Extraction And Characterirization Of Sunflower Crude Oil.

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Citation

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Abstract

The oil samples used for this work were obtained from sunflower seeds. The seeds was prepared, dried, dehulled, conditioned and flaked. The oil was extracted by solvent extraction. The oil sample was investigated for their physico-chemical parameters which were specific gravity, refractive index, colour, flash, fire smoke, soft and turbidity points. There values were 0.923± 0.016, 1.475±0.002, 18.00 units,339.00±2.20°C, 342±1.20°C, 235.00±1.75°C, 42.00±1.108.00±0.20, 42.00±1.10, respectively. Other were free fatty acid, acid value, saponification value, peroxide value iodine value and yield, the values were 1.40±0.007%, 3.09±0.24%,197.43±0.42mgKOH/goil,12.6±2.20Meq$0_{2/}$kg, 131.60±0.71WIJ, 41.3±2.12% respectively. The qualitative determination of the fatty acid composition was carried out by methylation and application of Gas chromatography. The percentage yield which was 41.3% makes it a good source of oil. The free fatty acid (1.40%), peroxide (12.6meg KOH goil/), confirm that the oil can be processed into edible vegetable oil. The high level of unsaturated fatty acids (linoleic and oleic acids) and low level of saturated fatty acids(Myristic, palmitic and stearic acids) makes the oil a liquid oil. Finally, the oil, if refined and consumed, it will be a good source of essential fatty acid needed in the body.

INTRODUCTION

Lipids are important nutritional component in grains and seeds of many major fruits, They solubilized vitamins A, B, E, and K, which are necessary for the proper maintenance of health and a source of essential fatty acids, thus contributing to several metabolic function Lawson,(1995).

Lipids can be referred to as heterogenous collection of biochemical substances, which have in common the properties of being soluble in organic polar solvent and insoluble or sparingly soluble in water. The term lipid covers edible fat, oils and certain related compounds, which includes phospholipids and steroid Anonymous,(2004).

The sunflower (Helianthus annus L.) is a member of the compositae (Asteracea) family and the genus Helianthus. It originates from North America, where it was traditionally cultivated by the Native Americans. The sunflower was introduced is into Spain in the middle of 16th century, where it was cultivated essentially as an ornamental plant. Its oil-bearing qualities were only discovered in the 18th century. Since that time, the sunflower for oil production has been considerable genetically improved. Some of the first improvements, through trait selection and hybridization, took place in Russia, then in U.S.A. and aimed at increasing the oil contents of the seeds. The breeding resulted in the development of strains with Oleic improved acid content Soldertor, (1976) . Recently, strains with a low content saturated fatty acids have been developed [4]. However, sunflower seed was not commercially grown in Africa.

There are two types of sunflowers, the oil seed and non-oilseed, which are nevertheless of the same species. Oil seed sunflower, constituting the major part of oil World production and are characterized by their solid black hulls that are firmly attached to the seed[5]. There are also a high oleic acid oilseed sunflower that has a fatty acid profile similar to canola oil .It is estimated that 95% of the world production is the traditional oilseed type and only 5% is the non-oilseed type Gunstone, (2002) .

Roughly 80% of the value of sunflower seeds is attributed to their oil content, the oil content of sunflower seed is 23 to 46% NRC,(2001). Like all vegetable oils, sunflower oil is composed of triglycerides (98-99%) and other substances in the unsaponifiable fraction, which are also known as the “minor components” NRC, (2001)., Et Evrard, (1996).

The characterization of refined crude sunflower oil have been carried out extensively, but little have been reported on physico-chemical properties of the sunflower oil Salunke et al, (1992). The chemical composition of oil extract consequently gives a qualitative identification of oil, and is a very important area in the selective application guide in the

commercialization and utility of oil products Salunke et al ,(1992). Such analysis as the iodine value gives an index of the drying and polymerizing properties of oil while flash points, indicate a substantial removal of solvent from a solvent-extracted oil like the one being discussed , where a standard not below121C is required, for example by the open cup method of analysis Erickson et al ,(1980).

The fatty acid composition of sunflower oil makes it very important oil to be used for cooking. The fatty acid composition of refined sunflower oil as reported by AOAC, (1984)., Mar ,(2005), includes myirstic acid (C14:0), palmitic acid (C16:0), palmtoleic acid 9C16:1), stearic acid (C18:0), Oleic acid (C18:1), Linoleic acid (C18:2), linolenic acid (C18:3), and Arachidic acid (C20:1).

It is considered a highly polyunsaturates oil due to its high linoleic acid content (48.3 to 74.0%) and its moderate oleic acid content (14.0 to 39.4%) and low level of saturated fatty acid content (12%) on average Gunstone, (2002). These fatty acids are essential fatty acid to the body because it cannot be synthesized by the body.

The characterization based on different fatty acid group gives insight into the distribution of acid as in the unsaturated fraction among oleic, linoleic and linolenic acid as in the case with the linoleic, acid group, though,it is not a conclusive pointer USDA (littp:// www.Nal.Usda. Gov/fnic/foodcompO).

This paper is however aimed at extracting and investigating the physico-chemical and fatty acid composition of crude sunflower oil. This will be achieved through the realization of the following: extraction of oil through solvent extraction process; determination of the physico-chemical parameters of crude sunflower oil.

MATERIAL AND METHODS

The sunflower seeds used for this work were obtained from a Horticultural farm located at Kaduna in Kaduna state of Nigeria. They were prepared for use by dehulling, bin conditioning, and flasking. A soxhlet extractor was used for extraction of the oil. The solvent (Hexane) was recovered by simple distillation and the residual oil was collected and used for analytical work.

The moisture content and specific gravity were determined according to Erickson et al, (1980). While the refractive index was determined using Abbey Refractometer. The colour was determined using Lovibond tintometer in one inche cell. Gibb et al (2004).

The flash point which is the temperature at which the mixtures of vapour with air will ignite, and fire point was the temperature at which oil will sustain continued at combustion were measured using Gallenkamp Automatic Pensky- Martens flash points Gibb et al (2004).

The smoke point is the temperature at which oil gives off a thin bluish smoke was determined by standard method in open dish specified by the ASTM,(1984). The temperature at which turbidity is first detectable was also measured using palm test turbidity, tube Gibb et al (2004)

The chemical properties of the oil sample were determined by official method of analysis Erickson et al (1980). The chemical properties include free fatty acid, saponification value, peroxide value, iodine value and acid value.

Analytical test method for fatty acid methyl esters, the fatty acid methyl esters were analysed using Agilent 6890 series. Gas chromatography filled with a flame ionization detector and enhanced integrator. Helium gas was used as carrier gas. The column initial temperature was 250C rising at 10C / mm to a final temperature at 300c while the injection and the detector were maintained at 250C and 300C respectively. The peaks were identified by comparism with standard fatty acid methyl esters obtained from Johnson wax Nig Ltd, Lagos Erickson et al (1980).

RESULTS

Figure 1

Table 1:- Physico-chemical parameters of crude sunflower oil

Parameters	Crude sunflower oil.
Melting point	-17.0 ± 1.15
Specific gravity	0.923 ± 0.016
Refractiveindex 20^{0}C	1.475 ± 0.002
Colour (unit)	18.00
Flash point (^{0}C)	339.00 ± 2.20
Fire point (^{0}C)	342.00 ± 1.20
Smoke point (^{0}C)	235.00 ± 1.75
Turbidity point (JTU)	8.00 ± 0.20
Soft point (^{0}C)	42.00 ± 1.10
Moisture content	Nil
Free fatty acid (% oleic acid)	1.40 ± 0.07
Saponification value (mg KOH/g oil)	197.43 ± 0.42
Peroxide value (meqO_2 /kg)	12.6 ± 2.20
Iodine value (WIJ)	131.60 ± 0.71)
Acid value (%)	3.09 ± 0.24
Yield (%)	41.3 ± 2.10

Mean ± standard deviation of triplicate determination.

Figure 2

Table 2: Fatty Acid composition of crude sunflower oil

Fatty acid Methyl ester	Fatty acid	Carbon Number	Crude sunflower oil (%)
Methyl myristate	Myristic	14:0	0.183
Methyl Palmiteate	palmitic	16:0	6.269
Methyl Palmitoleate	palmitoleic	16:1	0.154
Methyl Stearate	stearic	18:0	4.330
Methyl Oleate	Oleic	18:1	17.558
MethylLinoleate	linoleic	18:2	52.654
Methyl Linolenate	Linolenic	18:3	0.418
Arachideate	Arachidic	20:0	0.057

RESULTS AND DISCUSSION

Table 1 presents the result of the physico-chemical parameters of crude sunflower oil. The moisture content of the oil was not detected. The colour of the crude oil was determined to be 18.00 lovibond unit. This was calculated based on the expression (5R +Y-B) where R is the red pigment, Y is the yellow Pigment and B is the blue pigment. The yield was calculated to be 41.3±2.10. The melting point was determined to be -17.00±1.15 C while the specific gravity and Refractive index were 0.9230±0.016 and 1.475±0.002 respectively. These values were inline with the value range of 0.924 to 0926 and 0.472 to 1.476 respectably reported by [15]. The result of flash , fire and smoke points were determined to be 339.00±2.20C,342.00±1.20C and 235±1.75C respectively. These values can be compared to the crude soybean values reported by [16]. The soft point was measured to be 42.00±1.10C, the range reported by [17].

Free fatty acid and acid value are among the characteristics that are necessary for the confirmation of the identity and edibility of oil. These were determined to be 1.40% and 3.09% respectively. The low value of free fatty acid is an indication that the oil can be refined to edible vegetable oil. These values were within the range value of 0.5 to 2.8% reported by [9]. The result of the peroxide value in milliequivalent /peroxide / kg was 12.6Meq /peroxide /kg. The high peroxide value was an indication that the oil is susceptible to oxidative rancidity due to the presence of double bond.

The unsaturated glycerides of oil have the ability to absorb a definite amount of iodine Morris and Jacob,(1999). The determined iodine value was 131.6(WIJ) this is owing to the fact that the oil contain unsaturated hydrocarbon Prevot (1986). The saponification value result was 197.43mg KOH/g oil. This value is very much close to that of soybean oil and it is an indication that the oil will not be good for soap making.

Table 2 depicts the fatty acid composition of crude sunflower oil,The fatty acids detected were Myristic, palmitic, palmtoleic, stearic, oleic, linoleic, linoleric and arachidic acids, and their value. The values were oil 0.183, 6.269, 0.154, 4.330, 17.558, 52.654, 0.418 and 0.057 % /100g of oil respectively. The fatty acid detected were within the fatty acid detected by[11]. The high level of linoleic acid content (52.654% /100g of oil) and low level of saturated fatty acid (`10.839 % of oil) is an indication that sunflower oil is more of unsaturated fatty acid. This further confirms the reason why sunflower oil is more of liquid than solid hence, it cannot easily congeal at ordinary temperature which was also reflected in the value of melting point(-17.0±1.15°C) obtained for the oil.

The result also shows the summary of the total fatty acid composition of the oil. The value for saturated fatty acid was sum up to 10.839 5 % of oil, monounsaturated fatty acid was 17.712 5 of oil and polyunsaturated fatty acid was 53.072 % %of oil. The total fatty acids in oil were 81.623 % of oil. The

18.377 % of oil were the fatty acid that cannot be detected. This might be as a result of impurities contains in the crude oil.

CONCLUSION

The results of the investigation carried out on crude sunflower oil suggest that, if the oil is refined and consumed, it will supply the essential fatty acid needed in the body. This will reduce the risk of cardiovascular diseases in human being. The result of the physicochemical properties supported the suitability of the oil for consumption rather than industrial application of soap making.

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