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Quality of western Canadian mustard 2008

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Introduction

This report presents information on the oil, protein and glucosinolate contents and the fatty acid composition of oriental (*Brassica juncea*), brown (*Brassica juncea*) and yellow (*Sinapis alba*) mustard grown in western Canada in 2008. The data were obtained from analyses of harvest survey samples collected by the Canadian Grain Commission (CGC).

Summary

Compared to 2007 means, all three types of mustard seed were significantly higher in fixed oil content and lower in crude protein content. Top grade oriental mustard had a fixed oil content of 42.0%, an increase of 4.4% from the 2007 value of 37.6%. Top grade brown mustard samples had a fixed oil content of 38.9%, a 2.4% increase from the 2007 value of 36.5%. Oriental and brown mustard samples had average protein contents of 27.1% and 27.5%, decreases of 1.5% and 0.2% from the 2007 values. Compared to 2007 values, the average glucosinolate content of the 2008 oriental and brown mustard samples decreased 19 and 1 micromoles per gram respectively. Compared to 2007, the yellow mustard survey samples were 3.0% higher in fixed oil at 30.1% and 1.7% lower in protein content at 32.0%.

Weather and production review

Weather review

Temperature and precipitation patterns for the 2008 western Canadian growing season can be found on the PFRA web site (http://www.agr.gc.ca/pfra/drought/mapscc_e.htm). The prairie provinces experienced cool spring weather to start the 2008 growing year. A cooler and wetter than normal growing period characterized much of the south, while some northern regions experienced near drought like conditions. The Weather and Crop Surveillance department of the Canadian Wheat Board provided the majority of the detailed weather review for the 2008 crop year.

Seeding

The early spring season was characterized by very cool temperatures which delayed planting in the south and slowed the snowmelt in the northern growing areas. Cool soil temperatures delayed crop germination and early seeded regions reported poor crop emergence. Moderate to heavy precipitation fell in the southern growing regions during the late-April to mid-May period, which provided much needed moisture for the seeding and germination of the crop. Northern areas of the Prairies were mostly dry, which allowed regions that had received heavy snowfall to plant most of the crop by the end of May. The dry trend in the northern growing areas persisted through the first half of growing season.

Growing conditions

Precipitation during June was close to normal or above normal in most of the Prairie region, which helped boost crop prospects. Temperatures during the month of May and June were significantly below normal, which delayed crop development. By the end of June, growth was 10 days to two weeks behind normal, but the crop condition was rated as mostly good to excellent. In July, moderate temperatures were reported, with many stations in the western Prairies reporting monthly averages that were 2 to 5 degrees Celsius below those received in July 2007. The cooler temperatures allowed crops to move through the reproductive stage without significant stress. Dry conditions persisted in the northern growing areas during July and caused some crop deterioration. The Peace River region of Alberta and British Columbia was dry throughout the month, with above normal temperatures that caused significant crop stress and significantly reduced yield expectations. In northern areas of Alberta and Saskatchewan, the cooler than normal temperatures in July helped maintain crop conditions until rains arrived in late July and early August.

Harvest conditions

Above normal temperatures were reported in August across the Prairies, which helped boost crop development. However, frost and crop damage were reported during the month in parts of Alberta and western Saskatchewan. Warmer temperatures allowed the harvest of the canola crop to begin by the first week of September. Persistent rains in the last week of August and the first ten days of September slowed the harvest. Temperatures remained mild during September, with many areas reporting their first fall frost one to two weeks later than normal. This allowed late developing crops to mature without significant quality damage. Drier and warmer conditions returned to the entire Prairie region during the mid-September to mid-October period, which allowed for a rapid completion of the harvest. Approximately 98% of the western Canadian mustard crop was harvested by October 5, 2008.

Production and grade information

As shown in Table 1, mustard seed production for 2008 increased by 41% to 161.0 thousand metric tonnes as a result of increased planted area and higher than average yields. About 44% of western Canadian mustard production was estimated to be the yellow type, followed by 42% brown and 14% oriental mustard. Saskatchewan accounted for 77% of western Canada's total seeded acreage and production of mustard. According to *Saskatchewan Agriculture and Food*, the 2008 Saskatchewan yield of 770 lb/acre (349 kg/acre) was above the ten-year (1998-2007) average of 739 lb/acre (335 kg/acre) and 40% above the 2007 yield of 550 lb/acre (249 kg/acre). Detailed information on production factors and yields for Saskatchewan crop districts can be found at: http://www.agr.gov.sk.ca/DOCS/crops/special_crops/production_information/specialtycroprpt.asp

Saskatchewan Agriculture and Food estimated 83% of the 2008 Saskatchewan mustard crop graded No. 1 Canada, compared to 73% in 2007 and 73% for the 1998–2007 period. The good harvest conditions, particularly in southern Saskatchewan and Alberta, produced a mustard crop with less visible damage than in 2004, a frost year. Compared to the 2007 CGC survey results there were notably less yellow mustard samples in the lower grades.

Table 1 – Seeded area and production for western Canadian mustard

	Seeded area[1]	Seeded area[2]	Production[1]	Production[2]	Mean production[2]
Region	2008	2007	2008	2007	1998-2007
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba	n/a	n/a	n/a	n/a	3.5
Saskatchewan	149.7	141.6	123.9	87.3	162.4
Alberta	44.5	34.4	37.1	27.0	29.8
Western Canada	**194.2**	**176.0**	**161.0**	**114.3**	**192.5**

[1] *Field Crop Reporting Series No. 8,* December 2008; Statistics Canada
[2] *Field Crop Reporting Series No. 8*, revised estimates for 1998-2007

Harvest survey samples

The 288 samples from the 2008 mustard survey included 148 yellow mustard, 90 brown mustard and 50 oriental mustard. Approximately 80% of the 2008 harvest survey samples came from Saskatchewan.

Producers, grain companies and elevators that routinely handle mustard seed submitted samples of mustard grown in 2008 to the CGC. The individual samples were cleaned to remove dockage and graded by the CGC's Industry Services Division.

The oil, protein, and glucosinolate contents were determined on all individual whole seed samples using a 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. Composite samples were tested for fatty acid composition.

Quality of western Canadian mustard – 2008

The three mustard crops grown in western Canada in 2008 showed the general characteristics of a crop grown under generally cooler and wetter than normal conditions. The Grain Research Laboratory (GRL) long-term harvest survey results show that cool, moist growing conditions tend to produce an oilseed crop with higher oil contents and iodine values, but lower protein contents. Research also shows that glucosinolate levels may decrease when Brassica crops are grown under cooler conditions. Because mustard processors generally prefer lower fixed oils, the quality of the 2008 mustard crop might be considered less than ideal for some end-users.

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 2008 quality data with the previous years' surveys is provided in Table 4.

Quality of Domestic Mustard Seed, Canada, Oriental and Domestic Mustard Seed, Canada, Brown

In 2008, the average fixed oil content of the Oriental Mustard, No. 1 Canada samples increased 4.4% to 42.0% while the average crude protein content decreased by 1.5% to 27.1%. The fixed oil contents of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 36.6% to 46.7%. The protein content of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 23.0% to 30.2%.

In 2008, the average fixed oil content of Brown Mustard, No. 1 Canada samples increased 2.4% to 38.9% while the average crude protein content decreased by 0.2% to 27.5%. The fixed oil content of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 33.3% to 43.1%. The protein content of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 22.8% to 32.5%.

In 2008, the average glucosinolate contents for Oriental Mustard, No. 1 Canada samples decreased by 19 umol/g to 124 μmol/g while Brown Mustard, No. 1 Canada samples decreased by 1 umol/g to 113 umol/g. The glucosinolate contents of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 101 to 158 μmol/g. The glucosinolate contents of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 95 to 132 μmol/g.

Fatty acid compositions for the oriental and brown mustard composites are provided in Table 3. The 2008 average erucic acid level increased by 3.3% for Oriental Mustard, No. 1 Canada samples while Brown Mustard, No. 1 Canada samples increased by 1.2%. The average 2008 erucic acid values of 22.8% and 23.8% for oriental and brown mustards are typical of *Brassica juncea* condiment mustards. The oriental mustard variety Forge showed some differences in oleic (C18:1), linoleic (C18:2), and erucic acid (C22:1) content compared to the variety Cutlass.

The total saturated fatty acids for the Oriental and Brown, No.1 Canada composites were 5.9% and 5.9% respectively; about 0.9% and 0.6% lower than last year's respective values. The 2008 mustard composites had increased levels of linolenic acid and decreased levels of oleic acid. As a result, the iodine value, an indicator of oil unsaturation, will be higher in 2008 mustard samples.

The plant's objective in making the oil unsaturated is to give a more liquid (*i.e.* unsaturated) oil at lower temperatures. To do this, the plants have evolved mechanisms in the form of enzyme systems that are more active in making the oil unsaturated when the weather is cool and less active when it is hot. The cooler temperatures in 2008 resulted in shifts in the overall fatty acid profiles.

Quality of Domestic Mustard Seed, Yellow

The yellow mustard had the characteristically lower oil content and higher protein content than oriental and brown mustards. For Yellow Mustard, No. 1 Canada samples, the average fixed oil content increased 3.0% to 30.1% while average crude protein content decreased 1.7% to 32.0% (Table 4). The fixed oil contents of Yellow Mustard, No. 1 Canada samples from producers in western Canada ranged from 23.7% to 35.3%. The crude protein content of Yellow Mustard, No. 1 Canada samples from producers in western Canada ranged from 27.1% to 37.9%.

Fixed oil in yellow mustard contained higher amounts of oleic (C18:1) and erucic acid (C22:1) but lower amounts of linoleic (C18:2) and linolenic (C18:3) acid compared to the oriental and brown mustard oils. The oil from the 2008 Yellow Mustard, No.1 Canada seed had a mean erucic acid content of 36.1% compared to the 34.1% in 2007. Total saturated fatty acids, at 4.9%, were 0.6% lower than the 5.5% in 2007.

Table 2 – Quality of 2008 western Canadian mustard

Grade	No. of samples	Oil content[1]	Protein content[2]	Glucosinolate content[3]	
		%	%	μmol/g	mg/g
Domestic Mustard Seed, Canada, Oriental					
No. 1	40	42.0	27.1	124	12.3
No. 2	6	41.1	28.1	133	13.2
No. 3	1	37.9	29.1	138	13.6
No. 4	2	41.2	27.3	128	12.6
Sample	1	43.7	26.3	146	14.5
Domestic Mustard Seed, Canada, Brown					
No. 1	73	38.9	27.5	113	11.2
No. 2	3	41.6	25.1	104	10.3
No. 3	1	40.1	27.6	120	11.9
No. 4	2	39.0	27.7	119	11.8
Sample	11	40.4	25.5	100	9.9
Domestic Mustard Seed, Canada, Yellow					
No. 1	108	30.1	32.0	—	—
No. 2	21	29.7	32.4	—	—
No. 3	3	32.3	29.9	—	—
No. 4	10	31.6	30.5	—	—
Sample	6	31.5	31.4	—	—

[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 3a – Fatty acid composition of 2008 western Canadian mustard

Category	No. of samples	Fatty acid composition (%)[1]								
		C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1	C20:2
Domestic Mustard Seed, Canada, Oriental										
No. 1										
Saskatchewan	33	2.6	0.1	1.5	21.2	21.2	11.8	0.9	13.0	1.1
Alberta	5	2.7	0.1	1.5	23.3	22.1	11.9	0.9	12.7	1.1
No. 2	6	2.6	0.1	1.3	19.3	20.3	12.5	0.9	13.1	1.2
No. 3	1	3.0	0.1	1.5	24.7	23.9	10.6	0.9	12.2	1.0
No. 4	2	2.7	0.1	1.5	22.6	21.9	11.7	0.9	12.8	1.1
Sample	1	2.5	0.1	1.4	19.6	20.2	12.8	0.9	13.3	1.1
Cutlass , No. 1	21	2.5	0.1	1.4	20.2	20.4	12.1	1.0	13.3	1.1
Forge , No. 1	15	2.8	0.1	1.6	24.1	22.9	11.2	0.9	12.4	1.0
Domestic Mustard Seed, Canada, Brown										
No. 1										
Manitoba	2	2.7	0.2	1.5	20.1	20.6	13.5	0.9	12.7	1.0
Saskatchewan	50	2.8	0.2	1.3	20.1	20.4	13.0	0.9	13.0	1.1
Alberta	14	2.7	0.2	1.4	21.0	20.1	13.1	1.0	13.2	1.0
No. 2	3	2.7	0.2	1.4	21.1	20.3	13.2	0.9	13.2	1.0
No. 3	1	2.7	0.2	1.3	19.1	20.8	14.6	0.9	12.1	1.1
No. 4	2	2.7	0.2	1.3	19.1	20.5	13.7	0.9	12.8	1.2
Sample	10	2.8	0.2	1.4	21.9	20.4	13.1	0.9	12.8	1.0
Centennial, No. 1	21	2.8	0.2	1.2	19.3	20.1	13.3	0.9	13.3	1.2
Common, No. 1	9	2.8	0.2	1.4	20.5	20.9	12.7	1.0	12.8	1.1
Duchess, No. 1	17	2.7	0.2	1.4	21.1	20.3	13.0	1.0	13.0	1.0
Domestic Mustard Seed, Canada, Yellow										
No. 1										
Manitoba	1	2.4	0.2	0.9	21.6	9.2	10.2	0.6	10.6	0.3
Saskatchewan	74	2.4	0.2	1.0	24.7	9.1	10.4	0.7	11.4	0.3
Alberta	26	2.4	0.2	1.0	23.7	8.9	11.0	0.7	11.4	0.3
No. 2	20	2.5	0.2	1.0	24.4	9.1	10.7	0.7	11.4	0.3
No. 3	3	2.4	0.2	1.0	24.9	8.9	10.6	0.7	11.3	0.3
No. 4	9	2.5	0.2	1.0	24.4	9.1	10.6	0.7	11.2	0.3
Sample	6	2.5	0.2	1.0	25.3	9.6	10.6	0.7	10.8	0.3
AC Pennant , No. 1	21	2.4	0.2	1.0	24.2	8.9	10.5	0.7	11.3	0.3
Andante, No. 1	47	2.4	0.2	1.0	24.3	9.1	10.5	0.7	11.4	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), eicosenoic (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 3b – Fatty acid composition of 2008 western Canadian mustard

Category	No. of samples	Fatty acid composition (%)[1]					Saturated fatty acids[2]	Iodine value
		C22:0	C22:1	C22:2	C24:0	C24:1	%	units
Domestic Mustard Seed, Canada, Oriental								
No. 1								
Saskatchewan	33	0.5	23.1	0.5	0.3	1.5	5.9	116
Alberta	5	0.5	20.7	0.4	0.3	1.4	5.9	118
No. 2	6	0.5	24.9	0.5	0.3	1.6	5.7	117
No. 3	1	0.5	19.0	0.4	0.3	1.3	6.3	117
No. 4	2	0.5	21.5	0.4	0.3	1.4	5.9	117
Sample	1	0.5	24.7	0.5	0.3	1.5	5.6	117
Cutlass, No. 1	21	0.5	24.4	0.5	0.3	1.5	5.7	116
Forge, No.1	15	0.5	19.8	0.4	0.3	1.3	6.1	117
Domestic Mustard Seed, Canada, Brown								
No. 1								
Manitoba	2	0.5	23.6	0.4	0.3	1.4	5.9	119
Saskatchewan	50	0.5	23.9	0.5	0.3	1.4	5.9	118
Alberta	14	0.5	23.4	0.4	0.3	1.3	5.8	118
No. 2	3	0.5	23.2	0.4	0.3	1.3	5.8	118
No. 3	1	0.4	24.1	0.4	0.2	1.5	5.6	121
No. 4	2	0.5	24.1	0.5	0.3	1.5	5.7	119
Sample	10	0.5	22.4	0.4	0.3	1.2	5.9	118
Centennial, No. 1	21	0.5	24.2	0.5	0.3	1.5	5.7	118
Common, No. 1	9	0.5	23.5	0.4	0.3	1.3	6.0	117
Duchess, No. 1	17	0.5	23.3	0.4	0.3	1.3	5.9	117
Domestic Mustard Seed, Canada, Yellow								
No. 1								
Manitoba	1	0.6	39.8	0.3	0.3	2.4	4.9	101
Saskatchewan	74	0.6	35.9	0.3	0.3	2.3	4.9	102
Alberta	26	0.6	36.6	0.3	0.3	2.3	4.9	102
No. 2	20	0.6	35.9	0.3	0.3	2.3	4.9	102
No. 3	3	0.5	35.9	0.3	0.3	2.2	4.9	102
No. 4	9	0.6	36.1	0.3	0.3	2.3	5.0	102
Sample	6	0.5	35.4	0.3	0.3	2.2	5.0	102
ACPennant, No. 1	21	0.6	36.6	0.3	0.3	2.3	4.9	102
Andante, No. 1	47	0.6	36.0	0.3	0.3	2.3	5.0	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), eicosenoic (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 – Quality of western Canadian mustard from CGC surveys

Year	No. of samples	Oil content[1]	Protein content[2]	Glucosinolate content[3]	
		%	%	μmol/g	mg/g
Domestic Mustard Seed, No. 1 Canada, Oriental					
2008	40	42.0	27.1	124	12.3
2007	73	37.6	28.6	143	14.2
1998-07	602	41.5	26.8	131	13.0
Domestic Mustard Seed, No. 2 Canada, Oriental					
2008	6	41.1	28.1	133	13.2
2007	14	36.4	29.8	146	14.4
1998-07	95	41.8	27.0	130	12.9
Domestic Mustard Seed, No. 3 Canada, Oriental					
2008	1	37.9	29.1	138	13.6
2007	1	42.1	28.2	133	13.1
1998-07	34	43.0	26.2	126	12.5
Domestic Mustard Seed, No. 1 Canada, Brown					
2008	73	38.9	27.5	113	11.2
2007	90	36.5	27.7	114	11.3
1998-07	655	39.5	26.3	108	10.7
Domestic Mustard Seed, No. 2 Canada, Brown					
2008	3	41.6	25.1	104	10.3
2007	8	36.4	27.4	113	11.2
1998-07	45	38.5	27.1	110	10.9
Domestic Mustard Seed, No. 3 Canada, Brown					
2008	1	40.1	27.6	120	11.9
2007	1	30.8	32.4	125	12.4
1998-07	32	38.4	26.9	110	10.9
Domestic Mustard Seed, No. 1 Canada, Yellow					
2008	108	30.1	32.0	—	—
2007	113	27.1	33.7	—	—
1998-07	741	30.1	32.3	—	—
Domestic Mustard Seed, No. 2 Canada, Yellow					
2008	21	29.7	32.4	—	—
2007	24	27.0	34.0	—	—
1998-07	194	30.5	32.1	—	—
Domestic Mustard Seed, No. 3 Canada, Yellow					
2008	3	32.3	29.9	—	—
2007	14	28.0	32.4	—	—
1998-07	85	30.8	31.6	—	—

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