# Quality of Canadian soybean

# 1998

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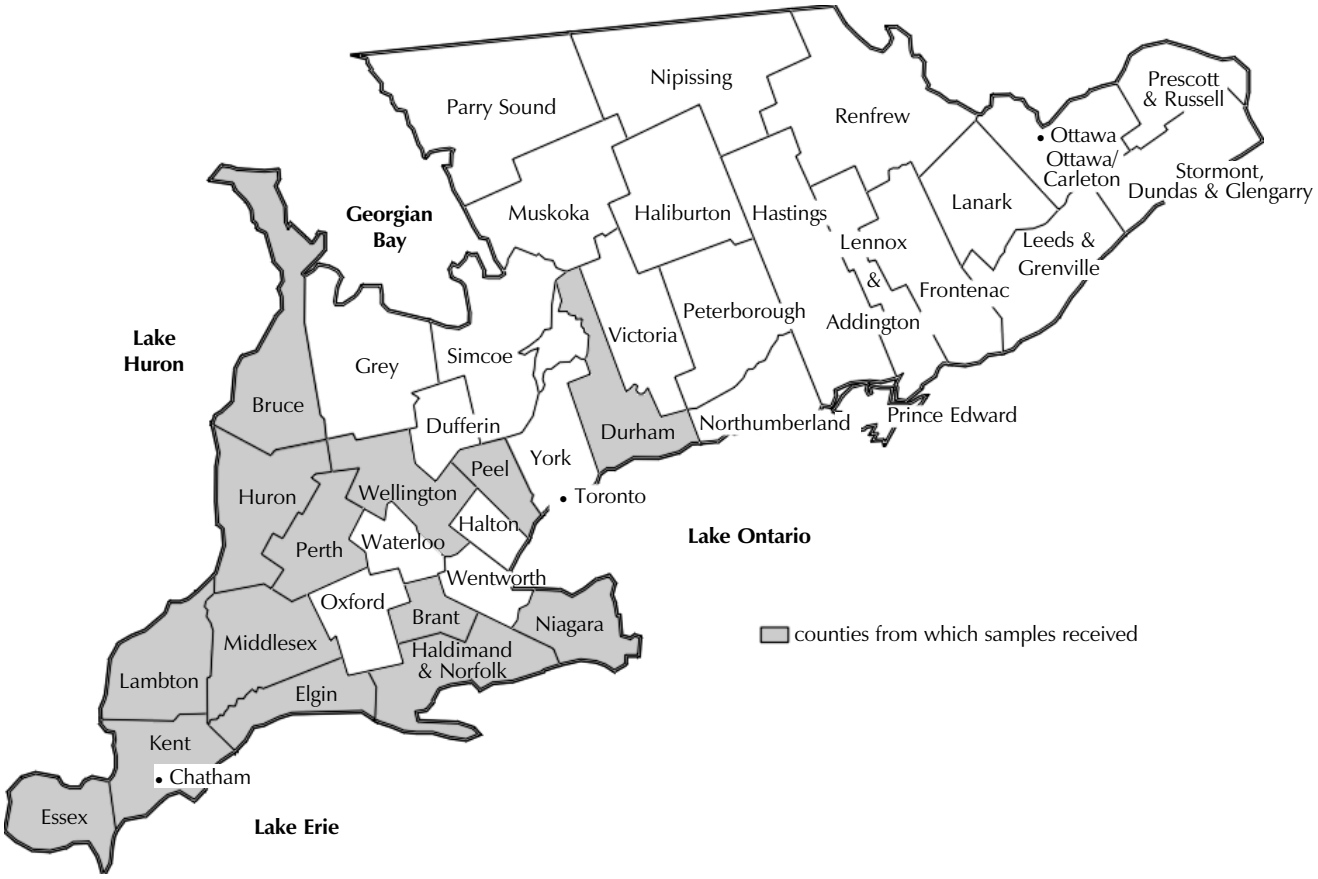
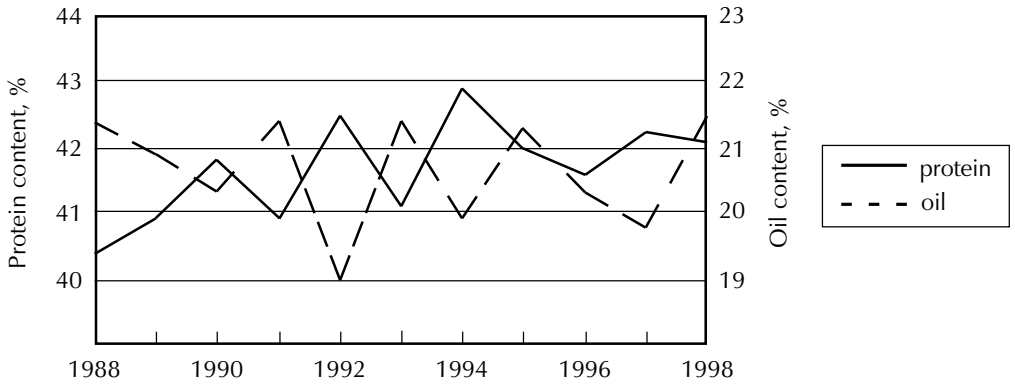
**Figure 1 • Map of southern Ontario showing counties from which 1998 soybean survey samples were received**



## Introduction

Information on the quality, specifically, oil, protein, and fatty acid composition, of the 1998 crop of Ontario soybean was obtained from analysis of samples collected by the Ontario Soybean Growers' Marketing Board. The 1998 survey consisted of 127 dark hilum and 79 white hilum samples. The Canadian Grain Commission, Industry Services, in Chatham, Ontario indicated that 155 of the samples graded No. 1 Canada and 51 graded No. 2 Canada soybean. The survey samples came from producers in 14 different counties with the majority of samples coming from the counties of Kent (39), Essex (32), Lambton (28) and Bruce (23). Trends in oil and protein data since 1988 are provided in graphical form (Figure 2).

**Figure 2 • Annual mean oil and protein contents of Canadian soybean 1988 to 1998**



## Weather and production review

Soybean production in Canada was 2.74 million tonnes in 1998, only one thousand tonnes less than the 1997 record production (Table 1). In Ontario, the 849,800 hectares of harvested soybean yielded an average of 2.75 tonnes/ha for a total crop of 2.34 million tonnes. Ontario accounted for about 84% of the total Canadian soybean production.

In contrast to 1997, the 1998 Ontario soybean growing season started early after an exceptionally mild winter and a warm spring. The majority of soybean was seeded into relatively dry soil and was completed earlier than normal. A large percentage of the fields were planted by the end of May although seeding continued into the first week of June in certain areas.

Early June had cool temperatures with several nights of frost. A significant portion of the crop germinated unevenly due to lack of moisture. The remainder of June and most of July and August was generally hot and dry. Total rainfall varied widely and ranged from just below normal to well below normal. Consistently warm temperatures and timely rains resulted in some of the best growing conditions in several years.

Harvest began as early as late August and was completed by the third week of October. Despite the hot and dry growing conditions, yields were often higher than expected. The 1998 Ontario mean soybean yield of 2.75 tonnes/ha (41 bu/acre) was better than last year and above the long-term average.

**Table 1 • Production statistics for Canadian soybeans**

| Year | Seeded area | Production | Yield |
|---|---|---|---|
| | hectares | tonnes | tonnes/ha |
| 1988 | 533 000 | 1 152 000 | 2.16 |
| 1989 | 539 500 | 1 219 000 | 2.26 |
| 1990 | 491 200 | 1 292 000 | 2.63 |
| 1991 | 575 500 | 1 459 900 | 2.44 |
| 1992 | 643 600 | 1 455 300 | 2.34 |
| 1993 | 728 700 | 1 851 300 | 2.57 |
| 1994 | 820 100 | 2 250 700 | 2.74 |
| 1995 | 826 000 | 2 293 000 | 2.78 |
| 1996 | 875 300 | 2 170 400 | 2.51 |
| 1997 | 1 061 700 | 2 737 700 | 2.58 |
| 1998 | 980 600 | 2 736 600 | 2.79 |

Source—Statistics Canada, *Field Crop Reporting Series, No. 8*, 1988–98

## Quality of 1998 soybean

There are two major types of soybeans grown in Canada, commonly referred to as oil beans and food beans. A complete listing 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.cfia-acia.agr.ca/english/plant/variety/list_e.html).

Oil beans include soybeans designed primarily for producing oil used in salad oil, shortening and margarine products, and in defatted meal, which is used as a protein supplement in livestock rations. Key quality factors for oil beans include oil content, protein content, and fatty acid composition. Oil and protein content give quantitative estimates of the seed as a source of oil and of the resulting meal as a source of protein for animal feed. The fatty acid composition provides information about the nutritional, physical and chemical characteristics of the oil extracted from the seed.

Food beans are those varieties of soybeans that have been bred for specific attributes required in the production of traditional soyfoods. The quality of these beans is measured by such attributes as a clear or white hilum, larger seed size, and a higher protein content. White hilum soybeans that do not meet quality standards for food processing can be used as oil beans.

Soyfoods are divided roughly into two classes: nonfermented and fermented. Nonfermented soyfoods include soymilk, soybean curd or tofu, toasted soy powder, and bean sprouts. Fermented products include soy sauce, miso, tempeh, and natto.

**Table 2 • Quality data for GRL harvest survey soybean No. 1 and No. 2 Canada grades[1]**

| Quality parameter | 1998 | 1997 | 1988–97 |
|---|---|---|---|
| Oil content[2], % | 21.5 | 19.8 | 20.6 |
| Protein content[3], % | 42.1 | 42.2 | 41.6 |

[1] means for the combined grades
[2] moisture-free basis
[3] %N x 6.25; moisture-free basis

## Oil and protein content

The 1998 mean oil content of 21.5% was 1.7 percentage units higher than in 1997 and 0.9 percentage units higher than the ten-year mean. The mean protein content in 1998 decreased 0.1 percentage units to 42.1% from last year and is above the ten-year-mean of 41.6% (Table 2). While No. 1 and No. 2 Canada soybean were similar in oil content, the No.2 grade was higher in protein content (Table 3). This was largely due to the presence of several high protein, tofu type samples which graded No. 2 Canada. While the white hilum and dark hilum beans were similar in oil content, the white hilum beans were 0.6 percentage units higher in protein content (Table 3).

The oil and protein data were summarized by grade and county in Tables 4 and 5. The oil and protein content of the major varieties identified in the 1998 survey are provided in Table 6.

**Table 3 • Quality data for 1998 Ontario harvest survey soybean by grade and hilum type**

| Type | Oil content[1], % | | | Grade | Protein content[2],% | | | No. of samples |
|---|---|---|---|---|---|---|---|---|
| | mean | min. | max. | | mean | min. | max. | |
| | % | % | % | | % | % | % | |
| **No. 1 Canada** | | | | | | | | |
| Dark Hilum | 21.7 | 20.0 | 24.1 | | 41.8 | 35.5 | 44.8 | 98 |
| White Hilum | 21.5 | 20.0 | 23.2 | | 42.1 | 38.4 | 45.1 | 57 |
| **All types** | **21.6** | **20.0** | **24.1** | | **41.9** | **35.5** | **45.1** | **155** |
| **No. 2 Canada** | | | | | | | | |
| Dark Hilum | 21.5 | 19.8 | 23.9 | | 42.1 | 35.4 | 45.5 | 29 |
| White Hilum | 20.8 | 19.1 | 22.4 | | 43.7 | 39.8 | 48.0 | 22 |
| **All types** | **21.2** | **19.1** | **23.9** | | **42.8** | **35.4** | **48.0** | **51** |
| **No. 1 Canada & No. 2 Canada** | | | | | | | | |
| Dark Hilum | 21.6 | 19.8 | 24.1 | | 41.9 | 35.4 | 45.5 | 127 |
| White Hilum | 21.3 | 19.1 | 23.2 | | 42.5 | 38.4 | 48.0 | 79 |
| **All types** | **21.5** | **19.1** | **24.1** | | **42.1** | **35.4** | **48.0** | **206** |

[1] moisture-free basis
[2] %N x 6.25; moisture-free-basis

**Table 4 • Oil and protein content of 1998 Ontario harvest survey soybean by county and grade**

| County | Oil content[1], % | | | Protein content[2], % | | | No. of Samples |
|---|---|---|---|---|---|---|---|
| | mean | min. | max. | mean | min. | max | |
| | % | % | % | % | % | % | |
| **No. 1 Canada** | | | | | | | |
| Brant | 22.2 | 20.7 | 23.2 | 40.7 | 38.4 | 42.2 | 7 |
| Bruce | 21.4 | 20.5 | 21.9 | 41.9 | 40.6 | 43.4 | 19 |
| Durham-West | 21.4 | 21.4 | 21.5 | 41.7 | 41.4 | 41.9 | 2 |
| Elgin | 21.7 | 21.0 | 23.1 | 42.0 | 40.5 | 43.2 | 8 |
| Essex | 21.4 | 20.0 | 22.5 | 42.7 | 40.5 | 45.1 | 22 |
| Haldimand | 22.4 | 20.1 | 23.5 | 39.7 | 37.4 | 43.3 | 6 |
| Huron | 21.0 | 20.5 | 21.5 | 42.9 | 42.1 | 43.6 | 3 |
| Kent | 21.7 | 20.6 | 23.2 | 42.1 | 39.5 | 44.6 | 32 |
| Lambton | 21.2 | 20.0 | 21.9 | 42.4 | 40.6 | 44.8 | 20 |
| Middlesex | 21.9 | 21.0 | 22.7 | 41.5 | 40.0 | 43.6 | 15 |
| Niagara | 22.1 | 21.1 | 24.1 | 41.0 | 35.5 | 42.9 | 6 |
| Peel | 22.2 | 21.1 | 23.0 | 41.1 | 39.4 | 43.4 | 4 |
| Perth | 21.9 | 20.9 | 23.4 | 41.3 | 37.5 | 43.9 | 10 |
| Wellington | 21.0 | 21.0 | 21.0 | 42.4 | 42.4 | 42.4 | 1 |
| **All samples** | **21.6** | **20.0** | **24.1** | **41.9** | **35.5** | **45.1** | **155** |
| **No. 2 Canada** | | | | | | | |
| Bruce | 22.2 | 21.6 | 23.9 | 39.6 | 35.4 | 41.4 | 4 |
| Elgin | 21.5 | 20.2 | 22.0 | 42.2 | 41.4 | 43.9 | 4 |
| Essex | 20.9 | 19.9 | 22.1 | 43.9 | 42.2 | 46.0 | 10 |
| Haldimand | 22.3 | 21.8 | 23.3 | 40.3 | 39.3 | 41.0 | 3 |
| Huron | 21.5 | 20.4 | 22.4 | 42.5 | 39.8 | 45.2 | 5 |
| Kent | 20.7 | 19.3 | 21.5 | 44.0 | 41.7 | 48.0 | 7 |
| Lambton | 20.2 | 19.1 | 21.7 | 44.4 | 41.1 | 47.6 | 8 |
| Middlesex | 20.2 | 19.8 | 20.5 | 42.9 | 42.6 | 43.3 | 2 |
| Peel | 22.1 | 21.9 | 22.3 | 41.0 | 40.9 | 41.1 | 2 |
| Perth | 21.9 | 21.2 | 22.4 | 42.3 | 41.5 | 42.7 | 6 |
| **All samples** | **21.2** | **19.1** | **23.9** | **42.8** | **35.4** | **48.0** | **51** |

[1] moisture-free basis

[2] %N x 6.25; moisture-free-basis

**Table 5 • Oil and protein content of 1998 Ontario harvest survey soybean by county No. 1 and No. 2 Canada grades combined**

| County | Oil content[1], % | | | Protein content[2], % | | | No. of samples |
|---|---|---|---|---|---|---|---|
| | mean | min. | max. | mean | min. | max. | |
| | % | % | % | % | % | % | |
| Brant | 22.2 | 20.7 | 23.2 | 40.7 | 38.4 | 42.2 | 7 |
| Bruce | 21.5 | 20.5 | 23.9 | 41.5 | 35.4 | 43.4 | 23 |
| Durham-West | 21.4 | 21.4 | 21.5 | 41.7 | 41.4 | 41.9 | 2 |
| Elgin | 21.6 | 20.2 | 23.1 | 42.1 | 40.5 | 43.8 | 12 |
| Essex | 21.2 | 19.9 | 22.5 | 43.1 | 40.5 | 46.0 | 32 |
| Haldimand | 22.4 | 20.1 | 23.5 | 39.9 | 37.4 | 43.3 | 9 |
| Huron | 21.3 | 20.4 | 22.4 | 42.6 | 39.8 | 45.2 | 8 |
| Kent | 21.5 | 19.3 | 23.2 | 42.4 | 39.5 | 48.0 | 39 |
| Lambton | 20.9 | 19.1 | 21.9 | 43.0 | 40.6 | 47.6 | 28 |
| Middlesex | 21.7 | 19.8 | 22.7 | 41.7 | 40.0 | 43.6 | 17 |
| Niagara | 22.1 | 21.1 | 24.1 | 41.0 | 35.5 | 42.9 | 6 |
| Peel | 22.2 | 21.1 | 23.0 | 41.1 | 39.4 | 43.4 | 6 |
| Perth | 21.9 | 20.9 | 23.4 | 41.7 | 37.5 | 43.9 | 16 |
| Wellington | 21.0 | 21.0 | 21.0 | 42.4 | 42.4 | 42.4 | 1 |
| **All samples** | **21.5** | **19.1** | **24.1** | **42.1** | **35.4** | **48.0** | **206** |

[1] moisture-free basis

[2] %N x 6.25; moisture-free-basis

**Table 6 • Oil and protein content of 1998 Ontario harvest survey soybean by variety No. 1 and No. 2 Canada grades combined**

| Variety[1] | Oil content[2], % | | | Protein content[3], % | | | No. of samples |
|---|---|---|---|---|---|---|---|
| | mean | min. | max. | mean | min. | max. | |
| | % | % | % | % | % | % | |
| OAC Bayfield | 21.8 | 19.8 | 23.9 | 41.5 | 35.4 | 43.4 | 16 |
| S 19-90 | 21.1 | 20.2 | 21.9 | 42.5 | 41.5 | 43.8 | 12 |
| S 24-12 | 21.3 | 20.6 | 22.0 | 42.4 | 41.7 | 42.9 | 9 |
| S 08-80 | 21.7 | 20.9 | 22.6 | 42.2 | 40.2 | 43.9 | 8 |
| Harovinton | 19.5 | 19.1 | 20.1 | 46.6 | 43.3 | 48.0 | 7 |
| FS671 | 20.6 | 20.3 | 21.1 | 44.4 | 43.6 | 45.0 | 7 |
| RCAT Bobcat | 22.4 | 22.1 | 22.7 | 41.0 | 40.0 | 41.6 | 6 |
| 9305 | 21.4 | 21.1 | 21.7 | 42.3 | 41.3 | 43.0 | 6 |
| CX232 | 21.6 | 21.2 | 22.0 | 42.2 | 41.4 | 42.6 | 5 |
| Sapphire | 21.5 | 21.3 | 21.9 | 41.8 | 41.3 | 42.2 | 4 |
| RS1493 | 20.9 | 20.5 | 21.4 | 44.2 | 43.6 | 44.8 | 4 |
| KG 41 | 22.0 | 21.6 | 23.2 | 41.1 | 39.1 | 42.6 | 4 |
| Kenwood 94 | 21.5 | 20.3 | 22.2 | 41.7 | 40.0 | 42.9 | 4 |
| 92B61 | 21.0 | 20.5 | 21.5 | 42.9 | 42.4 | 43.5 | 4 |
| 9163 | 22.4 | 21.8 | 23.2 | 39.7 | 38.4 | 40.5 | 4 |
| 9063 | 22.3 | 21.3 | 23.0 | 40.6 | 39.4 | 41.2 | 4 |

[1] as designated on sample envelope
[2] moisture-free basis
[3] %N x 6.25; moisture-free-basis

## Fatty acid composition

Compared to 1997, the No. 1 and No. 2 Canada composites had increased palmitic, stearic and oleic acid contents and decreased linoleic and linolenic acid contents (Table 7). The warm growing conditions of 1998 contributed to the decreased levels of the polyunsaturated fatty acids linolenic and linoleic acid.

**Table 7 • Fatty acid composition for 1998 Ontario harvest survey soybean by variety No. 1 and No. 2 Canada grades combined**

| Variety[2] | Fatty acid composition[1] | | | | | Iodine value[3] | No. of samples |
|---|---|---|---|---|---|---|---|
| | C16:0 | C18:0 | C18:1 | C18:2 | C18:3 | | |
| | % | % | % | % | % | | |
| OAC Bayfield | 9.6 | 4.1 | 22.0 | 55.6 | 7.5 | 134.8 | 16 |
| S 19-90 | 9.6 | 4.4 | 24.5 | 52.7 | 7.7 | 132.4 | 12 |
| S 24-12 | 9.4 | 3.7 | 26.4 | 52.7 | 6.7 | 131.4 | 9 |
| S 08-80 | 9.1 | 4.7 | 25.4 | 52.1 | 7.4 | 131.7 | 8 |
| Harovinton | 9.6 | 4.0 | 27.8 | 49.6 | 7.8 | 130.3 | 7 |
| FS671 | 10.1 | 4.2 | 26.7 | 50.3 | 7.5 | 129.6 | 7 |
| RCAT Bobcat | 9.4 | 4.0 | 27.6 | 51.0 | 6.6 | 129.5 | 6 |
| 9305 | 9.9 | 3.7 | 24.5 | 52.8 | 8.0 | 133.4 | 6 |
| CX232 | 10.9 | 4.6 | 23.2 | 52.2 | 7.8 | 130.8 | 5 |
| Sapphire | 10.3 | 3.8 | 26.0 | 51.3 | 7.5 | 130.7 | 4 |
| RS1493 | 9.8 | 4.6 | 24.2 | 52.0 | 8.2 | 132.4 | 4 |
| KG 41 | 9.7 | 4.1 | 25.5 | 52.2 | 7.3 | 131.3 | 4 |
| Kenwood 94 | 11.0 | 4.5 | 20.9 | 54.2 | 8.3 | 133.4 | 4 |
| 92B61 | 10.2 | 4.1 | 21.8 | 55.1 | 7.7 | 134.3 | 4 |
| 9163 | 9.5 | 4.6 | 23.2 | 53.8 | 7.8 | 133.5 | 4 |
| 9063 | 10.0 | 4.2 | 24.8 | 52.5 | 7.4 | 131.5 | 4 |
| **No. 1 Canada (all)** | **10.1** | **4.2** | **24.8** | **52.2** | **7.5** | **131.3** | **155** |
| **No. 2 Canada (all)** | **9.9** | **4.3** | **25.7** | **51.4** | **7.5** | **130.7** | **51** |

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

[2] as designated on the sample envelope

[3] calculated from the fatty acid composition

# Methods and definitions

**Harvest Survey**

Samples of newly harvested soybean were collected by the Ontario Soybean Growers' Marketing Board and forwarded to the Canadian Grain Commission's Industry Services Division in Chatham for grading. All samples were analysed for oil and protein content by near infrared (NIR) spectroscopy using a Tecator Infratec 1225 Grain Analyzer. The instrument was calibrated and verified against the appropriate listed reference method. Variety composites were tested for fatty acid composition.

**Oil content**

Oil content is determined by nuclear magnetic resonance (NMR) according to International Organization for Standardization method ISO 10565:1993(E), *Oilseeds—Simultaneous determination of oil and moisture contents—Method using pulsed nuclear magnetic resonance spectroscopy*. Results were obtained with a Bruker NMS 110 Minispec NMR Analyzer and are reported as percentage, calculated to a dry matter basis.

**Protein content**

Protein content is determined by the AOCS Official Method Ba 4e-93, *Generic combustion method for determination of crude protein*. Results were obtained with a LECO FP-428 Nitrogen Determinator and are converted to percentage protein by multiplying percentage nitrogen x 6.25, calculated to a dry matter basis.

**Fatty acid composition**

Fatty acid composition is determined by the International Organization for Standardization method ISO 5508:1990 (E), *Animal and vegetable fats and oils—Analysis by gas chromatography of methyl esters of fatty acids*. A 15-m by 0.32-mm column with a 0.5-micrometer Supelcowax 10 coating is used. Major fatty acids are reported although samples may also contain as much as 1% of other minor fatty acids, which are included in the calculations.

**Iodine value**

Iodine value is calculated from the fatty acid composition, according to AOCS Recommended Practice Cd 1c-85, *Calculated Iodine Value*.

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