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Research Article

Determination of Fatty Acid Composition and Physicochemical Properties of Cucurbita Maxima (Pumpkin) Seed Oil cultivated in northeast Nigeria

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Abstract: This research work aimed to examine the fatty acid composition and physicochemical properties of pumpkin cultivated in northeast Nigeria, locally known as Kabewa (Cucurbita maxima), The fatty acid composition were determined using Gas chromatography mass spectroscopy (GC-MS).The oil was found to contain four (4) fatty acids; Linoleic acid (53.42%), Linolenic acid (20.92 %), Palmitic acid (17.53 %), and Stearic acid (8.13 %). It was observed that unsaturated fatty acids were the most abundant in the pumpkin seed oil. The lipid content of cucurbita maxima seed oil was found to range from 90 to 100%. Specific gravity, refractive index, iodine value, acid value, sponification value, mixture content and free fatty acid were analysed using standard procedures and values were found to be 0.892, 1.120, 80-100I_2/100g, 45.23mgKOH/g, 260.87mgKOH/g, 11.00%, and 3.86% respectively The oil obtained from the pumpkin seed could be used in variuos applications such as industrial ingredients in soap production, cosmetics, phamaceuticals, and food complements.

Keywords: Pumpkin seed oil, physicochemical, fatty acid.

INTRODUCTION

The pumpkin seed oil is dark green in color that contains a high amount of free fatty acids including four dominant fatty acids (oleic, linoleic, palmitic and stearic) (Badr *et al.*, 2011) the variability of the oil contents in various pumpkin species is predominantly attributed to its broad genetic diversity (Younus *et al.*, 2000). In recent years, several studies (Bardaa *et al.*, 2016; Medjakovic etal., 2016; Wang, *et al.*, 2017) have highlighted the health properties of pumpkin seed oil against many diseases, including hypertension, diabetes, and cancer. It also shows antibacterial, antioxidant, and anti-inflammatory properties (Yadav *et al.*, 2010; Gutierrez, 2016). Due to the presence of interesting natural bioactive compounds, such as carotenoids, tocopherols, and sterols, pumpkin-derived products have a wide spectrum of biological activity, proven by in vivo experiments (Dyshlyuk *et al.*, 2017).

Curcubita maxima (Pumpkin) belong to the family of the cucurbitaceae, and are widely cultivated for their seeds, which have high content of fat and protein (Itam, 2006). The seeds are obtained either in shelled or unshelled forms in northern 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 (Odunfa, 1981; Ikereogu, 1984; Okigbo, 1984). As reported by Jacks, *et al.*, (1972), the seeds have about50% 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 formarketing 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

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varnishes and a variety of other industrial items (Bailey, 2002; 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, health impact and industrial values of simple and abundant northeastern Nigerian plants, this work aimed to determination of some physicochemical properties and fatty acid composition of curcubita maxima (Pumpkin) seed oils.

MATERIALS AND METHODS

Cucurbita maxima (*pumpkin*) seeds,kabewa, were purchased from a local market at Nguru, Yobe 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^{O}C for 24 hours to remove moisture content and then ground using mechanical grinder, put in air tight container and stored in a desiccator for further analysis. Similar procedure has been reported by (Edidiong and Ubong, 2012).

Oil extraction

Oil from the seeds of cucurbita maxima (kabewa) was extracted according to the method described (A.O.A.C, 1990) by continuous extraction in soxhlet apparatus using petroleum ether (40-60^{0}C) as solvent. 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

Determination of fatty acid profile of cucurbita maxima (kabewa) was carried out using GC-MS agilent 7890B, 5977A MSD and a HP-5MS analytical column (30m x 0.25mm) . Mass hunter GCMS solution software was used as the data analysis system. The oven temperature was programmed at 50^{0}C for 1min and then raised to 210^{0}C at 45^{0}C/min. the injection volume was 1UL using helium as carrier gas at spsi.

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Physicochemical Properties Analysis

The physicochemical parameters are (refractive index, acid, iodine, moisture content, saponification values, and density) were carried out according to the methods described (AOAC.1980) . Colour was measured with a colorimeter. The lipid content was determined by a procedure described by Akpan (2006).

RESULTS AND DISCUSSION

Table1. Physicochemical

Test	Value
Specific gravity	0.892
Refractive index	1.120
Mixture content %	11.00
Colour	Deep green
Sponification value mg KOH/g	260.87
Acid Value mg KOH/g	6.92
Lipid content %	45.23
Iodine value I_2/100g	90-100
Free fatty acid %	80-100
	3.86

The specific gravity and refractive index of cucurbita maxima seed oil was found to be 0.892 and 1.120 as shown in table 1 above. It is evidenced from the result obtained that cucurbita maxima seede oil cultivated in northeast nigeria is of high purity since the specific gravity and refractive index measures the purity of the oil(Edidiong and Ubong, 2012).Most processor use refractive index to measure the range of unsaturation when the fat or oil is hydrogenated. The refractive index of oils depend on their molecular weight, fatty acid chain length, degree of unsaturation (Nichols and Sanderson, 2003). It shows that these oils are less thick compared with most drying oils with refractive indices of 1.48 and 1.49 (Duel, 1951). The moisture content shows the presence of a lesser amount of dirt and impurities in the oil. The moisture content of the oils was found to be 11.00% and the low moisture content of *Cucurbta maxima* may be as a result of low perishability, low levels of moisture and presence of low levels of polyunsaturated fatty acids in *Cucurbita maxima* had been attributed to its relatively long shelf-life (Kester and Kader, 1993). The colour of the oil is used preliminarily in judging the quality and in determining the degree of bleaching of the oil. (Edidiong and Ubong, 2012), the darker the colour, the poorer the quality. The colour of cucurbita maxima was found to be dark green, thus indicate that cucurbita maxima seed oil cultivated in northeast nigeria is of modarate quality. The sponification value of cucurbita maxima seed oil was found to be 260.87 mg KOH/g. This value agree with those of saturated fatty acids rich oils such as *Cocos nucifera* coconut (248-265 mg KOH/g of oil), Ivorian *citrullus lanatus* (244.76;b 228.43; 239.61 and 239.34 mg KOH/g of oil), and *Elais guineensis*, palm kernel oils (230-254 mg KOH/g of oil) (Anne *et al*., 2015: Codex Alimentarius, 1999). As reported by Pearson (1996) , oil with higher saponification values contain high proportion of lower fatty acids. From the result obtained it indicate that cucurbita maxima seed oil in this study contain high amounts of higher fatty acids. The high saponification value of *Cucurbita maxima* suggests that the oils could be good for soap making and in the manufacture of lather shaving cream (Eka, 1980; Nzikou *et al.*, 2007).The free fatty acid content due to enzymatic activity can be determine by acid value of oil. The acid value of oil was found to be 6.92 mgKOH/g while 3.86

was found to be free fatty acid content of the studied oil this value is below 5.00% which is the maximum recommended tree fatty acid content for non-rancid oil. Based on the result obtained it indicated that the oil is non-rancid. The total lipid content of *Cucurbita maxima* seeds was found to be 45.23%.This indicates that *Cucurbita maxima* seeds has good lipid content.The iodine value obtained for the studied oil was found to range from 80-100 g I2/100g. The iodine value is used to determine the unsaturation of a fatty acids or its esters Lipids with unsaturated fatty acids (containing one or more double bonds) are easily assimilated and broken down to produce calorific energy than saturated fatty acids. The higher the iodine value, the more unsaturated the oil. However, when the iodine value becomes too high, the stability of the oil reduces because it is more likely to undergo oxidation. (Anne etal., 2015)**.** The iodine value obtained is similar to those of unsaturated fatty acid rich oils such as peanut (86.06-107.0 g I2/100g), cotton seed (100.0- 123.0 g I2/100g), but lower than that of sunflower (118.0-141.0 g I2/100g), of soybean oil (124.0- 139.0 g I2/100g) (Anne etal., 2015)**.**However, *Cucurbita maxima* seed oil has higher iodine value than those of saturated fatty acid-rich oils such as Theobroma cacao, cocoa butter (32.0-42.0 g I2/100g) , coconut (6.0- 10.0 g I2/100g), palm oil (50.0-55.0 g I2/100g), palm kernel (14.0-1.0 g I2/100g) (Anne etal., 2015). The classes 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 thick and remain sticky but do not form a hard dry film. They are used in the production of soap (Kinkela, 2006; Ulmanns, 2001). The results indicate that the oil is a semidrying oil consisting predominately polyunsaturated fatty acids mainly oleic and linoleic fatty acids (Ekpa *et al*., 1989; Fox, 1984).

Table2. Fatty acid composition of *Citrullus lanatus* seed oil

Fatty acid	Percentage composition
Palmitic	17.53
Stearic	8 .13
Linoleic	53.42
Linolenic	20.92

The fatty acid composition of pumpkin seed oil as determined by gas chromatography and mass spectrometry (GC-MS) was found to contain four (4) fatty acids namely: palmitic, stearic, linoleic and linolenic acids.From Table. 2, above it shows that the pumpkin seed oil contain high amount of unsaturated fatty acid linoleic acid (53.42%) and linolenic acid (20.92%) and low content of saturated fatty acid such as palmitic acid (17.53 %) and stearic acid 8.13%.It is now widely accepted that diet with low saturated fatty acids and high inunsaturated fatty acids is beneficial for health (Anne *et al.,* 2015)**.**

CONCLUSION

The result of this study showed that cucurbita maxima seed oil cultivated in northeast nigeria could be good sources of edible oils for cooking. The most abundant fatty acid detected was linoleic acid (53.42%).They may also be used in various applications such as industrial ingredients in soap production, cosmetics, phamaceutic, and food complemen.

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