

Original Research Article

Comparative Study of the Physiochemical Properties and Fatty Acid Composition of Some Indigenous Spices in Nigeria.

ABSTRACT

Oil of some common indigenous spices namely, “Omilo” (*Parinari excelsa*) “Country onion” (*Afrotyraxlepidophyllus*), “Gbafilo” (*Uapaccaguineense*) and “Taiko” (*Zanthoxylumzanthoxyloides*) were investigated for their physicochemical properties and fatty acid profile. The oil was extracted using n-hexane in a soxhlet apparatus and evaluated for refractive index, specific gravity, smoke point, oxidative stability as well as the acid, saponification, iodine and ester values. The fatty acid profile of the oil was determined by Gas Chromatography (GC). Results of the Refractive Index, Specific gravity and Oxidative stability values range between 1.44-1.46°C, 0.930-0.970°C, 40-72hr, respectively; while Iodine, Acid, Ester and Saponification values range between 94.14-105.20 I₂/100g, 2.58-19.25mgKOH/g, 164.28-231.14mgKOH/g and 170.92-233.72mgKOH/g, respectively. Oleic acid was the predominant fatty acid in Omilo (92.98%) and Country onion (72.73%); while palmitic acid was the predominant fatty acid in Gbafilo (39.45%) and Taiko (28.09%). Linolenic acid was present only in Country onion (12.84%) and Omilo (2.04%). The unsaturated fatty acid content was higher in Omilo (96.67%) and Country onion (91.30%) compared with Gbafilo (48.35%) and Taiko (46.19%). Gbafilo and Taiko showed high levels of saturated fatty acids (51.70% and 53.63% respectively). These results suggest that the spices have potentials for use as food supplements and industrial raw materials in addition to their traditional use as condiments.

Keywords: Physiochemical properties, fatty acids, indigenous spices, n-hexane.

INTRODUCTION

Edible plants have been reported to provide oils especially the α -linolenic acid and several mono and polyunsaturated fatty acids. Oil extracted from plants are important both for their application as nutrients in foods and as industrial raw materials. The characteristics of oils from different sources depend mainly on their compositions and since no oil from a single source can be suitable for all purposes, the study of their constituents becomes important ⁽²⁾. Despite numerous studies carried out on the nutritional and medicinal properties of spices ^(3,4,5) as well as changes in their physiochemical composition ^(6,7,8), more research is required especially with some underutilized spices common to the Niger Delta area of Nigeria known to be rich in a wide variety of fauna and flora. This is necessary as most of these indigenous spices could become extinct if not adequately explored, utilized and documented. The indigenous spices namely “Omilo” (*Parinari excelsa*), “Country onion” (*Afrotyraxlepidophyllus*), “Gbafilo” (*Uapaccaguineensi*) and “Taiko” (*Zanthoxylum zanthoxyloides*) are common rain forest trees commonly found in Gabon, Tanzania, Senegal, Cameroon, Uganda, France, Liberia, Ghana and in Nigeria. A brief description of these spices is shown

43 in table 1 below. The present study evaluates the physiochemical properties and fatty acid
44 profile of the oil extracted from these spices.

45 **Table 1: Brief description of the spices** (9, 10, 11, 12)

Botanical Name	Common Name/Ethnic group	Family	Uses
<i>Uapacca guineensis</i>	“Gbafilo” – Delta } Nderite – Ikwerre } Nigeria Sugar Plum } English Red cedar } Rikio } Liberia Paleturier rivier } French	Euphorbiaceae (phyllanthaceae)	- Seeds are used as condiments - Stembark and leaves relives pain - Roots are used for treatment of impotency in men. Steam bath with the roots relieves headache. The root bark can also treat leprous sores and taken as tonic by women who have just given birth.
<i>Parinari excelsa</i>	Guinea plum } Mobola plum } English	Chrysobalanceae	- Treatment of malaria - Epilepsy, diarrhea
<i>Aprostyrax lepidophyllus</i>	Country onion } English	Hauceae	- Used as spices in the traditional African cuisine and medicinal purposes
<i>Zanthoxylum zanthoxyloides</i>	Toothache bark } English Candle wood } Senegal Tagra jaaune } French Taiko (Delta) } Nigeria		- The root is commonly used as chewing stick. Used in traditional medicine e.g. root and bark are used to treat malaria, fever, sickle cell anaemia. - Seed used as condiments.

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47 MATERIALS AND METHODS

48 Seed Material Preparation

49 These spices were purchased from herb sellers at Mile 3 market in Port Harcourt, Rivers
50 State, Nigeria. Samples were sundried slightly, ground into fine flour and sieved. The sieved
51 samples were placed in an airtight container and stored in a cool place until ready for
52 analyses.

53 Lipid Extraction

54 Oil was extracted from the sieved samples in a soxhlet apparatus with n-hexane for 8hrs. The
55 oil was then recovered by evaporating the solvent using rotary evaporator (13). The oil
56 obtained was stored in an amber bottle and the percentage yield was calculated.

57 Physiochemical Analysis

58 The following physiochemical properties which include; refractive index, colour, specific
59 gravity, smoke point, oxidative stability, free fatty acids, percentage oil yield as well as acid,
60 peroxide, saponification, esterification and iodine values, were determined using standard
61 methods of AOAC, 1990 (14).

62 Fatty Acid Profile

Fatty acid profile of the seed oil of these spices was determined using NUCON series 5700 gas chromatography equipped with the flame ionization detector and stainless steel packed column, having internal diameter 2mm and length 2.0cm. About 0.1ml of the oil was converted to the methyl ester by using the boron-trifluoride and extracted in 1ml hexane before being injected into the gas chromatography. The detector temperature was programmed from 70°C to 200°C with the increasing rate of temperature 6°C/min. Nitrogen was used as the carrier gas. Hydrogen flow 40ml/min and air flow 60ml/min were used. The peak was identified by measuring the retention time of the samples and comparing it with the standard under the same operating conditions.

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73 STATISTICAL ANALYSIS

All analysis were performed in triplicates and the mean values and standard deviation calculated.

76 RESULTS AND DISCUSSION

77 Physiochemical Analysis

78 **Table 2: Physical properties of the seed oils**

Physical Parameters	Values for oil			
	Omilo	Country onion	Gbafilo	Taiko
Refractive index (°C)	1.46 ± 0.00	1.44 ± 0.01	1.45 ± 0.00	1.45 ± 0.00
Specific gravity (°C)	0.932 ± 0.01	0.930 ± 0.00	0.960 ± 0.01	0.970 ± 0.00
Smoke point (°C)	148 ± 1.22	147 ± 0.42	132 ± 2.14	140 ± 1.31
Oxidative stability (hr)	72 ± 1.14	63 ± 0.00	40 ± 0.00	42 ± 0.00
Colour	Light yellow	Yellow	Light yellow	Yellow

79 *Mean value ± Standard deviation (n=3)*

Table 2 reported the physical properties of the seed oil of these indigenous spices. The refractive index values obtained for the spices ranges from 1.44 (country onion) to 1.46 (omilo), these values corroborates the report of Justyna (15) as reported for conventional oils from soybean (1.466) and palm kernel (1.449). The high refractive index of this oil confirms the high number of carbon atoms in their fatty acids. The spices maintained a light yellow to a yellow colour. The oil had a specific gravity (°C) of 0.932, 0.930, 0.960 and 0.970 for omilo, country onion, gbafilo and taiko respectively. The values for omilo and country onion are closer to 0.939 reported for neem seed (16). The smoke point (140 – 152°C) of these spices is lower compared to groundnut oil (213.5°C). The free fatty acid content reported for omilo and country onion are lower than those of taiko and gbafilo. This is consistent with the report of FAO/WHO (17), they reported that the lower the free fatty acid content, the higher the smoke point. The oxidative stability which is the time required for the oil samples to develop a measurable rancidity was longer than that of soybean oil and are comparable to that of carica papaya (18).

94 **Table 3: Chemical properties of the seed oils**

Chemical Parameters	Values for oil			
	Omilo	Country onion	Gbafilo	Taiko
Iodine value (I ₂ /100g)	103.40 ± 1.14	105.20 ± 0.00	96.12 ± 2.22	94.14 ± 1.24
Saponification value (mg KOH/g)	233.72 ± 0.00	170.92 ± 2.19	222.40 ± 2.00	216.45 ± 1.99
Esterification value (mg KOH/g)	231.14 ± 0.12	164.28 ± 1.14	209.73 ± 1.19	197.20 ± 0.98

Acid value (mg KOH/g)	2.58 ± 0.00	3.69 ± 0.04	12.68 ± 1.03	19.25 ± 1.01
Peroxide value (mEqO ₂ /kg)	9.42 ± 0.00	9.62 ± 0.10	33.94 ± 0.06	39.02 ± 0.02
Free fatty acid (%)	2.46 ± 0.02	6.25 ± 0.00	10.24 ± 0.11	8.49 ± 0.00
Oil content yield (%)	61.12 ± 1.40	9.71 ± 0.00	12.37 ± 0.98	21.36 ± 0.00

95 *Mean value ± standard deviation (n=3)*

96 The oil yield and chemical properties of these seed oil are reported in Table 3. The spices had
 97 a high iodine value ranging from 94.14 (taiko) to 105.20 I₂/100g (country onion). These
 98 values agree with the level of unsaturation present in the various seed oils. The values
 99 compared favourably to iodine value of seed oil of *Telfaria accidentalis* (19) and white and
 100 red sesamum indicum seed (20) as well as seed oil of *Jatropha curcas* L. (21). The iodine
 101 values obtained from these oil seeds can serve in industries as control method for
 102 hydrogenation, biodiesel production and in assessing oxidative stability. The saponification
 103 value range from 170mgKOH/g (country onion) to 233.72mgKOH/g (omilo). The high
 104 saponification values of these spices indicates high content of triacylglycerol and is consistent
 105 with the high esterification values (164.28 – 231.14 mgKOH/g). These values indicates that
 106 the seed oils has potential to be used in the cosmetic industry. The low acid value observed
 107 for omilo (2.58mgKOH/g) and country onion (3.69mgKOH/g) indicates that the
 108 triacylglycerols have not been hydrolysed a sign of good stability. The acid value for this
 109 seed oils fell within the acceptable range of 0.00 to 4.00mg/KOH/g (18); therefore, these seed
 110 oils are suitable for consumption contrary to gbafilo and taiko with high acid values. The high
 111 acid value corresponds to high free fatty acids recorded for both gbafilo and taiko. The
 112 peroxide value is an index of rancidity, thus, the peroxide value for omilo (9.42 mEqO₂/kg) is
 113 within the acceptable value of 10mEqO₂/kg (22). Oil seeds of gbafilo and taiko had high
 114 peroxide values, suggesting that these oils will be prone to rancidity. The percentage oil yield
 115 for omilo was higher than the rest. The high lipid content found in omilo seed may be
 116 economically attractive for industrial extraction.

117 **Table 4: Fatty acid profile**

Fatty Acids	Relative Percentage (%)			
	Omilo	Country onion	Gbafilo	Taiko
Caprylic acid (8.0)	ND	1.12 ± 0.11	2.68 ± 0.41	7.44 ± 0.22
Capyric acid (10.0)	ND	4.55 ± 0.72	4.19 ± 0.11	10.64 ± 1.02
Lauric acid (12.0)	2.95 ± 0.31	3.13 ± 0.42	5.38 ± 1.14	7.46 ± 0.36
Myristic acid (14.0)	0.41 ± 0.01	ND	ND	ND
Myristoleic acid (14.1)	1.65 ± 0.03	5.73 ± 0.78	35.68 ± 1.14	20.99 ± 1.13
Palmitic acid (16.0)	ND	ND	39.45 ± 1.16	28.09 ± 1.02
Palmitoleic acid (16.1)	ND	ND	ND	12.06 ± 1.02
Oleic acid (18.1)	92.98 ± 2.40	72.73 ± 1.17	12.67 ± 0.00	13.14 ± 0.03
Linolenic acid 918.3)	2.04 ± 0.31	12.84 ± 0.02	ND	ND
TSF	3.36	8.80	51.70	53.63
TUSF	96.67	91.30	48.35	46.19

118 *Mean value ± standard deviation (n=3)*

119 Fatty Acids Composition of Omilo, Country Onion, Gbafilo and Taiko are presented in Table
 120 4. The major fatty acid in omilo (92.98%) and country onion (72.73%) is oleic acid. While
 121 gbafilo (39.45%) and taiko (28.09%) showed high content of palmitic. Linoleic acid was
 122 present only in country onion (12.84%). High content of monounsaturated fatty acids was
 123 found in the oils of omilo and country onion. The fatty acid composition of both omilo and

country onion showed high content of oleic acid as those of olive oil and papaya oil that has 71% and 71.3% respectively (18). Recent evidence suggest that diets rich in monounsaturated fatty acids can lower Total and LDL-cholesterol levels when substituted for saturated fatty acids in the diet. Therefore, consumption of monounsaturated fatty acids may play a preventive role in the battle against coronary heart disease (23). Monounsaturated fatty acid has also been proved to be better than polyunsaturated fatty acids because they are less susceptible to oxidation (24). Gbafilo and taiko are moderately rich in saturated fatty acids may not be good sources of dietary fat since saturated fats in the diet raise blood cholesterol and LDL-cholesterol levels.

CONCLUSION

The study of the seed oil of these spices showed a moderate to high lipid content. The high proportion of unsaturated fatty acids observed for omilo and country onion make these oils an acceptable substitute for other highly unsaturated fats. The physiochemical properties of omilo and country onion area in agreement with those of conventional seed oils and can therefore be used as food supplements for edible oils, besides their uses as condiments.

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