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Organic Chemistry

Elixir Org. Chem. 54 (2013) 12700-12703

ISSN: 2229-712X

Chemical analysis of *Citrullus lanatus* seed oil obtained from Southern Nigeria

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ARTICLE INFO

Article history:

Received: 29 June 2012;

Received in revised form:

26 January 2013;

Accepted: 28 January 2013;

Keywords

Citrullus lanatus,

Oils,

Seeds,

Fatty acids,

Potential asset,

Southern Nigeria.

ABSTRACT

Nigeria is one of the countries of the world with a variety of oil seeds, therefore the potential of Nigeria leading Africa, and the world at large, in the area of seeds oil production was examined by evaluating the oil yield and physicochemical qualities of oil extracted from *Citrullus lanatus* from the southern region of the country. The lipid content of *Citrullus lanatus* seeds was found to be 57.26%. The iodine, saponification, acid, free fatty acid, peroxide, specific gravity, refractive index and pH, were analysed using standard procedures and values were found to be 114.94g I_2/100g, 220.19 mgKOH/g, 7.09 mgKOH/g, 4.512%, 20.00 meq/kg, 0.913, 1.35, and 4.45 respectively. The oil contains five main fatty acids: palmitic, stearic, oleic, linoleic are linolenic acids, but the most abundant fatty acid is linoleic with a value of 64.15% which is used industrially as a drying agent in gloss paint. Due to their high oil yield and abundance, oils from *Citrullus lanatus* seeds may be considered as Nigeria potential asset for soap production and other industrial applications.

Introduction

Cucurbitaceae seeds such as melon seeds are protein-rich and are commonly used in sauces, soups, and other dishes in West African countries. The use of cucurbit seeds as sources of oils and proteins have been reviewed by Jacks *et al*., (1972). After the hull is removed, cucurbit seeds contain about 50 percent oil and up to 35 percent proteins. *Citrullus lanatus* is popularly called "*egusi*" in southern Nigeria. *Egusi*, which is a creeping annual plant and an intercropping plant, thrives well on rich light soil in the hot climatic region of Africa. It, however, has been noted to tolerate low rainfall (Cobley, 1957). In this region of Nigeria, *egusi*, is best cultivated after the first rain of each year (Ogbonna and Obi, 2000).

The first fruits are harvested at about thirteen weeks after planting. They belong to the family of the cucurbitaceae, and are widely cultivated for their seeds, which have high content of fat and protein (Ng, 1993; Itam, 2006). The seeds are obtained either in shelled or unshelled forms in southern markets and are used greatly in West African cookery (Anhwange *et al*., 2010). The shelled seeds can be ground or milled before and after roasting used in soups and as soup condiments. Melon seeds may be eaten as snacks, either as whole toasted seed or as fried cake prepared from milled seeds (Odunfu, 1981; Ikereogu, 1984; Okigbo, 1984).

As reported by Jacks, *et al*., (1972), the seeds has about 50% lipid. Most of their oil is made of non-saturated fatty acids, thus of high nutritional values. Conjugated fatty acids among some cucurbitaceae oils make them highly useful as drying oils (i.e. they combine readily with oxygen to form an elastic, water proof film). The economic importance of oil crops has made it necessary that they be properly investigated to ascertain their oil quality parameters, since this is an important criterion for marketing and processing seed oil (Abayeh *et al*., 1998; Attah and Ibemsi, 2009). Vegetable oils are used principally for food (mostly as shortening, margarine, salad and cooking oils), in the manufacture of soaps and detergents paints and varnishes and a variety of other industrial items (Bailey, 2000; Ekpa, 1989). Oil is found in large amount usually in the seeds of the plant and occasionally in the fleshly part of the fruits as in the olive and oil palm, and seeds contain 1-60% oil (Okoye *et al*., 1999).

As a contribution to the investigation of the quality and industrial values of simple and abundant southern Nigerian plants, this work determines lipid content, physicochemical properties and fatty acid composition of *Citrullus lanatus* seed oil.

Materials and methods

Melon (*Citrullus lanatus*) seeds, *Egusi*, were purchased from a local market at Nung Udoe-Ibesikpo, Akwa Ibom State, Nigeria. The seeds were deshelled manually, screened to remove the bad ones.

The seeds were then dried to constant weight in an oven at 60°C for 24 hours to remove moisture content and then ground using mechanical grinder, put in air tight container and stored in a desiccators for further analysis. Similar procedure has been reported by (Ekpa, 1989).

Oil extraction

Oil from the seeds of *egusi* melon was extracted by continuous extraction in soxhlet apparatus (cehmglass) for six hours using petroleum ether (40-60°C) as solvent according to the method described (A.O.A.C., 1990). At the end of the extraction, the extraction solvent was evaporated in a rotary evaporator. The extracted oil was assayed using standard methods.

Fatty acid composition analysis

The fatty acid profile of melon oil was determined by gas liquid chromatography (Hewlett Packard, Model 6890).

Physicochemical analysis of the seed oil (*Citrullus lanatus*)

The physicochemical properties of the extracted oil were assayed using standard methods.

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Table 1: Physicochemical properties of *Citrullus lanatus seed oil*

S/N	TEST	VALUE
1	Specific gravity	0.9129 ± 0.1
2	Relative viscosity, Nsm^{-2}	5.89 ± 0.2
3	Refractive index	1.35 ± 0.1
4	Moisture content, %	27.30
5	pH	4.45
6	Boiling point, ^oC	220-320
7	Colour	Pale yellow
8	Saponification value, mgKOH/g	220.19 ± 0.4
9	Acid value, mgKOH/g	7.09 ± 0.2
10	Free Fatty Acid, %	4.512 ± 0.1
11	Iodine value, $gI_2/100g$	114.94 ± 0.4
12	Peroxide value, meq/kg	20.00 ± 0.3
13	Lipid content, %	57.26

Values are means ± SD of 3 determinations

Table 2: Fatty acid composition of *Citrullus lanatus* seed oil

Fatty acid	Percentage composition
Palmitic	10.57
Stearic	8.333
Oleic	13.65
Linoleic	62.14
linolenic	5.293

The iodine, saponification, acid, free fatty acid, peroxide, specific gravity and refractive index, relative viscosity, moisture content, pH, unsaponifiable matter values, were used to characterize the oil from standard procedure (A.O.A.C., 1994 and 2008).

Results and Discussion

The total lipid content of *Citrullus lanatus* seeds (Table 1) was found to be 57.26%. From the results, *Citrullus lanatus* has good lipid content. The iodine value of *Citrullus lanatus* was 114.94 $gI_2/100g$. The results indicate that the oil is a semi-drying oil consisting predominately polyunsaturated fatty acids mainly oleic and linoleic fatty acids (Ekpa *et al*., 1994; Fox, 1984). The class of oils whose iodine values are between (100-150) possess the property of absorbing oxygen in exposure to the atmosphere; though, they do not do so sufficiently to qualify them as drying oils (Kaly, 2008). They become thicken and remain sticky but do not form a hard dry film. They are used in the production of soap (Kinkela, 2006; Ulmanns, 2001)

Saponification value (which indicates the average molecular weight of oil (Booth and Wickens, 1988)) of *Citrullus lanatus* oil was 220.19 mgKOH/g. And high saponification value implies greater proportion of fatty acids of low molecular weight. The results indicate that the oil contained higher proportion of low molecular weight fatty acids. The values compared favourably with the saponification value of palm oil (196 – 205 mgKOH/g), olive oil (185 - 196 mgKOH/g), soyabean oil (193 mgKOH/g) and linseed oil (193 - 195 mgKOH/g) (Folkard and Sutherland, 1996). The high saponification value of *Citrullus lanatus* suggests that the oils could be good for soap making and in the manufacture for lather shaving cream (Eka, 1980; Nzikou *et al*., 2007).

The acid value represents free fatty acid content due to enzymatic activity. The acid value was found to be 7.09 mgKOH/g while the free fatty acid value was 4.512% which is below 5.00% free fatty acid content recommended as the maximum for non-rancid oil (Savage *et al*., 1997; Rethinam, 2003). This implies that the oils are not rancid.

The peroxide values of *Citrullus lanatus* seed oils were obtained to be 20.00. The peroxide value is the measure of oxidative rancidity of oil (Ekpa and Ekpa, 1996). The peroxide value was low and is pointer to the fact that the oils may not be easily susceptible to deterioration. Oxidative rancidity is the addition of oxygen across the double bonds in unsaturated fatty acids in the presence of enzyme or certain chemical compounds (Guthrie *et al*., 1954; Oyenuga, 1998). The odour and flavour associated with rancidity are due to liberation of short chain carboxylic acids. High peroxide values are associated with higher rate of rancidity. The low peroxide values of the oils indicate that they are less liable to oxidative rancidity at room temperature (Odoemelam, 2005 and Anyasor *et al*., 2009). These oils are fresh because the content peroxide lower than 10 $meqO_2/kg$ and oil grow rancid when the content peroxide lies between 22 and 40.0 $meqO_2/kg$ (Pearson, 1976; Ojeh, 1981). In the contrary, oils having high percentage of peroxide are unstable and grow rancid easily (an unpleasant odour). These oils are saturated therefore there is no risk of formation of peroxides (Ekpa and Ekpa, 1996)

The specific gravity of the oils was found to be 0.913 and the refractive index was 1.35. The specific gravity and refractive index measures the purity of the oil. The results indicate that the oils are of high purity.

The moisture content of the oils was 27.30% and the low moisture content of *Citrullus lanatus* may be responsible for its low perishability, low levels of moisture and presence of low levels of polyunsaturated fatty acids in *Citrullus lanatus* had been attributed to its relatively long shelf-life (Kester and Kader, 1993). The moisture content shows the presence of a lesser amount of dirt and impurities in the oil. This value is in agreement with the reported value given in Encyclopedia of Chemical Technology (Powe, 1998).

The oil yield levels (57.26 %) reported in this work for *Citrullus lanatus* may be useful in soap industries, paint industries, printing ink and can also be considered economical available oil seed when compared to other vegetable oil (Otech, 1994).

The colour of the oil is used preliminarily in judging the quality and in determining the degree of bleaching of the oil. For Powe (1998), the darker the colour, the poorer the quality. Therefore the pale yellow colour of melon oil shows that the

quality of the oil is good and confirms to Encyclopedia of Chemical Technology (Powe, 1998; Onimawo *et al*., 2003).

The fatty acid profile of melon seed oil as determined by gas liquid chromatography was found to compose of five (5) fatty acids: palmitic, stearic, oleic, linoleic and linolenic acids. The fatty acid composition of the oil is in agreement with values obtained in previous studies (Achu *et al*., 2005; Akpambang *et al*., 2008; Akinhanmi *et al*., 2008). Of the five fatty acids listed in table 2, linoleic acid is the most prevalent with the relative abundance of 62.14%. The total saturated and unsaturated fatty acids contents of the melon seed oil are 18.9 and 81.9%, respectively. The palmitic acid (10.57 %) is the predominant saturated fatty acid (Peter, 2003; Sweden, 1998; Vairo, 1998).

Conclusion

The result of the study reveals that the oil of this abundant southern Nigerian plant, *Citrullus lanatus*, has a good lipid content of 57.26%, linoleic acid was the most prevalent of the five fatty acids found, with the relative abundance of 62.14%, and the plant may be considered as Nigeria's potential asset in the seed oil for industrial application. The oil of the plant found in this area has a considerable high quality and a good shelf life too.

Additional information:

Ubong M. Eduok had been involved in several researches and projects in University of Uyo, Nigeria before leaving for KFUPM, Saudi Arabia.

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