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CHARACTERISATION OF SEED OILS OF TWO PLANT SPECIES FROM ARID AND SEMI ARID REGION OF RAJASTHAN

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ABSTRACT

Seeds of Asparagus racemosus (family; Asparagaceae) and Xanthium strumarium (family; Compositeae) were investigated for their physico-chemical properties and fatty acid compositions using chemical and analytical techniques. The oil yield from the seed of Asparagus racemosus and Xanthium strumarium was found to be 16.71% and 23.44% respectively, show high saponification and iodine values. Linoleic acid was found major fatty acids in both seed oil. Seed oil of Asparagus racemosus show 67.13% of polyunsaturated fatty acids (PUFAs) and 3.1635 P/S index while seed oil of Xanthium strumarium show 68.33% of PUFAs and 3.7961 P/S index; indicated us to use these parameters to establish them as alternate oil sources for various domestic and industrial purposes. Higher amount of PUFA content in seed oils of both the species made them medicinally important as it lowers the bad cholesterol in human body therefore their oils help in curing cardiac diseases.

KEY WORDS

fatty acid compositions, analytical techniques, polyunsaturated fatty acids (PUFAs), P/S index, medicinal property.

INTRODUCTION

About 80% of the world population relies on traditional medicinal practices; most of them are based on the medicinal plant, especially in the third world counties.[1,2] Medicinal plants contain various phytochemical, phytonutrient and mineral which have great demand in pharmaceutical industries, they do contain some economically important fatty acid which has antioxidant, antimicrobial properties and also used at industrial level.[3-5] Plants seed are important source of oil and their demand increase by many folds in last few decades because of diversification of there utility include oleo chemical, pharmaceutical, food processing, soap industries. India is one of the largest producers of oilseed yet has to import to fulfill the domestic demand. [6] In India, Rajasthan is in top five in production of oilseeds. In this regard we analyses the seed oil of two plant species prominently found in semi arid region of western Rajasthan. In this regard we have analyzed the seed and seed oil of two plant species (*Asparagus racemosus* and *Xanthium strumarium*).

Asparagus racemosus belongs to family Asparagaceae, show wide therapeutic effects include cooling, antioxidant, dysentery, anti-inflammatory, demulcent, effective against ulcer and hyperacidity. Its cooling effect works on rheumatism, stomach, kidney and sexual organs. [7,8] Methanolic extract of seeds show antidepressant and antioxidant properties. [9]

Xanthium strumarium L. belongs to family compositeae, show anthelmintic, diuretic, anti-inflammatory, antiulcerogenic, antitrypanosomal, anthelmintic, anti-inflammatory, diuretic, antileishmanial, antifungal and hypoglycemic properties.[10-17] Previous studies have reported that *X. strumarium* induces intoxication and can be lethal to cattle, sheep, pigs and humans.[18-21] Also, the consumption of fruits (burrs) and

cotyledonary-stage leaves (two-leaf stage) leads to hepatic necrosis and myocardial injury in humans. The toxic principle in *X. strumarium* poison was isolated and identified as carboxyatractyloside (CAT), a highly selective inhibitor of oxidative phosphorylation. [22-23]

MATERIAL AND METHOD

1. Collection and Preparation of Samples: -

Seeds were collected at maturity from semi arid region of western Rajasthan (India). The whole seeds were used for the analyses, they were freeze-dried and ground to powder using mortar and analyzed immediately. Oil extraction was performed from grounded seeds of with light petroleum ether (40-60°C) using soxhlet extraction technique. The solvent was removed completely under vacuum using rotary evaporator. Refractive index (at 40°C) of oils was determined by using Abbey Refractometer. The analytical values of seeds and seed oils were determined according to the standard American Oil Chemist Society (AOCS) methods. [24] Methyl esters of oils were prepared using *trans*-esterification technique. [25]

2. Analyses of Fatty Acid Methyl Esters

IR spectrum of Fatty Acid Methyl Esters (FAMEs) 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. FAMEs 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 °C. The oven starting temperature was 80 °C and 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. 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 used as carrier gas at a flow rate of 1 ml/min. The injector temperature was 250 °C and detector temperature was 260 °C. The oven starting temperature was 80 °C and increased to 200 °C at rate of 8 °C/min, held for 10 min. then increased to 250 °C at rate of 10 °C/min, held for 10 min.

RESULT AND DISCUSSION

Seed oils of *Asparagus racemosus* (family; Asparagaceae) *and Xanthium strumarium* (family; Compositeae) were liquid at room temperature (at 298 K) and free from any sediment. The physico-chemical properties of seeds and seed oils are given in Table- I. The seed *Asparagus racemosus* showed 7.69% of oil and 16.43% of protein content while the seed of *Xanthium strumarium* showed 11.54% of oil and 16.81% of protein content to the total seed weight. The refractive index of seed oil of *Asparagus racemosus* and *Xanthium strumarium* is 1.4723 and 1.4763 respectively at room temperature (at 298 K).

Table I Analytical values of seeds and seed oils

	Asparagus racemosus	***Xanthium strumarium***
Oil %	7.69	11.54
Protein %	16.43	16.81
Moisture %	2.37	3.53
Unsaponifible matter %	2.12	4.52
Saponification value	195.32	215.84
Iodine value	115.62	121.25
Refractive index	1.4723	1.4763

Saponification and iodine values of seed oil of *Asparagus racemosus* are 195.32 and 115.62 and that of *Xanthium strumarium* seed oil are 215.84 and 121.25 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.

Table II Fatty acid and their cumulative compositions of seed oils

Fatty acids	*Asparagus racemosus*	*Xanthium strumarium*
Palmitic acid (16:0)	-	1.34
Stearic acid (18:0)	21.22	16.69
Oleic acid (18:1)	11.50	13.30
Linoleic acid (18:2)	63.79	60.33
α-Linolenic acid (18:3)	2.85	8.00
γ-linolenic acid (18:3)	0.52	-
cis-11-eicosenoic (20:1)	-	0.33
Others	0.17	-
ΣSFAs (S)	21.22	18.03
ΣUFAs (U)	78.63	81.96
ΣPUFAs (P)	67.13	68.33
P/S index	3.1635	3.7961

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

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 respectively. Among unsaturated fatty acids (UFAs); linoleic acid (ω-6, essential fatty acid) was found to be the most abundant fatty acid with 63.79% and 60.33 followed by oleic acid (ω-9, non-essential fatty acid) with 11.50% and 13.30% in seed oil of *Asparagus racemosus* and *Xanthium strumarium* respectively to the total fatty acid content. These seed oils also found to contain 2.85% and 8.00% of α-linolenic acid (ω-3, essential fatty acid) in seed oil of *Asparagus racemosus* and *Xanthium strumarium* respectively. There are some other unsaturated fatty acids in minor amount like 0.52% of γ-linolenic acid in *Asparagus racemosus* and 0.33% of *cis*-11-eicosenoic in *Xanthium strumarium*. Among saturated fatty acids (SFAs), stearic acid was most abundant with 21.22% and 16.69% for *Asparagus racemosus* and *Xanthium strumarium* respectively. Palmitic acid was also present in sedd oil of *Xanthium strumarium* with 1.34 and some other fatty acids with 0.17% in seed oil of *Asparagus racemosus*. Both the seed oils; *Asparagus racemosus* and *Xanthium strumarium* were found to be good source of UFAs (78.63 and 81.96% respectively) and PUFAs (67.13 and 68.33% respectively) with high P/S index; 3.1635 for *Asparagus racemosus* and 3.7961 for *Xanthium strumarium*.

CONCLUSION

Since both seed categorized as drying oils on the basis of PUFAs content and contain P/S ratio more than 1, good for paints-varnishes and Oleo chemical industries.[26] These seed oils showed high saponification values, could be used in soap industries.[27,28] Linolenic and linoleic acids (PUFAs-essential fatty acids) increase the HDL-cholesterol and decrease the LDL-cholesterol while oleic acid (monounsaturated fatty acids; MUFAs) decreases LDL-cholesterol and triacylglicerols blood levels but does not effect HDL-cholesterol level, makes oleic acid more effective in the prevention of heart diseases.[29-31] However PUFAs are important to maintain the adequate ratio of low density lipoprotein (LDL)-cholesterols and high density lipoprotein (HDH)-cholesterols therefore helpful for the heart patients . Ratio of PUFAs and SFAs (P/S index) of oil has great importance and should be greater than 1 to consider them suitable for human consumption.[32] The present study envisage that on accounting high P/S index (more than 1), appreciable amount of oleic acid, adequate content of SFAs and absence of any *trans* unsaturation and conjugation, the seed oil of *Asparagus racemosus* could be suitable for human consumption and because of moderate protein content it could be proved a local animal feedstock as protein source. However, *X. strumarium* induces intoxication and exhibit poisonous property, would be more suitable at industrial scale and oleo chemical

industries. The by-product of both the seeds after oil extraction could also be useful as bio-mass for various applications. Apart from these parameters there are many other parameters likewise their stability at high temperature and resistance against oxidation process should also to be taken in account before establishing as potential source for edible and industrial purpose, need further investigations. The result obtained from our study suggested that the above data could be used as base parameter to develop them for domestic and commercial purpose with a sustainable manner and also for medicinal purposes to cure cardiac problems in southern, mid-western and western region of India.

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