Quality of western Canadian mustard

1999

Douglas R. DeClercq

Oilseeds Chemist

Grain Research Laboratory
Canadian Grain Commission
1404–303 Main Street
Winnipeg MB R3C 3G8
www.cgc.ca

Table of contents

Tables

Summary

The 1999 harvest survey shows, compared to 1998, both oriental and brown mustard have similar oil and protein content averages and yellow mustard has higher oil content but lower protein content averages. The glucosinolate content decreased slightly from the values in 1998 for oriental and brown mustard survey samples.

Introduction

This report presents information on the oil, protein and glucosinolate contents and the fatty acid composition of oriental (Brassica juncea), brown (B. juncea) and yellow (Sinapis alba) mustard grown throughout western Canada in 1999. The data are obtained from analyses of harvest survey samples collected by the Canadian Grain Commission's (CGC) Grain Research Laboratory (GRL).

Weather and production review

Weather review

The weather and crop review for the 1999 mustard harvest survey is based on information found in Saskatchewan Agriculture and Food's 1999 Specialty Crop Report. Detailed information on the seeding dates, growing and harvest conditions, along with production and yields by Saskatchewan crop districts can be found at:

http://www.agr.gov.sk.ca/research/stat_pubs/crop_prod/99specialtycrp.asp

Cool soil temperatures and strong winds limited seeding activity during April 1999. Dry conditions were alleviated by precipitation in late April and early May, but continued precipitation in the remainder of May saturated soils and delayed seeding operations, especially in southeast Saskatchewan. The delayed seeding and cool weather during the growing season, which further slowed development, put mustard crops from one to four weeks behind average. Harvest was a long, drawn out affair. Crops that were harvested early and when conditions were dry had good yields and good quality.

Production and grade information

As shown in Table 1, mustard seed production for 1999 has increased by 28% to 306 thousand metric tonnes. About 40% of western Canadian mustard production was the yellow type, followed by 35% oriental and 25% brown mustard. Saskatchewan accounted for 85% of western Canada's total seeded acreage and production of mustard. In Saskatchewan, the 1999 yield of 448 kg/acre was 17% above the ten-year average of 381 kg/acre and also above the 1998 yield of 343 kg/acre (Saskatchewan Agriculture and Food).

A high percentage—83%—of the 1999 Saskatchewan crop was expected to grade No.1 Canada, similar to 85% in 1998 and above the 78% average for the 1989–1998 period. Weathering and disease lowered the grade estimates of crops harvested later in 1999. There were reports that green seed levels were higher than last year in many of the mustard growing regions.

Table 1 ı Seeded area and production for the 1999 and 1998 crops of western Canadian mustard and average annual mustard production for the 10-year period 1989 to 1998

	Seeded area thousand hectares		Production thousand tonnes		Average production[2] thousand tonnes
	1999[1]	1998[2]	1999[1]	1998[2]	1989–98
Manitoba	2.8	4.0	1.9	3.4	6.4
Saskatchewan	236.6	234.8	259.7	195.5	166.4
Alberta	40.5	44.5	44.8	39.7	35.2
Western Canada	279.9	283.3	306.4	238.6	208.0

[1] Source—Field Crop Reporting Series, No. 8, December 3, 1999, Statistics Canada
[2] Source—Field Crop Reporting Series, No. 8, revised final estimates for 1989–98

Harvest survey samples

A total of 105 harvest survey samples for 1999 included 29 yellow mustard (S. alba), 47 oriental mustard (B. juncea) and 29 brown mustard (B. juncea). Over 79% of the 1999 harvest survey samples came from Saskatchewan.

Samples of mustard grown in 1999 were submitted to the GRL by producers, grain companies and elevators that routinely handle mustard seed. The individual samples were cleaned to remove dockage and graded by the CGC's Industry Services Division.

The oil, protein, and glucosinolate contents are determined on all individual whole seed samples using an NIRSystems 6500 scanning near infra-red spectrometer calibrated to and verified against the appropriate listed reference methods. The glucosinolate content of oriental and brown mustard are expressed as µmoles/g of allyl glucosinolate and mg/g of allyl isothiocyanate on a whole-seed, dry moisture basis. A molar mass of 99.16 g/mole for allyl isothiocyanate is used to convert µmoles of allyl glucosinolate (sinigrin) to mg/g of allyl isothiocyanate. Composite samples are used for fatty acid composition. See Oilseeds Methods.

Acknowledgments

The Grain Research Laboratory acknowledges the cooperation of the producers and grain companies for supplying the mustard samples, the assistance of the Industry Services Division of the Canadian Grain Commission for grading the individual survey samples and The Mustard Association for providing sources of samples. The technical assistance of the GRL staff, in particular Ken Howard, Michelle Kisilowsky, Barry Misener, and Bert Siemens is acknowledged.

Quality of 1999 harvest survey mustard

The oil, protein, and glucosinolate contents for yellow, brown and oriental mustard are summarized by grade in Table 2. The fatty acid compositions of the mustard oils are detailed in Table 3. A comparison of the 1999 quality data with the previous years' surveys is provided in Table 4. The means and standard deviations of the 1999 analytical data by grade and province can be found at http://www.cgc.ca/Quality/qualmenu-e.htm#Mustard

Quality of oriental and brown mustard

The oil content of harvest survey samples representing 1999 No.1 Canada oriental mustard increased 0.3% to 42.5% while the protein content decreased 0.3% to 25.9%. Both the oil and protein contents of samples representing No. 1 Canada brown mustard decreased 0.3% to give average contents of 40.0% oil and 25.6% protein. In 1999, slightly less allyl isothiocyanate was found in both the oriental mustard—12.3 mg/g—and brown mustard—10.1 mg/g—samples. The provincial and grade differences are detailed in the statistical tables for oriental and brown mustard. See below

http://www.cgc.ca/Quality/grlreports/Mustard/99MOriental-e.pdf

http://www.cgc.ca/Quality/grlreports/Mustard/99MBrown-e.pdf

The No. 1 Canada composites of the two B. juncea mustard oils had similar fatty acid compositions as shown in Table 3. The oriental mustard varieties showed some variation in oleic (C18:1), linoleic (C18:2), linolenic (C18:3) and erucic acid (C22:1) content. The 1999 erucic acid levels were 21.2% for oriental and 22.5% for brown mustard. The total saturated fatty acids were 6.0% for the brown and 6.1% for the oriental. These values are about 0.1% lower compared to the 1998 harvest survey.

Quality of yellow mustard

The harvest survey samples representing yellow mustard grown in 1999 had the characteristically lower oil content and higher protein content than oriental and brown mustards. For samples grading No. 1 Canada yellow mustard, oil content increased 1.5% to 32.2% while protein content decreased 0.6% to 30.5% as shown in Table 4. The provincial and grade differences are detailed in the statistical tables found at

http://www.cgc.ca/Quality/grlreports/Mustard/99MYellow-e.pdf

The yellow mustard oils contained higher amounts of oleic (C18:1) and erucic acid (C22:1) but lower amounts of linoleic (C18:2) acid compared to the oriental and brown mustard oils. The oil from 1999 No. 1 Canada yellow mustard seed had a mean erucic acid content of 36.3%, unchanged from the 36.3% in 1998. Total saturated fatty acids, at 5.1%, were 0.2% lower than those in 1998.

Table 2 ı Quality data for 1999 harvest survey mustard seed

Grade	No. of samples	Oil content[1]	Protein content[2]	Glucosinolates[3]	Glucosinolates[3]
		%	%	µmol/g	mg/g
Oriental					
No. 1 Canada	36	42.5	25.9	124	12.3
No. 2 Canada	7	42.1	27.4	118	11.7
No. 3 Canada	2	44.1	24.5	120	11.9
Sample Canada	2	44.7	24.0	114	11.3
Brown					
No. 1 Canada	22	40.0	25.6	102	10.1
No. 2 Canada	3	39.4	25.7	105	10.4
No. 3 Canada	3	41.0	25.0	101	10.0
Sample Canada	1	41.9	22.5	82	8.1
Yellow					
No. 1 Canada	20	32.2	30.5		
No. 2 Canada	4	31.9	30.5		
No. 3 Canada	1	33.5	28.1		
No. 4 Canada	2	33.8	27.3		
Sample Canada	2	33.1	28.3		

[1] Dry matter basis
[2] N x 6.25; dry matter basis
[3] Allyl glucosinolate (µmoles/g) and allyl isothiocyanate (mg/g); dry matter basis

Table 3 ı Fatty acid composition for the 1999 harvest survey mustard

		Fatty acid composition, %[1]								
	N	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C20:2
Oriental No. 1										
Saskatchewan	29	2.9	0.2	1.5	22.7	22.1	12.4	0.9	12.6	1.2
Alberta	7	2.9	0.2	1.5	21.8	21.1	12.7	0.9	12.9	1.3
Oriental No. 2	7	2.7	0.2	1.4	19.1	21.2	13.6	0.9	12.7	1.4
Oriental No. 3	2	2.7	0.2	1.4	19.4	20.7	13.1	0.9	13.2	1.3
Cutlass all	4	2.7	0.3	1.5	20.5	19.9	13.2	0.9	13.3	1.3
Forge all	11	2.9	0.2	1.6	23.8	22.8	12.4	1.0	12.4	1.3
Brown No. 1										
Saskatchewan	18	2.9	0.3	1.5	21.0	20.7	13.6	0.9	12.9	1.2
Alberta	4	2.9	0.3	1.4	20.6	21.2	13.6	0.9	12.7	1.2
Brown No. 2	3	2.9	0.3	1.4	20.6	21.0	13.6	0.9	12.7	1.2
Brown No. 3	3	2.9	0.3	1.4	20.7	21.0	13.9	0.9	12.7	1.2
Yellow No. 1										
Manitoba	1	2.6	0.2	1.0	23.6	9.8	10.5	0.7	10.6	0.4
Saskatchewan	11	2.6	0.2	1.0	24.3	9.3	10.5	0.7	11.0	0.4
Alberta	8	2.5	0.2	1.0	24.9	8.9	10.2	0.7	11.3	0.4
Yellow No. 2	4	2.5	0.2	1.0	24.7	9.2	10.6	0.7	11.0	0.3

[1] Percentage of total fatty acids including: palmitic (C16:0), palmitoleic (C16:1), stearic (C18:0), oleic (C18:1), linoleic (C18:2), linolenic (C18:3), arachidic (C20:0), gadoleic (C20:1), eicosadienoic (C20:2), behenic (C22:0), erucic (C22:1), docosadienoic (C22:2), nervonic (C24:0), and lignoceric (C24:1)

[2] Saturated fatty acids are defined as the sum of C16:0, C18:0, C20:0, C22:0, and C24:0.

Table 3 ı Fatty acid composition for the 1999 harvest survey mustard (continued)

		Fatty acid composition, %[1]						
	N	C22:0	C22:1	C22:2	C24:0	C24:1	Saturated fatty acids[2]	Iodine value
Oriental No. 1								
Saskatchewan	29	0.5	20.7	0.4	0.3	1.4	6.1	119
Alberta	7	0.5	21.7	0.4	0.3	1.5	6.1	118
Oriental No. 2	7	0.5	23.6	0.5	0.3	1.7	5.8	120
Oriental No. 3	2	0.5	23.7	0.8	0.3	1.6	5.8	119
Cutlass, all	4	0.5	23.3	0.4	0.3	1.6	5.9	118
Forge, all	11	0.4	18.8	0.4	0.2	1.3	6.3	119
Brown No. 1								
Saskatchewan	18	0.5	22.5	0.4	0.2	1.3	6.0	119
Alberta	4	0.5	22.5	0.4	0.3	1.3	6.0	120
Brown No. 2	3	0.5	22.6	0.4	0.3	1.3	6.0	119
Brown No. 3	3	0.4	22.4	0.4	0.2	1.3	6.0	120
Yellow No. 1								
Manitoba	1	0.5	36.7	0.3	0.3	2.5	5.1	103
Saskatchewan	11	0.5	36.3	0.3	0.3	2.3	5.1	102
Alberta	8	0.5	36.2	0.3	0.3	2.3	5.1	101
Yellow No. 2	4	0.5	35.9	0.3	0.3	2.4	5.1	102

[1] Percentage of total fatty acids including: palmitic (C16:0), palmitoleic (C16:1), stearic (C18:0), oleic (C18:1), linoleic (C18:2), linolenic (C18:3), arachidic (C20:0), gadoleic (C20:1), eicosadienoic (C20:2), behenic (C22:0), erucic (C22:1), docosadienoic (C22:2), nervonic (C24:0), and lignoceric (C24:1)

[2] Saturated fatty acids are defined as the sum of C16:0, C18:0, C20:0, C22:0, and C24:0.

Table 4 ı Quality data of western Canadian mustard from GRL surveys

Grade	Year	No. of samples	Oil content[1]	Protein content[2]	Glucosinolates[3]	Glucosinolates[3]
			%	%	µmol/g	mg/g
			Oriental			
No. 1 Canada	1999	36	42.5	25.9	124	12.3
	1998	102	42.2	26.2	129	12.8
	1989-98	713	42.3	26.3	116	11.5
No. 2 Canada	1999	7	42.1	27.4	118	11.7
	1998	2	44.8	24.6	115	11.4
	1989-98	70	42.0	26.9	113	11.1
No. 3 Canada	1999	2	44.1	24.5	120	11.9
	1998	2	45.2	23.0	117	11.6
	1989-98	48	42.0	26.4	117	11.6
			Brown			
No. 1 Canada	1999	22	40.0	25.6	102	10.1
	1998	93	40.3	25.9	105	10.4
	1989-98	582	40.1	26.2	97	9.6
No. 2 Canada	1999	3	39.4	25.7	105	10.4
	1998	8	39.5	26.1	103	10.2
	1989-98	15	38.0	28.1	104	10.3
No. 3 Canada	1999	3	41.0	25.0	101	10.0
	1998	9	38.3	27.0	109	10.8
	1989-98	79	38.8	26.8	100	9.9
			Yellow			
No. 1 Canada	1999	20	32.2	30.5		
	1998	92	30.7	31.1		
	1989-98	554	31.3	31.1		
No. 2 Canada	1999	4	31.9	30.5		
	1998	14	30.9	31.9		
	1989-98	92	30.6	32.0		
No. 3 Canada	1999	1	33.5	28.1		
	1998	4	32.6	29.7		
	1989-98	48	31.5	31.3		

[1] Dry matter basis
[2] N x 6.25; dry matter basis
[3] Allyl glucosinolate (µmoles/g) and allyl isothiocyanate (mg/g); dry matter basis

Methods

Chlorophyll content

Chlorophyll content is determined by International Organization for Standardization method reference number ISO 10519:1992(E), Rapeseed—Determination of chlorophyll content—Spectrometric method. Results are expressed as milligrams per kilogram (mg/kg), seed basis.

Fatty acid composition

Fatty acid composition is determined by the International Organization for Standardization method reference number ISO 5508:1990 (E), Animal and vegetable fats and oils—Analysis by gas chromatography of methyl esters of fatty acids. A 15m by 0.32mm column with a 0.25µm Supelcowax 10 coating is used. Major and important fatty acids are reported although samples may also contain as much as 1% of other minor fatty acids which are included in the calculations.

Free fatty acid content

Free fatty acid content is determined by a method adapted from the procedure of Ke et al, *Analytica Chemica Acta* 99:387–391 (1978), and is expressed as a percentage by weight of fatty acid of a specified molecular weight in the oil. Oleic acid with a molecular weight of 282 is used.

Glucosinolate content

Glucosinolate content is determined by International Organization for Standardization method reference number ISO 9167-391(E), Rapeseed—Determination of glucosinolate content—Part 1: Method using high performance liquid chromatography. Results are total seed glucosinolates expressed as micromoles per gram (µmol/g), calculated to an 8.5% moisture basis for canola and on a dry matter basis for all mustard seeds.

Iodine value

Iodine value is a measure of unsaturation calculated from the fatty acid composition according to AOCS Recommended Practice Cd 1c-85 as re-approved 1993 and updated 1995, Calculated Iodine Value.

Oil content

Oil content is determined by nuclear magnetic resonance (NMR) according to the International Organization for Standardization, reference number ISO 10565:1998(E) Oilseeds—Simultaneous determination of oil and moisture contents—Method using pulsed nuclear magnetic resonance spectroscopy. A Bruker NMS 110 Minispec NMR Analyzer calibrated with the appropriate oilseed samples extracted with petroleum ether is used. Results are reported as percentage, calculated to a specified moisture basis. Canola is calculated to an 8.5% moisture basis, and flaxseed, solin, soybean and all mustard seeds are calculated on a dry matter basis.

Protein content

Protein content is determined by the AOCS Official Method Ba 4e-93, revised 1995, Combustion method for determination of crude protein, using a LECO FP-428 Nitrogen and Food Protein Determinator. Results are reported as percentage, N x 6.25, calculated to specified moisture basis. Canola is calculated to an 8.5% moisture basis, and flaxseed, solin, soybean and all mustard seeds are calculated on a dry matter basis.