Bioscience Discovery, 10(4):203-206, Oct. - 2019

Print & Online, Open Access, Research Journal Available on http://jbsd.in
ISSN: 2229-3469 (Print); ISSN: 2231-024X (Online)
Research Article

Germplasm collection of potential natural oil resources for energy

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Article Info

Received: 21-07-2019,
Revised: 19-09-2019,
Accepted: 26-09-2019

Keywords:
Non-edible oil resources; physicochemical analysis; oil contents; fatty acids

Abstract

During last few decades in view of increase in demand and cost of petroleum products alternative resources like edible and non-edible oil resources as well as animal fat are used as bio-energy source. Vegetable oil as biodiesel is an environment friendly replacement for petroleum based fuel. India has a great potential for production of bio-fuels from non-edible oil resources. There are more than 100 varieties of non-edible oil seed resources available in wild state. They exhibit tremendous genetic diversity in morphology, chemical characters and oil content with respect to seasonal change. During last two years germplasm collection of non edible oil seeds like *Jatropha*, *Caesalpinia*, *Madhuca*, *Aphanamixis*, *Callophyllum*, etc. from Kolhapur, Ratnagiri, Satara, Pune, Solhapur, Raigad districts from Maharashtra was carried out. The present paper deals with physico-chemical analysis, oil content variation and fatty acids composition.

INTRODUCTION

There has been considerable interest in the use of vegetable oils, animal fats as fuels for diesel (Azam *et al.*, 2005, Oliver, 2005). Biodiesel, based on edible and non-edible oils has already made much headway in the U.S, European countries, Australia, Japan, Malaysia, etc. where regular production plants are already in operation. In Europe bio-diesel is mainly made from rapeseed, sunflower, US from Soybean and Malaysia from palm oil. Nicaragua is used to replace petro-diesel by bio-diesel from *Jatropha* oil. Extensive literature on fatty acid alterations and composition for improving oil quality is available in case of edible oils like rapeseed, sunflower and soybean.

Central Agriculture Research Institute (CARI), Andaman and Nicobar have made efforts to search on Alligator apple (*Annona glabra* L.) as a potential source of seed oil as biodiesel (Singh *et al*.2005). *Caesalpinia* crista L. seeds oil is a potential source for biodiesel (Kulkarni et al. 2008). Indian Institute of Petroleum (IIP), New Delhi has developed a pilot plant and is actively pursuing the utilization of non-edible oils for the production of bio-diesel, additives for lubricating oils, saturated and unsaturated alcohols and fatty acids and many other value-added products. (Jayanthi, 2005). Kulkarni *et al.* (2000, 2009) carried out germplasm collection of *Azadirachta indica* A. Juss. from Pune region for oil content and azadirachtin variation in bitter and non-bitter types. Maharashtra state in general and Konkan region in particular is known for traditional non-edible oil resources like *Madhuca longifolia* Macb., *Hydnocarpus laurifolia* Sleumer, *Mesua ferrea* L. *Scheilchera oleosa* Oken, etc. (Kulkarni, 2004, Bhagat & Kulkarni, 2009, Bhagat & Kulkarni, 2010 a,b & c, Bhagat *et al.*, 2010).

Germplasm collection of non edible oil seeds like *Jatropha*, *Caesalpinia*, *Calophyllum*, *Madhuca*, *Aphanamixis*, etc. from Maharashtra state. Seed material of above species collected and processed for oil content variation, fatty acid estimation and phyco-chemical properties which are major part required for bio-diesel production.

MATERIAL AND METHODS

Collection of germplasm of superior genotype having high oil yield and suitable for cultivation in different climatic zones is an essential requirement. Germplasm of *J. curcas*, were collected from Maharashtra including Kolhapur, Solhapur, Satara, Raigad, Ratnagiri and Pune districts. While *Madhuca longifolia var. latifolia* (Roxb.) Chev. from Nasik, Dhule, Nandurbar areas were made. *Calophyllum inophyllum* L. fruits were collected from Raigad district. Matrure fruits of *Aphanamixis polystachya* (wall.) parker were collected from Pune area.

Seed samples:

Well dried and matured seeds were collected from different locations of Western Maharashtra. They were dried under shade for few days for further processing.

Oil extraction:

The seeds were crushed in a grinder machine for few minutes. Oil was extracted with petroleum ether (60°-80°) in a Soxhlet apparatus. Solvent was removed under reduced temperature and pressure. The yield of oil was calculated using replicate samples.

Physico-chemical properties:

The iodine value, saponification value and acid value of the oil were estimated by standard procedures described by the AOAC (1984, 1995), Sadasivam & Manikam (1996). The mean molecular mass (MMM) was estimated from the relationships (560/saponification value) x100 Ajiwe *et al*. (1994, 1995ab, & 1996). The FFA was calculated from the relationship given by; Sadasivam & Manikam (1996) 1 unit of Acid value ≠ 0.503 % FFA (calculated as oleic acid). The specific gravity was determined by the method of Williams (1966).

Crushed seeds of collected sample were used for determination of fatty acids Primomo *et al*., (2002). Fatty acid estimation was done on Agilent 6890 N GC with auto sampler and auto injector. The samples were injected in 30mm long and 0.32mm diameter HP-Innovax Capillary Column. Auto Injector, oven temperature and Flame ionization Detector (FID) were adjusted to 225°, 115°, and 275° respectively. The initial oven temperature was 150° ramped by 15°C/min up to 250°C. Flame ionization Detector was used to detect the signals. Hydrogen and air with flow rates of 30 mL/min and 400 mL/min, respectively, were used to ignite the flame of FID. Nitrogen gas (2mL/min) was used as carrier gas. Standard fatty acids of Sigma Chemicals Ltd. were used as standards to calibrate the method. The signals from the detector were integrated as normal percentages of calibration curve by using HP chemstation software.

RESULT AND DISUSSION

In present work oil content variation, fatty acids and physico-chemical properties of *Jatropha curcas, Madhuca longifolia, Callophyllum inophyllum* were studied. Oil percentage reported in these species includes *Jatropha* 30- 46 %, Madhuca 48 % and *Calophyllum* 66-75 % respectively. Acid values are as follows *Jatropha* 1.9 mg/g, *Callophyllum* 31.25 mg/g and *Madhuca* 7.64 mg/g. Iodine value is 101.7 to 139 g/100g in *Jatropha.* It is lower in *Maduca* 35.58 g/100g and 94.87g/100g in *Callophyllum.* Saponification values ranges from 195-326.6 mg/g in *Jatropha*, 550.73 mg/g in *Madhuca* and 364 mg/g in *Callophyllum.* Free fatty acids ranges from 7.64 to 18.10 mg/g in three species. Specific gravity ranges from 0.922 to 0.943 in above species. Fatty acid estimation carried out by Gas Chromatography shows that saturated fatty acids are more in *Madhuca* as compaired to *Jatropha* and *Callophyllum* respectively.

Table-1 :Physico-chemical analysis of oils

Parameters	*Calophyllum*	*Madhuca*	*Jatropha*
Oil content of seeds (%)	66.7	48.00	37.00
Saponification value (mg/g)	364.0	550.7	324.6
Iodine value (g/100g)	94.9	35.6	139
Acid value (mg/g)	31.3	7.6	1.9
Free fatty acids (mg/g)	18.1	3.8	10.4
Specific gravity at RT (28°C)	0.943	0.924	0.922
Mean molecular mass	15.4	10.2	17.25

This indicates that different ecotypes showed difference in their oil content and physico-chemical properties depending on the climatic conditions. These results are helpful for screening other oil yielding tree resources and its suitability to use as biofuel. Germplasm collection of non-edible oil seed resources is the most important and essential part of the natural resource management programmer. These sources of genetic diversity must include useful alleles, present in elite populations that may be useful for the discovery and development resistance to pests and other stresses that adversely affect productivity and quality. (Borwn,1983). Most of the natural oil seed resources are genetically varied and need to be collected from different regions to know their diversity.

Acknowledgement

Authors are thankful to President, BAIF Development Research Foundation, Pune for providing facilities. Botany group of ARI, Pune for encouragement in present work. Authors are grateful to Ms. Archana Patil for her valuable help during present work

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How to cite this article

Bhagat RB, DK Kulkarni and SP Taware, 2019. Germplasm collection of potential natural oil resources for energy. *Bioscience Discovery*, **10**(4):203-206.