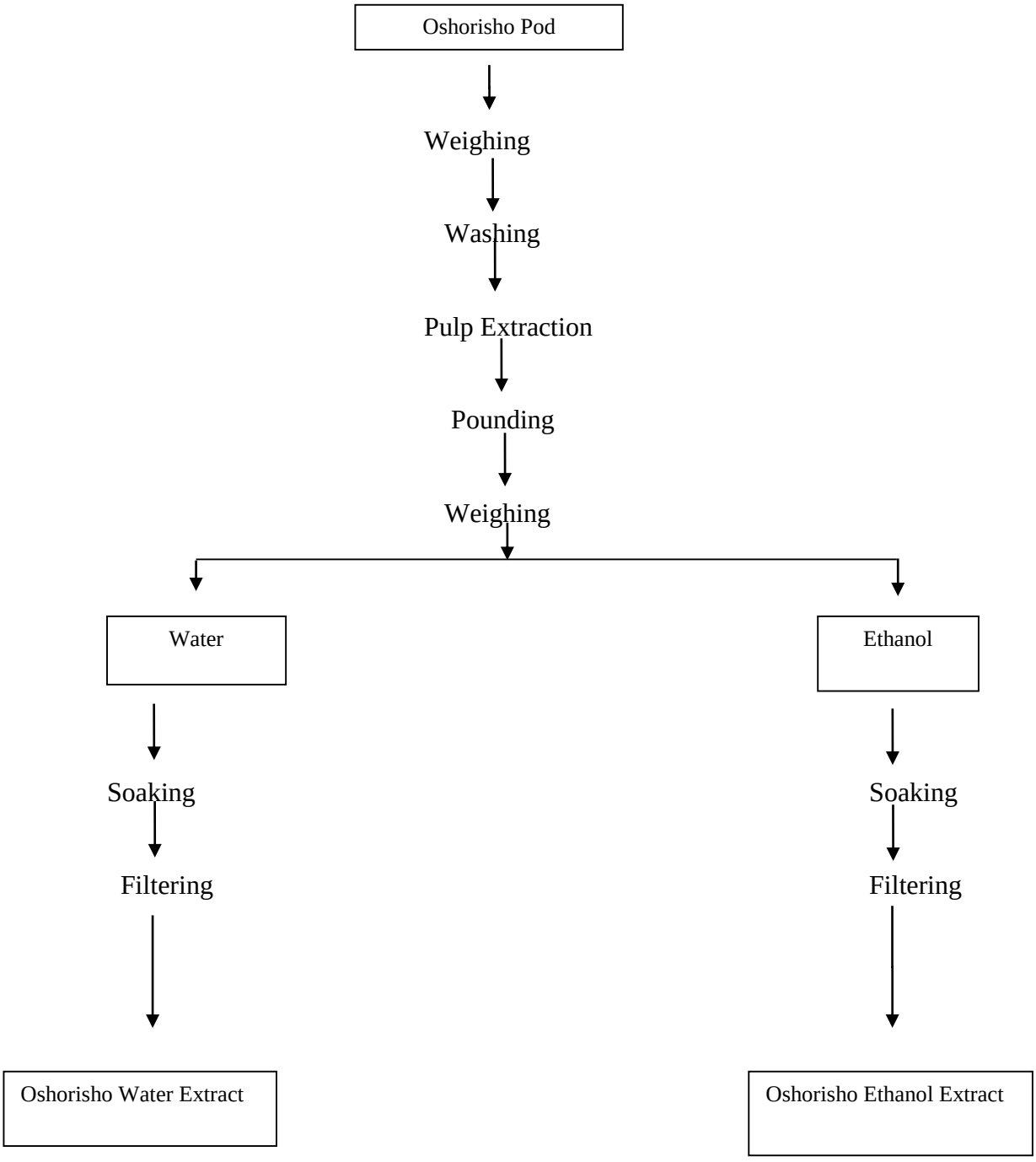

Figure 2: Flow diagram for flavour extraction from *Tetrapleura tetraptera* (Oshorisho)

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Crude Fat Analysis

A Soxhlet extraction unit with a reflux condenser and a small round bottom flask (250ml) was used. The flask was weighed after washing and drying and half filled with light petroleum ether (Boiling point 40-60^{0}C) and fitted back to the unit. Two (2) gram portion of each sample was wrapped with Whatman filter papers and gradually lowered into a thimble then fitted into the reflux flask. The boiling flask containing 200ml petroleum ether was heated with heating mantle for 5h. The ether in the bottom flask, evaporated, condensed in the reflux flask until it filled. Then it refluxed into the boiling flask carrying the extracted fat and oil. Heating was stopped after 5hrs and the bottom flask with solvent was allowed to cool. The ether in the flask was evaporated at 60^{0}C and its oil content was dried. The flask with the oil was reweighed. The difference was used to calculate the percentage (%) of crude fat in the sample.

$$\% \text{ crude fat} - \frac{\text{Mass of fat}}{\text{Mass of sample}} \times 100$$

Crude Protein Analysis

The Kjeldahl method was adopted. Half a gram (0.5) of each dry sample was weighed and placed in a Kjeldahl digestion flask. A blank experiment was also setup involving the digestion of all material except the sample. One table spoon of selenium catalyst was added into each of the flask and mixed with 10ml of concentrated H_2S04.The mixture was heated to red hot temperature under a fumed cupboard for 2hours until a clear solution was obtained. The clear solution (the digest) was transferred quantitatively to 100ml volumetric flask and diluted to mark with distilled water. The digest was mixed with equal volume of 45% NaOH solution in a semi micro kjeldahl distillation apparatus. The mixture was distilled and the distillate collected into 10ml of 40% boric acid solution containing about three (3) drops of mixed indicator, methylene red and bromocresol green. A total of 50ml distillate was collected and titrated against 0.02N H_2S0_4 solution. The above distillation process was also carried on the blank sample. The titer value was subtracted from that of the sample and the difference used to calculate the crude protein as thus;
The % of nitrogen content is given by;

$$\%N = (14 \times Na\ (VF/VA)\ (100/w)\ XT$$

Where T-titer less blank
Na-normality of acid used
VF – total volume of aliquot
VA – Aliquot volume distilled
W – Mass of sample analyzed

Thus % crude protein (%P) %N x 6.25

Crude Fibre Analysis

Two gram (2g) of each defatted samples was boiled in 200ml of 125% H_2S0_4 for 30 minutes. The boiled samples were washed with hot water using a two-fold muslin cloth to retain particles. The retained particles were returned to the flask and boiled again in 200ml of 125% NaOH solution and was again washed with hot water and allowed to cool before being transferred to a weighed

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porcelain crucible. The samples were transferred to the oven to dry at 105^0C to a constant weight and were subsequently placed in muffle furnace at 550^0C for 4h and finally cooled in a desiccator and reweighed. By differences in mass, the mass of the fibre was then determined and used in calculating the percentage (%) fibre:-

$$\% \text{ crude fibre} = \frac{(\text{loss in mass on ignition} \times 100)}{\text{Mass of sample}}$$

Ash Content Analysis

A measured mass (2g) of each sample was weighed into a crucible of known weight. The samples in the crucibles were placed in a muffle furnace at a temperature of 550^0C for 3h until samples were free of carbon. The crucibles were cooled in a desiccator to room temperature and weighed. The percentage (%) ash was calculated as thus;

$$\%\text{Ash} = \frac{\text{Massof ash} \times 100}{\text{Mass of sample}}$$

Carbohydrate Content

Minerals and vitamins occur in minute quantity. Thus to determine the % carbohydrate content, the sum of the contents, moisture (%M.C), ash (%A), protein (%N), fat (%F) and crude fibre (%C) has been deducted from the total mass and is given by;

$$\% \text{ carbohydrate} = 100-(\%MC+A+\%N+\%F+\%C)$$

Determination of Sugar Concentration in *Tetrapleura tetraptera* (Oshorisho)

The contents of glucose, fructose and sucrose in Oshorisho were determined using the Phenol Sulphuric Acid method. Two milliliter (2ml) aliquots of the sample solution were mixed with 1ml of 5% aqueous solution of phenol in three test tubes. Next, 5ml of concentrated H_2SO_4 was added to each mixture. The test tubes were rested for 10minutes. The solutions were vortexed for 30minutes and placed for 20minutes in a water bath at room temperature for colour development. The absorbance values of the solutions were observed and read in spectrophotometer at wavelengths of 490nm (glucose), 520nm (fructose) and 590nm (sucrose) and the absorbances were used to trace their various concentrations from their respective standard calibration curves. Reference solutions were prepared in identical manner as above except that the 2ml aliquot of the sample was replaced by Distilled Deionized (DDI) water (AOAC, 2006).

Popped Corn Production

In the production of the control popped corn sample, 50ml of vegetable oil was added into a hot pot, and 100g of unpopped grains was added. The grains in the hot oil were then agitated over heating stove, and the grains allowed popping. The popping grains were seasoned with 10g of granulated sugar. In the production of the spice flavoured samples, 100g portions of grain were separately soaked in the selected (Table 4.2) spice extracts (Extracts of 15g Ehuru with 30ml water, 10g Ehuru with 30ml ethanol, 10g Oshorisho with 30ml water and 10g Oshorisho with 30ml ethanol) for 2mins, and after air-dried. These samples were then popped by the same method used for control.

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Sensory Evaluation

The sensory evaluations of the popcorn samples (5 samples) were carried out 24h after popping. A twenty-member panel familiar with popcorn quality attributes was randomly selected from students of the department of Food Science and Technology, Federal University of Technology, Owerri for the evaluation. A 9- point hedonic scale as described by Larmond, (1997) was used to evaluate the appearance, aroma, taste, mouth feel and general acceptability of the samples.In this scale, 9 represented like extremely; 8-like very much; 7-like moderate; 6-like neither slightly; 5-niether like nor dislike; 4-dislike slightly; 3-dislike moderately; 2-dislike very much; and 1-dislike extremely. Necessary precautions were taken to prevent carrying over the flavour perception of the first taste to the next during tasting by ensuring that the panelists rinsed their mouth with potable water after each stage of sensory evaluation.

Statistical Analysis

The data obtained were analyzed using the Analysis of Variance (ANOVA) method. Where the variance ratio was found significant, The Least Significant Difference (LSD) was used to separate the means. Significant difference is considered at $P \leq 0.05$ unless stated otherwise.

RESULTS AND DISCUSSION

Proximate Composition of *Monodora myristica* (Ehuru) and *Tetrapleura tetraptera* (Oshorisho)

The proximate compositions of *Monodora myristica* (Ehuru) and *Tetrapleura tetraptera* (Oshorisho) are summarized in Table 1. The moisture contents (Table 1) of *M.myristica* (Ehuru) (3.48%) and *T.tetraptera* (Oshorisho) (6.0%) are low. Moisture content of any food is an index of its water activity and is used as a measure of stability and susceptibility to microbial contamination (Darey, 1989; Okaka and Okaka, 2001; Aruah *et al,* 2012). The low moisture content is indicative of the fact that these spices can be stored for a long period without deterioration in quality or microbial spoilage since microbial activity may be reduced to a minimum.Ash represents the mineral matter left after feeds are burnt in oxygen (Bingham, 1978). It is used as a measure of the mineral content in any sample (Pearson, 1981). The spices had moderately high value of ash: *M.myristica* (Ehuru) (4.52%) and *T.tetraptera* (Oshorisho) (4.90%). This means that they have good mineral content, and thus serves as a viable tool for nutritional evaluation (Lienel, 2002). However, the value for the ash content in *T.tetraptera* (Oshorisho) is slightly lower than the 9% reported by Abii and Elegalam (2007). Such differences may arise from variations in soil micronutrients (Okwu, 2001). It could also be partly attributed to the method of analyses.

Table 1: Proximate Compositions (%) of *M.myristica* (Ehuru) and *T.tetraptera* (Oshorisho)

Parameters/Compositions	*T.tetraptera*±SD	*M.myristica*±SD
Moisture	3.48±0.01	6.0±0.02
Ash	4.52±0.07	4.90±0.03
Crude fat	47.09±0.33	24.33±0.05
Crude fibre	8.38±0.09	3.30±0.12
Crude protein	27.57±0.10	18.69±0.19
Carbohydrate	8.96±0.02	42.78±0.01

Values are mean of triplicate determinations

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Crude fat (lipid) content of both spices: *M.myristica* (Ehuru) (47.09%) and *T.tetraptera* (Oshorisho) (24.33%) are high. Although, the lipid content of *M.myristica* (Ehuru) is significantly higher than *T.tetraptera* (Oshorisho). The high lipid content is indicative of the fact that these spices are good sources of flavour since they are rich in essential oil and also suggests possible sources of oil-soluble vitamins. The percentage of crude fibre in *T.tetraptera* (Oshorisho) (3.30%) is in line with the value reported in the literature and also compares favourably with reports of 4.5% by Abii and Elegalam (2007), but lower than 7.76% by Osagie and Eka (1998), and 8.75% by Dike (2010). Fibre has some physiological effects in the gastrointestinal tract (Effiong *et al*, 2009) and low fibre in diet is undesirable as it may cause constipation. However, the low fibre reported in this work for *T.tetraptera* (Oshorisho) may not affect the use of the plant, as they are not consumed directly (as main meal) but are used as flavouring agent. The crude fibre content of *M.myristica* (Ehuru) (8.38%) is average in quantity as revealed from this analysis. This implies that when this spice is incorporated into food, it will help to prevent many metabolic or digestive disorders such as constipation, irritable bowels e.t.c, as this is the work of fibre in the body (Akinlawon, 1998). The crude protein of the two spices *M.myristica* (Ehuru) (27.57%) and *T.tetraptera* (Oshorisho) (18.69%) are fairly high. This differs from the report of Okoli (1988) which indicated the low protein content of vegetables ranging from 3.00 to 5.00%. It is generally known that any plant food that provides more than 12% of their caloric value from protein is considered to be a good source of protein. Thus, these spices are good sources of protein. However, this does not correspond to the work carried out by Uyoh *et al*, (2013) which confirmed *T.tetraptera* (Oshorisho) as a non-protein supplement. The total carbohydrate content of *T.tetraptera* (Oshorisho) (42.78%) is fairly high and compares favourably with the value stated in the literature. This agrees with the report of Manay (1987) that spices are rich in carbohydrates but differs from that of *M.myristica* (Ehuru) (8.96%) which has a low carbohydrate content and much lower than that stated in the literature. This observed difference could be attributed to the stage of maturity of the spice at the time of harvest, the variety of cultivar and partly to the method of analyses used. Carbohydrate provides energy to the cells in the body, particularly the brain, which is the only carbohydrate-dependent organ in the body (Effiong *et al*, 2009). It is necessary for maintenance of the plasma level; it spares the body protein from being easily digested and helps to prevent the using up of protein. The high carbohydrate content observed in *T.tetraptera* (Oshorisho) suggests high caloric value and is indicative of its high sugar concentration.

Sucrose, Glucose and Fructose Concentration in *T.tetraptera* (Oshorisho)

The results of the contents of glucose, fructose and sucrose in Oshorisho are shown in Figures 3, 4, and 5. From the graphs (Figs.3, 4 and 5), Oshorisho has very high contents of glucose, fructose, and sucrose. This supports the findings of Adesina (1982) and Enwereuzoh (2011) that the fruits of *T.tetraptera* (Oshorisho) contain carbohydrates (glucose, fructose, and sucrose). The presence of these sugars is responsible for the sugary taste of the *T.tetraptera* (Oshorisho) extracts dictated by the production guidance panel during the product development.

Panel Recommendation

The production guidance assessment was carried out by a team of five untrained panelists. While there were different concentrations of the both spices (Ehuru and Oshorisho), what was perceived as common to each and every one of them was the aroma of the volatile oils. This was confirmed by Susheela (2000), that spice extractives, which are highly concentrated forms of spices, contain

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the volatile and non-volatile oils that give each its characteristics flavour. The volatile portions of spice extractives, also referred to as essential oils, typify the particular aroma of the spice. Expectedly, the 15g/30ml (the highest concentration) had the strongest flavour for the both spices. The production guidance panel commented that the ethanol extracts of both spices had somewhat bitter taste but more pronounced in the highest concentration (15g/30ml) of *T.tetraptera* (Oshorisho). The result of the production guidance panel (Table 2) showed that 3 panelists liked the extract of 15g of Ehuru with 30ml of water (MBA3), 4 panelists liked the extract of 10g of Oshorisho in 30ml of water (TBA2), 3 panelists liked extract of 10g of Ehuru with 30ml of alcohol (MBB2), 2 panelists liked extract of 15g of Ehuru with 30ml of alcohol (MBB3), 3 panelists liked extract of 10g of Oshorisho with 30ml of alcohol (TBB2), while for extract of 5g of Oshorisho with 30ml of alcohol (TBB1); extract of 10g of Ehuru with 30ml of alcohol (MBB2) and extract of 5g of Ehuru with 30ml of water(MBA1) only one panelist each liked them. The samples liked by three or more persons (MBA3, MBB2, TBA2, TBB2) were chosen and used in the pilot popcorn production.

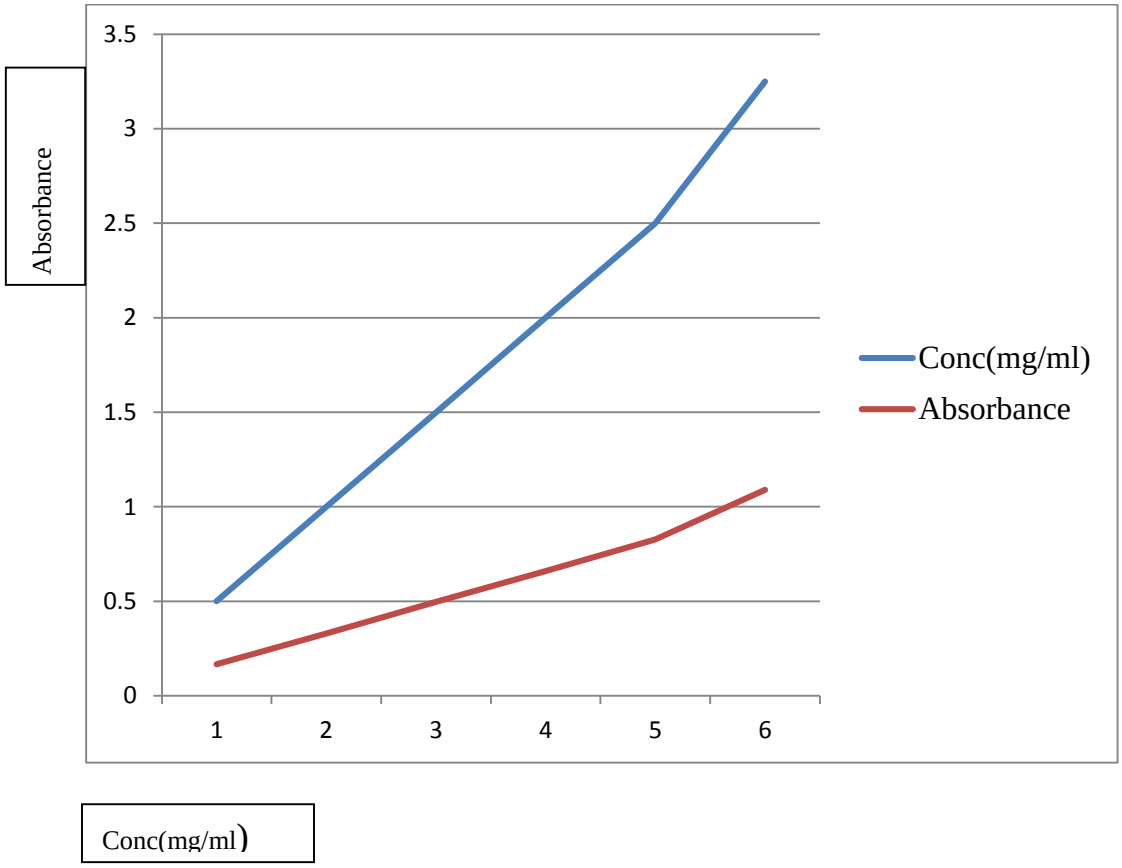

Figure 3: The concentration of Glucose in *T.tetraptera* (Oshorisho)

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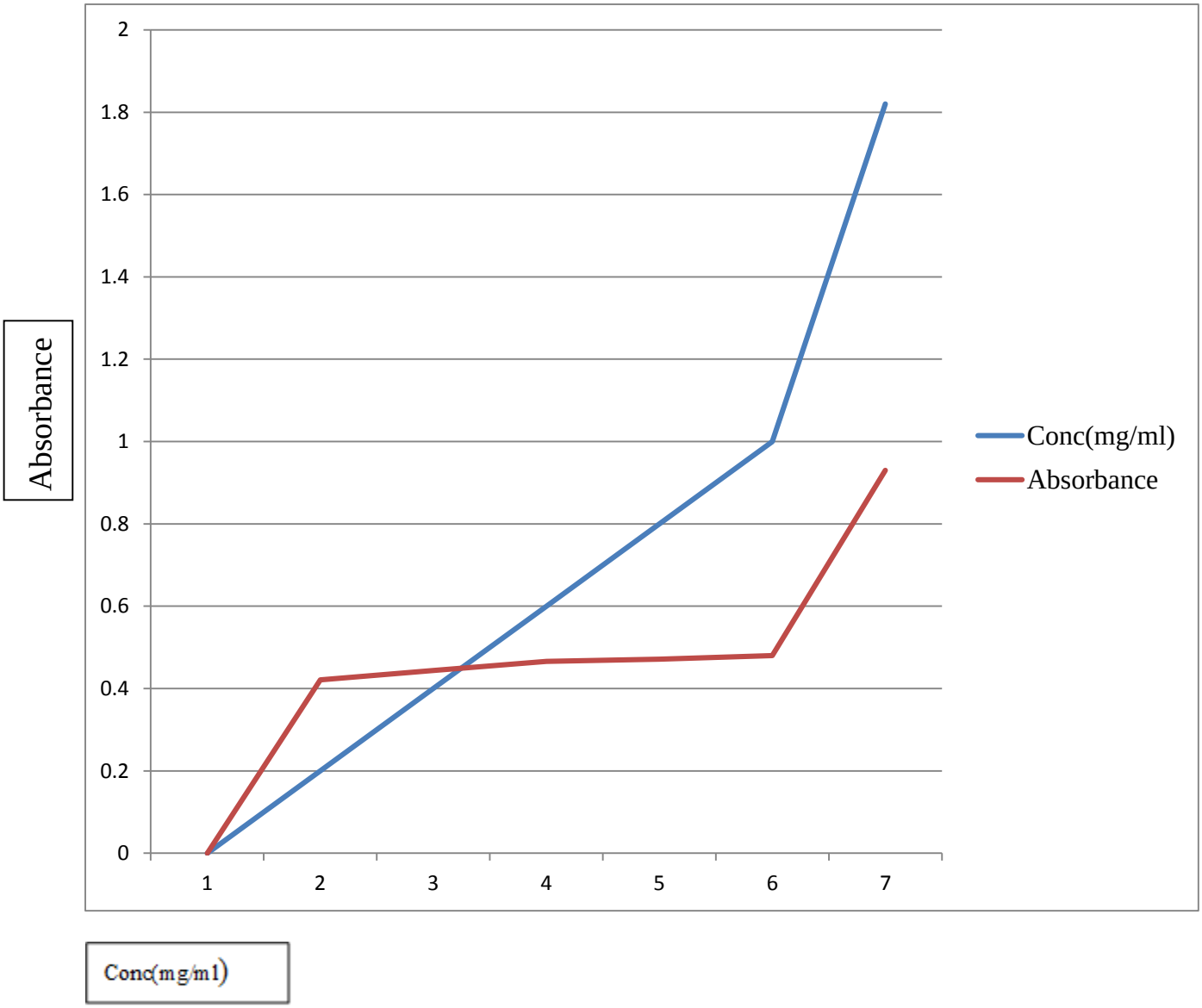

Figure 4: The concentration of Fructose in *T.tetraptera* (Oshorisho)

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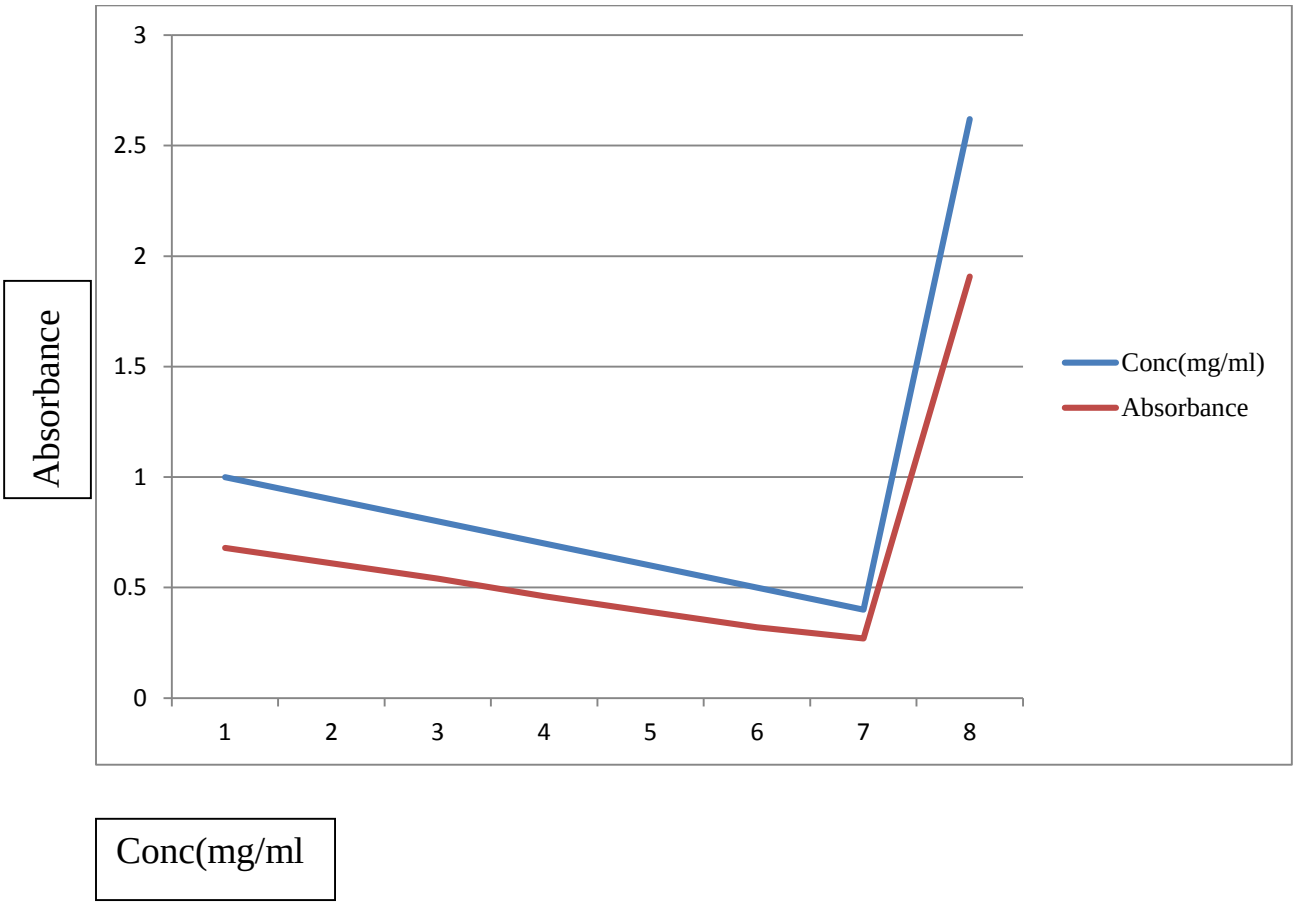

Figure 5: The concentration of Sucrose in *T.tetraptera* (Oshorisho)

Table 2: Production Guidance Panel Recommendation

Panelists	Recommended extract samples	Samples chosen by ≥3 Panelists
1	MBA3, TBA2, MBB3	
2	MBA3, MBB2, TBA2, TBB2	MBA3, MBB2, TBA2, TBB2
3	TBB2, TBA2, MBB2, MBA2	
4	TBA2, MBB2, MBA1, TBB2	
5	MBA3, MBB3, TBB1	

M- Ehuru
T- Oshorisho
MBA3- Extract of 15g of Ehuru with 30ml of water
MBA2- Extract of 10g of Ehuru with 30ml of water

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MBA1- Extract of 5g of Ehuru with 30ml of water
MBB2- Extract of 10g of Ehuru with 30ml of alcohol
MBB3- Extract of 15g of Ehuru with 30ml of alcohol
TBA2- Extract of 10g of Oshorisho in 30ml of water
TBB2- Extract of 10g of Oshorisho with 30ml of alcohol
TBB1- Extract of 5g of Oshorisho with 30ml of alcohol

Sensory Evaluation of Popcorn Samples

From the sensory evaluation (Table 3), the appearance of the control sample ranked highest with a mean score of 8.05 (very much liked) and was significantly different ($p \leq 0.05$) from other samples. The popcorn flavoured with ethanol extract of *T.tetraptera* (Oshorisho) had the lowest mean score (4.95) which indicates that the sample was neither liked nor disliked by the panelists and it was significantly different ($p \leq 0.05$) from all other samples. There was significant difference ($p \leq 0.05$) in appearance between the popcorn flavoured with water extract of *M.myristica* (Ehuru) and other samples but no significant difference ($p \geq 0.05$) observed between the popcorn flavoured with ethanol extract of *M.myristica* (Ehuru) and that flavoured with water extract of *T.tetraptera* (Oshorisho). Aroma is an important parameter of food (Iwe, 2002). Good aroma from food excites the taste buds, making the system ready to accept the product. Poor aroma may cause outright rejection of food before they are tasted. There was no significant difference ($p \geq 0.05$) in aroma among the samples except for control which showed significant difference ($p \leq 0.05$). Taste is also an important sensory attribute of any food. Food intake is often enhanced by taste (Sim and Tam, 2001). There was no significant difference ($p \geq 0.05$) in taste among all the samples. In terms of mouth feel, all the samples showed either strong or slight similarities except for the sample flavoured with ethanol extract of *T.tetraptera* (Oshorisho) which showed significant difference ($p \leq 0.05$). From the result (Table 3), the control had the highest mean score (7.0) for general acceptance, which indicated that the sample was highly accepted by the panelists followed by the sample flavoured with water extract of Ehuru (6.3), next by the sample flavoured with water extract of Oshorisho (5.95), and then the sample flavoured with ethanol extract of Ehuru (5.7). The least accepted was the sample flavoured with ethanol extract of Oshorisho (5.25). The better acceptability of the water extracts of the spices compared to their ethanol extracts could be as a result of the bitter taste commented for the ethanol extracts by the production guidance panel during product development. The control had the highest score for all the sensory characteristics.

Table 3: Mean Sensory scores of popcorn samples produced with different flavour extracts

Sample	Appearance	Aroma	Taste	Mouthfeel	General Acceptance
MBA	6.9 ± 1.14^{b}	5.8 ± 1.12^{b}	5.8 ± 1.4^{a}	6.4 ± 1.53^{a}	6.3 ± 1.38^{b}
MBB	6.15 ± 0.79^{c}	5.65 ± 1.06^{b}	5.65 ± 1.32^{a}	6.1 ± 1.51^{ab}	5.7 ± 0.95^{bc}
TBA	5.95 ± 1.07^{c}	5.8 ± 1.4^{b}	6.0 ± 1.92^{a}	6.0 ± 1.79^{bc}	5.95 ± 1.43^{b}
TBB	4.95 ± 1.16^{d}	5.8 ± 1.75^{b}	5.4 ± 1.91^{a}	5.45 ± 1.80^{d}	5.25 ± 1.84^{cd}
CPP	8.05 ± 0.87^{a}	7.1 ± 0.99^{a}	6.45 ± 1.91^{a}	6.5 ± 1.63^{a}	7.0 ± 1.76^{a}

^{abc} Means with different superscript within the same column are significantly different ($p \leq 0.05$).

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CPP - Control
MBA - Water extract of Ehuru
MBB - Ethanol extract of Ehuru
TBA - Water extract of Oshorisho
TBB - Ethanol extract of Oshorisho

This observation may be attributed to the novelty of the new products (Stone and Sidel, 1993). The attitudes of consumers may be tuned to accept new products if health claim, or social status is attached. In fact, there was the tendency for the control to consistently show high sensory scores, since the age bracket used were sugar-loving and sugar was added in the control product. However, some panelists still expressed some degree of likeness for the new products. This observation may be attributed to personal choice or an influence of the experimental conditions.

CONCLUSION AND RECOMMENDATION

It is evident from this study that *Monodora myristica* (Ehuru) and *Tetrapleura tetraptera* (Oshorisho) have high oil content and probably essential oil. This could be a plausible explanation for the flavour characteristics exhibited by the spice extracts. The water extracts were however preferred in the sensory evaluation compared to their ethanol extracts. This is confirmed by the acceptability of their flavoured products when compared with their alcohol extracts. Therefore, this work is an eye opener for the discovery of novel flavouring agents for industrial use, as the two indigenous spices studied were promising sources. Ehuru and Oshorisho are hereby recommended as flavouring agents for popcorn and maybe other snacks. The extracts from these spices should be standardized and used in food processing industries to replace some of the artificial flavouring agents. It is believed that regular supply, publicity and introduction of health claims on the products may enhance improved production strategy and quality. In addition, the spices should be subjected to intensive research and more research work should be done on other culinary herbs and local spice extracts for flavouring characteristics.

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