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DEVELOPMENT OF ERUCIC ACID AND GLUCOSINOLATE-FREE RAPESEEDS (CRUCIFERS) IN PAKISTAN*

Part IV. The Instance of Erucic Acid and Glucosinolate Occurrence in Some Wild Crucifers of Pakistan

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The seeds from wild growing *Alyssum desertorum, Cardaria chalepense Conringia planisiliqua, Coronopus didymus Descurania sophia, Erysimum repandum, Malcolmia cabulica, Nastrutium officinale* and *Sisymbrium irio* (N.O. Crucifereae), have been analysed for their oil, erucic acid and glucosinolate contents. It has been found that all these species have a wide variation of erucic acid (1.55-31.42%) and glucosinolate (0-0.5%).

INTRODUCTION

The germplasm of the cultivated crucifers, both native and introduced, was evaluated with a view to determining its suitability for raising an oil seed crop providing erucic acid free oil and glucosinolate free meal. The results of these evaluation studies have been communicated in the earlier reports on these series of Publications[1-4]. The present report describes the situation with regard to some of the wild crucifers occuring in Pakistan.

Because of the climatic diversity a number of crucifers exist in Pakistan. As reported earlier only *Brassica juncea, Brassica campestris* and *Eruca sativa* are the native cultivars whereas *Brassica napus Brassica carinata, Brassica nigra* and *Camelina sativa* of European origin have also been introduced in Pakistan for cultivation trials.

However, a large number of wild crucifers also thrive in the local ecological environment and it was decided to determine the erucic acid and glucosinolate levels in their germplasm as well. Consequently, therefore, the seeds of these wild species were collected and analysed with a view to knowing the instance of erucic acid and glucosinolate occurance in them. The names of the wild crucifers, alongwith the place of collection, are given in the Experimental.

EXPERIMENTAL

Collection of Wild Crucifers. Seed samples of these wild species of curicfers were collected from different parts of the country and are given below:

Name of wild Crucifers with place of occurrence and collection[5].

Sl. No.	Name	Place
1.	*Alyssum desertorum*	Chitral, Peshawar, Hazara, Swat, Kashmir, Punjab; Rawalpindi, Hassan Abdal, Baluchistan; Quetta, Peshin, Ziarat, Kalat.
2.	*Cardaria chalepense*	Gilgit, Chitral, Hazara, Peshawar, Punjab; Rawalpindi.
3.	*Conringia planisiliqua*	Chitral, Kashmir, Karakorum, Rawalpindi, Baluchistan, Quetta, Urak, Hazarganji.
4.	*Coronopus didymus*	Peshawar, Rawalpindi, Lahore, Khairpur, Karachi.
5.	*Descurainia sophia*	Chitral, Gilgit, Hazara, Kashmir, Campbellpur, Quetta, Fortsandeman, Mustung.
6.	*Erysimum repandum*	Chitral, NWFP; Abbotabad, Kashmir, Kurrum Valley.
7.	*Malcolmia cabulica Var. cabulica*	Peshawar, Hazara, Rawalpindi Hassan Abdal, Salt-range, Loralai, Harnai.
8.	*Nasturtium officinale*	Chitral, Hazara, Kashmir, Rawalpindi, Quetta, Ziarat, Sukkur.

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9.	*Sisymbrium irio*	Chitral, Dir, Peshawar, Rawalpindi, Quetta, Lahore, Saltrange, Khairpur.

ANALYTICAL METHODS

1. Extraction of Oil. Oil from weighted quantities of the seeds of all the species was separately extracted in Soxhlet using Hexane as the solvent. The solvent was removed from the dried extracts under nitrogen atmosphere to afford residual oil with dark golden yellow colour. The weights of the oils were then used to determine their percentages.

2. Preparation of Methyl Esters. The methyl esters of the fatty acids, constituting the tri-glycerides in the oils of all the species, were prepared by direct esterification using methanol: benzene: acetyl chloride (20:4:1) mixture [6]. The dried esters were kept under nitrogen atmosphere till their resolution into individual components by the vapour phase chromatographic technique.

3. Separation of Methyl Esters and Identification of Component Fatty Acids. Dry and purified methyl esters of the oils from different species were separately resolved into the component fatty acids by using a Pye Unicam Model 204 gas chromatograph under the following conditions: Glass column (5 ft x 1.5 m), packed with DEGS (10%) injector port 220°C, flame ionisation detector 250°C, column oven 200°C, N_2 flow rate 40 ml/min. H_2 40 ml/min air 550 ml./min. The determined fatty acid composition of the seed oils of all the wild species of crucifers is given in Table 1.

4. Glucosinolate Contents of the Seed Meals. The glucosinolate percentages in the seeds of wild crucifers, studied so far, were determined by the previously reported procedure[7] and are given in Table 2 alongwith the oil percentage.

Table 2. Oil percentage and glucosinolate contents of wild Crucifers

Sl. No.	Botanical name	Oil %age	Glucosinolate %age.
1.	*Alyssum desertorum*	11.14	Traces
2.	*Cardaria chalepense*	8.66	0.1
3.	*Conringia planisiliqua*	27.72	0.25
4.	*Coronopus didymus*	7.05	0.25
5.	*Descurainia sophia*	21.00	0.1
6.	*Erysimum repandum*	18.3	0.25-0.5
7.	*Malcolmia cabulica Var. cabulica*	21.18	0.1
8.	*Nasturtium officinale*	28.2	0.1-0.25
9.	*Sisymbrium irio*	22.00	0.1

DISCUSSION

A wide variety of crucifers exist in the wild and many are found in Pakistan also. Evaluation of such species, existing else-where, has already been reported in the literature [8]; Wild crucifers found in Pakistan, have now been examined for their oil, glucosinolate and erucic acid contents. These data are considered important for a breeding pro-

Table 1. Fatty acid composition of some wild Crucifers of Pakistan.

Sl. No.	Botanical name	$C_{12:0}$	$C_{14:0}$	$C_{16:0}$	$C_{16:1}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{22:1}$	Other acids
1.	Alyssum desertorum	1.72	6.88	10.33	2.58	1.72	17.21	13.08	44.75	1.55	0.17
2.	*Cardaria chalepense*	1.25	0.93	8.41	3.12	5.92	14.02	15.58	21.81	19.63	9.34
3.	*Conringia planisiliqua*	2.80	2.80	9.83	3.37	3.65	16.85	4.49	11.24	28.65	16.3
4.	*Coronopus didymus*	–	–	8.17	–	1.92	21.63	17.79	21.63	28.84	–
5.	*Descurainia sophia*	–	0.25	4.42	–	0.85	14.14	30.43	39.80	10.90	T
6.	*Erysimum repandum*	1.66	1.32	8.28	3.31	1.32	10.60	11.59	59.60	2.32	–
7.	*Malcolmia cabulica Var. cabulica*	2.58	3.49	13.97	3.49	3.49	13.27	2.09	8.73	31.42	17.45
8.	*Nasturtium officinale*	0.94	0.75	11.24	2.64	2.81	22.47	20.60	11.24	22.47	4.86
9.	*Sisymbrium irio*	1.09	0.75	12.69	–	3.37	16.18	14.62	36.16	10.01	4.92

Table 3. Oil yield, fatty acid composition and glucosinolate levels of common crucifers cultivated as oilseed crops.

Sl. No.	Cultivar	Oil yield %	$C_{12:0}$	$C_{14:0}$	$C_{16:0}$	$C_{16:1}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{22:1}$	Other acids	Gluco-sino-late
1.	*Brassica campestris*	40.8	–	1.83	4.65	–	2.48	25.33	26.37	29.26	10.86	–	0.25
2.	*Brassica juncea*	39.0	–	0.50	3.55	–	8.21	13.23	19.73	25.21	52;51	2.22	0.25
3.	*Brassica napus* (introduced)	40.0	–	1.18	5.09	–	0.97	17.89	12.03	12.56	45.74	4.54	0.1
4.	*Eruca sativa*	33.0	–	0.22	5.39	–	3.20	19.28	13.70	16.02	42.12	–	0.25

gramme providing a glucosinolate as well as erucic acid free germplasm that could be cultivated as a source of oil crop. An additional benefit of selection from the wild species will be their resistance to disease.

The data obtained from the study of the wild species, however, suggest that there is a large variation in all the three characteristics viz. oil, glucosinolate and erucic acid levels. The fatty acid composition of the seed oils of the nine wild species studied here, is given in Table 1. It is observed that this composition is not much different in the general pattern of the fatty acid profile of the crucifers. However, the specific differences related to the percentages of the individual fatty acids are discernable. Thus the major fatty acids present in these oils are palmitic, oleic, linoleic, linolenic and erucic acids. Lauric, myristic and palmitoleic acids are, however, the minor components of the glycerides of these crucifers.

This fatty acid composition is almost similar to that of the common crucifers cultivated as oil seed crops. In Table 3 these compositions are presented for comparison purposes. Although the compositions have a resemblance yet there exist a wide variation among the percentages of different acids, i.e., palmitic (4-13%), oleic (10-22%), linoleic (2-30%), linolenic (8-60%) and erucic acid (1.55-31%).

The oil percentages and glucosinolate contents of the wild species (Table 2) also vary from (7-28%) and (0-0.5%) respectively.

It is observed that some species have low erucic acid in their oils. For example *Alyssum desertorum* (1.55%) *Erysimum repandam* (2.32%) *Sisymbrium irio* (10.01%) and *Descurania sophia* (10.9%) and high amounts of linolenic acid 44.75%, 59.6%, 36.16%, 39.08% respectively in them.

It is found that in all these wild species both Erucic acid and glucosinolate percentages are relatively low and these wild species can be used for developing new lines having low or zero contents of both Erucic acid as well as glucosinolate by suitable crossings. Additionally these species can be introduced as crops, after suitable selection on arid and semi-arid land and there are certain species i.e. *Nastrutium officinale* which can be cultivated on water-logged soil. It is thus seen that a potential exists that can be utilisied for introducing a cruciferous oil seed crop having desirable characteristics both with regard to the erucic acid and glucosinolates.

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