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Quality of western Canadian canola 2021

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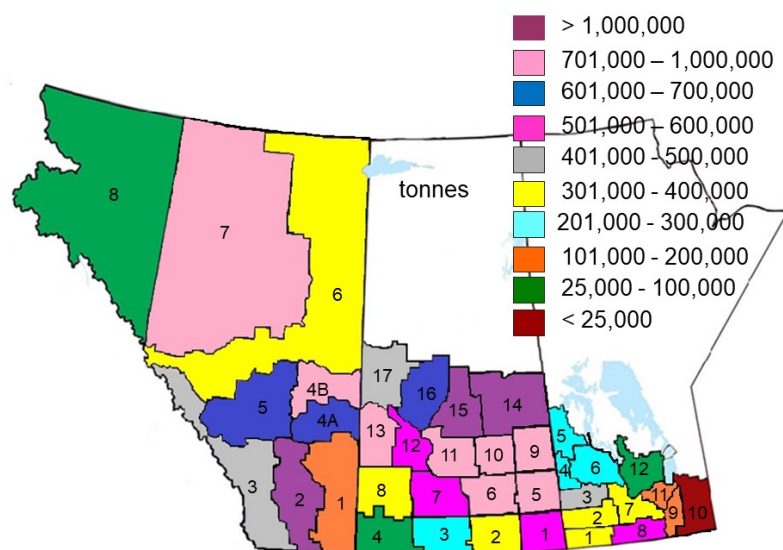
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Introduction

This report presents quality data and information based on the Canadian Grain Commission's 2021 Harvest Sample Program results of western Canadian canola. Canola samples were submitted throughout the harvest period by producers, grain companies and oilseed crushing companies. The following canola quality parameters were measured: oil, protein, chlorophyll, total glucosinolates, free fatty acids and fatty acid composition.

Figure 1 shows the distribution of the 2020 canola production in western Canada according to crop districts in Manitoba and Alberta, and census agricultural regions (CARs) in Saskatchewan. Prior to 2018, all production reporting in the prairie provinces was based on small area data (SAD) that corresponded to crop districts. In 2018, Statistics Canada began using CARs to describe production areas in Saskatchewan instead of SAD. The new CARs approach did not correspond well with the crop districts in Saskatchewan, affecting the comparison of historical quality data. Samples received from the Peace River area of British Columbia (crop district No. 8) were combined with Alberta (crop district No. 7) samples. Averages of these samples will be referred to as Alberta-Peace River.

Figure 1 2020 canola production (tonnes) in western Canada according to crop districts (Manitoba and Alberta-Peace River) and census agricultural regions (Saskatchewan)



Summary

The 2021 harvest had a similar percentage of samples graded Canola, No. 1 Canada (90.6%) when compared to the 2020 harvest (90.5%) and a higher percentage when compared to the 5-year average (88.1%; Table 1). Alberta-Peace River showed the lowest percentage of samples graded Canola, No. 1 Canada, with 84.2% (90.8% in 2020), followed by Manitoba with 93.9% (92.2% in 2020) and Saskatchewan with 94.3% (89.4.2% in 2020). Crop districts No. 7 (73.1%), 3 (77.2%) and 6 (77.3%) from Alberta-Peace River, in the western part of the province, showed the lowest percentage of samples graded Canola, No. 1 Canada.

The 2021 western Canola, No. 1 Canada crop was characterized by an average oil content that was much lower than that measured in the 2020 crop (41.3% versus 44.1%) and a much higher average protein content (24.0% versus 20.8%; Table 1). The average chlorophyll content for Canola, No. 1 Canada samples was identical in 2021 and 2020 (10 mg/kg; Table 1). In 2021, the average total seed glucosinolate content of 12 micromole per gram ($\mu\text{mol/g}$) was higher than the 2020 value of 9 $\mu\text{mol/g}$.

The fatty acid compositions of the 2021 and 2020 crops are presented in Table 1. The 2021 average oleic acid content is slightly higher than in 2020 (64.2% versus 63.9%) and higher than the 5-year-average (63.2%). Alpha-linolenic acid content in 2021 was slightly lower than in 2020 (8.6% versus 8.9%) while linoleic acid content was unchanged (18.3%). Total saturated fatty acid content for the 2021 canola crop was slightly lower than in 2020 (6.6% versus 6.8%). This resulted in a slightly lower iodine value for the 2021 canola crop when compared to 2020 (110.9 versus 111.2 units).

Average free fatty acid content in 2021 Canola, No. 1 Canada seed (0.24%) was slightly higher than in 2020 (0.15%; Table 1) with some Manitoba crop district averages higher than 0.40%.

Table 1 Quality data for 2021 and 2020 harvest samples and 5-year means for Canola, No. 1 Canada

Quality parameter	2021	2020	2016 to 2020 mean
Number of received samples	2185	2430	2296
Number of Canola, No. 1 Canada samples	1979	2199	2017
Percentage of samples graded Canola, No. 1 Canada	90.6	90.5	88.1
Oil content (% , 8.5% moisture)	41.3	44.1	44.4
Protein content ¹ (% ,)	24.0	20.8	20.5
Oil-free protein of the meal (% , 12% moisture) ²	42.0	38.6	38.3
Chlorophyll content (mg/kg ³ in seed)	10	10	11
Total seed glucosinolates (µmol/g ⁴ , 8.5% moisture)	12	9	10
Oil-free total glucosinolates of the meal (µmol/g ⁴ , 8.5% moisture)	20	18	19
Free fatty acids (%)	0.24	0.15	0.16
Oleic acid (% in oil)	64.2	63.9	63.2
Linoleic acid (% in oil)	18.3	18.3	18.6
α-Linolenic acid (% in oil)	8.6	8.9	9.3
Erucic acid (% in oil)	0.01	0.01	0.01
Total saturated fatty acids ⁵ (% in oil)	6.6	6.8	6.7
Iodine value (unit of oil)	110.9	111.2	112.4
Total monounsaturated fatty acids (MUFA) ⁶ (% in oil)	65.8	65.4	64.8
Total polyunsaturated fatty acids (PUFA) ⁷ (% in oil)	27.0	27.3	28.0

¹ protein content calculated from nitrogen content using N x 6.25, 8.5% moisture basis

² trading rules for the North American sale of canola meal requires that calculations for protein claims must be reported on a 12% moisture basis with N x 6.25

³ mg/kg = milligrams per kilogram

⁴ µmol/g = micromole per gram

⁵ total saturated fatty acids are the sum of lauric (C12:0), myristic (C14:0), palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0) and lignoceric (C24:0)

⁶ total monounsaturated fatty acids are the sum of palmitoleic (C16:1), oleic (C18:1), eicosenoic (C20:1), erucic (C22:1) and nervonic (C24:1) acids

⁷ total polyunsaturated fatty acids are the sum of linoleic (C18:2), linolenic (C18:3) and eicosadienoic (C20:2) acids

Weather and production review

Weather

The weather review and weather maps (Figures 2 to 5) were obtained from [Agriculture and Agri-Food Canada](#).

Seeding and harvest progress graphs for each province (Figures 6a and 6b) were made using data reported by the provincial reports for [Manitoba](#), for [Saskatchewan](#) and for [Alberta](#).

Seeded area (Figure 7a) and production data (Figure 7b) were obtained from [Statistics Canada](#).

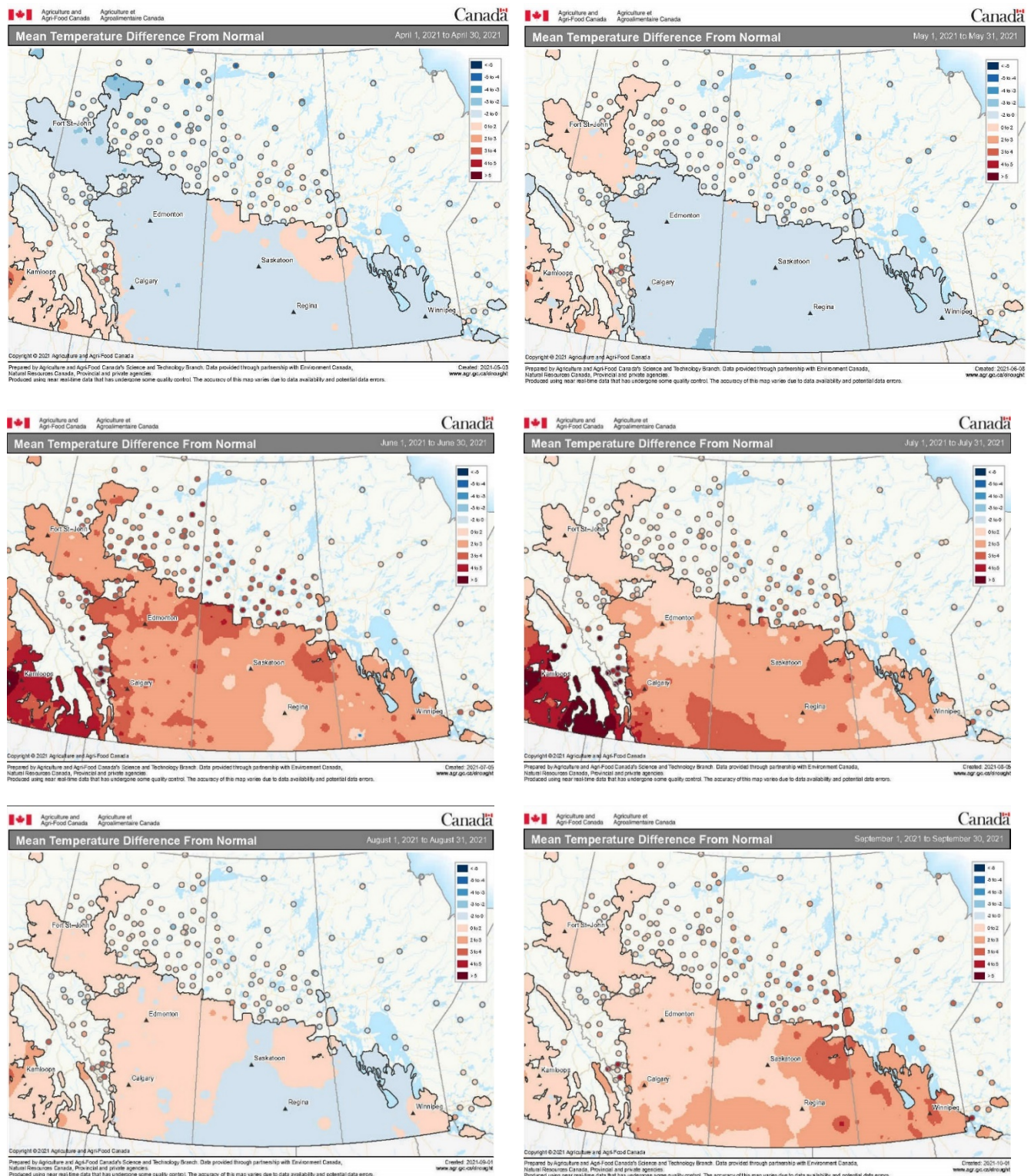
Seeding conditions: The season started with lower than normal snow accumulations that melted early. May temperatures did not differ from normal, as days were warm, but overnight freezing temperatures were still recorded (Figure 2). There was, however, an earlier than normal start to seeding in the three provinces (Figure 6) due to warm day temperatures and lack of precipitation (Figure 3). At the end of May, a night frost in the southern part of Manitoba and Saskatchewan, as well as some snow in Alberta, resulted in some producers needing to reseed a few canola fields. By the first week of June over 98% of the canola crops were seeded, which is at least a week earlier than in 2020 (Figure 6a). Low soil moisture in early May (Figure 4) associated with low precipitation in May and June (Figure 3) led to variable germination and emergence of crops.

Growing season: Figure 2 shows the warmer than normal temperatures recorded in June, July, August and September for the 2021 growing season. In June, day temperatures reached the mid 30°C range in the three prairies provinces (Figure 4). During July, temperatures continued to be high, with a large number of days over 30°C (Figure 3). The lack of precipitation was also an issue during the hot summer months (Figure 3). Evening temperatures were high (over 25°C) for a large number of nights, which did not allow the crops to recover from the heat stress of the day. Research has shown that temperatures higher than 29.5°C during canola flowering negatively affect the yield of crops. The 2021 growing conditions were ideal to produce a poor yield for western Canadian canola.

Harvest conditions: In 2021, the harvest started earlier and ended earlier than in 2020 (Figure 6b). In August, the harvest was affected by rain (Figure 3), which impeded the harvesting of mature crops. The amount of precipitation led to some plant regrowth which made harvest a bit more difficult for producers. By the end of September harvest was mostly completed in the three provinces (Figure 6b), at least one week earlier than last year. The late August precipitation did not really improve soil moisture, as indicated by the September drought map, and western Canada remained in a state of severe to extreme drought (Figure 4).

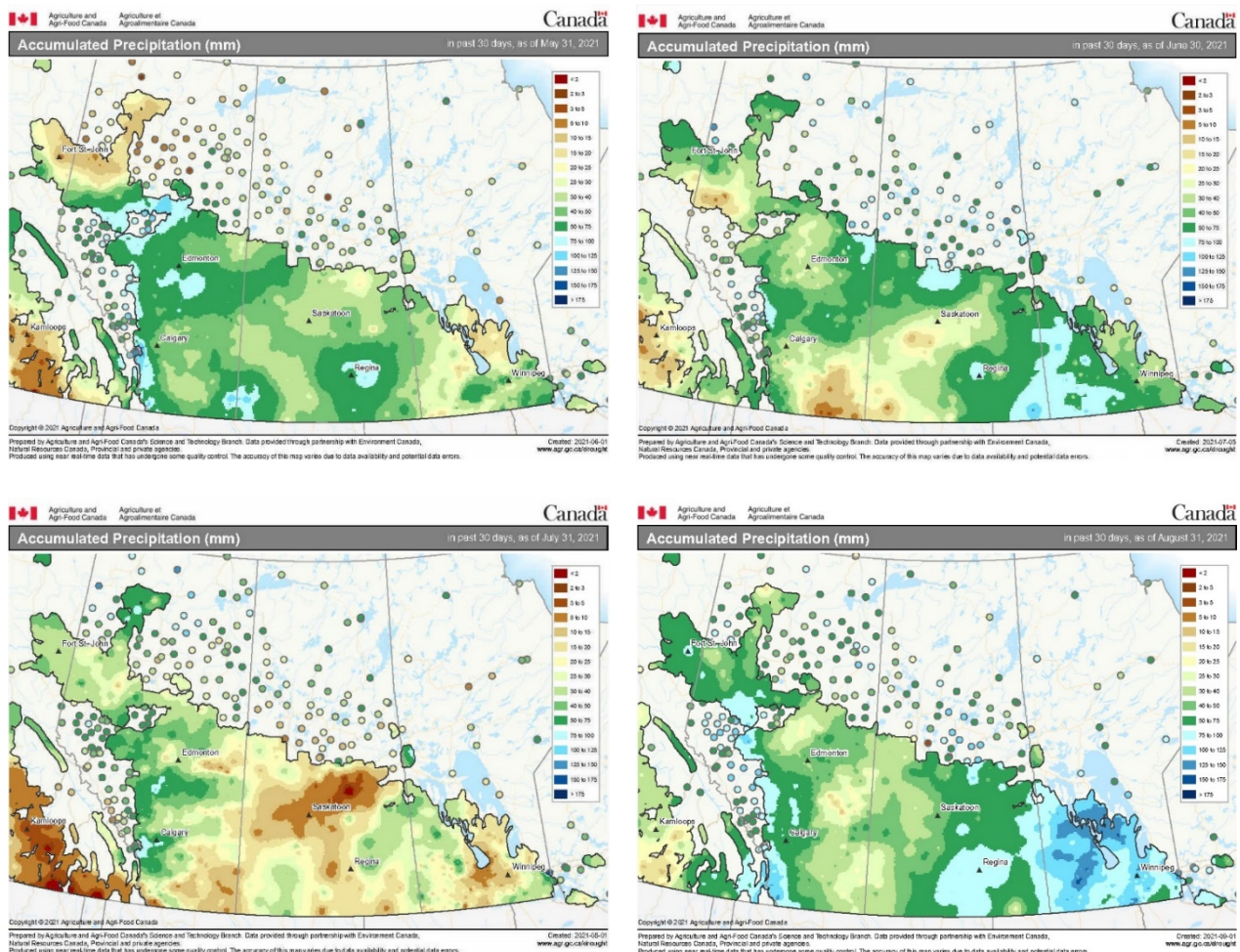
It has been reported that the 2021 drought was the most severe and widespread drought in Canada in the last 50 years.

Figure 2 Monthly mean temperature differences from normal in the prairie region during the 2021 growing season (April to September)



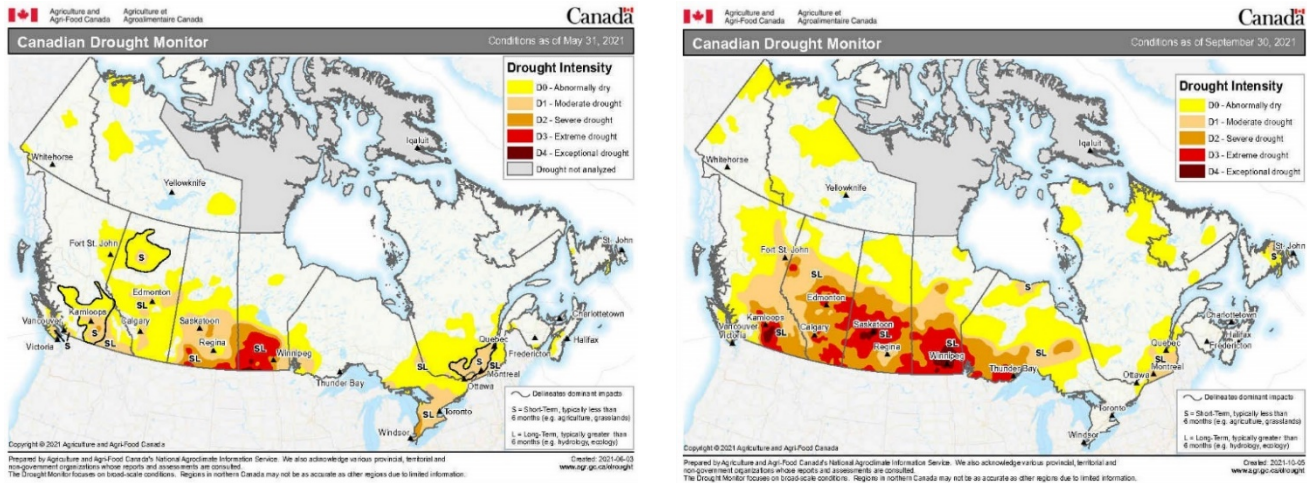
Source: Agriculture and Agri-Food Canada

Figure 3 Accumulated precipitation (mm) in the prairie region during the 2021 growing season (May to August)



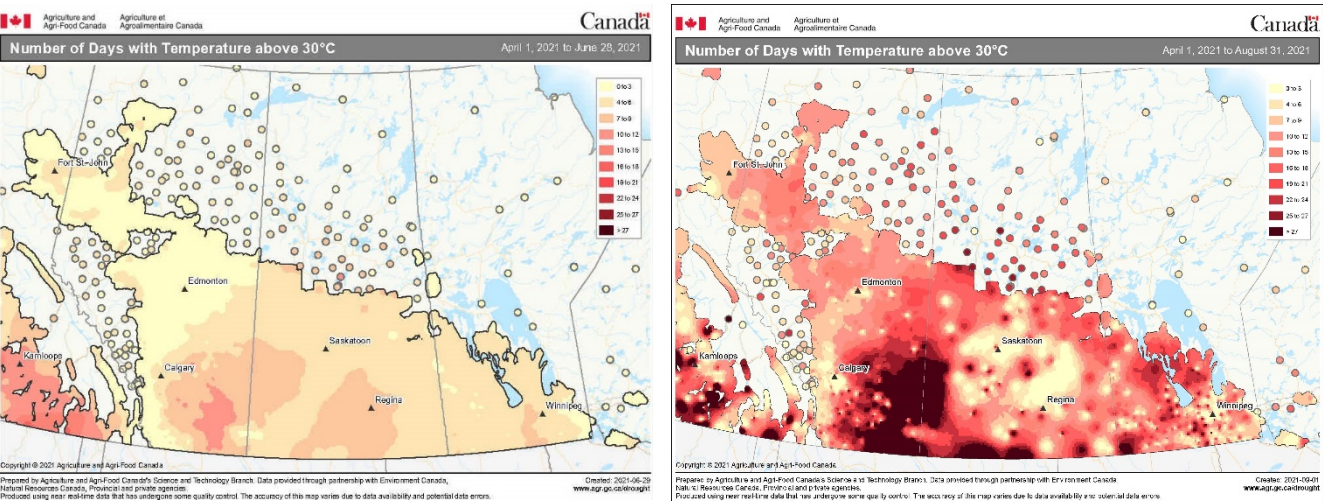
Source: Agriculture and Agri-Food Canada

Figure 4 Drought intensity in Canada as of May 31 and September 30, 2021



Source: Agriculture and Agri-Food Canada

Figure 5 Number of days with temperatures above 30°C in the prairie region during the 2021 growing season (April 1 to June 29 and April 1 to August 31)



Source: Agriculture and Agri-Food Canada

Figure 6a Seeding progress in Manitoba, Saskatchewan and Alberta during the 2020 and 2021 growing seasons

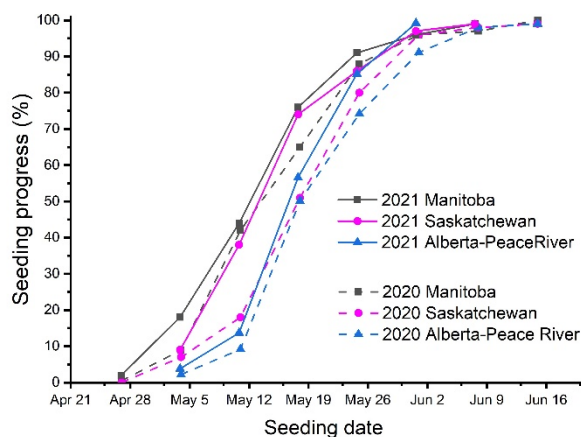
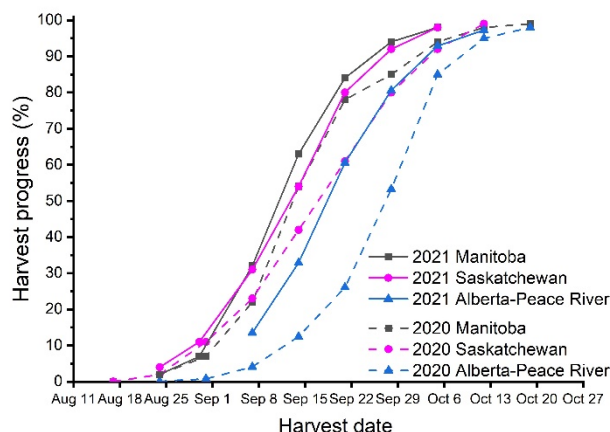


Figure 6b Harvest progress in Manitoba, Saskatchewan and Alberta during the 2020 and 2021 growing seasons



Production

The number of hectares (ha) of canola seeded in Canada since 2000 is presented in Figure 7a. In 2021, it was estimated that canola producers seeded approximately 686,300 ha more than in 2020 (9,096,700 versus 8,410,000 ha). This is approximately 3.9% more than the 5-year average of 8,841,700 ha and only 216,700 ha less than the record set in 2017 when 9,313,400 ha of canola were seeded (Figure 7a).

Statistics Canada reported that the 2021 western Canada average yield was estimated at 1,399 kilograms per hectare (kg/ha), much lower than the yield reported in 2020 (2,340 kg/ha) and the 5-year average yield (2,350 kg/ha). It was the lowest average yield since 2002 (1,200 kg/ha). In 2021, the highest average yield was reported in Manitoba at 1,662 kg/ha (2,321 kg/ha in 2020), followed by British Columbia (1,600 kg/ha versus 1,681 kg/ha in 2020) and Alberta (1,551 kg/ha versus 2,253 kg/ha in 2020). The largest decrease in yield compared to 2020 was reported in Saskatchewan (1,231 kg/ha in 2021 versus 2,395 kg/ha in 2020). Since 2017, the decrease in Canadian canola production (Figure 7) has been related to the decrease in seeded area but that was not true this year. In 2021, there was a marked increase in seeded area but a net production decrease. As of January 2022, Statistics Canada reported an estimated Canadian canola production of 12.645 million metric tonnes (MMT), which is more than 6.89 MMT less than the production in 2020 (19.484 MMT) and more than 7.64 MMT less than the 5-year average (20.235 MMT). This is the lowest canola production since 2008 (12.64 MMT; Figure 7).

In 2021, Saskatchewan grew 47.5% of the Canadian canola, compared to 54.5% in 2020. Alberta, Manitoba and British Columbia grew 33.1%, 18.2% and 0.5% of the Canadian canola, respectively. The main production areas in 2020 (2021 data not yet available) were in the northwest areas of the prairie provinces (Figure 1).

Figure 7a Canola seeded area (hectares) in western Canada from 2000 to 2021

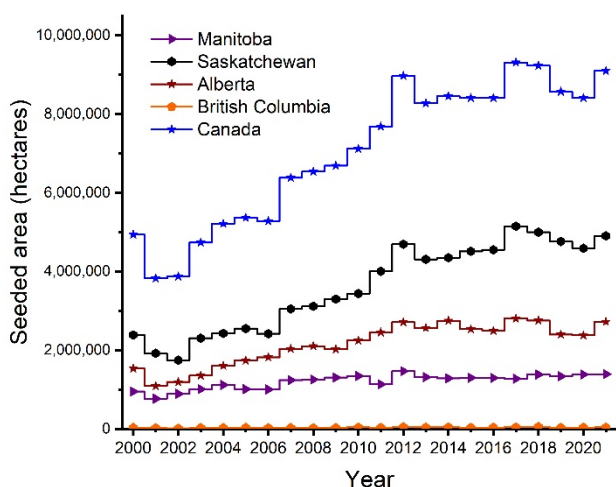
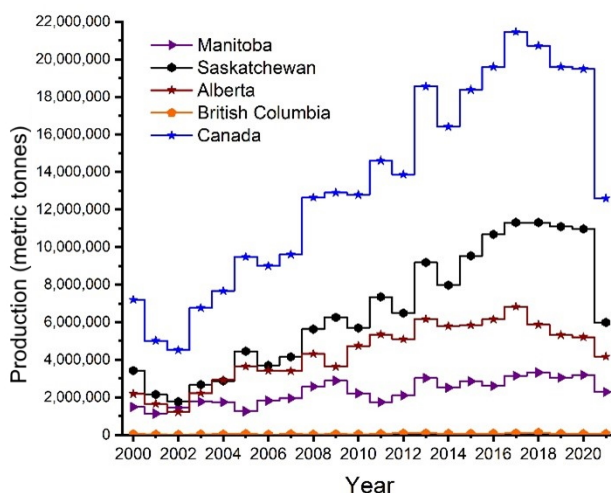


Figure 7b Canola production (metric tonnes) in western Canada from 2000 to 2021



Harvest Sample Program samples and grade distribution

This report of quality data for the 2021 harvest is based on the analyses of 1,979 individual canola samples. Composites of Canola, No.1 Canada were made from samples from each crop district and from each province. Specialty oil samples, such as high oleic acid, low α -linolenic acid and high erucic acid, are excluded from this report. In 2021, we received 245 less samples than in 2020 which is only 111 less than the 5-year average (Table 1). Crop district composites of Canola, No.1 Canada samples were prepared using 1,969 samples.

Canola samples for the Canadian Grain Commission's Harvest Sample Program were collected from producers, crushing plants and grain handling offices across western Canada. The samples were cleaned to remove dockage prior to grading and testing. Canadian Grain Commission grain inspectors assigned grade level based on Chapter 10 of the [Official Grain Grading Guide](#) for canola and rapeseed.

Individual harvest samples were analyzed for oil, protein, chlorophyll and total glucosinolates using a near-infrared (NIR) spectrometer. This report is based on the analyses, by reference methods, of composite samples made of the same grade canola by crop district and province. Composites were prepared by combining:

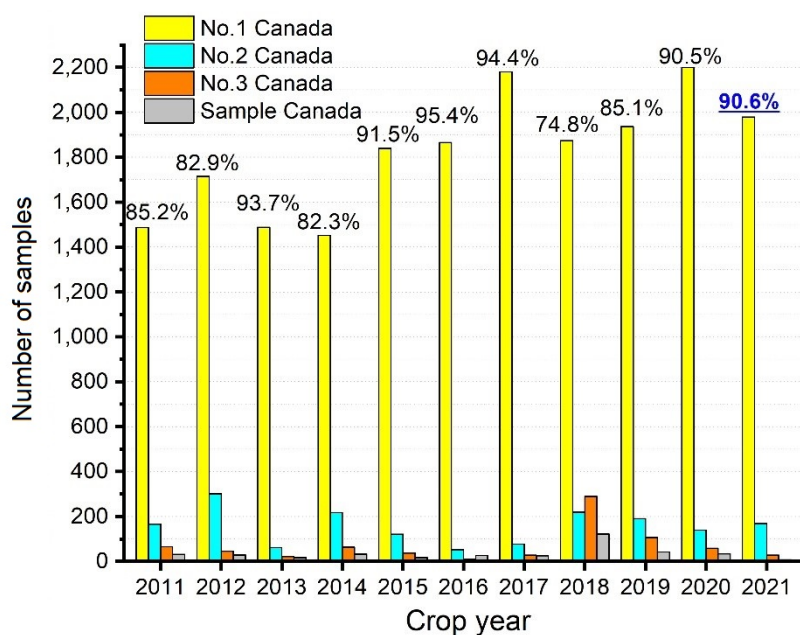
- Canola, No. 1 Canada samples by provincial crop district
- Canola, No. 2 and Canola, No. 3 Canada samples by province
- Canola Sample Canada samples prepared for western Canada

Oil, protein and total seed glucosinolate content are reported on an 8.5% moisture basis. Meal protein content is reported at 12% moisture, whereas total meal glucosinolate content is reported at 8.5% moisture.

Crop district canola quality data for Manitoba and Alberta and census agricultural region quality data for Saskatchewan can be acquired through the Canadian Grain Commission. [Canola variety data](#) is also published yearly.

Exports of commercially clean (CC) canola from August 2021 to December 2021 contained an average dockage of 1.65%, ranging from 0.73% to 2.5%. This negatively affects quality factors such as oil content, chlorophyll and free fatty acids. Canola exports containing more than 2.5% dockage are considered not commercially clean (NCC) and the values of their quality parameters are usually further reduced.

Figure 8 Number of canola samples received by the Harvest Sample Program and their grade distribution from 2011 to 2021



In 2021, 90.6% of the harvest samples were graded Canola, No. 1 Canada. This is comparable to what was obtained in 2020 (90.5%) and 2.5% higher than the 5-year average (Figure 8). The grade distribution of the 2021 canola crop varied greatly between provinces and between crop districts within a province. Distinctly green (DGR) seed count, sprouting and admixture were the main degrading factors observed in the 2021 canola crop. The level of DGR seed was 0.6% (0.4% in 2020) for Canola, No. 1 Canada, 2.7% (3.2% in 2020) for Canola, No. 2 Canada, 7.1% (9.4% in 2020) for Canola, No. 3 Canada and 3.7% (6.0% in 2020) for Sample grade. In 2021, 85.1% of the samples graded Canola, No. 1 Canada showed sprouting; with levels ranging from 0.1% to 4.7%. Rain at the end of August and early September, during harvest, may be responsible for this. In addition, observations of seed sprouting in the pod, due to heat stress, were reported by Canola Watch in August 2021.

Quality of the western Canadian canola 2021

Tables 2 and 3 contain detailed information on the quality of western Canadian canola harvested in 2021, while Table 4 compares the quality of harvest samples to recent canola exports. It is important to note that the numbers of samples in each grade or province may not be representative of the total production or grade distribution. However, there were sufficient samples to provide good quality information for each province and grade. Provincial and western Canadian averages were calculated using the quality results for each crop district or CAR, weighted with the production data (5-year average) and the grade percentile per crop district or CAR.

All oil and protein content values presented below use the Canadian Grain Commission's historical 8.5% moisture basis to permit annual and regional comparisons. Protein content of oil-free meal is reported on 12% moisture, while the glucosinolate content of oil-free meal is reported on a dry basis to reflect meal-trading rules established by the Canadian Oilseed Processors Association (COPA).

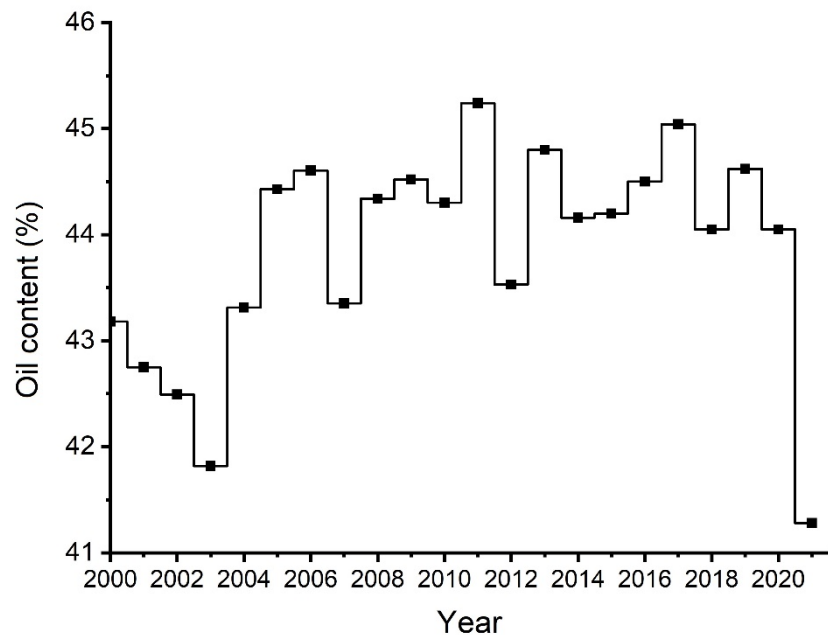
Oil content

In 2021, Canola, No.1 Canada had an oil content of 41.3%, which is much lower than the 2020 average of 44.1% and the 5-year average of 44.4% (Table 1). The 2021 average canola oil content was the lowest average oil content observed since 2003 (41.8%; Figure 9). In 2021, only 13.4% of the samples showed an oil content greater than the 5-year average.

Canola, No. 1 Canada samples from Alberta-Peace River showed a slightly higher average oil content at 41.6% than samples of the same grade from Manitoba and Saskatchewan (41.1%) (Table 2). The oil content of individual Canola, No.1 Canada samples harvested in 2021 ranged from 36.2% to 47.2% in Manitoba, 33.9% to 49.4% in Saskatchewan and 34.2% to 48.9% in Alberta-Peace River (Table 2).

Oil content for Canola, No. 2 Canada (40.6%) is lower than Canola, No. 1 Canada (41.3%). Oil content for Canola, No. 2 Canada samples from western Canada ranged from 34.2% to 48.9% (Table 2). In 2021, the average oil content for Canola, No. 3 Canada and Sample grade was 39.2% and 41.2%, respectively.

Figure 9 Oil content of seed (% , 8.5% moisture) for Canola, No. 1 Canada



Oil content is influenced by both genetic and environmental factors. For any known canola variety, hot and dry growing conditions rather than cool conditions, will result in canola seeds with lower oil content. The high number of days with temperatures over 30°C (Figure 5), both pre and post flowering, combined with the lack of precipitation during the entire 2021 growing season (Figure 3) explains the record low oil content observed this year. These extreme growing conditions were spread throughout the entire western canola growing area, leading to no major geographical differences in terms of seed oil content in 2021. Precipitation was extremely localized, however, which explains why some samples still had a very high oil content.

The mean oil content of CC Canola, No.1 Canada exports was 40.9% for December 2021 and 41.0% for August to November 2021 (Table 4). When compared to oil content from the harvest samples, the CC and the NCC exports of Canola, No.1 Canada both had a lower average oil content due to dilution from dockage. Harvest samples are completely clean (0.00% dockage). Average dockage for the CC exports was 1.82% for December 2021 and 1.61% for the August to November 2021, while the value for last year’s shipping season was 1.61% (Table 4). NCC exports had an average of 2.83% for August to December 2021 (Table 4). The exports for this year’s shipping season showed an important decrease in oil content compared to last year exports, which corresponds to the decreased oil content found in the 2021 harvest samples.

Protein content

The average protein content of canola seeds (% , 8.5% moisture) and the calculated protein content of oil-free meal (12% moisture) from 2000 to 2021 is presented in Figures 10a and Figure 10b, respectively. The average crude protein content was 24.0% for Canola, No. 1 Canada, 24.6% for Canola, No. 2, Canada, and 26.0% for Canola, No. 3 Canada (Table 2). The lowest protein content was found in samples graded Canola, Sample Canada

at 23.7% (Table 2). Average protein seed content for Canola, No. 1 Canada in 2021 was a record high, much higher than the 2020 average (20.8%) and the 5-year average of 20.5% (Table 1 and Figure 10a). Protein content of individual producer samples ranged from 16.4% to 30.5% for Canola, No. 1 Canada and from 17.7% to 29.7% for Canola, No. 2 Canada. The protein content of Canola, No. 3 Canada and Canola, Sample Canada samples ranged from 19.1% to 28.1% and 20.1% to 26.8%, and averaged 26.0% and 23.7%, respectively (Table 2).

Research has shown that there is a strong inverse relationship between oil content and protein content in canola seeds. In 2021, seed oil content was 2.8% less than in 2020 and seed protein content concurrently increased by 3.2% compared to 2020.

The average seed protein content of Canola, No. 1 Canada CC exports was 23.9% for December 2021 and 23.6% for August to November 2021 (Table 4). Average protein content for this shipping season (August to December 2021) was higher than that for last year's shipping season (20.9% for August 2020 to July 2021), which is consistent with the 2021 canola protein content of harvest samples (Table 4).

The calculated meal protein content, on an oil-free basis, is the maximum protein content of a theoretical meal that would be obtained if a crushing plant was able to extract 100% of the oil from the seeds. In 2021, the protein content calculated on an oil-free meal at 12% moisture was 42.0%. This is significantly higher than the 2020 value of 38.6% and the 5-year average of 38.3% (Table 1 and Figure 10b). The calculated protein content of the oil-free meal at 12% moisture was highest for samples from Saskatchewan (42.3%), followed by Alberta-Peace River (41.9%) and Manitoba (41.7%).

Figure 10a Protein content of seed (% 8.5% moisture) for Canola, No. 1 Canada

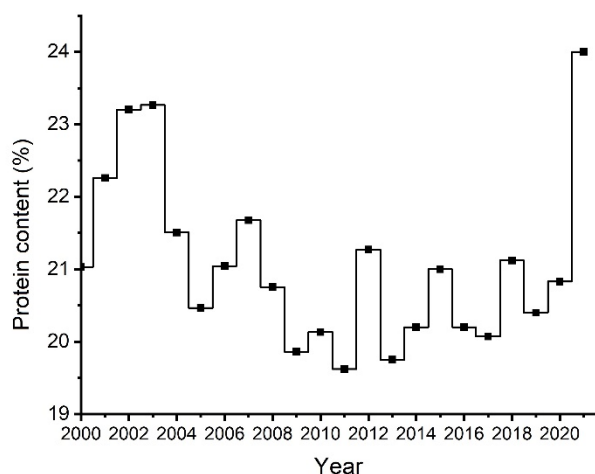
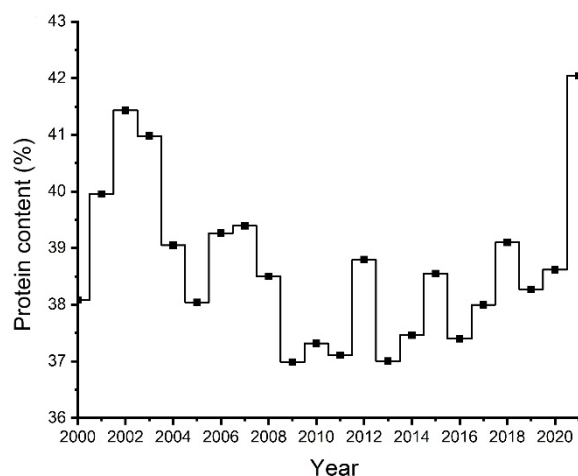


Figure 10b Protein content of meal (% oil-free basis, 12% moisture) for Canola, No. 1 Canada



CC exports of Canola, No. 1 Canada had a calculated average meal protein content (oil-free, 12% moisture) of 41.0% and 41.5% for August to November 2021 and December 2021, respectively. These results are higher than the value of 38.2% determined for the last shipping season (August 2020 to July 2021) for CC exports of Canola, No. 1 Canada (Table 4).

Chlorophyll content

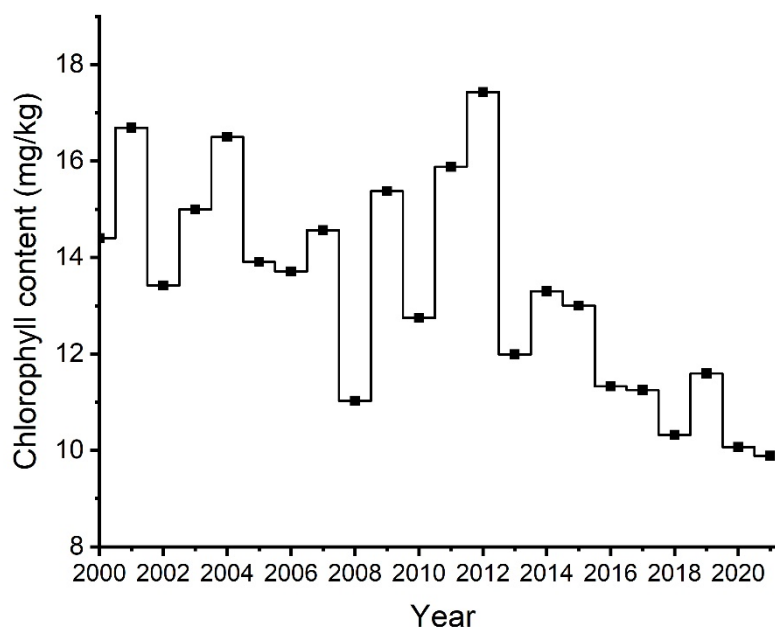
In 2021, average chlorophyll content for Canola, No. 1 Canada harvest samples was 8 milligrams per kilogram (mg/kg), 9 mg/kg and 12 mg/kg in Manitoba, Saskatchewan and Alberta-Peace River, respectively (Table 2). The overall average for Canola, No. 1 Canada was 10 mg/kg which is identical to that observed for the 2020 harvest (10 mg/kg) and similar to the 5-year average of 11 mg/kg (Table 1). This is the lowest average chlorophyll content observed in the last 10 years (Figure 11). Individual producer samples of Canola, No. 1 Canada showed variations in chlorophyll content due to variable growing conditions. Chlorophyll content values of Canola, No. 1 Canada samples from Manitoba ranged from 4 to 29 mg/kg, Saskatchewan values ranged from 4 to 36 mg/kg and Alberta values ranged from 4 to 37 mg/kg (Table 2). Historical chlorophyll content means vary greatly from year to year (Figure 11) due to the variability in growing conditions. High chlorophyll content is usually related to delays in seeding due to cold temperatures and rain, poor growing conditions due to lack of heat units or early frost; none of which occurred in 2021. Crop district 6 from Alberta-Peace River showed the highest chlorophyll content average at 19 mg/kg.

Chlorophyll levels for Canola, No. 2 Canada samples (Table 2) averaged 19 mg/kg, which is much lower than that observed in 2020 harvest samples (30 mg/kg). Samples graded Canola, No. 3 Canada and Canola, Sample Canada had an average chlorophyll content of 37 mg/kg and 12 mg/kg, respectively. This is much lower than what was observed in 2020 (60 mg/kg and 43 mg/kg).

To be graded Canola, No. 1 Canada, samples must contain no more than 2.00% distinctly green (DGR) seeds. The average DGR content in Canola, No. 1 Canada samples was 0.61% (0.48% in 2020), 0.50% (0.41% in 2020) and 0.74% (0.57% in 2020) for Manitoba, Saskatchewan and Alberta-Peace River, respectively.

The chlorophyll content of Canadian canola exports is affected by DGR and dockage content. The average DGR content was 0.9%, 0.7% and 0.6% for December 2021 CC canola exports, August to November 2021 CC canola exports, and August to December 2021 NCC canola exports, respectively (Table 4). The average chlorophyll content was slightly higher for the NCC export samples with a slightly lower DGR content (0.6%) and higher dockage content (2.8%) than the CC export and the harvest samples (Table 4).

Figure 11 Chlorophyll content of seed (mg/kg, as is moisture content) for Canola, No. 1 Canada



Glucosinolate content

The averages of total glucosinolate content of canola seeds at 8.5% moisture and the averages of calculated total glucosinolate content of canola meal (after oil removal) at 8.5% moisture from 2000 to 2021 are presented in Figure 12a and Figure 12b, respectively.

In 2021, Canola, No. 1 Canada seeds (Table 2) had an average glucosinolate content of 11 micromoles per gram ($\mu\text{mol/g}$), higher than the 2020 average of 10 $\mu\text{mol/g}$ but identical to the 5-year average of 11 $\mu\text{mol/g}$. This is the highest average glucosinolate content since 2015 (Figure 12a). There was no significant difference in total glucosinolate content between various crop districts or provinces.

The December 2021 and the August to November 2021 CC canola exports had an average level of total seed glucosinolates of 12 $\mu\text{mol/g}$ of seed which is slightly higher than the level in last year's shipping season samples (10 $\mu\text{mol/g}$; Table 4).

In 2021, 11 $\mu\text{mol/g}$ of total glucosinolates in seed corresponded to 20 $\mu\text{mol/g}$ in oil-free meal on an 8.5% moisture basis. This is slightly higher than both the 5-year average (19 $\mu\text{mol/g}$, 8.5% moisture basis) and the 2020 harvest average (18 $\mu\text{mol/g}$, 8.5% moisture basis) (Figure 12b and Table 1). The total glucosinolates in Canadian canola meal obtained from conventional crushing plants (expeller press followed by solvent extraction) is much lower than this calculated value. The calculated values assume that 100% of the oil is recovered from the seed during crushing and that no glucosinolates are destroyed during processing, which is never the case.

Research done in Australia showed that for canola, the total glucosinolate content for a given variety can be affected by environmental conditions. It was found that hot and dry conditions post flowering led to an increase in glucosinolate content in the seeds. In 2021, heat and lack of moisture were prevalent in western Canada. The severe growing conditions are likely responsible for the increase in total glucosinolates observed this year.

Figure 12a Total glucosinolate content of seed ($\mu\text{mol/g}$, 8.5% moisture) for Canola, No. 1 Canada

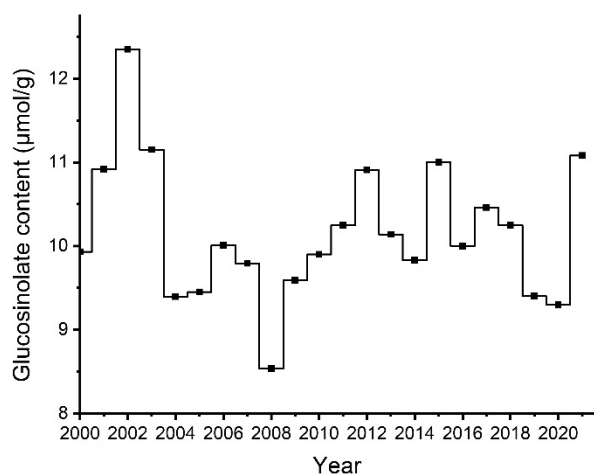
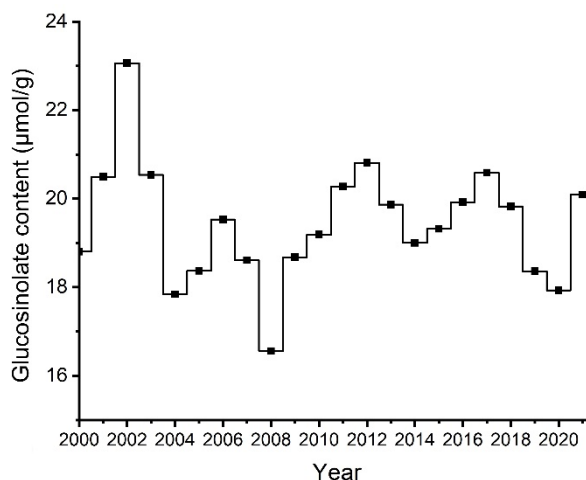


Figure 12b Total glucosinolate content of meal ($\mu\text{mol/g}$ oil-free, 8.5% moisture) for Canola, No. 1 Canada



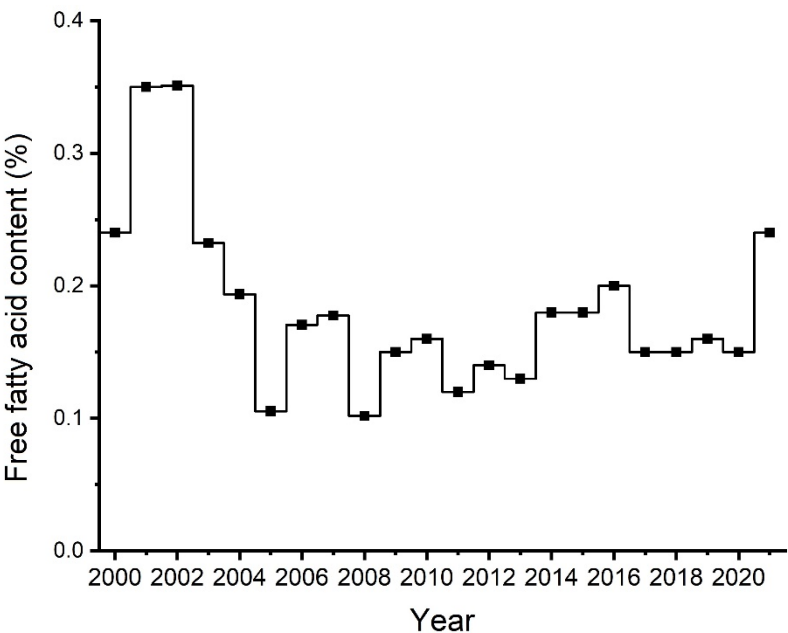
Free fatty acid content

In 2021, the average free fatty acid (FFA) content of oil for Canola, No. 1 Canada was 0.24%. This is notably higher than the average in 2020 (0.15%) and the 5-year average of 0.16% (Table 1 and Figure 13). The average FFA content for Canola, No. 1 Canada samples (Table 2) from Manitoba (0.31% in 2021 versus 0.24% in 2020) was similar to the Alberta-Peace River average (0.29% in 2021 versus 0.14% in 2020) and much higher than the Saskatchewan average (0.18% in 2021 versus 0.13% in 2020). Canola, No. 1 Canada samples from Manitoba crop districts 9 and 10 had a higher average FFA content of 0.52% and this may pose a problem for local crushers.

Overall, samples graded Canola, No. 2 Canada presented a higher average FFA content than the Canola No. 1, Canada samples (0.45% versus 0.24%) as seen in Table 2.

In 2021, plant stress and seed sprouting, due to hot and dry growing conditions and rain at harvest, led to the production of higher than normal FFA content in Canola, No. 1 Canada when compared to the previous 10 years.

Figure 13 Free fatty acid content of oil (% as oleic acid) for Canola, No. 1 Canada



FFA levels of CC Canola, No.1 Canada averaged 0.29% for the December 2021 exports and 0.33% for the August to November 2021 exports (Table 4). FFA levels of individual CC Canola, No.1 Canada export samples ranged from 0.06% to 0.49%.

Over the years, it has been observed that FFA levels can increase during the shipping season as storage conditions can affect the activation of the seed’s hydrolytic enzymes, leading to FFA production. This year, FFA content could vary considerably from each load throughout the entire shipping season.

Fatty acid composition

The average erucic acid (C22:1) content of the 2021 canola crop was 0.01%. Over the last several years, its average content in Canola, No. 1 Canada samples ranged from below limit of detection to 0.01% (Tables 1 and 3, Figure 14a). Similar to the total glucosinolate content, these low values are a direct result of breeding efforts by the Canadian canola industry.

In 2021, the average α -linolenic acid (C18:3) content of Canola, No. 1 Canada was 8.6%, which is lower than the 2020 average (8.9%) and much lower than the 5-year average (9.3%; Table 1 and Figure 14b). Samples from Manitoba and Saskatchewan had the same average α -linolenic acid content (8.4%), whereas samples from Alberta-Peace River had a slightly higher average (9.2%; Table 3). Samples from the most northwest part of Alberta-Peace River (crop districts 6 and 7) had the highest average α -linolenic acid content (10.0% and 10.4% for crop districts 6 and 7, respectively), whereas samples from southern Saskatchewan had the lowest average range (7.1% to 7.7%).

In 2021, the average oleic acid (C18:1) content of Canola, No. 1 Canada samples was 64.2%, which is higher than the 2020 average (63.9%) and the 5-year average (63.2%; Table 1 and Figure 14c). The lowest average oleic acid content was found in samples from Alberta-Peace River (63.8% in 2021 versus 62.7% in 2020), whereas the highest average was obtained from Saskatchewan (64.4% in 2021 versus 65.1% in 2020; Table 3).

The total content of monounsaturated fatty acids (MUFA) in 2021 samples was 65.9% in Manitoba (65.8% in 2020), 66.0% in Saskatchewan (66.7% in 2020) and 65.4% in Alberta-Peace River (64.3% in 2020). The average for western Canada was 66.0% (65.4% in 2020; Table 3).

Linoleic acid (C18:2; Figure 14d) content followed a similar pattern to that of α -linolenic acid (Figure 14b) in response to environmental conditions since hot and dry growing conditions can also reduce the linoleic acid content of canola seeds. This year's average was one of the lowest from the last 10 years, but identical to the 2018 average of 18.3% (Figure 14d).

In 2021, the total average content of polyunsaturated fatty acids (PUFA) was 26.9% in Manitoba (26.8% in 2020), 26.8% in Saskatchewan (26.8% in 2020) and 27.4% in Alberta-Peace River (28.5% in 2020). This resulted in an overall average of 27.0% for western Canada (27.3% in 2020; Table 1 and Table 3). In canola, PUFA content is directly related to the α -linolenic acid (C18:3) and linoleic acid (C18:2) content. After flowering, the hot temperatures in August 2021 (Figure 5) led directly to the low total unsaturated content in canola seed oil (similar to 2020) and as a result, PUFA content was lower compared to 2019. The northern and the southern parts of the prairies were affected differently by the hot temperatures. Crop districts 6 and 7 of Alberta-Peace River produced canola with the highest PUFA content at 29.3% and 28.7%, respectively.

Fatty acid composition (oleic acid, linoleic acid and α -linolenic acid) in the 2021 crop was slightly different when compared to 2020 (0.3% higher for oleic acid, equal for linoleic acid and 0.3 % down for α -linolenic acid). As a result, the iodine value, which is a representation of the degree of unsaturation of oil, was slightly lower in 2021 (110.9 units) when compared to 2020 (111.2 units) (Table 1). It was the second lowest iodine value observed over the last 10 years and identical to 2018 (Figure 14e). The 2021 iodine value was 1.5 units lower than the 5-year average of 112.4 units (Table 1). For Canola, No. 1 Canada, the iodine value averages were 110.6 units (110.3 units in 2020), 110.5 units (109.2 units in 2020) and 111.7 units (113.3 units in 2020) for Manitoba, Saskatchewan and Alberta-Peace River, respectively (Table 3). This year, the iodine value of individual Canola, No. 1 Canada samples ranged from 104.5 units to 119.1 units while in 2020 they ranged from 103.6 units to

121.5 units. Samples graded Canola, No. 2 Canada showed higher average iodine values, with higher linoleic and α -linolenic acid content, and lower oleic acid content than the Canola, No. 1 Canada samples (Table 3).

The average saturated fatty acid content was 6.6% in 2021, which is slightly lower than the 2020 average of 6.8% and the 5-year average of 6.7% (Tables 1 and 3). Since 2009, the average saturated fatty acid content varied from 6.6% to 6.9% (Figure 14f). In 2021, the average saturated fatty acid content was similar for the three prairie provinces at 6.6%, 6.6% and 6.5% for Manitoba, Saskatchewan and Alberta-Peace River, respectively (Table 3).

Total saturated fatty acid content, controlled through plant breeding, has been very stable. It was lower than 7.0% and has ranged from 6.6% to 6.9% since 2009 (Figure 14f). However, other fatty acids (except erucic acid) are greatly affected by genetic and environmental factors. This year, individual samples of Canola, No. 1 Canada, had oleic acid, linoleic acid and α -linolenic acid content that ranged from 56.5% to 69.8%, 15.8% to 21.0% and 5.1% to 13.1%, respectively. Samples from southern Alberta-Peace River (crop districts 1, 2, and 3) had a very different fatty acid composition than samples from northern Alberta-Peace River (crop districts 6 and 7). In general, oil in samples from northern areas, especially Alberta-Peace River, had higher unsaturation than oil in samples from southern areas. The hot and dry growing conditions this year and the number of days over 30°C after flowering, helped to decrease the total unsaturation of the oils and especially reduced the PUFA content.

The fatty acid composition of the 2021 harvest corresponded well with the fatty acid composition from the August to December 2021 exports compared to last year (Table 4).

Figure 14a Erucic acid content of the oil (%) for Canola, No. 1 Canada

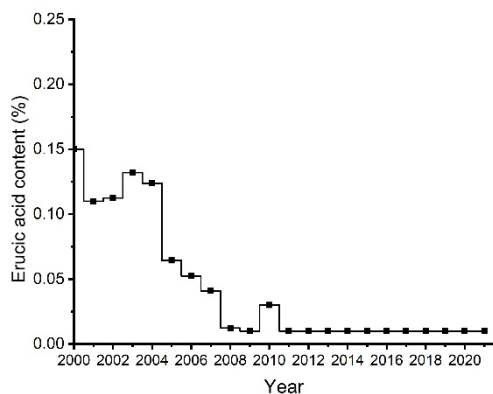


Figure 14b Alpha-linolenic acid content of the oil (%) for Canola, No. 1 Canada

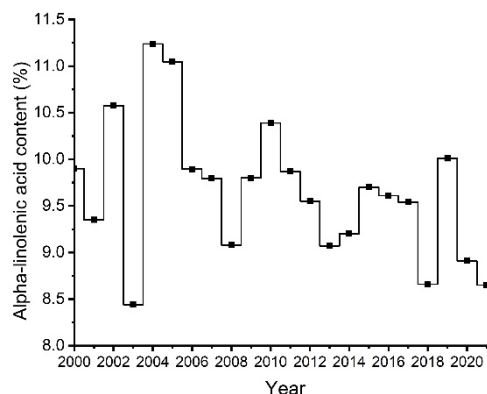


Figure 14c Oleic acid content of the oil (%) for Canola, No. 1 Canada

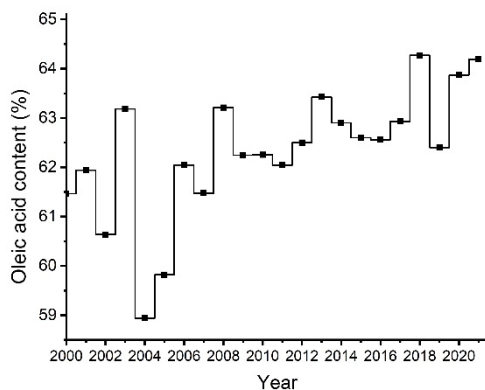


Figure 14d Linoleic acid content of the oil (%) for Canola, No. 1 Canada

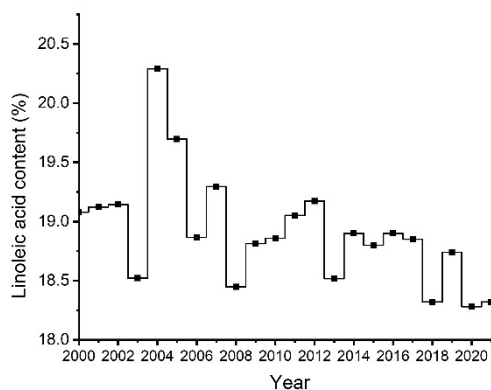


Figure 14e Iodine value of the oil (units) for Canola, No. 1 Canada

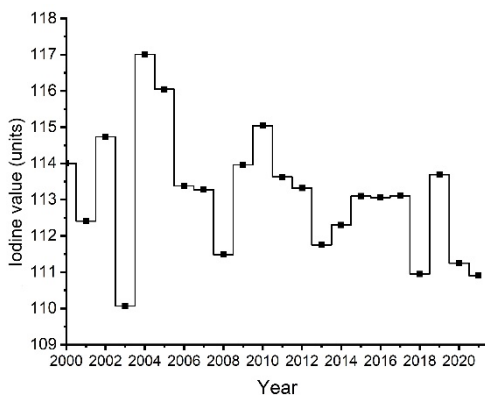


Figure 14f Saturated fatty acid content of the oil (%) for Canola, No. 1 Canada

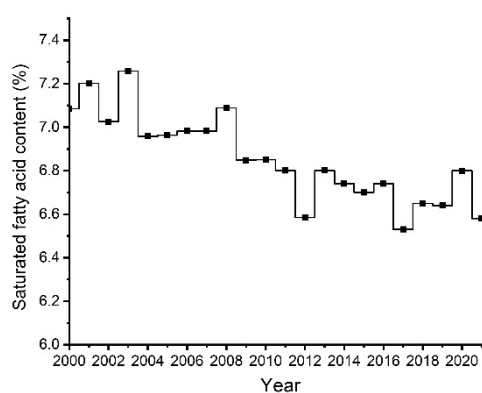


Table 2 Oil, protein, chlorophyll and total glucosinolate content of seeds and free fatty acid content of oil in 2021 canola harvest samples according to grade and province

Grade	Provinces	Number of samples in aggregates	Oil content ¹ %			Protein content ² %			Chlorophyll content ³ mg/kg ⁴			Glucosinolates ⁸ μmol/g ⁵			Free fatty acids (%)
			Mean	Min ⁶	Max ⁶	Mean	Min ⁶	Max ⁶	Mean	Min ⁶	Max ⁶	Mean	Min ⁶	Max ⁶	
Canola, No. 1 Canada	Manitoba	411	41.1	36.2	47.2	23.9	17.7	28.7	8	4	29	11	3	27	0.31
	Saskatchewan	899	41.1	33.9	49.4	24.2	17.6	30.5	9	4	36	11	5	22	0.18
	Alberta-Peace River ⁷	659	41.6	34.2	48.9	23.8	16.4	30.3	12	4	37	11	3	28	0.29
	Western Canada⁸	1969	41.3	33.9	49.4	24.0	16.4	30.5	10	4	37	11	3	28	0.24
Canola, No. 2 Canada	Manitoba	20	40.4	34.9	43.8	25.1	21.0	28.4	19	4	41	10	6	15	0.71
	Saskatchewan	48	40.4	35.8	47.0	24.6	18.4	29.6	18	4	48	12	5	22	0.46
	Alberta-Peace River ⁷	100	40.7	34.2	48.9	24.5	17.7	29.7	20	4	69	11	4	28	0.40
	Western Canada⁸	168	40.6	34.2	48.9	24.6	17.7	29.7	19	4	69	11	4	28	0.45
Canola, No. 3 Canada	Manitoba	4	39.8	35.1	46.4	25.6	22.2	27.3	28	18	60	9	5	13	0.64
	Saskatchewan	2	37.8	37.2	47.0	27.7	18.4	29.6	8	4	15	12	12	13	0.17
	Alberta-Peace River ⁷	21	39.3	35.6	48.9	25.9	17.7	29.7	42	5	68	13	6	21	0.50
	Western Canada⁸	27	39.2	35.1	48.9	26.0	17.7	29.7	37	4	68	12	5	21	0.49
Canola, Sample Canada	Western Canada⁸	7	41.2	34.2	48.9	23.7	20.1	26.8	12	6	105	11	7	18	0.18

¹ 8.5% moisture basis

² protein content calculated from nitrogen content using N x 6.25, 8.5% moisture basis

³ as-is moisture basis

⁴ mg/kg = milligram per kilogram

⁵ μmol/g = micromole per gram

⁶ Min = minimum, Max = maximum

⁷ includes part of the Peace River area that is in British Columbia

⁸ values are weighted averages based on production by province as estimated by Statistics Canada

Table 3 Main fatty acid composition, total SFA¹, PUFA² and MUFA³ content and iodine value of oil in 2021 canola harvest samples according to grade and province

Grade	Provinces	Relative fatty acid composition of oil (%)										SFA ¹	PUFA ²	MUFA ³	Iodine value ⁴ (units)		
		Oleic acid (C18:1)			Linoleic acid (C18:2)			Alpha-linolenic acid (C18:3)			Erucic acid (C22:1)						
		Mean	Min ⁵	Max ⁵	Mean	Min ²⁰	Max ⁵	Mean	Min ²⁰	Max ⁵	Mean	Mean	Mean	Mean	Mean	Min ²⁰	Max ⁵
Canola, No. 1 Canada	Manitoba	64.3	58.7	68.3	18.5	16.1	21.0	8.4	5.5	12.3	0.00	6.6	26.9	65.9	110.6	104.5	119.1
	Saskatchewan	64.4	56.5	69.3	18.4	15.8	20.6	8.4	5.1	12.7	0.01	6.6	26.8	66.0	110.5	103.4	121.7
	Alberta- Peace River ⁶	63.8	57.6	69.8	18.1	15.8	20.9	9.2	5.6	13.1	0.00	6.5	27.4	65.4	111.7	103.7	120.3
	Western Canada⁷	64.2	56.5	69.8	18.3	15.8	21.0	8.6	5.1	13.1	0.01	6.6	27.4	66.0	110.9	103.4	121.7
Canola, No. 2 Canada	Manitoba	61.5	58.7	64.0	19.4	16.7	20.1	10.0	8.5	12.6	0.00	6.4	29.5	63.2	114.1	110.7	119.7
	Saskatchewan	62.5	57.9	66.4	19.3	16.0	20.5	9.1	7.3	12.2	0.02	6.6	28.5	64.2	112.5	106.9	118.9
	Alberta- Peace River ⁶	61.8	57.1	65.6	18.9	16.3	20.9	10.3	7.5	13.3	0.02	6.4	29.3	63.5	114.3	108.2	120.9
	Western Canada⁷	62.0	57.1	65.6	19.1	16.0	20.1	9.9	7.3	13.3	0.01	6.5	29.1	63.7	113.7	106.9	120.9
Canola, No. 3 Canada	Manitoba	63.6	61.6	64.1	18.5	17.9	18.6	8.8	8.6	10.0	0.00	6.4	27.4	65.3	111.1	110.8	113.3
	Saskatchewan	63.3	61.8	65.8	20.2	18.3	20.0	7.4	6.8	9.1	0.00	6.7	27.6	64.9	110.0	107.5	112.9
	Alberta-Peace River ⁶	61.1	56.1	64.7	19.4	16.2	21.0	10.5	7.7	13.0	0.06	6.4	29.9	62.8	114.9	109.3	121.8
	Western Canada⁷	61.6	56.1	64.1	19.3	16.2	21.0	10.0	6.8	13.0	0.05	6.4	29.3	63.4	114.0	107.5	121.8
Canola, Sample Canada	Western Canada⁷	63.3	58.1	66.2	18.6	15.9	19.2	9.2	5.1	13.3	0.01	6.5	27.9	64.9	112.2	108.6	117.4

¹ SFA = saturated fatty acids (total SFA are the sum of lauric (C12:0), myristic (C14:0), palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0) and lignoceric (C24:0) acids)

² PUFA = polyunsaturated fatty acids (total PUFA are the sum of linoleic (C18:2), α-linolenic (C18:3) and eicosadienoic (C20:2) acids)

³ MUFA = monounsaturated fatty acids (total MUFA are the sum of palmitoleic (C16:1), oleic (C18:1), eicosenoic (C20:1), erucic (C22:1) and nervonic (C24:1) acids)

⁴ calculated from fatty acid composition

⁵ Min = minimum, Max = maximum

⁶ includes part of the Peace River area that is in British Columbia

⁷ values are weighted averages based on production by province as estimated by Statistics Canada

Table 4 Comparison of quality data from 2021 harvest samples and recent export shipments for Canola, No. 1 Canada

Quality parameter	2021 Harvest Sample Program	Commercially clean exports			Not commercially clean exports
		December 2021	August to November 2021	2020-2021 shipping season	August to December 2021
Oil content ¹ (%)	41.3	40.9	41.0	43.3	41.0
Protein content ² (%)	24.0	23.9	23.6	20.9	23.1
Oil-free protein content ³ (%)	42.0	41.5	41.0	38.2	40.3
Chlorophyll ⁴ (mg/kg ⁵ seed)	10	14	13	12	15
Total glucosinolates ²³ of the seed (µmol/g seed ⁶)	11	12	12	10	12
Free fatty acids (% in oil, as oleic acid)	0.24	0.29	0.33	0.26	0.40
Erucic acid (% in oil)	0.01	0.02	0.03	0.02	0.02
Oleic acid (% in oil)	64.2	63.8	64.0	63.7	63.7
α-Linolenic acid (% in oil)	8.6	9.1	8.9	9.0	9.0
Total saturates ⁷ (% in oil)	6.6	6.5	6.6	6.8	6.6
Iodine value ⁸ (units in oil)	110.9	111.6	111.2	111.4	111.6
MUFA ⁹ (% in oil)	65.8	65.5	65.7	65.3	65.3
PUFA ¹⁰ (% in oil)	27.0	27.3	27.2	27.4	27.4
Distinctly green seed (DGR, %)	0.6	0.9	0.7	0.8	0.6
Dockage (%)	NA ¹¹	1.8	1.6	1.6	2.83
Loading moisture (%)	NA	7.8	8.0	7.8	8.0
Number of export samples	NA	12	52	225	23
Tonnage (tonnes)	NA	392,995	1,851,126	8,012,421	485,914

¹ 8.5% moisture basis

² protein content calculated from nitrogen content using N x 6.25, 8.5% moisture basis

³ protein content calculated from nitrogen content using N x 6.25, 12% moisture basis

⁴ as-is moisture basis

⁵ mg/kg = milligram per kilogram

⁶ µmol/g seed = micromoles per gram of seed

⁷ total saturated fatty acids are the sum of lauric (C12:0), myristic (C14:0), palmitic (C16:0), stearic (C18:0), arachidic (C20:0), behenic (C22:0) and lignoceric (C24:0) acids

⁸ calculated from fatty acid composition

⁹ MUFA = monounsaturated fatty acids (total MUFA are the sum of palmitoleic (C16:1), oleic (C18:1), eicosenoic (C20:1), erucic (C22:1) and nervonic (C24:1) acids)

¹⁰ PUFA = polyunsaturated fatty acids (total PUFA are the sum of linoleic (C18:2), α-linolenic (C18:3) and eicosadienoic (C20:2) acids)

¹¹ N/A = not applicable

Acknowledgments

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