Pak. J. Biotechnol. Vol. 16 (2) 119-126 (2019) pISSN: 1812-1837 eISSN 2312-7791 www.pjbt.org
http://doi.org/10.34016/pjbt.2019.16.1.18

COMPARATIVE STUDY ON THE ANTIOXIDANT PHYTOCHEMICAL CONTENTS OF SOME SELECTED COMMERCIAL VEGETABLE OILS IN NIGERIA

[1]Nkwocha, C. Chinelo; [2]Ekeanyanwu C. Raphael and [3]Nwagwe R. Onyinyechi

[1]Department of Biochemistry, University of Nigeria, Nsukka, Enugu State, Nigeria. [2]Department of Biochemistry, Imo State University,Owerri, Imo State, Nigeria. [3]Department of Biochemistry, Federal University, Oye-Ekiti, Ekiti State, Nigeria. Email: austinelonwa@gmail.com

Article received 14.4.2019, Revised 10.6.2019, Accepted 17.7.2019

ABSTRACT

The present study was aimed at comparing the locally produced vegetable oils (Mamador vegetable oil, Imo palm oil, Nsukka palm oil, Kings vegetable oil) with a foreign produced vegetable oil (Turkey vegetable oil), as to the levels of total flavonoids, total phenolic compounds, total glycosides and total alkaloids. In order to quantify and identify the aforementioned antioxidants, GC model of GC SR18610 Gas chromatography FID/ECD was employed. Kings vegetable oil was characterized by high content of total flavonoids (40.798 g/100g). Turkey vegetable oil was characterized by high content of phenolics (67.173 g/100g). Imo palm oil was characterized by high content of total alkaloids (39.194 g/100g), while Mamador vegetable oil was characterized by high content of total glycosides (40.511g/100g). However, the locally produced vegetable oil (Kings vegetable oil) presented important content of the four antioxidants: total flavonoids (38.141g/100g), total alkaloids (23.132g/100g), total phenolics (51.672g/100g) and total glycosides (19.730g/100g). According to the result, it is therefore suggested that the locally produced vegetable oil (Kings Vegetable Oil) can be used as specialty oil since it contains relatively high amount of the aforementioned antioxidants. However, the other vegetable oils under study such as Imo palm oil, Turkey Vegetable Oil, Nsukka palm oil and Mamador Vegetable Oil are all suitable for consumption since they contain reasonable amount of antioxidants.

Key Words: vegetable oil, total glycosides, total flavonoids, total phenolics, total alkaloids, gas chromatography
Running title: Antioxidant levels of some vegetable oil

INTRODUCTION

Oil can be said to be any non-polar chemical substance, viscous liquid at ambient temperature and contains both hydrophobic and lipophilic properties. They contain high carbon and hydrogen content and are also flammable and surface active. Oils can be generally defined as classes of chemical compounds that may be otherwise unrelated in structures, properties, and uses but are from either animal, vegetable, or petrochemical origin, and may be volatile or non-volatile. They can be used for food, fuel or medical purposes and in the manufacture of many types of paints, plastics, and other materials. Organic oils which are the oils of interest in this study are produced in remarkable diversity by plants, animals and other organisms through natural metabolic processes. Lipid is the scientific term for the fatty acids, steroids and similar chemicals often found in the oils produced by living things, while oil refers to an overall mixture of chemicals. Organic oils may also contain chemicals other than lipids, including proteins, waxes and alkaloids. Lipids can be classified by the way they are made by an organism, their chemical structure and their limited solubility in water compared to oils. They have a high carbon and hydrogen content and are considerably lacking in oxygen compared to other organic compounds and minerals; they tend to be relatively nonpolar molecules, but may include both polar and nonpolar regions as in the case of micelles.

Vegetable oils are fats extracted from seeds, or less often, from other parts of fruits. Vegetable fats are mixtures of triglycerides. Soybean oil, rapeseed oil, and cocoa butter are examples of fats from seeds. Olive oil, palm oil and rice bran oil are examples of fats from other parts of fruits. In common terminology, vegetable oil may refer exclusively to vegetable fats which are liquid at room temperature (Alfred *et al.,* 2015).Vegetable oils are obtained from oil containing seeds, fruits, or nuts by different pressing methods, solvent extraction or a combination of these (Bennion, 1995). Crude oils obtained are subjected to a number of refining processes, both physical and chemical. (Fennema, 1985; Bennion, 1995). There are numerous vegetable oils derived from various sources. These include the popular vegetable oils: the foremost oilseed oils - soybean, cottonseed, peanuts and sunflower oils; and others such as palm oil, palm kernel oil, coconut oil, castor oil, rapeseed oil and others. They also include the less commonly known oils such as rice bran oil, tiger nut oil, patua oil, kome oil, Niger seed oil, piririma oil and numerous others. Their yields, different compositions and by extension their physical and chemical properties determine

their usefulness in various applications aside edible uses.

Numerous experimental works have established the positive effect of anti-oxidants on the oxidative stability of vegetable oils for both edible uses and industrial uses. An important class of anti-oxidants consists of the phenolic compounds butylhydroxyanisole (BHA), butylhydroxytoluene (BHT), propyl gallate, and tert-butyl hydroquinone (TBHQ). Their use in vegetable oils meant for domestic and industrial processes is widespread. Vegetable oils in their natural form possess constituents that function as natural antioxidants. Amongst them are ascorbic acids, α-tocopherole, β-carotene, chlorogenic acids and flavanols (Ullah *et al*., 2003). This study was therefore aim at comparing the anti-oxidant properties of foreign produced vegetable oil (turkey vegetable oil) with some locally produced vegetable oils

MATERIALS AND METHODS

Materials

Sample collection: The vegetable oil samples used were put in neat containers from Ogige market, Nsukka, Enugu state, Nigeria. The samples involved both branded and unbranded oil from different spots. The samples were Turkey Vegetable Oil (foreign produced), Mamador Vegetable oil, Imo palm oil, Nsukka palm oil, Kings Vegetable Oil (locally produced) stored in a 200ml sterile capped glass bottles at room temperature in a cupboard to prevent exposure to light which could affect its properties.

Table I: Producers of oil brands analyzed

OIL BRANDS	*PRODUCED COMPANIES*
Mamador Vegetable Oil	Pz wilmar limited
Nsukka palm oil	Unbranded
Kings Vegetable Oil Imo palm oil	Wilmar international limited unbranded
Turkey Vegetable Oil	Ngo chew hong edible oil pte limited

Chemicals and Reagents: All the chemicals and reagents used were all purchased from Sigma Aldrich, St Louis, USA.

Equipment and Instruments: The equipment and instrument were obtained from the laboratory units of the IITA research institute, Ibadan, Oyo state, Nigeria. They include: Measuring cylinder (Gents products, India), Centrifuge (Vicka Ltd, England), HPLC injection (Mount Holly, NJ, USA), Hand gloves (Supermax Ltd, Malaysia), Centrifuge tubes (Vickas Ltd, England), Glass vials (Sigma Aldrich, USA), Fluorescence detector (Jenway, UK), Jasco v-630 spectrophotometer (Jenway, UK), Analyser cups (Pyrex, England), Digestion tubes (Vickas Ltd, England.

Methods

Determination of Phenolics*:* Phenolics content was analysed using GC model of GC SR18610 Gas chromatography FID/ECD after extraction of the Phenolic compound according to the methods described by Henriques *et al*., (2004) and Van de santos *et al*., (2001). Briefly, 2.5 ml f sample was weighed into a set of test tube and 30 ml of 70 % acetone in ultra-pure water was added to the test tubes. T he tubes containing the samples were placed in an ultrasonic water bath at 10˚C for 2 minutes and stirred occasionally with a glass rod. It was filtered into a 50ml Erlenmeyer flask. The above extraction procedure was carried 3 times to have the expected extraction volume needed for the analysis. 2 ml of 0.1M acetate and 15 ml of 0.1 M TEA reagent were added into the filtrate. The flask was closed with a rubber stopper and kept in a cold storage (4˚C) for complete cold extraction. The following day, it was shaked for 10 minutes, centrifuged for 5 minutes at 5000 rpm. The supernatant was then collected in a set of GC auto analyser cups ready for analysis.

Sample concentration

10 ml of sample extracts each were pipette and concentrated to 2 ml each. The sample extracts were diluted using methylene chloride.

Calculation

$$\text{ppm in sample} = \frac{\text{ppm in extract} \times \text{extraction volume} \times \text{dilution factor}}{\text{Weight of sample}}$$

$$\text{g/100 g concentration} = \frac{\text{ppm in sample}}{10{,}000}$$

Determination of flavonoids: Flavonoids content was analyzed using GC model of GC SR18610 Gas chromatography FID/ECD after extraction of the Phenolic compound according to the method described by Gatti, Gioia, Cavrini, (2004) and Bringmann *et al*., (1999). Briefly, 25ml of sample solution was pipette into 300 ml standard taper 24/40 round bottom boiling flask, 25 ml of dioxane was added and swirled to mix. Also 25ml of H_2SO_4 was slowly added to the mixture. The flask was connected to water cooled condenser and refluxed vigorously for 1 hour 30 minutes. Through the top of the condenser, 75ml ultra pur water followed immediately by 100 ml CH_3Cl_3 were added and refluxed 15-20 minutes more. The mixture was allowed to cool to room temperature and transferred into a 500 ml separator. 100 ml of ice ultra pure water was added and shaked vigorously for 5 minutes. The phase was allowed to separate completely.

Sample Concentration: This was done by heating to almost dryness before making the expected volume. Also the dilution factors 2X, 5X and 10X

were made on the sample extract depending on the concentration.

Calculation:

The software determined the relative response factor (RF) from the standard of known concentration (i.e. 6 ml ammonium glycyrrhetic standard solution). From this relationship, the peak area obtained by triangulation equation is used by the software to calculate concentration of the samples of unknown concentration using the following equation as installed in the software below:

$$RF = \frac{PA_{AG} \times S_{AG}}{PA_{C} \times S_{C}} \times \frac{W_{C}}{W_{AG}}$$

where subscript AG and C refer to hydrolysed standard ammonium glycyrrhizinate (i.e. glycyrrhetic acid and cholesterol internal standard respectively) AA=peak area; S=Attenuation; W=mg standard weight

Determination of glycosides: Glycosides content was analyzed using GC model of GC SR18610 Gas chromatography FID/ECD after extraction of the Phenolic compound according to the method described by Boligon *et al*., (2014) and Carter et al., (2010). Briefly, 2ml of sample was weighed into a set of 50 ml test tubes and 40 ml of extraction solution was added (the extraction solution was prepared by adding 30 ml of ultrapure water, 50 ml of glacial acetic acid and 5 g of $NaHSO_3$ into a litre of volumetric flask. It was dissolved and made to mark). The extraction process was made to 1 litre volume with the extraction solution. It was shaked for 10 minutes on a mechanical shaker and centrifuged for 10 minutes at 4500 rpm. The supernatant was decanted to a set of GC auto analyser cups for determination on GC instrument.

Sample Concentration: 20 ml of sample extracts were pipette each to a set of crucible, heated to reduce the volume to 10 ml and transferred after cooling to room temperature to a set of auto analyser vial.

Calculation:

$$\text{ppm in sample} = \frac{\text{ppm in extract} \times \text{extraction volume} \times \text{dilution factor}}{\text{Weight of sample}}$$

$$\text{g/100g concentration} = \frac{\text{ppm in sample}}{10{,}000}$$

Determination of alkaloids: The alkaloids content was analyzed using GC model of GC SR18610 Gas chromatography FID/ECD after extraction of the alkaloids compound according to the method described by Brachet, et al., (2002) and Alali et al., (2008). Briefly, 5ml of sample was weighed into a set of conical flasks and 50ml of 20% acetic acid solution in ethanol was dispensed into each sample flask. The mixture was shaked well for 4 hours for extraction to be completed. The filtrate was evaporated to a quarter of its original volume after centrifuging for 15 minutes at 3500 rpm. The supernatant was then transferred to a set of vials for analysis.

Sample Concentration: 5 ml of sample extracts were pipette and concentrated to 3.5 ml each. The sample extracts were diluted using methyl ethanoate solution.

Calculation

This was done using the software interphased with the instrument as follows:

$$\text{ppm in sample} = \frac{\text{ppm in extract} \times \text{extraction volume} \times \text{dilution factor}}{\text{Weight of sample}}$$

$$\text{g/100 g concentration} = \frac{\text{ppm in sample}}{10{,}000}$$

RESULTS

Alkaloids Contents of Different Vegetable Oils: The total alkaloid concentrations of the five different vegetable oils range from 21.502-39.194 g/100g. From the Table II below, Imo palm oil has the highest total alkaloid concentration followed by Nsukka palm oil; Turkey Vegetable Oil, Kings Vegetable Oil and Mamador Vegetable Oil have the least total alkaloid concentration in that descending order.

Table II: Alkaloid composition of the different vegetable oils

Sample particulars	Mamador vegetable oil	Imo palm oil	Turkey vegetable oil	Nsukka palm oil	Kings vegetable oil
Caffiene (g/100g)	0.138	0.471	0.194	0.392	0.150
Colchicine (g/100g)	1.279	2.555	1.825	1.938	1.428
Rauwolfia (g/100g)	0.071	0.120	0.375	0.263	0.249
Morphine (g/100g)	0.054	0.107	0.077	0.081	0.060
Apomorphine (g/100g)	0.273	0.054	0.389	0.413	0.305
Atropine (g/100g)	0.088	0.273	0.125	0.133	0.098
Apoatropine (g/100g)	0.129	0.258	0.184	0.195	0.144
Psychotrine (g/100g)	0.059	0.048	0.052	0.035	0.028
Cinchonidine (g/100g)	0.030	0.060	0.043	0.046	0.034
Quinine (g/100g)	9.728	18.535	13.242	14.061	10.363
Narcotine (g/100g)	0.232	0.463	0.331	0.351	0.259

Codeine (g/100g)	1.801	3.597	2.570	2.729	2.011
Papaverine (g/100g)	0.087	0.175	0.125	0.133	0.098
Nicotine (g/100g)	1.890	3.776	2.698	2.865	2.111
Coninem (g/100g)	0.160	0.319	0.228	0.242	0.179
Piperine (g/100g)	0.234	0.468	0.334	0.355	0.262
Ricinine (g/100g)	0.112	0.225	0.160	0.170	0.126
Strycinine (g/100g)	1.362	2.720	1.943	2.064	1.521
Theophylline (g/100g)	0.289	0.234	0.254	0.171	0.139
Nornicotine (g/100g)	0.015	0.029	0.021	0.022	0.016
Vincristine (g/100g)	0.215	0.429	0.307	0.326	0.240
Eserine (g/100g)	0.165	0.330	0.236	0.250	0.184
Pilocarpine (g/100g)	0.031	0.062	0.044	0.047	0.035
B-carboline (g/100g)	1.154	0.937	1.015	0.685	0.555
Reserpine (g/100g)	0.152	0.303	0.217	0.230	0.170
Heroin (g/100g)	0.736	0.461	0.759	0.177	0.290
Cocaine (g/100g)	0.020	0.041	0.029	0.031	0.023
Acridine (g/100g)	0.005	0.010	0.007	0.007	0.005
Emetine (g/100g)	0.153	0.291	0.210	0.841	0.199
Quinidine (g/100g)	0.050	0.100	0.071	0.076	0.056
Hyoscine (g/100g)	0.013	0.026	0.018	0.020	0.014
Berberine (g/100g)	0.314	0.255	0.276	0.186	0.151
Cephaline (g/100g)	0.076	0.818	0.016	0.045	0.025
Pyridine (g/100g)	0.010	0.007	0.007	0.005	0.008
Theobromine (g/100g)	0.095	0.077	0.083	0.056	0.046
Phenylethylame (g/100g)	0.002	0.008	0.003	0.016	0.004
Ergotamine (g/100g)	0.014	0.027	0.019	0.021	0.015
Tubocurarine (g/100g)	0.050	0.100	0.071	0.076	0.056
Vinblastine (g/100g)	0.032	0.058	0.899	0.079	0.269
Peletrevine (g/100g)	0.152	0.303	0.217	0.230	0.170
Norpseudoepherne g/100g)	0.032	0.064	0.046	0.049	0.036
Total alkaloids (g/100g)	21.502	39.194	29.720	30.112	23.132

Phenolic Content of Different Vegetable Oils*:* The total phenolic concentrations of the five different vegetable oils range from 33.294-67.173g/100g. From the Table III below, Turkey Vegetable Oil has the highest total phenolic concentration followed by Kings Vegetable Oil, Mamador Vegetable Oil, and Imo palm oil with Nsukka palm oil having the least total phenolic content.

Table III: Phenolic composition of the different vegetable oils

Sample particulars	Mamador vegetable oil	Imo palm oil	Turkey vegetable oil	Nsukka palm oil	Kings vegetable oil
Cinnamic acid (g/100g)	2.963	2.267	3.736	1.979	3.282
Piperonic acid (g/100g)	1.693	1.295	2.135	1.131	1.875
Valnilic acid (g/100g)	13.333	10.201	16.811	8.906	14.767
Genticitic acid (g/100g)	0.071	0.054	0.090	0.048	0.079
Galic acid (g/100g)	0.361	0.276	0.455	0.241	0.400
Salicylic acid (g/100g)	0.116	0.089	0.146	0.078	0.129
Carreic acid (g/100g)	0.171	0.131	0.215	0.114	0.189
Sinagic acid (g/100g)	1.730	1.323	2.181	1.188	0.944
Caffeic acid (g/100g)	0.066	0.051	0.083	0.044	0.073
Contaric acid (g/100g)	0.804	0.615	1.014	0.537	0.890
Sinamic acid (g/100g)	12.283	9.397	15.486	8.205	13.604
Ferulic acid (g/100)	0.307	0.235	0.387	0.205	0.340
Homogenistic acid (g/100g)	2.384	1.824	3.006	1.592	2.640
Homovanilic acid (g/100g)	0.116	0.089	0.146	0.077	0.128
Pyrogallic acid (g/100g)	2.502	1.914	3.155	1.671	2.771
Syringic acid (g/100g)	0.212	0.162	0.267	0.141	0.234
Benzoic acid (g/100g)	0.310	0.149	1.803	0.866	0.017
Izoferulic acid (g/100g)	0.237	0.114	1.379	0.139	0.013
Mendelic acid (g/100g)	0.391	0.188	2.273	0.004	0.022
p-cumaric acid (g/100g)	0.207	0.099	1.204	0.598	0.011
Cutissin acid (g/100)	0.343	0.165	1.997	0.572	0.019

Salicitic acid (g/100g)	0.284	0.218	0.359	0.190	0.315
P-OH-benzoic acid (g/100g)	0.219	0.167	0.276	0.146	0.242
M-OH-benzoic acid (g/100g)	0.041	0.032	0.052	0.028	0.046
Homovanillic acid (g/100g)	0.278	0.662	0.458	0.547	0.720
Caffein acid (g/100g)	2.689	2.059	3.391	1.796	2.979
Catechin acid (g/100g)	0.642	0.491	0.809	0.429	0.711
Astringin acid (g/100g)	0.778	0.360	0.241	0.187	0.969
Ferteric acid (g/100g)	0.026	0.020	0.033	0.017	0.029
Castarinol c2 acid (g/100g)	0.043	0.033	0.054	0.028	0.047
Singlic acid (g/100g)	0.270	0.797	0.905	0.188	0.944
P-OH-benzoic acid (g/100g)	0.470	0.245	0.940	0.326	0.489
Caffaric acid (g/100g)	0.201	0.154	0.253	0.134	0.223
Couramic acid (g/100g)	0.005	0.008	0.004	0.007	0.005
Cyanidin-30-glucoside (g/100g)	0.006	0.005	0.008	0.004	0.007
Couramoyl 30-glucoside (g/100g)	0.027	0.021	0.034	0.018	0.030
Castarinol c1 acid (g/100g)	0.018	0.014	0.023	0.012	0.020
Castarinol c3 acid (g/100g)	0.019	0.015	0.025	0.013	0.022
Castarinol c4 acid (g/100g)	0.040	0.031	0.050	0.027	0.044
Aesculetin acid (g/100g)	0.223	0.170	0.281	0.149	0.247
Ethyl/caffeati Acid (g/100g)	0.366	0.280	0.462	0.245	0.406
Ethyl/gallon Acid (g/100g)	0.004	0.003	0.005	0.002	0.004
Protocatechic Acid (g/100g)	0.188	0.969	0.541	0.465	0.746
Total Phenolics (g/100g)	47.220	37.391	67.173	33.294	51.672

Flavonoids Content of Different Vegetable Oils*:* The total flavonoid concentrations of the different oils range from 15.473-38.141 g/100g. From the tables below, Kings Vegetable Oil has the highest total flavonoid concentration followed by Mamador Vegetable Oil, Turkey Vegetable Oil, Nsukka palm oil and with Imo palm oil having the least total flavonoid concentration.

Table IV: Flavonoid composition of the different vegetable oils

Sample particulars	Mamador vegetable oil	Imo palm oil	Turkey vegetable oil	Nsukka palm oil	Kings vegetable oil
Hesperidin (g/100g)	0.042	0.359	0.545	0.509	0.780
Nanirutin (g/100g)	1.953	0.777	1.454	1.172	2.160
Poncirin (g/100g)	0.080	0.118	0.045	0.229	0.010
Didymin (g/100g)	0.082	0.033	0.061	0.049	0.091
Eriocitrin (g/100g)	0.0417	0.166	0.310	0.250	0.461
Rhoifolin (g/100g)	0.134	0.053	0.100	0.080	0.148
Diosmin (g/100g)	0.197	0.078	0.147	0.118	0.218
Naringin (g/100g)	0.358	0.142	0.266	0.215	0.396
Acacetin (g/100g)	0.354	0.141	0.263	0.212	0.391
Apigenin (g/100g)	0.121	0.992	0.703	0.074	0.783
Nobiletin (g/100g)	0.169	0.636	0.549	0.502	0.670
Raxifolin (g/100g)	2.750	1.094	2.047	1.650	3.041
Sinerisetrin (g/100g)	0.134	0.053	0.099	0.080	0.148
Tangeretin (g/100g)	2.887	1.148	2.149	1.732	3.192
Neodiosmin (g/100g)	0.244	0.097	0.182	0.146	0.270
Myricetrin (g/100g)	0.252	0.100	0.188	0.151	0.279
Quercetin (g/100g)	2.079	0.827	1.548	1.248	2.300
Glycetein (g/100g)	1.995	0.794	1.485	1.197	2.207
Luteolin (g/100g)	0.302	0.280	0.626	0.982	0.241
Genistein (g/100g)	3.102	1.234	2.310	1.862	3.431
Daidzein (g/100g)	0.844	0.302	0.796	0.507	0.523
Eriodicytol (g/100g)	0.328	0.130	0.244	0.197	0.363
Kaempterol (g/100g)	0.048	0.019	0.035	0.029	0.053
Anthocyanin (g/100g)	7.232	2.877	5.385	4.340	7.999
Acacetin (g/100g)	0.022	0.009	0.017	0.013	0.025
Taxifolin (g/100g)	0.046	0.018	0.034	0.028	0.051
Tangeretin (g/100g)	0.020	0.008	0.015	0.012	0.022

Hesperetin (g/100g)	0.049	0.020	0.037	0.030	0.054
Epicatechin (g/100g)	0.076	0.030	0.057	0.046	0.084
Thearubigins (g/100g)	0.003	0.006	0.004	0.008	0.009
Theaflarins (g/100g)	0.232	0.092	0.173	0.139	0.256
Naringenin (g/100g)	0.172	0.068	0.128	0.103	0.190
Epicatechin gallate (g/100g)	0.007	0.003	0.006	0.004	0,008
Epigallocatechin gallate (g/100g)	0.031	0.012	0.023	0.019	0.035
Proanthocyanidin (g/100g)	0.021	0.008	0.015	0.012	0.023
Isorharmnetic (g/100g)	5.984	2.380	4.455	3.591	6.618
Epigallocatechin (g/100g)	0.927	0.369	0.691	0.557	1.026
Total flavonoids (g/100g)	33.319	15.473	27.192	22.093	38.141

***Glycoside content of Different Vegetable Oils**:* The total glycoside concentrations of the five different oils range from 19.730-40.511g/100g. From the tables below, Mamador Vegetable Oil has the highest total glycoside concentration followed by Imo palm oil, Nsukka palm oil, and Turkey Vegetable Oil with Kings Vegetable Oil having the least total glycoside concentration.

Table V: Glycoside content of the different vegetable oils

Sample particulars	Mamador vegetable oil	Imo palm oil	Turkey vegetable oil	Nsukka palm oil	Kings vegetable oil
Glycyrhizic acid (g/100g)	4.254	3.454	3.741	2.526	2.044
Glycyrrhetinic Acid (g/100g)	2.431	1.974	2.138	1.443	1.168
Digoxin acid (g/100g)	0.102	0.083	0.090	0.061	0.049
Digitoxin acid (g/100g)	0.518	0.421	0.456	0.308	0.249
Oleandrin acid (g/100g)	0.167	0.135	0.146	0.099	0.080
Varapamil acid (g/100g)	0.245	0.199	0.216	0.146	0.118
Nifedipine acid (g/100g)	17.637	14.317	15.507	10.472	8.472
Lisinopril acid (g/100g)	3.423	2.779	3.010	2.032	1.644
Captopril acid (g/100g)	3.593	2.917	3.159	2.133	1.726
Furosemide acid (g/100g)	0.445	0.361	0.392	0.264	0.214
Enalapril acid (g/100g)	0.166	0.135	0.146	0.099	0.080
Propranolol acid (g/100g)	0.214	0.173	0.188	0.127	0.103
Atenonol acid (g/100g)	2.588	2.101	2.276	1.537	1.243
Metoprolol acid (g/100g)	0.408	0.332	0.359	0.242	0.196
Hydrochorathiazide acid (g/100g)	0.304	0.247	0.267	0.180	0.146
18-beta-glycyrrhetinic acid (g/100g)	2.431	1.974	2.138	1.443	1.168
E-strophanthin Acid (g/100g)	1.145	5.542	1.833	4.367	0.820
Amedipine acid (g/100g)	0.440	0.357	0.387	0.261	0.212
Total glycosides (g/100g)	40.511	37.501	36.449	27.740	19.730

DISCUSSION

Vegetable oils are comprised of fats/lipids that are sourced from some cereals, certain fruits, grains, nuts and seeds (Sanders, 2016). Vegetable oils are made up of mixtures of triacylglycerols (usually >95%) with some minor amounts of diacylglycerols (<5%). They also contain minor non fatty acid components which are of nutritional significance, some of which include alpha tocopherol, gamma tocopherol, tocotrienols as well as pro vitamin A and vitamin K (Sanders, 2016). Some cold pressed oils are rich in polyphenols for which several health claims have been made in literature. All the vegetable oils analysed in the present study also had different levels of these non fatty acid components (antioxidants phytochemicals).

The Turkey Vegetable Oil exhibited the highest phenolic content (67.173g/100g), while Nsukka palm oil presented the lowest (33.294g/100g). Block et al., (1992) believe that a diet rich in phenolics reduces the risk for colon cancer. Graf et al., (2005) stated that phenolics display important functions like inhibition of pathogens and microorganisms generally, anti-deposition of triglycerides, reduction in the incidence of non-communicable diseases such as cardiovascular diseases, diabetes, cancer and stroke, anti-inflammation and anti-allergic effect through processes involving reactive oxygen species. The foreign produced vegetable oil (Turkey Vegetable Oil) provides a reasonable amount of phenolics which implies that it is suitable for usage as an antioxidant than the locally produced ones as to the levels of phenolics.

All the oils presented relatively high levels of total flavonoids. The highest content is presented in Kings Vegetable Oil (38.141 g/100g) followed by Mamador Vegetable Oil, Turkey Vegetable Oil, Nsukka and Imo palm oil which contain 33.319 g

/100g, 27.192 g/100g, 22.093 g/100g, 15.473g/ 100g respectively. Lewis acids have been employed in literature to synthesize proanthocyanidins; thus aluminium trichloride was used to synthesize dimeric and oligomeric procyanidins of (+)-catechin and (-)-epicatechin units (Saito *et al.,* 2002). In these reactions, the role of Lewis acids is to promote the formation of the benzylic carbocation at C4 of a flavanol subunit starting from a C4 hetero substituted flavanol, which thereafter undergoes a Friedel-Craft-like addition on a second flavanol subunit (Kawamoto *et al.*, 1991). The locally produced vegetable oil (Kings vegetable oil) presented the highest flavonoid content. Flavonoids have a protective effect towards oxidative damages of DNA in lymphocytes (Lairon and Amiotn, 1999). Flavonoids, catechins and their derivatives are considered as therapeutic agents in studies focused on degenerative diseases and brain aging processes; they serve as possible neuroprotective agents in progressive neurodegenerative disorders such as Parkinson's and Alzheimer's diseases. The locally produced vegetable oils provide more flavonoids indicating more beneficial antioxidant role to human health.

All the vegetable oils in this study presented important levels of total alkaloids. The highest content is presented in Imo palm oil (39.194 g/100g) followed by Nsukka palm oil, Turkey Vegetable Oil, Kings Vegetable Oil and Mamador Vegetable Oil, 30.112g/100g, 29.720g/100g, 23.132g/100g, 21.502 g/100g respectively. The locally produced vegetable oil (Imo palm oil) presented the highest content of alkaloids than the foreign produced one (Turkey vegetable oil). Stary (1996) stated that alkaloids and their synthetic derivatives are used as basic medicinal agents all over the world for their analgesic, antispasmodic, and bactericidal effects. Alkaloids can accept electrons and become quartenized thus may be regarded as antioxidants in this regard.

All the oils presented important level of total glycosides. Mamador Vegetable Oil presented the highest content of total glycosides (40.511 g/100g) followed by Imo palm oil, Turkey Vegetable Oil, Nsukka palm oil and Kings Vegetable Oil, (37.501 g/100g), (36.449 g/100g), (27.740 g/100g), (19.730 g/100g) respectively. The locally produced vegetable oil (Imo palm oil) presented higher content of glycosides than the foreign produced one (Turkey Vegetable Oil). Varisa (2013) stated that cardiac glycosides have been shown to have anticancer activities during various stages of carcinogenesis. This implies that the locally produced vegetable oil (Mamador Vegetable Oil) is more suitable as to the level of total glycosides.

The antioxidant composition of vegetable oils has a big impact on the properties and quality of food. The industrial and commercial use of these vegetable oils will be beneficial to health as they contain considerable amounts of antioxidants. However, the domestic use of the locally produced vegetable oil such as kings vegetable oil will be of paramount importance since they contain reasonable amounts of antioxidants. This implies that locally produced vegetable oils can be utilized as specialty oil both industrially and commercially.

Conflict of interest: The authors have declared no conflict of interest.

REFERENCES

Alali, F.Q., Gharaibeh, A., Ghawanmeh, A., Tawaha, K. and N.H. Oberleis, Colchicinoids from *Cohchicum crocfolium Boiss:* A case study indepreplication strategies for (-)-colchine and related analogues using LC-MS and LC-PDA techniques. *Phytochem. Anal.* **19**: 385 (1985).

Alfred, T., Bertrand, M. and Hans-Jochen, F. Fats and fatty oils. *Ullmann's Encyclopedia of Industrial Chemistry* **13**: 441-470 (2015).

Bennion, M., *Introductory Foods*. 10th edition. Prentice-Hall Inc, Upper saddle river, New Jersey USA Pp. 265-286 (1995).

Block, G., Patterson, B. and A. Subar, Fruit, vegetables, and cancer prevention: A review of the epidemiological evidence. *Nutrition and Cancer* **18**: 1-29 (1992).

Boligon, A.A and M.I. Athyade, Importance of HPLC in analysis of plant extract. *Austin Chromatography* **1**(3): 2 (2014).

Brachet, A., Christen, P and J.L. Venthev, Focused microwave assisted extraction of cocaine and benzoylecgonine from coca leaves. *Phytochem. Anal.* **13**: 162-169 (2002).

Bringmann, G., Teltsihik, F., Michael, M., Busemann, S. and M. Rucker, Ancistrocladinium A and B, the First N, C-Coupled Naphthyldihydroisoquinoline Alkaloids, from a Congolese *Ancistrocladus* species. *Phytochem* **52**: 321-332 (1999).

Carter, P., Gray, L.J. and J. Troughton, Fruit and vegetable intake and incidence of type 2 diabetes mellitus. Systematic review and meta-analysis. *British Med. J.* **341**: 4229 (2010).

Fennema, O.R. Food Chemistry, 2nd edition Marcel Dekker, Inc, Pp. 991 (1985)

Gatti, R., Gioia, M.G. and V. Cavrini, *Analytical Chimica Acta* **512**: 85-91 (2004).

Graf, B.A., Milbury, P.E. and J.B. Blumberg. Flavonols, flavones, flavanones, and human health: Epidemiological evidence. *J. Med. Food* **8**: 281-290 (2005).

Henriques, A.T., Lopes, S.O., Paranhos, J., Gregianin, T.S., Von Pose, G.L., Fett-Neto, A.G. et al., Bioactive alkaloids from South American *psychotria* and related species. *Phytochem* **65**: 449 (2004).

Kawamoto, H., Nakatsubo, F. and K. Murakami, Synthesis of condensed tannin derivatives regiosepecifically linked through a single interflavanoid-linkage and their protein precipitating capacities. *Mokuzai Gakkaishi* **37**: 488-493 (1991).

Lairon, D. and M.J. Amiot, Flavonoids in food and natural antioxidants in wine. *Curr. Opinion in Lipid* **10**: 23-28 (1999).

Saito, A., Nakajima, N., Tanaka, A. and M. Ubukata, Synthetic studies of proanthocyanidins. Part 2: Stereoselective gram-scale synthesis of procyanidin-B3 *Tetrahedron* **39**: 7829-7837 (2002).

Sanders, T., Functional Dietary Lipids; Food Formuation, Consumer Issues and Innovation for Health. Wood Head Publishing, 225 Wyman St, Waltham, MA, Pp. 309 (2016).

Singleton, V.L., Orthofer, R. and R.M. Lamuela-Raventos, Analysis of total phenols and other oxidation substances and antioxidants by means of Folin-Ciocalteu reagent. *Methods of Enzymology* **299**:152–178 (1999).

Stary, F., *The Natural Guide to Medicinal Herbs and Plants*. Barnes & Noble Inc. Pp. 50 (1966).

Swain, T. and W.E. Hillis, The phenolic constituents of *Prunusdomestica*. The quantitative analysis of phenolic constituents. *J Sci Food Agric.* **10**: 63–68 (1959).

Ullah, J., Hamayoun, M., Ahmad, T., Ayab, M. and M. Zarafullah, Effects of lights, natural and synthetic anti-oxidants on stability of edible oil and fats. *Asian J. Plant Sci.* **2**(17-24): 1192-1194 (2003)

Van de santos, L., Fett-neto, A.G., Kerber, V.A., Elisabetsky, E; Quiron, J.C.H. and A.T. Henriques, *Biochem Systema Ecol.* **29**: 1185 (2001).

Varisa, P., Anticancer properties of glycosides: Antiproliferative effects of glycosides. *American Association for Cancer Res.* **18**: 65-71 (2013).