Canadian Grain Commission | Commission canadienne des grains

ISSN 1498-9654

Quality of western Canadian wheat 2012

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Quality Innovation Service

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Summary

Land seeded to wheat and durum increased by more than 1 million hectares in 2012 over the previous two years to the current estimate of 9.16 million hectares. Total wheat production for Western Canada is estimated at 25.0 million tonnes[1], with spring wheat (excluding durum) production estimated at 18.4 million tonnes representing an increase of about 5% over last year. Durum production is estimated at 4.63 million tonnes, an increase of approximately 11% over last year.

Overall protein content of all grades of Canada Western Red Spring (CWRS) wheat, at 14.0% is almost 1% higher than last year. High grade CWRS wheat exhibits similar test weight, falling number, starch damage and farinograph absorption to last year. Wheat ash and flour ash content in Wheat, No. 1 CWRS are lower compared with last year resulting in considerable improvement in milling yield at constant 0.50% ash basis. Farinograph results show some improvements in dough strength for both No. 1 and No. 2 CWRS compared with last year, although the improvements are more evident in the No. 1 grade. Extensograph results, while improved over last year, continue to appear weaker than the 10 year average values when compared at the same protein level. Bread dough mixing characteristics supported the improvements in strength indicated by farinograph and loaf volumes were consistent with the long term average. Overall protein content of 2012 Canada Western Amber Durum (CWAD) wheat is higher than last year at 13.0%. The 2012 CWAD crop is exhibiting a high percentage of hard vitreous kernels across all grades, very good yellow colour, improved dough strength with higher alveograph W values and higher gluten index values, and improved cooked pasta firmness.

Methodology

Methodology used to obtain quality data is described in a separate report available on the CGC website at http://www.grainscanada.gc.ca/wheat-ble/method-methode/wmtm-mmab-eng.htm.

[1] Statistics Canada, Table 001-0010 Estimated areas, yield, production and average farm price of principal field crops, in metric units, annual. CANSIM (database) http://www5.statcan.gc.ca/cansim/a33?RT=TABLE&themeID=2024&spMode=tables&lang=eng Accessed Jan 2, 2012

Nine classes of Canadian wheat

This report presents information on the quality of the top grades of Canada Western Red Spring and Canada Western Amber Durum wheat for the 2012 crop. Further information on other classes of western Canadian wheat is not reported for the 2012 crop because insufficient material was available to provide statistically valid information.

Canada Western Red Spring (CWRS) wheat is a hard wheat with superior milling and baking quality. It is offered at various guaranteed protein levels. There are four milling grades in the CWRS class.

Canada Western Hard White Spring (CWHWS) wheat is a hard white spring wheat with superior milling quality producing flour with excellent colour. It is suitable for bread and noodle production. There are three milling grades in the CWHWS class.

Canada Western Amber Durum (CWAD) wheat is a durum wheat producing a high yield of semolina with excellent pasta-making quality. There are four milling grades in the CWAD class.

Canada Western Extra Strong (CWES) wheat is a hard red spring wheat with extra-strong gluten suitable for blending purposes and for special breads. There are two milling grades in the CWES class.

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. There are two milling grades in the CPSR class.

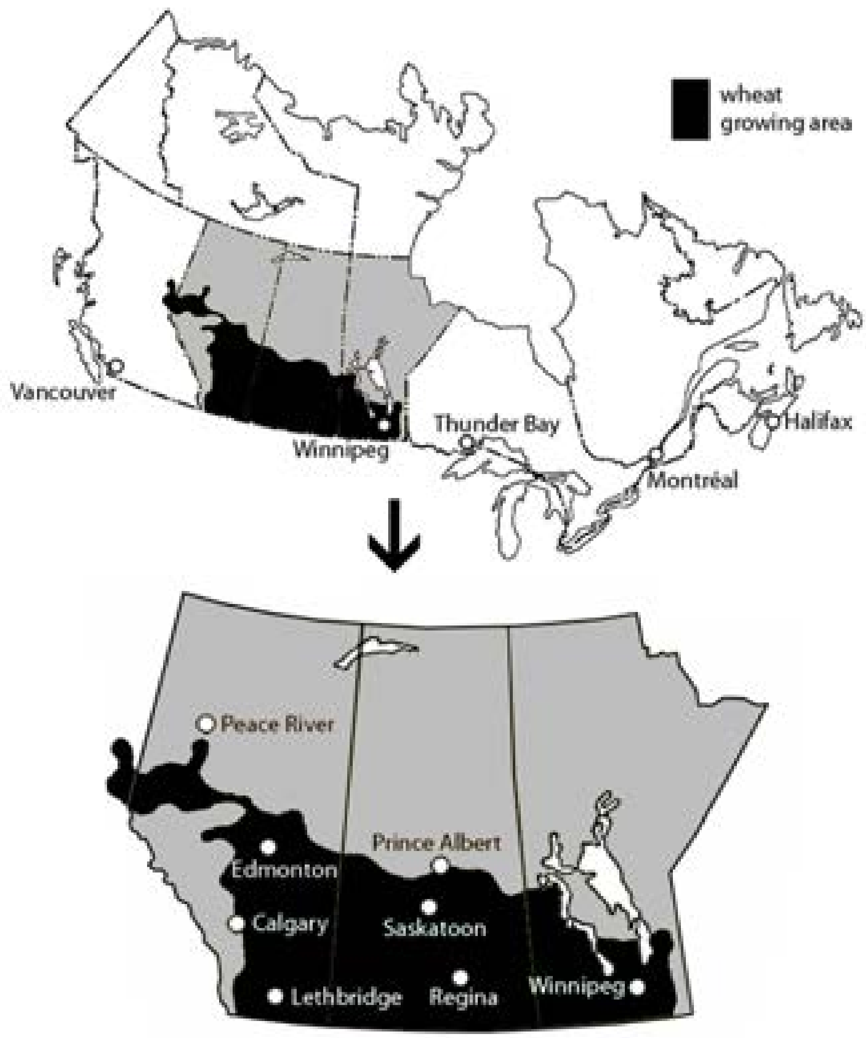
Canada Western Red Winter (CWRW) wheat is a hard wheat with very good milling quality suitable for the production of a wide variety of products including French breads, flat breads, steamed breads, noodles and related products. There are two milling grades in the CWRW class.

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. There are two milling grades in the CPSW class.

Canada Western Soft White Spring (CWSWS) wheat is a soft wheat of low protein content suitable for the production of cookies, cakes and pastry as well as various types of flat breads, noodles, steamed breads and chapatis. There are three milling grades in the CWSWS class.

Canada Western General Purpose (CWGP) wheat is lower protein wheat suitable for animal feed and industrial processing; it is not intended for milling.

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 representing approximately 4000 individual samples submitted by producers and primary elevator managers from the three Prairie provinces. Figure 1 highlights the wheat producing regions in the Prairie provinces: from east to west, Manitoba, Saskatchewan and Alberta. These data are not quality specifications for Canadian wheat. Rather, they represent our best estimate of overall quality and provide information on relative performance among successive harvests. As with any estimate, some variation in the quality characteristics of wheat of any given grade exported during the coming year from the data presented here is to be expected. The amounts and relative quality of carryover stocks of each grade will contribute to this variation.

Background for the 2012 crop

Background information for the 2012 crop was compiled based on reports published by the Alberta, Saskatchewan and Manitoba provincial departments of agriculture.

Production and grade information

That the Canadian Prairie climate is one of extremes has been demonstrated over the past few years. Despite excess moisture in some areas most producers were able to get their fields seeded and completed seeding earlier this year in contrast with the past two years. Hot and dry weather in July and August brought the crop along rapidly, but depending on the timeliness of rainfall yields were variable and some areas suffered from heat stress. Drier conditions in July and August, combined with favourable weather in September resulted in good quality prospects for wheat and durum.

Concerns about excess moisture conditions in parts of the eastern Prairies and the Peace area were prevalent in the early spring as soils were still saturated from the heavy rains and flooding encountered in 2011. In contrast, most of the Prairies had been through a mild winter with record low snowfall resulting in low levels of spring run-off, but rains in April and May helped to alleviate low soil moisture conditions. Seeding got off to an early start in most areas and was generally completed about two weeks ahead of average completion date.

The weather during July across virtually all of the Prairies was hotter than normal and moderated slightly in August but still remained above average across much of the growing region. While most of the Prairies were considerably drier than usual, moderate to heavy rains covered the northern and central growing areas of Saskatchewan and the east-central parts of Alberta in June and mid-July. Southern areas dealt with high temperatures causing plants to suffer heat stress in areas low in soil moisture. The warm temperatures in the Prairies helped boost crop development and significant harvest progress occurred during August.

The warm dry conditions continued into September, allowing harvest to move ahead of normal in all areas of the Prairies. Ideal conditions resulted in completion of harvest approximately two weeks ahead of normal completion dates. Crop quality for wheat and durum is good, with the bulk of the wheat and durum crops meeting specifications for the top two grades.

Total wheat production for Western Canada is currently estimated at 25.0 million tonnes[1], up 11% over 2011. Spring wheat production (excluding durum) is estimated at 18.4 million tonnes, while durum production is expected to increase to 4.6 million tonnes, approximately 11% higher than 2011. Spring wheat yields are estimated at 2.8 tonnes per hectare, which is slightly lower than last year. Durum yields are also slightly lower than last year at 2.5 tonnes per hectare.

Overall protein content of Canada Western Red Spring wheat at 14.0% is 0.8% higher than last year. High grade Canada Western Red Spring wheat exhibits test weight, wheat falling number, starch damage and farinograph absorption that are comparable to last year. Starch damage and farinograph absorption are again higher than the long term average. Wheat and flour ash content, wet gluten content and 1000 kernel weights are lower than last year but are similar to the long term results. Extensograph testing indicates dough properties to be marginally stronger than last year but continue to exhibit weaker properties than seen over the long term. Due to the lower flour ash content seen this year the milling yield at constant 0.50% ash was improved over last year and was higher than seen over the long term for the No. 1 grade. The same advantage was less apparent for the No. 2 grade. Overall protein content of Canada Western Amber Durum wheat at 13.0% was 0.8% higher than last year. This year's crop is characterized by high test weight and hard vitreous kernel content, increased semolina and spaghetti yellow colour, higher gluten index and increased cooked spaghetti firmness.

The lower grade CWRS resulted primarily from fusarium damage, midge damage and mildew. Lower grade CWAD resulted primarily from fusarium damage, midge and severe midge damage and mildew. Tight grading tolerances for these factors ensure that the high inherent quality of the top milling grades of Canada Western Red Spring and Canada Western Amber Durum wheat are protected.

[1] Statistics Canada, Table 001-0010 Estimated areas, yield, production and average farm price of principal field crops, in metric units, annual. CANSIM (database) http://www5.statcan.gc.ca/cansim/a33?RT=TABLE&themeID=2024&spMode=tables&lang=eng Accessed Jan 2, 2012

Protein

Table 1 compares available mean protein values for the milling grades for five of the eight classes of western Canadian wheat surveyed in 2012 to corresponding values obtained in the 2011 and 2010 harvest surveys as of October 31, 2012. Milling grades of all classes, have higher average protein content than last year. Canada Western Red Spring (CWRS) wheat protein content is 0.8% higher than 2011 and 0.5% higher than 2010. Canada Western Amber Durum (CWAD) protein values are 0.6% and 0.2% higher than in 2011 and 2010, respectively. Canada Prairie Spring Red wheat at 12.4% is 1.3% higher than last year. Canada Western Red Winter (CWRW) is 0.3% higher than last year while Canada Western Soft White Spring (CWSWS) is 0.6% higher this year. Insufficient sample was available at the time of writing this report to assess the protein content of Canada Western Hard White Spring (CWHWS), Canada Western Extra Strong (CWES) and Canada Prairie Spring White (CPSW) wheat accurately.

Table 1 – Mean protein content of milling grades of western Canadian wheat classes, 2012, 2011 and 2010

Class	Protein content, %[1]		
	2012	2011	2010
CWRS	13.9	13.1	13.4
CWAD	12.9	12.3	12.7
CPSR	12.4	11.1	11.6
CWRW[2]	11.9	11.6	10.2
CWSWS	10.5	9.9	10.7

[1] N x 5.7; 13.5% moisture content basis (mb) effective Nov 19/12

[2] Effective Aug 1/11 a minimum protein content of 11.0% (13.5 mb) was instituted for No. 1 and No. 2 CWRW

Canada Western Red Spring wheat

Protein and variety survey

Table 2 lists mean protein values for Canada Western Red Spring (CWRS) wheat by grade and province for 2012. Comparative values for western Canada by grade are shown for 2011 and for the previous 10 years (2002-2011). Figure 2 shows the fluctuations in annual mean protein content since 1927.

The average protein content of milling grades of the 2012 western Canadian wheat crop is 13.9%, 0.8% higher than 2011 and 0.3% higher than the ten year average protein content. Protein content is exhibiting a slight increase across grades, ranging from 13.6% for 1 CWRS to 14.4% for 3 CWRS. The range in protein content across provinces is wider than has been seen most years.

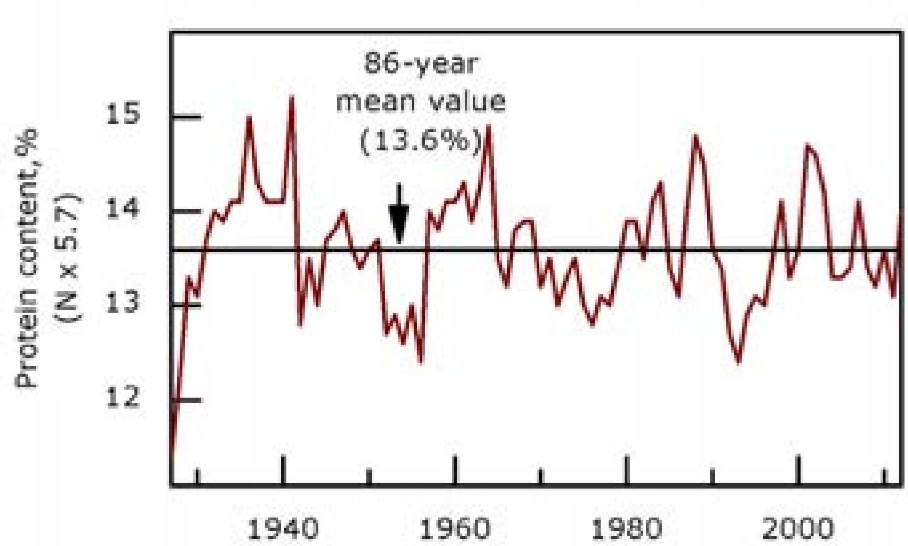
This year wheat variety distribution was determined using acid-polyacrylamide electrophoresis (A-PAGE) testing at the Grain Research Laboratory (GRL). Composite samples were tested and the results compiled to provide an overall picture of the varieties grown in 2012 in western Canada. Results indicated that the major varieties represented in the composites were Harvest (18%), Lillian (13%), Unity VB (7%), Carberry (7%), Glenn (5%) and Kane (5%). Lillian is a solid stem variety that is successful in reducing yield losses due to infestations of wheat stem sawfly that have been prevalent in southern Alberta and western Saskatchewan in recent years. Unity VB is resistant to the orange wheat blossom midge, improving the possibility of maintaining yield and grade. Carberry, Glenn and Kane all show some improvement in resistance to fusarium head blight.

Table 2 – Mean protein content of 2012 Canada Western Red Spring wheat, by grade and province, with comparisons to 2011 and the 10-year mean

	Protein content, %[1]					
	Western Canada			2012		
Grade	2012	2011	2002-2011	Manitoba	Saskatchewan	Alberta
Wheat, No. 1 CWRS	13.6	13.0	13.6	14.2	13.6	13.4
Wheat, No. 2 CWRS	14.1	13.2	13.6	14.3	14.2	13.9
Wheat, No. 3 CWRS	14.4	13.2	13.6	14.6	14.5	14.0
All milling grades	**13.9**	**13.1**	**13.6**	**14.3**	**14.1**	**13.6**

[1] N x 5.7%; 13.5% moisture basis; as of Nov 19/12

Figure 2 – Mean protein content of Canada Western Red Spring wheat – 1927 to 2012



Milling and baking quality – Allis-Chalmers laboratory mill

To assess the quality of the 2012 CWRS wheat crop, composites were prepared from harvest survey samples representing the top two milling grades. The No. 1 CWRS samples were segregated into composites having minimum protein levels of 13.0%, 13.5% and 14.5%. The No. 2 CWRS samples were segregated into composites having 13.5%, 14.0% and 14.5% protein.

These data are meant as guidelines to provide information on the performance of this year's wheat relative to last year and the 10 year average. All the flour was generated using an Allis-Chalmers mill. For those using a Bühler ML202 laboratory mill you should expect to see 3% to 4% lower farinograph absorption and bake absorption.

Wheat, No. 1 Canada Western Red Spring

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 covering 2002-2011.

Test weight of the 2012 No. 1 grade protein segregates is comparable to last year and to the ten year average. Kernel weight is typical for high grade CWRS and is consistent with the long term average. Wheat ash is 0.08% lower than last year and 0.03% lower than the long term average and produced flour ash lower than last year at 0.47% and 0.01% lower than the long term average. The No. 1 CWRS composites show a high degree of soundness with high falling number values and flour amylograph peak viscosities and low α-amylase activities.

Flour yield on clean wheat basis is equivalent to the long term average. When considering flour yield on a constant 0.50% ash basis, there is a distinct yield advantage this year compared with last year and the long term average. The lower wheat and flour ash contents this year resultedin a 1.3% yield advantage compared to last year and 0.8% advantage over the past ten years. Flour colour is bright white (L*) with little redness (a*) or yellowness (b*) evident. Starting this year we are including flour colour measured as L*, a* and b* on a dry flour basis. Wet gluten content continues to remain higher than the ten year average. Flour starch damage is comparable to last year and continues to be higher than the long term average, probably as a result of the hot and dry weather conditions experienced from July through September across most of the growing region producing harder kernels.

Farinograph absorption is comparable to last year and is 0.9% higher than the long term average for the 13.5% protein segregate. The relatively high starch damage is contributing to the higher absorption. Farinograph dough strength properties for the 13.5% protein segregate appear stronger than last year and the long term average with longer stability. Relatively short development time (DDT) and longer stability provides optimum flexibility for performance in a variety of baking processes which may vary in mixing times and rate of work input. Extensograph results indicate dough strength properties that are slightly improved over last year, but continue to exhibit weaker properties than seen over the previous 10 year term. Alveograph W values show definite improvement over 2011 and over the ten year average, although the increase relative to the ten year average results are at least partially influenced by the higher starch damage and higher water absorption capacity seen in the 2012 crop.

CSP baking absorption is 1% higher than last year, but at 68% is 1% lower than the ten year average. Mixing time requirement is almost a minute longer than last year which represents a significant increase in mixing strength. Please note that we have not included mixing energy requirements for last year or the ten year average due to a recent change in hardware used to capture power consumption during mixing. Loaf volumes are not significantly different from last year or the ten year average and are typical for the grade and protein content.

Wheat, No. 2 Canada Western Red Spring

Quality data for the 2012 No. 2 CWRS composites at 13.5%, 14.0% and 14.5% protein and comparative data for the 13.5% minimum protein level for last year's composite and the ten-year average, 2002-2011 are shown in Table 4. Discussion here provides some interpretation comparing the 13.5% protein segregate with the same protein level tested in 2011 and the ten year average values. As seen with the No. 1 CWRS, test weight values are similar to last year. Kernel weights are considerably lower than 2011 and slightly lower than the ten year average. Wheat ash is consistent with last year and higher than the long term average value. Wheat falling number, α-amylase activity and amylograph peak viscosity values are all indicative of the soundness of this years' wheat crop, with no evidence of sprouting.

Milling extraction level of the No. 2 grade 13.5% protein composite expressed on clean wheat basis is 1.1% lower than last year and the long term average but is 0.4% higher than last year when compared on constant 0.50% ash basis. The flour yield advantage at constant 0.50% ash basis is due to 0.03% lower flour ash content this year. Wet gluten content is consistent with last year but shows a 1.2% improvement over the long term average. Flour starch damage is similar to 2011.

Farinograph absorption at 67.6% is 0.6% lower than last year but is slightly higher than the ten-year average value. Dough development time is similar to 2011, but stability is 2.0 minutes longer, results that are in line with long term average values. Extensograph values indicate a slight increase in dough strength properties compared with last year but continue to be weaker than what have been seen over the long term. Alveograph curves for No. 2 CWRS 13.5 have marginally higher W values than last year but are lower than the ten year average. The No. 2 CWRS 13.5 baked using the CSP bake method exhibited more typical performance for the grade and protein level and a dramatic improvement over last year with considerably higher loaf volumes at 1120 cm^3 versus 1025 cm^3 for 2011. Loaf volume was consistent with the ten year average.

Comparative Bühler laboratory mill flour data

Samples of 2012 and cold stored 2011 harvest survey No. 1 CWRS 13.5 and No. 2 CWRS 13.5 composites were milled consecutively on the same day on the tandem Buhler laboratory mill to produce 74% extraction straight grade and 60% long patent flour, allowing for direct comparison between the performance of the 2012 and 2011 crops. The 2012 No. 1 CWRS 14.5 and No. 2 CWRS 14.5 were also milled on the tandem Buhler laboratory mill to produce 74% and 60% extraction flours, however there was no corresponding wheat at 14.5% protein available from 2011 for comparison.

Analytical and baking quality

Wheat, No. 1 Canada Western Red Spring 13.5

Data are shown in Table 5 for the No. 1 CWRS 13.5% minimum protein segregate. The trends in quality characteristics are generally in agreement with the Allis-Chalmers milling data.

Straight grade and patent flours from the 2012 composites for No. 1 CWRS 13.5% protein segregates exhibit similar wet gluten content, starch damage values and ash content (straight grade) relative to the composite flours from last year. High amylograph peak viscosities are indicative of sound wheat.

Farinograph absorption in this year's No. 1 CWRS 13.5 straight grade and patent flour is marginally, but consistently lower than last year. The 2012 flours exhibit some improvement in dough strength with slightly longer stabilities for both the straight grade and patent flours relative to last year.

Sponge and dough baking absorption is 1% higher for the 2012 straight grade and unchanged for the 60% patent flour compared with the re-milled 2011 flour. Sponge-and-dough loaf volumes for 2012 and 2011 are similar for straight grade flour and show some improvement for the 2012 60% patent flour over last year. We are seeing increased mixing requirements this year for both straight grade and patent flour with longer mixing times and higher work inputs (mixing energy) indicative of improved strength. The CSP baking of both the straight grade and patent flours found the 2012 stronger mixing, with higher mixing energy requirements and somewhat longer mixing time. Bake absorptions were unchanged from 2011 and loaf volumes were similar. Improved crumb structure was observed in the bread made using straight grade flour this year over last year.

Wheat, No. 1 Canada Western Red Spring 14.5

Data are available in Table 6 for the 1 CWRS 14.5% protein segregate. Consistent with the higher protein content, the wet gluten content of both straight grade and patent flour was higher than seen in the 13.5% protein segregate.

Straight grade flour and patent flour both baked very well, with higher loaf volumes for both CSP and sponge and dough bread than the corresponding No. 1 CWRS 13.5 flours, as would be expected given the higher protein content.

Wheat, No. 2 Canada Western Red Spring 13.5

Data are shown in Table 7 for the No. 2 CWRS 13.5% minimum protein segregate. Straight grade and patent flours milled from No. 2 CWRS 13.5 wheat exhibited lower flour ash for the 2012 wheat as compared with the 2011 wheat. High amylograph peak viscosities are indicative of highly sound wheat with no indications of sprouting. Farinograph absorption was slightly lower this year for both the straight grade and patent flour, while dough development times were slightly longer. Stability was similar to last year for the straight grade flour, but was slightly shorter this year compared with 2011 re-milled patent flour.

Sponge and dough baking properties are comparable to last year in terms of bake absorption and loaf volumes, but both the 2012 straight grade and patent flours exhibited slightly longer mixing requirements suggesting some improvement in dough strength. In the CSP baking process the bake absorptions are unchanged from 2011. Loaf volumes for both the 2012 straight grade and patent flour were improved over the 2011 flours. In agreement with the No. 1 CWRS Buhler milled flour, the 2012 No. 2 CWRS straight grade and patent flours exhibited stronger mixing properties with longer mixing times and higher mixing energy requirements.

Wheat, No. 2 Canada Western Red Spring 14.5

Table 8 contains quality data for the 2012 No. 2 CWRS 14.5 Buhler milled 74% straight grade and 60% patent flours. Consistent with the higher protein content of these flours, the wet gluten content of both No. 2 CWRS 14.5 flours was approximately 3% higher compared with the No. 2 CWRS 13.5 flours. Farinograph absorption was slightly higher and dough strength similar to slightly stronger when compared to the No. 2 CWRS 13.5 Buhler milled flour. Baking performance, particularly in the sponge and dough formulation, reflected the higher protein content of the No. 2 CWRS 14.5 with greater loaf volumes and improved loaf appearance compared with the corresponding No. 2 CWRS 13.5 flours. Bake absorptions ranged from 63 to 64%, comparable to the No. 2 CWRS 13.5 flours.

Yellow alakline and white salted noodle quality

Noodle preparation

No. 1 CWRS from the 2011 and 2012 crop harvest composites, at 13.5 % protein were milled on the G.R.L. Tandem Buhler mill to produce a patent flour (60% yield on a clean wheat basis) and a straight grade flour (74% yield). A similar 2012 14.5% protein wheat composite was milled on the Buhler mill although no corresponding protein content 2011 material was available to mill concurrently for comparative purposes. Yellow alkaline noodles were prepared with a 1% w/w kansui reagent (9:1 sodium and potassium carbonates) at a 32 % water absorption level. White salted noodles were also prepared at the 32% absorption level with 1% NaCl w/w added to their respective flours. All noodles were prepared in a temperature and humidity controlled room maintained at 23° C +/-2.0°C with relative humidity at 50% +/-2.0%. Cooked noodle texture was determined on optimally cooked noodles. The optimum cooking time was defined as the time at which the loss of the noodle's core in all three test strands occurred, when pressed between plexiglass plates.

Yellow alkaline noodles

Wheat, No. 1 Canada Western Red Spring 13.5

Yellow alkaline noodles prepared from the 2012 No.1 13.5% protein CWRS crop composite, patent (60%) flour, yielded significantly improved raw noodle brightness (L*) to their 2011 counterparts at 2 hours after production (Table 9). The 2012 straight grade flour's noodle raw noodle brightness, at 2 hours, was brighter by almost 2 units, than that observed in the 2011 material while the 2012 60% patent noodles were brighter by 1 unit versus their 2011 counterpart. L* values of the raw 2012 noodles, patent and straight grade, after aging for 24 hours remained brighter than the 2011 patent flour noodles, most notably in the patent noodle. A very desirable decrease in 2 hour raw noodle redness, a*, was observed in the 2012 straight grade noodles relative to those from the 2011 crop. No change was detected in the patent noodle flours at 2 hours after production between years. Aging the noodles for 24 hours resulted in no meaningful difference in the straight grade noodles' a* values across years although a slight improvement was detected in the 2012 patent noodles relative to 2011. In general, a slight reduction in raw noodle yellowness, b*, was observed in both noodles prepared using the 2012 13.5% protein patent flours relative to 2011 for both flours and at both time periods.

Cooked noodle brightness revealed equivalent values for 2012 and 2011 60% patent flour noodles. A minimal increase in 2012 patent cooked noodle redness was detected relative to 2011 material although a minor improvement in a* values was shown in the noodles prepared from the 2012 straight grade flours. Cooked noodle yellowness increased slightly in the 2012 straight grade noodles and displayed a significant and desirable increase in the patent flour noodles relative to last year.

Cooked noodle thickness for the 2012 straight grade noodles was slightly reduced relative to 2011 yet the 2012 patent noodles exhibited slightly thicker noodles upon cooking. A very significant and desirable increase in noodle "bite" (MCS) was observed for both patent and straight grade 2012 13.5% protein noodles relative to 2011. Additionally a desirable increase in the textural attribute RTC for the 2012 cooked noodles was detected for both flours relative to the 2011 material. The 60 % patent flour exhibited a large increase in RTC value compared to their 2011 counterpart while the 74% straight grade noodles displayed a limited increase. REC was roughly equivalent to that of the previous year for the 2012 straight grade noodles however a very desirable increase was observed in the 2012 patent noodles over last year.

Wheat, No. 1 Canada Western Red Spring 14.5

Fresh (raw) yellow alkaline noodles prepared from 2012 No.1 14.5% protein displayed a reduction in L* in the straight grade noodles relative to corresponding 2012 13.5% protein flours at 2 hours after production which was anticipated on the basis of flour protein. Upon aging for 24 hours the difference between the two flours was significantly reduced. Noodles prepared with the patent flour were almost equivalent (within 1 unit) to the corresponding 13.5% protein patent flour at both 2 and 24 hours after production. The 2012 14.5% protein patent flour noodles' redness, a*, at 2 hours reflected the increased protein content in both flours. Interestingly the 2012 14.5% straight grade noodle exhibited (Table 10) a significantly better, (higher) b* at 2 hours and slightly higher after aging than the 13.5 % protein counterpart. The patent flour noodle however exhibited a modest reduction in b* at both 2 and 24 hours relative to the corresponding 13.5% protein patent noodle.

No appreciable difference was detected in cooked alkaline noodle brightness for either 14.5% flour noodle relative to the 13.5% protein flours. While no difference was observed in 14.5% straight grade flour noodles with its corresponding 13.5% counterpart, a slight reduction was observed for the higher protein patent flour noodles. While little difference was detected in 14.5% protein straight grade cooked noodle a* with its 13.5% protein counterpart, the 14.5% protein patent flour cooked noodle displayed a higher a* value. Upon cooking both the 14.5% straight grade and patent flour noodles they exhibited a lower yellowness, b*, than the corresponding 13.5% protein noodles

Minimal difference was detected in the 14.5% protein straight grade cooked noodle thickness when compared to the corresponding 13.5% protein noodle. However a noticeably thicker noodle was observed in the 14.5% protein patent noodle versus the 13.5 % protein noodle. As expected there was a significant improvement in cooked noodle bite (MCS) with increasing protein content in both the straight grade and patent flour noodles. Interestingly this texture improvement did not manifest itself in either straight grade or patent noodle for RTC or REC.

Wheat, No. 2 Canada Western Red Spring 13.5

Yellow alkaline noodles prepared from the 2012 No.2 13.5% protein CWRS crop composite, patent (60%) flour, displayed lower raw noodle brightness (L*) to that of their 2011 counterparts at both 2 and 24 hours after production (Table 11). The 2012 60% patent flour raw noodle exhibited a higher redness, a* values, to 2011, at 2 hours and 24 hours. The 2012 straight grade noodles also displayed poorer redness at 2 and 24 hours after production. A desirable improvement (elevated) in raw noodle yellowness, b*, was observed in both noodles prepared using the 2012 13.5% protein flours relative to 2011 at each time interval.

Cooked 2012 noodle brightness L*, displayed a slight improvement relative to 2011 noodles for both patent and straight grade flours along with desirable, minor reductions in a* values relative to the previous year's noodles. No appreciable change in cooked noodle yellowness, b*, in either of the 2012 samples, both patent and straight grade, relative to 2011 was observed.

A very slight reduction in cooked noodle thickness for both patent and straight grade 2012 noodles was detected between the two years studied. A decrease in noodle "bite" (MCS) was observed for the 2012 patent and straight grade flour noodles relative to their 2011 counterparts. Minimal differences were detected in straight grade flour noodle RTC and REC relative to 2011 however the 2012 patent flour noodles did reveal a significant decline in RTC relative to 2011. No significant difference was observed for REC.

Wheat, No. 2 Canada Western Red Spring 14.5

As expected, the fresh (raw) yellow alkaline noodles prepared from 2012 No.2 14.5% protein flours revealed lower L* for both the patent and straight grade noodles relative to their No. 2 13.5% protein flours at 2 hours and upon aging for 24 hours. The 2012 patent and straight grade flour noodles' redness, a*, at 2 hours after production was higher than the corresponding 13.5% noodles although upon aging the difference between protein segregations was reduced. The 2012 60% patent noodle exhibited (Table 12) equivalent b* at 2 hours which had an improved yellowness, b* value, while at 24 hours it was comparable to its 13.5% counterpart. Straight grade flour noodles (14.5%, 2012) were equivalent in b* at 2 hours to the No. 2 13.5% protein flour and showed only a slight decline, relative to the 13.5% protein noodle upon aging for 24 hours.

Minimal differences were observed in the cooked colour brightness, L*, of the No. 2 14.5% protein noodles versus their corresponding 13.5% noodles. While straight grade flour a* was equivalent, the 14.5% patent flour noodles did show an anticipated protein effect on a*, with a slightly higher value. Noodles prepared from either of the No. 2 14.5% protein flours exhibited slightly lower yellowness, b*, than their respective 13.5% flours.

No difference was observed in cooked 14.5% protein patent flour noodle thickness with the corresponding 13.5% patent flour. Noodles prepared with the straight grade 14.5% flour were however thicker than their respective 13.5% protein noodles. Cooked noodle texture prepared from the 2012 No.2, 14.5% straight grade flour exhibited a significantly greater bite (MCS) while REC and RTC were equivalent to the corresponding 13.5% protein flour. Patent flour noodles also exhibited a higher MCS value than their 13.5% counterpart and improved REC and RTC, reflecting noodle chewiness.

White salted noodles

Wheat, No. 1 Canada Western Red Spring 13.5

Evaluation of white salted noodles (Table 9) indicated that the 2012 straight grade noodles were slightly brighter than the previous year at 2 hours after production while the 2012 patent noodles displayed a slight reduction relative to last year. Upon aging for 24 hours however both the 2012 patent and straight grade flour noodles remained significantly brighter than their 2011 counterparts. Straight grade noodles (2012) displayed slightly better a* values at both time intervals than those of 2011 while patent (2012) exhibited slightly redder noodles than the previous year. A modest increase in noodle yellowness, b* was detected in the 2012 patent noodles at both time periods relative to the 2011 material while the 2012 straight grade white salted noodles displayed a slightly less yellow noodle at both 2 and 24 hours after production when compared to the 2011 flour noodles.

Cooked noodle brightness of the 2012 patent flour and straight grade noodles exhibited a minor reduction in L* values relative to the 2011 noodles. In both the 2012 patent and straight grade cooked noodles there was an increase in a* relative to 2011. A modest increase in cooked noodle yellowness, b*, was observed in both 2012 patent and straight grade flour noodles.

White salted noodles prepared from either of the 2012 flours exhibited noodle thickness comparable to last year. As was the case in the alkaline noodles, noodle bite (MCS) of both 2012 patent and straight grade flour noodles was improved over their 2011 counterparts. A reduction in RTC and REC in the 2012 patent flour noodles relative to the 21011 noodles was observed. The 2012 straight grade noodles also displayed a decline in REC but RTC remained equivalent when compared to its 2011 control.

Wheat, No. 1 Canada Western Red Spring 14.5

As would be expected for a higher protein flour (Table 10) the 2 hour raw white salted noodles prepared from the 2012 14.5% protein 60% patent flour displayed a reduction in brightness to that of the 13.5% protein flour noodles. This decline however was approximately half of that observed in the corresponding straight grade flours at the same time period. Upon aging for 24 hours, both 14.5% noodles displayed ~ 1 unit drop in brightness relative to their 13.5% counterparts. Redness, a*, of both the 14.5% protein noodles exhibited the anticipated higher values at both time periods. Noodles prepared using either 2012 14.5% patent or straight grade flours exhibited a greater yellowness, b*, at both 2 and 24 hours after production than those prepared using their respective 13.5% protein flours.

The brightness of the cooked 2012 14.5% straight grade white salted noodle was reduced by ~0.5 units relative to its 13.5% counterpart although the patent flour cooked noodle exhibited a modestly higher L* to its counterpart. As expected, the higher protein generated elevated a* values relative to the 13.5% noodles for both flours. Surprisingly the higher protein, both straight grade and patent cooked noodles, displayed very desirable b* values, lower than those detected in those made with 13.5% protein. Straight grade and patent white salted noodle thickness was greater in the higher protein flours although no significant difference was detected amongst the 2012 flour noodles. The elevated protein content was reflected in both flours' noodle's texture attributes particularly with firmer noodles, with more bite being measured in the 14.5% protein noodles.

Wheat, No. 2 Canada Western Red Spring 13.5

White salted noodles prepared using the 2012 patent flour exhibited a slightly lower L* value, at both 2 and 24 hours after production compared to the 2011 material. Noodles prepared with the 2012 straight grade flours yielded noodles which were equivalent in brightness to the previous year at both 2 and 24 hours (Table 11). As was the general trend this year, the 2012 noodles, patent or straight grade yielded slightly elevated redness, a*, in their raw noodles as compared to 2011. This was true for both time intervals tested. An increase in noodle yellowness, b* was detected in the 2012 patent noodles at both time periods relative to the 2011 material. However the 2012 straight grade flour noodles surprisingly displayed a lower b* value at 2 hours relative to its 2011 counterpart, yet upon aging for 24 hours, it did display an elevated b* value.

Cooked noodle brightness of the 2012 60% patent and straight grade flour noodles were less bright than their corresponding 2011 noodles. An increase in a* relative to the 2011 noodles, both patent and straight grade was also apparent. No appreciable difference in cooked noodle yellowness, b*, was detected for either of the 2012 flour noodles relative to those prepared from their corresponding 2011 material.

White salted noodles prepared from either of the 2012 flours exhibited equivalent noodle thickness to those made from the previous, 2011, flours. The textural attributes of the 2012 noodles, both patent and straight grade, were relatively consistent with their corresponding 2011 values. An improvement in RTC (a portion of noodle chewiness) was observed in the 2012 noodles relative to 2011.

Wheat, No. 2 Canada Western Red Spring 14.5

The 2 and 24 hour raw white salted noodles prepared from the 2012 14.5% protein 60% patent flour displayed only slightly lower noodle brightness, L*, as compared to that of the 13.5% protein noodles. The 2012 14.5% protein straight grade noodles did exhibit a slightly lower L* value when compared to their 13.5% counterparts at both time intervals (Table 12). Similarly noodle redness for both 14.5% flours' noodles displayed slightly higher a* values at both time intervals. Only a modest increase in b*, yellowness was detected in the straight grade noodles at 2 hours while the patent flour noodles exhibited a minor reduction in b* relative to their 13.5% protein counterparts.

An improvement in noodle brightness of the cooked 14.5% protein patent and straight grade white salted noodles was observed relative to either of the No. 2 13.5% flour noodles. While an increase in redness a* was anticipated with the higher protein content the difference between flours on the basis of protein was minimal. The 14.5% protein patent and straight grade cooked noodles exhibited good b* values, less than their 13.5% protein counterparts.

A modest reduction in 14.5% protein straight grade and minimal change in patent white salted noodle thickness was observed relative to their 13.5% protein noodles. As expected, cooked noodle bite (MCS) was higher in both 14.5% protein noodles reflecting their higher protein content. While the 14.5% protein straight grade noodle displayed equivalent REC and RTC to its 13.5% counterpart, the values for the 14.5% patent flour noodles were significantly reduced when compared to their corresponding 13.5% protein noodle.

Table 3. Wheat, No. 1 Canada Western Red Spring - Allis-Chalmers laboratory mill Analytical and milling data, physical dough properties and baking quality data 2012 harvest grade composites compared to 2011 and 2002-2011 mean

	Minimum protein content, %			No. 1 CWRS 13.5	
Quality parameter[1]	13.0	13.5	14.5	2011	2002-2011 mean
Wheat					
Test weight, kg/hL	82.2	81.9	81.3	81.9	81.4
Weight per 1000 kernels, g	34.0	32.1	33.5	34.6	32.4
Protein content, %	13.2	13.7	14.8	13.7	13.8
Protein content, % (dry matter basis)	15.3	15.8	17.1	15.8	16.0
Ash content, %	1.57	1.57	1.60	1.65	1.60
Alpha-amylase activity, units/g	3.0	2.5	2.5	2.5	3.8
Falling number, s	430	445	445	425	406
PSI,%	51	52	54	54	N/A[2]
Milling Flour Yield - Allis-Chalmers Mill					
Clean wheat basis, %	75.8	75.6	75.6	76.3	75.6
0.50% ash basis, %	76.3	77.1	76.6	75.8	76.3
Flour					
Protein content, %	12.5	13.1	14.2	13.1	13.2
Wet gluten content, %	35.3	37.0	40.2	37.2	36.2
Ash content, %	0.49	0.47	0.48	0.51	0.48
Brightness, L*	94.4	94.3	94.1	N/A[3]	N/A[3]
Redness, a*	0.56	0.59	0.63	N/A[3]	N/A[3]
Yellowness, b*	10.1	10.2	10.2	N/A[3]	N/A[3]
Starch damage, %	9.3	9.2	8.6	8.9	8.3
Alpha-amylase activity, units/g	0.5	1.0	1.0	1.0	1.2
Amylograph peak viscosity, BU	705	705	725	615	641
Maltose value, g/100g	3.1	3.0	2.8	3.0	2.7
Farinogram					
Absorption, %	68.0	68.3	68.1	68.5	67.4
Development time, min	5.75	5.00	8.75	5.50	6.39
Mixing tolerance index, BU	30	10	30	20	23
Stability, min	12.0	13.0	11.0	9.5	10.6
Extensogram					
Length, cm	19	21	19	20	21
Height at 5 cm, BU	285	255	330	240	312
Maximum height, BU	480	440	560	415	569
Area, cm^2	115	120	135	105	152
Alveogram					
Length, mm	91	101	121	93	107
P (height x 1.1), mm	136	139	131	138	133
W, x 10^{-4} joules	431	490	522	420	477
Baking (Canadian short process baking test)					
Absorption, %	67	68	67	67	69[4]
Mixing energy, W-h/kg of dough	8.7	9.9	9.5	N/A[2]	N/A[2]
Mixing time, min	4.0	4.2	4.0	3.4	3.9[4]
Loaf volume, cm^3/100 g flour	1055	1080	1110	1075	1106[4]

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.
[2] Not available due to change in equipment.
[3] Not available due to change in method. See http://grainscanada.gc.ca/wheat-ble/method-methode/wmtm-mmab-eng.htm.
[4] Mean of data generated starting in 2004.

Table 4. Wheat, No. 2 Canada Western Red Spring - Allis-Chalmers laboratory mill
Analytical and milling data, physical dough properties and baking quality data
2012 harvest grade composites compared to 2011 and 2002-2011 mean

	Minimum protein content, %			No. 2 CWRS 13.5	
Quality parameter[1]	13.5	14.0	14.5	2011	2002-2011 mean
Wheat					
Test weight, kg/hL	81.5	80.4	80.4	81.3	80.5
Weight per 1000 kernels, g	32.6	32.3	32.3	34.2	33.7
Protein content, %	13.7	14.4	14.8	13.7	13.7
Protein content, % (dry matter basis)	15.8	16.6	17.1	15.8	16.0
Ash content, %	1.65	1.66	1.67	1.64	1.60
Alpha-amylase activity, units/g	3.5	5.0	4.5	4.0	5.0
Falling number, s	450	435	420	415	400
PSI,%	55	54	54	55	N/A[2]
Milling Flour Yield - Allis-Chalmers Mill					
Clean wheat basis, %	74.5	75.0	74.6	75.6	75.6
0.50% ash basis, %	75.0	76.5	75.1	74.6	75.4
Flour					
Protein content, %	13.1	13.7	14.2	13.1	13.2
Wet gluten content, %	37.4	38.4	41.0	37.5	36.2
Ash content, %	0.49	0.47	0.49	0.52	0.50
Brightness, L*	94.2	94.2	94.0	N/A[3]	N/A[3]
Redness, a*	0.58	0.59	0.63	N/A[3]	N/A[3]
Yellowness, b*	10.2	10.0	10.2	N/A[3]	N/A[3]
Starch damage, %	8.8	8.4	8.6	8.6	8.2
Alpha-amylase activity, units/g	1.0	1.5	1.0	1.5	1.7
Amylograph peak viscosity, BU	700	635	625	590	526
Maltose value, g/100g	2.9	2.7	2.8	2.8	2.6
Farinogram					
Absorption, %	67.6	68.1	68.6	68.2	67.2
Development time, min	5.50	6.00	6.75	5.25	6.00
Mixing tolerance index, BU	30	25	25	35	28
Stability, min	8.5	9.0	8.5	6.5	9.0
Extensogram					
Length, cm	21	21	21	21	21
Height at 5 cm, BU	275	240	250	225	298
Maximum height, BU	455	405	430	400	538
Area, cm^2	120	115	120	110	151
Alveogram					
Length, mm	104	110	110	103	117
P (height x 1.1), mm	123	121	122	130	129
W, x 10^{-4} joules	429	442	437	410	488
Baking (Canadian short process baking test)					
Absorption, %	67	68	67	68	69[4]
Mixing energy, W-h/kg of dough	8.6	9.1	8.8	N/A[2]	N/A[2]
Mixing time, min	3.8	4.0	3.7	3.4	3.9[4]
Loaf volume, cm^3/100 g flour	1120	1135	1140	1025	1103[4]

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.
[2] Not available due to change in equipment.
[3] Not available due to change in method. See http://grainscanada.gc.ca/wheat-ble/method-methode/wmtm-mmab-eng.htm.
[4] Mean of data generated starting in 2004.

Table 5. Wheat, No. 1 Canada Western Red Spring - Bühler laboratory mill -13.5% protein segregate
Analytical data, physical dough properties and baking quality data
Comparative data - 2012 and 2011 harvest sample composites*

	74% Straight grade		60% Patent	
Quality parameter[1]	2012	2011	2012	2011
Flour				
Yield, %	74.0	74.0	60.0	60.0
Protein content, %	12.9	12.8	12.4	12.4
Wet gluten content, %	36.2	36.8	35.8	35.8
Ash content, %	0.41	0.41	0.35	0.36
Brightness, L*	93.9	93.9	94.5	94.5
Redness, a*	0.63	0.59	0.59	0.54
Yellowness, b*	10.8	10.7	10.6	10.4
Alpha-amylase activity, units/g	0.5	1.0	0.5	1.0
Amylograph peak viscosity, BU	830	780	910	860
Starch damage, %	6.7	6.7	7.1	7.1
Farinogram				
Absorption, %	64.0	64.4	63.9	64.4
Development time, min	6.00	7.00	8.25	7.75
Mixing tolerance index, BU	25	35	10	15
Stability, min	12.0	10.5	23.5	22.0
Sponge-and-dough baking test (40 ppm ascorbic acid)				
Absorption, %	64	63	63	63
Mixing energy dough stage, W-h/kg	8.5	6.2	8.5	6.5
Mixing time dough stage, min	4.2	3.3	4.5	3.8
Loaf volume, cm^3/100 g flour	1100	1080	1090	1055
Appearance	7.4	7.4	7.4	7.2
Crumb structure	6.2	6.3	6.2	6.2
Crumb colour	7.8	7.8	8.0	8.0
Canadian short process baking test (150 ppm ascorbic acid)				
Absorption, %	64	64	64	64
Mixing energy, W-h/kg of dough	9.1	8.5	9.5	8.3
Mixing time, min	4.1	3.6	4.1	3.8
Loaf volume, cm^3/100 g flour	1080	1065	1090	1090
Appearance	7.7	7.7	7.7	7.8
Crumb structure	6.3	6.0	6.3	6.2
Crumb colour	7.7	7.9	7.8	7.8

* The 2011 composite was stored and milled the same day as the 2012.
[1] Data reported on 14.0% moisture basis.

Table 6. Wheat, No. 1 Canada Western Red Spring – Bühler laboratory mill- 14.5% protein segregate
Analytical data, physical dough properties and baking quality data
Comparative data - 2012 harvest sample composites*

Quality parameter[1]	74% Straight grade 2012	60% Patent 2012
Flour		
Yield, %	74.0	60.0
Protein content, %	13.8	13.4
Wet gluten content, %	39.6	38.1
Ash content, %	0.43	0.36
Brightness, L*	93.7	94.2
Redness, a*	0.69	0.63
Yellowness, b*	10.8	10.6
Alpha-amylase activity, units/g	0.50	0.50
Amylograph peak viscosity, BU	825	890
Starch damage, %	6.3	6.6
Farinogram		
Absorption, %	64.6	64.4
Development time, min	6.50	9.25
Mixing tolerance index, BU	25	20
Stability, min	10.5	19.0
Sponge-and-dough baking test (40 ppm ascorbic acid)		
Absorption, %	64	64
Mixing energy dough stage, W-h/kg	7.0	7.1
Mixing time dough stage, min	3.6	3.7
Loaf volume, cm^3/100 g flour	1155	1155
Appearance	7.5	7.7
Crumb structure	6.3	6.0
Crumb colour	7.8	7.9
Canadian short process baking test (150 ppm ascorbic acid)		
Absorption, %	64	64
Mixing energy, W-h/kg of dough	9.5	8.9
Mixing time, min	3.9	4.0
Loaf volume, cm^3/100 g flour	1130	1105
Appearance	7.8	7.5
Crumb structure	6.3	6.4
Crumb colour	8.0	7.8

* No 2011 harvest sample composites for 14.5% protein segregate.
[1] Data reported on 14.0% moisture basis.

Table 7. Wheat, No. 2 Canada Western Red Spring - Bühler laboratory mill -13.5% protein segregate
Analytical data, physical dough properties and baking quality data
Comparative data - 2012 and 2011 harvest sample composites*

	74% Straight grade		60% Patent	
Quality parameter[1]	2012	2011	2012	2011
Flour				
Yield, %	74.0	74.0	60.0	60.0
Protein content, %	12.9	12.8	12.5	12.4
Wet gluten content, %	36.6	37.2	36.0	36.4
Ash content, %	0.42	0.45	0.37	0.38
Brightness, L*	93.9	93.9	94.3	94.5
Redness, a*	0.65	0.59	0.60	0.53
Yellowness, b*	10.9	10.6	10.6	10.7
Alpha-amylase activity, units/g	1.5	1.0	1.0	1.0
Amylograph peak viscosity, BU	715	730	815	800
Starch damage, %	6.5	6.7	7.0	6.9
Farinogram				
Absorption, %	64.0	64.6	63.9	64.8
Development time, min	6.25	5.75	8.25	6.50
Mixing tolerance index, BU	30	30	25	15
Stability, min	9.5	9.0	17.0	20.0
Sponge-and-dough baking test (40 ppm ascorbic acid)				
Absorption, %	64	64	63	63
Mixing energy dough stage, W-h/kg	6.7	6.6	7.1	6.7
Mixing time dough stage, min	3.7	3.4	4.0	3.6
Loaf volume, cm^3/100 g flour	1115	1090	1075	1070
Appearance	7.5	7.2	7.4	7.5
Crumb structure	6.0	6.2	6.2	6.0
Crumb colour	7.5	8.0	7.9	7.9
Canadian short process baking test (150 ppm ascorbic acid)				
Absorption, %	64	64	64	64
Mixing energy, W-h/kg of dough	8.8	8.0	10.8	8.7
Mixing time, min	3.8	3.3	4.4	3.7
Loaf volume, cm^3/100 g flour	1135	1100	1120	1055
Appearance	7.7	7.9	7.5	7.7
Crumb structure	6.3	6.0	6.3	6.2
Crumb colour	7.9	7.8	7.9	7.8

* The 2011 composite was stored and milled the same day as the 2012.

[1] Data reported on 14.0% moisture basis.

Table 8. Wheat, No. 2 Canada Western Red Spring – Bühler laboratory mill - 14.5% protein segregate
Analytical data, physical dough properties and baking quality data
Comparative data - 2012 harvest sample composites*

Quality parameter[1]	74% Straight grade 2012	60% Patent 2012
Flour		
Yield, %	74.0	60.0
Protein content, %	13.9	13.4
Wet gluten content, %	40.0	39.9
Ash content, %	0.42	0.37
Brightness, L*	93.7	94.2
Redness, a*	0.70	0.64
Yellowness, b*	10.9	10.6
Alpha-amylase activity, units/g	1.5	1.5
Amylograph peak viscosity, BU	680	735
Starch damage, %	6.4	6.7
Farinogram		
Absorption, %	64.8	64.9
Development time, min	7.50	7.50
Mixing tolerance index, BU	25	20
Stability, min	9.5	19.0
Sponge-and-dough baking test (40 ppm ascorbic acid)		
Absorption, %	63	64
Mixing energy dough stage, W-h/kg	5.3	6.8
Mixing time dough stage, min	2.9	3.6
Loaf volume, cm^3/100 g flour	1160	1150
Appearance	7.7	7.5
Crumb structure	6.2	6.3
Crumb colour	7.7	7.8
Canadian short process baking test (150 ppm ascorbic acid)		
Absorption, %	64	64
Mixing energy, W-h/kg of dough	8.8	9.3
Mixing time, min	3.6	3.7
Loaf volume, cm^3/100 g flour	1150	1155
Appearance	7.8	7.9
Crumb structure	6.3	6.0
Crumb colour	7.9	7.9

* No 2011 harvest sample composites for 14.5% protein segregate.
[1] Data reported on 14.0% moisture basis.

Table 9. Wheat, No. 1 Canada Western Red Spring –Bühler laboratory mill - 13.5% protein segregate
Noodle quality data
Comparative data - 2012 and 2011 harvest sample composites*

	74% Straight grade		60% Patent	
Quality parameter	2012	2011	2012	2011
Fresh yellow alkaline noodles				
Raw colour at 2 hrs (24 hrs)				
Brightness, L*	80.4 (73.0)	78.6 (72.1)	82.9 (78.1)	81.9 (76.7)
Redness, a*	-0.13 (0.69)	-0.03 (0.70)	-0.25 (0.09)	-0.25 (0.16)
Yellowness, b*	26.8 (27.3)	27.4 (28.3)	26.5 (27.7)	27.1 (28.3)
Cooked colour				
Brightness, L*	68.8	69.0	70.5	70.5
Redness, a*	-1.56	-1.46	-1.95	-2.00
Yellowness, b*	28.3	27.9	29.1	28.2
Texture				
Thickness, mm	2.39	2.44	2.39	2.28
RTC, %	29.0	28.1	30.4	25.2
Recovery, %	34.5	34.0	34.6	32.9
MCS, g/mm^2	34.9	32.7	34.5	31.0
Fresh white salted noodles				
Raw colour at 2 hrs (24 hrs)				
Brightness, L*	82.0 (75.5)	81.3 (73.8)	82.3 (78.0)	83.4 (76.2)
Redness, a*	2.47 (3.18)	2.69 (3.38)	2.28 (2.73)	2.16 (2.43)
Yellowness, b*	23.1 (23.8)	24.0 (24.9)	24.0 (25.4)	23.5 (24.3)
Cooked colour				
Brightness, L*	75.1	75.6	75.3	75.7
Redness, a*	1.07	0.96	0.78	0.58
Yellowness, b*	20.1	19.7	20.6	20.2
Texture				
Thickness, mm	2.49	2.51	2.48	2.50
RTC, %	23.6	23.6	21.9	23.0
Recovery, %	23.9	26.9	23.9	25.6
MCS, g/mm^2	27.9	26.1	28.8	27.4

* The 2011 composite was stored and milled the same day as the 2012.

Table 10. Wheat, No. 1 Canada Western Red Spring - Bühler laboratory mill - 14.5% protein segregate

Noodle quality data

Comparative data - 2012 harvest sample composites*

Quality parameter	74% Straight grade 2012	60% Patent 2012
Fresh yellow alkaline noodles		
Raw colour at 2 hrs (24 hrs)		
Brightness, L*	76.9 (71.6)	82.0 (77.1)
Redness, a*	0.31 (0.79)	-0.09 (0.27)
Yellowness, b*	28.3 (27.8)	25.9 (27.2)
Cooked colour		
Brightness, L*	68.8	70.0
Redness, a*	-1.55	-1.76
Yellowness, b*	27.0	27.6
Texture		
Thickness, mm	2.41	2.56
RTC, %	27.6	28.2
Recovery, %	33.7	34.1
MCS, g/mm^2	36.5	38.4
Fresh white salted noodles		
Raw colour at 2 hrs (24 hrs)		
Brightness, L*	80.5 (74.3)	81.3 (76.8)
Redness, a*	2.94 (3.71)	2.61 (3.08)
Yellowness, b*	24.0 (24.8)	24.4 (25.9)
Cooked colour		
Brightness, L*	74.6	75.7
Redness, a*	1.15	0.86
Yellowness, b*	19.5	20.0
Texture		
Thickness, mm	2.58	2.59
RTC, %	23.9	22.0
Recovery, %	25.1	24.5
MCS, g/mm^2	32.2	31.4

* No 2011 harvest sample composites for 14.5% protein segregate.

Table 11. Wheat, No. 2 Canada Western Red Spring –Bühler laboratory mill - 13.5% protein segregate
Noodle quality data
Comparative data - 2012 and 2011 harvest sample composites*

	74% Straight grade		60% Patent	
Quality parameter	2012	2011	2012	2011
Fresh yellow alkaline noodles				
Raw colour at 2 hrs (24 hrs)				
Brightness, L*	78.1 (71.9)	79.9 (72.1)	81.2 (76.6)	83.3 (78.6)
Redness, a*	0.18 (1.00)	-0.12 (0.72)	-0.05 (0.32)	-0.41 (0.01)
Yellowness, b*	28.1 (28.3)	27.0 (27.5)	26.2 (27.5)	25.6 (26.9)
Cooked colour				
Brightness, L*	68.8	68.2	70.5	69.8
Redness, a*	-1.50	-1.43	-1.95	-2.06
Yellowness, b*	28.3	28.3	28.6	28.9
Texture				
Thickness, mm	2.38	2.43	2.42	2.44
RTC, %	28.7	28.8	27.1	29.2
Recovery, %	34.8	35.0	33.3	33.5
MCS, g/mm^2	34.2	35.4	34.7	35.4
Fresh white salted noodles				
Raw colour at 2 hrs (24 hrs)				
Brightness, L*	80.6 (74.4)	80.8 (74.8)	82.0 (77.4)	83.0 (78.0)
Redness, a*	2.74 (3.68)	2.61 (3.20)	2.37 (2.91)	2.15 (2.65)
Yellowness, b*	23.3 (25.4)	24.3 (24.4)	24.3 (26.1)	23.4 (25.4)
Cooked colour				
Brightness, L*	73.7	74.5	75.3	75.6
Redness, a*	1.37	1.10	0.82	0.76
Yellowness, b*	20.5	20.0	20.7	20.7
Texture				
Thickness, mm	2.53	2.53	2.46	2.44
RTC, %	23.5	22.2	25.0	24.3
Recovery, %	24.9	25.4	25.1	25.5
MCS, g/mm^2	29.0	28.5	29.7	30.2

* The 2011 composite was stored and milled the same day as the 2012.

Table 12. Wheat, No. 2 Canada Western Red Spring –Bühler laboratory mill - 14.5% protein segregate
Noodle quality data
Comparative data - 2012 harvest sample composites*

	74% Straight grade	60% Patent
Quality parameter	2012	2012
Fresh yellow alkaline noodles		
Raw colour at 2 hrs (24 hrs)		
Brightness, L*	76.6 (70.8)	80.3 (73.8)
Redness, a*	0.38 (0.98)	0.20 (0.65)
Yellowness, b*	28.1 (27.9)	27.2 (27.7)
Cooked colour		
Brightness, L*	68.4	69.7
Redness, a*	-1.55	-1.76
Yellowness, b*	27.1	27.7
Texture		
Thickness, mm	2.46	2.43
RTC, %	29.4	28.8
Recovery, %	34.8	34.8
MCS, g/mm^2	37.3	35.5
Fresh white salted noodles		
Raw colour at 2 hrs (24 hrs)		
Brightness, L*	79.7 (73.9)	82.7 (77.3)
Redness, a*	2.97 (3.97)	2.53 (3.15)
Yellowness, b*	23.9 (25.8)	23.8 (25.5)
Cooked colour		
Brightness, L*	74.1	76.0
Redness, a*	1.44	0.85
Yellowness, b*	20.3	19.9
Texture		
Thickness, mm	2.48	2.47
RTC, %	23.5	21.2
Recovery, %	24.8	24.2
MCS, g/mm^2	31.3	32.1

* No 2011 harvest sample composites for 14.5% protein segregate.

Canada Western Amber Durum wheat

Protein and variety survey

Table 13 lists the mean protein content values for Canada Western Amber Durum (CWAD) wheat by grade. Comparative values are shown for 2012, 2011 and for the previous 10 years (2002-2011). Figure 3 shows the variation in annual mean protein content since 1963.

The average protein content of the 2012 milling grades of CWAD at 12.9% is 0.6% higher than 2011 and is similar to the 10-year mean. Wheat, No. 1 CWAD protein content is 0.5% higher than last year but 0.6% lower than the 10-year mean. Wheat, No. 2 CWAD protein content is 0.6% higher than last year and 0.1% lower than the 10-year mean. Annual mean protein content values since 1963 (Figure 3) demonstrate that this quality factor is highly variable, primarily in response to environmental conditions.

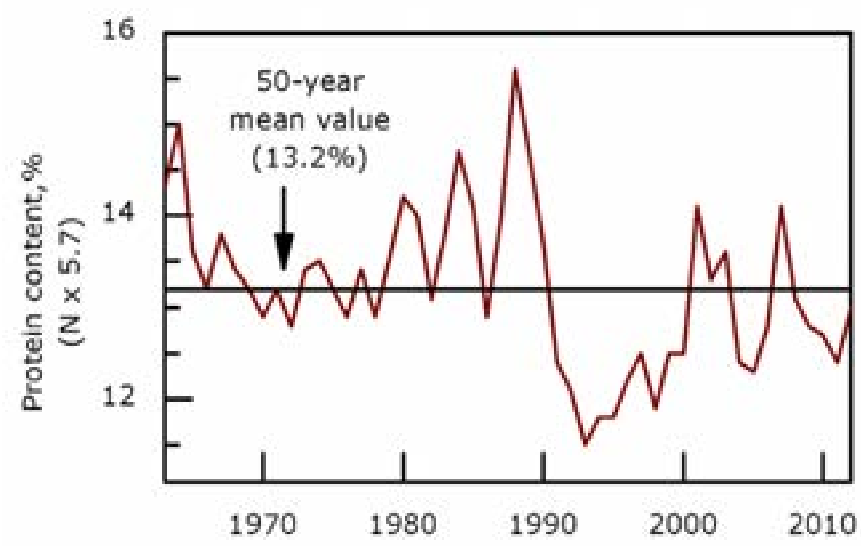
The Canadian Grain Commission conducted variety identification using DNA based technology on the No. 1, No. 2, and No. 3 CWAD composites prepared from samples submitted by producers. Results indicated that the variety Strongfield remains the most popular variety with western Canadian producers representing 54% of the three composites combined. AC Avonlea and CDC Verona represent 16% and 14% of the three composites combined, respectively, and AC Navigator represents only 4% of the three grades combined. Both Strongfield and CDC Verona are low cadmium varieties. They have good milling performance, strong and balanced gluten characteristics along with high protein potential and high yellow pigment content.

Table 13 – Mean protein content of 2012 Canada Western Amber Durum wheat, by grade and year.

Grade	Protein content, %[1]		
	2012	2011	2002-2011
Wheat, No. 1 Canada Western Amber Durum	12.7	12.2	13.3
Wheat, No. 2 Canada Western Amber Durum	12.8	12.2	12.9
Wheat, No. 3 Canada Western Amber Durum	13.6	12.5	12.9
All milling grades	**12.9**	**12.3**	**12.9**

[1] N x 5.7; 13.5% moisture content basis as of Nov. 24/11

Figure 3 – Mean protein content of Canada Western Amber Durum wheat – 1963-2012



Wheat and pasta processing quality

Wheat, No. 1 and 2 Canada Western Amber Durum

Data describing the quality characteristics for composite samples of Wheat, No. 1 and No. 2 CWAD are shown in Table 14. Corresponding data for 2011 No. 1 CWAD and 2011 No. 2 CWAD are provided for comparison. The primary degrading factors in the 2012 No. 2 CWAD were midge damage, mildew and hard vitreous kernel count. Test weight is comparable and weight per 1000 kernels is lower than the 2011 crop for both No.1 CWAD and No. 2 CWAD. Hard vitreous kernel count is slightly higher than 2011 for No. 1 CWAD, and is significantly higher than 2011 for No. 2 CWAD. The wheat protein content is 12.7% for No. 1 CWAD, 0.5% higher than the 2011 crop of the same grade. No. 2 CWAD has a protein content of 12.8%; significantly higher than 12.3% of the 2011 No. 2 CWAD. Falling number values for both wheat and semolina are indicative of sound kernel characteristics.

Several changes have been made in the procedures for assessment of CWAD quality starting from the 2011 Harvest Survey. Firstly, all semolina samples were made up to a constant extraction rate of 70% following milling in order to be consistent with current commercial practice. This was accomplished by taking the semolina and adding the highest quality flour streams until 70% extraction was attained. All semolina and spaghetti tests were conducted using the 70% extraction granulars. Speck counts are now conducted using a flatbed scanner and specially developed software. Specks are reported as total, dark and large specks per 50 cm^2. Changes have also been made to semolina and spaghetti colour measurements and we have included dough sheet colour measurements at 0.5 and 24 hrs. There were changes to the spaghetti extrusion and drying method, and textural analyses of the cooked spaghetti. All of these changes are explained at http://grainscanada.gc.ca/wheat-ble/method-methode/wmtm-mmab-eng.htm

When compared to the 2011 crop, total milling yield and semolina yield are slightly lower for No. 1 CWAD, but slightly higher for No. 2 CWAD. Ash contents of wheat and semolina are higher for the 2012 crop. Total speck counts are slightly higher than 2011 for No. 1 CWAD, but lower than 2011 for No. 2 CWAD. Dark and large speck counts are all similar to those of the 2011 crop. Overall the milling quality of the 2011 CWAD crop is consistent with expectations for top grades.

Semolina protein contents are higher by 0.6% and 0.8% for No. 1 CWAD and No. 2 CWAD, respectively. Wet gluten contents are 1.7% higher for No. 1 CWAD and 1.9% higher for No. 2 CWAD. Gluten index and Alveograph P and W values demonstrate slightly stronger gluten strength characteristics compared to 2011. The stronger gluten of CWAD in recent years is mainly due to newer varieties including Strongfield, CDC Verona, and AC Navigator, which exhibit stronger gluten characteristics than earlier varieties such as Kyle and AC Avonlea.

Semolina yellow pigment contents for the top two grades are significantly higher than those of the 2011 crop, as is the yellowness (b*) of the semolina samples. Overall, CWAD exhibits a significant improvement in colour over the years resulting from continued breeding emphasis placed on increasing yellow pigment levels in new varieties. The brightness (L*) and yellowness (b*) of semolina dough sheets are similar to 2011 crop. The higher redness (a*) of the dough sheets is due to the increased protein content in the 2012 crop.

Spaghetti yellowness (b*) values for both grades show significant improvement over the 2011 crop. Higher protein and yellow pigment contents in the 2012 crop account for the elevated redness (a*) values of the spaghetti. Spaghetti cooked texture, as indicated by peak cutting force, exhibits significantly higher firmness for both 2012 No.1 and No. 2 CWAD compared the 2011 crop year reflecting the considerable higher protein content of the 2012 crop.

Wheat, No. 3 Canada Western Amber Durum

Due to the favourable weather during harvest, only about one quarter of the 2012 durum crop was downgraded to No. 3 CWAD (~20%) or lower (~8%). The primary degrading factors in the No. 3 CWAD are fusarium damage and severe midge. Data describing the quality of No. 3 CWAD can be found in Table 15. Corresponding data for the 2011 No. 3 CWAD are provided for comparison. Test weight and weight per 1000 kernels are slightly lower. The hard vitreous kernel count is significantly higher than that of the 2011 crop. The wheat protein content is 13.6%, much higher than the 2011 crop. The falling number value of 440 sec. indicates that kernel characteristics of the 2012 crop were very sound due to the absence of grading factors related to excessive moisture during harvest.

Total milling yield and semolina yield are almost identical. Ash contents of wheat and semolina are significantly higher for the 2012 No. 3 CWAD. Speck counts are also higher.

Semolina protein content and wet gluten content are much higher than those of the previous crop year. Gluten index and Alveograph W values demonstrate slightly stronger gluten strength characteristics compared to the 2011 crop.

Semolina yellow pigment content is higher than that of the 2011 crop, so is the yellowness (b*) of the semolina sample. The semolina dough sheet prepared from the 2012 No. 3 CWAD crop has lower yellowness (b*) and higher redness (a*).

Spaghetti yellowness (b*) is higher than that of 2011 No. 3 CWAD. Higher protein and yellow pigment contents in the 2012 crop account for the elevated redness (a*) values of the spaghetti. Cooked spaghetti, as indicated by peak cutting force, exhibits much firmer texture compared to the 2011 No. 3 CWAD.

Table 14. Wheat, No. 1 and 2 Canada Western Amber Durum
Wheat and pasta processing quality
Quality data for harvest sample grade composites compared to 2011

Quality parameter[1]	No. 1 CWAD 2012	No. 1 CWAD 2011	No. 2 CWAD 2012	No. 2 CWAD 2011
Wheat				
Test weight, kg/hL	82.7	83.2	82.4	82.8
Weight per 1000 kernels, g	39.6	43.6	41.3	43.7
Vitreous kernels, %	91	88	93	82
Protein content, %	12.7	12.3	12.8	12.3
Ash content, %	1.53	1.49	1.63	1.52
Falling number, s	440	420	450	430
Milling				
Milling yield, %	75.0	75.8	75.7	75.4
Semolina yield, %	67.2	67.5	67.3	66.8
Semolina ash content, %	0.66	0.63	0.69	0.64
Speck count per 50 cm^2				
Total	30	25	32	38
Dark	10	7	13	12
Large (≥ 0.06 mm^2)	12	12	11	12
Semolina[2]				
Protein content, %	11.8	11.2	11.9	11.1
Wet gluten content, %	31.1	29.4	31.1	29.2
Gluten index, %	65	46	61	50
Alveogram				
Length, mm	89	96	97	97
P (height x 1.1), mm	61	52	53	51
P/L	0.68	0.54	0.55	0.53
W, x 10^{-4} joules	158	132	135	128
Yellow pigment content, ppm	10.0	9.5	9.8	9.1
Yellowness, b*	33.0	31.9	32.7	31.2
Dough sheet colour at (0.5 hrs) 24 hrs				
Brightness, L*	(80.6) 77.9	(80.9) 78.3	(80.5) 78.4	(81.1) 78.9
Redness, a*	(-1.3) -0.8	(-1.9) -1.5	(-1.1) -0.8	(-1.8) -1.5
Yellowness, b*	(37.1) 41.1	(37.3) 41.2	(36.2) 39.3	(36.4) 39.9
Falling number, s	520	465	520	490
Spaghetti - Dried at 85°C				
Brightness, L*	73.0	73.4	72.6	73.3
Redness, a*	5.7	4.2	6.3	4.2
Yellowness, b*	64.5	62.7	64.1	62.0
Strand diameter, mm				
Dry	1.68	1.69	1.67	1.69
Cooked	2.50	2.49	2.50	2.49
Texture Cutting force (g) at				
25% diameter	98	96	97	100
50% diameter	329	332	323	350
Peak	582	495	569	498

[1] Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for semolina.
[2] Semolina analyses are conducted using granular products with a constant extraction rate of 70%.

Table 15. Wheat, No. 3 Canada Western Amber Durum
Quality data for 2012 harvest sample grade composites compared to 2011

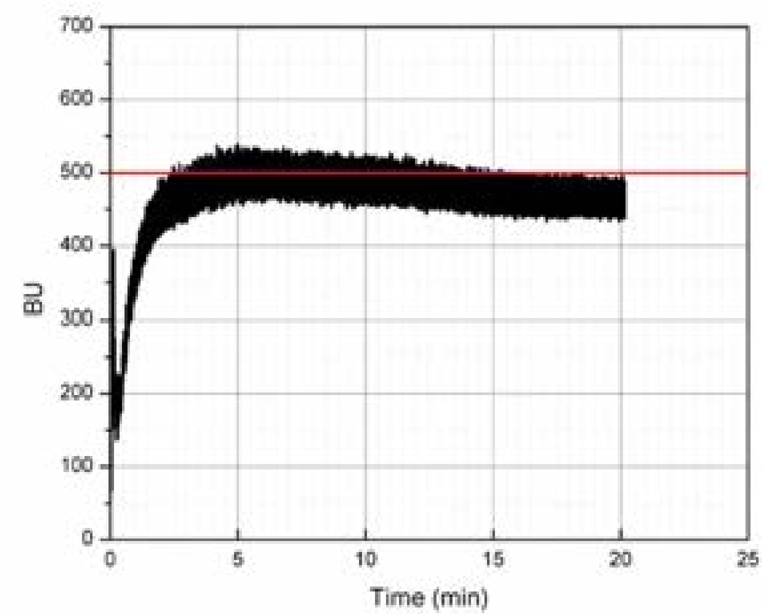
Quality parameter[1]	No. 3 CWAD 2012	No. 3 CWAD 2011
Wheat		
Test weight, kg/hL	81.5	82.1
Weight per 1000 kernels, g	40.3	41.8
Vitreous kernels, %	89	70
Protein content, %	13.6	12.6
Ash content, %	1.71	1.60
Falling number, s	440	430
Milling		
Milling yield, %	75.3	75.3
Semolina yield, %	67.0	66.9
Semolina ash content, %	0.74	0.67
Speck count per 50 cm^2		
Total	57	42
Dark	22	15
Large (≥ 0.06 mm^2)	21	18
Semolina[2]		
Protein content, %	12.5	11.5
Wet gluten content, %	33.5	30.1
Gluten index, %	52	38
Alveogram		
Length, mm	99	91
P (height x 1.1), mm	53	52
P/L	0.53	0.57
W, x 10^{-4} joules	134	121
Yellow pigment content, ppm	9.9	9.2
Yellowness, b*	31.8	31.1
Dough sheet colour at (0.5 hrs) 24 hrs		
Brightness, L*	(79.7) 79.3	(80.6) 78.9
Redness, a*	(-0.9) -0.6	(-1.6) -1.3
Yellowness, b*	(35.1) 36.4	(36.0) 39.8
Falling number, s	495	455
Spaghetti - Dried at 85°C		
Brightness, L*	71.6	72.5
Redness, a*	7.3	4.9
Yellowness, b*	63.2	61.8
Strand diameter, mm		
Dry	1.68	1.69
Cooked	2.51	2.50
Texture Cutting force (g) at		
25% diameter	100	100
50% diameter	333	348
Peak	599	504

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

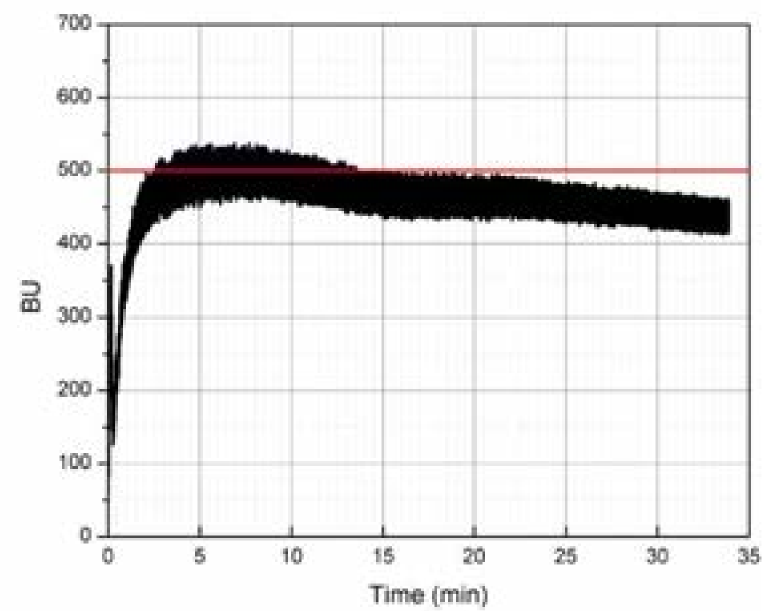
[2] Semolina analyses are conducted using granular products with a constant extraction rate of 70%.

Farinograms
2012 crop composite samples

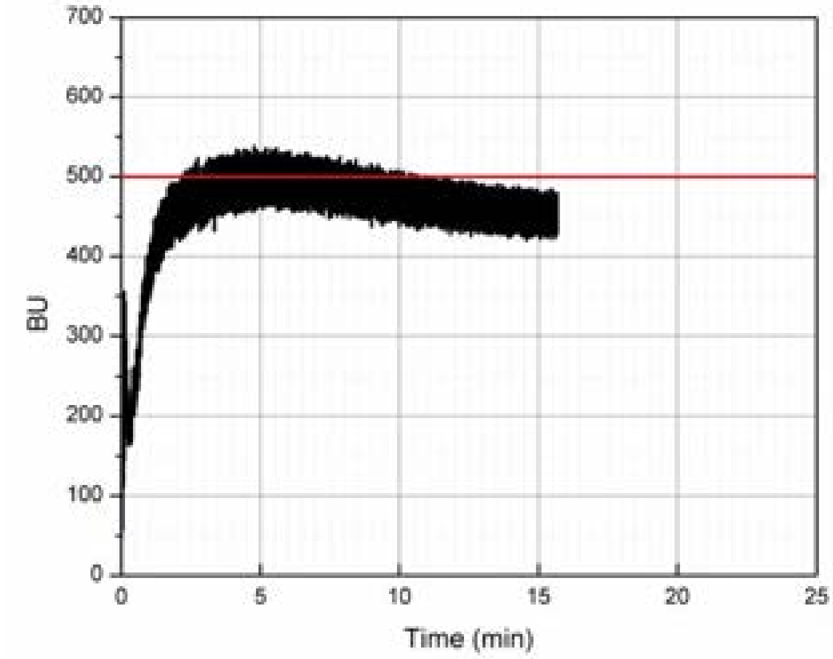
Wheat, No. 1 Canada Western Red Spring wheat – 13.5% protein segregate



Wheat, No. 1 Canada Western Red Spring wheat – 14.5% protein segregate



Wheat, No. 2 Canada Western Red Spring wheat – 13.5% protein segregate



Wheat, No. 2 Canada Western Red Spring wheat – 14.5% protein segregate