ORIGINAL ARTICLE

Physico-Chemical Analyses of Some Seed Oils from Western Rajasthan

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ABSTRACT Seed oils from seven indigenous species of lesser known six botanical families are reported. All the species were collected from Western Rajasthan State and analysed for their physicochemical characteristics and fatty acid compositions using chromatographic and spectroscopic techniques viz. I.R., U.V., TLC, GLC, GC-MS. All the seed oils have been found simple "linoleic-oleic-palmitic" type. The main components were oleic and linoleic acids constituting 33.2-74.1% of the total fatty acids. The predominating saturated acids were palmitic 5.5-18.4% and stearic 6.4-26.4%. Out of these one seed oil has been reinvestigated and the data were compared with previous results.

Keywords: Fatty acid composition, Chromatographic and Spectroscopic characterization, PUFAs, Industrial oils

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Submited: 15-Feb-2021 **Accepted:** 06-Dec-2021 **Published:** 19-Jan-2022

INTRODUCTION

The dry land of Western Rajasthan has a good source of wild flora which can be used to discover new sources of oils and fats. The physico-chemical studies have been carried out in our laboratory and the oils were chemically and spectroscopically analysed using AOCS recommended techniques[1-3]. The aim of this study is to explore non-traditional oil sources in order to establish them for various medicinal and/or industrial purposes.

The non-traditional oils are generally not good for human consumption, unless they are properly treated. However such oils can be good sources of fatty acids which are being used in oleo-chemical industries.

A large part of the world population relies on the use of traditional medicines, predominantly based on herbal medicines[4]. During last few decades there has been a fast increase in the demand and supply of seed oils at domestic and industrial level, which ultimately increases the consumption of natural products.

Access this article online
Website: www.ijfans.org
DOI: 10.54876/ijfans_50_21

EXPERIMENTAL SECTION

Material Collection and Sample Preparation

The seeds were collected, cleaned, dried and powdered, the collection of seeds was mainly on maturity and specifically from arid land of Rajasthan. The oil extraction was performed from the ground seeds using light petroleum ether (40-60 °C) using soxhlet extraction method. The solvent was removed under vacuum with rotary evaporator. The physico-chemical properties of seeds and seed oils were determined using standard procedures[5]. Methyl esters of the oils were prepared using trans-esterification technique. Direct analytical TLC tests were also carried out for the presence of any unusual fatty acid component.

Analyses of Fatty Acid Methyl Ester (FAMEs)

IR spectrum of FAMEs was carried out using Perkin Elmer

How to cite this article: Dave Shikha, Khan Soyal, Sherwani M.R.K., Chowdhary Vimla. Physico-Chemical Analyses of Some Seed Oils from Western Rajasthan. Int J Food Nutr Sci 2022;11:9-12.

RX-I FTIR on KBR cell. The UV-visible spectrum was recorded on Perkin Elmer Lambda-15 UV/Vis spectrophotometer. The fatty acid composition of the FAME was obtained using 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 ìm) was used. Nitrogen was the carrier gas at a flow rate of 0.75 l/min. The injection temperature and the detector temperature was 260 °C. The oven starting temperature was 80 °C and then increased to 200 °C at a rate of 6 °C/min., held for 5 min. then increased to 250 °C at a rate of 10 °C/min. The peaks were identified using methyl ester standards (Rapeseed oil mix and PUFAs from sigma). The position of double bonds was confirmed by a Thermo Scientific TS Q 8000 Gas chromatograph – massspectrophotometer. 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 °C and the detector temperature was 260 °C. The oven starting temperature was 80 °C and then increased to 200 °C at a rate of 8 °C/min., held for 10 min. then increased to 250 °C at a rate of 10 °C/min., held for 10 minutes.

RESULTS AND DISCUSSION

Direct TLC tests, U.V. and I.R. spectra very clearly showed the absence of any oxygenated fatty ester, conjugation and trans-unsaturation or any other functional group. Silver nitrate impregnated TLC of FAMEs showed spots corresponding to saturated, monoene, diene and triene when run along with reference standards. The physico-chemical properties of seeds and seed oils have been given in [Table 1].

The seeds of *Baliospermum montanum*, *Moringa concanensis*, *Aegle marmelos* and *Momordica charantia* have been found to have high oil percentages, 47.20, 45.27, 27.46 and 20.95% respectively. Except *M. charantia* and *Zizipus mauritiana* other seed oils were liquid at room temperature (298 K). The seeds of *M. concanensis*, *Mimosa pudica* and *A. marmelos* showed high protein level 25.0, 22.8 and 19.1% respectively. The iodine values of all the seed oils recorded by the experimental procedure were in close agreement with fatty acid composition of the seed oils. The oils as their methyl esters were subjected to GLC and GC-MS analyses for their fatty acid contents. The fatty acid composition of seed oils have been shown in [Table 2].

All the seed oils except *M. concanensis* have been found to contain linoleic acid as the predominating acid where as *M. concanensis* has oleic acid as the most abundant acid up to 56.4 % of total fatty acids. All the seed oils have been found to contain linolenic acid, characteristic of vegetable oils as the minor component.

Among saturated fatty acids, the stearic acid has been found to be the most abundant acid except in *Trigonella foenum-graecum* which showed palmitic acid contents up to 14.9%. Myristic acid has also been recorded in three species viz. *M. concanensis*, *A. marmelos* and *M. charantia*, 3.7, 3.5 and 2.4% respectively. Arachidic acid has also been recorded as minor component in these seed oils except *A. marmelos* and *M. charantia*. The results of fatty acid composition of seed oils from GLC and GC-MS were in good agreement and confirm the position of double bonds. The IR spectra of FAMEs of seed oils showed peaks at 1730 cm^{-1} for carbonyl function along with usual peaks, thereby confirming the absence of any other functional group. The seed oils of *T. foenum-graecum*, *A. marmelos*, *B. montanum* and *Z. mauritiana* were

Table 1: Physico-Chemical Characteristics of Seeds and Oils

S. No.	Plant Name	Oil %	Moisture %	Protein % N x 6.25	RI Value $_nD^{30}$	U.M. %	I.V.	S.V.
1	Plant A	45.27	0.62	25	1.4849	1.46	77.46	157.02
2	Plant B	27.46	0.49	19.1	1.4863	2.32	122.25	181.36
3	Plant C	20.95	0.47	16.5	1.4742	0.95	99.11	218.36
4	Plant D	47.2	0.52	13.4	1.4795	0.76	89.45	178.31
5	Plant E	4.3	0.65	21.9	1.4851	2.45	126.09	205.61
6	Plant F	14.04	0.95	22.8	1.4872	2	92.49	183.26
7	Plant G	6.99	0.53	18.7	1.4782	1.87	95.21	189.51

Note: *Plant A = *Moringa concanensis* (Moringaceae); Plant B = *Aegle marmelos* (Rutaceae); Plant C = *Momordiaca charantia* (Cucurbitaceae); Plant D = *Baliospermum montanum* (Euphorbiaceae); Plant E = *Trigonella foenum-graecum* (Fabaceae); Plant F = *Mimosa pudica* (Leguminosae); Plant G = *Ziziphus mauritiana* (Rhamnaceae); R.I. = Refractive Index; U.M. = Unsaponifiable matter; I.V. = Iodine value; S.V. = Saponification value.

Table 2: Component Fatty Acids of Seed Oils by GLC

Fatty Acids	Plant A	Plant B	Plant C	Plant D	Plant E	Plant F	Plant G
14:00	3.7	3.5	2.4	-	-	-	-
16:00	6.6	5.5	14.9	8	14.9	18.4	10.9
18:00	10.8	12.3	26.4	18.4	6	20.9	20.2
18:01	56.4	23.5	22.5	21.2	20.3	25.2	16.5
18:02	14.6	50.6	29.4	47.3	44.9	29.5	43.1
18:03	5.3	4.5	4.3	2.6	10.6	3.7	4.9
20:00	2.5	-	-	2.4	3.2	2.2	4.3
22:00	-	-	-	-	-	-	-
TS	23.6	21.3	43.7	28.8	24.1	41.5	35.4
TU	76.3	78.6	56.2	71.1	75.4	58.4	64.5
PUFA	19.9	55.1	33.7	49.9	55.5	33.2	48
Category	Non-Drying	Semi-Drying	Non-Drying	Semi-Drying	Semi-Drying	Non-Drying	Semi-Drying

Note: *TS = Total saturation; TU = Total unsaturation; PUFA = Poly unsaturated fatty acid.

found to be good source of PUFAs with 55.5, 55.1, 49.9 and 48.0% respectively of the total fatty acids and may be categorized as semi-drying oils while others have been classified as non-drying oils. The seed oil of *M. concanensis* has earlier been reported[6-9], showed results quite close to our present study.

CONCLUSION

The seeds of *A. marmelos*, *M. charantia* and *T. foenum-graecum* have been constantly use in traditional medicine system. The high oil content, oleic acid percentage of *M. concanensis* and total unsaturated fatty acids proved to be a good source for edible purpose and in oleo-chemical industries at major scale. Other seed oils with promising high percentage of total unsaturated fatty acids, PUFA and other parameters in the present study would be useful sources as animal feed stock. The seed oils of *A. marmelos*, *B. montanum* and *T. foenum-graecum* belong to semi drying class. The results obtained from this investigation may be used as base parameters to develop these seed oils for domestic, commercial and/or medicinal purposes.

ACKNOWLEDGMENT

The authors are thankful to Head, Department of Chemistry, J.N.V. University, The Chairman B.S. Rathore, Aishwarya College, Jodhpur for providing necessary facilities, to Prof. (Dr.) P. Kasera and Prof. (Dr.) S.S. Murthy for seed collection and plant identification.

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