The Composition of Wild Mustard (*Sinapis arvensis* L.) and the Effect of Its Admixture on the Quality of Rapeseed

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Introduction

Wild mustard (charlock), has become a severe weed problem in Manitoba and Eastern Saskatchewan.

The Canada Grain Grading regulations allow up to 5% wild mustard and 1% of other small weed seeds as admixture in rapeseed without the overall grade of the sample being affected (1). In 1982, 20% of the samples received from Manitoba in the Grain Research Laboratory's new crop survey were found to contain in excess of 5% wild mustard.

The effect of dockage inclusion on the quality of rapeseed oil and meal and its possible use as animal feed has been studied and a summary of some of these projects has recently been published (2). The present study examines the composition of wild mustard grown at different locations in Western Canada and the effect of the admixture of wild mustard on some rapeseed quality factors.

Materials and Methods

Wild mustard is also known as charlock, jotte, moutarde des champs and moutarde commune. It has had several botanical names including *Brassica arvensis*, *Brassica kaber* (DC.) Wheeler var *pinnatifida* (Stokes) Wheeler, and *Sinapis arvensis* L. *S. arvensis* has been most widely accepted although some North American botanists still prefer *B. kaber*.

Samples of wild mustard were received from various government agencies, universities, and crushing plants or were collected from sunflower fields in Southern Manitoba and North Dakota by the authors. The identity of all the

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samples was confirmed by Agriculture Canada's Food Production and Inspection Branch (Manitoba Regional Seed Laboratory).

The small sample size, in some cases only about 50 seeds, made standard methods of analysis impossible. Oil content was determined gravimetrically after grinding the sample and extracting with hexane on a Goldfisch extractor. The oil obtained from the extraction was used for analysis of fatty acid composition (3) and the meal was analyzed for protein by Kjeldahl (4) and for glucosinolates by gas-liquid chromatography of the desulphated pertrimethylsilyl ethers (5).

Results and Discussion

Composition of wild mustard. Table 1 shows the oil content, protein content, fatty acid composition, and glucosinolates content of wild mustard samples from nine different locations and years in Western Canada and one location in North Dakota, USA. These compositions were similar to those reported from previous sources (6 to 9).

Rapeseed contamination in samples analyzed by Shires et al (9) and their use of trehalose as an internal standard in the glucosinolate determination explains the qualitative and quantitative differences between the present study and their reports (D.I. McGregor, personal communication). Fatty acid composition, especially erucic acid was quite variable. Samples from Alberta had more erucic acid than samples from the Eastern Prairies.

Samples of wild mustard from Western Canada were substantially different in fatty acid composition (and perhaps in the total glucosinolate content) from samples collected from Europe and the Middle East (Table 2). Wild mustard from Western Canada had less erucic acid, more linolenic acid and higher iodine values than wild mustard from other parts of the world. S. arvensis has been noted to contain 30% or more of erucic acid (11,12) and also 5 to 10% erucic acid (6,12). In a study of several wild mustard selections, Appelqvist (12) noted one genotype with 5.4% erucic acid which presumably is similar to the type of S. arvenis in Western Canada. The point of origin of this sample is not known.

Effect on Rapeseed Quality. In a previous study (13) wild mustard seed added to pedigreed rapeseed in levels up to 50% reduced the oil content but resulted in little change in protein content. The erucic acid content increased from 0.4% to 3.4%. To further demonstrate this effect using naturally occurring samples, rapeseed samples submitted to the Grain Research Laboratory's 1982 new crop survey were composited, according to their degree of contamination with wild mustard, as indicated by the grain company which supplied the sample. The mixed composites were analyzed for wild mustard content by the Canadian Grain Commission's Inspection Division and were tested for quality factors (Table 3).

The amounts of wild mustard found in the composites were quite different from the amounts expected based on the grain companies analyses. The official analyses gave amounts, on the average, much lower than the grain companies' analyses. This discrepancy illustrates the difficulty in estimating the wild mustard content of rapeseed samples.

Table 3 shows quality factors for the composites and for the 1982 new crop survey of Canadian rapeseed. Since most of the wild mustard samples came from Manitoba, quality results from the composites are best compared with the average results for Manitoba rapeseed. Significant decreases were noted in oil and aliphatic glucosinolates when samples with greater than 10% wild mustard were compared with the samples with less than 10% wild mustard or with average values for 1982 Manitoba rapeseed. The same comparison showed significant increases of erucic acid, linolenic acid and iodine value. Since both wild mustard and rapeseed have similar protein contents,little effect is noted on protein. Since the level of sinalbin increases with wild mustard this compound could be used as a quantitative indicator of wild mustard contamination in rapeseed.

Shires *et al* (9) observed that wild mustard present in rapeseed did not seriously affect the growth of mice when mixed 2% or 4% with canola seed. They extrapolated that wild mustard might be fed in myrosinase free diets at relatively high levels.

Conclusions

Wild mustard admixtures with Canadian rapeseed, at levels greater than 10% cause a significant decrease in the oil content of the seed and increase in linolenic acid and iodine value of the oil produced from the seed. High erucic acid genotypes of wild mustard would significantly increase the erucic acid content of the seed at 10% admixture. The wild mustard found in Canadian rapeseed, however, has a low level of erucic acid and no commercially significant increase in the erucic acid content of rapeseed was noted when the wild mustard contamination was less than 10%.

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Table 1
Quality factors for samples of Sinapis arvensis grown in Canada

Location	Year	Oil Content[1] (%)	Protein Content[2] (%)	Fatty Acid Composition C22:1 %[3]	C18:3 %[3]	I.V. g/100 g	Glucosinolates (μ M/g)[4] Aliphatic[5]	Sinalbin	Indolyl[6]
Western Canada	1971	24.4	41.8	6.4	19.6	131	0.2	159	1.4
S. Sask.	1978	25.4	42.7	3.5	21.0	134	0.5	159	2.3
S. Alta.	1982	26.7	41.6	9.0	19.1	127	1.2	164	1.0
C. Alta.	1982	28.3	36.1	11.9	15.4	122	2.6	160	1.2
Manitoba[7]	1980	27.0	40.5	7.6	20.2	130	0	159	1.4
Waskada[7]	1982	18.6	41.6	6.0	18.4	130	0.6	151	1.4
Starbuck[7]	1982	28.0	43.0	4.0	19.1	127	0	186	2.1
Elm Creek[7]	1982	28.2	40.0	5.4	17.5	130	0	192	1.3
Oakville[7]	1982	32.1	31.9	3.1	17.2	127	0	168	0.9
N. Dakota (Fargo)[7]	1982	20.4	45.5	8.9	13.9	118	0	128	0.8

[1] Tel quel (about 6% moisture)
[2] oil-free, dry basis
[3] percent of total fatty acids
[4] oil-free, air-dried (about 6% moisture)
[5] 3-butenyl, 4-pentenyl; 2-hydroxy-3-butenyl- and 2-hydroxy-4-pentenyl glucosinolates
[6] 1-Methoxy-3-indolylmethyl glucosinolate
[7] harvested from 1 to 4 individual plants at each location, means of all samples taken reported

Table 2

Quality factors for samples of Sinapis arvensis from different parts of the world

Location	Year	Oil Content[1] (%)	Protein Content[2] (%)	Fatty Acid Composition C22:1 %	Fatty Acid Composition C18:3 %	Fatty Acid Composition I.V. g/100 g	Glucosinolates (μ M/g)[4] Aliphatic[5]	Glucosinolates (μ M/g)[4] Sinalbin	Glucosinolates (μ M/g)[4] Indolyl[6]
W. Canada	1971-82	25.9	40.4	6.6	18.1	128	0.5	162	1.2
Yugoslavia	-	23.4	42.0	31.1	13.3	111	0.6	129	1.0
Yugoslavia	-	24.1	40.7	32.1	13.2	114	0.5	151	1.8
Turkey	-	17.8	35.6	36.1	16.9	115	0.2	129	0.9
Spain	1976	25.4	38.0	34.7	18.9	118	0	101	1.3
Spain	1977	27.0	42.5	38.9	16.7	114	0.7	148	1.2
Israel	-	25.8	36.9	36.9	14.6	111	0	124	1.0

[1] Tel quel (about 6% moisture)
[2] oil-free, dry basis
[3] % of total fatty acids
[4] oil-free, air-dried (about 6% moisture)
[5] 3-butenyl, 4-pentenyl; 2-hydroxy-3-butenyl- and 2-hydroxy-4-pentenyl glucosinloates
[6] 1-Methoxy-3-indolylmethyl glucosinolate
[7] mean from table 1

Table 3

Quality factors for (a) samples of rapeseed with known wild mustard content and (b) Western rapeseed, 1982 harvest

Wild Mustard in Composite[1]	Oil Content (%)[2]	Protein Content (%)[3]	Fatty Acid Composition C22:1 (%)[4]	Fatty Acid Composition C18:3 (%)[4]	Fatty Acid Composition I.V. g/100 g	Glucosinolates (μM/g)[5] Aliphatic[6]	Glucosinolates (μM/g)[5] Sinalbin	Glucosinolates (μM/g)[5] Indolyl[7]
(a) Rapeseed with Wild Mustard								
1.6	43.8	42.4	0.7	9.9	113	21	4	11
5.5	43.5	42.0	1.1	10.8	116	20	15	10
7.5	43.5	41.5	0.6	10.5	116	17	17	11
11.5	42.2	41.2	0.9	10.9	117	16	22	8
11.0	42.5	40.1	1.3	10.1	114	18	27	10
15.0	40.9	39.7	1.5	11.3	117	19	41	8
15.0	40.0	40.3	1.8	12.1	119	14	46	8
19.0	40.4	41.1	1.1	11.8	119	13	45	10
42.5	33.3	41.2	3.0	15.1	126	7	78	5
33.5	36.7	40.5	1.8	13.0	121	8	65	6
(b) Rapeseed (1982 New Crop)								
W. Canada	45.0	40.3	1.2	11.4	117	24	-	10
Man.	44.4	42.2	0.5	9.9	114	17	-	10
Sask.	45.5	40.1	0.7	10.9	116	23	-	10
Alta.	44.8	39.5	2.0	12.7	120	28	-	10

[1] mean of two analyses by Canadian Grain Commission, Inspection Division
[2] dry basis
[3] oil-free, dry-basis
[4] % of total fatty acids
[5] oil-free, air-dried (about 6% moisture content)
[6] 3-butenyl, 4-pentenyl-, 2-hydroxy-3-butenyl- and 2-hydroxy-4-pentenyl
[7] 1-methoxy-3-indolylmethyl glucosinolate