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Croton tiglium Seed Oil –A Potential Sourceofω-6Fatty Acid from Arid Zone of Rajasthan

Indresh Kumar
Department of Chemistry, Jai Narain Vyas University, Jodhpur– 342033 (Rajasthan) INDIA,

ABSTRACT: *Arid zone plant Croton tiglium was systematically analyzed for its physico-chemical properties and fatty acid composition. Physico-chemical properties were determined by standard AOCS methods. Gas chromatography- Mass spectrometry (GCMS) analysis of Fatty Acid Methyl Esters using Flame Ionization Detector showed presence of Myristic acid, Palmitic acid, Oleic acid, Linoleic acid, Stearic acid, Lauric acid, Gondoic acid and Arachidic acid. Oil percentage of Croton tiglium was found to be 42.0% and the protein content was observed as 24.0 % . The higher fatty acids obtained in Croton tiglium were linoleic acid (50.51%) and oleic acid (20.93%). Croton tiglium has potentialities to be used as a source of biofuel in view of its economic and environmental advantages.*

KEYWORDS -*Crotontiglium, FattyAcidMethylEster, Gaschromatography-Massspectrometry, Physico-chemical properties.*

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I. INTRODUCTION

The croton tiglium plant is a native of India and is grown all through the Thar desert. The Croton tiglium plant belongs to euphorbiaceous family. It has been used in traditional medication by many generations. Croton tiglium is widely believed to function as laxative [1].Dr. Irvine, in 1848, gave a short account of the materiamedica of Patna (part of theprovince of Bengal) mentioning "jamalgoota," which isderived from Croton tigliumand several other species of croton. It is medium-sized tree, 3-6 m in height. Leaves are alternate, toothed, glabrous and pinkishviolet when young. Infloresence in terminal raceme, unisexual flowers, monoecious and female flowers are without petals. Seeds are small with hard brownish-yellow shell [2]. Flowering period is from May to July, fruits are oblong-obovoid, 3-lobed capsule 2–2.5 cm long, dull yellow, roughlystellate hairy and 3-seeded. The processed seeds are used in treating flatulence, dyspepsia, constipation, colic, edema, dyspnoea and persistent cough. Oil isgiven in the form of pillsor extract. Theseed iswidelyused because it is believed to have healing power and it functions as laxative[3] However the knowledge of the plant is not in depth except that theyinherited from their previous generation. Its dosage and active materials contained have not yet beenfound [4,5]Most of the traditional medicines are developedfrom nature. They have not yet fulfilled the scientific requirements needed to be developed and classified as modern medicines [6,7] For scientific back up, a research is needed to search their bioactive components, their efficacy and safety [8] . Usually,mostcompoundsusefulformedicinalpurposearesecondarymetabolites

[9]The most common fuelthat is being developed and used at present is biodiesel, which has fatty acid methyl esters (FAMEs) of seed oils and fats which have already been found to be suitable for use as fuel in diesel engine[10].The seed and seed oil have long been used in tropical Asia as a strong purgative, cathartic and poison. In Malaysia one seed is eaten as a purgative byadultsand coconut milk isdrunk to stop the effect. Thelethal dose for an adulthuman isabout 4 seedsandfor a horse about 15 seeds. The seed oil was formerlyincluded in several pharmacopoeias as a purgative. [11]The seed oil and bark were widely used in folk medicine as a remedy for cancerous sores and tumors, carbuncles, colds, dysentery, fever,paralysis, scabies, schistosomiasis, snakebite, sore throat and toothache. The oil is a strong vesicant but when diluted it can be employed as a counterirritant for various skin affections. Caution shouldbe taken in all applicationsin viewofitstoxicity. Crotin is a mixture of the toxic protein's croton globulin and croton albumin. It has haemolytic and blood coagulantproperties with adelayed poisonous effect [12] In Ghanatheseeds areknown tobe verypoisonous, andareused as fish poison or for criminal purposes. In Sudanthe powdered seeds mixed with datesare eaten asa purgative. In South-East Asia theroot is used as an abortifacient and purgative. An extract of the seed can be used as an insecticide forfield application and in stored cereals and pulses [13] The seed oil may also be used in the production of soap and candles. The seed oil of Croton tiglium is commonly used inlaboratories throughout the world forits vesicant properties. The phorbol esters isolated fromthe oil also have interesting tumourpromoting or tumour-inhibiting properties and although much research has been done,

more is needed to elucidate their future potential[14]The extensive ongoing research may lead to new developmentselsewhere too. The purpose of this research is to characterize the physico-chemical and fatty acid composition of C. tiglium seed collected from the arid region zone of Rajasthan, India.

II. INDENTATIONS AND EQUATIONS

Fresh seeds of C. tiglium were collected from arid and semi-aridregion of Rajasthan, India. Seeds were dried in air. The oil was extracted from the crushed seeds by extraction with petroleum ether (60-80°C) in a Soxhlet apparatus for 6 hr. The obtained oil was stored in cool place (refrigerator) untilfurther investigation. Theiodine value, saponification value, free fatty acid, peroxide value, specific gravity and refractive index were determined using the methods described by A.O.C.S. [15] The fatty acid composition of C. tiglium oil was determined in two steps. In first step hydrolysis of oil was done and mixed fatty acids were obtained and in second step this mixture of fatty acids were further derivatized to their methyl esters. The formation of methyl ester was monitored byusing thin layer chromatography(TLC) technique. Coated silica gel glass plates were spotted with C.tiglium oil and the sample of ester. The spotted samples were developed in solvent system in glass chamber using solvent ratio in volume of 79:20:1 (hexane: ether: acetic acid). This confirms the formation of methyl esters. The methyl esters so obtained were analyzed by GCMS QP2010gas chromatograph with a capillary column, CP-Sil 88 (100 m long, 0.25 mm ID, and film thickness 0.25 µm) [16]. The temperature programmed was from 155°C heated to 220°C (1.5°C/min.), 10 min isotherm; injector 250°C, detector 250°C; carrier gas 1.07mL/min hydrogen; manual injection volume less than 5 µL. The integration software computed the peak areas and percentages of fatty acid methyl esters (FAME) were obtained as weight percent by direct internal normalization.

Triglycerides make up 60–70% of its composition. Polyunsaturated fatty acids, particularly linoleic acid (LA) and arachidonic acid (AA), are also present in substantial amounts. These ω-6 fatty acids support the formation of energy, the structure of cell membranes, and the synthesis of eicosanoid hormones, which are essential for immunological and inflammatory responses [17]. Notwithstanding its beneficial qualities, croton oil's oxidation-proneness can lead to the production of free fatty acids, which gives it an unpleasant smell and may irritate the skin and mucous membranes. The breakdown reveals that the main ω-6 fatty acids in this complex oil are AA at 5–10% and LA at 50–60% [18]. The fatty acid profile of crotontiglium seed oil is dominated by linoleic acid (LA), which makes up 50–60% and has a significant impact. The secondary fatty acid, arachidonic acid (AA), comes next and makes up 5–10% of the overall makeup. The last 30–40% consists of small fatty acids, including oleic acid, palmitic acid, stearic acid, and eicosenoic acid [18]. The breakdown in detail is as follows: 1.44% for lauric acid (C12:0), 6.91% for myristic acid (C14:0), 5.66% for palmitic acid (C16:0), 2.67% for stearic acid (C18:0), 20.93% for oleic acid (C18:1), 50.51% for linoleic acid (C18:2), 2.22% for arachidic acid (20:0), and 9.67% for gondoic acid (20:1). Crotontiglium seed oil's varied fatty acid profile adds to its many qualities and possible health advantages [19]. Crotontiglium seed oil is composed of triglycerides, which are the building blocks of fats and oils, and fatty acids, which are essential for cell membrane structure and function. It is rich in polyunsaturated fatty acids, such as linoleic acid (LA) and arachidonic acid (AA), which are omega-6 fatty acids [20]. LA is an essential fatty acid that the body cannot produce on its own and is precursor to eicosanoids. Arachidonic acid is another essential omega-6 fatty acid that the body cannot synthesize. Crotontiglium seed oil also contains minor components like sterols, tocopherols, and phospholipids. Sterols regulate cell growth, while tocopherols protect cells from free radical damage. Phospholipids provide structural integrity and facilitate cell signaling [21].

III. FIGURESANDTABLES

Theresultsshowed that 42.0% oil was obtained from theseed of C. tiglium . Physico-Chemical Properties of*C. tiglium* showed higher protein content (24.0 %). The Physico-Chemical results are summarized in **Table 1**. Fattyacid composition so obtained as shown in gas chromatogram of C. tiglium(Figure1) was tabulated in **Table 2**. **Table 2** showed that Linoleic Acid (C18:2) has the highest component fattyacid up to 50.51% followed by Oleic Acid (C18:1) up to 20.93 %. The remainingfattyacidsareGondoicAcid(20:1)9.67%,MyristicAcid (C14:0) 6.91%,PalmiticAcid(C16:0)5.66%,Stearic Acid (C18:0) 2.67, Arachidic Acid (20:0)2.22% and Lauric Acid (C12:0) 1.44 %respectively. The retention time for these fatty acids were 19.113, 19.183, 22.118, 12.893, 16.256, 19.482, 22.449 and 10.242 minutes respectively.

ThePhysico-chemicalproperties of seedoilswereobtainedusingthemethoddescribed byAOCSaregivenin**Table1**.

TABLE1: PHYSICO-CHEMICALPROPERTIESOF*C.TIGLIUM*:-

Seed properties	Oil properties

MoistureContent	7.2	Refractiveindex(40^0C)	1.4733
Oil content (%byw)	42 .0	Saponification Value(mg/gKOH)	201
		Un-saponifiedmatter(%w/w)	7.0
Protein content (% byw)	24.0	Acid value (mg/gKOH)	4.8
		IodineValue (g I2/100 g)	98.0

Table2:-Fattyacidscomposition(%)of*C.tigliumseedoil*:-

FattyAcid	**%weight obtained**
LauricAcid(C12:0)	1.44
MyristicAcid(C14:0)	6.91
PalmiticAcid(C16:0)	5.66
StearicAcid(C18:0)	2.67
OleicAcid(C18:1)	20.93
LinoleicAcid(C18:2)	50.51
ArachidicAcid(20:0)	2.22
GondoicAcid(20:1)	9.67

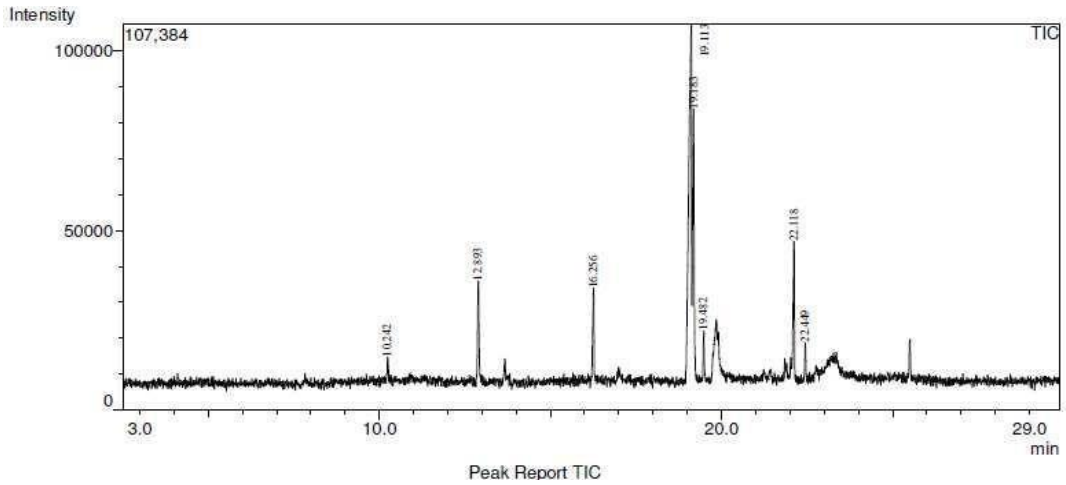

FIG: 1 GASCHROMATOGRAMOFCROTONTIGLIUMFATTYACIDS

IV. CONCLUSION

Based ontheresultsofthisstudy, thefollowingspecificconclusionsweredrawn:- The seed oil is good source of essential ω-6 (linoleic acid C18:2) fatty acid.
Thesignificanceoffattyacidanalysishasgainedmuchattentionbecauseofthenutritionaland healthimplications.

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