



Canadian Grain
Commission

Commission canadienne
des grains

ISSN 2560-7545

Quality of Canadian oilseed-type soybeans

2017

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Summary

In 2017 the average oil content for Soybean, No. 1 and No. 2 grades combined, was 20.9% on a dry matter basis (Table 1 and 3). This was lower than last year's average of 21.7% (Table 1) and the 5-year average (2012-16) of 21.4%. The average protein content for Soybean, No. 1 and No. 2 grades was 38.6%, which was lower than last year's 40.1% and the 5-year average 39.8%. 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 21.0% and a protein content of 37.4%, whereas Saskatchewan had an oil content of 21.9% and a protein content of 36.1%. Alberta had a similar result as Saskatchewan with oil content of 21.4% and protein of 36.0%. In the east Ontario's oil content was 20.9% and a protein content of 39.4%; Québec's oil content was 20.1% and protein content of 40.3%; while New Brunswick had an oil content and protein content of 21.2% and 37.3%, respectively. Unfortunately, we received no samples from Prince Edward Island or Nova Scotia this year.

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. We also, acknowledge the work of the Industry Services Division of the Canadian Grain Commission in grading producer samples. The technical assistance of the Oilseeds staff in the Grain Research Laboratory is recognized.

Introduction

Canadian soybean growing area has expanded over the last couple of years so that they are now a crop grown countrywide from the Maritimes to the Prairie Provinces (Figure 1).

This harvest survey report is based on 437 samples of oilseed-type soybean (previously described as non-food grade), more than what was received in 2016 (371). Samples were from Manitoba (106), Saskatchewan (37), Alberta (6), Ontario (209), Québec (60), and New Brunswick (19). Of the submitted samples, 32.3% graded Soybean, No. 1 Canada; 65.4% Soybean, No. 2 Canada; 1.1% Soybean, No. 3 Canada; 0.7% Soybean, No. 4 Canada and 0.5% as Soybean, No.5 Canada.

Quality data (oil, protein, free fatty acid, chlorophyll and 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 the Maritimes (New Brunswick), central Canada (Ontario and Québec), and western Canada (Manitoba, Saskatchewan and Alberta). Table 1 compares this year's data to last year and to the 5-year average. In Table 1, we have provided the oil and protein content on a dry matter basis and on a 13% moisture basis. Quality results for all combined grades for each province are in Tables 3 and 4.

Table 1: Soybeans, No. 1 and No. 2 Canada: Quality data for 2017 and 2016 harvest plus the 5-year means

Quality parameter	2017	2016	2012-16 Mean
Number of Soybean, No. 1 and No. 2 Canada samples	427	363	298
Oil content (% dry basis)	20.9	21.7	21.4
Oil content (% 13% moisture)	18.2	18.9	18.6
Protein content ¹ (% dry basis)	38.6	40.1	39.8
Protein content (% 13% moisture)	33.6	34.9	34.6
Oil-free protein of the meal (% 13% moisture)	42.5	44.6	44.1
Chlorophyll content (mg/kg in seed)	0.3	0.4	0.3
Free fatty acids ² (%)	0.13	0.12	0.11
Oleic acid (% in oil)	22.0	22.7	22.1
Linoleic acid (% in oil)	54.4	53.1	53.2
Linolenic acid (% in oil)	9.6	8.2	8.7
Total saturated fatty acids ³ (% in oil)	15.2	15.3	15.3
Iodine value	137.0	133.2	134.1

¹ Protein content calculated from nitrogen content using N x 6.25

² calculated as % of oleic acid

³ sum of all saturated fatty acid from C12:00 to C24:0

Figure 1: Soybean production area in Canada



Source: Soy Canada

Weather and production review

Weather review

In Ontario, a wet spring followed by a relatively cool summer resulted in challenging planting conditions, reduced stands and slow growth, according to the Ontario Crop Report (OMAFRA). Some regions started the season with wet conditions but turned dry in August and September. In spite of these challenges overall yields turned out close to average while conditions did influence quality factors, such as protein.

Favourable weather and good field conditions in Manitoba and Saskatchewan allowed seeding operations to start in early May and finish by the end of the month. Timely rains and cool conditions in early June allowed the crop to progress well but iron chlorosis was an issue in some areas. The general lack of moisture during July and August negatively affected the soybean development during the pod filling stage. The negative impact of these conditions included lower the expected yields and lower protein content. Dry conditions during September and October allowed the harvest to progress with few problems; most of the crop was harvested by mid-October.

Source:

Ontario crop report: <http://www.omafra.gov.on.ca/english/crops/field/reports/2017summary-soybean.htm>

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>

Saskatchewan specialty crop report: <http://publications.gov.sk.ca/documents/20/105205-Specialty%20Crop%20Report%202017.pdf>

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

Production and grade information

Seeded area and production data for 2017 and 2016 are in Table 2. In 2017, the seeded soybean area in western Canada increased by 67% and in central Canada 13%. Since 2007, soybean production in Canada has been steadily increasing (Figure 2). This year's production increased by over 17% compared to last year; from 6.55 million tonnes to 7.72 million tonnes. The biggest increase in production was in western Canada 38% followed by central Canada at 9%. The production increase was primarily due to an increase in the seeded area since the average yield in Canada decreased from 3,000 kg/ha in 2016 to 2,800 kg/ha in 2017. Central Canada accounts for 63.6% of Canada's total production while western Canada is at 35.3%.

Figure 2: Historic soybean production data in Canada, 2000 to 2017

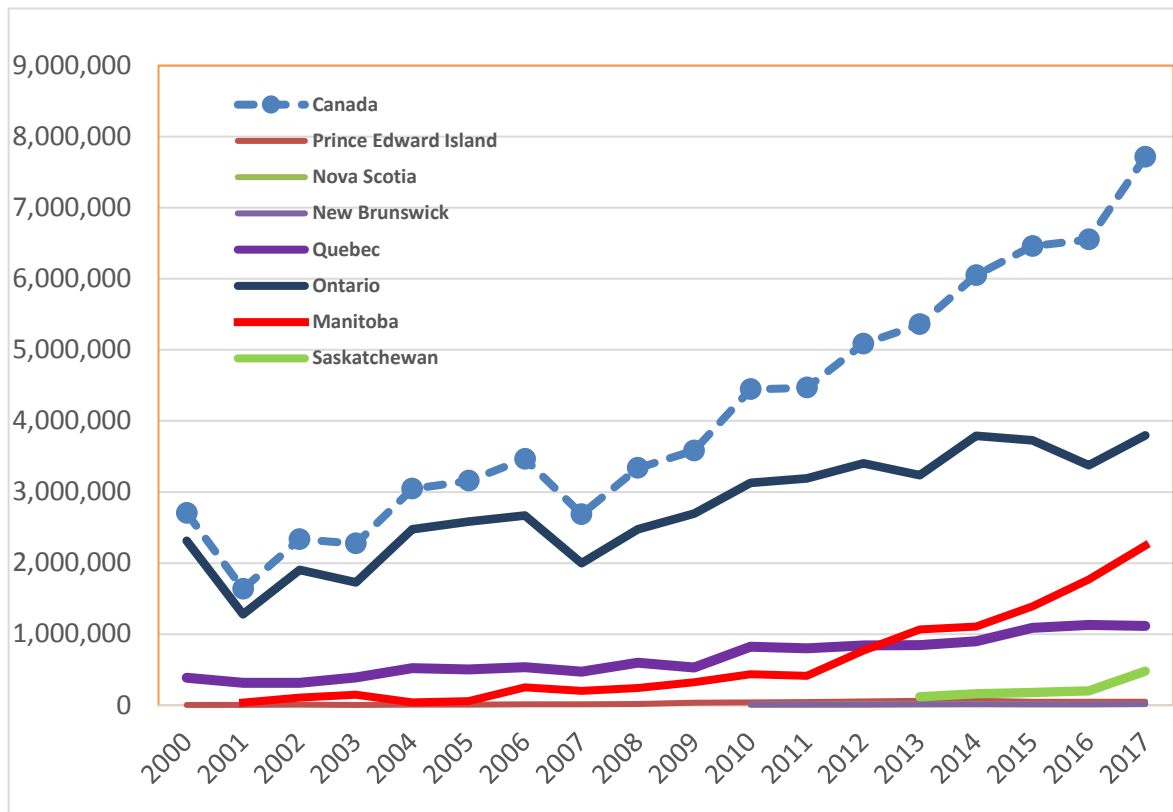


Table 2: Seeded area and production for Canadian soybeans¹

Province	Seeded area		Production		5-Year average production
	2017	2016	2017	2016	2012-16
	Hectares		Tonnes		Tonnes
Manitoba	926,700	661,700	2,245,300	1,769,000	1,221,160
Saskatchewan	344,000	97,100	479,000	202,500	165,950
Alberta	n/a ²				
Western Canada	1,270,700	758,800	2,724,300	1,971,500	1,353,920
Québec	398,000	353,000	1,115,000	1,129,400	961,100
Ontario	1,244,400	1,096,700	3,796,600	3,374,700	3,506,960
Central Canada³	1,642,400	1,449,700	4,911,600	4,504,100	4,468,060
Prince Edward Island	20,200	21,400	49,000	49,000	53,840
New Brunswick	5,100	4,500	15,500	12,800	12,600
Nova Scotia	8,500	6,100	16,200	14,700	12,600
Maritimes	33,800	32,000	80,700	76,500	79,040
Total Canada	2,946,900	2,240,500	7,716,600	6,552,100	5,901,020

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&id=10017>)

² Data not available

³ In this table Central Canada represents Ontario and Québec

Harvest survey samples

For the 2017 soybean survey 437 samples were received, 288 from eastern Canada and 149 from western Canada (Table 3). Canadian Grain Commission inspectors graded these samples according to the Official Grain Grading Guide (<http://www.grainscanada.gc.ca/oggg-gocg/20/oggg-gocg-20-eng.htm>). In the 2017 survey, 97.7% of the submitted samples were in the top 2 grades. A few samples (2.3%) were graded Soybean, No. 3 Canada and lower.

Individual samples were analyzed for oil and protein content using either a FOSS NIRSystems 6500 or a DS2500 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>.

The data presented in this report for areas where a low number of samples were received might not reflect the true quality of the crop. The average data presented in this report were weighted using a combination of

provincial production data (2017 as reported by Statistics Canada, <http://www5.statcan.gc.ca>) and sample numbers from the area.

There are two major types of soybeans grown in Canada: those commonly referred to as oilseed-type beans (“crush” or non-food grade) and food grade beans (used for tofu and other soy products). This report deals with the oilseed-type soybean samples used for the feed or crushing industry.

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 are 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 protein content was 38.6% in 2017, significantly lower than last year (40.1%) and lower than the 5-year average (2012-16) of 39.8%. Samples from central Canada showed a higher protein content than from the Maritimes and western Canada (39.6% for central Canada, 37.3 % for the Maritimes and 37.1% for western Canada). For all grades combined individual producer samples ranged in protein from 29.9% to 44.2%. Figure 3 shows the protein content trend since 2006 eastern (Québec, Ontario and Maritimes) and western Canada (Manitoba, Saskatchewan and Alberta). Western averages were consistently lower than eastern averages from 2006. Western yearly averages also show high yearly variability when compared eastern averages.

The average oil content was 20.9% (Tables 1 and 3) for soybean graded No. 1 and No. 2 Canada lower than what was observed in 2016 at 21.7% (Table 1) and the 5-year average of 21.4%. There were noticeable difference between the averages of soybean No. 1 and No. 2 Canada between the different provinces, with samples from Saskatchewan (21.9%) having higher oil contents than those from Quebec (20.1%) (Table 3). All grades combined, individual samples ranged from 16.9% to 25.1% oil. Figure 4 shows the oil content trend since 2006 for eastern, western and all of Canada. There is a marked difference between the eastern and western averages but it varies from year to year due to environmental growing conditions and varietal differences.

Important variations in protein and oil contents in the top two grades were observed among all provinces and between eastern and western provinces (Table 3). While quality parameters are influenced by environmental conditions, the variety and soil fertility will also affect quality. Typically, there is an inverse relationship between oil and protein content for eastern and western Canada soybeans, the higher the oil content lower the protein.

Fatty acid composition

Table 4 shows fatty acid composition for the combined No. 1 and 2 grade composites from the various provinces. Linolenic acid (C18:2), the main fatty acid found in soybean oil, averaged 54.4% and ranged from 52.5% to 55.7%, whereas last years average was 53.1% with a range from 52.6% to 55.1%. Oleic acid, the second most important soybean fatty acid, averaged 20.0% in 2017 that is lower than the 2016 value of 22.7%. The other important unsaturated fatty acid, α -linolenic acid (C18:3), averaged 9.6% in 2017 (8.2% in 2016) and ranged from 8.7% to 10.4%. Total saturates averaged 15.2% in Canada varying from 15.0% (Québec) to 15.7% (Alberta).

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 the level of unsaturation. For 2017 the α -linolenic acid average was higher than last year; this is reflected in the iodine values being higher to last year, 137.0 units in 2017 versus 133.2 units in 2016. Figure 5 presents the iodine value trend since 2006 for eastern Canada and western Canada and the overall Canadian averages. The yearly variations are a reflection of the environmental differences that includes geography (temperature and precipitation being different between eastern and western Canada).

Up until this year eastern Canada was growing over twice the amount of soybean than western Canada, therefore Canadian averages were weighted towards eastern averages. In 2017, eastern Canada produced about 1.8 times more soybean than western Canada. If production keeps increasing in the west, the Canadian averages will reflect both production areas equally.

Free fatty acid (FFA) content

Grade composites of Soybean, No. 1 Canada and Soybean, No. 2 Canada showed free fatty acid levels averaging 0.13% in 2017 (Table 1 and 3). This is similar to last year's results (0.12%).

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. Free fatty acid levels could increase during storage due to storage and environmental conditions.

Figure 3: Protein content averages of Canadian oilseed type soybean, 2006 to 2017



Figure 4: Oil content averages of Canadian oilseed type soybean, 2006 to 2017

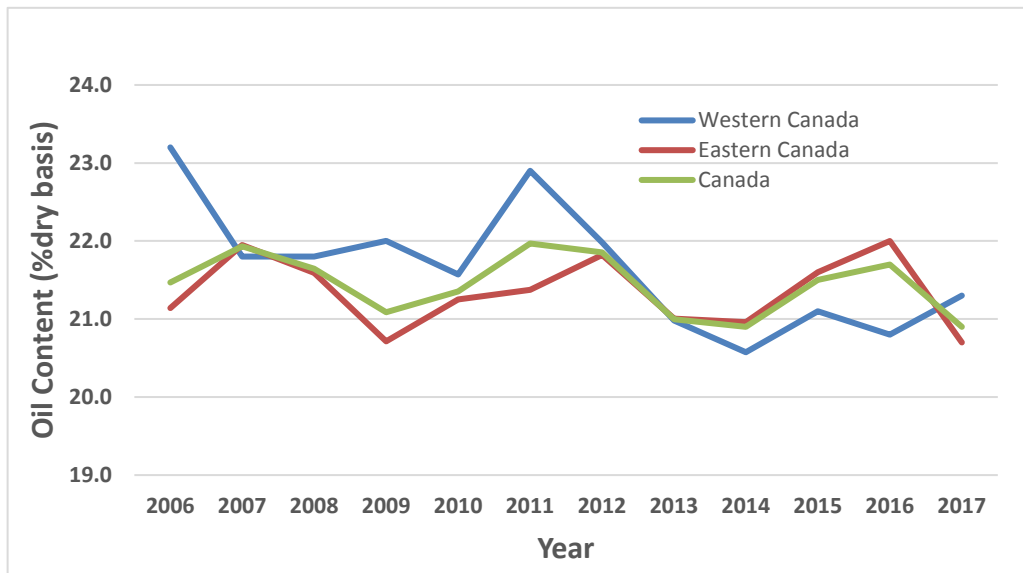


Figure 5: Iodine value averages of Canadian oilseed type soybean, 2006 to 2017

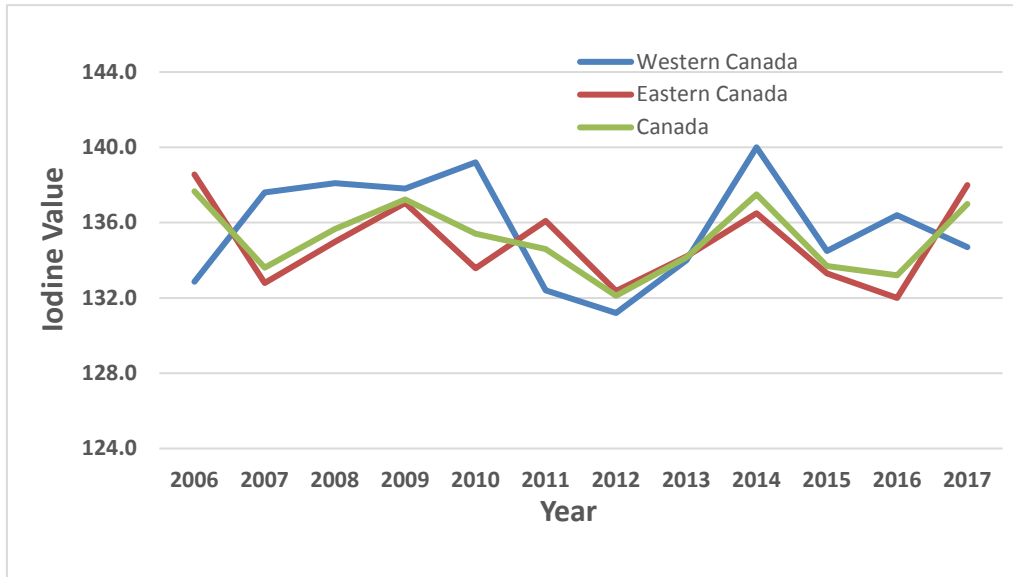


Table 3: Oil, protein, chlorophyll contents and free fatty acid content of the oil of the 2017 soybean survey by province and grade

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	104	21.0	18.2	23.4	37.4	33.0	41.2	0.5	0.17
Saskatchewan	31	21.9	18.7	24.3	36.1	29.9	40.9	1.2	0.09
Alberta	6	21.4	17.6	24.3	36.0	31.4	38.6	1.7	0.15
Western Canada	141	21.3	17.6	24.3	37.1	29.9	41.2	0.7	0.15
Ontario	209	20.9	16.9	25.1	39.4	35.1	43.7	0.3	0.12
Québec	58	20.1	17.9	22.2	40.3	35.0	44.2	0.2	0.13
Central Canada	267	20.7	16.9	25.1	39.6	35.0	44.2	0.2	0.12
Prince Edward Island	NA								
New Brunswick	19	21.2	19.4	21.9	37.3	33.5	39.9	0.0	0.02
Nova Scotia	NA								
Maritimes	19	21.2	19.4	21.9	37.3	33.5	39.9	0.0	0.02
Canada	427	20.9	16.9	25.1	38.6	29.9	44.2	0.4	0.13
Soybean, No. 3									
Western Canada	5	22.2	18.4	24.0	35.3	32.6	39.8	2.8	0.13
Eastern Canada ³	NA								
Canada	5	22.2	18.4	24.0	35.3	32.6	39.8	2.8	0.13
Soybean, No. 4									
Western Canada	2	22.6	21.5	23.5	35.2	33.5	38.0	4.8	0.11
Eastern Canada	1	19.8			39.3			0.1	0.26
Canada	3	21.7	19.8	23.5	36.6	33.5	38.0	3.2	0.16
Soybean, No. 5									
Western Canada	1	23.0			33.7			5.8	0.03
Eastern Canada	1	21.8			42.5			0.0	0.70
Canada	2	22.4	21.8	23.0	38.1	33.7	42.5	2.9	0.37
Soybean, All grades combined									
Western Canada	149	21.3	17.6	24.3	37.0	22.9	41.2	0.9	0.15
Eastern Canada	288	20.8	16.9	25.1	39.4	33.5	44.2	0.2	0.12
Canada	437	20.9	16.9	25.1	38.6	29.9	44.2	0.4	0.13

¹ calculated from nitrogen content with N x 6.25

² calculated as % of oleic acid

³ Eastern Canada represent Central Canada and the Maritimes

NA non applicable, no samples

Table 4: Main fatty acid contents and iodine value of the oil of the 2017 soybean survey by province and grade

Province	N	C16:0	C18:0	C18:1	C18:2	C18:3	SATS ¹	Iodine Value ² Units
%, in oil								
Soybean, No. 1 Canada and Soybean No. 2 Canada								
Manitoba	104	9.8	4.4	21.6	53.5	9.0	15.1	135.2
Saskatchewan	31	9.9	4.6	22.5	52.5	8.7	15.5	133.3
Alberta	6	9.9	4.8	22.3	52.5	8.7	15.7	133.2
Western Canada	141	9.8	4.5	21.9	53.2	8.9	15.2	134.7
Ontario	209	10.5	4.0	19.2	54.8	9.9	15.3	137.7
Québec	58	10.2	3.9	18.6	55.3	10.4	15.0	139.3
Central Canada	267	10.5	4.0	19.1	54.9	10.0	15.3	138.0
Prince Edward Island	NA							
New Brunswick	19	10.2	4.1	18.5	55.7	9.9	15.2	138.6
Nova Scotia	NA							
Maritimes	19	10.2	4.1	18.5	55.7	9.9	15.2	138.6
Canada	427	10.3	4.1	20.0	54.4	9.6	15.2	137.0
Soybean, No. 3								
Western Canada	5	9.5	4.7	23.5	51.9	8.5	15.3	132.6
Eastern Canada ³	NA							
Canada	5	9.5	4.7	23.5	51.9	8.5	15.3	132.6
Soybean, No. 4								
Western Canada	2	9.9	4.9	25.3	50.9	7.0	16.0	128.6
Eastern Canada	1	10.1	4.0	21.1	52.9	10.2	15.0	136.9
Canada	3	10.0	4.6	23.9	51.6	8.1	15.7	131.3
Soybean, No. 5								
Western Canada	1	10.0	4.9	26.2	50.2	6.8	16.0	127.6
Eastern Canada	1	10.0	3.8	22.8	55.2	6.1	14.7	131.5
Canada	2	10.0	4.3	24.5	52.7	6.4	15.4	129.5
Soybean, All grades combined								
Western Canada	149	9.8	4.5	22.0	53.1	8.9	15.2	134.5
Eastern Canada	288	10.5	4.0	19.0	55.0	10.0	15.3	138.0
Canada	437	10.2	4.2	20.0	54.4	9.6	15.2	136.8

¹ sum of all saturated fatty acid from C12:00 to C24:0

² Calculated from the fatty acid composition

³ Eastern Canada represent Central Canada and the Maritimes

NA non applicable, no samples