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Screening of some lesser known tree-borne oilseed plants from North-East India for their oil content and major fatty acid components

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ABSTRACT

Forest of North-East India is rich in a variety of tree borne oilseeds and there were no serious efforts to exploit the less known oilseeds of the forest origin. Considering the vast plant wealth and with an objective to explore these untapped potentialities of oilseed resources of NE India, a research program was undertaken. The present communication is based on the investigation of seeds of 14 lesser known plant species for fats and oils. The screened plant species exhibited oil yield ranging from 4.71% to 48.43% on dry weight basis. *Alseodaphne andersonii* showed significant amount of tocols while *Garcinia xanthochymus* showed significant amount of phytosterol. Gas liquid chromatography analysis of methyl ester extracted fatty acid indicated dominant fraction of Oleic acid in 6 numbers of species, followed by Linoleic acid in 3 species, Lauric acid in 3 species, and Palmitic acid in 2 species. The majority of the species (9 species) showed higher amount of unsaturated fatty acid content in the oils which suggested that the species may serve as valuable raw materials for vegetable oil which can be explored as substitute for industrial feasibility while restshowed higher amount of saturated fatty acids which suggested that these species may serve as important industrial by-products.

1. Introduction

Oilseeds and edible oils are two of the most sensitive essential commodities. India is fortunate in having a wide range of oilseed crops grown in its different agro climatic zones. The oilseeds of tree and forest origin, which grow mostly in tribal inhabited areas, are a significant source of oils. Indian production of oilseeds is almost stagnant at 8–9 million tons for the last five years and the ratio of production to consumption is also low. Therefore, it is necessary to screen oilseeds from tree borne origin to have serious introspection in this sector in order to make India self-sufficient in vegetable oils.

Oilseeds are important sources of nutritional oils, industrial raw materials and nutraceuticals. The quality of edible oils is generally detected by the composition of fatty acid and several physico-chemical parameters. No oil from a single source can be suitable for all purposes thus the study of their constituents is important [1]. The major components of vegetable oils are triglycerides (glycerol and fatty acids) and others include mono and diacylglycerols, free fatty acids, phosphatides, sterols, tocopherols, fat-soluble vitamins etc. [2]. Fatty acids are both saturated (lauric, palmitic, myristic, stearic, arachidic, behenic, capric, etc.) and unsaturated (oleic, linoleic, linolenic). Unsaturated fatty acids are MUFA (includes ω-9) and PUFA (include ω-6 and ω-3). Linoleic acid is the most important of all ω-6 fatty acids, obtained with other group such as ALA or GLA. In dry skin Linoleic acid strengthens the lipid barrier of epidermis, protects against transepidermal loss of water and normalizes the skin metabolism. Linoleic acid is a natural component of sebum. Diet with increasing intake of linoleic and linolenic acid increases HDL-cholesterol and decreases LDL-cholesterol, while higher intake of oleic acid decreases LDL-cholesterol without affecting HDL-cholesterol levels [3]. Vegetable oils are the principal sources of linoleic

Abbreviations: **ADHD**, Attention Deficit Hyperactivity Disorder; **ALA**, α- linolenic acid; **DHA**, docosahexaenoic acid; **DWB**, Dry Weight Basis; **EFAs**, Essential fatty acids; **EFSA**, The European Foods Safety Authority; **EPA**, Eicosapentaenoic acid; **FA**, Fatty acids; **FAME**, Fatty Acid Methyl Ester; **FDA**, Food and Drug Administration; **GC-MS**, Gas chromatography–mass spectrometry; **GLA**, γ-linolenic acid; **HDL**, High density lipoprotein; **HPLC-FLD**, High Performance Liquid Chromatography with fluorescence detection.; **IPNI**, The International Plant Names Index; **Less Known**, Seeds which are not exploited (with limited available literature & not collected in organized sector); **LDL**, Low density lipoprotein; **MUFA**, Monounsaturated fatty acids; **PUFA**, Polyunsaturated fatty acids; **SFA**, Saturated fatty acids; **Unknown**, No data available on oil content / fatty acid composition; **WHO**, World Health Organization; **ω-3**, Omega- 3 fatty acids (n-3); **ω-6**, Omega- 6 fatty acids (n-6); **ω-9**, Omega- 9 fatty acids (n-9); **g**, gram; **m**, metre; **mg**, milligram; **μg/g**, micrograms per gram

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and linolenic acids that is the EFAs which the body cannot synthesize. The human body needs EFAs to manufacture and repair cell membranes, enabling the cells to obtain optimum nutrition and expel harmful waste products. A primary function of EFAs is the production of prostaglandins, which regulate body functions such as heart rate, blood pressure, blood clotting, fertility, conception, and play a role in immune function. EFA deficiency and ω-6/ω-3 imbalance is linked with serious health conditions, such as heart attacks, cancer, insulin resistance, asthma, lupus, schizophrenia, depression, postpartum depression, accelerated aging, stroke, obesity, diabetes, arthritis, ADHD, and Alzheimer's disease, among others [4].

In addition to the fatty acids, tocols (tocopherols and tocotrienols) and unsaponifiable matter content profile of vegetable oil is also important for industrial applications. Tocopherols and tocotrienols occur in plants in variable amounts, their biological and antioxidative activity varies between individual compounds [5]. Vegetable oils are probably the major dietary source of vitamin E [6], with a variable isomer profile according to the oil identity [7]. Tocopherols protect food from oxidation by protecting the stability of oils and fats [8]. The high values of unsaponifiable matter may indicate adulteration and contamination [9].

North-Eastern region of India, due to its varied topography, climate and soil is rich in plant diversity representing about 50% of the total flowering plants of the country. The region also endowed with a vast treasury of tree borne oil seed plants many of which are even used by the native people for edible purposes [10]. As a very few study has been carried out in this regard, the present investigation aims to exploit newer tree-borne oilseed sources for edible and non-edible applications from both known and unknown plants. However the less known plants have been given priority. Screening of 14 plants has been undertaken, selection of which were mostly based on their availability, medicinal properties and edible and non-edible characters. The plants selected and the results encountered have been presented in this communication. Out of the 14 plants selected only 2 plant species (*Sapindus mukorossi* and *Litsea cubeba*) have been reported earlier while the rest belong to the less known category (Table 1).

These 14 screened species though not cultivated for commercial purpose, but they have been reported as traditional medicines by various people. The local traditional medicinal uses are listed below (Table 2).

A taxonomic key is also provided on the basis of seed structure to understand the seed morphology of the selected species and the identified species have been confirmed in IPNI.

1.1. Taxonomic key

1a.) Rounded, spheroid or globose……..
……1
1b.) Seeds ovoid or ellipsoid or otherwise……..
……..6
2a.) Seeds slightly undulate……..***Litsea cubeba*** *(*Loureiro)Person
2b.) Seeds lineate, granulate,puncticulate or undulate……..3
3a.) Seeds granulate,undulate, small brown spots present.
…….
…….***Litsea coriacea*** Hook.f
3b.) Seeds lineate glaucous to puncticulate…….
……4
4a.) Seeds flat and lineate……..***Albizia procera****(roxb.)*Benth
4b.) Seeds lineolate puncticulate …….
……5
5a.) Seeds blackish,lineolate puncticulate……..
……..***Sapindus mukorossi***Gaertn.
5b.) Seeds redish brown, bilobed and depressed
……
……***Kayea assamica***Prain.
6a.) Seeds slightly bilobed and ruminate…….
……
……***Machillus bombycina*** King ex Hook.f.
6b.) Seeds single loculed or bilobed,ridged……7
7a.) Seeds depressed, truncate in one side……. ***Garcinia morella*** Desr.
7b.) Seeds ellipsoid, obovoid or ovoid or oblonged……..
…….
……
……..8
8a.) Seeds ellipsoid……..9
8b.) Seeds ovoid or oblonged …….
……..……10
9a.) Seeds surface puncticulate, seeds ridged in the middle…….
…….
……***Chisocheton paniculatus*** Hiern
9b.) Seeds surface granulate and uniform……***Croton joufra*** Roxb.
10a.) Seeds ovoid……
……..11
10b.) Seeds oblonged, ovate……..12
11a.) Seeds transverslate, surface ribbon foveolate……..
……
……***Nyctanthes arbor-tristis*** Linn.
11b.) Seeds uniformly ovoid to broadly ovoid, surface puncticulate to prominently undulate.
…….
……..13
12a.) Seeds oblonged, brown in colour, surface ruminate puncticulate……..
……***Cinnamomum impressinervium*** Meisn.
12b.) Seeds ovate, brown in colour, white striped present
……
……***Garcinia xanthochymus*** J. D. Hooker ex T. Anderson in J. D. Hooker
13a.) Seeds grayish brown, size (1.6 × 1.8 cm.) surface puncticulate…….
……***Camellia sinensis***(L.) Kuntze var. *assamica* (J.W.Mast.) Kitam.
13b.) Seeds dark brown, size ranges (1.4 × 0.8 cm.), surfaces prominently undulate……..
……***Alseodaphne andersonii*** *(*King ex J.D. Hooker) Kostermans.

2. Materials and methods

The matured seeds were collected from the areas in and around Jorhat viz. Gibbon Wildlife Sanctuary, Mariani and Nambar Reserve Forest, Golaghat of Upper Assam and North Lakhimpur district. The time of fruit maturity and the average seed yield per annum of the plant species were recorded during the field studies. The weight of each seed