Canadian Grain Commission
Commission canadienne des grains

Quality of western Canadian mustard 2000

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Acknowledgments

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Summary

The 2000 harvest survey of western Canadian mustard shows oriental and brown mustard samples have lower fixed oil content and higher protein contents than in 1999. The glucosinolate contents of both oriental and brown mustard are slightly higher in 2000 compared to 1999.

Yellow mustard samples tested for the 2000 harvest survey also show lower oil content and higher protein content compared to yellow mustard tested in 1999.

Introduction

This report presents quality data and information based on the Canadian Grain Commission (CGC) harvest survey of oriental (*Brassica juncea*), brown (*B. juncea*) and yellow (*Sinapis alba*) mustard grown in western Canada in 2000. Quality data includes oil, protein and glucosinolate contents, and fatty acid composition of samples collected by the CGC.

Weather and production review

Weather review

The weather review for the 2000 harvest survey is provided by the Weather and Crop Surveillance department of the Canadian Wheat Board.

Seeding

Seeding on the Prairies in 2000 was completed in early June, and the average seeding date was approximately two weeks earlier than normal.

Early seeding was a welcome contrast to the delays experienced during seeding in 1999. Because of warmer than normal temperatures and dry conditions during April and the first half of May, seeding began early and was completed quickly, especially in Manitoba and Alberta. Close to half of the crop in Alberta and over three-quarters of the crop in Manitoba was in the ground by the second week of May. While seeding was slightly slower in Saskatchewan, it was nevertheless earlier than normal.

Soil moisture was significantly below normal in southern and eastern Alberta and western Saskatchewan due to a lack of precipitation during the fall and winter. Although parts of this area received precipitation in the second half of May, drought conditions persisted in southern Alberta and parts of western Saskatchewan throughout the growing season.

Growing conditions

Cooler temperatures during the second half of May and most of June slowed early crop development. Some of the benefits of early seeding were lost to slow growth during this period. Temperatures were 1–5°C below normal across the Prairies during the month of June. Cooler temperatures helped minimize crop stress in southern Alberta and western Saskatchewan.

Precipitation during June ranged from significantly above normal in the eastern Prairies to well below normal in southern Alberta. Dry regions of western Saskatchewan received rainfall during the month of June, considerably reducing the size of the area affected by drought. Remaining dry areas were concentrated in the west-central region of the province, where soil moisture levels only partially recovered.

Temperatures during July increased to near normal levels improving crop development. Frequent, heavy rainfall covered a good portion of the Prairies during July, with exceptional amounts reported in various locations in the eastern Prairies. While the cloudy weather that accompanied the rainfall slowed crop development slightly, crops were on average one week ahead of schedule by the end of the month. Rains during July caused concerns about disease development in crops, especially in the eastern growing areas. Southern Alberta, however, received only 3–7 mm of moisture during July. The dry weather combined with the warm temperatures caused significant stress to crops, eventually resulting in significantly lower than normal yields in the region. Scattered frosts during the middle of July in northeastern and east central Saskatchewan caused some damage to flowering oilseed and cereal crops.

Harvest conditions

The harvest began during the first two weeks in August in Manitoba and Alberta where crops were seeded early and matured quickly. Elsewhere in Alberta and southern Saskatchewan, most of the crops were not ready to harvest until the third week in September. Weather during September was poor for harvesting. Below normal temperatures, i.e., 1–2°C, and moderate to heavy rainfall persisted throughout the month. Particularly damaging was a heavy and widespread rainfall across the Prairies during the first weekend in September. Combined with damp conditions during the following weeks, it caused some cereal and oilseed crops to sprout. Severe frost during the third week in September caused some damage to crops in the Peace River region.

Production and grade information

As shown in Table 1, mustard seed production for 2000 decreased by 34% to 202 000 metric tonnes. About 50% of western Canadian production was the oriental type, followed by 26% yellow and 24% brown mustard. Saskatchewan accounted for 89% of western Canada's total seeded acreage and production of mustard. In Saskatchewan, the 2000 average yield of 407 kg/acre was similar to the 10-year (1990-99) average of 406 kg/acre but below the 1999 yield of 448 kg/acre.

An average percentage—79%—of the 2000 Saskatchewan mustard crop was expected to grade No. 1 Canada, compared to 83% in 1999 and 78% for the 1990–1999 period. Weathering and disease lowered the grade estimates of crops harvested later in 2000.

Detailed information on the seeding dates, growing and harvest conditions, along with production and yields by Saskatchewan crop districts are available from Saskatchewan Agriculture and Food at:

http://www.agr.gov.sk.ca/DOCS/reports/crop_report/crprpt001030.asp?firstPick=Reports&secondPick=Crop%20Report

Table 1 • Seeded area and production for western Canadian mustard

	Seeded area thousand hectares		Production thousand tonnes		Average production[2] thousand tonnes
	2000[1]	1999[2]	2000[1]	1999[2]	1990–99
Manitoba	4.0	2.8	3.3	1.9	5.5
Saskatchewan	188.1	236.6	185.1	259.7	187.8
Alberta	20.2	40.5	13.8	44.8	37.6
Western Canada	**212.3**	**279.9**	**202.2**	**306.4**	**230.8**

[1] Source—*Field Crop Reporting Series*, *No. 8*, December 5, 2000, Statistics Canada
[2] Source—*Field Crop Reporting Series*, *No. 8*, revised final estimates for 1990–99

Harvest survey samples

The Canadian Grain Commission (CGC) collected a total of 253 samples for the 2000 harvest survey, including 87 yellow mustard (*Sinapis alba*), 97 oriental mustard (*Brassica juncea*) and 69 brown mustard (*B. juncea*). Over 87% of the samples were grown in Saskatchewan, well in proportion with Saskatchewan's major role in mustard production.

Samples for the 2000 harvest survey were provided by producers, grain companies and elevators that routinely handle mustard seed. The CGC's Industry Services division cleaned the individual samples to remove dockage and graded all samples before analysis by the Grain Research Laboratory.

The Grain Research Laboratory tests whole-seed samples for oil, protein, and glucosinolate contents using an NIRSystems 6500 scanning near infra-red spectrometer calibrated to and verified against the appropriate listed reference methods. The glucosinolate contents 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.

Fatty acid composition is determined on composite samples prepared by combining all harvest survey samples of each grade of each mustard class and composites of samples identified as Cutlass (3) and Forge (11) varieties of oriental mustard.

Quality of western Canadian 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 2000 harvest survey with the previous years' quality data is provided in Table 4. The means and standard deviations of the analytical data by grade and by province are available at

http://www.cgc.ca/Quality/qualmenu-e.htm#Mustard

Quality of oriental and brown mustard

The 2000 harvest survey shows both oriental and brown mustard have lower oil content and higher protein content compared to 1999. Oil content of No. 1 Canada oriental mustard samples has decreased 0.6% to 41.9%, while protein content has increased 0.7% to 26.6%. Similarly, oil content of No. 1 Canada brown mustard has decreased 1.1% to 38.9% while the protein content has increased 0.7% to 26.3%.

Slightly more allyl isothiocyanate was found in both the oriental mustard (12.6 mg/g) and brown mustard (10.5 mg/g) harvest survey samples grown in 2000. Details of the provincial and grade differences may be examined in the statistical tables for oriental and brown mustard at

http://www.cgc.ca/Quality/qualmenu-e.htm#Mustard

The oils of the two *Brassica juncea* mustards—oriental and brown —show similar fatty acid compositions in their No. 1 Canada grade composites (Table 3). Erucic acid levels are 21.6% for oriental mustard and 22.3% for brown mustard. The total saturated fatty acids for the oriental and brown mustard samples are 6.3% and 6.4%, respectively. These saturated fatty acid values are 0.2 and 0.4 percentage units higher than their conterparts in 1999. The oriental mustard varieties Forge and Cutlass showed some differences in oleic (C18:1), linoleic (C18:2), and erucic acid (C22:1) content.

Quality of yellow mustard

Harvest survey samples of yellow mustard grown in 2000 show the characteristically lower oil content and higher protein content than oriental and brown mustards. Compared to yellow mustard grown in 1999, No. 1 Canada yellow mustard samples have decreased an average of 1.7% to 30.5% in oil content, while protein content has increased 1.2% to 31.7% (Table 4). Regional and grade differences in seed quality are detailed at

http://www.cgc.ca/Quality/qualmenu-e.htm#Mustard.

Yellow mustard oil from 2000 harvest survey samples contains higher amounts of oleic (C18:1) and erucic (C22:1) acids but lower amounts of linoleic (C18:2) and linolenic (C18:3) acids, compared to oriental and brown mustard oils. The oil from the 2000 No.1 Canada yellow mustard seed had a mean erucic acid content of 36.2%, similar to the 36.3% in 1999. Total saturated fatty acids at 5.2%, were 0.1% higher than those in 1999.

Table 2 • 2000 Harvest survey
Quality data of western Canadian mustard seed

Grade	No. of samples	Oil content[1]	Protein content[2]	Glucosinolates[3]	Glucosinolates[3]
		%	%	µmol/g	mg/g
Oriental					
No. 1 Canada	44	41.9	26.6	128	12.6
No. 2 Canada	21	41.7	27.1	129	12.8
No. 3 Canada	9	43.9	25.5	122	12.1
No. 4 Canada	9	42.4	26.7	120	11.9
Sample Canada	14	41.7	26.5	128	12.7
Brown					
No. 1 Canada	59	38.9	26.3	106	10.5
No. 2 Canada	1	38.9	26.3	103	10.2
No. 3 Canada	4	39.3	25.6	100	9.9
No. 4 Canada	2	40.7	24.2	99	9.8
Sample Canada	3	37.9	27.6	103	10.2
Yellow					
No. 1 Canada	34	30.5	31.7		
No. 2 Canada	19	30.1	32.6		
No. 3 Canada	9	29.8	32.5		
No. 4 Canada	13	29.9	32.7		
Sample Canada	12	31.8	30.5		

[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 • 2000 Harvest survey
Fatty acid composition of western Canadian 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	44	3.0	0.2	1.6	22.8	22.4	11.8	0.9	12.2	1.1
Oriental No. 2	21	2.9	0.2	1.5	21.5	22.3	12.2	0.9	12.4	1.1
Oriental No. 3	8	2.8	0.2	1.4	20.3	20.9	12.0	0.9	12.0	1.1
Oriental No. 4	9	2.9	0.2	1.5	20.8	21.5	12.2	0.9	12.9	1.1
Oriental Sample	14	2.9	0.2	1.5	22.2	22.4	11.8	0.9	11.8	1.1
Cutlass, No. 1	3	2.8	0.2	1.5	21.1	20.7	11.9	1.0	13.3	1.1
Forge, No. 1	11	3.0	0.2	1.6	24.1	23.5	11.6	0.9	12.1	1.1
Brown No. 1	59	3.1	0.2	1.5	21.7	21.3	12.7	1.0	12.8	1.0
Brown No. 2	1	3.1	0.2	1.6	21.0	21.6	12.7	1.0	12.7	1.0
Brown No. 3	4	3.2	0.3	1.5	21.0	21.8	13.2	0.9	12.5	1.0
Brown No. 4	2	3.1	0.2	1.5	21.8	21.0	12.8	1.0	13.0	1.0
Brown Sample	3	3.1	0.2	1.6	21.4	21.6	12.9	1.0	12.6	1.0
Yellow No. 1	34	2.6	0.2	1.0	25.1	9.4	10.0	0.7	11.1	0.3
Yellow No. 2	19	2.5	0.2	1.0	25.8	9.5	9.8	0.7	11.0	0.3
Yellow No. 3	9	2.7	0.2	1.1	25.3	9.7	10.1	0.7	11.0	0.3
Yellow No. 4	13	2.6	0.2	1.0	26.0	9.8	10.2	0.7	10.6	0.3
Yellow Sample	12	2.7	0.2	1.1	26.8	10.1	10.3	0.7	11.1	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), lignoceric (C24:0), and nervonic (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 • 2000 Harvest survey
Fatty acid composition of western Canadian 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	44	0.5	21.6	0.4	0.3	1.4	6.3	118
Oriental No. 2	21	0.5	22.0	0.5	0.3	1.4	6.2	118
Oriental No. 3	8	0.6	25.3	0.5	0.3	1.5	6.0	116
Oriental No. 4	9	0.5	23.0	0.5	0.3	1.5	6.1	117
Oriental sample	14	0.5	22.5	0.5	0.3	1.4	6.1	118
Cutlass, No. 1	3	0.5	23.5	0.5	0.3	1.4	6.1	116
Forge, No. 1	11	0.5	19.4	0.4	0.3	1.4	6.3	118
Brown No. 1	59	0.5	22.3	0.4	0.3	1.2	6.4	118
Brown No. 2	1	0.5	22.4	0.4	0.3	1.3	6.5	118
Brown No. 3	4	0.5	22.0	0.4	0.3	1.2	6.4	119
Brown No. 4	2	0.5	22.2	0.4	0.3	1.2	6.3	118
Brown sample	3	0.5	22.2	0.4	0.3	1.3	6.4	119
Yellow No. 1	34	0.6	36.2	0.3	0.3	2.3	5.2	101
Yellow No. 2	19	0.5	35.6	0.3	0.3	2.4	5.1	101
Yellow No. 3	9	0.6	35.5	0.3	0.3	2.3	5.3	102
Yellow No. 4	13	0.6	35.0	0.3	0.3	2.3	5.2	102
Yellow sample	12	0.5	33.4	0.3	0.3	2.1	5.4	103

[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), lignoceric (C24:0), and nervonic (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 • Western Canadian mustard
Quality data for harvest survey samples, 1990-2000

Grade	Year	No. of samples	Oil content[1]	Protein content[2]	Glucosinolates[3]	Glucosinolates[3]
			%	%	µmol/g	mg/g
Oriental						
No. 1 Canada	2000	44	41.9	26.6	128	12.6
	1999	36	42.5	25.9	124	12.3
	1990-99	693	42.7	26.0	117	11.6
No. 2 Canada	2000	21	41.7	27.1	129	12.8
	1999	7	42.1	27.4	118	11.7
	1990-99	44	42.6	26.5	112	1.2
No. 3 Canada	2000	9	43.9	25.5	122	12.1
	1999	2	44.1	24.5	120	11.9
	1990-99	34	42.8	25.8	116	11.5
Brown						
No. 1 Canada	2000	59	38.9	26.3	106	10.5
	1999	22	40.0	25.6	102	10.1
	1990-99	604	40.1	26.1	98	9.7
No. 2 Canada	2000	1	38.9	26.3	103	10.2
	1999	3	39.4	25.7	105	10.4
	1990-99	18	38.2	27.8	104	10.3
No. 3 Canada	2000	4	39.3	25.6	100	9.9
	1990	3	41.0	25.0	101	10.0
	1990-99	82	39.0	26.6	100	9.9
Yellow						
No. 1 Canada	2000	34	30.5	31.7		
	1999	20	32.2	30.5		
	1990-99	571	31.6	30.8		
No. 2 Canada	2000	19	30.1	32.6		
	1999	14	30.9	31.9		
	1990-99	4	31.9	30.5		
No. 3 Canada	2000	9	29.8	32.5		
	1999	1	33.5	28.1		
	1990-99	48	32.2	30.2		

[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 • Oilseeds

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 0.25mm 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 9167–1:1992(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 or 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 10565:1992(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 appropriate oilseed samples extracted with petroleum ether is used. Results are reported as a 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 a 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.