



VALUE ADDED WHEAT CRC

**Project 2.1.5 Australian wheat for the sponge and dough
bread making process**

Benchmarking North American Wheat Samples for Sponge and Dough Bread Production

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Executive Summary

Background

Three samples of North American wheat were obtained for evaluation of wheat and flour properties with specific reference to their sponge and dough bread making quality. The samples were compared to the National Reference sample of Sunco and where possible a flour sample of the variety Kennedy.

The objective of this study was to provide a benchmark against which Australian wheat varieties could be compared for sponge and dough bread making quality. Whilst it is generally accepted in Asia that CWRS and DNS wheat grades have superior sponge and dough bread making performance, there is little data available actually comparing samples of these wheats under Australian test conditions.

Results

The milling quality of Sunco was superior to the three samples, when extraction rate was taken into consideration with ash and flour colour values. This observation was supported at 60% and straight run extraction. Sunco is recognized to be an excellent milling wheat and it would be valuable to compare these results to grade samples as the advantage of Australian wheat may not be as great as anticipated.

The North American samples had protein contents above 14% and also milled to produce higher starch damage. The result was higher water absorption than Sunco which is attractive to bakers.

The dough strength measurements including, farinograph dough development time and dough stability, and extensograph maximum resistance, indicate that the sample of Sunco was actually stronger than the North American samples. This was a surprising result as these wheats are often reported as having greater strength than Australian wheat. Again it would be good to compare a typical Prime Hard sample of 14% protein content.

The sponge and dough bread making performance of the North American wheat samples was clearly superior to the sample of Sunco. As there are many differences between the samples there is no single factor that can account for the superior baking.

Kennedy

A flour sample of the variety Kennedy which had been Pilot milled several years ago and stored at 4°C was also included in the comparison. Although this cannot be considered a direct comparison due to the different milling treatment and flour age, it has still provided an interesting opportunity. The sample of Kennedy had similar starch damage to the DNS and a higher ash content than the all the North American samples. This sample of Kennedy was also considerably stronger and had higher farinograph water absorption than the other samples tested. The sponge and dough performance of this Kennedy sample was equivalent to the North American samples tested. In previous comparisons to commercial flours from Asia this sample of Kennedy has compared very favourably. This particular sample of Kennedy is exceptionally strong and its baking performance is better than other samples of Kennedy tested.

In a comparison of 13 Prime Hard wheat types from the 2000 harvest, Kennedy produced the highest sponge and dough bread scores. However, with a similar sample set repeated in 2001, Kennedy although still performing well, was not in the top group. Other samples of Kennedy obtained opportunistically have performed well but have not achieved the high scores of the Pilot milled sample used in the current testing. Study of the protein composition of Kennedy has not revealed any stand out features that appears to be associated with its high baking quality.

Recommendations

1. Continue to collect North American wheat samples and evaluate them for flour quality and sponge and dough performance. A larger database is required to establish what the key differences between North American and Australian wheats determine superior baking performance.
2. Include Prime Hard wheat grade samples in future comparisons of sponge and dough performance. Whilst it is important to have individual variety samples, grade samples would provide an additional point of reference.
3. The wheat variety Kennedy has consistently shown superior baking performance. It can now be recommended as a parent for baking quality. However the actual traits contributing to this baking performance are not understood and further analysis of this variety in the context of other Australian wheats is required to better define the target quality.
4. Test baking is still the only effective method to determine the sponge and dough baking performance of wheat varieties. Further work is required to identify key traits that can be used to predict performance in earlier generations and at less cost than baking tests.

Samples

The following wheat samples were obtained from North America for evaluation in the sponge and dough bread making process.

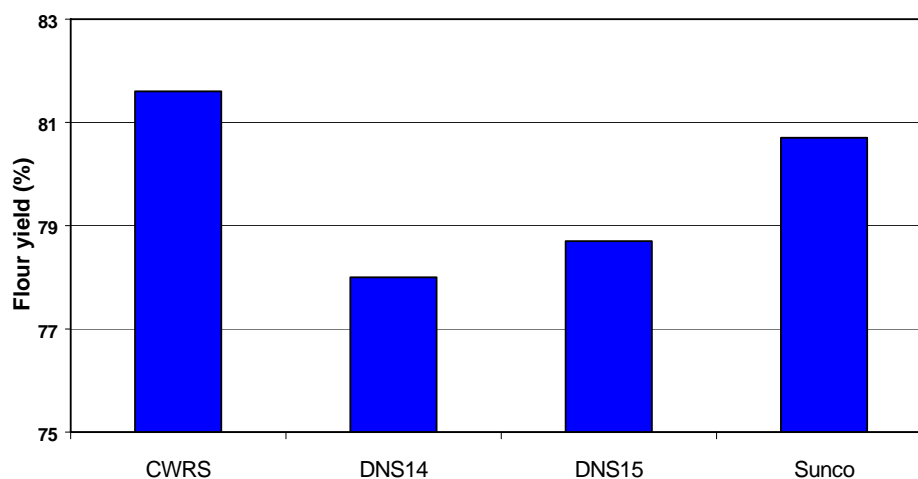
	Wheat protein content (%)	
1. Canadian Western Red Spring (CWRS)	15	Canada
2. Dark Northern Spring (DNS) 14	14.4	US
3. Dark Northern Spring (DNS) 15	15.1	US

These samples were compared to the national reference sample of Sunco (wheat protein content of 13.2%). However, it is also possible to compare the data to other NWQEP samples as the testing and data are in the same format. Flour produced from the above samples is also compared to a flour sample of the wheat variety Kennedy. This sample is from a BRI Pilot Milling of Kennedy and is not directly comparable to the other samples. This sample has produced excellent baking results on the sponge and dough system. The sample has now been stored for over two years. Although this has been at 4°C, the sample has shown some increase in dough strength and water absorption.

Sample size was limited for the North American wheats, which were milled to a straight run extraction to measure milling performance with adequate flour for most quality tests. This straight run extraction data allows direct comparison with the NWQEP. A sample of each grade was also milled to 60% extraction. This sample was large enough for more extensive testing which included extensographs and sponge and dough baking. The following graphs compare the key features of these samples and detailed test results are presented on pages 11 to 13.

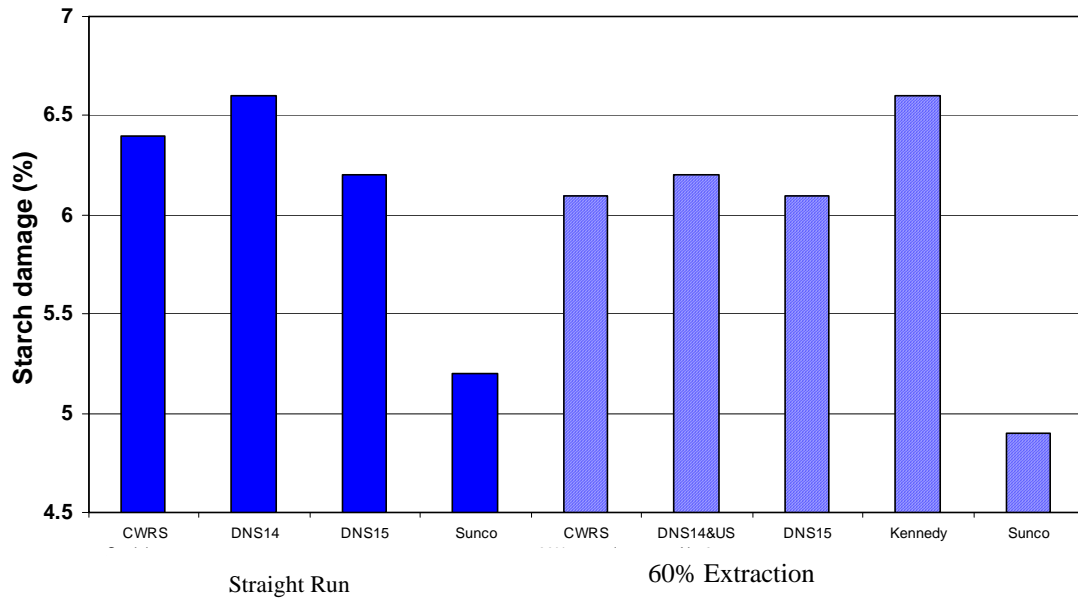
Flour yield

The sample of CWRS achieved the highest straight run flour yield, this result is considered very high. To put the results in context, a sample of Sunco submitted to the NWQEP from the 2001 season, achieved an extraction rate of 77.5, below that of the present DNS 14 sample.



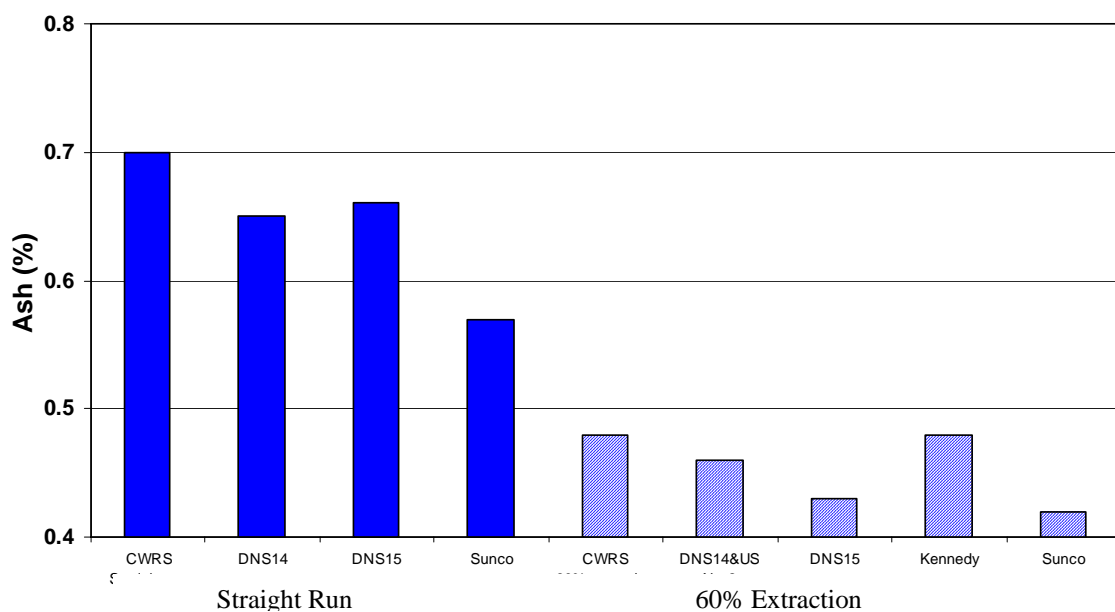
Starch Damage:

The sample of Sunco produced lower starch damage than the north American samples at both straight run and 60% extractions. The Sunco sample had the lowest PSI of the samples. The starch damage values for these DNS samples are similar to what we would expect for Hartog. Kennedy had a similar level of starch damage to DNS14.



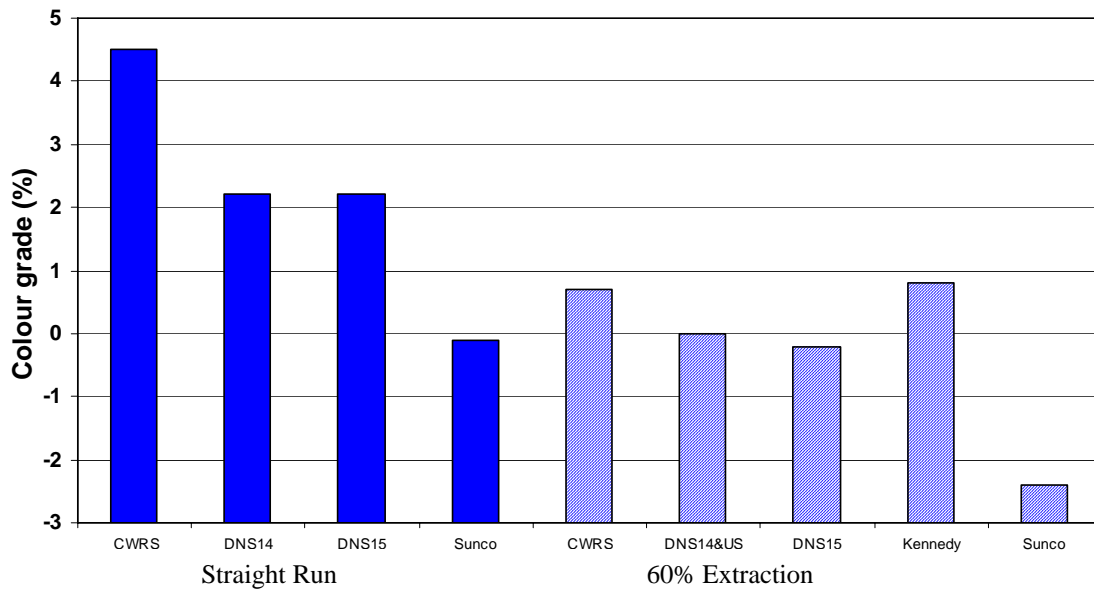
Ash:

The straight run ash values were clearly higher than for the 60% extraction samples. At both extraction rates the CWRs had the highest ash and Sunco the lowest. Considering the ash values and extraction rates this sample of Sunco clearly has superior milling quality.



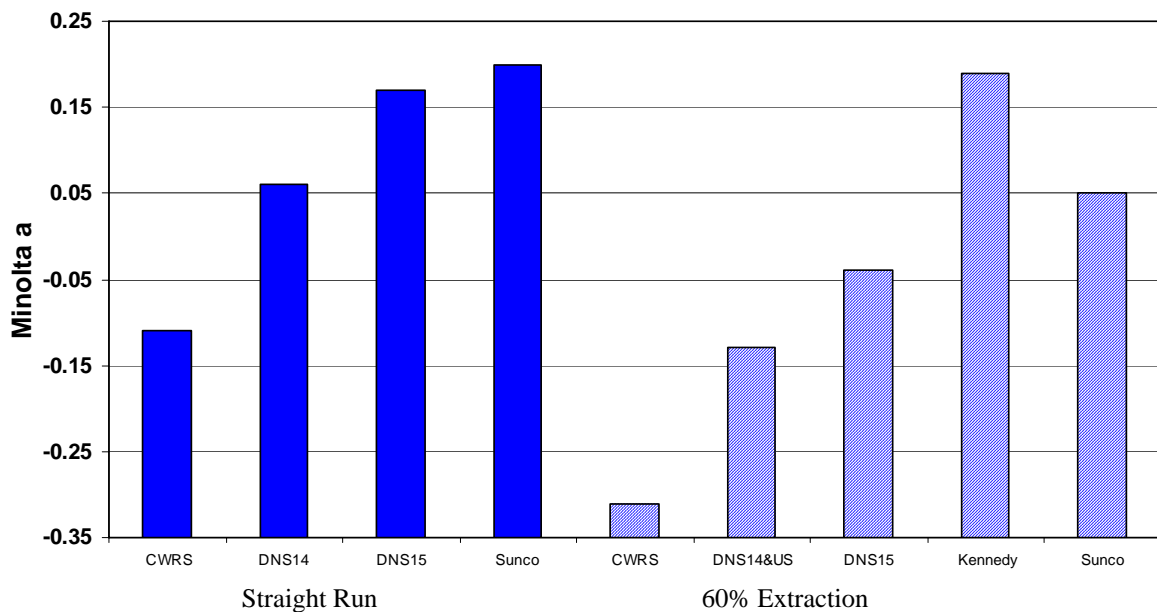
Colour grade:

The Sunco colour grade at a straight run extraction was better than or similar to the North American samples at 60% extraction. Again the superior colour grade of the Sunco sample reflects better milling performance. At straight run extraction, Hartog would be expected to achieve a colour grade of 0.5 to 1.0 still considerably lower than the north American samples.



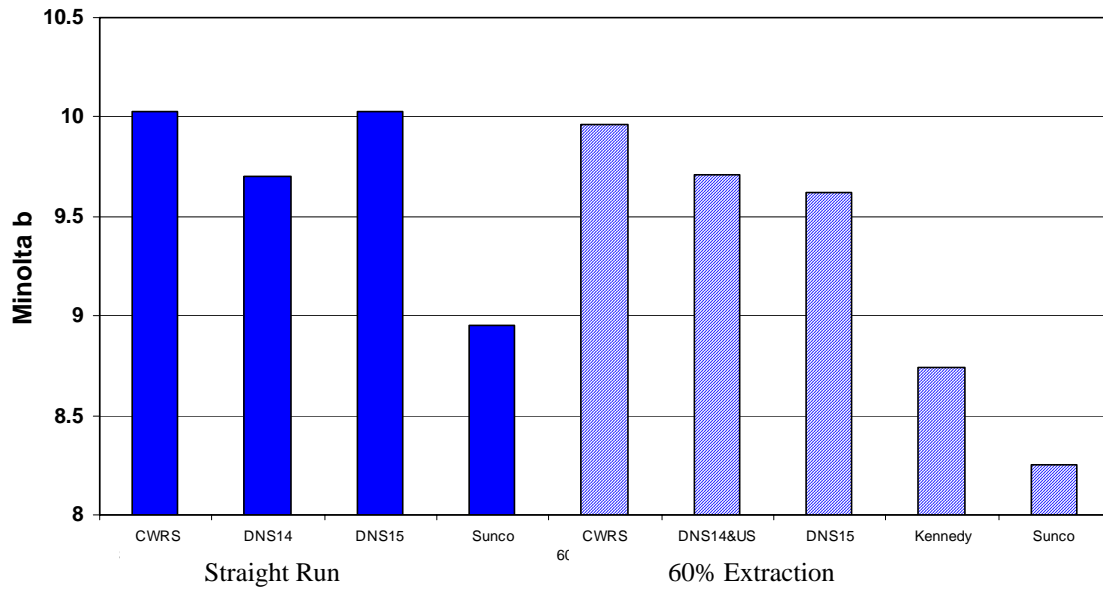
Flour Colour: Minolta a*:

We do not usually comment on the Minolta a values, however, although the differences between the samples are small, the trend is interesting with Sunco appearing to have the highest red values at both extractions, a result which is difficult to interpret given that the north American wheats were red grained.



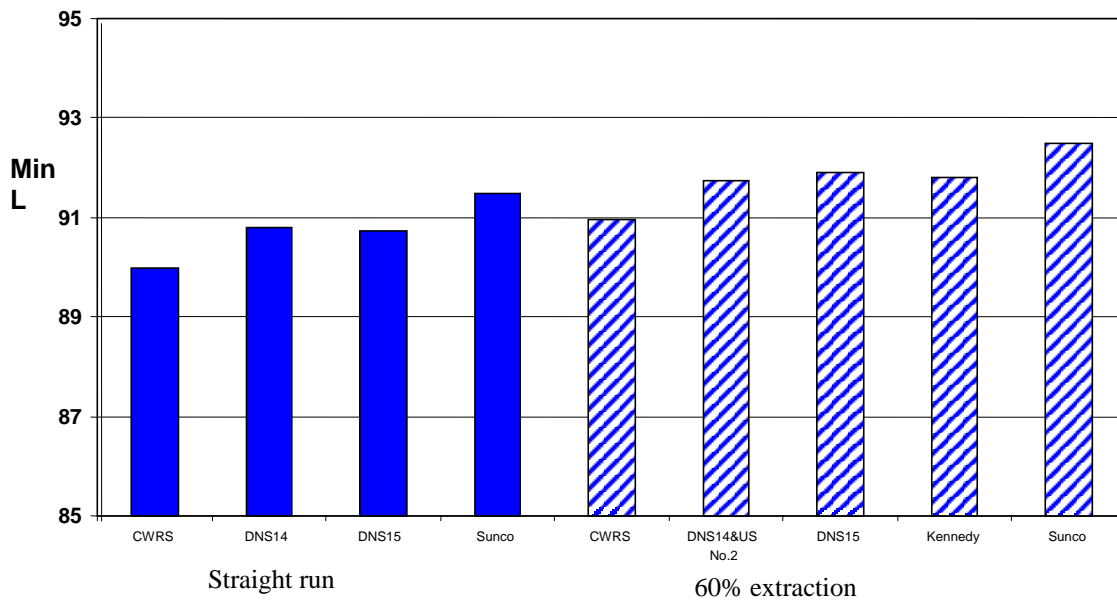
Flour Colour: Minolta b*:

Sunco produced a less yellow flour than the north American samples, as did the Kennedy. This would be considered an advantage for bread making.



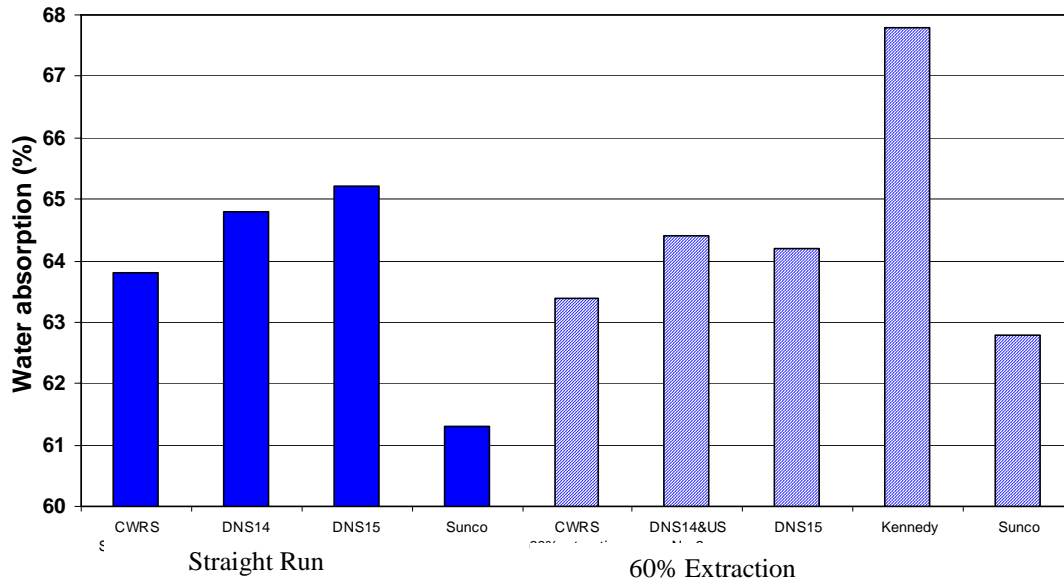
Flour colour: Minolta L*:

Sunco produced the brightest flour at both extraction rates. CWRS has the least bright flour at both extraction rates.



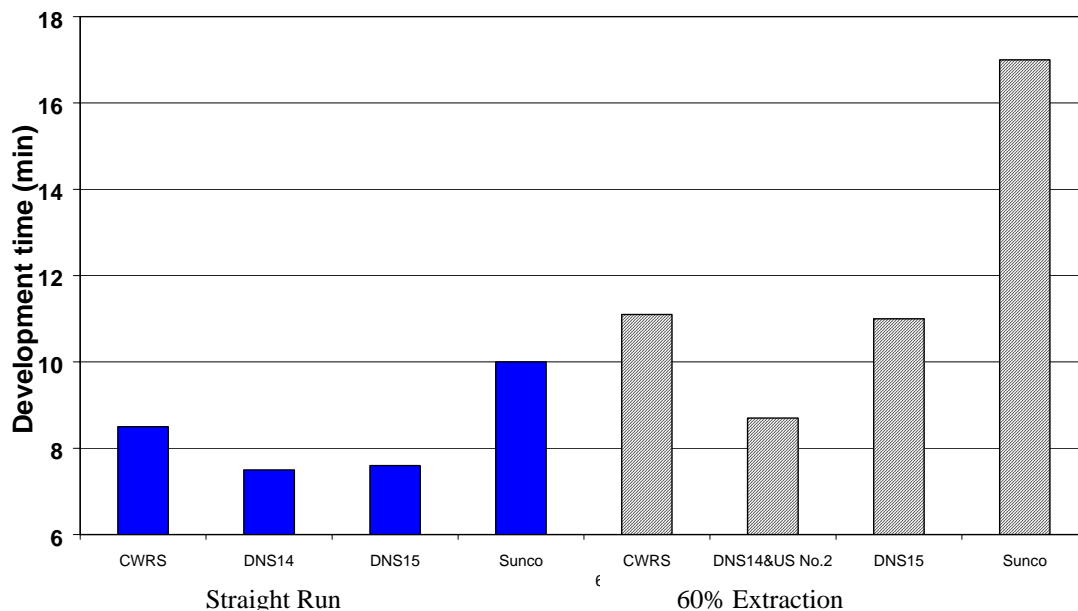
Farinograph Water Absorption:

Sunco had a significantly lower Farinograph water absorption than the north American samples. The value measured for this sample of Kennedy is particularly high.



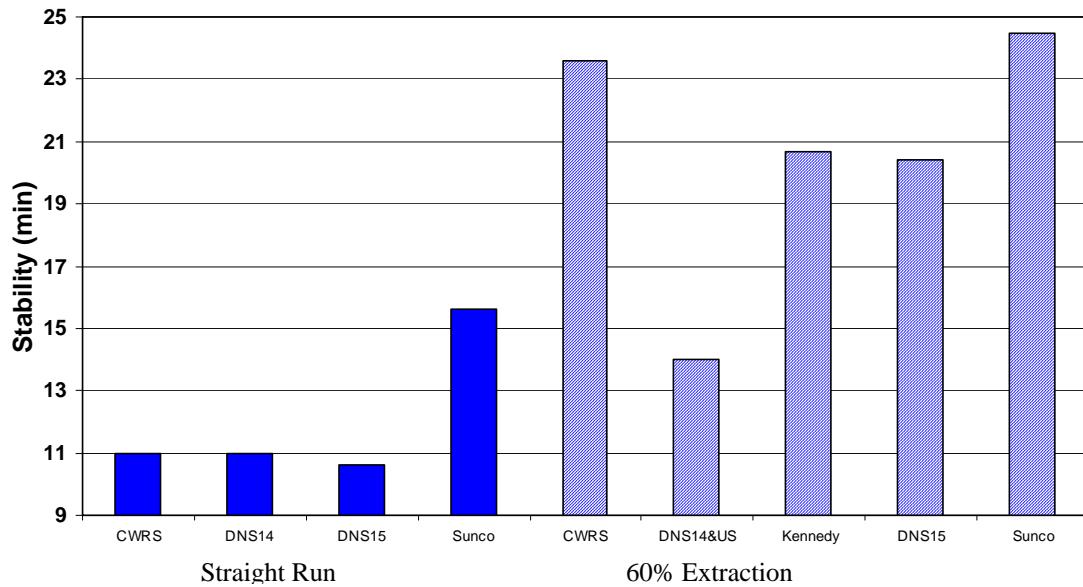
Farinograph Development Time

Farinograph development times were higher for the 60% extraction samples. At each extraction rate Sunco had the highest development time.



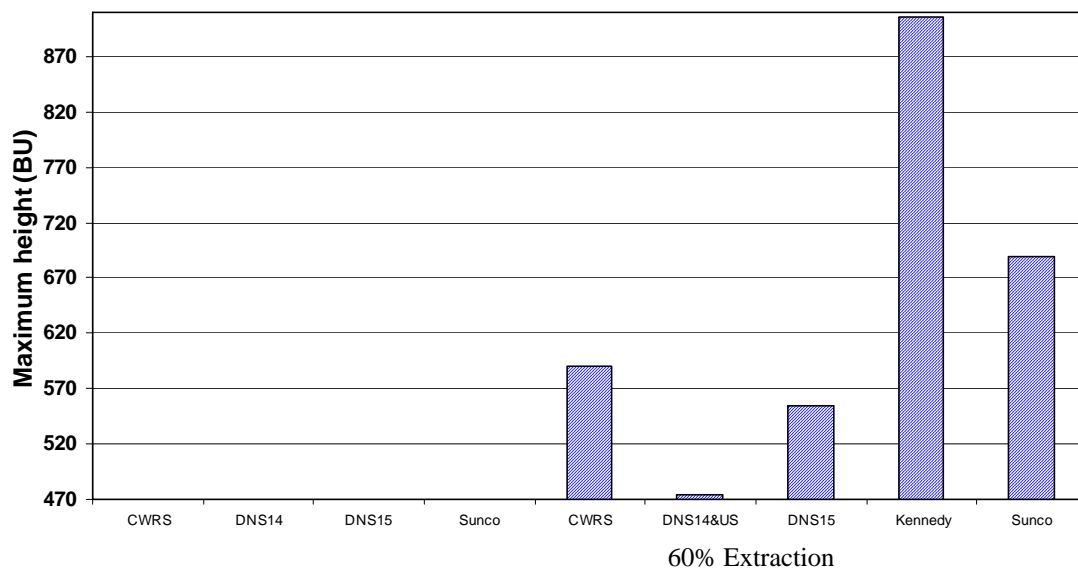
Farinograph Dough Stability

Dough stability values were significantly higher at the 60% extraction rate. At both extraction rates Sunco had the highest dough stability values.



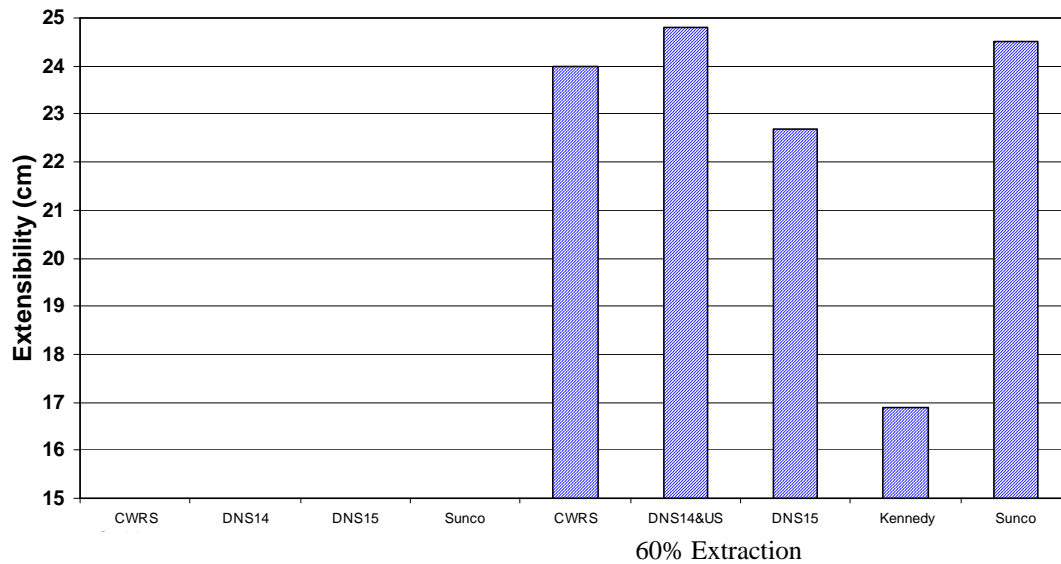
Extensograph Rmax:

Due to sample size we did not complete extensographs on the straight run flour samples. This test was carried out on the 60% extraction samples as these were used for baking. The Sunco sample had higher dough strength than the north American samples. This was consistent with the dough strength indicators of Farinograph stability and development time. The sample of Kennedy was extremely strong.



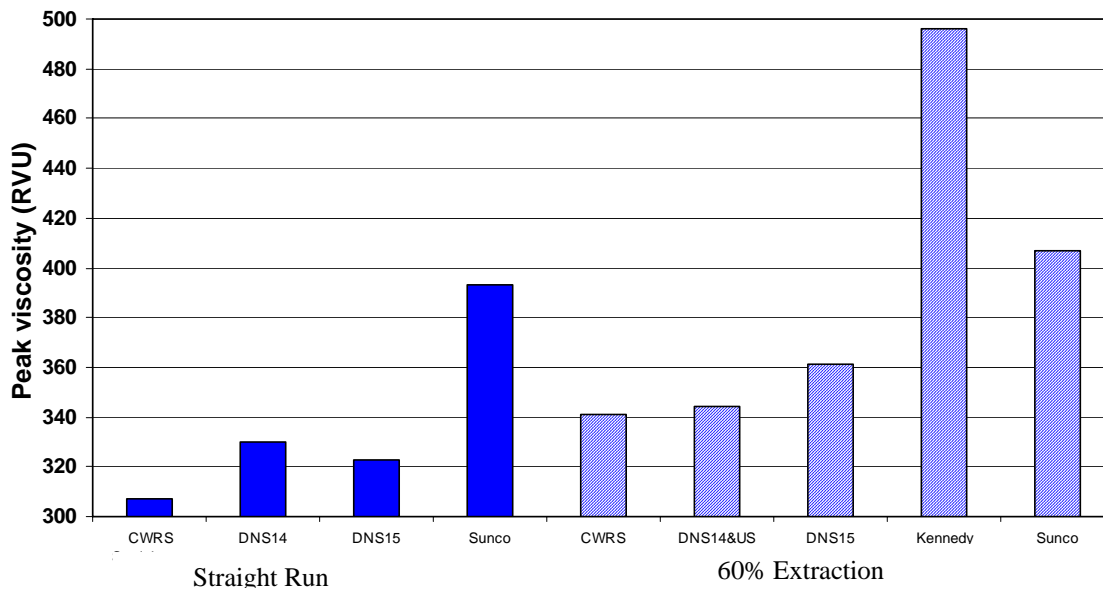
Extensograph extensibility

At the highest protein content the DNS 15 had the lowest extensibility. Sunco clearly had the highest extensibility per unit of protein.



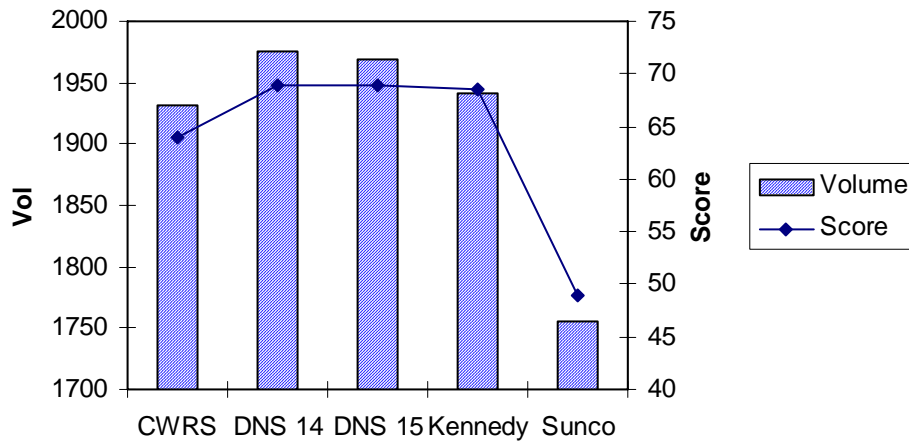
RVA peak viscosity

The 60% extraction flours had marginally higher RVA peak viscosity. Sunco had higher RVA viscosity than the north American samples, yet by Australian standards Sunco is not considered to have high starch pasting properties. Kennedy had significantly higher RVA peak viscosity.



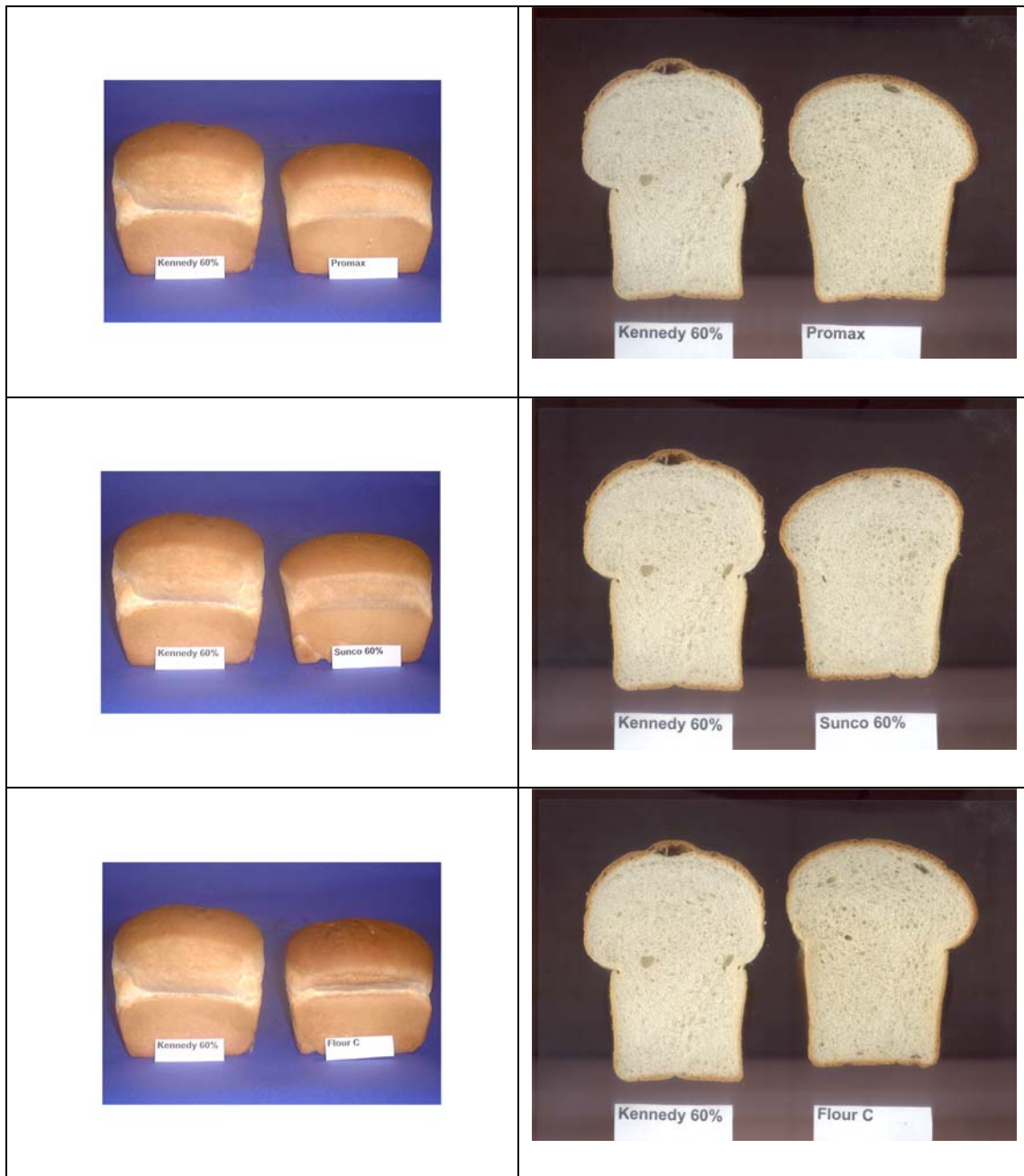
Sponge and Dough Baking

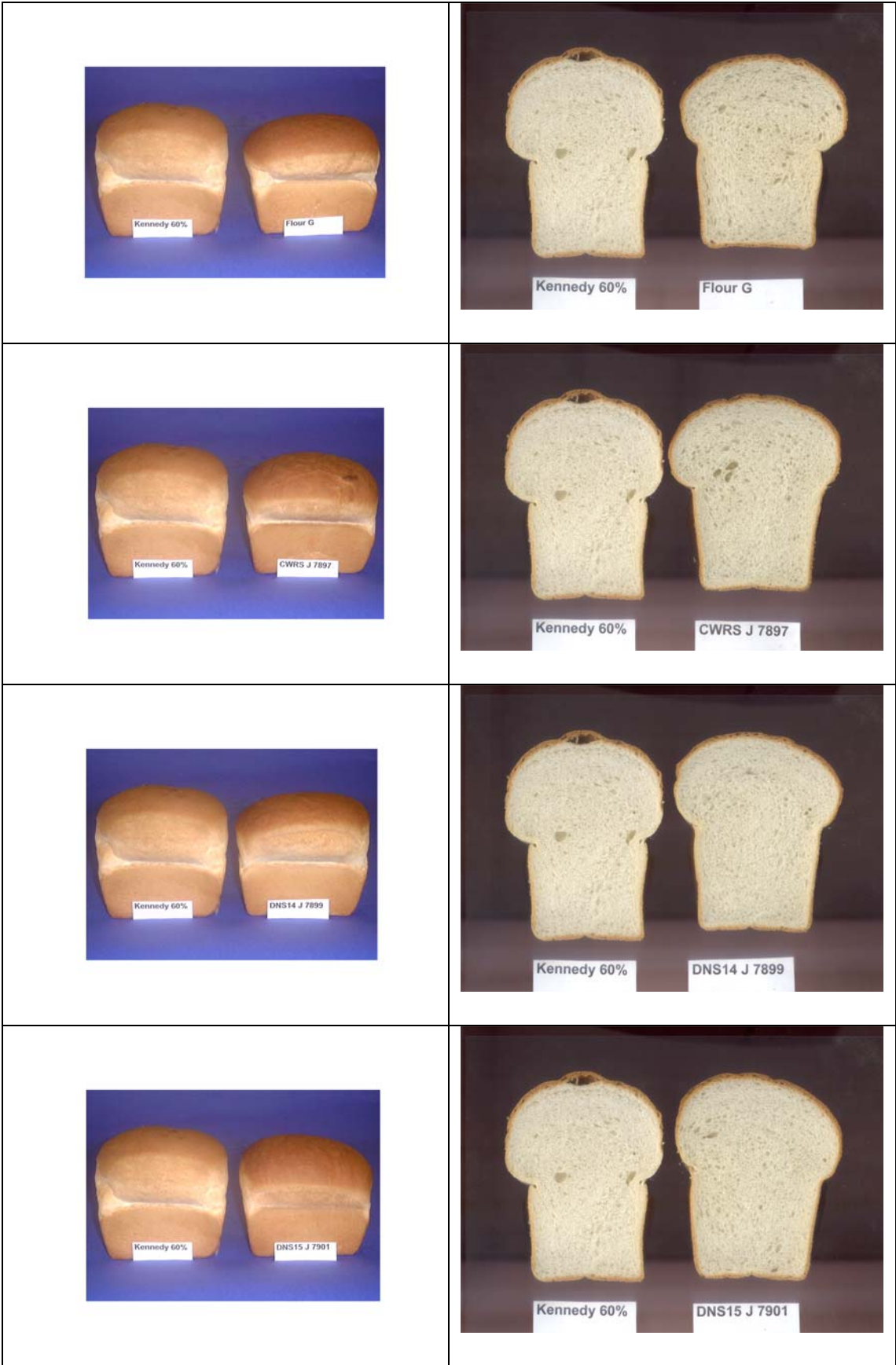
The north American samples produced significantly higher bake scores and loaf volumes compared to this sample of Sunco. The sample of Kennedy was marginally lower than the DNS samples and similar to the CWRS.

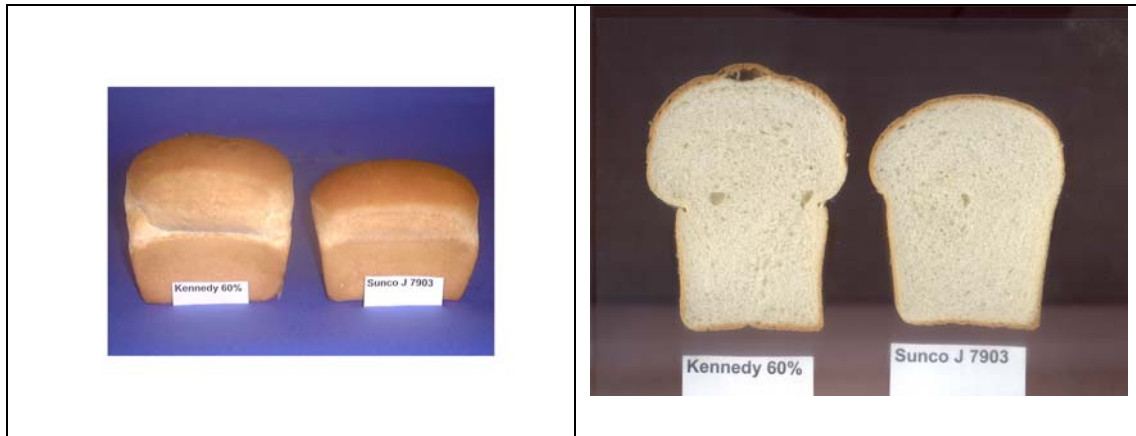


Photographs

Photographs of the bread are provided in the following pages







North American Wheats - Sponge & dough process- Straight run flours

	CWRS	DNS14	DNS15	Sunco
	J7896	J7898	J7900	J7902
Wheat				
Test weight (kg/hl)	73.5	82.0	81.1	82.9
Thousand kernel weight (g)	35.2	33.3	31.5	32.8
Grain hardness (PSI)	15	12	13	16
Protein (% , N x 5.7)	15	14.4	15.1	13.2
SKCS (Hardness)	68.5	71.5	69.2	
Flour extraction (%)	81.6	78.0	78.7	80.7
Flour				
Protein (% , N x 5.7)				
14% moisture basis	14.3	13.5	14.3	12.8
Starch damage (%)	6.4	6.6	6.2	5.2
Ash (%)				
14% moisture basis	0.70	0.65	0.66	0.57
Colour grade	4.5	2.2	2.2	-0.1
Minolta - L	89.98	90.81	90.73	91.49
- a	-0.11	0.06	0.17	0.2
- b	10.03	9.70	10.03	8.95
- L-b	79.95	81.11	80.7	82.54
Farinograph				
- water absorption (%)	63.8	64.8	65.2	61.3
- development time (min)	8.5	7.5	7.6	10.0
- stability (min)	11.0	11.0	10.6	15.6
Extensograph				
- extensibility (cm)	N/A	N/A	N/A	N/A
- maximum height (BU)	N/A	N/A	N/A	N/A
RVA				
-peak viscosity (RVU)	307	330	323	393

Comments

The test weight of the CWRS was quite low, however the TKW was the highest of the samples with DNS 15 displaying the smallest grain size. Sunco was the softest and DNS 14 the hardest sample, this was also reflected in the starch damage results. The ash content of Sunco was significantly lower than for the CWRS and DNS samples, this was also reflected in the colour grade. On the Minolta, Sunco produced brighter and whiter flour. Sunco had the lowest water absorption, and highest development time and stability.

North American Wheats - Sponge & dough process- 60% extraction flours

	CWRS	DNS14	DNS15	Sunco
	J7897	J7899	J7901	J7903
Wheat				
Test weight (kg/hl)	73.5	82.3	81.1	82.9
Thousand kernel weight (g)	35.2	32.3	31.5	32.8
Grain hardness (PSI)	15	13	13	16
Protein (% , N x 5.7)	15.0	14.4	15.1	13.2
SKCS (Hardness	68.5	71.5	69.9	
Flour extraction (%)	60	60	60	60
Flour				
Protein (% , N x 5.7)				
14% moisture basis	14.1	13.1	13.8	12.0
Starch damage (%)	6.1	6.2	6.1	4.9
Ash (%)				
14% moisture basis	0.48	0.46	0.43	0.42
Colour grade	0.7	0.0	-0.2	-2.4
Minolta - L	90.96	91.75	91.89	92.48
- a	-0.31	-0.13	-0.04	0.05
- b	9.96	9.71	9.62	8.25
- L-b	81.00	82.04	82.29	84.23
Farinograph				
- water absorption (%)	63.4	64.4	64.2	62.8
- development time (min)	11.1	8.7	11.0	17.0
- stability (min)	23.6	14.0	20.4	24.5
Extensograph				
- extensibility (cm)	24.0	24.8	22.7	24.5
- maximum height (BU)	590	475	555	690
RVA				
-peak viscosity (RVU)	341	344	361	407

Comments

The protein content of the CWRS and DNS samples was at least 1.2% higher than for Sunco. The grain was harder and at an identical extraction rate CWRS had the highest ash. The CWRS and DNS had significantly higher colour grade values than the Sunco sample. Colour measured on the Minolta indicated that the Sunco sample was brighter and whiter.

The sample of Sunco had the lowest water absorption but the longest development time. It also had the highest dough strength. Note that when milled to straight run extraction the Sunco Rmax was 515BU.

North American Wheats - Sponge & dough process - 60% extraction flours

	CWRS J7897	DNS14 & US No. 2 J7899	DNS15 J7901	Kennedy	Sunco J7903
Sponge and Dough bread					
Water addition (%)	160	160	160	160	120
Mixing time (sec)	180	220	220	270	240
Sponge height (cm)	8.5	10.5	10.5	6.5	8
Proof time (min)	45	47	46	52	52
Average volume (cc)	1931	1975	1969	1942	1756
Total score /100	64	69	69	69	49

Comments

The baking results of the DNS samples were clearly superior and these were considered very good scores. This sample of Kennedy has consistently produced sponge and dough bread of a very high standard.

Of interest in these results is the sponge height, which is the height of the sponge after fermentation. The DNS samples produce a high sponge height, which appears to be consistent with the better “flow or softness” of these doughs. We also note that both Australian samples required longer proof times. This could be due to different fermentation rates or the ease of dough expansion in the prover. It is considered that the Sunco and Kennedy samples have very strong doughs that might restrict expansion and therefore require a longer proof. This may also be consistent with the lower sponge height values. What this indicates is that strength alone is not enough for good sponge and dough performance. There is also a dough flow property that is not expressed by extensibility, as the DNS samples were no more extensible than the Sunco (although clearly more extensible than Kennedy). It is possible that it is a balance between strength and extensibility or there is another measure/factor we are not effectively measuring.

Further investigation is required and additional North American samples will assist.