IJFANS
International Journal of Food And Nutritional Sciences

Volume 4, Issue 4, Jul-Sep 2015, www.ijfans.com e-ISSN: 2320-7876

INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

IMPACT FACTOR ~ 1.021

Official Journal of IIFANS

INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

e-ISSN 2320 –7876 *www.ijfans.com*
Vol.4, Iss.4, Jul-sep, 2015

Research Paper ***Open Access***

FATTY ACID PROFILING OF SEED OILS FROM TWO CONVOLVULACEAE SPECIES

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Received on: 12th August, 2015 **Accepted on: 11th September, 2015**

ABSTRACT

Seeds from two plant species; *Argyeria nervosa* and *Merremia aegyptia* belonging to convolvulaceae family were investigated for their physico-chemical properties and fatty acid compositions using chemical, chromatographic and spectroscopic techniques. The oil yield from the seed of *Argyeria nervosa* and *Merremia aegyptia* was found to be 16.71% and 23.44% respectively. Linoleic and oleic acids were found major fatty acids in seed oils. The seed oil of *Merremia aegyptia* contains high percentage of polyunsaturated fatty acids (PUFAs), could be useful for edible purpose and in Oleo-chemical industries.

Keywords: fatty acid compositions, chromatographic and spectroscopic techniques, polyunsaturated fatty acids (PUFAs), Oleo-chemical industries.

INTRODUCTION

Convolvulaceae is a family of flowering plants, includes about 56 genera and 1820 species distributed mainly in the tropical and sub tropical region. In India, these are mainly concentrated in southern and western region. There are number of economically important members in this family such as *Ipomoea batatas* (sweet potato), *Ipomoea aquatica* (Nari-ka-sag), *Rivea hypocrateriformis* etc.

Argyreia nervosa (Hawaiian Baby Wood rose) is a perennial climbing vine, also known as Elephant Creeper and Woolly Morning Glory. It is a popular Indian medicinal plant, has been used in Ayurvedic medicinal system. Various plant parts of *Argyreia nervosa* showed broad pharmacological activities (Habbu PV, *et al,* 2008, Hemet LE, *et al,* 2008, Hanumanthachar J, et al, 2007, Srivastava MC, *et al*, 1972, Vyavhare NS, Bodhankar SL, 2009, Babber OP, *et al,* 1978, Praveen N, *et al,* 1990). Leaves of *Argyreia nervosa* have been used by Rajasthani tribes to prevent conception (A dictionary of Indian Raw materials and industrial products. Publication and Information Directorate, CSIR, New Delhi, India. The Wealth Ind. 2004). Seeds of *Argyreia nervosa* proved effective against hypotension, spamolytic, anti-inflammatory and show antibacterial activities (Agarwal RS, Rastogi RP , 1994, Gokhale AB, et al, 2002, Batra A, Mehta BK, 1985). Chemical screening revealed the presence of lipids, triterpenoids, flavanoids and steroids (Srivatasav A, et al, 1998). Roots of *Argyreia nervosa* showed the immunomodulatory activities against the myelosuppressive effects induced by Cyclophosphamide (Gokhale AB , et al, 2003) and its alcoholic extract exhibited significant anti-inflammatory activity against granuloma formation technique in albino rats (Bacchav AS, *et.al*, 2009), comparable to acetylsalicylic acid. Pharmacologically it helps in healing of wounds and increases blood circulation to the effective part. It is anti-inflammatory (Bacchav AS, et al, 2009) in action and is cardiac supporter. The fixed oil composition of seed oil has been reported by several workers (Batra A, Mehta BK, 1985, Kelkar GM, *et al,* 1947). *Merremia aegyptia* is a climber weed, its leaves proved effective against jaundice (Ratna Manjula R, *et al*, 2011). Phytochemical screening of leaves of *Merremia aegyptia* showed presence of alkaloids, tannin, saponins, terpenes and flavanoids (Omotayo FO, Borokini TI, 2012). Generally, whole plant has been taken internally to cure stomach problems (Raju Sathiyaraj, *et al*, 2015).

About 80% of world population relies on the use of traditional medicines, prominently based on herbal medicines (Shanley P, Luz L, 2003). In past few decades; there has been rapid increase in demand and supply of plant oil at domestic and industrial level. The shift towards traditional medicinal system increases the demand of natural products. The objective of this study was to explore the non-traditional oil sources and evaluate their potential for various aspects.

EXPERIMENTAL SECTION

MATERIALS COLLECTION AND SAMPLE PREPARATION

Seeds were collected at maturity from arid and semi arid region of Rajasthan (India). The whole seed was used for the analyses, they were freeze-dried and ground to powder using mortar and analyzed immediately. Oil extraction was performed from grounded seeds with light petroleum ether (40-60^{o}C) using soxhlet extraction technique. The solvent was removed completely under vacuum using rotary evaporator. The physico-chemical properties of seeds and seed oils were determined according to American Oil Chemist Society (AOCS) methods (W.E. Link, 1973). Methyl esters of oil were prepared using *trans*-esterification technique (Miwa TK, et al, 1963). Direct analytical TLC test (Hosamani KM, 1994) 2, 4-DNP TLC test (Davis EN, et al, 1969), Halphen test (Halphen G. J, 1867), picric-acid TLC test (Fioriti JA, Sims RJ, 1968) and alkaline picrate test (Feigl F, 1954) were also performed for the presence of any unusual fatty acid.

ANALYSES OF FATTY ACID METHYL ESTERS (FAME)

IR spectrum of FAME was recorded by using Perkin Elmer RX-I FTIR on KBr cell. The UV-Vis. spectrum was performed on Perkin Elmer Lambda 15 UV/Vis spectrophotometer. Fatty acid methyl esters (FAME) were analyzed in Perkin Elmer Autosystem XL gas chromatograph equipped with flame ionization detector. A capillary column of fused silica of high polarity (SP 2330; length: 30 m; internal diameter: 0.25 mm; thickness of film: 0.2 µm) was used. Nitrogen was the carrier gas at a flow rate of 0.75 l/min. The injector temperature and detector temperature was 260^{o}C. The oven starting temperature was 80 ^{o}C and increased to 200^{o}C at a rate of 6 ^{o}C/min, held for 5 min. then increased to 250^{o}C at a rate of 10^{o}C/min. Peaks were identified using methyl ester standards (Rapeseed oil mix and PUFAS from sigma). Position of double bonds was verified by a Thermo scientific TSQ 8000 Gas Chromatograph- mass spectrophotometer. A capillary column of polysilphenylene -siloxane (BPX 70 TM; length: 25 m; internal diameter: 0.22 mm; thickness of film: 0.25 µm) was used. Helium was the carrier gas at a flow rate of 1 ml/min. The injector temperature was 250^{o}C and detector temperature was 260^{o}C. The oven starting temperature was 80^{o}C and increased to 200^{o}C at rate of 8^{o}C/min, held for 10 min. then increased to 250^{o}C at rate of 10 ^{o}C/min, held for 10 min.

RESULTS AND DISCUSSION

Seed oils of *Argyeria nervosa and Merremia aegyptia* were liquid at room temperature (at 298 K). The physico-chemical properties of seeds and seed oils are given in Table- I. The seed of *Argyeria nervosa* showed 16.71% of oil and 17.39% of protein content while the seed of *Merremia aegyptia* showed 23.44% of oil and 26.93% of protein content to the total seed weight. The refractive index of seed oil of *Argyeria nervosa* and *Merremia aegyptia* is 1.4769 and 1.4782 respectively at room temperature (at 298 K).

Saponification and iodine values of seed oil of *Argyeria nervosa* are 197.19 and 100.17 and that of *Merremia aegyptia* seed oil are 200.73 and 119.74 respectively. The iodine value of both oils obtained by experimental procedure was in close agreement with fatty acid composition of seed oils. The seed oils and their FAME showed negative response to any unusual fatty acid in the seed oils. The oils as methyl esters were subjected to GLC and GC-MS analyses for their fatty acid contents. Fatty acid compositions of seed oils are given in Table II.

Linoleic acid was found to be the most abundant fatty acid with 31.47% followed by oleic acid with 28.83% to the total fatty acid content for *Merremia aegyptia* seed oil while the seed oil of *Argyeria nervosa* contain oleic acid as the most prominent fatty acid with 33.03% followed by linoleic acid with 23.78%. These seed oils also found to contain 7.59% and 13.89% of linolenic acid for *Argyeria nervosa* and *Merremia aegyptia* respectively. Among saturated fatty acids (SFAs), stearic acid was most abundant with 13.63% and 10.29% for *Argyeria nervosa* and *Merremia aegyptia* respectively. Palmitic acid was second most abundant SFAs in both the seed oils. Lauric, myristic, arachidic and other fatty acids were also present in small amount. The fatty acid composition of seed oils obtained from GLC and GC-MS were in good agreement and confirm the position of double bonds. The IR spectra of FAME of seed oils exhibited peak at 1738 cm^{-1} for carbonyl ester besides the usual peaks for hydrocarbon end, confirmed the absence of any other functional group. The IR and UV-Vis spectra of FAME of seed oils exhibited no absorption band for the presence of any *trans* unsaturation and conjugation respectivily. The seed oil of *Merremia aegyptia* was found to be a good source of PUFAs with 45.36% of total fatty acid, categorized as semi-drying oil while the seed oil of *Argyeria nervosa* showed only 31.37% of PUFAs, categorized as non-drying oil. The content of SFAs was 24.20% in seed oil of *Merremia aegyptia* and 34.23% in seed oil of *Argyeria nervosa*. The same was reported by Parameshwari and Nazni (2012).

Table- I-Physico-chemical properties of seeds and seed oils

	Argyeria nervosa	***Merremia aegyptia***
Oil %	16.71	23.44
Protein %	17.39	26.39
Moisture %	3.87	4.09
Unsaponifible matter %	2.71	3.72
Saponification value	197.19	200.73
Iodine value	100.07	119.74
Refractive index	1.4769	1.4782

Table- II Fatty acid composition of seed oils

Fatty acids	***Argyeria nervosa***	***Merremia aegyptia***
Lauric	1.39	2.69
Myristic	3.43	1.76
Palmitic	12.19	7.69
Stearic	13.63	10.29
Oleic	33.03	28.83
Linoleic	23.78	31.47

Linolenic	7.59	13.89
Arachidic	3.59	1.77
Others	1.37	1.61
ΣSFAs	34.23	24.20
ΣUFAs	64.40	74.19
ΣPUFAs	31.37	45.36

SFAs= saturated fatty acids, UFAs= unsaturated fatty acids, PUFAs= polyunsaturated fatty acids

CONCLUSION

The seeds of both plant species have been in vogue in traditional medicine systems. On considering moderate oil and high PUFAs content with adequate ratio of oleic acid, the seed oil of *Merremia aegyptia* proved to be a good source for edible purpose and in Oleo-chemical industries at major scale. While the seed oil of *Argyeria nervosa* showed comparatively low PUFAs content and oil %, not suitable for edible purpose at major scale but on considering total UFAs, it could be useful for edible purpose at low scale. However seeds of both plant species were found to contain adequate protein content, could be a useful protein source as animal feed stock. The result obtained from our study suggested that the above data could be used as base parameter to develop *Argyeria nervosa* and *Merremia aegyptia* for domestic and commercial purpose.

ACKNOWLEDGEMENT

We are thankful to Head, Department of Chemistry, J.N.V. University for providing necessary facilities and Prof. Pavan Kasera for plants identification.

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