Pakistan J. Sci. Ind. Res., Vol. 28, No. 6, December 1985

FATTY ACIDS FROM INDIGENOUS RESOURCES FOR POSSIBLE INDUSTRIAL APPLICATIONS

Part VIII, Investigations of Some Species of Compositeae Family

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(Received December 21, 1984)

The seed oils from *Carthamus oxycantha* (34.8%), *Saussuria candicans* (30.0%), *Silybum marianum* (25.7%), *Vernonia anthelmintica* (26.3%), and *Vernonia pauciflora* (37.0%). (N.O. Compositeae) have been analysed for their fatty acid composition. The occurrence of high percentage of vernolic acid (72-80%) in the Vernonia varieties and oleic (30-40%) and linoleic (40-60%) in *Carthamus oxycantha, Saussuria candicans,* and *Silybum marianum* suggests that these seed oils can find applications both for industrial and edible purposes.

INTRODUCTION

The plant family Compositeae is reported to have 950 genera and over 20000 species. Many plants of this family grow abundantly in the wild and cater for diverse uses such as in food, medicine, rubber, oil, detergents, protective coatings, insecticides and dyes. However, only *Helianthus annus* (sunflower) and *Carthamus tinctorious* (safflower) of this family are cultivated as oilseed crops.

In Pakistan also a large number of weeds, belonging to Compositeae, grow abundantly in different seasons of the year. In the present study the seed oils of *Carthamus oxycantha, Silybum marianum, Saussuria candicans, Vernonia anthelmintica* and *Vernonia pauciflora* have been examined for their fatty acid composition in continuation of the earlier reported work [1-7]. All plant seeds including *Vernonia pauciflora* that have been introduced in Pakistan were collected from areas in and around Lahore. The names, areas of growth and the time of collection of these plants along with brief description are mentioned below.

Carthamus oxycantha [8], locally known as "dohli" grows as a weed in the wheat crop all over Pakistan. It ripens after the harvesting of the wheat and sheds its seeds in the fields for the continuation of growth cycle. The whole spiky plant is used as a source of domestic fuel in the villages. The seeds were collected from plants in the months of May and June.

Silybum marianum [9] is another annual herb that grows in the wheat fields as a weed and also in the fallow lands in all parts of the country. The seeds from these weeds are collected in the months of May and June for the extraction of an alkolid, silymarin. So far the seeds have not been used for the recovery of oil.

Saussuria candicans [10] is also an annual herb that grows in the plains of Punjab and bears large quantity of small seeds. The plant stalk is used as fuel whereas the seeds find no application whatsoever. The seeds were collected in the month of May.

Vernonia anthelmintica [11] is yet another tall leafy annual weed that is said to have anthelmintic properties. It grows wild in all the waste places near the villages and bears seeds in the months of May and June.

Vernonia pauciflora [12] is a sturdy medium size plant that has recently been introduced to the Pakistani environment. It matures in 180-190 days and is an attractive source of vernolic acid. It also matures in the months of May and June.

EXPERIMENTAL

(i) Materials. Seeds of all the species were collected from the mature wild growing plants in the months of May and June.

Vernonia pauciflora seeds were, however, obtained from the plants grown in the fields of the PCSIR Laboratories. Initially these seeds had been imported from USA and had their wild origin in Ethopia and Kenya.

(ii) Extraction of the oil: Clean dry seeds of all the species were separately crushed with a pestle and in a mortar and then extracted in a Soxhlet extractor with hexane (b.p. 60-70°). The extracts were dried and the solvent removed under reduced pressure to afford light coloured clear oils. These oils were kept under nitrogen atmosphere for further evaluation.

(iii) Examination of the oils: Clear oils, as obtained in (ii) above were evaluated for their percentages and various physico-chemical characteristics by common methods [13]. These values are given in Table 1.

iv) Analysis of the component fatty acids of the oils: The oils (5.0 g) of each species were separately saponified with 0.5 N alcoholic potassium hydroxide (50 ml). by refluxing for 5 hr. under a nitrogen atmosphere. The soap solutions, after removal of the non-saponifiable matter with diethyl ether, were acidified with 4 N sulphuric acid. The liberated fatty acids were extracted with diethyl ether and then converted to their methyl esters which were subjected to vapour phase chromatographic analysis under the following conditions:

Column	Diethylene glycol succinate (DEGS)
Colum temp.	190°
Carrier gas	Nitrogen
Detector	Flame ionization
Chart flow rate	10 mm/min.
Gas flow rates	N_2 = 40 ml/min.
	H_2 = 10 ml/min.

The identity and the percentage composition of the constitutent fatty acids in each oil were determined from the retention time and the peak areas of their methyl esters respectively. The final composition are given in Table 2.

The seed oils from *Vernonia anthelmintica* and *Vernonia pauciflora* were directly esterified by the method of Kumar and Tsunoda [14]. The esters thus obtained were separated into the epoxy and the non-epoxy fraction on TLC and then subjected to GLC analysis.

DISCUSSION

The occurrence of oleic and linoleic acids in the oils as the major constituents is a common characteristic of the species of the Compositeae. The fatty acid composition of the oils from the species of Compositeae studied here has shown certain interesting features. This composition in the wild growing *Carthamus oxycantha* and *Silybum marianum* shows the general distinctive characters and compares favourably with that of *Carthamus tinctorious* (safflower) and *Halianthus annus* (sunflower), the two species of compositeae cultivated as oilseed crops. The fatty acid composition for comparison purposes, is given below:

	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$
1. *Carthamus oxycanthus* [8]	3.0	3.6	55.8	36.8
2. *Silybum marianum* [9]	9.7	7.1	37.0	42.11
3. *Carthamus tinctorious* [15]	9.9	4.5	17.0	68.0
4. *Halianthus annus* [16]	11.5	T	55.0	32.0

Table 1. Physico chemical characteristics of the oils from the species of compositeae

	Oil%	Ref. Index.	Acid Value	Iodine Value	Saponification value	Non-saponifiable matter
Carthamus oxycantha	34.8	1.4680	1.4	113.0	205	1.78
Silybum marianum	25.7	1.457	2.1	108.3	225	1.89
Saussuria candicans	30.0	1.4870	1.8	103.0	226	1.9
Vernonia anthelmintica	26.3	1.4860	34.4	107.6	223	7.9
Vernonia pauciflora	37.0	1.4740	27.4	107.5	193	2.6

Table 2. Fatty acid composition of the oils from the species of compositeae

Species	$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{20:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	Vernolic acid
Carthamus oxycantha	0.7	3.6	3.6	–	55.8	36.8	–	–
Silybum marianum	–	9.7	7.1	3.3*	37.0	42.0	–	–
Saussuria candicans	2.9	5.8	T	34.75	19.30	36.67	–	–
Vernonia anthelmintica	0.20	2.8	1.70	–	4.20	6.70	–	76.8
Vernonia pauciflora	–	2.04	2.68	–	3.60	10.78	0.45	80.45

*$C_{22:0}$, 3.0% also detected.

An examination of Table 2 indicates that the seed oils from the *Saussuria candicanss, Vernonia anthelmintica* and *Vernonia pauciflora* exhibit a different pattern of the constituent fatty acids acids in their seed oils. In addition to the general occurrence of oleic and linoleic acids these species have other acids as the major constituents. In the case of *S. candicans* it is arachidic acid (34.75%) and in the case of *V. anthelmintica* and *V. pauciflora,* it is vernolic acid (72% and 80%) respectively. The occurrence of vernolic acid, (12, 13-epoxy-oleic acid) in the Vernonia varieties is already known. However, it is for the first time that the seed oils from locally available Vernonia varieties and that of *S. candicans* have been evaluated for their fatty acid composition. *Vernonia pauciflora,* mentioned here, was introduced to the Pakistani environments after its collection from Ethopia in 1978 and it has adapted itself admirably to the local conditions.

Keeping in view the compsotions of these oils, it is seen that both *C. oxycanthus* and *S. marianum* can provide good quality edible oils. The only difficulty with these wild plants is the collection of their seeds. In view of the chronic shortage of vegetable oils in Pakistan it is emphasised that efforts be directed to collect such seeds as they should add to the country's natural resource and help to reduce pressure on the ever-increasing import bills of this vital commodity.

The seedoils from vernonia varieties could find excellent applications in the paint industry where ordinary vegetable oils with significant olefinic character are applied as a protective coating after expoxidation. Naturally occurring expoxy oils such as those from *V. anthelmintica* and *V. pauciflora* can thus advantageously replace these synthetically prepared and value added products. Additionally these natural epoxy oils can also become a useful ingredient of synthetic detergents.

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