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OIL AND MEAL QUALITY OF CULTIVATED BRASSICAS AND THEIR WILD RELATIVES

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INTRODUCTION

Among the crops grown domestically for oil in India, the group of cruciferous oilseeds ranks second to peanut, both in acreage and production. Due to their being rich in both oil and well-balanced proteins, it is logical to look on them as one of the major future sources of providing relief to the protein-calorie malnutrition problem of our country.

In the present study a number of Indian cultivated oleiferous Brassica and their related wild species and genera were examined for their quantitative and qualitative characteristics of oil and seed meal and the results from the same are presented in this paper.

MATERIALS AND METHODS

Seeds of 22 different crucifers which included the important commercially grown oilseed rapes and mustards of India together with their related species and genera and 5 synthesised amphidiploids were utilized for the present study. Seeds of these were analysed to determine quantitatively the percent oil content and fatty acid composition of the oil, and percent protein content and glucosinolates of the meal. The oil content was determined by NMR on a 2 gm sample of partially dried whole seeds, while fatty acid composition was determined on a gas liquid chromatograph (GLC) fitted with a UCW-98 column. The protein content in the meal was determined in terms of total nitrogen, estimated using a Technicon Autoanalyser, and was converted to percent protein by multiplying by a factor 5.53. The glucosinolate content in the meal was determined by the 'Thiourea Method' of Wetter and Youngs (1976).

RESULTS AND DISCUSSION

The data for oil content (Table 1) revealed marked differences between various crucifers studied. The oil content ranged from 14.0 to 43.9%. The commercially grown rapes and mustards possessed high oil content with an average of 40% oil in the seeds. The related wild species of Brassica viz., tournefortii and alba and Crambe abyssinica showed less than 18% oil content. The remaining crucifers had on the average 30% oil content.

The pattern of fatty acid distribution within different crucifers revealed approximately similar trends. The major fatty acids belonged to the C_{22}, C_{20} and C_{18} groups, with C_{24} the least (Table 1). The first three groups accounted for ca 96% of the total fatty acid composition. The cruficers included in the study were invariably grown under wider agro-climatic conditions and were expected to reveal wider differences in their fatty acid composition. However, similar trend in their chemical composition of oil suggested that growing conditions had little effect

TABLE 1

OIL CONTENT AND FATTY ACID COMPOSITION OF THE OIL OF SOME CRUCIFERS

Crucifer/Amphidiploid (A)	Oil content %	Fatty acid composition, % C 16	C 18	C 20	C 22	C 24
Brassica campestris var. *toria*	38.0	2.6	32.3	11.5	53.1	0.4
B. campestris var. *sarson*	43.9	1.5	31.9	9.1	57.0	0.5
B. campestris var. *dichotoma*	42.4	2.0	33.8	10.9	52.4	0.9
B. campestris var. *rapa*	40.1	2.2	34.9	13.1	48.9	0.8
B. juncea	38.3	1.9	36.1	8.7	51.6	1.7
B. napus	42.1	4.6	36.4	9.4	48.2	1.4
B. oleracea	34.9	3.2	32.9	8.1	55.4	0.4
B. nigra	38.6	3.6	38.2	10.3	45.5	2.4
B. japonica	39.4	2.0	32.2	8.4	56.7	0.7
B. chinensis	29.4	1.8	32.7	10.1	55.1	0.3
B. narinosa	30.4	2.0	35.4	10.8	51.0	0.7
B. pekinensis	31.0	2.1	34.3	9.6	53.1	1.0
B. tournefortii	14.0	3.1	32.1	10.2	53.5	1.1
B. alba	17.6	3.3	39.2	11.5	43.5	2.5
B. hirta	22.7	2.9	40.1	12.2	42.5	2.2
B. carinata	26.9	2.6	37.3	11.0	47.1	2.0
B. integrifolia	32.8	2.6	38.5	9.2	48.1	1.5
B. amarifolia	35.4	1.9	36.5	9.2	51.3	1.1
Eruca sativa	33.3	3.1	33.8	13.9	47.9	1.3
Camelina sativa	21.5	3.2	50.0	12.8	33.4	0.6
Crambe abyssinica	17.5	2.1	25.9	5.4	65.3	1.3
Raphanus sativus	32.6	4.6	43.0	10.9	40.7	0.8
B. chinensis x *B. nigra* (A)	31.5	2.2	38.3	9.7	48.2	1.6
B. pekinensis x *B. nigra* (A)	27.5	2.3	37.2	10.5	48.1	1.9
B. narinosa x *B. nigra* (A)	31.1	2.3	34.5	9.9	51.9	1.4
B. japonica x *B. nigra* (A)	32.7	2.4	35.5	10.0	50.8	1.3
B. campestris x *B. oleracea* (A)	33.0	3.0	35.9	13.9	46.4	0.8

on the fatty acid pattern. This may be an advantage in breeding where more effective selection for a particular fatty acid could be brought in the specific direction. Similar reports of small environmental effects on the fatty acid pattern in the developing seeds of crucifers are not uncommon in literature (Appelqvist, 1968, 1970; Craig and Wetter, 1959; and Downey and Craig, 1964).

Among the fatty acids, erucic acid contributed on an average approx. 50% of the total fatty acid composition and ranged from 33.4% in Camelina sativa to as high as 60.5% in Crambe abyssinica. In none of the Indian domesticated species of Brassica, erucic acid ranged lower than 50%. The C_{18} group which included the major nutritive fatty acids, the oleic and linoleic, together with stearic and linolenic comprised on an average around 35% and ranged from 25.9% in Crambe to 50.0% in Camelina. In view of the reported harmful effects of higher erucic acid together with restrictions imposed on the commercialisation of high erucic oil in the major rapeseed production of the West, a modification in the fatty acid composition of the existing cultivars of Indian Oilseed Brassica (as suggested by Anand, 1975) is of immediate consequence.

Only 18 crucifers were analysed for glucosinolates. All crucifers were analysed for protein content but data are presented for the same 18 crucifers in Table 2. The overall range for protein content of the analysed samples varied from 20% (B. tournefortii) to 46.7% (Raphanus sativus) on oil-free meal basis. However, the range was comparatively narrower for the listed crucifers. Considerable plant to plant variation was observed for oleiferous species of Brassica, which suggested the possibility of enhancing protein content by plant breeding procedures.

The utility of protein cake as a source of animal feed of human diet is restricted due to considerable proportion of sulphur containing glucosinolates that are often met within the crucifers. The analysis of some of the crucifers (Table 2) revealed that total glucosinolate content in the meal ranged from 0.20% (B. carinata) to 2.97% (B. alba). The predominant glucosinolate in Indian cultivated Brassica was 'Gluconapin', which ranged from 79.84 to 98.05%. This was followed by 'Glucobrassicanapin' for the majority of species except B. juncea, where 'Sinigrin' was ca 18%. The present study thus supports the previous report of Anand (1974) for Indian cultivated Brassica. The related species of domesticated oilseed Brassica showed variation for glucosinolate composition and could be grouped based on their natural amphidiploid origin. An interesting relationship was the presence of Sinigrin in all the amphidiploids of Brassica where one genome was contributed by B. nigra (n=8). This was supported by the synthesised amphidiploids (A) of n=18 (B. chinensis x B. nigra and B. pekinensis x B. nigra) which like the natural existing B. juncea (n=18) possessed sinigrin in their seed meals.

ACKNOWLEDGEMENTS

The authors are indebted to Dr.R.K. Downey of Canada Dept. of Agriculture, Saskatoon, Canada and Dr. G. Röbbelen of Institut für Pflanzenbau und Pflanzenzüchtung, Göttingen, W.Germany for providing analyses of the cruciferous seed samples.

TABLE 2

PROTEIN CONTENT AND GLUCOSINOLATE COMPOSITION OF THE MEAL OF SOME CRUCIFERS

Crucifer/ Amphidiploid (A)	Protein content %	Total gluco-sino late %	Percent glucosinolate SIN	GNA	GBN	PRO	2-4
Brassica campestris var. *toria*	34.49	1.39	0.00	96.94	0.92	0.06	2.18
B. campestris var. *sarson*	36.53	1.17	0.00	97.88	0.81	0.06	1.25
B. campestris var. *dichotoma*	36.45	0.89	0.00	98.05	1.10	0.10	0.76
B. campestris var. *rapa*	37.60	1.10	0.00	96.02	2.28	0.89	0.80
B. juncea	39.24	0.90	18.38	79.84	1.56	0.10	0.10
B. japonica	44.80	1.17	83.34	6.30	5.77	0.10	4.49
B. chinensis	39.24	0.69	0.00	88.22	6.83	4.82	0.13
B. narinosa	42.01	0.66	0.00	77.78	10.63	3.15	8.44
B. pekinensis	37.58	0.69	0.00	97.25	1.47	1.18	0.10
B. alba	44.21	2.97	14.88	0.81	0.80	67.82	15.69
B. carinata	44.80	0.20	69.97	7.51	20.68	0.13	1.71
B. integrifolia	48.15	1.24	83.05	5.86	4.06	2.60	4.43
B. amarifolia	37.62	1.11	41.82	49.39	2.22	3.08	3.49
Eruca sativa	34.30	1.31	0.00	23.58	4.06	4.07	68.29
Camelina sativa	38.72	0.36	0.00	20.24	7.64	17.44	54.68
B. chinensis x *B. nigra* (A)	32.92	1.05	57.11	36.78	3.55	2.46	0.10
B. pekinensis x *B. nigra* (A)	34.17	0.87	61.51	34.99	3.28	0.11	0.11
B. campestris x *B. oleracea* (A)	45.34	0.40	0.00	39.68	1.69	57.96	0.67

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