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EFFECT OF VARIETAL DIFFERENCE ON THE PHYSICOCHEMICAL PROPERTIES AND FATTY ACID PROFILE OF KENAF SEED OIL

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Abstract

Kenaf (Hibiscus cannabinus L.), has a lot of potential to be utilized in the production of fibre and edible oil for food, medicinal, biodiesel etc. Two varieties of kenaf seed grown in Nigeria: Cuba-108 and Dowling were investigated. The oilseeds were extracted with hexane using cold maceration method. Physicochemical parameters were determined according to established methods. The fatty acid composition was determined by trans esterification of a known quantity of kenaf oils with methanol using potassium hydroxide as catalyst. The result obtained showed percentage oil content of 14.8 % and 12.7 %; acid value 3.8mgKOH/gm, 5.5mgKOH/gm, for Cuba -108 and Dowling respectively. Fatty acid composition of kenafoil sample Dowling (KS (D)) is predominantly, linoleic, while Cuba -108 Cuba -108 (KS (C)) is predominantly oleic. From the results obtainedKenaf seed oil has very great industrial potential in food and non-food utilization.

Key words: *Kenaf (Hibiscus cannabinus L.), fatty acid composition, trans esterification, cuba 108, Dowling, acid value, saponification value, peroxide value.*

Introduction*:* Oils are derived from seeds and fruit of plants which grow in different parts of the world. About 100 tropical and subtropical plants belonging to about 40 different botanical families are known to have oil-bearing seeds or fruits (Alfredand Patrick,1985). To meet the increasing demand for vegetable oils, efforts are being made to source nonconventional oilseeds that have the ability to produce desirable fats and oils. Kenaf, Hibiscus cannabinus L. is a plant in the Malvaceae family similar to okra and cottonseed (Scott and Taylor, 1988), native to Central Africa. It is a short-day, annual herbaceous plantcultivated for the soft bast fibre in its stem. Kenaf is cultivated in different parts of the world as a source of fiber.

This plant contains various phytochemicals: tannins, saponins, polyphenolics, alkaloids, essential oils and steroids, and has long been prescribed in traditional folk medicine in Africa and India (Agbor et al., 2005; Kobaisy et al., 2001).

Currently in Nigeria, there is an increase attention on Kenaf tree because of its environmental and economic potentials (Nkaaet al., 2007). It is mainly cultivated for its fibre used in the production of agro-sacks, pulp and paper; the leaves are edible and consumed in human and animal diets. Despite its importance, little or no attention is given to Kenaf oilseeds.Kenaf seed contains various bioactive constituents such as fatty acids, phenolic acids, phytosterols and tocopherols (Coetzee et al., 2008; Nyam et al., 2009).Palmitic, oleic, and linoleic acids were reported as major fatty acids in kenaf oil (Singh et al., 1988).

Kenaf seeds yield between 19 – 26% vegetable oil that is edible and also find uses in cosmetics, industrial lubricants and biofuel production (Coetzee et al., 2008; Mohamed et al., 1995). The oil contains high percentage of polyunsaturated fatty acids (PUFA) which are necessary for normal growth and health. Also, it is important for reducing cholesterol and heart diseases (Hafez et al., 1990).

Kenaf's relatively high oil content and its similarity to cottonseed oil suggest that the seed oil may be used as a source of edible oil (Mohamed et al., 1995). It does not contain the toxic compound gossypol present in cottonseed oil. Alternative use of kenaf as a source of edible oil could facilitate its production and enhance its economic potential. Therefore, the aim of this study is to evaluate the effect of varietal difference on the physicochemical properties and fatty acid profile of kenaf oil.

Materials and methods: Kenaf oilseeds were collected from the Institute of Agricultural Research and Training Ibadan, Oyo State, Nigeria.Dirt, extraneous materials were removed by sorting. The seeds were washed and sun-dried. The cleaned seeds were crushed in its natural state because separation of the episperm from the kernel and decortications is difficult and wasteful. Oil was extracted from the crushed kenafseeds using n-hexane by cold maceration method.After extraction, the excess hexane was removed by distillation at 40oC under reduced pressure using arotary evaporator (Buchi 461).

Physicochemical properties: specific gravity, refractive index, acid value, free fatty acid, peroxide, saponification and iodine values of the oils were determined according to standard methods (AOAC 1997). The fatty acid composition was determined by trans esterification of a known quantity of kenaf oils with methanol using potassium hydroxide as catalyst. Catalyst concentration was 1% w/w of the oil. The reaction mixture was stirred using a magnetic stirrer heated to 60oC; and refluxed for 1hr. The temperature was fixed at 60oC based on previous work (Darnokoet al., 2000). The mixture was allowed to separate overnight; the upper layer consisting of fatty acid methyl ester (FAME) was separated and sent for analysis to determine the fatty acid composition using gas chromatography-mass spectra (GC/MS).

The FAME of the oil was analysed by GC/MS (Shimadzu QP 2010 Ultra) under the following conditions: injector programme was 50oC for 2 min then increased to 250oC at 7oC/ min.The initial and final holds up temperature was 2 min, respectively. The ion source temperature and interface temperature were held at 230 and 250oC respectively. Helium was used as the carrier gas. Identification of the fatty acids was done by comparing retention times with standards analysed under the same conditions. Relative percentages of each fatty acid were determined based on measurement of peak area.

Results and discussion: Two varieties of kenaf seeds were extracted with hexane using cold maceration method. Soxhlet extractor was used to extract residual oil from the cake.From table 1, the percentage yield for Cuba (KS(C)) and Dowling (KS (D)) is 14.8 % and 12.7 % respectively. These values are lower than the valuespreviously obtained (Coetzee et al., 2008, Mohamed et al., 1995).This is probably due to the differences in climate, extraction method, ripening stage and harvesting time of the seeds.Thekenaf oil KS (C), KS (D) had acid value of 3.80mgKOH/g, 5.50 mgKOH/g, iodine value of 121 g I2/100 g, 104 g I2/100 g while peroxide and saponificationvalues were 5meq O2/kg, 13 meq O2/kg; and 192 mg KOH/g, 187 mg KOH/g respectively. The acid value represents free fatty acid and is a valuable measure of oil quality.It also shows the level of hydrolytic rancidity. The peroxide value is the measure of oxidative rancidity of oil (Ekpa and Ekpa, 1996).Cuba variety showed peroxide values less than 10meq O2/kg thus indicating good storage stability. Oils become rancid when peroxide value is between 22 and 40 meq O2/kg (Pearson, 1976). The values in the tables are averages of two separate determinations.

Table 1: Physicochemical properties of Kenaf oil (cold maceration).

S/N	Parameters	Cuba	Dowling
1	% Yield	14.8	12.7
2	Colour	golden Yellow	light Yellow
3	Refractive Index	1.4761	1.4774
4	Density	0.9059	0.9112
5	AV (mgKOH/g)	3.80	5.50
6	% FFA	1.9	2.7
7	SV (mgKOH/g)	192	187
8	IV (g/100g)	121	104
9	PV(meq O2/kg)	5	13

In this study, varietal differences are significant in all the physicochemical properties apart from refractive index and density. Saponification value indicates the average molecular weight of oil (Booth and Wickens, 1988). In the present investigation, the kenafoils showed high saponification. The values compare favourably with saponification value of cottonseed oil(189-198 mgKOH/g), soyabean oil (188-195mgKOH/g).The high saponification valuessuggest that the oils have potential for use in soap and cosmetic industries (Dash et al., 2015).The result also shows high iodine value for the two varieties. The values are similar to cottonseed (100-115 g/100g) but lower than soyabean oil (124-139 g/100g). The iodine value indicates the degree of unsaturation.The fatty acid methyl ester profile of the kenaf oils as determinedby GC/MS is given in Table 2.Both varieties contain high amount of oleic and linoleic acids. The values obtained are less than values reported by Mohamed et al. (1995) and Coetzee et al. (2008).

From table 2, kenaf sample (KS (D)) is predominantly, linoleic, while KS (C) is predominantly oleic. The higher percentage of oleic acid in KS (C) variety makes it more desirable in terms of nutrition especially with the current trend of replacing polyunsaturated vegetable oils with those containing high amount of monounsaturated acids. Also, high oleic gives it better oxidative stability in applications like frying.

Table 2: Fatty acid composition of Kenaf Seed Oils

Variety	C13:0	C16:0C18:0	C18:1	C18:2	C18:3
Cuba	13.4	-	33.0; Δ-9 (Z) 13.8-oleic acid	27.2; Δ-9,12 (EE) 1.1; Δ-9,15	nd
Dowling	17.9		24.8; Δ-11	24.4; Δ-9,12 (EE); 12.7; Δ-9,15	nd
Reference oil					
Cottonseed[a]			13-44	13-50	0.1-2.1
Soyabean[a]			19-30	44-62	4-11
Kenaf (cuba)		1.6	31.3-34.91	42.6-44.06[c]	0.43

Δ-position of double bond Z,Z-cis, E,E- trans, nd-not detected. a: The data for cottonseed oil is reported by Gunstone et al.(1986), forkenaf andsoyabean oil from Mohamed et al. (1995), Coetzee et al. (2008).

However, palmitic C16:0, and linolenic C18:3 acids were not detected in the two varieties tested, but 13.4 %, 17.9 % ofTridecanoic acid, C13:0 for KS(C), KS (D) respectively was detected in the oil samples.This is a significant difference compared to other oils such as cottonseed, soybean and sunflower.

The notations in parenthesis signify the number of carbon atoms and double bonds respectively.

Conclusion: Variety has a profound effect on the physicochemical and fatty acid profile of kenaf seed oil. The oils from the two varieties are predominantly oleic and linoleic acids. High oleic content in kenafoilmakes it more desirable in terms of nutrition especially with the current trend of replacing polyunsaturated vegetable oils with those containing high amount of monounsaturated acids.Also, higher oleic givesit a better heat stability during frying than that of soyabean.

Although kenaf is mainly used for its fiber, the data suggest that the seeds, as a byproduct, would provide oil for food and industrial purposes. The meal can be a source of raw materialfor feed and food. Such uses could significantly increase its economic potential.

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