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Spongegourd and Snakegourd Seeds as Potential Unconventional Oil-Rich Source

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Cucurbit seed kernels of spongegourd and snakegourd were explored as unconventional rich sources of deep greenish brown oil. Physico-chemical oil characteristics and fatty acid composition confirmed that spongegourd seeds constitute a potential source of good quality edible oil compared to groundnut oil whereas snakegourd drying oil is likely to be suitable for manufacture of paints and varnishes.

INTRODUCTION

In India, there is acute shortage of both edible and non-edible oils. To alleviate this, it is imperative to explore non-conventional oil-rich newer sources. Several commercially cultivated species of cucurbitaceae are propagated throughout the country. If the seeds of these species are collected and exploited fully, these could form a potential source of edible/industrial oils. In order to utilize them as newer sources of oil production for food and industrial purposes, it is necessary to know their chemical composition. So, in the present study, oils obtained from spongegourd and snakegourd seeds were investigated in detail for their physico-chemical characteristics and fatty acid composition in comparison with groundnut and coconut oils.

MATERIAL AND METHODS

The seeds of spongegourd *(Luffa cylindrica)*, snakegourd *(Trichosanthes anguina)* and groundnut (*Arachis hypogaea* L.) were procured from local market. Viability of seeds was tested by germination which ranged from 80–95%. The seeds were decorticated by hand and fresh oil from the kernels was extracted by cold percolation method of Kartha and Sethi[1] using carbon tetrachloride as solvent. Parachute brand coconut oil (refined) was, however, purchased from local market and used for estimation of fatty acids by G.L.C. Refractive indices were measured by using Abbe's refractometer. Other physico-chemical characteristics of these oils *viz.* iodine value, sap value, acid value, unsaponifiable matter, Hehner value, soluble acids, R.M., Polenski values and acetyl values were determined by the procedures described by AOAC[2].

Fatty acid composition of the oils was determined by G.L.C. The methyl esters were prepared according to the method of Christie[3] and the purity of methyl esters was checked by T.L.C. The methyl esters were analysed by Shimadzu gas liquid chromatograph GC-6 AMPrf equipped with flame ionization detector. A glass column (6′ × 1/8″) packed with 15% diethylene glycol succinate on 80–100 mesh acid washed silanized chromosorb-W, AW-DMCS was used. The following analytical conditions were maintained on the G.L.C.

Column temperature 190 ± 0.5°C. Gas flow rates were: N_2, 60 mL/min, hydrogen 40 mL/min and attenuation 64. 1.0 μL of the sample was injected for analysis. The peak areas were calculated using Shimadzu data processor chromatopac EIA and converted to relative percentages directly.

RESULTS AND DISCUSSION

Physico-chemical characteristics of oils extracted from seed kernels of two cucurbit species and groundnut have been presented in Tables 1 (a) and 1 (b). These have also been compared with those of coconut oil reported by Williams[4].

TABLE-1 (a)
PHYSICO-CHEMICAL ANALYSIS OF THE CUCURBIT SEEDS KERNEL OIL

Cucurbit	Oil (%)	Colour	Refractive index (ND^{40})	Iodine value	Saponification value	Unsaponifiable matter
Luffa cylindrica (spongegourd)	41.0	Deep greenish brown	1.4658	86.0	180.0	0.9
Trichosanthes anguina (snakegourd)	56.0	Greenish brown	1.4910	148.0	190.0	1.2
Groundnut oil	45.0	Light yellow	1.4631	88.0	189.0	0.8
*Coconut oil	66.0	Colourless	1.4480	8.6	257.3	0.2

*Williams (1966)

TABLE-1 (b)
PHYSICO-CHEMICAL ANALYSIS OF CUCURBIT SEEDS KERNEL OIL

Cucurbit	Hehner value	Soluble acids	R.M. value	Polenski value	Acetyl value	Acid value
Luffa cylindrica (spongegourd)	95.8	Traces	2.1	1.5	1.5	1.5
Trichosanthes anguina (snakegourd)	94.4	Traces	0.8	0.4	84.5	0.4
Groundnut	95.8	—	1	1	9.0	0.5
*Coconut	—	—	7.5	16.5	—	0.09

*Williams (1966)

Spongegourd and snakegourd seeds, respectively, constituted a potential source of oil (41% and 56%) which were in close agreement with that of Jacks *et al.*[5] The colour of these cucurbit oils was deep greenish brown due to co-extraction of liposoluble pigments from perisperm and endosperm seed layers and so needs refining.

R.I.'s nD^{40} ranged from 1.4480 (coconut) to 1.4910 (snakegourd). Highest R.I., I.V. (148) and acetyl values (84.5) of snakegourd oil indicated presence of appreciable amounts of α-eleostearic acid (42.59% as determined by G.L.C.). The freshly extracted oil polymerizes to a gel in atmosphere within 48 h. Also, when the oil was heated with acetic anhydride, it polymerized to a plastic mass. So this oil can be characterized as drying oil, suitable for manufacture of paints and varnishes. Results of similar studies on *C. digitata*, *C. palmata* oils recorded by Bolly *et al.*[6] and on *Momordica charantia* (bittergourd) oil by Sharma[7] indicated that this oil is also similar to linseed drying oil and quite suitable for use in protective coatings as constituents of paints and varnishes.

I.V. of spongegourd oil (86.0) was in close proximity with groundnut oil (88.0) and so it can be classified as non-drying oil as per classification by Jamasin. Its acetyl value (1.5) exhibited very low oxygenated functional groups. Sap value of spongegourd was lowest (180) which shows that this oil is constituted of fatty acids with relatively longer chain lengths, whereas a sap. value of 190 was observed in snakegourd oil, which was in close agreement to sap. value of watermelon oil (189) as determined by Sharma[8]. Sap. value of coconut oil was reported much higher (257.3) by Williams[4] which shows that short chain fatty acids were present in coconut oil to a large extent. Very low acid values (0.4–1.5) and unsaponifiable matter (0.9–1.2%) of all these oils were within normal limits. The Hehner values ranged from 94.3–95.8 and soluble acids were present in traces. R.M. (0.8–2.1) and Polenski values (0.4–1.5) revealed that these cucurbit seed oils were constituted of very less short chain lower fatty acids, with the exception of coconut oil in which lower fatty acids were present to a large extent as estimated by Williams[4]. Dhingra and Biswas[9] also reported about 3.1% steam volatile fatty acids in muskmelon.

Fatty Acid Composition of Oils

Fatty acid compositon of cucurbit seed oils along with those of groundnut and coconut oils is given in Table 2. It is evident from tha data that spongegourd seed oil is a very rich source of linoleic acid—an essential fatty acid (58.58%) which is higher than that of groundnut (42.4%). The snakegourd oil is mainly constituted of a conjugated trienoic fatty acid *i.e.* 42.59% α-eleostearic acid [$C_{18:3}$ $^{9, 11, 13}$ (*cis, trans, trans*)] and it contains only 16.64% of $C_{18:2}$ acid. Sharma[7] also observed 50% α-eleostearic acid in a related species *i.e.* in bittergourd seed oil. The levels of oleic acid (next important component in cucurbit seed oils) was 19.30–26.95 per cent. Among the saturated fatty acids, the concentration of palmitic acid (12.87%) was higher in spongegourd as compared to snakegourd (3.8%) while stearic acid contents were nearly similar (9.37; 10.02%).

TABLE-2
FATTY ACID COMPOSITION OF THE OILS (PER CENT)

Oil	Palmitic acid ($C_{16:0}$)	Stearic acid ($C_{18:0}$)	Oleic acid ($C_{18:1}$)	Linoleic acid ($C_{18:2}$)	α-eleo-stearic acid	Total unsatu-rated	Total saturated	Ratio (unsatu-rated/ saturated)
Spongegourd	12.87	9.37	19.30	58.48	—	77.77	22.24	3.5
Snakegourd	3.00	10.02	26.95	16.64	42.59	86.18	13.82	6.2
Groundnut*	16.09	3.09	42.40	34.97	—	79.27	20.94	3.8
Coconut†	12.45	3.80	9.66	3.60	—	13.26	86.69	0.15

*$C_{20:1}$ = 1.90; $C_{22:0}$ = 1.56
†$C_{14:0}$ (myristic) = 23.36; lower chain fatty acids = 47.08 ($C_{8:0}$ = 6.52; $C_{10:0}$ = 14.47 and $C_{12:0}$ = 26.09)

In contrast to cucurbit oils, coconut oil had very high concentration of saturated fatty acids amounting to 86.7% including 60.44% lower chain fatty acids (< $C_{16:0}$) and only a small amount of linoleic acid (3.6%). On the other hand, groundnut oil had sufficient amount of linoleic (35.0%), oleic acid (42.4%). Stearic acid was, however, nearly equal (3.09, 3.08) in both conventional oils. The concentration of palmitic acid is also fairly better than cucurbit seed oils. Groundnut oil also contained 3.46% of higher fatty acids ($C_{20:1}$ and $C_{22:0}$).

Hence the present study showed that spongegourd and snakegourd oils constituted a very rich and potential source of oil. Various physico-chemical characteristics revealed that spongegourd oil can be exploited as good quality edible oil whereas snakegourd drying oil could find industrial application in the manufacture of paints, varnishes and other products requiring drying oils as a base.

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