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

Part III. Erucic Acid and Glucosinolate Levels of Eatable Crucifers of Pakistan.

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Seed oils from ten species of eatable Crucifers have been evaluated for their physico-chemical characteristics and fatty acid compositions. The glucosinolate levels of the seed meals have also been determined. It has been observed that in all these species the erucic acid and glucosinolate levels (33-57%) and (T–0.5%) respectively, have wide variations.

INTRODUCTION

In continuation of the earlier programme to search for a germplasm of low erucic acid and low glucosinolate, the crucifers cultivated for consumption as vegetables have now been examined [1-3]. The present study lists 10 such Crucifers that are grown annually to obtain their various parts including fruits, flowers, stems, leaves and roots which are commonly used as vegetable but not as oil seed crop. Selected plants are, however, allowed to mature and they provide seeds for the next sowing.

For the purpose of the present study the seeds were procured from the local market and then analysed for their oil, erucic acid and glucosinolate levels. One purpose of the study was to evaluate the germ-plasm and the other to plan further crossing, where desirable and possible, with any of the cultivated crucifers for obtaining low erucic acid and low glucosinolate seeds. It has however, been observed that there is a higher level of erucic acid (33-57%) and low levels of glucosinolate (T-0.5%) in all the seeds examined so far.

EXPERIMENTAL

Materials and Methods

Seeds: Seed samples were procured from the local market and their authentity was checked by the Agriculture Research Institute Faisalabad.

Analytical Methods: The percentage of oil in the seeds was determined by separately extracting them with hexane in a Soxhlet extractor.

Physico-chemical characteristics of the clear, pale yellow coloured oil were then determined by the standard methods and are given in Table-2 alongwith the oil percentages [4].

The methyl esters were prepared by direct esterification of the oils using methanol-benzene-acetyl chloride (20:4:1) mixture and refluxing for 2 hours [5].

The fatty acid composition of the oils was determined by vapour phase chromatographic analysis of the purified methyl esters on a poly-ethylene-glycol succinate (PEGS) column under the following conditions and is given in Table 1.

Glass column (5ft x 1.5ft), packed with BEGS (100%), injector port 220°C, flame ionisation detector 150°C, column oven 220°C, flow rate (N_2) 40/ml per minute, (H_2) 40/ml minute, air 550 ml/minute.

The glucosinolate [6] contents, of the seed meals, were estimated by the method of McGregor and Downey using Tes-Tape (Courtesy Eli-Lilly & Co. Canada) and are also given in Table 2.

DISCUSSION

Various physico-chemical characteristics, including erucic acid and glucosinolate levels, of the oils from the seeds of eatable and commonly cultivated crucifers are respectively given in Tables 2 and 3 for comparison purposes. From these results it is seen that almost all the

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Table 1. Fatty Acid composition and glucosinolate levels of eatable crucifers

No.	Botanical name	Local name	$C_{12:0}$	$C_{14:0}$	$C_{16:0}$	$C_{16:1}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{22:0}$	$C_{22:1}$	$C_{24:0}$	Other acids	Glucosinolate
1.	*Brassica oleracea var. botrytis*	Phool Gobhi (Cauli flower)	T	0.36	4.11	0.12	0.82	16.25	12.12	14.46	0.09	51.18	0.21	0.27	0.25
2.	*B. oleracea var. capitata*	Band Gobhi (Cabbage drumhead)	1.45	0.22	4.34	0.12	0.69	13.92	18.30	19.67	0.08	40.27	0.17	0.76	0.1
3.	*B. oleracea var. gongylodes*	Ganth Gobhi (Knol Knol)	1.69	2.53	6.36	0.39	1.23	19.31	1.71	8.03	0.21	57.19	0.61	0.72	0.1
4.	*B. rapa ssp. rapa*	Turnip (red ball)	0.33	0.76	4.08	0.26	1.30	13.83	13.50	11.69	0.47	51.82	0.53	1.43	0.5
5.	*B. rapa ssp. rapa*	Turnip (purple top)	0.49	1.59	3.42	0.16	1.36	18.29	7.35	12.08	0.27	54.76	T	0.24	0.5
6.	*B. rapa ssp. rapa*	Turnip (Golden ball)	2.41	4.94	4.88	0.43	1.50	14.09	0.41	10.63	0.87	57.77	0.31	1.74	0.1
7.	*Raphanus sativus var. cardatus*	Moongra bara	1.43	0.78	6.30	0.22	2.04	22.62	12.24	18.16	0.33	34.69	0.18	1.01	0.1
8.	*Raphanus raphanistrum*	Moongra Chota	–	0.26	6.23	0.26	1.85	21.15	13.22	20.24	0.69	33.35	1.14	1.60	T
9.	*Raphanus sativus var. satuvus*	Mooli Safed (Desi)	0.46	1.49	8.12	0.30	2.07	30.98	3.84	11.37	0.56	38.24	0.44	2.13	0.1
10.	*Raphanus sativus var. sativus.*	Mooli Safed (Japani)	1.61	2.65	8.88	0.32	2.35	31.99	1.01	10.79	0.82	35.18	0.98	3.42	T

Table 2. Physico-chemical characteristics of the seed oils of eatable crucifers of Pakistan

Sr. No.	Botanical name	Common name	Oil yield (%)	Iodine value	Saponification value	Acid value	Non saponifiable matter	Erucic Acid %	Glucosinolate (%)
1.	*Brassica oleracea var. botrytis*	Phool Gobhi	34.4	108.69	103.57	2.9	–	51.18	0.25
2.	*Brassica oleracea var. capitata*	Band Gobhi	30.7	109.78	188.13	1.18	3.27	40.27	0.1
3.	*Brassica oleracea var. gongylodes*	Ganth Gobhi	32.6	101.32	198.49	3.29	–	57.19	0.1
4.	*Brassica rapa ssp. rapa*	Shaljam (red ball)	34.7	109.33	209.29	3.35	2.19	51.82	0.5
5.	*Brassica rapa ssp. rapa*	Shaljam (Purple top)	40.11	107.14	135.21	2.15	1.4	54.76	0.5
6.	*Brassica rapa ssp. rapa*	Shaljam (Golden ball)	41.6	98.56	143.03	1.5	–	57.77	0.1
7.	*Raphanus sativus var. cardatus*	Moongra bara	40.4	107.44	225.21	3.4	–	34.69	0.1
8.	*Raphanus raphanistrum*	Moongra chota	41.12	106.63	237.88	3.83	–	33.35	T
9.	*Raphanus sativus var. sativus*	Mooli Safed (Desi)	35.5	104.26	213.10	3.54	–	38.24	0.1
10.	*Raphanus sativus var. sativus*	Mooli Safed (Japani)	40.03	100.4	185.76	1.44	3.35	35.18	T

Table 3. Physico-chemical characteristics of the seed oils of common crucifers cultivated as oil seed crops

Sl. No.	Botanical name	Common name	Oil yield	Iodine value	Saponification value	Acid value	Unsaponifiable matter	Erucic acid %	Glucosinolate %
1.	*Brassica campestris*	Sarson/Toria	39-44	94.55 to 106.14	175.75 to 178.0	2.6 to 2.98	1.10 to 1.14	19-57	0-0.5
2.	*Brassica Juncea*	Sarson/Raya	40-44	89.28 to 103.24	172.0 to 173.5	2.43 to 2.8	1.06 to 1.13	17-64	0-2
3.	*Brassica napus*	Gobhi Sarson	36-41	100.7 to 102.95	169-170	2.73 to 2.80	1.18 to 1.2	T-37	T-0.25
4.	*Brassica nigra*	Kali Sarson	30-35	100.35 to 107.30	176.75 to 178.99	2.75 to 3.20	1.20 to 1.24	40-57	0.1-0.25
5.	*Brassica carinata*	–	35-42	120.85 to 126.20	168-169	2.90 to 3.90	1.14 to 1.17	T-35	T-2
6.	*Eruca sativa*	Taramira	22-37	105.95 to 108.36	177-179	5.8 to 7.02	2.0 to 2.27	26-56	0-2

characteristics are similar. Such a similarity is not un-expected but explainable as these seed oils belong to the same family i.e. *Crucifereae*. The results of the present study, therefore, indicate that the germ-plasm of eatable crucifers is not much different from that of the oil seed crop raised from the other members of the Cruciferae family [1].

The instance of erucic acid and glucosinolate occurance in the oil seed crop is 12-64% and 0-2% respectively whereas in the eatable crucifers it has been found to be 33-57% and T-0.5% respectively. It is, therefore, inferred that for the low erucic acid germplasm selection will be more beneficial from the cultivated crucifers as they are already well adapted to cultivation conditions as an oil seed crop. However, for low glucosinolate seeds recource can be had from both type of seed stocks available in Pakistan as this character is present to the minimum extent.

A wide variation, however, exists between the oil percentages of different seeds of the crucifers grown in Pakistan. This difference can also be utilised for breeding more oil yielding lines in the future programme for developing crucifers of desirable characteristics. A major advantage of this approach will be more oil yield per acre from the existing crop without any increase in the acrage of cultivated crucifers. Such crossings are a routine practice with the agriculture botanists and should pose no problems whatsoever.

Selection and development of a germplasm with low erucic acid and low glucosinolate will also be facilitated from the evaluation and subsequent crossing of lines available in the wild crucifers occuring in Pakistan. The evaluation data on such wild crucifers that have both these characters will be presented in the next study on this series of publications.

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