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COMPARING THE ANTIOXIDANT ACTIVITIES OF TOMATO SEED OIL EXTRACTED FROM TWO VARIETIES OF TOMATO FRUITS

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ABSTRACT

Comparing the antioxidant activities of tomato seed oil extracted from two varieties of tomato fruits (Riogrande and Roma VF) demonstrated by five spectrophotometric methods: DPPH, β- carotene linoleic antioxidant, HRSA, ORAC, FRAP. Tomato seed is the major by-product of the tomato paste manufacturing industry in the world today. The tomato seed was extracted from healthy tomato fruits of the two varieties and were washed with water and dried in an oven at 60°C for 3 days, and milled to powder. Ten gram of the powdered samples was placed in a soxhlet extractor, using 300 ml of n-Hexane, and allowed to boil at 40-60°C for 6 hours repeatedly to obtain the oil. The oil was placed in a water bath at 70°C to remove the excess n-Hexane. The results showed that tomato seed oil (TSO) is stable, translucent and highly penetrating oil and the refractive index, Density and the specific gravity of the oil of both varieties are all in line with the FAO/WHO standard. The fatty acid composition results showed that TSO is an excellent source of essential fatty acids. Though Roma VF seed oil at a lower concentration of DPPH (43.270±0.028), β- carotene linoleic antioxidant (15.855±0.035), FRAP (10.765±0.021) and HRSA (31.010±0.014) demonstrated higher oxidation rates of scavenging free radicals, chelating prooxidative metals, quenching singlet oxygen and photosensitizers, and inactivating lipoxygenase compared to the Riogrande seed oil which had the only lower reducing potential of ORAC (1.480±0.014).

Keywords: Spectrophotometric methods, soxhlet extractor, fatty acid composition, essential fatty acids, scavenging free radicals

INTRODUCTION

Tomato based products are gaining increased demand as consumers continue to discover the functional and nutritive benefits that tomatoes offer. Tomato seed is the major by-product of the tomato paste manufacturing industry in the world today, large amount of wastes are produced from both seeds and the skin (Sogi and Bawa, 1998). Tomato pulp primarily consists of skin and seeds. The tomato wastes are lignocellulosic based products that often creates disposal difficulty (Brodowski and Geisman, 1980). Several unit operations such as drying, grinding, squeezing and filtrating were used to obtain tomato seed oil from tomato seeds (Roy *et al.,* 2003). Tomato oil extracted from the seeds with hexane as a solvent gives the highest oil yield. The extraction rate increased as solvent flow rate increased. Tomato seed meal, the main byproduct during tomato oil production, could be used as animal food (Roy *et al.,* 1994; Roy *et al.,* 2003). Studies have documented that the seeds of tomatoes contain essential fatty acids, anti-oxidants, vitamins, minerals, carotenes including lycopene and phytosterols and other

important nutrients that play important roles in the health and radiance of the skin. Although, it is the seed and the skin of the tomato that are the most nutritious, both are typically removed from most tomato based products [www.natural sourcing on tomato seed oil.com]. The tomato seed oil is packed with carotenoid antioxidants such as zeaxanthin, lutein and lycopene along with Phytosterols, polyunsaturated fatty acids and minerals. The oil is mainly composed of glycerides (>98%) and of the so called unsaponifiable fraction (1-2%). The unsaponifiable matter of the tomato seed oil is a quantitatively small but important fraction in which the so called minor components are present (Giuffre' and Capocasale, 2016). It gives important information about the quality of the oil. The unsaponifiable fraction of the oil contains many components which characterize each vegetable oil (Giuffre' and Capocasale, 2015). The oil contains a lot of antioxidants such as alpha-tocopherol and gamma-tocopherol, which are Vitamin E compounds.

Antioxidants quench, scavenge and suppress the formation of reactive oxygen species and free radicals or oppose their actions (Adesegun *et al.,* 2008). The oil also contains carotenoids like lycopene isomers, lutein and beta-carotene. This research will focus on comparing the antioxidant activities of the extracted oil from the two varieties of tomato seeds and determine which variety possesses more antioxidant.

MATERIALS AND METHODS

Healthy tomato fruits of two varieties; Riogrande and Roma VF were carefully harvested at breaker stage by hand picking from the experimental farm in Makurdi, Makurdi Local government area of Benue state, Nigeria and was authenticated by Dr Liamngee Kator of the Department of Biological Sciences, Benue State University, Makurdi, Nigeria. Fruits were selected on the consideration that they were all of similar sizes and maturity level with absence of visual symptoms of disease and defects. The fruits were placed in plastic basket and taken to the laboratory for further studies.

Study location, Study duration

The experiment was carried out in the biology and chemistry laboratories of the Benue State University, Makurdi. Makurdi, the capital of Benue state, Nigeria, is located in North central Nigeria along the Benue River, on latitude 07°43'N and longitude 08°35'E. It is situated within the Benue trough at an elevation of 104 meters above sea level at the lower Benue valley and found in the guinea savannah region. The study was carried out during the period of May- October, 2019 after a preliminary experiment in April, 2019 with temperatures and relative humidity (RH) within the region fluctuating between 25.9 °C to 35.0 °C and 25 % to 79 % respectively using Digital Thermo Hygrometer (THERMO, TFA, Germany).

Seed preparation

The tomato seeds of each variety (Riogrande and Roma VF) were separated and cleaned from pulp with water and then dried in an oven at 60°C for 3 days. The dried seeds of the two varieties of tomato fruits were milled to powder using a mechanical grinder and stored in a safe place until ready for oil extraction.

Oil Extraction from the seeds sample

Ten gram of the powdered tomato seeds was put into a porous thimble and placed in a soxhlet extractor, using 300 ml of n-Hexane (with boiling point of about 40-60°C.) as extracting solvent for six (6) hours repeatedly until the required quantity was obtained. . The extracted oil was placed in a water bath at

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70°C to remove the excess n-Hexane. The oil was kept in the refrigerator (0˚C to 4˚C) without further treatment until needed for further analysis (AOAC, 2005).

Determination of Fatty Acid Composition

The oils were subjected to methylation or derivatization as described by AOAC (2012). The extracted oil was methylated into fatty acid methy ester (FAME). Hexane (1 ml) was put into 0.1 ml of the oil, and 1 ml of sodium methoxide solution (1.55 g NaOH in 50 ml methanol) was added to the oil solution. The solution was stirred with a hard spin using a Vortex stirrer for 10 seconds. The solution was allowed for 10 minutes to separate the clear-coloured FAME solution from a cloudy aqueous layer. The top layer was carefully collected. The collected oil was measured using a UV-Vis DAD detector at a predetermined wavelength. The analysis was carried out using GC-MS Shimadzu QP 2010. A 1 µl sample was injected into GC-MS operated using a 30 meter long glass column M, 0.25 mm diameter and 0.25 µm thickness with CP-Sil 5CB stationary phase with a pre-programmed oven temperature of 60-220°C with a temperature rise rate of 10°C / min. The carrier gas was 12 kPa pressurized Helium with a total rate of 30 ml/ min, and a split ratio of 1:50. From the chromatogram, the type and content of fatty acids belonging to saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids were determined. The oil samples were evenly daubed on the GCM spectrophotometer. Spectroscopic absorption in the infrared region was obtained with a resolution of 2cm^{-1} 3 scans and thin the wavelength range of 800-4000 cm^{-1}

Physico-Chemical Properties of the extracted oil

The Physico-Chemical properties: Saponification value, peroxide number, iodine value, acid value, free fatty acid content, refractive index, oil yield and specific gravity of the two varieties of tomato seed oil and their organoleptic properties was determined according to standard analytical methods recommended by AOAC (2007).

Evaluation of Antioxidant Activity of the Extracted Oil

Determination of DPPH Radical Scavenging Activity (DRSA)

Initial DPPH assay on TLC plate was done and then the antioxidant activity of the different crude extracts was evaluated as described by Hossain *et al.* (2013) with modification. 4 ml of each concentration was placed in a working test tube and then DPPH (2,2-diphenyl-1-picrylhydrazyl) (1mL,0.1mM, methanol) added to the test tube and shaken vigorously. After shaking, all the test tubes were allowed to stand at 27˚C in a dark place for 45 min. A control sample was prepared according to the same procedure without any extract. The absorbances of the tested samples were then measured by UV spectrophotometer at the wavelength 517 nm. The antioxidant activity of each sample was expressed in terms of concentration required to inhibit DPPH radical formation by 50% (IC_{50} µg/ml) and calculated from the log-dose inhibition curve.

$$\%DPPH = \frac{(Ac-At)100}{Ac}$$

Where Ac=Absorbance of Control is the absorbance in absence of standards or extracts

At= Absorbance of Sample is the absorbance in presence of standards or extracts

Determination of Hydroxyl Radical Scavenging Assay

The scavenging activity of tomato seed oil on OH^- as measured using a Fenton reaction with a few modifications (Jin *et al.*1996). OH^- could oxidize Fe^{2+} into Fe^{3+}, and only Fe^{2+} could combine with 1,10-phenanthroline to form a red colour complex with the maximum absorbance at 536 nm. The concentration of hydroxyl radical was determined by the degree of decolourization of the reaction solution. The reaction mixture contained 1 ml of 0.75 M 1,10-phenanthroline, 2 ml of 0.2 M phosphate buffer (pH = 7.4), 1 ml of 0.75 mM $FeSO4 \cdot 7H_2O$, 1 ml H_2O_2 (0.01% v/ v), and 1 ml tomato oil sample (concentrations ranging from 0.01 to 200 µg/ml) or ascorbic acid (as a positive control, ranging from 1 to 500 µg/ml), and was incubated at 37°C for 60 min in a water bath, the absorbance of reaction mixture was measured at 536 nm against reagent blank. The Hydroxyl radical scavenging assay (HRSA) was calculated below,

$$HRSA\ (\%) = [(As\ _\ An)/(Ab\ _\ An)] \times 100$$

Where *A*s, *A*n, and *A*b were the absorbance values determined at 536 nm of the sample or ascorbic acid, the negative control, and the blank after reaction, respectively.

Determination of Oxygen Radical Absorbance Capacity (ORAC)

The method employed by Girgih *et al.* (2005) was used. The samples were dissolved in sodium phosphate buffer (75 mM, pH 7.4) and then mixed with 300nM fluorescein in a 96-well microplate followed by incubation of the mixture in the dark at 37°C for 15min (final peptide concentration of 1mg/m. Thereafter, a 50µl aliquot of 80mM 2,2^1-azobis (2-amidinopropane) dihydrochloride (AAPH) was added to the mixture and the change in fluorescence due to AAPH-induced oxidation of fluorescein measured at 1 min intervals for 90 min at excitation and emission wavelengths of 485 nm and 528 nm, respectively, using a fluorescence microplate reader. Different concentration of Trolox (5–80 µM) was used to prepare a standard curve and the ORAC values of the samples calculated as follows:

$$1 + = \sum_{i=1}^{i-100} \frac{\int i}{\int 0}$$

ORAC value was expressed asµ MT trolox Equivalent (TE)/g of sample.

Determination of Ferric Reducing Antioxidant Power (FRAP)

The method employed by Girgih *et al.* (2005) was used. 250µl of the sample was dissolved in 0.2M sodium phosphate buffer at pH 6.6 and blank (250µl of buffer) was mixed with 250µl of same buffer followed by addition of 250µl of 1% (w/v) potassium ferricyanide solution. Thereafter, 250µl of peptide/TCA mixture was combined with 50µl of 0.1% (w/v) ferric chloride and 200µl of double distilled water and allowed to stand at room temperature for 10min.The solution was then centrifuged at 10,000rmp and 200µl of the clear supernatant transferred to a 96-well plate for determination of the absorbance of the supernatant at 700nm.

Determination of β-Carotene Bleaching Antioxidant Assay

In this assay the antioxidant capacity of the tomato seed oils were determined in emulsion by the β-carotene bleaching method of Farag et al. (2003) consisting in a coupled oxidation of linoleic acid and β-carotene. A stock solution of β-carotene/linoleic acid (Sigma–Aldrich) was prepared as follows. β-carotene (0.5 mg) was dissolved in 1 ml of chloroform (HPLC grade), then 25 µl of linoleic acid and 200 mg of Tween 40 (Merck) were added. The chloroform was subsequently evaporated, then

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distilled and oxygenated water (100 ml) was added with vigorous shaking. Aliquots (2.5 ml) of the stock solution were transferred to test tubes, and 300 ml portions of the extracts (1 g/l in methanol) were added before incubating for 48 h at room temperature. The antioxidant activity was evaluated by absorbance measurement at 470 nm against a blank containing emulsified linoleic acid without β-carotene

RESULTS

Table 1: Physicochemical Properties of oils from two varieties of tomato seeds

Physiochemical properties	Riogrande	Roma VF	FAO/WHO (2009) Standard
1. Oil yield (%) (w/w)	35.59±0.120	38.355±0.065	38-40
2. Refractive index	1.466±0.000	1.468±0.000	1.468-1.471
3. Density	0.903±0.001	0.898±0.001	0.896- 0.898
4. Specific gravity	0.9125±0.001	0.9085±0.001	0.900-1.160
5. Acid value (mEq/kg)	6.0545±0.123	1.351±0.094	4.000
6. Iodine value (I_2/100g)	88.680 ±0.023	65.500±0.013	80- 106
7. Saponification value (mg KOH/g)	208.5915±1.165	216.576±2.838	181.4±2.60
8. Peroxide value (mmol/kg)	2.995±0.003	9.955±0.044	10.000
9. Odour	slightly spicy	slightly spicy	
10. Colour	red-yellowish	red-yellowish	
11. Appearance (room temperature)	transparent liquid	transparent liquid	

Values are mean ± common difference of three replicates.

Table 2. Fatty acids compositions of oils from two varieties of tomato seeds

Fatty acids	Name	Symbol	Riogrande	Roma VF
Saturated	Myristic	C14:0	0.171^{b}±0.00	0.222^{c}±0.00
	Palmitic	C16:0	22.610^{a}±0.07	33.660^{c}±0.45
	Stearic	C18:0	9.045^{b}±0.06	10.705^{c}±0.02
	Arachidic	C20:0	0.315^{a}±0.01	0.645^{b}±0.02
	Behenic	C22:0	0.320^{b}±0.01	1.340^{c}±0.01
	Lignoceric	C24:0	0.180^{b}±0.01	1.285^{c}±0.01
Monounsaturated	Margaroleic	C17:1	0.305^{b}±0.01	0.170^{a}±0.01
	Oleic	C18:1	23.405^{c}±0.02	22.115^{a}±0.17
	Gadoleic	C20:1	0.405^{b}±0.01	0.220^{a}±0.01
Polyunsaturated	Linoleic	C18:2	35.605^{b}±0.01	26.520^{a}±0.55
	Linolenic α	C18:3n3	3.080^{c}±0.01	1.895^{a}±0.03
	Linolenic	C18:3n6	4.320^{b}±0.01	1.045^{a}±1.32

Values are mean ± standard deviation of three replicates.
Means across rows with the same superscript were not significantly different at $p \leq 0.05$

Table 3 Antioxidant assay Determination values of oils from two varieties of tomato seeds

SAMPLE	RIOGRANDE	Roma VF	STANDARD	ANOVA
DPPH scavenging Activity (IC_{50} % INHBITION)	80.665^{c} ±0.005	43.270^{a} ±0.028	83.140^{d} ±0.028	0.001
β-carotene Acid oxidation (IC_{50} % INHBITION)	31.045^{c} ±0.010	15.855^{a} ±0.035	43.920^{d} ±0.028	0.001
ORAC (μMTE/mL)	1.480^{a}±0.014	2.325^{b} ± 0.007	16.440^{d} ±0.042	0.001
FRAP ($mgFe^{2+}$/mL)	26.820^{c} ±0.014	10.765^{a} ±0.021	57.315^{d} ±0.021	0.001
HRSA (IC_{50} % INHBITION)	39.415^{c} ±0.021	31.010^{a} ±0.014	46.515^{d} ±0.021	0.001

Values are mean ± common difference of three replicates.
Means across rows with the same superscript were not significantly different at $p \leq 0.05$.

DISCUSSION

Oil content and organoleptic properties of the extracted tomato seed oil

The oil yield of tomato seeds ranged from 35.6 % to 38.4 % (Table 1) on a dry weight basis that are similar to those of other investigators (Morad *et al.,* 1980; Botinestean *et al*., 2012; Fahimdanesh and Bahrami, 2013), with Riogrande having the least yield (35.6%) while the Roma VF had the highest yield (38.4%). Data showed from other researchers that each solvent and each extraction system has a differing effect on the oil yield and physicochemical properties of TSO, for this reason, the choice of the n-hexane solvent and of an extraction system is related to the type of TSO to be obtained (Giuffrè *et al.,* 2017). This is most evident for the biological stability-related parameters. Also, the Soxhlet apparatus extracted both the most oxidized and the highest phenol-containing tomato seed oils which are the more evidence the apparatus is used for the extraction and the oil yield are presented in table 1. The seed oil was a red-yellowish liquid at room temperature and had a pleasant tomato fruit-like odor (slightly spicy) and taste good. The Tomato Seed Oil is stable, translucent and highly penetrating oil.

The Refractive index (RI), Density and the specific gravity of the oils of both varieties in table 1 are all in line with the FAO/WHO (2009) standard and those reported in literature (Morad *et al*., 1980; Lazos and Kalathenos, 1988). The Riogrande seed oil had the higher acid value of 6.054 meq/kg and the lower value was shown by the Roma VF seed oil with 1.351 meq/kg which could be due to the strong tomato flavour and odour exhibited by the Riogrande seed oil variety compared to the mild flavour and odour possessed by the Roma VF. The elevated iodine value of Riogrande variety of the tomato seed oil indicated a high level of unsaturation of polyunsaturated fatty acids especially linoleic and linolenic acids, which was reflected in Table 2 using gas chromatography.

The Roma VF seed oil had the higher Peroxide Value of 9.955 meq/Kg while Riogrande seed oil had the lower value of 2.994 meq/kg. Though peroxide values of the tomato seed oil were lower than 10 meq/kg of FAO/WHO (2009) standard but fell in the range adopted as

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satisfactory. The higher peroxide value of the Roma VF seed oil may be due to high content of tocopherols and hence showed an overall stability of the crude oil. The high saponification value for both varieties of oil indicates the high proportion of low fatty acids the tomato seed oils are made up of. There were significant differences ($p<0.05$) among the TSOs in the physicochemical quality parameter of the extracted oil.

Fatty acid profile of the extracted oil

The palmitic acid (saturated fatty acid) and Linoleic, Linolenic α and Linolenic acids (polyunsaturated fatty acids) showed that there was significant difference ($p<0.05$) in fatty acid compositions of the oils from the two varieties of tomato seeds while no significant difference was seen in the other fatty acids. The chemical compositions of fatty acids of tomato seed oil from the two varieties are presented in table 2. Twelve fatty acids were detected, with a chain length ranging from 14 to 22 carbon atoms. Myristic C14:0), palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0), lignoceric (C24:0), margaroleic (C17:1), oleic (C18:1), gadoleic (C20:1), linoleic (9c, 12c-C18:2) and linolenic (C18:3n3, C18:3n6) were identified in the oil samples. Unsaturated fatty acids such as margaroleic acid, oleic acid, gadoleic acid, linoleic acid and linolenic acid totally reached as high as 67.12% in Riogrande and 51.965% in Roma VF. Linoleic acid was the major unsaturated fatty acid followed by oleic acid. In Riogrande, linoleic acid was found to be 35.605% while oleic was found to be 23.405% while Roma VF had a relatively low amount of linoleic acid, 26.520% and 22.115% oleic acid. Generally, the level of linoleic acid falls in the range of 50-60%, while Swem (1979) reports concentrations of oleic acid higher (46%) than those of linoleic (35%). Palmitic acid was the major saturated fatty acid and was found to be dominant the saturated fatty acid followed by stearic acid. Palmitic acid in Roma VF was 33.660% while stearic acid was 10.705%, while Riogrande had 22.610% palmitic acid and 9.045% stearic acid. Palmitic acid was found to be the dominant saturated fatty acid and was in line with values reported (Takasova *et al*., 1995; Lazos *et al.,* 1998). Other small to trace amount of fatty acids are present in Roma VF (arachidic acid 0.645, behenic acid 1.340, lignoceric acid 1.285) while that of Riogrande are less than 1.

Tomato seed oil is an excellent source of essential fatty acids, omega-6 (linoleic acid) and omega-9 (oleic acid). The differences in individual contents of fatty acids of the two varieties when compared to the bibliographic references may be due to the cultivars used and to the cultivation or environmental factors (Takasova *et al*., 1995: Lazos *et al.,* 1998). Tsatsaronis and Boskou (1972) have reported that odd and even-chain length saturated acids from C12:0-C28:0, except C21:0 were present in the oil. Based on the results obtained, the fatty acid composition of tomato seed oil showed that it falls in the linoleic-oleic acid oils category. Therefore, the oil could be useful for edible purposes and for some industrial applications like hydrogenation, shortening production and others.

Antioxidant activities of the tomato seed oil

The antioxidant activities of the tomato seed oil determined by spectrophotometric method are presented in Table 3. Due to the complex nature of phytochemicals and oil extracted from seeds, it has been recommended that the antioxidant activities of the oil must be analyzed by at least two systems to establish authenticity (Tenore *et al.,* 2011). For this reason, the antioxidant activity of tomato seed oil was demonstrated by five

spectrophotometric methods: DPPH, β-carotene linoleic antioxidant, HRSA, ORAC, FRAP.

The ability of a compound to scavenge DPPH radicals is dependent on their ability to pair with the unpaired electron of a radical (Park et al., 2008). The DPPH radical scavenging assay on Table 3 showed that the inhibition values (IC_{50}) for the TSOs were significantly lower than that of the standard (Ascorbic acid) antioxidant which was 83.140±0.028 IC_{50} % inhibition. Roma VF oil had the lowest IC_{50} value (43.270±0.02) and Riogrande oil had a higher IC_{50} value (80.655±0.021). The inhibition value (IC_{50}) observed for the Riogrande oil was significantly higher than that of the tandard due to a low amount of phenolic components in the oil. The result showed that the TSO with the lower inhibition value, Roma VF possessed better antiradical activity in terms of DPPH radical scavenging activity while the DPPH assay for the Riogrande oil exhibited relatively weaker antioxidant activity. This shows that the degree of scavenging potential of the antioxidant compounds in the Roma VF seed oil in terms of hydrogen donating ability is high compared to the Riogrande seed oil. DPPH radical scavenging assay is widely used to test the ability of compounds to act as free radical scavengers or hydrogen donors, and to evaluate antioxidant activity of foods (Bubonja-Sonje *et al*., 2011).

The bleaching of β-carotene in this assay is due to the presence of peroxyl free radicals which are created as a by-product of linoleic acid oxidation and this process can be altered if antioxidants present are able to compete with peroxyl radicals and thereby reduce or prevent the bleaching of β-carotene (Takada *et al*., 2006). The β-carotene Linoleic antioxidant assay showed that Riogrande had IC_{50} % inhibition of 31.045±0.021 which was comparable to that of the synthetic antioxidant which had a value of 43.920±0.028 IC_{50} % inhibition. This value was twice that for the Roma VF which had a value of 15.855±0.035 IC_{50} % inhibition and at this lower concentration was capable of quenching more singlet oxygen and scavenging free-radical species than the synthetic antioxidant. This result showed that the TSO from the Roma VF variety possessed better antioxidant activity since a lower concentration can cause 50% inhibition.

The Hydroxyl radical scavenging activity (HRSA) method was also applied to determine antioxidant effect of the oil. EC_{50} values of the TSOs and positive control (Ascorbic acid) are given in Table 3. The inhibition values (EC_{50}) for the TSOs were significantly lower than that of ascorbic acid ($p < 0.05$). The Riogrande oil had the higher inhibition value of 39.4150±0.021, while Roma VF had the lower inhibition value of 31.0100±0.014. The lower EC_{50} value (HRSA) of Roma VF oil variety in table 3 is associated with a higher radical scavenging activity.

The Oxygen reducing absorbance capacity (ORAC) assay uses a biological relevant radical source and it combines both inhibition time and degree of inhibition into one quantity. The ORAC test showed that the Riogrande oil had the lower reducing potential of 1.480±0.014 μ Mol TE/g, while Roma VF recorded a higher value of 2.325±0.007 μ Mol TE/g, which had a significantly higher ($p<0.05$) reducing potential. These values were lower than that of the standard antioxidant which was 16.440±0.042 μ Mol TE/g.

The Ferric reducing antioxidant power (FRAP) assay measures the ability of an antioxidant compound to reduce a ferric

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oxidant (Fe^{3+}) to a ferrous complex (Fe^{2+}) by electron-transfer, this indicates the capacity of the compound to reduce reactive species (Benzie and Szeto, 1999). The Riogrande oil variety exhibited the highest FRAP activity at 26.820 mgFe^{2+}/ml while the Roma VF oil variety displayed significantly lower ($P< 0.05$) FRAP activity at 10.765 mgFe^{2+}/ml, however the FRAP value of 57.315±0.021 mg Fe^{2+}/ml of the standard Ascorbic Acid was the highest reducing power among the samples.

CONCLUSION

Most scientists are now looking for natural antioxidants which do not have any side effects on animal and human health. Tomato seed oil is stable and compare with the FAO/WHO standard for edible oils, and based on the results obtained, the fatty acid composition falls in the linoleic-oleic acid oils category. The antioxidant activities of the oil were tested by five assays. The oil inhibits the oxidation of useful components by inactivating free radicals, chelating prooxidative metals, and quenching singlet oxygen. Though Roma VF seed oil at a lower concentration demonstrated higher oxidation rates of scavenging free radicals, chelating prooxidative metals, quenching singlet oxygen and photosensitizers, and inactivating lipoxygenase compare to the Riogrande seed oil and the standard on the antioxidant assays of the following; DPPH, β- carotene linoleic antioxidant, HRSA, FRAP. Therefore, the oil could be useful for edible purposes and for some industrial applications like hydrogenation, shortening production, foods and pharmaceutical preparations to replace the synthetic antioxidants.

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