Quality of Western Canadian wheat • 1997

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Crop Bulletin No. 233
ISSN 0849–3855

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Summary

In 1997, Western Canada enjoyed one of its earliest harvests for many years and a high percentage of the crop should qualify for the top grades. Production of all prairie wheat is estimated to be lower by more than 20% compared to 1996, as a result of decreases in both seeded area and yield. Protein content generally shows a welcome increase but still continues to be lower than the long-term average in Saskatchewan and Alberta, in sharp contrast to very high values obtained for Manitoba samples.

Milling and baking quality of composite samples representing the top two grades of CWRS wheat is good. Doughs appear to be stronger this year, but seed size and water absorption values are lower. This year's crop of CWAD wheat produces semolina and spaghetti with excellent colour and with good overall quality for the protein content.

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Seven classes of Canadian wheat

This report presents detailed information on the quality of the 1997 crop of seven classes of western Canadian wheat offered on the world market.

Canada Western Red Spring (CWRS) wheat is a hard wheat with superior milling and baking quality. It is offered at various guaranteed protein levels.

Canada Western Amber Durum (CWAD) wheat is a durum wheat producing a high yield of semolina with excellent pasta-making quality.

Canada Western Extra Strong (CWES) wheat is a hard red spring wheat with extra-strong gluten suitable for blending purposes and for special breads.

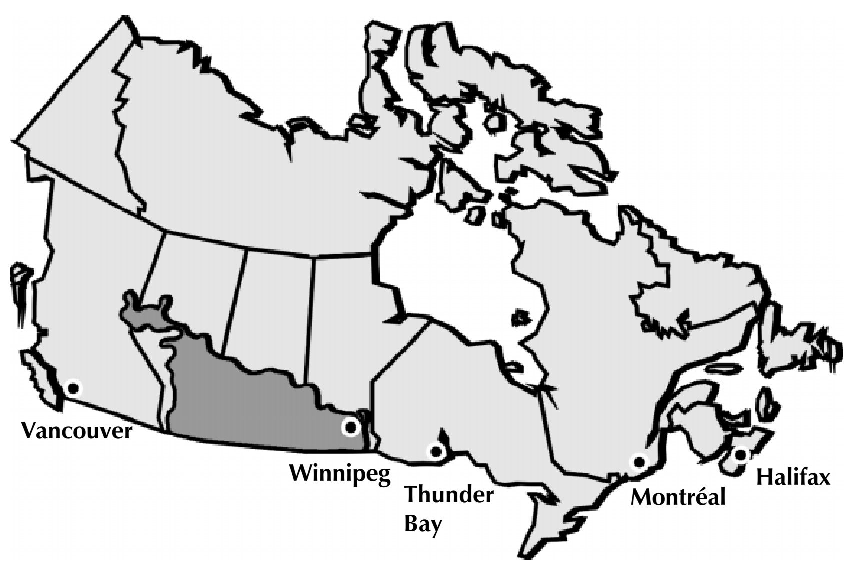
Canada Prairie Spring Red (CPSR) wheat is a medium-strength wheat suitable for the production of certain types of hearth breads, flat breads, steamed breads, noodles, and related products.

Canada Western Red Winter (CWRW) wheat is a hard wheat of excellent milling quality suitable for the production of a wide variety of products including French breads, flat breads, steamed breads, and certain types of noodles.

Canada Prairie Spring White (CPSW) wheat is a medium-strength wheat suitable for the production of various types of flat breads, noodles, chapatis, and related products.

Canada Western Soft White Spring (CWSWS) wheat is a soft wheat of low protein content for production of cookies, cakes, and pastry, as well as various types of flat breads, noodles, steamed breads, and chapatis.

Figure 1 • Map of Canada showing major wheat producing areas in the prairies



Introduction

What data in this report represent

Data presented in this report were generated from quality tests carried out on composites of over 13 000 individual samples submitted by producers and primary elevator managers from the three prairie provinces. Figure 1 highlights the wheat producing areas, which are in the provinces of, from east to west, Manitoba, Saskatchewan and Alberta. These data are not quality specifications for Canadian wheat. Rather, they represent our best estimate of quality. How closely they represent the exact quality characteristics of wheat of any given grade exported during the coming year depends on

- The amounts and relative quality of carryover stocks of each grade
- The degree to which the harvest survey composites are representative of 1997 production

Background for the 1997 crop

Despite delays in seeding, generally hot dry weather during crop development and favourable harvesting conditions contributed to one of the earliest harvests for many years.

Seeding

Seeding of the 1997 wheat crop was delayed by cool conditions in late April and early May. Seeding started in the first week of May in the southwestern areas of the prairies, but not until the last two weeks of May in the eastern and northern regions. Seeding operations in northern Alberta and northeastern Saskatchewan were delayed by wet soil conditions and the fact that farmers still had to complete an overwintered portion of the 1996 harvest. Flooding in the Red River Valley of Manitoba also caused significant delays and seeding in that region did not get underway until early June.

Western Canadian producers seeded 8.9 million hectares to spring wheat, a decrease of 10 percent compared to 1996. The area seeded to durum increased eight percent to 2.2 million hectares, while winter wheat area decreased 30 percent to 67 000 hectares. The reduction in wheat area was mainly due to increased seeding of oilseeds and special crops.

Growing conditions

June temperatures were warmer than normal in the eastern regions and mostly normal in the western regions. Rainfall in June was variable, with western areas receiving close to normal amounts of rainfall and eastern regions receiving below normal amounts. The dry weather was particularly acute in southwestern Manitoba and southeastern Saskatchewan, resulting in poor germination and limited yield potential for all crops. The above normal temperatures in the eastern regions also contributed to the stressful conditions. The normal to above normal rainfall in the western regions was welcomed in the south, but the northern areas, especially in Alberta, did not need the moisture. The rain delayed seeding in this region, and the excess soil moisture weakened stands and in some cases drowned the crop.

July temperatures were normal during the first two weeks but were above normal in the latter half of the month. July rainfall was below normal in most areas of the prairie region with the exception of Manitoba. Above normal rainfall, especially in the central and eastern portions of the province, resulted in increased disease pressure. The combination of above normal temperatures and little or no precipitation on the rest of the prairies caused crop conditions to decline rapidly in the last half of July.

The dry, hot weather continued for the first two weeks in August and caused further deterioration. The southern prairies suffered the most, as moisture reserves in this region were very low. In most cases, the stress resulted in incompletely filled heads. Wheat matured rapidly under the warm, dry weather and harvesting began in some southern areas by the middle of August. Rains returned in mid-August, which helped improve conditions in some northern areas, but the rain was too late to help most of the crop.

Harvest conditions

The wheat harvest began in the south by the middle of August, and close to one-third of the crop was in bins by the first week in September. The weather during the last half of August and September was nearly ideal and the wheat harvest was nearly 90 percent complete by the end of September. Northern Alberta had less than ideal weather during September. Heavy rains in the Peace River region delayed the harvest and caused a reduction in quality.

Production

Early completion of most of the wheat harvest under generally favourable conditions means that a high proportion of the 1997 wheat crop should enter the top grades. Although the three prairie pool elevator companies had not published clear estimates at the time this bulletin went to press, indications are that a high percentage of the CWRS and CWAD wheat should qualify for the top two grades. Similarly, it appears likely that much of the wheat of the other five classes will enter the top grade.

Total wheat production is considerably lower than in 1996 as a result of both a decrease in seeded area and a reduction in yields. Statistics Canada (*Field Crop Reporting Series*, No. 7, October 8, 1997) estimates production of all wheat in western Canada to be 22.605 million metric tonnes, a reduction of almost 22% from 1996. Production of the five classes of common spring wheat is estimated at 18.180 million tonnes, down 24% from last year. Although spring wheat production by class was not available at the time this bulletin was prepared, if last year’s proportion of 83% is maintained, the production of the major class, Canada Western Red Spring wheat, should be a little over 15 million tonnes.

Production of amber durum wheat is estimated to be 4.265 million tonnes, a decrease of nearly 8% from 1996. The Statistics Canada estimate for Canada Western Red Winter wheat is 160 600 tonnes, a reduction of 25% from last year.

Protein

Table 1 compares mean protein values for each of the seven classes of western Canadian wheat surveyed in 1997 to corresponding values obtained in the 1996 harvest survey. Wheat protein is higher for all classes except Canada Western Soft White Spring, which has essentially the same protein content as last year. The increase for the other classes over 1996 values ranges from 0.3 percentage units higher for Canada Western Amber Durum and Canada Western Extra Strong wheats, to 1.1 percentage units higher for Canada Prairie Spring Red wheat.

Table 1 • Mean protein content of milling grades of western Canadian wheat classes, 1997 and 1996

Class	Protein content (%)[1]	
	1997	1996
CWRS	13.5	12.9
CWAD	12.5	12.2
CWRW	11.5	11.1
CPSR	11.8	10.7
CPSW	11.6	10.8
CWES	12.5	12.2
CWSWS	10.5	10.6

[1] mean value, N x 5.7; 13.5% moisture content basis

Canada Western Red Spring wheat

Protein survey

Table 2 lists mean protein values for Canada Western Red Spring (CWRS) wheat by grade and province for 1997. Comparative values for western Canada by grade are shown for 1996 and for the previous ten years (1986–95). Figure 2 shows the fluctuations in annual mean protein content since 1927.

This year sees a welcome return to protein values close to the long-term average. The weighted mean protein for all milling grades of 1997 CWRS wheat is 13.5%, which is 0.6 percentage units higher than in 1996. The survey was based on a total of 9981samples tested by October 16, 1997.

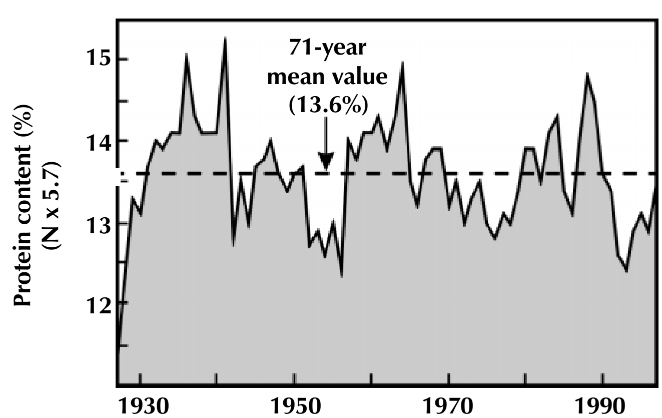
Protein is again not evenly distributed across the wheat growing area, and the trend for decreasing protein content from east to west across the prairies, observed in each of the past two years, is also evident in 1997. Protein content is very high in Manitoba, where a mean value of 14.9% is in sharp contrast to the averages of 13.3% for Saskatchewan and 12.7% for Alberta. As a result, the Canadian Wheat Board will continue to have to source high protein wheat from the eastern prairies and lower protein wheat from the western prairies.

Table 2 • Mean protein content of 1997 Canada Western Red Spring wheat, by grade, year and province

	Protein content (%)[1]					
	Western Canada			1997		
Grade	1997	1996	1986-95	Manitoba	Saskatchewan	Alberta
No. 1 CWRS	13.4	13.1	13.6	14.7	13.2	13.0
No. 2 CWRS	13.8	13.3	13.4	15.0	13.6	12.7
No. 3 CWRS	12.7	12.1	13.2	15.0	13.2	11.7
All milling grades	**13.5**	**12.9**	**13.4**	**14.9**	**13.3**	**12.7**

[1] N x 5.7; 13.5% moisture content basis

Figure 2 • Mean protein content of harvest survey Canada Western Red Spring wheat—1927 to 1997



Milling and baking quality Allis-Chalmers laboratory mill

To assess the quality of the 1997 CWRS wheat crop, composites were prepared from harvest survey samples representing the top two milling grades. The No. 1and No. 2 CWRS samples were segregated into composites having minimum protein levels of 14.5%, 13.5%, 12.5% and 11.5%.

No. 1 Canada Western Red Spring wheat

Table 3 summarizes quality data for the No. 1 CWRS composites. Corresponding data are provided at the 13.5% minimum protein level for both last year's composite and the ten-year average, 1986–95.

Seed size is significantly smaller than last year. This and a slightly higher wheat ash content likely result from drought stress during crop development. Falling number values, while marginally lower than last year, continue to underline the soundness of the grade. While α-amylase activity is relatively higher than last year, it is in the range expected for sound wheat.

Particle size index values indicate hardness similar to last year, although starch damage values of milled flours are higher. Milling quality is good. Lower flour yield values are offset by lower flour ash and better flour colour compared with 1996 and the ten-year average. Flour amylograph peak viscosity values are somewhat lower than normal, but still indicate low α-amylase activity. Farinograph water absorption and baking absorption values are lower this year. Rheological tests indicate stronger dough properties for flours milled from 1997 No. 1 CWRS wheat. Mixing requirements in baking are also generally longer. Loaf volumes in the Canadian Short Process Baking Test are consistent with normal expectations for each protein content.

No. 2 Canada Western Red Spring wheat

Table 4 shows quality data for the 1997 No. 2 CWRS composites and comparative data for the 13.5% minimum protein level for last year's composite and the ten-year average, 1986–95.

Compared with the 1997 No. 1 CWRS composites, this year's No. 2 CWRS wheat is a little softer and shows lower test weight, higher wheat ash, and lower falling number. Milling yields are comparable, but flour ash values are higher. Flour colour is not quite as good.

Flour amylograph peak viscosity is lower and water absorptions are down about one percentage unit compared with the equivalent No. 1 CWRS samples. Otherwise, dough strength and baking quality are similar to those of the top grade.

Compared with last year's harvest survey composite, 1997 No. 2 CWRS shows the same trends as No. 1 in smaller seed size, lower flour ash, better flour colour and stronger dough characteristics. Water absorption is down slightly more this year than observed with the top grade but loaf volumes are at a normal level for the protein content.

Table 3 • No. 1 Canada Western Red Spring wheat
Quality data for 1997 harvest survey grade composite samples

Quality parameter[1]	Minimum protein content 14.5	13.5	12.5	11.5	No. 1 CWRS 13.5 1996	1986–95 Mean
Wheat						
Test weight, kg/hl	80.5	81.3	82.1	82.3	81.9	81.0
Weight per 1000 kernels, g	29.0	30.0	30.0	30.4	32.5	31.5
Protein content, %	14.6	13.7	12.7	11.7	13.6	13.7
Protein content, % (dry matter basis)	16.9	15.8	14.7	13.5	15.7	15.8
Ash content, %	1.60	1.58	1.56	1.56	1.53	1.56
α-amylase activity, units/g	6.0	7.0	7.5	7.0	3.0	4.5
Falling number, s	390	385	375	375	400	400
PSI	54	53	52	50	53	N/A
Milling						
Flour yield						
Clean wheat basis, %	75.1	75.1	75.2	74.6	75.9	75.6
0.50% ash basis, %	76.1	76.6	77.2	75.1	75.9	76.6
Flour						
Protein content, %	14.0	13.0	12.0	10.7	13.1	13.1
Wet gluten content, %	36.8	34.1	31.4	27.9	37.6	N/A
Ash content, %	0.48	0.47	0.46	0.49	0.50	0.48
Grade colour	-1.3	-1.7	-2.1	-2.3	-1.4	-1.1
AGTRON colour, %	69	72	74	76	67	N/A
Starch damage, %	6.7	7.2	7.4	7.7	6.5	N/A
α-amylase activity, units/g	1.5	1.5	2.0	2.0	1.0	1.5
Amylograph peak viscosity, BU	655	630	610	560	795	690
Maltose value, g/100 g	2.1	2.2	2.3	2.5	2.2	2.1
Zeleny sedimentation, ml	72	71	68	63	66	N/A
Farinogram						
Absorption, %	65.8	65.0	64.8	63.6	65.7	65.5
Development time, min	5.5	5.0	4.0	3.25	5.0	4.75
Mixing tolerance index, BU	25	20	25	30	30	30
Stability, min	10.0	11.0	9.0	6.5	8.5	9.25
Extensigram						
Length, cm	21	22	21	20	21	22
Height at 5 cm, BU	310	290	290	300	270	280
Maximum height, BU	535	525	500	510	470	470
Area, cm^2	155	160	140	140	130	140
Alveogram						
Length, mm	122	110	90	76	123	127
P (height x 1.1), mm	107	112	114	122	106	103
W, x 10^{-4} joules	453	425	371	342	396	414
Baking (Canadian Short Process Baking Test)						
Absorption, %	70	69	69	68	70	69
Mixing energy, W–h/kg	8.6	9.8	9.2	10.2	8.5	7.8
Mixing time, min	7.9	8.5	8.6	10.4	6.9	7.3
Loaf volume, cm^3/100 g flour	1160	1105	1055	1010	1115	1100

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

Table 4 • No. 2 Canada Western Red Spring wheat
Quality data for 1997 harvest survey grade composite samples

	Minimum protein content				No. 2 CWRS 13.5	
Quality parameter[1]	14.5	13.5	12.5	11.5	1996	1986–95 Mean
Wheat						
Test weight, kg/hl	79.1	79.7	80.7	81.1	79.8	79.2
Weight per 1000 kernels, g	30.0	30.6	30.9	31.1	33.2	31.5
Protein content, %	14.6	13.7	12.6	11.8	13.7	13.7
Protein content, % (dry matter basis)	16.9	15.8	14.6	13.6	15.8	15.8
Ash content, %	1.71	1.68	1.63	1.60	1.64	1.59
α-amylase activity, units/g	16.0	14.5	12.5	14.0	7.5	9.5
Falling number, s	355	360	360	355	380	375
PSI	56	56	54	53	54	N/A
Milling						
Flour yield						
Clean wheat basis, %	75.6	75.5	75.6	75.1	75.7	75.2
0.50% ash basis, %	75.1	75.5	75.6	75.6	74.7	75.7
Flour						
Protein content, %	13.9	13.0	12.1	11.1	13.2	13.1
Wet gluten content, %	37.3	35.2	32.2	29.0	37.0	N/A
Ash content, %	0.51	0.50	0.50	0.49	0.52	0.49
Grade colour	-1.0	-1.3	-1.5	-1.9	-1.1	-0.9
AGTRON colour, %	65	71	73	75	69	N/A
Starch damage, %	6.1	6.3	6.7	6.9	6.3	N/A
α-amylase activity, units/g	2.5	3.5	4.0	3.5	3.5	3.0
Amylograph peak viscosity, BU	575	480	470	490	530	520
Maltose value, g/100 g	2.0	2.2	2.3	2.4	2.2	2.1
Zeleny sedimentation, ml	71	69	68	65	66	N/A
Farinogram						
Absorption, %	64.5	64.4	64.1	63.1	65.3	65.1
Development time, min	5.5	5.25	4.5	3.75	4.75	4.75
Mixing tolerance index, BU	30	30	30	30	30	30
Stability, min	9.0	8.5	8.5	7.0	7.5	8.75
Extensigram						
Length, cm	22	24	22	21	23	22
Height at 5 cm, BU	280	280	270	280	255	275
Maximum height, BU	495	490	445	460	405	460
Area, cm^2	155	165	130	130	135	140
Alveogram						
Length, mm	163	131	105	82	132	130
P (height x 1.1), mm	86	93	100	111	100	98
W, x 10^{-4} joules	433	390	356	337	400	398
Baking (Canadian Short Process Baking Test)						
Absorption, %	69	69	68	67	71	69
Mixing energy, W–h/kg	10.4	9.4	9.5	9.1	8.5	7.4
Mixing time, min	8.7	8.2	8.1	8.5	6.9	7.1
Loaf volume, cm^3/100 g flour	1110	1100	1065	1020	1070	1095

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

Milling and baking quality GRL pilot mill

Samples of 1997 and 1996 harvest survey No. 1 CWRS wheat were milled consecutively with the GRL pilot mill to complement laboratory-scale milling data. The wheat protein content for the 1997 composite is 13.7% and for the 1996 composite was 13.6%. Both results are CNA values calculated on a 13.5% moisture basis.

Cumulative ash curves shown in Figure 3 were computed from the ash content and yield of individual mill streams. A straight-grade flour and a low-ash patent flour (prime quality reduction streams representing 60 percent of total flour) were prepared to allow evaluation of commercial milling potential. The pilot mill flours also were used to compare the baking potential of the 1997 and 1996 crops by a 4.5-hour Sponge-and-Dough Baking Test and a no-time dough procedure, the Canadian Short Process Baking Test. Results are shown in Table 6.

In general, the pilot mill results shown in Table 5 confirm the laboratory scale milling results, except that the lower water absorption of the 1997 No. 1 CWRS is more evident. As with the Allis Mill, flour yield under constant milling conditions is lower for the 1997 composite. However, this is compensated for by lower flour ash values in the straight grade flour. Cumulative ash curves are similar for both years. Somewhat lower wet gluten and amylograph viscosity values are also consistent with the trends seen in Table 3. As usual, starch damage values are lower for the pilot milled flours than for the Allis flours, and Farinograph absorptions are correspondingly lower. Whereas small scale millings carried out a year apart suggest higher starch damage values for the 1997 samples, the pair of samples milled side by side this year on the pilot mill indicate little difference in starch damage. As a consequence, the relative reduction in Farinograph absorption for 1997 No. 1 CWRS straight grade flours is more pronounced (-2.4% vs. -0.7%). This difference is carried through to baking where both the Sponge-and-Dough and Canadian Short Process methods indicate lower water absorption by 3% for straight grade and 2% for patent flours.

Mixing requirements in both baking methods are longer for the 1997 straight grade and patent flour samples, consistent with the stronger dough properties noted for the Allis flours. Loaf volumes are comparable to those obtained for the 1996 flours.

Figure 3 • Cumulative ash curves for pilot mill flour 1997 and 1996 harvest survey composites

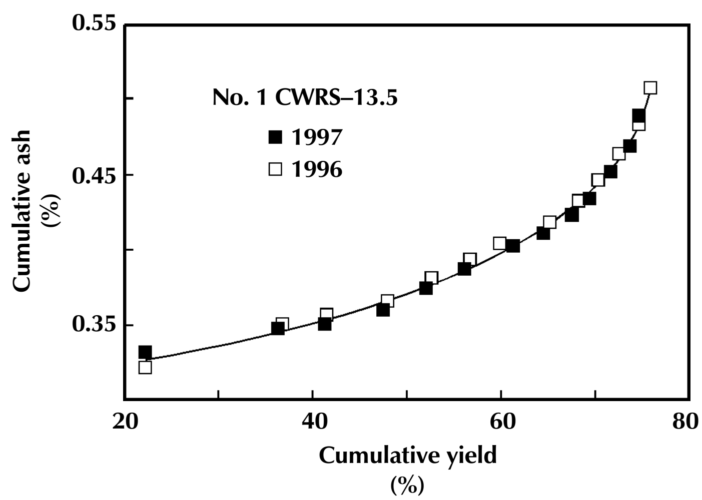


Table 5 • No. 1 Canada Western 13.5 Red Spring wheat
Pilot mill flour data • 1997 and 1996 harvest survey composites

	Straight-grade		Patent	
Quality parameter[1]	1997	1996	1997	1996
Flour				
Yield, %	74.7	75.9	45.0	45.0
Protein content, %	13.2	13.2	11.9	12.1
Wet gluten content, %	35.1	36.4	31.7	33.1
Ash content, %	0.47	0.51	0.35	0.35
Grade colour	-0.5	-0.2	-3.3	-3.2
AGTRON colour, %	63	61	85	85
Amylograph peak viscosity, BU	600	690	720	815
Starch damage, %	5.8	6.0	6.2	6.1
Farinogram				
Absorption, %	62.1	64.5	61.3	62.5
Development time, min	5.0	4.5	4.25	5.25
Mixing tolerance index, BU	35	40	15	20
Stability, min	8.5	7.0	26.5	18.0

[1] Data are reported on a 14.0% moisture basis.

Table 6 • No. 1 Canada Western 13.5 Red Spring wheat
Pilot mill flour baking data • 1997 and 1996 harvest survey composites

	Straight-grade		Patent	
Quality parameter	1997	1996	1997	1996
Sponge-and-Dough Baking Test	**(40 ppm ascorbic acid)**		**(20 ppm ascorbic acid)**	
Absorption, %	64	67	63	65
Mixing energy[1], W–h/kg	6.8	5.2	6.3	5.9
Mixing time[1], min	6.6	5.5	7.2	6.7
Loaf volume, cm^3/100 g flour	1100	1130	1045	1065
Appearance	7.9	7.5	7.4	7.5
Crumb structure	6.0	6.0	6.0	6.2
Crumb colour	8.0	8.0	8.2	8.2
Canadian Short Process Baking Test	**(150 ppm ascorbic acid)**		**(150 ppm ascorbic acid)**	
Absorption, %	66	69	65	67
Mixing energy, W–h/kg	9.1	7.2	9.7	8.4
Mixing time, min	8.5	7.1	8.1	7.1
Loaf volume, cm^3/100 g flour	1050	1055	1035	1060
Appearance	7.3	7.4	7.4	7.7
Crumb structure	6.0	6.0	6.0	6.0
Crumb colour	8.0	8.0	8.0	8.1

[1] dough stage

Canada Western Amber Durum wheat

Table 7 lists mean protein values for Canada Western Amber Durum (CWAD) wheat by grade for 1997 and 1996, and the average of the previous ten years, 1986–95.

Protein content continues to be well below the long-term average for the sixth consecutive year, although values are slightly higher than those of last year. The mean protein content of the 1997 crop for the 2994 samples tested is 12.5%, which is 0.3 percentage units higher than in 1996, but still 0.6 lower than the long-term average as illustrated in Figure 4.

This year's CWAD wheat does not show the same marked decrease in protein content with decreasing grade that was seen last year.

Quality data for composite samples representing the top three grades of 1997 CWAD wheat are shown in Tables 8 and 9. Corresponding data for 1996 composites and mean values for previous years are presented for comparison.

Colour characteristics of the 1997 crop are excellent. The top three grades exhibit very good semolina colour as indicated by high yellow pigment, AGTRON, and Minolta b* values. Pasta colour is superior with Minolta b* values substantially higher than those seen in the 1996 crop and Minolta a* values below or near zero. Of note is the application of different methods for determining semolina and pasta colour. Beginning with the 1997 crop, colour is evaluated as Lightness (L*), redness (a*) and yellowness (b*). Hunter lab data are now determined using the tristimulus method. This change was made in response to widespread use of this colour measurement system in the durum and pasta industries.

Test weights are slightly higher than the nine-year average and are similar to those of the 1996 crop. Kernel weight is lower than last year. All three grade composites are very sound with high falling numbers, which reflect the early, dry harvest conditions this year. Wheat ash contents for the top three grades are similar to those seen in 1996 and overall are similar to the long-term average. Durum kernels are somewhat softer than in 1996 as shown by higher particle size indexes.

Milling quality is comparable to that of the 1996 harvest and superior to the long-term average. Semolina ash values also are similar to those seen in 1996 and overall are similar to the long-term average. Protein content is about the same as it was last year for No 1. CWAD, but showed an increase for No. 2 and 3 grades. Vitreous kernel count in the top three grades is lower than in 1996, but, despite this, semolina yields remain high. As was the case in the past two years, non-vitreous kernel count is the major degrading factor in 1997.

SDS sedimentation volumes, indicative of gluten strength, are comparable to the long term averages and slightly better than those seen in 1996 for No. 2 and 3 CWAD. Alveograph parameters are reported for the first time this year, again in response to customer needs. Strength characteristics of the three grades are similar, although No. 1 CWAD is slightly stronger as shown by a higher W value. All grades exhibit good extensibility. Wet gluten contents are similar to long term averages. Overall cooking quality is slightly lower than normal, but not unduly so, considering the lower protein content. Cooking quality is comparable to last year for No. 1 and 2 CWAD and notably better for No. 3 CWAD. Cooking scores do not decrease significantly with decreasing grade, which underlines the intrinsic protein quality of the currently registered varieties.

The varietal distribution in the 1997 durum crop is much the same as in the past few years. Kyle continues to be the most popular variety grown on the western prairies, continuing to represent over 60% of the crop. Plenty is again found at about 10%, followed by Sceptre at about 8%. AC Avonlea, a new CWAD variety, was supported for registration in 1996. This variety is widely adapted across the prairies and shows a significantly higher protein potential than currently registered varieties. Producers will see this variety in about three years. A new stronger gluten variety, AC Melita, will be available to farmers next growing season, and a second variety, AC Morse, by the following summer.

Table 7 • Mean protein content of Canada Western Amber Durum wheat, by grade and year

	Protein content (%)[1]		
Grade	1997	1996	1986–95
No. 1 CWAD	12.7	12.8	13.4
No. 2 CWAD	12.3	12.0	13.1
No. 3 CWAD	12.3	11.8	12.8
No. 4 CWAD	12.5	11.0	12.4
All milling grades	**12.5**	**12.2**	**13.1**

[1] N x 5.7; 13.5% moisture content basis

Figure 4 • Mean protein content of harvest survey Western Canadian Amber Durum wheat—1963 to 1997

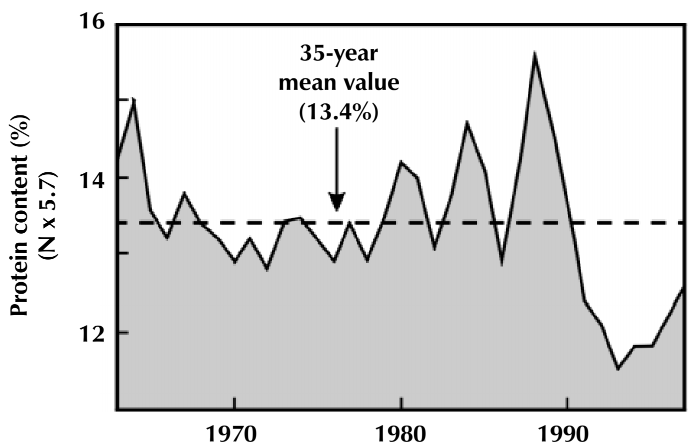


Table 8 • No. 1 and No. 2 Canada Western Amber Durum wheat
Quality data for 1997 and 1996 harvest survey grade composite samples

Quality parameter[1]	No. 1 CWAD 1997	No. 1 CWAD 1996	No. 1 CWAD 1988-96 Mean	No. 2 CWAD 1997	No. 2 CWAD 1996	No. 2 CWAD 1988–96 Mean
Wheat						
Test weight, kg/hl	82.1	82.3	81.5	81.9	82.3	80.9
Weight per 1000 kernels, g	41.4	44.1	42.3	41.9	42.9	41.9
Hard vitreous kernels, %	80	89	89	67	77	79
Protein content, %	12.7	12.8	13.3	12.4	12.0	12.8
Protein content, % (dry matter basis)	14.7	14.8	15.4	14.3	13.9	14.8
SDS sedimentation, ml	39	37	37	37	33	35
Ash content, %	1.52	1.53	1.55	1.55	1.57	1.60
Yellow pigment content, ppm	8.6	8.6	8.5[2]	8.9	8.2	8.3[2]
Falling number, s	420	390	405	390	380	370
Milling yield, %	74.7	75.2	74.7	73.9	74.9	74.4
Semolina yield, %	66.3	66.3	65.1	65.0	65.9	64.4
PSI	39	36	N/A	39	38	N/A
Semolina						
Protein content, %	11.7	11.8	12.5	11.4	11.2	12.1
Wet gluten content, %	35.8	34.0	33.9	34.7	33.4	32.9
Dry gluten content, %	13.6	12.8	N/A	13.2	12.2	N/A
Ash content, %	0.65	0.65	0.66	0.65	0.65	0.67
Speck count per 50 cm^2	18	25	25	19	35	32
Falling number, s	455	500	475[2]	430	465	445[2]
Yellow pigment content, ppm	7.9	8.2	7.7[2]	7.9	7.8	7.4[2]
AGTRON colour, %	80	79	75	78	79	76
Minolta colour						
L* (L)	88.4 (85.4)	N/A	N/A	88.6 (85.6)	N/A	N/A
a* (a)	-3.5 (-3.5)	N/A	N/A	-3.7 (-3.6)	N/A	N/A
b* (b)	34.7 (23.6)	N/A	N/A	34.2 (23.4)	N/A	N/A
Alveogram						
Length, mm	88	N/A	N/A	96	N/A	N/A
P (height x 1.1), mm	44	N/A	N/A	40	N/A	N/A
P/L	0.5	N/A	N/A	0.4	N/A	N/A
W x 10^{-4} joules	116	N/A	N/A	103	N/A	N/A
Spaghetti						
Dried at 70°C						
Minolta colour						
L* (L)	78.5 (73.5)	78.5 (73.5)	N/A	78.6 (73.6)	78.5 (73.5)	N/A
a* (a)	-0.4 (-0.4)	-0.7 (-0.6)	N/A	-0.4 (-0.4)	-0.8 (-0.7)	N/A
b* (b)	67.0 (34.2)	65.1 (33.7)	N/A	67.4 (34.4)	63.9 (33.3)	N/A
Cooking quality, CQP	33	37	43	33	34	40

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14% moisture basis for semolina.
[2] Mean of data generated starting in 1992

Table 9 • No. 3 Canada Western Amber Durum wheat
Quality data for 1997 and 1996 harvest survey grade composite samples

	No. 3 CWAD		
Quality parameter[1]	1997	1996	1988–96 Mean[2]
Wheat			
Test weight, kg/hl	80.7	81.1	80.0
Weight per 1000 kernels, g	40.7	44.5	42.6
Hard vitreous kernels, %	53	57	62
Protein content, %	12.3	11.6	12.5
Protein content, % (dry matter basis)	14.2	13.4	14.5
SDS sedimentation, ml	34	30	33
Ash content, %	1.61	1.53	1.61
Yellow pigment content, ppm	8.8	8.1	8.1[3]
Falling number, s	365	285	305
Milling yield, %	74.3	75.9	74.4
Semolina yield, %	64.7	63.8	63.6
PSI	42	39	N/A
Semolina			
Protein content, %	11.4	10.8	11.7
Wet gluten content, %	34.3	29.3	31.5
Dry gluten content, %	13.2	11.2	N/A
Ash content, %	0.71	0.68	0.67
Speck count per 50 cm^2	27	32	38
Falling number, s	395	340	400[3]
Yellow pigment content, ppm	7.9	7.6	7.2[3]
AGTRON colour, %	76	77	74
Minolta colour			
L* (L)	88.3 (85.3)	N/A	N/A
a* (a)	-3.6 (-3.5)	N/A	N/A
b* (b)	33.8 (23.2)	N/A	N/A
Alveogram			
Length, mm	107	N/A	N/A
P (height x 1.1), mm	40	N/A	N/A
P/L	0.4	N/A	N/A
W x 10^{-4} joules	105	N/A	N/A
Spaghetti			
Dried at 70°C			
Minolta colour			
L* (L)	77.7 (72.6)	78.3 (73.3)	N/A
a* (a)	0.2 (0.2)	-0.7 (-0.6)	N/A
b* (b)	66.6 (33.8)	60.6 (32.3)	N/A
Cooking quality, CQP	28	23	37

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14% moisture basis for semolina.
[2] Excluding data for 1991
[3] Mean of data generated starting in 1992

Canada Western Extra Strong wheat

Canada Western Extra Strong Spring (CWES) wheat is a red spring wheat characterized by hard kernel texture and very strong physical dough properties. Two milling grades are available.

The strength of CWES makes it ideal as a correctional wheat in blends with weaker wheat. It also can be used for producing pan breads, hearth breads, and related products where very strong dough properties are desirable.

Table 10 shows the mean protein content of No. 1 and No. 2 CWES, with comparative data from 1996 and 1995.

Table 11 summarizes quality data for the 1997 No. 1 CWES grade composite. Data for 1996 are included for comparison.

Glenlea continues to be the predominant variety in this class although the percentage dropped to 67% in the 1997 composite from 78% last year.

Test weight and kernel weight are lower this year, consistent with the trend seen for other classes. Wheat falling number and flour amylograph peak viscosity are lower for the 1997 composite, in line with higher α-amylase activity. Milling quality is similar to last year but doughs are a little stronger. Loaf volume is, as usual, excellent for the protein content when dough is adequately developed.

Table 10 • Mean protein content of Canada Western Extra Strong wheat, by grade and year

	Protein content (%)[1]		
Grade	1997	1996	1995
No. 1 CWES	12.4	12.2	12.6
No. 2 CWES	13.3	12.1	12.8

[1]N x 5.7; 13.5% moisture content basis

Table 11 • No. 1 Canada Western Extra Strong wheat
Quality data for 1997 and 1996 harvest survey grade composite samples

Quality parameter[1]	1997	1996
Wheat		
Test weight, kg/hl	79.2	80.2
Weight per 1000 kernels, g	38.3	41.9
Protein content, %	12.4	12.2
Protein content, % (dry matter basis)	14.3	14.1
Ash content, %	1.58	1.51
α-amylase activity, units/g	10.5	6.5
Falling number, s	335	360
Flour yield, %	75.7	76.1
PSI	48	48
Flour		
Protein content, %	11.6	11.5
Wet gluten content, %	27.4	27.4
Ash content, %	0.56	0.57
Grade colour	-0.7	-0.7
AGTRON colour, %	64	61
Starch damage, %	8.3	8.0
α-amylase activity, units/g	4.0	2.5
Amylograph peak viscosity, BU	390	560
Maltose value, g/100 g	3.0	2.8
Zeleny sedimentation, ml	65	63
Farinogram		
Absorption, %	62.0	63.2
Development time, min[2]	6.0	6.0
Extensigram		
Length, cm	25	24
Height at 5 cm, BU	350	340
Maximum height, BU	660	660
Area, cm^2	225	210
Alveogram		
Length, mm	98	85
P (height x 1.1), mm	117	116
W, x 10^{-4} joules	460	373
Baking (Remix-to-Peak Baking Test)		
Absorption, %	64	63
Remix time, min	4.1	3.0
Loaf volume, cm^3/100 g flour	880	880

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.
[2] At the normal Farinograph speed of 63 rpm, CWES flour does not develop and appears weak. Therefore Farinograph speed has been increased from 63 rpm to 90 rpm in order to achieve full development.

Canada Prairie Spring Red wheat

Canada Prairie Spring Red (CPSR) wheat is suitable for production of a wide range of products such as hearth breads, crackers, certain types of flat breads, steamed breads and noodles.

Table 12 shows the mean protein content of No. 1 and No. 2 CPSR for 1997, with comparative data for 1996 and 1995.

Table 13 summarizes quality data for composites of No. 1 CPSR for 1997. Data from 1996 are included for comparison.

Compared with the 1996 composite, this year's No. 1 CPSR wheat sample has lower test weight, smaller kernels and higher protein content. Milling quality and most other quality characteristics are similar to those of last year's composite.

Consistent with the higher protein content, dough properties are stronger as indicated by a higher Zeleny sedimentation value, longer Farinograph development time, larger extensigram and alveogram areas, and higher loaf volume.

AC Taber continues to be the predominant variety in the CPSR class. The 1997 composite contains 78% of this variety compared to 64% last year.

Table 12 • Mean protein content of Canada Prairie Spring Red wheat, by grade and year

	Protein content (%)[1]		
Grade	1997	1996	1995
No. 1 CPSR	11.8	11.0	11.4
No. 2 CPSR	11.8	10.3	11.1

[1] N x 5.7; 13.5% moisture content basis

Table 13 • Canada Prairie Spring Red wheat
Quality data for 1997 and 1996 harvest survey grade composite samples

Quality parameter[1]	1997	1996
Wheat		
Test weight, kg/hl	80.9	81.7
Weight per 1000 kernels, g	37.1	40.2
Protein content, %	11.7	11.2
Protein content, % (dry matter basis)	13.5	12.9
Ash content, %	1.50	1.56
α-amylase activity, units/g	7.0	5.0
Falling number, s	355	350
Flour yield, %	75.5	76.2
PSI	59	56
Flour		
Protein content, %	11.0	10.4
Wet gluten content, %	27.6	27.7
Ash content, %	0.47	0.48
Grade colour	-1.8	-1.5
AGTRON colour, %	70	69
Starch damage, %	5.9	6.1
α-amylase activity, units/g	1.5	1.0
Amylograph peak viscosity, BU	650	705
Maltose value, g/100 g	1.9	1.9
Zeleny sedimentation, ml	57	47
Farinogram		
Absorption, %	60.1	60.4
Development time, min	5.5	4.0
Mixing tolerance index, BU	40	55
Stability, min	8.0	5.5
Extensigram		
Length, cm	20	21
Height at 5 cm, BU	305	250
Maximum height, BU	550	435
Area, cm^2	145	125
Alveogram		
Length, mm	123	124
P (height x 1.1), mm	76	73
W, x 10^{-4} joules	299	262
Baking (Remix-to-Peak Baking Test)		
Absorption, %	61	58
Remix time, min	2.2	1.8
Loaf volume, cm^3/100 g flour	740	700

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

Canada Western Red Winter wheat

Canada Western Red Winter (CWRW) wheat is known for its excellent milling quality. Flour from high grade CWRW is well suited for hearth bread, crackers and certain types of noodles. CWRW flour also performs well in the production of flat bread, steamed bread, and related products. Two grades of CWRW are available.

Table 14 shows the mean protein content of No. 1 and No. 2 CWRW for 1997, with comparative data from 1996 and 1995.

Table 15 summarizes quality data for the 1997 No. 1 CWRW grade composite. Data for 1996 are included for comparison.

Analysis of the composite samples of No. 1 CWRW wheat indicates a change in the predominant variety to CDC Kestrel, which increased to 47% from 12% in 1996. AC Readymade has dropped to second place, from 42% to 20%, and the older variety Norstar has gone from 40% to 12% this year.

Quality data for the 1997 sample show lower test weight and slightly smaller kernels compared to the 1996 composite. Protein content, falling number and milling quality are similar to last year. Flour amylograph peak viscosity is lower but physical dough tests suggest doughs are slightly stronger.

Loaf volume, as usual for this class, is very good for the protein content.

Table 14 • Mean protein content of Canada Western Red Winter wheat, by grade and year

	Protein content (%)[1]		
Grade	1997	1996	1995
No. 1 CWRW	11.6	11.4	11.1
No. 2 CWRW	11.3	10.4	10.1

[1] N x 5.7; 13.5% moisture content basis

Table 15 • Canada Western Red Winter wheat
Quality data for 1997 and 1996 harvest survey grade composite samples

Quality parameter[1]	1997	1996
Wheat		
Test weight, kg/hl	81.7	83.7
Weight per 1000 kernels, g	31.9	32.6
Protein content, %	11.4	11.3
Protein content, % (dry matter basis)	13.2	13.1
Ash content, %	1.49	1.46
α-amylase activity, units/g	17.0	17.0
Falling number, s	325	345
Flour yield, %	75.1	75.7
PSI	57	57
Flour		
Protein content, %	10.9	10.6
Wet gluten content, %	28.1	29.3
Ash content, %	0.43	0.43
Grade colour	-2.1	-2.0
AGTRON colour, %	74	73
Starch damage, %	5.7	5.7
α-amylase activity, units/g	6.0	3.0
Amylograph peak viscosity, BU	290	480
Maltose value, g/100 g	2.2	2.0
Zeleny sedimentation, ml	59	55
Farinogram		
Absorption, %	59.2	60.1
Development time, min	5.25	4.5
Mixing tolerance index, BU	35	50
Stability, min	8.0	6.5
Extensigram		
Length, cm	19	23
Height at 5 cm, BU	300	255
Maximum height, BU	525	430
Area, cm^2	135	135
Alveogram		
Length, mm	132	157
P (height x 1.1), mm	74	66
W, x 10^{-4} joules	310	296
Baking (Remix-to-Peak Baking Test)		
Absorption, %	60	60
Remix time, min	2.1	1.9
Loaf volume, cm^3/100 g flour	750	715

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

Canada Prairie Spring White wheat

Canada Prairie Spring White (CPSW) wheat is suitable for the production of various types of flat breads, chapatis, and noodles.

Table 16 shows the mean protein content of No. 1 and No. 2 CPSW for 1997, with comparative data for 1996 and 1995.

Table 17 summarizes quality data for composites of No. 1 CPSW for 1997. Data from the 1996 harvest are given for comparison.

The improved CPSW wheat variety AC Karma has taken over from Genesis as the predominant variety in this class, going from 24% in the 1996 composite to 54% in this year's sample. Quality data for 1997 No. 1 CPSW wheat show similar trends seen for other classes in that test weight is lower, kernels are smaller, flour yield is reduced, and flour ash and flour colour values are lower compared with the 1996 results. The higher protein content contributes to somewhat stronger doughs and higher loaf volume. Falling number and flour amylograph peak viscosity are high, indicating sound wheat and good starch pasting characteristics. Other quality characteristics are similar to those observed last year.

Table 16 • Mean protein content of Canada Prairie Spring White wheat, by grade and year

	Protein content (%)[1]		
Grade	1997	1996	1995
No. 1 CPSW	11.5	10.9	10.7
No. 2 CPSW	12.3	10.7	11.4

[1] N x 5.7; 13.5% moisture content basis

Table 17 • Canada Prairie Spring White wheat
Quality data for 1997 and 1996 harvest survey grade composite samples

Quality parameter[1]	1997	1996
Wheat		
Test weight, kg/hl	81.6	82.7
Weight per 1000 kernels, g	34.9	38.3
Protein content, %	11.5	10.9
Protein content, % (dry matter basis)	13.3	12.6
Ash content, %	1.46	1.38
α-amylase activity, units/g	3.0	6.0
Falling number, s	390	365
Flour yield, %	75.1	76.9
PSI	60	60
Flour		
Protein content, %	10.6	10.1
Wet gluten content, %	28.1	28.2
Ash content, %	0.48	0.50
Grade colour	-2.1	-1.7
AGTRON colour, %	76	70
Starch damage, %	5.6	5.3
α-amylase activity, units/g	1.0	1.0
Amylograph peak viscosity, BU	845	900
Maltose value, g/100 g	1.8	1.7
Zeleny sedimentation, ml	42	38
Farinogram		
Absorption, %	60.2	60.6
Development time, min	3.5	2.5
Mixing tolerance index, BU	55	80
Stability, min	4.5	3.0
Extensigram		
Length, cm	22	23
Height at 5 cm, BU	220	180
Maximum height, BU	340	225
Area, cm^2	105	75
Alveogram		
Length, mm	118	117
P (height x 1.1), mm	70	63
W, x 10^{-4} joules	221	175
Baking (Remix-to-Peak Baking Test)		
Absorption, %	58	58
Remix time, min	1.3	1.1
Loaf volume, cm^3/100 g flour	640	575

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

Canada Western Soft White Spring wheat

Canada Western Soft White Spring (CWSWS) wheat is a soft wheat with weak dough properties. Flours milled from CWSWS wheat are used in the preparation of cakes, cookies, biscuits, and similar products. They can also be used alone or in blends with stronger wheat flours for the production of crackers, flat breads, steamed breads, and some types of noodles.

This type of wheat is usually grown under irrigation to minimize protein content and maximize wheat yield.

Table 18 shows the mean protein content of No. 1 and No. 2 CWSWS for 1997, with comparative data from 1996 and 1995.

Table 19 summarizes quality data for the 1997 No. 1 CWSWS grade composite. Data for 1996 are included for comparison.

The three major varieties of CWSWS wheat grown in western Canada are AC Reed, AC Phil, and Fielder. The 1997 No. 1 CWSWS composite of wheat, while slightly lower in test weight than the 1996 sample tested one year ago, does not show the smaller kernel size noted for the other classes. Wheat ash is lower this year and overall milling quality is very good. The lower flour yield compared with last year is more than offset by lower flour ash and flour colour. Cookie quality is slightly better for the 1997 sample. Other quality characteristics are generally similar to those of the 1996 composite.

Table 18 • Mean protein content of Canada Western Soft White Spring wheat, by grade and year

	Protein content (%)[1]		
Grade	1997	1996	1995
No. 1 CWSWS	10.5	10.5	10.4
No. 2 CWSWS	10.4	10.8	10.5

[1] N x 5.7; 13.5% moisture content basis

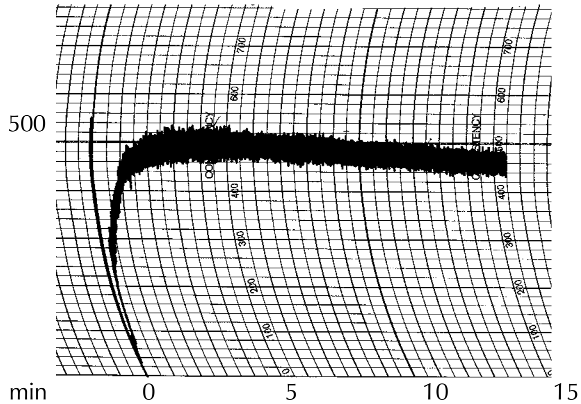
Table 19 • No. 1 Canada Western Soft White Spring wheat
Quality data for 1997 and 1996 harvest survey grade composite samples

Quality parameter[1]	1997	1996
Wheat		
Test weight, kg/hl	81.7	82.5
Weight per 1000 kernels, g	37.4	37.3
Protein content, %	10.3	10.4
Protein content, % (dry matter basis)	11.9	12.0
Ash content, %	1.54	1.66
α-amylase activity, units/g	8.0	17.0
Falling number, s	330	335
Flour yield, %	75.7	77.2
PSI	68	68
Flour		
Protein content, %	9.4	9.4
Wet gluten content, %	23.8	25.8
Ash content, %	0.47	0.54
Grade colour	-0.8	-0.1
AGTRON colour, %	67	63
Starch damage, %	3.2	3.1
α-amylase activity, units/g	2.0	1.5
Amylograph peak viscosity, BU	500	540
Maltose value, g/100 g	1.3	1.2
Zeleny sedimentation, ml	19	19
AWRC, %	60	64
Farinogram		
Absorption, %	54.8	54.6
Development time, min	1.25	1.25
Mixing tolerance index, BU	175	215
Stability, min	1.0	1.0
Alveogram		
Length, mm	95	83
P (height x 1.1), mm	23	21
W, x 10^{-4} joules	38	37
Cookie test		
Spread, mm	81.2	80.1
Ratio (spread/thickness)	8.7	8.2

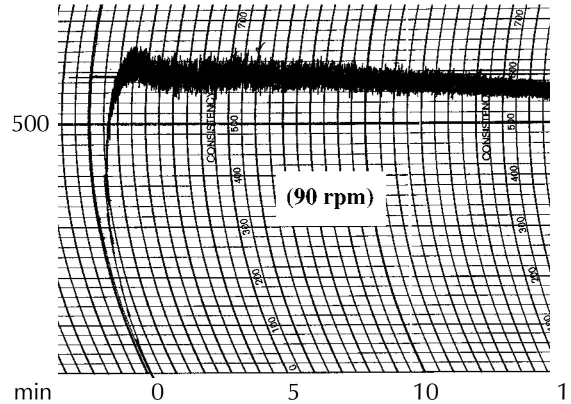
[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

Farinograms

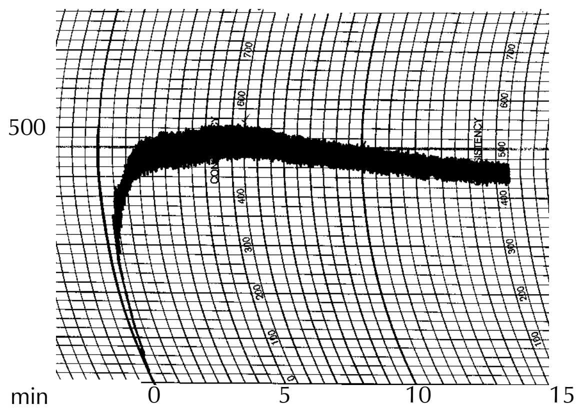
No. 1 Canada Western 13.5 Red Spring wheat



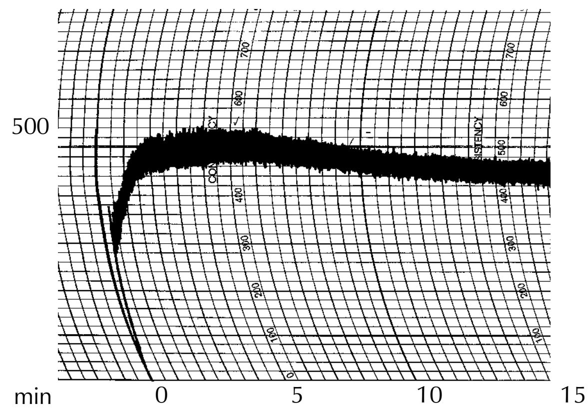
No. 1 Canada Western Extra Strong wheat



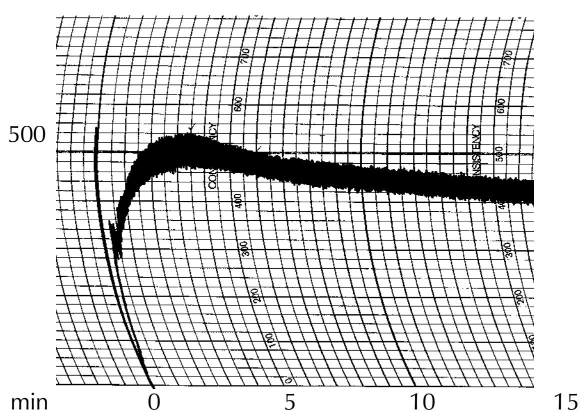
No. 1 Prairie Spring Red wheat



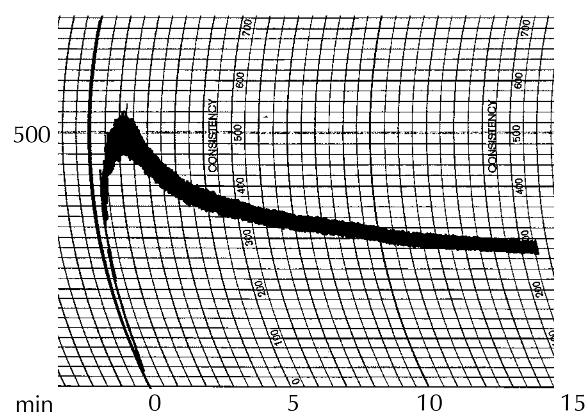
No. 1 Canada Western Red Winter wheat



No. 1 Canada Prairie Spring White wheat



No. 1 Canada Western Soft White Spring wheat



Methods and definitions

At the Grain Research Laboratory (GRL), unless otherwise specified,

- Analytical results for wheat are reported at 13.5% moisture content.
- Analytical results for flour and semolina are reported at 14.0% moisture content.
- AACC methods cited are from *The American Association of Cereal Chemists (AACC): Approved Methods of the Association*, Ninth Edition, 1995.
- ICC methods cited are those of the International Association for Cereal Science And Technology.

AGTRON colour

The AGTRON colour of flour and durum wheat semolina is determined using AACC Method 14-30. An AGTRON direct reading reflectance spectrophotometer is used.

Alveogram

ICC Standard Method No. 121 is followed, using the constant pressure Chopin Alveograph Model MA82.

α-Amylase activity

The α-amylase activity of wheat and flour is determined by the method of Kruger and Tipples (1981), *Cereal Chemistry* 58:271–274.

Amylograph peak viscosity

Sixty-five grams of flour and 450 ml of distilled water are used with the Brabender Amylograph and the pin stirrer. Other details are as in AACC Method 22-10. Peak viscosity is reported in Brabender units.

Ash content

To determine wheat and flour ash content, AACC Method 8-01 is used.

AWRC (Alkaline Water Retention Capacity)

AWRC (Alkaline Water Retention Capacity) is determined using AACC Method 56-10.

Canadian Short Process Baking Test

The Canadian Short Process Baking Test is carried out as described by Preston et al. (1982), *Canadian Institute of Food Science and Technology Journal* 15:29–36. For this test and for the Sponge-and-Dough Baking Test, loaves are produced from 200 g of flour in baking pans with cross-sectional dimensions similar to those of Canadian commercial baking pans. Loaf volume is reported for each 100 g of flour.

Cookie Test

The Cookie Test is performed according to AACC Method 10-50 D.

Dry gluten content

Dry gluten content is determined according to the Glutomatic System Operation manual.

Extensigram

Doughs are made from 300 g flour, 6 g salt, and distilled water equal to Farinograph absorption less 2.0% (for example, 65.0% reduced to 63.0%). The adjustment in Farinograph absorption is to compensate both for the salt and for the substitution of the large stainless steel Farinograph bowl. Doughs are mixed for one minute and rested for five minutes. Mixing continues until the curve is centred about the 500 Brabender Unit line. Curves are drawn for duplicate doughs at 45 and at 135 minutes, although doughs are rounded and shaped at 90 minutes. Average curves for 45 and 135 minutes are reproduced, but measurements are reported only for the 135-minute curve. Length is in centimetres, height is in Brabender units, and area is in square centimetres. The extensigraph is set so that 100 Brabender units equal a 100-g load.

Falling number

The falling number is determined on a 7-g sample of ground wheat or semolina by AACC Method 56-81B. A 300-g sample of wheat is ground in a Falling Number Laboratory Mill 3100 according to ICC Standard Method No. 107.

Farinogram

Fifty grams of flour are mixed in a small stainless steel Farinograph bowl at 63 rpm for 15 minutes with enough distilled water to give a maximum dough consistency centred about the 500 Brabender Unit line. Farinograph absorption is the amount of water that must be added to flour to give the required consistency. It is reported as a percent. Dough development time is the time required for the curve to reach its maximum height. For CWES, Farinograph absorption is determined at 63 rpm and dough development time is measured at 90 rpm. For additional details, see the *Farinograph Handbook*, AACC, 1960.

Flour yield

Wheat is cleaned, scoured and tempered overnight to optimum moisture as described by Dexter and Tipples (1987), *Milling* 180(7):16. All millings at the GRL are performed in rooms with environmental control maintained at 21°C and at 60% relative humidity.

- Common wheat is milled on an Allis-Chalmers laboratory mill using the GRL sifter flow as described by Black et al. (1980), *Cereal Foods World* 25:757–760. Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis. For CWRS wheat, flour yield also is expressed at a constant ash content of 0.50%, as described by Dexter and Tipples (1989), *Milling* 182(8):9–11. The procedure for pilot milling is described by Fajardo et al. (1995), *Cereal Chemistry* 72:291–298.
- Durum wheat is milled on a four stand Allis-Chalmers mill in conjunction with a laboratory purifier as described by Black (1966), *Cereal Science Today* 11:533. The mill flow is described by Dexter et al. (1990), *Cereal Chemistry* 67:405–412. Semolina is defined as having less than 1% pass through a 149-micron sieve. Semolina yield and milling yield (which includes semolina and flour combined) are reported as a percentage of the cleaned wheat on a constant moisture basis.

Grade colour

A colour index is obtained by the procedure of Kent-Jones, Amos, Martin, Scott and Elias (1956), *Chem. and Ind.* 1490–93. The procedure uses the automated Satake Series IV Colour Grader, which gives the relative reflectance of a flour-water slurry. Results are standardized to the Satake International Units—the lower the number, the brighter the colour.

Hard vitreous kernels (HVK)

Determination of hard vitreous kernels (HVK) is made according to Memorandum No. 95-5 of Industry Services, Canadian Grain Commission. A sieved 25-g sample is examined externally for the natural translucency associated with hardness. Bleached kernels may be cut transversely to determine vitreousness.

Maltose value

Maltose value is determined according to AACC Method 22-16.

Moisture content (flour)

To determine the moisture content of flour, a 10-g sample is heated for one hour in a semi-automatic Brabender oven at 130°C.

Protein content (N x 5.7)

Protein content of the composite samples is determined by Combustion Nitrogen Analysis (CNA). Protein content (total nitrogen) is determined on a LECO Model FP-428 Dumas CNA analyzer calibrated with EDTA. Samples are ground on a UDY Cyclone Sample Mill fitted with a 1.0-mm screen. A 250-mg sample is analyzed as received (it is not dried before analysis). Moisture is determined by the AACC Method No. 44-15A (Single stage air oven).

The CGC previously used the Kjeldahl method, but switched to CNA on August 1, 1996, after evaluating the method for two years.The CNA method is becoming the world standard for protein determination. The method is

- More environmentally acceptable because it uses no corrosive or potentially toxic chemicals
- Safer because it does not use hot liquids
- More economical to install and to use because it requires no drainage or fume exhaust
- More precise than the Kjeldahl method
- Suitable for sample sizes of up to 300 mg, which can be used with today's instruments, and which create less sampling error than the samples of only a few milligrams used with older instruments

The Dumas test extracts about 2% more nitrogen than the Kjeldahl test.Consequently, the results for any given wheat sample may be higher by 0.2–0.3 percentage units. The difference between CNA and Kjeldahl results increases with increasing protein content.

PSI (particle size index)

PSI is a measure of the hardness of a wheat kernel. AACC Method No. 55-30 is modified by using a UDY Cyclone Sample Mill fitted with a feed rate regulator and a 1.0-mm screen. A 10-g sample from 22 g of ground, blended wheat is sieved in a US Standard 200-mesh sieve for 10 minutes in a Ro-tap sieve shaker. The weight of throughs X 10 is recorded as the PSI.

Remix-to-Peak Baking Test

The Remix-to-Peak Baking Test is a modification of the Remix Baking Test of Irvine and McMullan (1960), *Cereal Chemistry* 37:603–613, as described in detail by Kilborn and Tipples (1981), *Cereal Foods World* 26:624–628. Dough is mixed to peak consistency at the second mixing stage.

SDS sedimentation

SDS sedimentation values are determined by the method of Axford and Redman (1979), *Cereal Chemistry* 56:582, using 3% SDS.

Semolina colour

A small metal container is filled with durum wheat semolina and covered with a low reflectance glass plate. Lightness (L*), redness (a*) and yellowness (b*), and Hunter lab L a b data are determined using the tristimulus method, with a Minolta CM 525i spectrophotometer (CIE 2° Standard Observer D65).

Spaghetti

Spaghetti is processed from semolina on a Demaco laboratory-scale continuous extrusion press as described by Matsuo et al. (1978), *Cereal Chemistry* 55:744, and dried at 70°C as described by Dexter et al. (1981), *Journal of Food Science* 46:1741.

Spaghetti colour

Whole strands of spaghetti are mounted on white cardboard for colour measurements. Lightness (L*), redness (a*) and yellowness (b*), and Hunter lab L, a, b data are determined using the tristimulus method, with a Minolta CM 525i spectrophotometer

Spaghetti cooking quality

Spaghetti cooking quality is determined as described by Dexter and Matsuo (1977), *Canadian Journal of Plant Science* 57:717–727.

Speck count

Speck count is determined as described by Dexter and Matsuo (1982), *Cereal Chemistry* 59:63.

Sponge-and-Dough Baking Test

The Sponge-and-Dough Baking Test is based on a 4.5-hour 70% sponge system as described by Kilborn and Preston (1981), *Cereal Chemistry* 58:198–201.

Starch damage, %

Starch damage is determined using AACC Method 76-31 Damaged Starch: Spectrophotometric Method. Starch damage is expressed as as a percentage of flour weight. The method is also referred to as the MegaZyme method. Conversion factors for alternate methods are

AACC 76-30A = 1.5662 * MegaZyme - 0.338
Farrand = 6.6092 * MegaZyme - 11.972

Test weight

Test weight is determined using the Schopper Chondrometer equipped with the one litre container. The weight in grams of the measured litre of wheat is divided by 10. The result is reported without reference to the moisture content.

Weight per 1000 kernels

Broken kernels and foreign material are handpicked from a sample to create a cleaned sample. The number of kernels in a 10-g subsample of the cleaned sample is then counted using an electronic seed counter.

Wet gluten content

ICC Standard Method No. 137 is followed using the Glutomatic System with metal sieves.

Note: When the GRL changed from the Theby Gluten washer, which was no longer available, to the Glutomatic in 1988, the buffer composition (salt, phosphate, pH 6.7) was maintained and dough mixing time was set at 30 seconds when testing common wheat flours. Under these conditions results were comparable to those obtained previously over many years using the Theby machine.

Effective August 1, 1996, we decided to change to exactly the conditions specified in ICC Standard Method No. 137 (20 seconds dough mixing time; salt-phosphate buffer pH 5.95) for common wheat flours. Results obtained using this changed procedure are significantly lower; for example, by up to 5 percentage units for CWRS. For this reason comparison figures for years previous to 1996 are not shown for common wheat classes.

No changes have been made to the wet gluten procedure used for durum wheat semolina.

W-h/kg

Watt-hours per kilogram. This is a measure of mixing energy used in the Canadian Short Process Baking Test.

Yellow pigment content

Yellow pigment content of durum wheat and semolina is determined using AACC Method 14-50.

Zeleny sedimentation

Zeleny sedimentation is determined according to AACC Method 56-60 for flour. Results are reported in millilitres.

Collection of samples

Samples for the 1997 surveys were collected from companies operating primary elevators and from producers in western Canada. Producers were requested to send in samples of each of the seven classes of wheat grown on the prairies, together with canola, flax, barley and oats. The sample documentation system was streamlined by barcoding, which was used for both producer and elevator company samples. Producers were given a toll-free number to call to find out the protein content and unofficial grade for their samples.

The first cutoff date for composite preparation of wheat was September 24 for No. 1 CWRS.

Acknowledgments

The Grain Research Laboratory acknowledges the cooperation and assistance of the following:

- The grain companies and their primary elevator managers and western Canadian wheat producers for providing samples
- The Winnipeg office of Industry Services, Canadian Grain Commission, in grading all harvest survey samples
- Dr. Paul Bullock of the Weather and Crop Surveillance Unit of the Canadian Wheat Board in providing the weather, crop condition and harvesting reviews

Tables

Figures