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Quality of Canadian oilseed-type soybeans 2021

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Summary

In 2021, the average oil content of the combined Soybeans, No. 1 Canada and Soybeans, No. 2 Canada samples was 22.3% on a dry basis (Tables 1 and 3). This is higher than last year's average of 21.8% (Table 1) and the 5-year average of 21.5% (2016 to 2020). The average protein content of the combined Soybeans, No. 1 Canada and Soybeans, No. 2 Canada samples was 38.6%, which is similar to last year's average of 38.3% and the 5-year average of 38.9%. The average oil and protein content of the combined Soybeans, No. 1 Canada and Soybeans, No. 2 Canada samples varied between the western, eastern and Maritime provinces. Combined samples from western Canada (Manitoba and Saskatchewan) had an oil content of 22.4% and a protein content of 36.0%, whereas combined samples from the eastern provinces (Ontario and Quebec) had an oil content of 22.3% and a protein content of 40.3% (Table 3). However, combined samples from the Maritimes (New Brunswick and Prince Edward Island) had an oil content and protein content of 22.0% and 38.7%, respectively.

Introduction

There are two major types of soybeans grown in Canada:

- those commonly referred to as oilseed-type soybeans (“crush” or non-food grade)
- food-grade soybeans (used for tofu and other soy products)

This report deals with the oilseed-type soybean samples, which are used in the crushing industry and in animal feed production. Oilseed-type soybeans are grown to produce oil and high-protein meal. Soybean oil is used in oil-based salad dressing, shortening and margarine products. The defatted soybean meal, which is protein rich, is used to supplement livestock rations.

The Canadian soybean production area has expanded in recent years and crops are now grown from the Maritimes to the Prairie provinces (Figure 1).

At the end of the 2021 harvest, 333 samples of oilseed-type soybeans had been received by the Harvest Sample Program, much less than in 2020 (506 samples). The 2021 samples originated from Saskatchewan (8), Manitoba (123), Ontario (172), Quebec (23), and the Maritimes (7). Of the submitted samples, 21.3% were graded Soybeans, No. 1 Canada, whereas 77.5% were graded Soybeans, No. 2 Canada, and 1.2% of the samples were graded Soybeans, No. 3 Canada or lower.

Quality data (oil, protein, free fatty acids, chlorophyll and fatty acid composition) for oilseed-type soybeans are based on the means of the combined Soybeans, No. 1 Canada and Soybeans, No. 2 Canada grades. This includes all samples received from western Canada (Manitoba and Saskatchewan), eastern Canada (Ontario and Quebec) and the Maritimes (New Brunswick and Prince Edward Island). Table 1 compares 2021 data to 2020 data, as well as to the 5-year average. Oil and protein content are provided on a dry basis and on a 13% moisture basis. Quality results according to province for Soybeans, No. 1 Canada and Soybeans, No. 2 Canada grades combined are presented in Tables 3 and 4.

Table 1 Quality data for 2021 and 2020 Canadian oilseed-type soybeans plus the 5-year means according to grade

Grade	Quality parameter	2021	2020	2016 to 2020
		n=329	n=464	n=391
Soybeans, No. 1 Canada and Soybeans, No. 2 Canada	Oil content (% dry basis)	22.3	21.8	21.5
	Oil content (% 13% moisture)	19.3	18.9	18.7
	Protein content ¹ (% dry basis)	38.6	38.3	38.9
	Protein content ¹ (% 13% moisture)	33.6	33.3	33.8
	Defatted meal protein of the meal (% 13% moisture)	43.3	42.6	43.1
	Chlorophyll content (mg/kg ² in seed)	0.4	0.8	0.4
	Free fatty acids ³ (%)	0.07	0.13	0.12
	Oleic acid (% in oil)	21.8	20.3	21.4
	Linoleic acid (% in oil)	53.8	54.9	54.1
	α-Linolenic acid (% in oil)	8.2	8.8	9.0
	Total saturated fatty acids ⁴ (% in oil)	15.4	15.2	15.3
	Iodine value (units)	133.6	135.8	135.6

¹ protein content calculated from nitrogen content using N x 6.25

² mg/kg = milligrams per kilogram

³ calculated as % of oleic acid

⁴ sum of all saturated fatty acid from C12:0 to C24:0

Figure 1 Soybean production areas in Canada



Source: [Growing Areas : SOY Canada](#)

Weather and production review

Weather

Eastern and western provinces experienced extreme weather conditions during the 2021 growing season. Soybeans are typically seeded in early May in eastern Canada and from the last week of May to the first week of June in western Canada.

In Ontario, most of the soybeans were planted by mid-May. Lack of soil moisture during planting was the main concern. Freezing temperatures in late May caused frost damage to the emerging crop. Excess rain in July caused flooded fields which turned some of the crop yellow due to the inaccessibility of nitrogen. Harvest started out well and most producers were able to remove their crop by early October.

Manitoba and Saskatchewan experienced extreme drought during the 2021 growing season. In Manitoba, seeding started earlier than usual due to lack of snow and dry soils. Most of the seeding began in early to mid-April. Some of the emerging crop experienced frost damage in late May. During most of June and July there was little to no precipitation. Rain in August did benefit the soybean crop yields. Most of the harvest was completed by mid-October. In Saskatchewan, most of the soybeans were seeded by the last week of May. Lack of topsoil moisture and strong winds were the main causes for concern. Prolonged heat and limited precipitation for much of June and July impacted the quality and yields of many crops. Harvest started early in 2021, with most of the crops in bins by early October.

Sources:

[Province of Manitoba | agriculture - Seasonal Reports \(gov.mb.ca\)](#)

[Crop Report | Crops Statistics | Government of Saskatchewan](#)

[Crop Reports | Field Crop News](#)

Production and grade

Seeded area and production data for 2021 and 2020 are presented in Table 2. In 2021, seeded soybean areas increased to 2,148,700 hectares (ha) from 2,046,800 ha in 2020.

Canada's overall soybean production increased steadily from 2007 to 2018 due to increased production in Ontario and Manitoba. Production in the west has decreased in recent years, however, due mainly to poor weather conditions and uncertainty in the market.

In 2021, soybean production in Canada increased approximately 5% compared to 2020 (Table 2). Approximately 82.9% of Canadian soybeans were produced in eastern Canada, 16.2% in western Canada and 0.9% in the Maritimes. The average yield in Canada decreased in 2021 to 2,940 kilograms per hectare (kg/ha) from 3,115 kg/ha in 2020. Average yields varied across the country, with 3,473 kg/ha in Ontario, 2,969 kg/ha in Quebec, 1,821 kg/ha in Manitoba and 1,481 kg/ha in Saskatchewan.

Table 2 Seeded area and production for Canadian soybeans in 2021 and 2020¹

Province	Seeded area (hectares)		Production (tonnes)		5-year average production (tonnes)
	2021	2020	2021	2020	2016 to 2020
Manitoba	532,900	465,200	963,764	1,162,800	1,606,200
Saskatchewan	34,400	51,300	50,935	68,800	217,860
Western Canada	567,300	516,500	1,014,699	1,231,600	1,824,060
Ontario	1,188,200	1,153,400	4,082,331	3,908,700	3,770,000
Quebec	374,500	358,300	1,101,708	1,159,700	3,122,800
Eastern Canada	1,562,700	1,511,700	5,184,039	5,068,400	6,892,800
Prince Edward Island	14,700	15,500	44,819	39,300	47,380
New Brunswick	4,000	3,100	11,269	5,400	13,825
Maritimes	18,700	18,600	56,088	55,900	75,560
Total Canada	2,148,700	2,046,800	6,254,826	6,344,700	6,843,740

¹ Statistics Canada Table 001-0010 - [Estimated areas, yield, production and average farm price of principal field crops, in metric units.](#)

Harvest samples

In 2021, the Canadian Grain Commission's Harvest Sample Program received 333 soybean samples, down from 506 in 2020 (Table 3). The distribution was as follows:

- 7 from the Maritimes (15 in 2020)
- 195 from eastern Canada (265 in 2020)
- 131 from western Canada (220 in 2020)

Canadian Grain Commission inspectors graded the samples according to [the Official Grain Grading Guide](#). In 2021, 98.8% of the submitted samples were graded Soybeans, No. 1 Canada and Soybeans, No. 2 Canada, while the remaining 1.2% were graded Soybeans, No. 3 Canada or lower. The grade distribution was relatively similar between eastern and western Canada, with 99.0% of the samples from the east (Maritimes, Ontario, and Quebec) graded Soybeans, No. 1 Canada and Soybeans, No. 2 Canada compared to 98.5% from the west (Manitoba and Saskatchewan).

Key quality factors for oilseed-type soybeans are oil content, protein content, free fatty acids (FFA), chlorophyll and fatty acid composition. Oil and protein content give quantitative estimates of soybean oil and of the defatted meal used for protein in animal feed. Fatty acid composition provides information about the nutritional, physical and chemical characteristics of the oil extracted from the beans.

Individual samples were analyzed for oil and protein content using a FOSS DS2500 near-infrared (NIR) spectrometer, calibrated and verified against the appropriate samples analysed by reference methods. Grade composite samples were analysed by reference methods for oil, protein, FFA, chlorophyll and fatty acid composition. [Oilseed method and test procedures](#) are available on our website.

Oil and protein content

The average oil content was 22.3% on a dry basis (19.3% at 13% moisture) for Soybeans, No. 1 Canada and Soybeans, No. 2 Canada. This is higher than in 2020 (21.8% on a dry basis, 18.9% at 13% moisture) and the 5-year average of 21.5% (18.7% at 13% moisture) (Table 1). For the top two grades combined, the oil content of individual samples ranged from 19.1% on a dry basis (16.6% at 13% moisture) to 24.9% on a dry basis (21.7% at 13% moisture). Figure 4 shows the oil content trend for eastern, western and all of Canada since 2006.

The average protein content was 38.6% on a dry basis (33.7% at 13% moisture) (Table 1). This is slightly higher than the results in 2020 (38.3% on a dry basis, 33.3% at 13% moisture) and similar to the 5-year average (38.9% on a dry basis, 33.8% at 13% moisture). Samples from eastern Canada had a higher protein content (40.3%) than western Canada (36.0%) and the Maritimes (38.7%) (Table 3). For the top two grades combined, the protein content of individual samples ranged from 29.7% (25.8% at 13% moisture) to 45.0% (39.2% at 13% moisture). Figure 2 shows the protein content trends from eastern and western Canada since 2006. Average protein content in western Canada has been consistently lower and showed slightly more yearly variability than that in eastern Canada.

Figure 3 presents the protein content of fully defatted soybean meal. The protein content of the defatted soybean meal from western Canada is lower (46.3%) than that in samples from eastern Canada (52.1%). This reflects the difference in the protein content of the seed between the two regions.

As is true for all oilseeds, there typically is an inverse relationship between oil and protein content for Canadian soybeans: the higher the oil content, the lower the protein. In 2021, protein content was similar to 2020, while oil content increased compared to 2020.

Environmental growing conditions are usually responsible for year-to-year variations, whereas genetics, or varietal differences, are usually responsible for trends over several years. A combination of genetics and environmental growing conditions is responsible for differences between eastern and western soybeans. Currently, breeding focuses primarily on yield and other agronomic factors. Quality factors, such as oil or protein content, are not considered when registering new soybean varieties in Canada.

Fatty acid composition

Table 4 shows the fatty acid composition of the combined Soybeans, No. 1 Canada and Soybeans, No. 2 Canada composites from the various provinces in 2021. Linoleic acid (C18:2), the main fatty acid found in soybean oil, averaged 53.8%, whereas the 2020 average was 54.9%. Oleic acid (C18:1), the second most important fatty acid in soybeans, averaged 21.9% in 2021, which is much higher than the 2020 value of 20.3%. The other important unsaturated fatty acid, α -linolenic acid (C18:3), averaged 8.2% (8.8% in 2020). Total saturates had an average level of 15.4% in soybeans from all of Canada.

Iodine value estimates the level of fatty acid unsaturation in oil. The higher the number of double bonds in the oil, the higher the iodine value and level of unsaturation. For 2021, both the average α -linolenic acid and the average linoleic acid values were lower than in 2020 and accordingly, the iodine values in 2021 (133.6 units) are lower than in 2020 (135.8 units). Figure 5 presents the iodine value trend since 2006 for eastern Canada, western Canada and all of Canada. The yearly variations reflect the environmental differences, including geographic factors and climatic factors such as temperature and precipitation.

There is no requirement to control the fatty acid composition of Canadian oilseed-type soybeans. Varieties can, therefore, show a large variation in fatty acid composition. Weather also plays a role in year-to-year fatty acid composition variability. In hot and dry conditions, seeds tend to produce an oil with more saturation. For example, seeds will produce less polyunsaturated fatty acids, such as α -linolenic and linoleic acids, and more total saturates and oleic acids. The opposite is observed if seeds are grown in cool conditions.

Free fatty acid content

Grade composites of Soybeans, No. 1 Canada and Soybeans, No. 2 Canada had FFA levels averaging 0.07% in 2021 (Tables 1 and 3), which is lower than results in 2020 (0.13%). High FFA values are mainly due to seed damage caused by wet harvest conditions and improper storage.

Chlorophyll content

Chlorophyll content is an indicator of maturity in soybeans: the lower the chlorophyll the more mature the seed. Chlorophyll content for the top grades was higher in the western provinces at 0.6 milligrams per kilograms (mg/kg) compared to the eastern and Maritime provinces at 0.2 mg/kg and 0.1 mg/kg, respectively (Table 3).

Figure 2 Seed protein content (% dry basis) of Canadian oilseed-type soybeans from 2006 to 2021

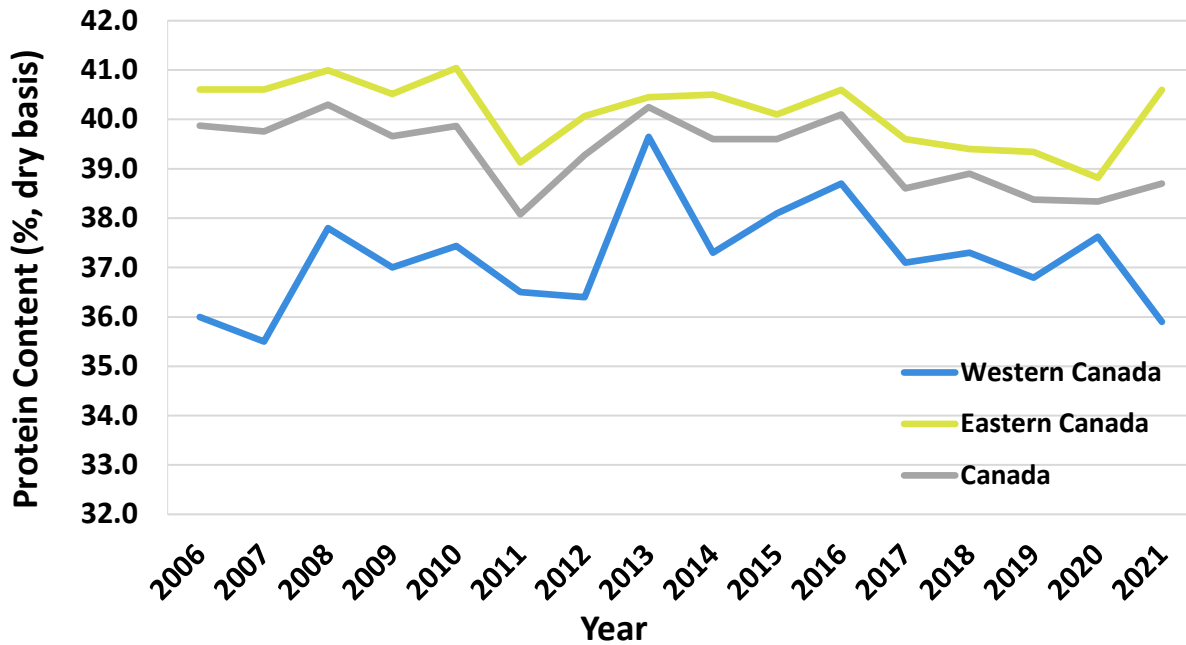


Figure 3 Defatted meal protein content (% dry basis) of Canadian oilseed-type soybeans from 2006 to 2021

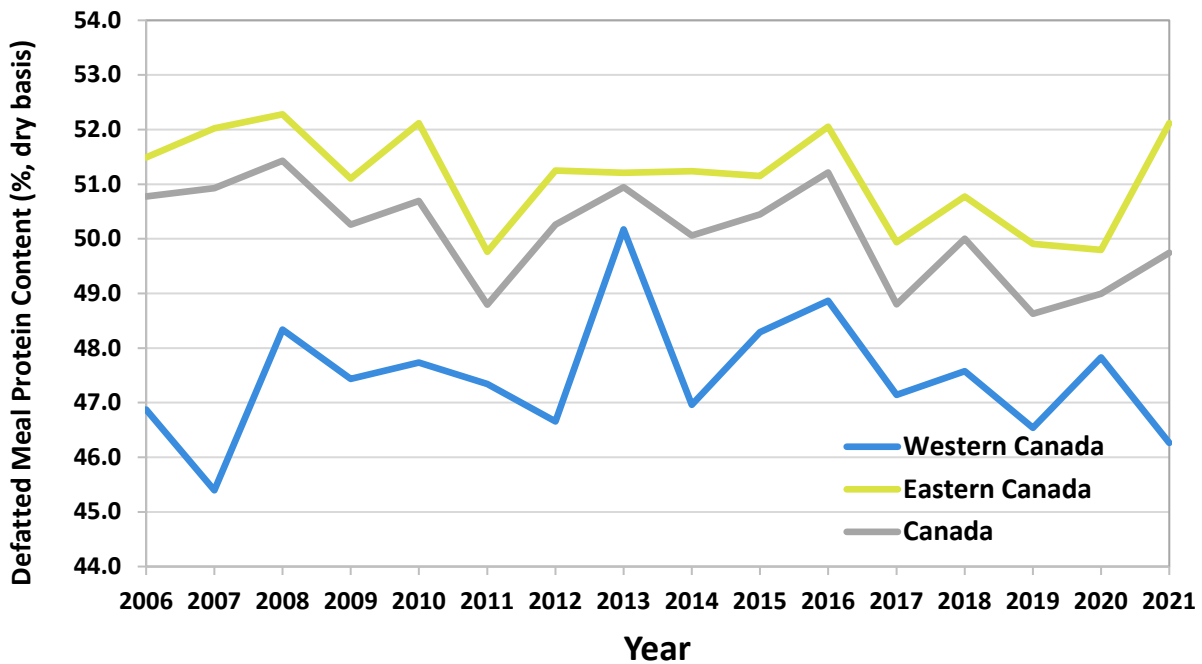


Figure 4 Seed oil content (% dry basis) of Canadian oilseed-type soybeans from 2006 to 2021

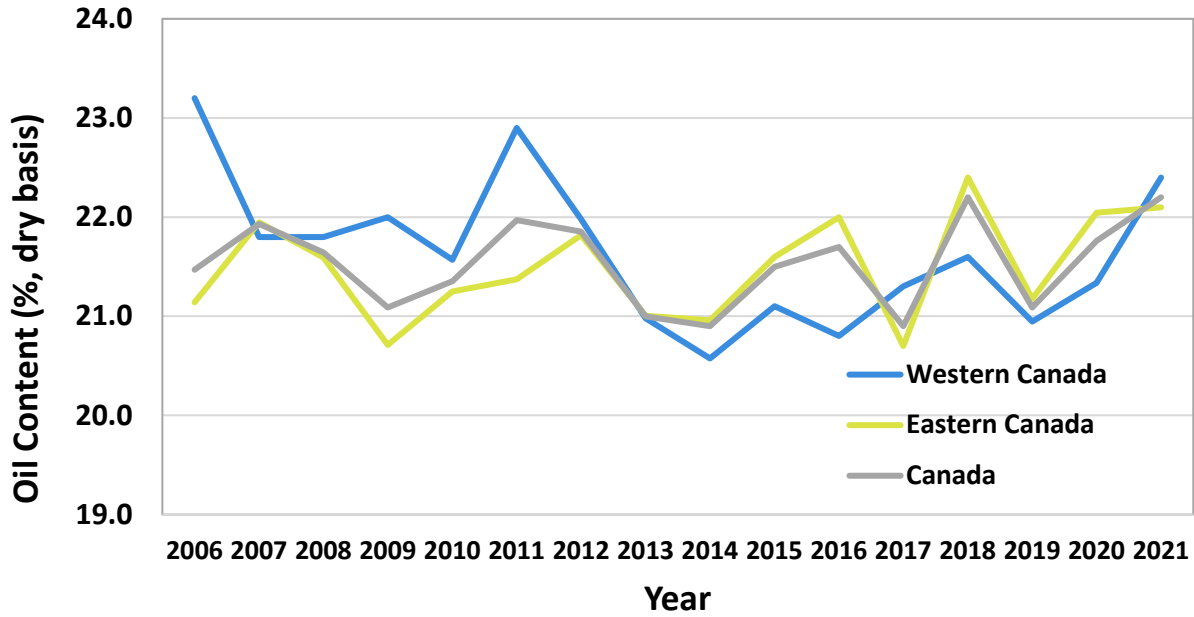


Figure 5 Oil iodine values (units) of Canadian oilseed-type soybeans from 2006 to 2021

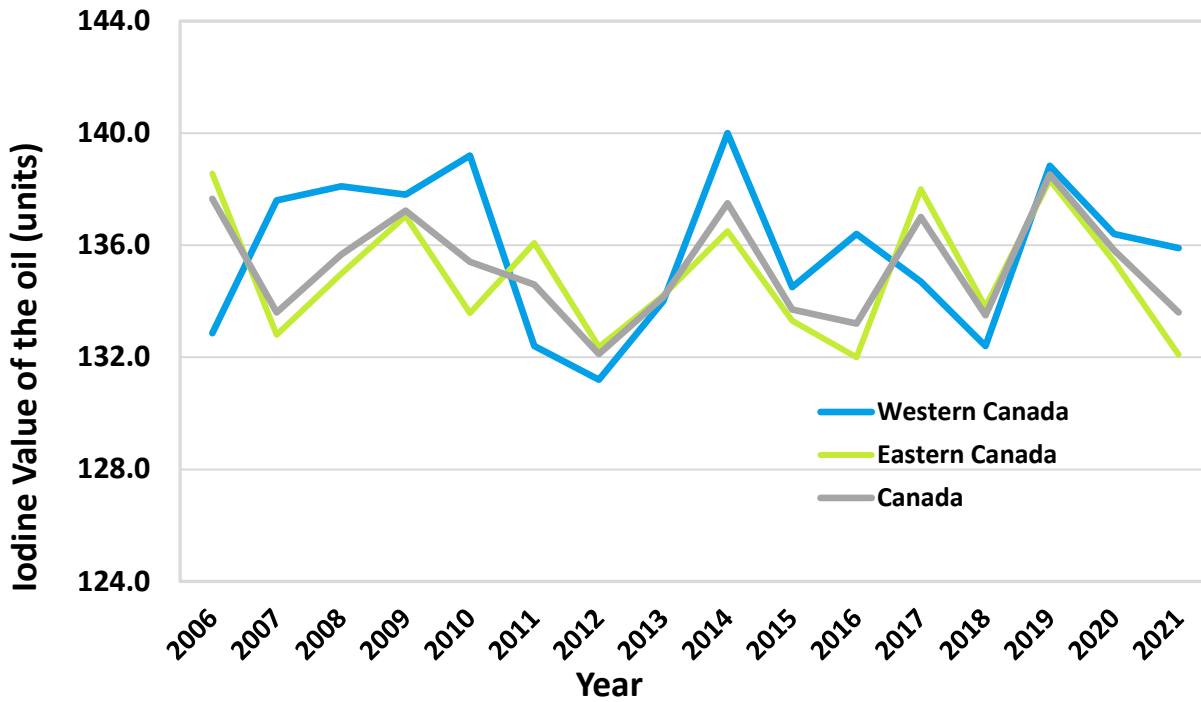


Table 3 Oil (% , dry basis), protein (% , dry basis), chlorophyll (mg/kg) and free fatty acid (%) content of 2021 Soybeans, No. 1 Canada and Soybeans No. 2, Canada composite samples according to province

Grade	Province	Number of samples	Oil			Protein ¹			Chlorophyll	Free fatty acids ⁴
			Mean	Min ²	Max ³	Mean	Min	Max		
Soybeans, No. 1 Canada and Soybeans, No. 2 Canada	Manitoba	121	22.4	19.6	24.9	36.0	29.7	41.9	0.60	0.02
	Saskatchewan	8	21.7	19.9	22.8	36.3	34.5	38.1	0.90	0.01
	Western Canada	129	22.4	19.6	24.9	36.0	29.7	41.9	0.62	0.02
	Ontario	170	22.3	20.4	24.9	40.4	37.2	43.8	0.20	0.10
	Quebec	23	22.4	19.1	24.6	39.9	33.1	45.0	0.30	0.10
	Eastern Canada	193	22.3	19.1	24.9	40.3	33.1	45.0	0.21	0.10
	Maritimes	7	22.0	20.9	23.4	38.7	37.4	40.4	0.10	0.10
	Canada	329	22.3	19.1	24.9	38.6	29.7	45.0	0.37	0.07

¹ calculated from nitrogen content with N x 6.25

² Min = minimum

³ Max = maximum

⁴ calculated as % of oleic acid.

Table 4 Main fatty acid content (% in oil) and iodine value (units) of oil in 2021 Soybeans, No. 1 Canada and Soybeans, No. 2 Canada composite samples according to province

Grade	Province	Number of samples	Palmitic C16:0	Stearic C18:0	Oleic C18:1	Linoleic C18:2	α -Linolenic C18:3	SFA ¹	Iodine value ²
Soybeans, No. 1 Canada and Soybeans, No. 2 Canada	Manitoba	121	10.3	4.0	20.5	55.4	8.5	15.2	135.8
	Saskatchewan	8	10.3	4.2	18.9	55.9	9.1	15.3	137.1
	Western Canada	129	10.3	4.0	20.4	55.5	8.5	15.2	135.9
	Ontario	170	10.8	4.0	23.3	52.4	7.9	15.6	131.7
	Quebec	23	10.8	3.8	21.7	54.0	7.9	15.5	133.2
	Eastern Canada	193	10.8	4.0	23.1	52.6	7.9	15.6	131.9
	Maritimes	7	11.4	3.5	18.2	56.1	9.5	15.4	137.9
	Canada	329	10.6	3.9	21.9	53.8	8.2	15.4	133.6

¹ SFA = saturated fatty acids, sum of all saturated fatty acids from C12:0 to C24:0

² calculated from the fatty acid composition

Acknowledgments

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