Fatty Acids Profile and Physico-Chemical Properties of Citrullus vulgaris Seed Oil

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Abstract
The composition of fatty acids (FA) and physico chemical properties of *Citrullus vulgaris*, seed oil was investigated. The oil yield was obtained by solvent extraction and analyzed for fatty acids using Gas chromatography Mass spectroscopy (GC-MS).The oil yield of the plant was found to be 24.00±1.20%.Both saturated and unsaturated FA were identified in the seed oil with- linoleic acid (76.25%) and Palmitic acid (14.42%) as predominant compounds, while, stearic acid (9.01%) and oleic acid (0.33%) were low and physicochemical properties determined using standard methods. Refractive index (1.458), specific gravity (0.864), colour (Light Yellow), Iodine value (58.54), peroxide value (10mEq), free fatty acid value was 4.8% and acid value 9.6%. This is an important variable in considering the quality of the oil because the lower the free fatty acid, the better the quality of the oil. Also, saponification value obtained (255.2mgKOH/g) in this study thereby confirmed its industrial applications.
Keywords: *Citrullus vulgaris*, GCMS, Fatty acid profile, oil

1. INTRODUCTION

Fatty acids are chains of covalently linked carbon atoms, bearing hydrogen atoms which terminate in a carboxyl group that is responsible for their properties as acids. The naturally occurring fatty acids in plants are for the most part unbranched molecules but complex structures with branched or cyclic chains do occasionally occur, particularly in lower biological forms, (Mc-Murray et al., 2010). Two general types of fatty acids exist, saturated and unsaturated, of which, more than 100 different fatty acids have been identified (Horton et al., 2006). In recent years, there has been observed, a trend in human diets towards reduction of saturated fats such as palmitic acid (C16:0) and an increase in polyunsaturated (C18:2 and C18:3), and monounsaturated (C18:1) fats. (Mailer,2004). Human body can produce all the fatty acids (FA), it needs, except linoleic acid (LA) and α-linoleic acid (ALA) which are widely distributed in plant oils/vegetable oils and are regarded as essential fatty acids (EFA) (Halver, 2011). Many vegetable oils are consumed directly or indirectly as ingredients in food and the oils serve a number of purposes in this role (Dubois et al., 2007). A high consumption of vegetable oils has been reported (Dobson et al., 1997; Ayerza & Coastes, 2005; Dubois et al., 2007; Rezanka & Singler, 2009; Ixtaina et al., 2011) which has greatly increased the demand for alternative plant based oils which are low in saturated fats, higher inmono-unsaturates and better sources of omega-3 fatty acid.

Oilseed crops are generally grown for the purpose of oil in their seeds and they vary considerably in their oil content, quality, and composition. These factors rely heavily on the crop species or cultivar and upon the environmental conditions in which the crop is grown (Mailer, 2004). A large quantity of oil and fats, whether for human consumption or for industrial purposes is presently derived from plant sources (Ramadan et al., 2006). To meet the increasing demands for oil, improvements are being made to produce unique and desirable oils, therefore increasing interest in newer sources of edible oils from natural sources. Plant seeds are important sources of oils of nutritional, industrial and pharmaceutical significance (Ramadan et al., 2006). No oil from any source has been found to be suitable for all purposes because oils from different sources generally differ in their composition. This necessitates the search for new sources of novel oils, of which several plants are now grown, not only for food and fodder, but also for a striking variety of products with applications in industry, including essential oils and pharmaceuticals.

Vegetable oils not only provide high quality food, containing essential nutrients for life, but also bestow bioactive compounds that have particular clinical significance (Mehmood et al., 2008). The advent of alternative vegetable oil production has also triggered the insatiable search for alternative sources of raw material for this purpose. More so, there could be a variable chemical composition depending on several factors such as the cultivation environment (Ixtaina et al., 2011). In addition, there is an increase in technological developments, particularly with the genetic modification of oilseeds to create a new range of products. For cooking oils and salad dressings, plant breeders have selected cultivars with lower levels of polyunsaturated and monounsaturated fats and an increase in monounsaturates for increased oxidative stability. New developments include oils with increased stearic acid to provide margarine type fats without the need for hydrogenation and the subsequent production of trans-fatty acids (Mailer, 2004). It is in the light of this scenario that we report here the FA and physico-chemical properties of the seed oils of *Citrullus vulgaris* by cold extraction and Gas Chromatography Mass Spectroscopy (GCMS) with a view to explore the possibility of potential sources of oils for the future.

2 .MATERIALS AND METHODS

2. 1 Collection of the plant material:

The fresh fruits of citrullus vulgaris were collected in Samaru market, Zaria, Kaduna state, Northern Nigeria and identified in the Herbarium of Department of Biological Sciences, Ahmadu Bello University Zaria, Nigeria.

2. 2 Extraction of the seed oil:

The seed kernels (40g) were blended using a blender. The blend was extracted with petroleum ether (40°C-60°C)in a Soxhlet apparatus by thermal cycles at 80°C for 8h, following the IUPAC standard method (IUPAC, 1992).

The solvent was removed using a rotator vacuum evaporator at 40°C. The oil content was gravimetrically determined and expressed as weight percent on dry basis (Ixtaina et al., 2011).

2. 3 Analysis

GCMS Analysis

The fatty acid composition was determined as methyl esters. Briefly, 100 µl oil plus 1 ml 10% potassium hydroxide in methanol were heated for 45 minutes at 85°C. Fatty acids were methylated with 1 ml boron triflouride-methanol-complex (20% solution in methanol) plus 1 ml methanol for 45 minutes at 60°C and then extracted from the methanolic phase with petroleum ether. The analyte, 1 µl was injected in the column equipped with column oven temperature of 60°C and column flow of 0.99 ml/min. The compounds were identified by the GCMS intensity of retention time (RT) and by comparison with those present in the National Institute for Standard Technology Computer DataBank library of 2010. The results were expressed as the relative percentage of each individual fatty acid (FA) present in each sample given by the corresponding RT.

3. Physicochemical Analysis

The physicochemical properties (Refractive index, specific gravity, colour, Iodine value, saponification value, acid value, free fatty acid value, peroxide value) were determined using standard procedures of AOCAC 1997.

4. RESULTS AND DISCUSSION

The Fatty acid profile of the oil is presented in table 1,while figure 1 shows the chromatogram. The result showed that the seed oil contains four main fatty acids namely: Oleic (0.33 ± 1.30 %), Linoleic (76.25 ± 1.20 %), palmitic (14.42 ± 1.60 %),and stearic acid (9.01 ± 1.50 %) .The Physicochemical properties presented on table 2; was found to be: Refractive index of 1.472 ± 1.33, This showed that the oil is less thick and comparable with most drying oils whose refractive indices are between 1.475 and 1.485 (Dosumu M.I *et al*,1995) The refractive index value also showed that the oil contained some double bonds in its fatty acid composition. (Duel H. *et al*, 1951) reported that refractive index increases as the double bond. This indicates that the seeds have a high proportion of unsaturated fatty acids (agreeing with the refractive index value), and suggests that the seed oil could be useful in the preparation of oil creams.

The saponification value of the oil was 255.26± 0.01 mgKOH/g which is above the values obtained for some vegetable oils ranging from 188-196mg KOH/g. However, there are some vegetables with high saponification values such as coconut oil (253mgKOH/g), palm kernel oil (247mgKOH/g) and butter fat 225 (mgKOH/g). It has been reported by Pearson that oils with high saponification values contain high proportion of short-chain fatty acids. (Eromosele C. *et al*, 2003)

The oil had high acid value of 9.58±0.04 mgKOH/g when compared with *Plukenetia conophora* (11.5mg KOH/g) as reported by (Akintayo et al 2002) and benniseed (47.6%) by (Ohsodi A.A. 1992) this value is however higher than that reported for cashew nut oil (0.82±0.4mgKOH/g) by (Aremu M. *et al* 2006b)**.** Acid value is used as an indicator for edibility. The iodine value of citrullus vulgaris (58.54±0.1mEq/g) is higher than the value (28.6±0.1 mEq/g) of citrullus lanatus seed oil (Aremu M. *et al*, 2006b) , Hausa melon seed 38.50 ±0.67% (Essien *et al, 2009)* and 44.4±0.1mEq/g for cashew nut oil (Oladimeji, M**.** *et al*,2001) In view of the fact that drying oils have an iodine value above 100, (Aremu M. *et al*, 2006a) citrullus vulgaris seed oil could only be categorized as a non-drying oil. The iodine value is also an index for assessing the ability of oil to go rancid (Dosumu, M. *et al*,1995 and Eka, B. *et al* 2009) The iodine value obtained (58.54) in this study indicates that the oil contain appreciable level of unsaturated bonds. Thus storage procedure to be used for this seed oil should ensure protection of the oil from oxidative deterioration. The peroxide value is used as an indicator of deterioration of oils. Fresh oils have values less than 10 mEq/g. Values between 20 and 40mEq/kg result to rancid taste. The low peroxide value (10.00±0.30mEq/kg) indicates that the oil is stable.

The free fatty acid value of 4.88±0.03% falls within the maximum limit of 5% for free fatty acids in high grade palm oil in Nigeria (Amoo I**.** et al, 2004) the oils could therefore be used as edible oil.

The high percentage of omega 6 (Linoleic acid 76.25%) is potentially useful as food additive and can be converted to gamma-linoleic acid that could be used as a dietary supplement to increase the production of anti-inflammatory 1-series prostaglandins. Series 1 Prostaglandins play an important role in the control of blood thickness and blood pressure. Therefore it has an anti-inflammatory effect and is an important nerve tissue food, helping in the maintenance of brain and nerve function. (Duel, H. *et al*, 1951) Pregnant women have an increased need for omega-3 and omega-6 fatty acids. They are needed for the fetal growth, brain development, learning and behavior. Lactating women should also increase their fatty acids intake, since infants receive their essential fatty acids through the breast milk.

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Table 1 Percentage composition of citrullus vulgaris seed oil.

S/N	COMPONENTS	PERCENTAGE (%)	R_{time}
1	Oleic acid	0.33	18.174
2	Linoleic acid	76.25	16.869
3	Stearic acid	9.01	16.614
4	Palmitic acid	14.42	14.959

Table 2
Physicochemical properties of citrullus vulgaris seed oil.

S/N	Analysis	Result
1	Colour	Light Yellow
2	Texture at 37oC	Liquid
3	Specific gravity	0.86g/ml
4	Refractive index	1.458
5	Lipid content	27%
6	Iodine value (g/100g)	58.54
7	Saponification value	255.26KOH/g
8	Acid value (%)	9.58KOH/g
9	Free fatty acid value (%)	4.88
10	Peroxide value (%)	10meq

BENEDICT ODJOBO (SAPLE-WSO2)

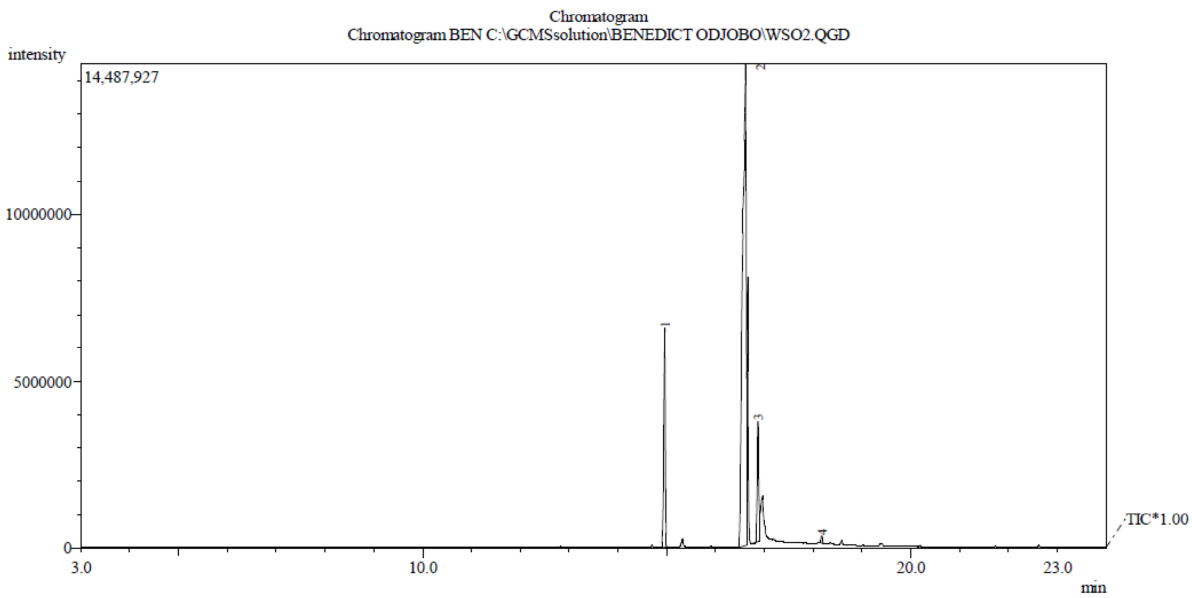

Fig i: Fatty acids composition of citrullus vulgaris seed oil. Peak 1 (RT = 14.959) is Palmitic acid (14.42%), Peak 2 (RT = 16.869) is Linoleic acid (14.42%) , Peak 3 (RT= 16.614) is Stearic acid (9.01%), Peak 4 (RT = 18.174) is Oleic acid (0.33%).

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CONCLUSION
In conclusion seeds characteristically contained high levels of oil. And is rich in linoleic fatty acid, many of the physicochemical properties of the oil studied compared favorably with other conventional seed oils such as palm kernel oil, groundnut oil, and soybean oil. The seed oil therefore has potential for use as domestic oil.