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Quality of western Canadian flaxseed 2005

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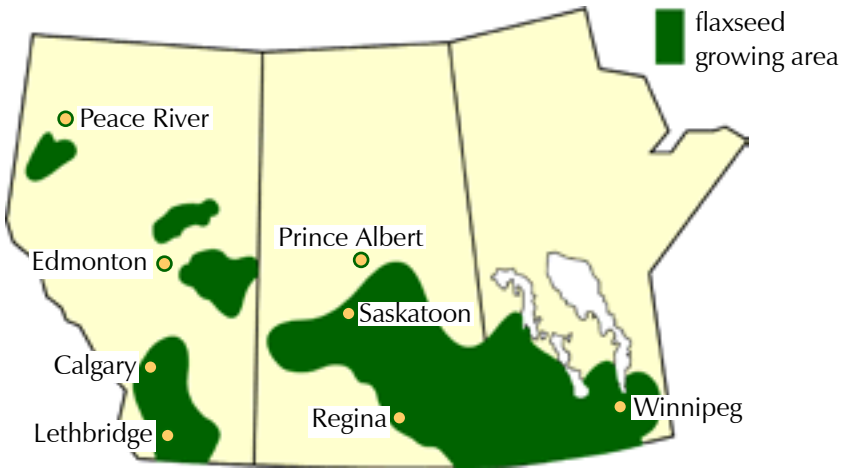
Introduction

This report presents quality data and information based on the Canadian Grain Commission (CGC) 2005 harvest survey of western Canadian flaxseed. Quality data presented includes oil, protein and free fatty acids content, the fatty acid composition, and the iodine value of harvest survey samples submitted to the Grain Research Laboratory (GRL) throughout the harvest period by producers, grain companies and oilseed crushing plants. The map shows the traditional growing areas for flaxseed in western Canada.

Figure 1 – Map of Canada showing traditional growing areas for flaxseed



Source: Flax Council of Canada

Summary

The Canadian Grain Commission (CGC) harvest survey of western Canadian flaxseed shows the 2005 crop to contain a record high oil content with a below average protein content and an average iodine value. The iodine value is 1 unit higher while the oil content is 1.9% higher and the protein content is 1.1% lower than the 10-year means.

Compared to 2004, the oil content, 46.2%, is 1.4% higher while the protein content, 22.0%, is 0.1% lower. The linolenic acid content, 57.7%, is 3.9% lower than in 2004, resulting in an iodine value of 194, seven units lower than in 2004.

The GRL's long-term harvest survey results have shown that cool, wet growing conditions tend to produce a flaxseed crop with higher oil contents and iodine values, but lower protein contents.

Table 1 – Flaxseed, No. 1 Canada Western
Quality data for 2005 harvest survey

Quality parameter	2005	2004	1995–2004 mean
Oil content[1], %	46.2	44.8	44.3
Protein content[2], %	22.0	22.1	23.1
Free fatty acids, %	0.18	0.26	0.23
Iodine value	194	201	193
Linolenic acid, % in oil	57.7	61.6	58.0

[1] Dry matter basis
[2] N x 6.25; dry matter basis

Table 2 – Flaxseed, No. 1 Canada Western
Fatty acid composition for 2005 harvest survey

Fatty acid[1], % in oil	2005	2004	1995–2004 mean
Palmitic	5.0	4.9	5.2
Stearic	3.3	3.0	3.4
Oleic	16.8	14.5	18.2
Linoleic	16.3	15.8	14.9
Linolenic	57.7	61.6	58.0

[1] Percentage of total fatty acids in the oil including palmitic (C16:0), stearic (C18:0), oleic (C18:1), linoleic (C18:2), and linolenic (C18:3)

Weather and production review

Weather review

Temperature and precipitation patterns for the 2005 western Canadian growing season can be found on the PFRA web site (http://www.agr.gc.ca/pfra/drought/drmaps_e.htm). Of particular note this growing season were the heavy rainfalls during the spring followed by moderate temperatures throughout the growing season. In Saskatchewan, June 2005 is tied with June 1953 for the wettest month on record in the last 90 years. The Weather and Crop Surveillance department of the Canadian Wheat Board provided the majority of the detailed weather review for the 2005 crop year.

Seeding

Precipitation from the beginning of April to the end of May 2005 was normal to above-normal in the Prairie region. Planting progress during the spring was dependent on location; the general trend saw western regions planted more rapidly than the eastern growing areas. The overall planting pace in western Canada was two to five days ahead of normal during the first three weeks of May, but rains slowed progress in the latter half of the month. Heavy rains in June delayed the completion of oilseed crop planting and caused some crop areas to be left unseeded.

Growing conditions

Persistent heavy rains throughout the southern Prairies in June caused flooding losses in Alberta and southern Manitoba. Manitoba was hardest hit by the wet conditions, with unseeded and drowned-out areas exceeding two million total crop acres. The rest of the Prairies received normal to above-normal amounts of precipitation during the June period, which helped increase crop yield potential. Precipitation during July was mostly normal across the Prairie region, with temperatures slightly below normal in western regions and above normal in the east. The moderate temperatures boosted crop growth, without causing stress to the crop. Crop development was significantly ahead of last year in most regions, due to the warmer temperatures received throughout the growing season. Cooler temperatures and frequent rainfall slowed crop development in Alberta and western Saskatchewan in August. The cooler weather also resulted in a number of locations in northwestern Saskatchewan and northern Alberta reporting spotty frost events in the first two weeks of the month. Eastern regions reported warmer-than-normal temperatures, which increased stress to crops in the late filling stage. Warm temperatures also boosted crop development in eastern Saskatchewan and Manitoba.

Harvest conditions

Southeastern areas of the Prairies began harvesting in the middle of August. The last week of August and the first two weeks of September were unseasonably wet, with heavy downpours falling across southern Alberta and into northeastern Saskatchewan. Crops in the regions that received the heaviest rainfall were downgraded. Weather conditions in the southern Prairies were better, with most of the harvest in Manitoba and the southern areas of Saskatchewan complete by the end of September. Harvesting in the northern areas of Saskatchewan and Alberta stretched into October. As of October 30, 2005 the flaxseed harvest was over 99% completed in Manitoba, 95% completed in Saskatchewan and about 75% completed in Alberta.

Production and grade information

Western Canadian farmers planted 842 thousand hectares of flaxseed in 2005 (Table 3), a sixteen percent increase from last year's area. The 2005 yield estimate of 1300 kg/ha was significantly higher than both the 1000 kg/ha reported in 2004 and the 10-year mean of 1197 kg/ha. Due to the significantly higher seeded area and higher yields, total flaxseed production more than doubled to 1.1 million tonnes. According to the Statistics Canada estimates in *Field Crop Reporting Series No. 8*, Saskatchewan accounted for 81 percent of flaxseed production while Manitoba and Alberta had 14 percent and five percent respectively.

The grade pattern of the 2005 flaxseed crop was considerably better than in 2004. For the 2005 Saskatchewan flaxseed crop, *Saskatchewan Agriculture, Food and Rural Revitalization Report Number 32* estimated the portion of Flaxseed, No.1 CW to be 83% compared to only 34% in 2004 and 80% for the ten-year mean. Poor harvest weather in September and October resulted in some regional downgrading in northern areas of Saskatchewan and Alberta

Table 3 – Seeded area and production for western Canadian flaxseed

	Seeded area[1]		Production[1]		Average production[2]
	2005	2004	2005	2004	1995–2004
	thousand hectares		thousand tonnes		thousand tonnes
Manitoba	154	142	147	132	269
Saskatchewan	656	567	881	356	531
Alberta	32	20	53	29	30
Western Canada	**842**	**729**	**1082**	**517**	**830**

[1] Source—*Field Crop Reporting Series, No. 8*, December 7, 2005; Statistics Canada
[2] Source—*Field Crop Reporting Series*, revised final estimates for 1995–2004

Harvest survey samples

Flaxseed samples for the CGC harvest survey are collected from producers, grain handling offices and oilseed crushing plants across western Canada. The samples are cleaned to remove dockage prior to testing. The samples are analyzed for oil, protein and iodine value using a NIRSystems 6500 scanning near-infrared spectrometer, calibrated to and verified against the appropriate reference method. Composite samples are used for free fatty acids and fatty acid composition analyses. Composites are prepared by combining Flaxseed, No.1 Canada Western (CW) samples by province.

This year's harvest survey report included 640 samples compared to 412 in 2004. Manitoba contributed 170 samples, Saskatchewan 442 samples and Alberta 28 samples during the harvest period from September 1 to December 1, 2005. Weighting factors used to calculate provincial and western Canadian means are derived from the previous five-year average production for each crop district and this year's provincial production estimates in Statistics Canada's *Field Crop Reporting Series No. 8*, December 7, 2005.

Quality of western Canadian flaxseed 2005

Tables 4 and 5 show detailed information on the quality of top grade western Canadian flaxseed harvested in 2005. A complete summary of the survey by province and lower grades can be found at: http://grainscanada.gc.ca/Quality/Flax/flaxmenu-e.htm. The number of harvest survey samples collected from each province may not represent the actual production or grade distribution. However, there were sufficient samples to provide good quality information for each province. To calculate western Canadian averages, provincial averages are weighted by the Statistics Canada production estimate and an estimate of grade distribution.

Table 6 compares the quality of recent flaxseed exports with this year's harvest survey data. The harvest survey data is from producer samples that have been cleaned to remove dockage, while recent exports of flaxseed from Thunder Bay and Vancouver contained 6.0% and 2.0% dockage respectively. Dockage will affect quality factors such as oil content, iodine value and free fatty acids. Flaxseed exports containing over 2.5% dockage are considered not commercially clean.

Oil and protein content give quantitative estimates of the value of the seed as a source of oil and of the resulting meal as a source of protein for animal feed. Iodine value is a measure of the overall unsaturation of the oils and is calculated from the fatty acid composition. Oils with higher iodine values, i.e., with more unsaturation, polymerize more rapidly in the presence of air. For flaxseed, the high level of linolenic acid is an important quality factor as it is this fatty acid, which is responsible for most of flaxseed oil's drying properties. Linolenic acid is also the omega-3 fatty acid considered to contribute to good health in humans and is responsible for the increasing use of whole and ground flaxseed in cereals and baked goods, and flaxseed oil in salads.

Table 4 – Flaxseed, No. 1 Canada Western
Quality data for 2005 harvest survey

Province	Number of samples	Oil content[1]			Protein content[2]			Iodine value		
		Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
			%			%				
Manitoba	164	45.9	41.7	50.2	21.9	18.3	26.9	194	186	204
Saskatchewan	440	46.2	40.9	50.0	22.0	18.3	29.5	193	179	207
Alberta	27	46.6	43.8	50.4	22.7	18.4	25.9	199	185	206
Western Canada[3]	**631**	**46.2**	**40.9**	**50.4**	**22.0**	**18.3**	**29.5**	**194**	**179**	**207**

[1] Dry matter basis
[2] N x 6.25; dry matter basis
[3] Mean values are weighted averages based on estimated production by province (Statistics Canada).

Table 5 – Flaxseed, No. 1 Canada Western
Fatty acid composition and free fatty acids content for 2005 harvest survey

Province	Number of samples	Fatty acid composition, %[1]					Free fatty acids
		C16:0	C18:0	C18:1	C18:2	C18:3	
Manitoba	164	5.1	3.3	16.4	16.0	58.3	0.28
Saskatchewan	440	5.0	3.4	17.0	16.4	57.3	0.16
Alberta	27	4.7	3.3	14.5	15.5	61.2	0.19
Western Canada[2]	**631**	**5.0**	**3.3**	**16.8**	**16.3**	**57.7**	**0.18**

[1] Percentage of total fatty acids in the oil including palmitic (C16:0), stearic (C18:0), oleic (C18:1), linoleic (C18:2), and linolenic (C18:3)
[2] Mean values are weighted averages based on estimated production by province (Statistics Canada).

Table 6 – Flaxseed, No. 1 Canada Western
Comparison of 2005 harvest survey quality data with recent export[3] shipments

Quality parameter	2005 survey	November 2005 exports	2004-2005 exports
Oil content[1], %	46.2	45.6	44.0
Protein content[2],%	22.0	22.4	22.6
Free fatty acids, %	0.18	0.25	0.44
Iodine value	194	192	198
Palmitic acid, % in oil	5.0	5.0	4.9
Stearic acid, % in oil	3.3	3.5	3.1
Oleic acid, % in oil	16.8	18.1	15.3
Linoleic acid, % in oil	16.3	16.7	15.6
Linolenic acid, % in oil	57.7	56.3	60.5
Number of samples	**631**	**4**	**22**

[1] Dry matter basis
[2] N x 6.25; dry matter basis
[3] Commercially clean exports containing less than 2.5% dockage

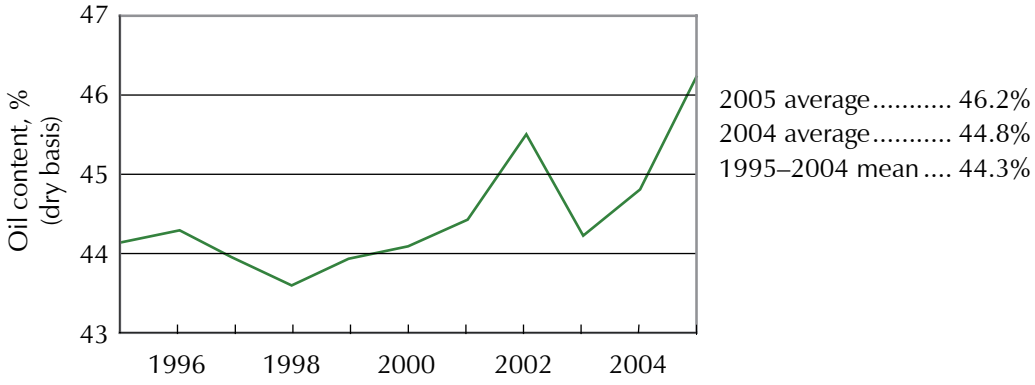
Oil content

The average oil content of 46.2% for Flaxseed, No.1 CW from the 2005 survey is a record high, surpassing the 45.9% of 1977. The 2005 average oil content value exceeds both the 44.8% in 2004 and the 10-year mean of 44.3%. The oil content of 45.9% for Manitoba is slightly lower than the 46.2% and 46.6% in Saskatchewan and Alberta samples. Compared to 2004, average oil contents are 2.1%, 0.6% and 0.4% higher for Saskatchewan, Alberta and Manitoba respectively. The oil content of Flaxseed, No.1 CW samples from producers across western Canada varied from 40.9% to 50.4%.

The increased oil contents seen in the 2005 survey are a result of the generally good growing conditions; i.e. moderate temperatures and ample moisture, in much of the Saskatchewan and Alberta regions of the flaxseed growing area. In Manitoba there was a high proportion of late-seeded flaxseed that tends to lower oil contents. The GRL's long-term harvest survey results have shown that cool growing conditions tend to produce a flaxseed crop with higher oil contents and iodine values, but lower protein contents (http://grainscanada.gc.ca/Cdngrain/flax/flaxq-e.htm). Another, contributing reason for the improvement in the western Canada mean oil content in the past few years is the continuing trend of planting more of the newer high quality Canadian flaxseed cultivars. Quality information on the varieties from the 2005 survey will be available at a later date on the above noted CGC website.

The oil content of November 2005 Flaxseed, No.1 CW exports averaged 45.6%, higher than the 2004–2005 export mean of 44.0%. This suggests the oil content of the 2005–2006 flaxseed exports will be significantly higher than the previous year. Flaxseed exports that are not commercially clean will have lower oil contents than exports that are cleaned to contain less than 2.5% dockage.

Figure 2 - Flaxseed, No. 1 Canada Western
Oil content of harvest survey samples, 1995–2005

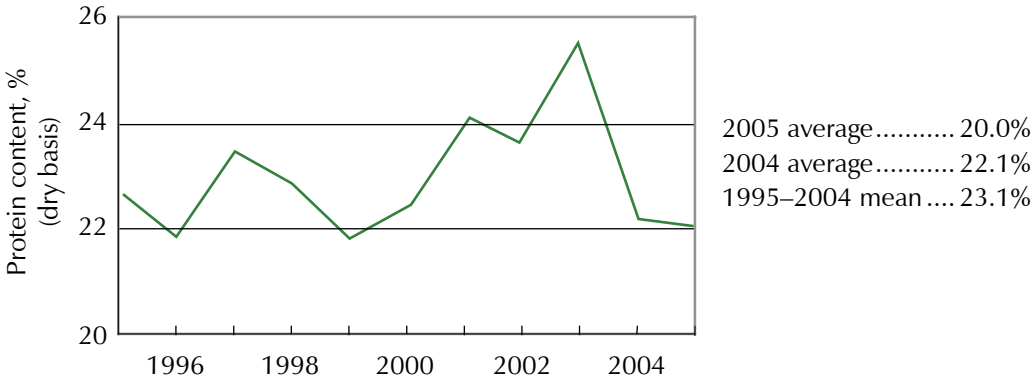


Protein content

The average protein content of 22.0% for Flaxseed, No.1 CW from the 2005 harvest survey is 0.1% lower than in 2004 and 1.1% lower than the 10-year mean of 23.1%. The Alberta average protein content of 22.7% was significantly higher than the 21.9% in Manitoba and the 22.0% in Saskatchewan. Compared to 2004, the average protein contents decreased by 0.3% and 0.2% in Alberta and Manitoba while it increased by 0.1% for Saskatchewan samples. The protein content of Flaxseed, No.1 CW samples from producers across western Canada varied from 18.3% to 29.5%.

As Table 6 shows, the protein content of 22.4% for November 2005 flaxseed exports is slightly lower than the 22.6% for the 2004–2005 shipping season. The protein content of flaxseed exports in 2005–2006 should be slightly lower than the export shipments of the previous season.

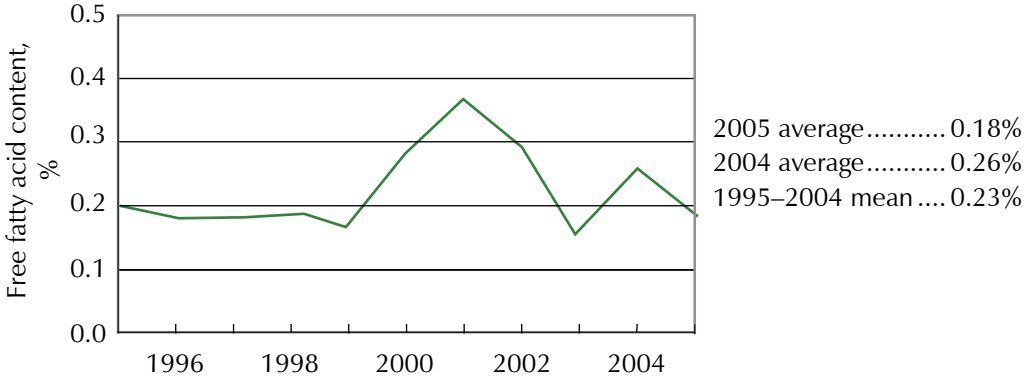
Figure 3 - Flaxseed, No. 1 Canada Western
Protein content of harvest survey samples, 1995–2005



Free fatty acids content

The average free fatty acids (FFA) content of 0.18 % in top grade 2005 survey samples is lower than both the 2004 average of 0.26% and the 10-year mean of 0.23%. The average FFA content of Manitoba samples (0.28%) is notably higher than those from Alberta (0.19%) and Saskatchewan (0.16%). Flaxseed from regions where the harvest was delayed due to wet conditions will have FFA levels well above the provincial means. The Flaxseed, No.2 CW and Flaxseed, Canada Sample Grade composites had FFA levels of 0.45%, and 0.32% respectively. The FFA content of Flaxseed, No.1 CW exports in November 2005 averaged 0.25%; suggesting the levels in 2005-2006 will be similar to the 2004–2005 values of 0.44% (Table 6).

Figure 4 - Flaxseed, No. 1 Canada Western
Free fatty acids content of harvest survey samples, 1995–2005



Fatty acid composition

The average linolenic acid content of 2005 harvest survey Flaxseed, No.1 CW samples is 57.7%, significantly lower than the record high 61.6% in 2004 but very similar to the 10-year mean of 58.0%. Compared to 2004, the average linolenic acid content decreased by 4.8% and 3.0% respectively in Saskatchewan and Manitoba but increased by 1.3% in Alberta samples. Flaxseed, No. 1 CW samples from producers across western Canada had a range of linolenic acid content from 48.9% to 66.8%.

The average iodine value of the oil from Flaxseed, No.1 CW samples is 194 units. Iodine value is a measure of the total degree of unsaturation of the oil and in flaxseed is heavily influenced by the linolenic acid content of the oil. The 2005 iodine value is 7 units lower than in 2004 but above the 10-year mean of 193 units. The average iodine value decreased by 8 and 7 units respectively for Saskatchewan and Manitoba, while Alberta samples increased by 1 unit on average. Flaxseed, No.1 CW samples from producers across western Canada varied in iodine value from 179 to 207 units.

Oils with iodine values greater than 188 units are desired by the coatings industry for products such as paints, varnishes and inks, while oils with iodine values around 183 units are preferred by the linoleum industry. Iodine value, like oil content, is influenced by growing temperatures and length of photoperiod. Generally, cooler growing conditions and longer photoperiods will result in both higher iodine value and oil content. While growing season temperatures in 2005 were relatively moderate there were periods of high temperatures in July and August, unlike the 2004 growing season that was the coolest reported in over 100 years.

The November 2005 export data in Table 6 shows the linolenic acid content at 56.3% and the iodine value at 192 units, significantly lower than the 2004–2005 mean export values. Flaxseed, No.1 CW exports will likely produce oils with iodine values between 190 and 195 units. Flaxseed exports that are not commercially clean may have lower iodine values than those exports that are cleaned to contain less than 2.5% dockage.

Figure 5 – Flaxseed, No. 1 Canada Western
Linolenic acid content of harvest survey samples, 1995–2005

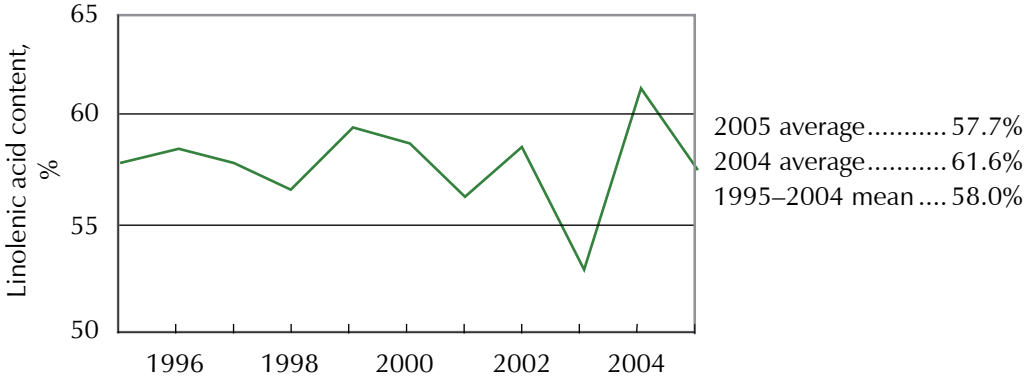
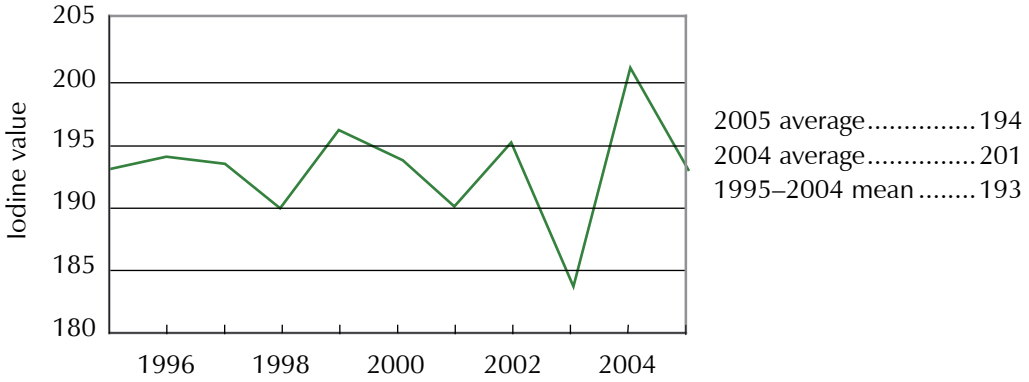


Figure 6 – Flaxseed, No. 1 Canada Western
Iodine value of harvest survey samples, 1995-2005



Chlorophyll content

Chlorophyll content is determined by International Organization for Standardization method reference number ISO 10519:1997 (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 methodreference 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 oleic acid in the oil. Oleic acid with a molecular weight of 282 is used as the fatty acid for the expression of the results.

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, revised 1995 and re-approved 1997, 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 and re-approved 1997, 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.