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Quality of western Canadian mustard 2007

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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 2007. The data were obtained from analyses of harvest survey samples collected by the Canadian Grain Commission (CGC).

Summary

Compared to the ten-year means, all three types of mustard seed were significantly lower in fixed oil content and higher in crude protein content. Both the oriental and brown mustard survey samples in 2007 had lower average fixed oils and higher protein contents compared to the 2006 values. Top grade oriental mustard had a fixed oil content of 37.6%, a decrease of 4.2% from the 2006 value of 41.8%. Top grade brown mustard samples had a fixed oil content of 36.5%, a 3.7% decrease from the 2006 value of 40.2%. Oriental and brown mustard samples had average protein contents of 28.6% and 27.7%, increases of 2.4% and 1.7% from the 2006 values. Compared to 2006 values, the average glucosinolate content of the 2007 oriental and brown mustard samples increased 12 and 6 micromoles per gram respectively. Compared to 2006, the yellow mustard survey samples were 3.4% lower in fixed oil at 27.1% and 1.9% higher in protein content at 33.7%.

Weather and production review

Weather review

Temperature and precipitation patterns for the 2007 western Canadian growing season can be found on the PFRA web site (http://www.agr.gc.ca/pfra/drought/drmaps_e.htm). The prairie provinces experienced wet spring weather to start the 2007 growing year. A drier and warmer than normal growing period eventually stressed many crops in the south, but also allowed for quicker crop maturity and an earlier than normal harvest. The Weather and Crop Surveillance department of the Canadian Wheat Board provided the majority of the detailed weather review for the 2007 crop year.

Seeding

Central Alberta and north-eastern Saskatchewan received heavy rains during the spring planting season which resulted in significant reduction in sown area. Late planting was also common in these areas, with significant acreage switched to earlier maturing crops. Planting in the northern areas wrapped-up during the first weeks of June, with significant cropped area left fallow in certain areas. The southern Prairies, conversely, were dry during the spring, which resulted in early planting in the region. The dryness also raised concerns about poor soil moisture levels, which have persisted since the 2006 growing season in the southern Prairies. Planting conditions in Manitoba were good across the province, with early planting reported in all areas except the north-western region.

Growing conditions

Precipitation during June was close to normal or above normal in most of the Prairie region, except in the southern areas of Alberta and Saskatchewan. These areas received enough moisture during June to sustain crop growth, but not enough to add to subsoil moisture reserves. Crop conditions at the end of June were mostly good to excellent. Above normal temperatures moved into the western areas of the Prairies during early July and migrated to eastern regions by the middle of the month. Temperature records were set in a number of locations in Alberta and Saskatchewan during July. The hot, dry conditions reduced yield expectations, especially in the southern growing areas of Alberta and Saskatchewan. In northern areas, the hot weather did help boost the development of crops that had been seeded later than normal. Cooler weather returned to the Prairies by the middle of August, with some scattered frosts reported in Alberta and Saskatchewan before the end of the month. The dry, hot conditions during July did help keep disease levels in check in most areas.

Harvest conditions

Mustard harvesting started during early August and was complete in the southern Prairies by the middle of September, due to mostly dry weather during the month of August. Central and northern areas of the Prairies received cooler temperatures and more rainfall during August and September, which caused some harvesting delays. Over 90% of the Saskatchewan mustard crop was harvested by September 23, 2007.

Production and grade information

As shown in Table 1, mustard seed production for 2007 increased by 5% to 114.3 thousand metric tonnes as a result of increased planted area but lower than average yields. About 50% of western Canadian mustard production was estimated to be the yellow type, followed by 35% brown and 15% oriental mustard. Saskatchewan accounted for 80% and 76% respectively of western Canada's total seeded acreage and production of mustard. According to *Saskatchewan Agriculture and Food*, the 2007 Saskatchewan yield of 550 lb/acre (249 kg/acre) was significantly below the ten-year (1997-2006) average of 758 lb/acre (344 kg/acre) and 21% below the 2006 yield of 700 lb/acre (318 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 73% of the 2007 Saskatchewan mustard crop graded No. 1 Canada, compared to 84% in 2006 and 74% for the 1997–2006 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. However, compared to the 2006 CGC survey results there were slightly more yellow mustard samples in the lower grades.

Table 1 – Seeded area and production for western Canadian mustard

Region	Seeded area ¹	Seeded area ²	Production ¹	Production ²	Mean production ²
	2007	2006	2007	2006	1997-2006
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba	n/a	n/a	n/a	n/a	4.1
Saskatchewan	141.6	108.6	87.3	82.6	172.3
Alberta	34.4	25.2	27.0	25.6	32.1
Western Canada	176.0	133.8	114.3	108.2	208.6

¹ *Field Crop Reporting Series No. 8*, December, 2007; Statistics Canada

² *Field Crop Reporting Series No. 8*, revised estimates for 1997-2006

Harvest survey samples

The 379 samples from the 2007 mustard survey included 183 yellow mustard, 102 brown mustard and 94 oriental mustard. Over 79% of the 2007 harvest survey samples came from Saskatchewan.

Producers, grain companies and elevators that routinely handle mustard seed submitted samples of mustard grown in 2007 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 $\mu\text{moles/g}$ 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 – 2007

The three mustard crops grown in western Canada in 2007 showed the general characteristics of a crop grown under generally drier and warmer than normal conditions. Some of the southern regions of the mustard growing area received very hot, dry weather in July which contributed to much lower fixed oils, higher crude proteins and higher glucosinolate levels in those regions. The Grain Research Laboratory (GRL) long-term harvest survey results show that hot, dry growing conditions tend to produce an oilseed crop with lower oil contents and iodine values, but higher protein contents. Research also shows that glucosinolate levels may increase when Brassica crops are grown under hot, dry conditions. Because mustard processors generally prefer lower fixed oils, the quality of the 2007 mustard crop should be very good for 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 2007 quality data with the previous years' surveys is provided in Table 4. The means and standard deviations of the 2007 analytical data by grade and province can be found at <http://www.grainscanada.gc.ca/Quality/Mustard/mustardmenu-e.htm>

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

In 2007, the average fixed oil content of the Oriental Mustard, No.1 Canada samples decreased 4.2% to 37.6% while the average crude protein content increased by 2.4% to 28.6%. The fixed oil contents of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 29.6% to 43.8%. The protein content of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 23.7% to 33.7%.

In 2007, the average fixed oil content of Brown Mustard, No. 1 Canada samples decreased 3.7% to 36.5% while the average crude protein content increased by 1.7% to 27.7%. The fixed oil content of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 29.1% to 42.7%. The protein content of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 23.3% to 34.7%.

In 2007, the average glucosinolate contents for Oriental Mustard, No. 1 Canada samples increased by 12 $\mu\text{mol/g}$ to 143 $\mu\text{mol/g}$ while Brown Mustard, No. 1 Canada samples increased by 6 $\mu\text{mol/g}$ to 114 $\mu\text{mol/g}$. The glucosinolate contents of Oriental Mustard, No. 1 Canada samples from producers in western Canada ranged from 115 to 166 $\mu\text{mol/g}$. The glucosinolate contents of Brown Mustard, No. 1 Canada samples from producers in western Canada ranged from 102 to 135 $\mu\text{mol/g}$. The provincial and grade differences are detailed in the statistical tables for oriental and brown mustard:
<http://www.grainscanada.gc.ca/Quality/Mustard/mustardmenu-e.htm>

Fatty acid compositions for the oriental and brown mustard composites are provided in Table 3. The 2007 average erucic acid level decreased by 1.1% for Oriental Mustard, No. 1 Canada samples while Brown Mustard, No. 1 Canada samples remained the same. The average 2007 erucic acid values of 19.5% and 22.6% 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 6.8% and 6.5% respectively; about 0.6% higher than last year's values. The 2007 mustard composites had decreased levels of linolenic acid and increased levels of oleic acid. As a result, the iodine value, an indicator of oil unsaturation, will be lower in 2007 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. A return to very warm temperatures in 2007 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 decreased 3.4% to 27.1% while average crude protein content increased 1.9% to 33.7% (Table 4). The fixed oil contents of Yellow Mustard, No. 1 Canada samples from producers in western Canada ranged from 22.2% to 32.6%. The crude protein content of Yellow Mustard, No. 1 Canada samples from producers in western Canada ranged from 27.8% to 40.3%. Regional and grade differences in seed quality are detailed at: <http://www.grainscanada.gc.ca/Quality/Mustard/mustardmenu-e.htm>

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 2007 Yellow Mustard, No. 1 Canada seed had a mean erucic acid content of 34.1% compared to the 36.2% in 2006. Total saturated fatty acids, at 5.5%, were 0.5% higher than the 5.0% in 2006.

Table 2 – Quality of 2007 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	73	37.6	28.6	143	14.2
No. 2	14	36.4	29.8	146	14.4
No. 3	1	42.1	28.2	133	13.1
No. 4	3	39.1	27.7	143	14.2
Sample	3	37.7	29.3	138	13.7
Domestic Mustard Seed, Canada, Brown					
No. 1	90	36.5	27.7	114	11.3
No. 2	8	36.4	27.4	113	11.2
No. 3	1	30.8	32.4	125	12.4
Sample	3	37.1	26.8	97	9.6
Domestic Mustard Seed, Canada, Yellow					
No. 1	113	27.1	33.7	—	—
No. 2	24	27.0	34.0	—	—
No. 3	14	28.0	32.4	—	—
No. 4	24	28.2	32.7	—	—
Sample	8	29.4	31.5	—	—

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 3a – Fatty acid composition of 2007 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	61	3.4	0.2	1.6	24.1	24.5	10.0	1.0	12.0	1.0
Alberta	12	3.3	0.2	1.6	24.2	24.2	10.1	1.0	12.0	1.0
No. 2	14	3.4	0.2	1.5	22.9	24.1	10.0	1.0	12.1	1.0
No. 3	1	2.8	0.1	1.4	19.4	21.9	14.2	0.8	11.9	1.3
No. 4	3	3.3	0.1	1.6	23.4	23.3	10.9	0.9	12.2	1.0
Sample	3	3.2	0.2	1.5	22.4	23.3	10.5	1.0	12.2	1.0
Cutlass, No. 1	19	3.2	0.2	1.5	21.7	22.4	10.7	1.0	12.7	1.0
Forge, No. 1	44	3.5	0.1	1.7	25.5	25.2	9.7	0.9	11.7	0.9
Domestic Mustard Seed, Canada, Brown										
No. 1										
Manitoba	1	3.3	0.2	1.5	21.8	22.3	11.4	1.0	12.3	1.0
Saskatchewan	80	3.3	0.2	1.4	21.8	22.0	11.3	1.0	12.4	1.0
Alberta	9	3.2	0.2	1.4	22.0	22.0	11.5	1.0	12.4	0.9
No. 2	8	3.4	0.2	1.4	21.8	22.2	11.1	1.0	12.4	1.0
No. 3	1	3.5	0.2	1.5	21.5	23.8	9.7	1.1	11.3	0.9
Sample	3	3.2	0.2	1.5	23.2	21.6	11.6	0.9	12.7	0.9
Common, No. 1	11	3.3	0.2	1.4	21.5	22.0	11.4	1.0	12.3	1.0
Duchess, No. 1	59	3.3	0.2	1.4	22.0	22.2	11.2	1.0	12.3	0.9
Domestic Mustard Seed, Canada, Yellow										
No. 1										
Manitoba	4	2.9	0.2	1.1	26.9	10.7	8.1	0.7	10.9	0.3
Saskatchewan	77	2.9	0.2	1.0	26.1	10.5	9.3	0.7	11.1	0.3
Alberta	32	2.9	0.2	1.0	26.6	10.4	8.8	0.7	11.1	0.3
No. 2	24	2.9	0.2	1.0	25.8	10.4	9.3	0.7	10.9	0.3
No. 3	14	2.9	0.2	1.0	25.5	10.3	9.4	0.7	11.1	0.3
No. 4	23	2.9	0.2	1.0	25.5	10.3	9.8	0.6	11.0	0.3
Sample	8	2.9	0.2	1.0	25.8	10.0	10.0	0.7	11.1	0.3
AC Pennant, No. 1	19	2.9	0.2	1.0	26.5	10.5	8.5	0.7	11.0	0.3
Ace, No. 1	13	2.9	0.2	1.0	24.9	10.5	8.4	0.7	11.0	0.3
Andante, No. 1	35	2.9	0.2	1.0	26.7	10.3	9.5	0.7	11.3	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 2007 western Canadian mustard

Category	No. of samples	Fatty acid composition (%) ¹					Saturated fatty acids ² %	Iodine value units
		C22:0	C22:1	C22:2	C24:0	C24:1		
Domestic Mustard Seed, Canada, Oriental								
No. 1								
Saskatchewan	61	0.5	19.4	0.4	0.3	1.3	6.8	116
Alberta	12	0.5	19.6	0.4	0.3	1.3	6.7	116
No. 2	14	0.6	20.8	0.5	0.3	1.3	6.9	115
No. 3	1	0.4	22.8	0.4	0.2	1.8	5.6	121
No. 4	3	0.5	20.3	0.4	0.3	1.3	6.6	116
Sample	3	0.6	21.4	0.5	0.3	1.3	6.6	116
Cutlass, No. 1	19	0.6	22.4	0.5	0.3	1.3	6.5	115
Forge, No.1	44	0.5	17.9	0.4	0.3	1.2	6.9	116
Domestic Mustard Seed, Canada, Brown								
No. 1								
Manitoba	1	0.5	22.4	0.5	0.3	1.2	6.6	116
Saskatchewan	80	0.6	22.7	0.5	0.3	1.2	6.5	116
Alberta	9	0.6	22.3	0.5	0.3	1.1	6.5	116
No. 2	8	0.6	22.7	0.5	0.3	1.2	6.7	115
No. 3	1	0.7	22.7	0.6	0.4	1.2	7.2	114
Sample	3	0.5	21.4	0.4	0.3	1.1	6.5	116
Common, No. 1	11	0.6	22.9	0.5	0.3	1.2	6.5	116
Duchess, No. 1	59	0.6	22.5	0.5	0.3	1.2	6.6	115
Domestic Mustard Seed, Canada, Yellow								
No. 1								
Manitoba	4	0.6	34.1	0.3	0.3	2.4	5.6	99
Saskatchewan	77	0.6	34.1	0.3	0.3	2.2	5.5	101
Alberta	32	0.6	34.2	0.3	0.3	2.2	5.4	100
No. 2	24	0.6	34.4	0.3	0.3	2.3	5.4	101
No. 3	14	0.6	34.8	0.3	0.3	2.2	5.4	101
No. 4	23	0.5	34.4	0.3	0.3	2.3	5.4	101
Sample	8	0.5	34.3	0.3	0.3	2.2	5.4	102
AC Pennant , No. 1	19	0.6	34.4	0.3	0.3	2.3	5.5	99
Ace, No. 1	13	0.6	36.0	0.3	0.3	2.3	5.5	99
Andante, No. 1	35	0.6	33.4	0.3	0.3	2.2	5.4	101

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					
2007	73	37.6	28.6	143	14.2
2006	84	41.8	26.2	131	13.0
1997-06	658	41.8	26.6	130	12.9
Domestic Mustard Seed, No. 2 Canada, Oriental					
2007	14	36.4	29.8	146	14.4
2006	6	43.5	24.6	127	12.6
1997-06	81	42.4	26.6	128	12.7
Domestic Mustard Seed, No. 3 Canada, Oriental					
2007	1	42.1	28.2	133	13.1
2006	0	—	—	—	—
1997-06	34	42.7	25.9	126	12.5
Domestic Mustard Seed, No. 1 Canada, Brown					
2007	90	36.5	27.7	114	11.3
2006	71	40.2	26.0	108	10.7
1997-06	624	39.9	26.0	107	10.6
Domestic Mustard Seed, No. 2 Canada, Brown					
2007	8	36.4	27.4	113	11.2
2006	3	39.9	26.2	111	11.0
1997-06	38	38.5	27.2	111	11.0
Domestic Mustard Seed, No. 3 Canada, Brown					
2007	1	30.8	32.4	125	12.4
2006	1	42.1	23.2	100	9.9
1997-06	32	39.1	26.3	109	10.8
Domestic Mustard Seed, No. 1 Canada, Yellow					
2007	113	27.1	33.7	—	—
2006	108	30.5	31.8	—	—
1997-06	701	30.4	32.1	—	—
Domestic Mustard Seed, No. 2 Canada, Yellow					
2007	24	27.0	34.0	—	—
2006	22	30.8	31.6	—	—
1997-06	180	30.9	31.8	—	—
Domestic Mustard Seed, No. 3 Canada, Yellow					
2007	14	28.0	32.4	—	—
2006	10	31.1	32.3	—	—
1997-06	74	31.0	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