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Quality of Canadian oilseed-type soybeans

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Véronique J. Barthet

Program Manager, Oilseeds Section

Contact: Véronique J. Barthet

Program Manager, Oilseeds Section

Tel : 204 984-5174

Email: veronique.barthet@grainscanada.gc.ca

Fax : 204-983-0724

Grain Research Laboratory

Canadian Grain Commission

1404-303 Main Street

Winnipeg MB R3C 3G8

www.grainscanada.gc.ca

Canada 

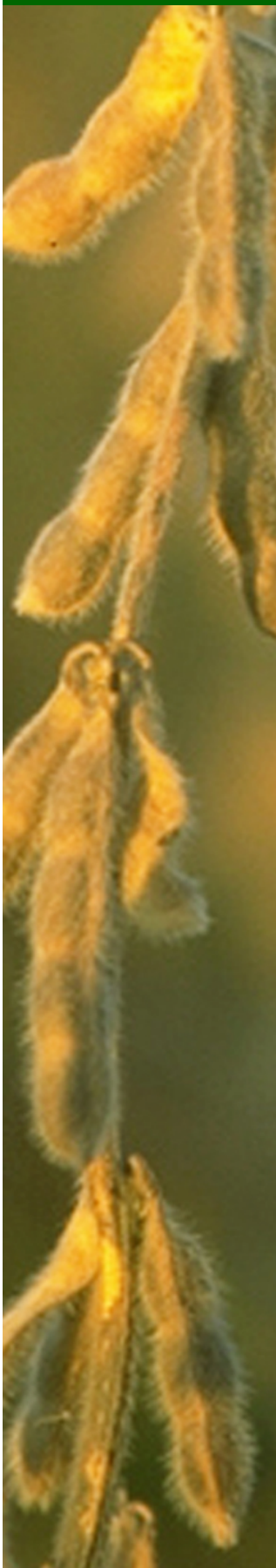


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Summary

In 2015, the average oil content for Soybean, No.1 and No. 2 grades was 21.5% on a dry matter basis (Table 2). The average was higher than last year's average of 20.9% and similar to the 5-year average (2010-14) of 21.4%. The average protein content for Soybean, No.1 and No. 2 grades combined was 39.6%, which is identical to last year's average (39.6%) and similar to the 5-year average (39.4%).

The oil and protein content averages for No. 1 and No. 2 grades combined varied between eastern and western provinces. Manitoba had an oil content of 21.2% and a protein content of 38.0%, whereas Saskatchewan had an oil content of 20.6% and a protein content of 38.4%. Ontario had an oil content of 21.7% and a protein content of 39.8%. Québec had an oil content of 21.2% and a protein content of 41.1%. Prince Edward Island and New Brunswick had an oil content and protein content of 22.2%, 20.9% and 35.7% and 39.5% respectively.

Acknowledgments

The Grain Research Laboratory acknowledges the cooperation of the soybean producers, grain handling offices, and oilseed crushing plants in eastern and western Canada for supplying the samples of newly harvested soybean. The assistance of the Industry Services Division of the Canadian Grain Commission in grading producer samples is also acknowledged. The technical assistance of the Oilseeds staff, Grain Research Laboratory is recognized.

Introduction

This harvest survey report is based on 225 samples of oilseeds type soybean (previously described as non-food grade), less than what we received in 2014 (346) and less than what we got in 2013 (318). Samples were from Manitoba (85), Ontario (69), Québec (39), Saskatchewan (25), New-Brunswick (3), Prince Edwards Island (2) and Alberta (2). Of the submitted samples, 11.6% were graded as Soybean, No. 1 Canada; 87.5% were graded as Soybean No. 2 Canada and 0.9% were graded as Soybean, No. 3 Canada and Soybean, No. 4 Canada.

Quality data (oil, protein, free fatty acid, chlorophyll as well as fatty acid composition) are based on the means of Soybean, No. 1 and No. 2 Canada grades combined for all oilseed-type samples received from eastern (Ontario, Québec, New Brunswick and Prince Edward Island) and western (Manitoba, Saskatchewan and Alberta), (Tables 3 and 4). In addition, results for all combined grades for each province are also provided for comparison (Tables 3 and 4). Table 5 presented 2014 quality data to compare with the 2015 harvest.

Weather and production review

Weather review

It was a challenging growing season for producers. In the west, warmer weather allowed an early seeding however there were two cold spells in May (mid and end of May) due to freezing temperatures and snow that delayed seeding. Some acreages seeded with canola ended up seeded with soybeans after the second re-seeding. Temperatures were higher than normal for most of the growing season allowing soybean to mature. There were some pockets of heavy rain in Manitoba that might have affected the crop but overall the crop was in good conditions. Harvest was able to proceed in spite of the heavy rains in September.

March and April were cooler than normal in the east part of Canada but May was about 3°C warmer than normal. June and July saw the return of lower than normal temperatures with warmer than normal temperatures returning in August and September. Precipitation was variable, dry with some heavy precipitations in some areas, particularly in some areas of Québec in May and June in Ontario.

Source:

Ontario crop report: <http://www.omafra.gov.on.ca/english/crops/field/reports/index.html>

Manitoba crop report: <http://www.gov.mb.ca/agriculture/crops/seasonal-reports/crop-report-archive/>

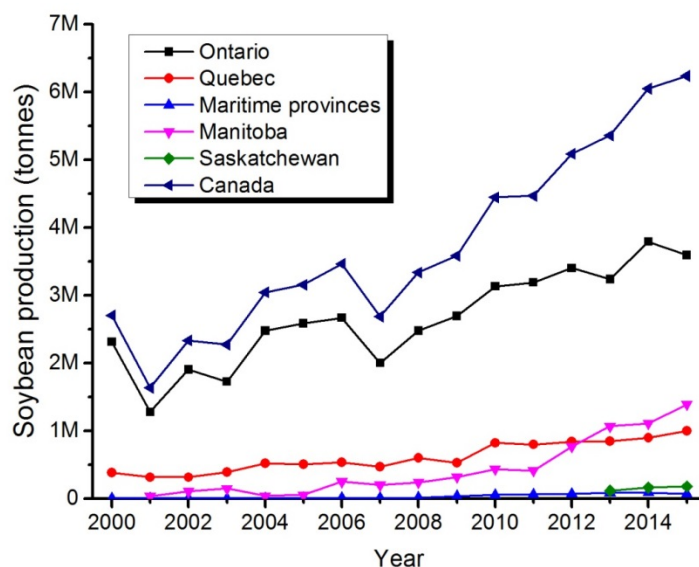
Saskatchewan crop report: <http://www.agriculture.gov.sk.ca/Crop-Report>

Canada weather maps: <http://www5.agr.gc.ca/DW-GS/historical-historiques.aspx?lang=eng&jsEnabled=true>

Production and grade information

Since 2007, soybean production in Canada keeps increasing (Figure 1). In 2015 the soybean production increased from 6.0 million tonnes in 2014 to 6.235 million tonnes (Table 1). The production increased in all provinces (Table 1) + 25% in Manitoba, + 11% in Québec and + 10% in Saskatchewan, except in Ontario where a 5% decrease was observed. This was partially due to an increase in seeded area in Manitoba (+ 9%) and an overall yield increase compared to 2014 (2,900 Kg/ha in 2015 versus 2,700 Kg/ha in 2014). The yield increase was very significant in Québec + 23% (3,200 Kg/ha in 2015 versus 2,600 Kg/ha in 2014) and Manitoba + 14% (2,500 Kg/ha in 2015 versus 2,200 Kg/ha in 2014), and in Saskatchewan + 6% (1,700 Kg/ha in 2015 versus 1,600 Kg/ha in 2014).

Figure 1 – Soybean production in Canada from 2000 to 2015



For the 2015 soybean survey, we received 225 samples, 113 from the East and 112 from the West (Table 2). All harvest survey samples submitted to the Canadian Grain Commission from all locations (Ontario, Québec, Prince Edward Island, New Brunswick, Manitoba and Saskatchewan) were graded by Canadian Grain Commission

inspectors according to the Official Grain Grading Guide (<http://www.grainscanada.gc.ca/oggg-gocg/20/oggg-gocg-20-eng.htm>). In the 2015 survey, 99.1% of the submitted samples were in the top 2 grades. The very few samples (0.9%) that were graded Soybean, No. 3 Canada and lower were from the east.

Table 1 - Seeded area and production for eastern and western Canadian soybean¹

Province	Seeded area		Production ¹		5-Year average production
	2015	2014	2015	2014	2010-14
	Hectares		Tonnes		Tonnes
Manitoba	560,500	514,000	1,390,700	1,107,700	601,720
Saskatchewan	109,300	109,300	179,600	163,300	23,680 ²
Western Canada	669,800	623,300	1,570,300	1,271,000	625,400
Ontario	1,173,600	1,242,400	3,592,500	3,791,100	3,130,860
Québec	315,000	348,000	1,000,000	898,000	768,600
Prince Edward Island	21,900	26,300	47,200	60,100	47,040
New Brunswick	5,300	6,100	12,200	13,600	8,000
Nova Scotia	4,500	4,900	12,800	14,800	7,700
Eastern Canada	1,520,300	1,627,700	4,664,700	4,777,600	3,962,200
Total Canada	2,190,100	2,251,000	6,235,000	6,048,600	4,587,600

¹ Statistics Canada. Table 001-0010 - Estimated areas, yield, production and average farm price of principal field crops, in metric units (<http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0010010&paSer=&pattern=&stByVal=1&p1=1&p2=-1&tabMode=dataTable&csid>).

² Statistics Canada started to report Saskatchewan Soybean production in 2013, and 2014 production data were 118,400 and 163,300 tonnes, respectively. To calculate the 5 year average, in 2010, 2011 and 2012 Saskatchewan production was assumed to be 0.

Harvest sample program

Individual samples were analyzed for oil and protein content using an Infratec 1241 Grain Analyzer near-infrared (NIR) spectrometer, calibrated and verified against the appropriate laboratory reference method. Grade composite samples were analyzed by reference methods for oil, protein, fatty acid composition and free fatty acids. The reference procedures are listed under Oilseeds Methods (<http://grainscanada.gc.ca/oilseeds-oleagineux/method-methode/omtm-mmao-eng.htm>).

Due to a low number of samples received from some areas, the data presented in this report for these areas might not truly reflect the true quality of the crop. The average data presented in this report were weighted using the 2015 provincial production data as reported by Statistics Canada (<http://www5.statcan.gc.ca>).

There are two major types of soybeans grown in Canada: those commonly referred to as oilseed-type (“crush” or non-food grade) beans and food grade beans (used for tofu and other soy products). This report deals with the oilseed-type or “non-food grade” soybean samples and could be considered those for the feed or crushing industry. A list of Canadian soybean varieties is provided in *List of Varieties which are Registered in Canada, Variety*

Registration Office, Variety Section, Plant Health and Production Division, Canadian Food Inspection Agency (http://www.inspection.gc.ca/active/netapp/regvar/regvar_lookupe.aspx)

Oilseed-type soybeans are grown to produce oil and high-protein meal. Soybean oil is used in salad oil, shortening and margarine products. Defatted soybean meal is used as a protein supplement in livestock rations. Key quality factors for oilseed soybeans are oil content, protein content, and fatty acid composition. Oil and protein content give quantitative estimates of the beans as a source of oil, and of the defatted meal as a source of protein for animal feed. Fatty acid composition provides information about the nutritional, physical and chemical characteristics of the oil extracted from the beans.

Oil and protein content

The average oil content was 21.5% (Table 2) for soybean graded No. 1 and No. 2 Canada, an increase when compared to the 20.9% observed in 2014 (Table 4). This result is similar to the 5-year average of 21.4%. There was not an important difference between the oil content averages obtained for the various grades (Table 2); Soybean No. 3 Canada averaged 21.8% and Soybean No. 4 Canada averaged 21.0%. There was a slight difference between the averages of the soybean No. 1 and No. 2 Canada from eastern and western provinces, with samples from the east showing overall a higher oil content than the samples from the west (Table 2). All grades combined, individual producer samples ranged from 17.4 to 25.8%, a higher oil content range than what was observed for the 2014 soybean harvest (16.8% to 24.5%).

The average protein content was 39.6%, identical to what was observed last year but much lower than what was observed in 2013 (40.2%). However, this result was similar to the 5-year average (2010-14) of 39.4%. Samples from the eastern provinces of Canada typically show higher protein content than samples from western Canada (40.1% versus 38.1%). For all grades combined individual producer samples ranged from 31.3 to 43.2%, this protein range was larger in 2014 (31.3% to 45.1%) than in 2015.

As Tables 2 and 4 show, in Ontario, the average oil and protein content (21.7% & 39.8%) had a significant increase in oil (+0.6%) associated with an decrease in protein (-1.0%) when compared to the 2014 harvest (oil: 20.9% & protein: 40.8%). In Québec, oil content increased to 21.2%, a slight increase compare to the 2014 average (20.8%). However the protein average of the soybean samples graded No. 1 and No. 2 Canada was higher when compared to 2014 (41.1 vs 39.9%). In Manitoba, the average oil content (21.2%) also showed a very slight increase compare to last year average (20.9%) while a significant increase in protein was observed (38.0% in 2015 compared to 37.2% in 2014).

A low number of samples were obtained from Prince Edwards Island and New Brunswick, oil content and protein content averages were 22.2 and 20.9% and 35.5 and 39.4%, respectively.

Important variations in the protein and oil contents in the top 2 grades could be observed between provinces and eastern and western provinces (Table 2). While quality parameters can be strongly affected by environmental conditions, the variety of soybean planted, plus soil fertility, can also affect quality. The inverse relationship between oil and protein content is illustrated in Figure 1 for eastern and western Canada. The figure also showed the effect of the sample location on the protein and the oil content.

Fatty acid composition

Table 3 shows fatty acid composition for the combined No. 1 and 2 grade composites from the various provinces. The fatty acid composition varied greatly from province to province, the linolenic acid (C18:2) is the

main fatty acid found in soybean oil, followed by oleic acid (C18:1), palmitic acid (C16:0) and α -linolenic acid (C18:3) (Table 3). This year, the linolenic acid (C18:2) ranged from 58.8% (Prince Edward Island) to 52% (Québec) while oleic acid ranged from 16.6% (Prince Edward Island) to 24.0% (Québec). Alberta samples showed the highest α -linolenic acid content (11.4%) while samples from Québec had the lowest (8.2%) followed by Ontario (8.4%). Overall samples from western Canada showed higher α -linolenic acid content than samples from eastern Canada (Table 3), this resulted in higher iodine value for samples from the west when compared to samples from the east. Total saturates averaged 15.2% in Canada varying from 14.1% (Prince Edward Island) to 15.4% (Ontario).

In 2014, the α -linolenic acid content was higher than in 2015, western Canada averaged 9.3% (9.0% in 2015) and 10.5% in eastern Canada (8.4% in 2015) while the overall Canadian average was 9.6% (8.5% in 2015). This was confirmed by the iodine value averages, 136.5, 140.4 and 137.5 units for western Canada, eastern Canada and Canada in 2014 versus 134.5, 133.3 and 133.7 in 2015.

All grades combined, the iodine value averages were higher in 2014 than in 2015, 135.0 versus 133.7 units reflecting the higher α -linolenic acid content averages (8.5% in 2015 versus 9.1% in 2014).

Variety selection, soil fertility and environmental growing conditions are factor contributing to the difference in the fatty acid composition between the provinces.

Free fatty acid (FFA) content

Grade composites showed free fatty acid levels, averaging 0.09% for composite samples of Soybean, No. 1 Canada and Soybean, No. 2 Canada (Table 3). This is lower than what was observed last year (0.16%).

High free fatty acid values are mainly due to seed damage, which results from exposure to moisture and oxygen, wet harvesting conditions and improper storage. It has been noted that free fatty acid levels could increase during storage due to storage and environmental conditions.

Figure 2 – Oil and Protein Content Trend for eastern and western Canada 2015

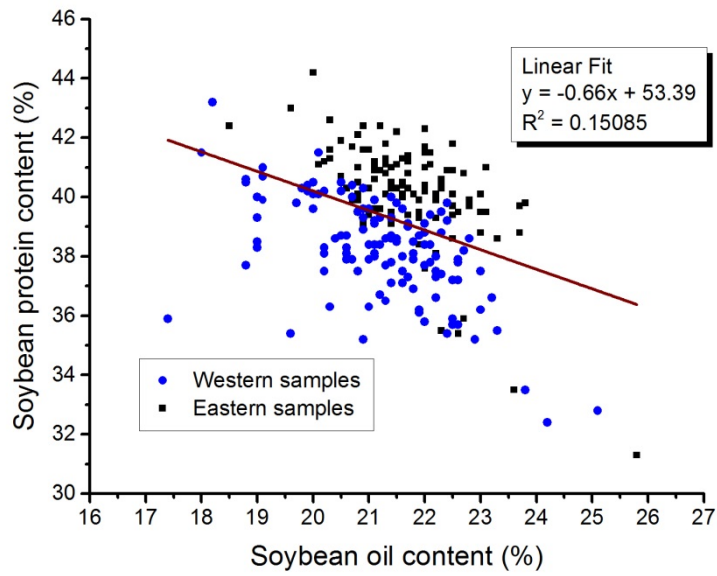


Table 2: Oil, protein and chlorophyll contents and free fatty acid content of the oil of the 2015 soybean survey by province and grade

Province	n	Mean	Oil		Protein ¹			Chlorophyll Mg/Kg	Free Fatty Acid ² %, in oil
			Min	Max	Mean	Min	Max		
Soybean, No. 1 Canada and Soybean No. 2 Canada									
Manitoba	85	21.2	18.0	25.1	38.0	32.8	43.2	0.4	0.04
Saskatchewan	25	20.6	18.8	24.2	38.4	32.4	40.2	0.8	0.11
Alberta	2	18.6	17.4	18.8	39.3	35.9	40.6	1.5	0.03
Western Canada	112	21.1	17.4	25.1	38.1	32.4	43.2	0.4	0.05
Ontario	69	21.7	20.1	25.8	39.8	31.3	42.2	0.3	0.18
Québec	37	21.2	18.5	23.1	41.1	38.4	44.2	0.3	0.08
Prince Edward Island	2	22.2	21.7	22.7	35.7	35.5	35.9	0.5	0.15
New Brunswick	3	20.9	20.7	21.0	39.5	39.4	40.1	0.2	0.09
Eastern Canada	108	21.6	20.1	22.4	40.1	31.3	42.2	0.3	0.10
Canada	220	21.5	17.4	22.4	39.6	31.3	43.2	0.3	0.09
Soybean, No. 3									
Eastern Canada	1	22.3			39.6			1.8	0.29
Western Canada	NA								
Canada	1	22.3			39.6			1.8	0.29
Soybean, No. 4									
Eastern Canada No. 4	1	21.0			41.6			0.3	1.05
Western Province	NA								
Canada	1	21.0			41.6			0.3	1.05
Soybean, All grades combined									
Manitoba	85	21.2	18.0	25.1	38.0	32.8	43.2	0.4	0.04
Saskatchewan	25	20.6	18.8	24.2	38.4	32.4	40.2	0.8	0.11
Alberta	2	18.6	17.4	18.8	39.3	35.9	40.6	1.5	0.03
Western Canada	112	21.1	17.4	25.1	38.1	32.4	43.2	0.4	0.05
Ontario	69	21.7	20.1	25.8	39.8	31.3	42.2	0.3	0.08
Québec	39	21.2	18.5	23.1	41.0	38.4	44.2	0.4	0.21
Prince Edward Island	2	22.2	21.7	22.7	35.7	35.5	35.9	0.5	0.15
New Brunswick	3	20.9	20.7	21.0	39.5	39.4	40.1	0.2	0.09
Eastern Canada	113	21.6	20.1	25.8	40.1	31.3	42.2	0.3	0.11
Canada	225	21.5	17.4	25.8	39.6	31.3	43.2	0.3	0.09

¹ calculated from nitrogen content with N x 6.25

² calculated as % of oleic acid

NA non applicable, no samples

Table 3: Main fatty acid contents and iodine value of the oil of the 2015 soybean survey by province and grade

Province	n	C16:0	C18:0	C18:1	C18:2	C18:3	SATS ²	MUFA ³	PUFA ⁴	Iodine Value ⁵ Units
Soybean, No. 1 Canada and Soybean No. 2 Canada										
Manitoba	85	10.0	4.0	23.1	52.4	8.8	14.8	23.5	61.3	134.1
Saskatchewan	25	10.0	4.4	20.0	54.1	9.9	15.3	20.3	64.1	137.1
Alberta	2	10.1	4.0	17.1	55.8	11.4	15.0	17.4	67.3	141.4
Western Canada	112	10.0	4.0	22.7	52.6	9.0	14.9	23.1	61.7	134.5
Québec	37	10.3	3.8	24.0	52.0	8.2	15.0	24.4	60.3	132.6
Ontario	69	10.4	4.2	22.4	53.1	8.4	15.4	22.8	61.5	133.4
Prince Edward Island	2	10.2	3.2	16.6	58.8	9.7	14.1	16.9	68.5	141.8
New Brunswick	3	10.7	3.7	18.8	55.7	9.5	15.3	19.1	65.2	137.8
Eastern Canada	108	10.4	4.1	22.7	52.9	8.4	15.3	23.0	61.3	133.3
Canada	220	10.3	4.1	22.7	52.8	8.5	15.2	23.1	61.4	133.7
Soybean, No. 3										
Eastern Canada	1	10.3	3.9	20.1	55.4	8.4	15.2	20.4	63.9	135.6
Western Canada	NA									
Canada	1	10.3	3.9	20.1	55.4	8.4	15.2	20.4	63.9	135.6
Soybean, No. 4										
Eastern Canada	1	11.8	4.0	20.2	53.1	9.2	16.6	20.5	62.4	133.8
Western Canada	NA									
Canada	1	11.8	4.0	20.2	53.1	9.2	16.6	20.5	62.4	133.8
Soybean, All grades combined										
Manitoba	85	10.0	4.0	23.1	52.4	8.8	14.8	23.5	61.3	134.1
Saskatchewan	25	10.0	4.4	20.0	54.1	9.9	15.3	20.3	64.1	137.1
Alberta	2	10.1	4.0	17.1	55.8	11.4	15.0	17.4	67.3	141.4
Western Canada	112	10.0	4.0	22.7	52.6	9.0	14.9	23.1	61.7	134.5
Ontario	69	10.4	4.2	22.4	53.1	8.4	15.4	22.8	61.5	133.4
Québec	39	10.4	3.9	23.8	52.2	8.2	15.0	24.2	60.4	132.7
Prince Edward Island	2	10.2	3.2	16.6	58.8	9.7	14.1	16.9	68.5	141.8
New Brunswick	3	10.7	3.7	18.8	55.7	9.5	15.3	19.1	65.2	137.8
Eastern Canada	113	10.4	4.1	22.6	52.9	8.4	15.3	23.0	61.3	133.4
Canada	225	10.3	4.1	22.7	52.9	8.5	15.2	23.0	61.4	133.7

² sum of all saturated fatty acid from C12:00 to C24:0

³ sum of all mono-unsaturated fatty acids (C16:1, C18:1, C20:1, C22:1 and C24:1)

⁴ sum to all poly-unsaturated fatty acids from C18:00 to C22:00

⁵ Calculated from the fatty acid composition

Table 4: Quality data (oil, protein, iodine value and free fatty acid) of the 2014 soybean survey by province

Province	Oil	Protein ₁	FFA ²	C16:0	C18:0	C18:1	C18:2	C18:3	Iodine Value ₃
	% , dry basis			% , in the oil					Units
2014 - Soybean, No. 1 Canada and Soybean No. 2 Canada									
Western Canada	21.0	40.5	0.17	10.4	3.7	20.8	54.3	9.3	136.5
Eastern Canada	20.6	37.3	0.15	10.3	3.7	17.7	56.2	10.5	140.4
Canada	20.9	39.6	0.16	10.4	3.7	20.0	54.8	9.6	137.5
2014 - Soybean, All grades combined									
Manitoba	20.9	37.2	0.12	10.3	3.7	18.0	56.2	10.2	140
Saskatchewan	19.3	37.8	0.28	10.3	3.8	16.5	56.3	11.6	142
Alberta	NA								
Western Canada	20.1	38.1							
Ontario	20.9	40.8	0.18	10.4	3.7	20.8	54.2	9.4	137
Québec	20.8	39.9	0.12	10.2	4.0	20.0	54.9	9.4	137
Prince Edward Island	22.2	21.8	0.16	10.8	3.7	18.3	56.5	9.2	138
New Brunswick	22.5	35.8	0.27	10.1	3.7	19.1	55.4	10.0	139
Eastern Canada	19.5	41.7							
Canada	20.8	39.7	0.16	10.4	3.7	19.7	54.0	9.1	135

¹ calculated from nitrogen content with N x 6.25

² calculated as % of oleic acid

³ calculated from the fatty acid composition

NA non applicable, no sample