



QUALITY WHEAT CRC PROJECT REPORT

Program 3a Processing of Wheat and Wheat products

Project 3.1.3

Pilot Milling Studies

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BRI Australia

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Pilot Milling Studies

2001

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EXECUTIVE SUMMARY

Samples:

Samples pilot milled in the 2001 Pilot Milling Studies Program included six varieties: Sunco, Strzelecki, Yitpi, Chara, H45 and Thornbill. Straight run flour was collected from all samples, 60% extraction flours from Sunco, Strzelecki, Chara and Thornbill and 82% extraction flours from Yitpi. All flour samples were distributed to the CRC partners who requested samples. Flour and wheat quality data was supplied by the Flour Millers Council of Victoria and BRI Australia and end product quality data by Goodman Fielder and Westons.

Wheat Quality Data:

Thornbill had the highest Test Weight while Yitpi had the greatest Thousand Kernel Weight. There were two samples with protein contents greater than 13%, one sample with less than 10% protein and the remaining samples were greater than 10%. The Thornbill sample had the softest grain as measured by the Particle Size Index.

Milling Quality Data:

The high Test Weight of Sunco was associated with this sample having one of the highest flour extraction rates. It is interesting to note that Strzelecki which had one of the highest extraction rates but lowest Test Weights. The soft wheat sample Thornbill released more flour from 2nd bk and and less from A and B rolls than the other samples. Thornbill and interestingly Chara produced less flour on D roll than the other samples.

Flour Quality Data:

Flour ash was significantly higher for Strzelecki flour than the other samples. Strzelecki also had the greatest amount of starch damage as expected for its relatively low PSI value. For this sample set Farinograph water absorption correlated relatively closely with starch damage and flour protein content but not with PSI. Strzelecki stood out again having the highest water absorption followed by H45. Dough Development Time was longest for Chara and Sunco and reflected the high dough strength and good extensibility particularly for Chara. The greatest dough strength and extensibility was found associated with the Chara sample making it very attractive for US style Sponge and Dough bread making.

End Product Quality:

Chara was found to be too tough in industry bake tests. Chara, Yitpi and H45 had good average loaf volume and brighter crumb colour compared with the controls. Sunco had excellent oven spring, loaf volume and colour. Strzelecki and Yitpi produced the softest loaves.

Pilot Milling Studies 2001 Report

Pilot Mill Samples 2001:

The samples milled on the BRI Pilot Mill during 2001 are summarised below:

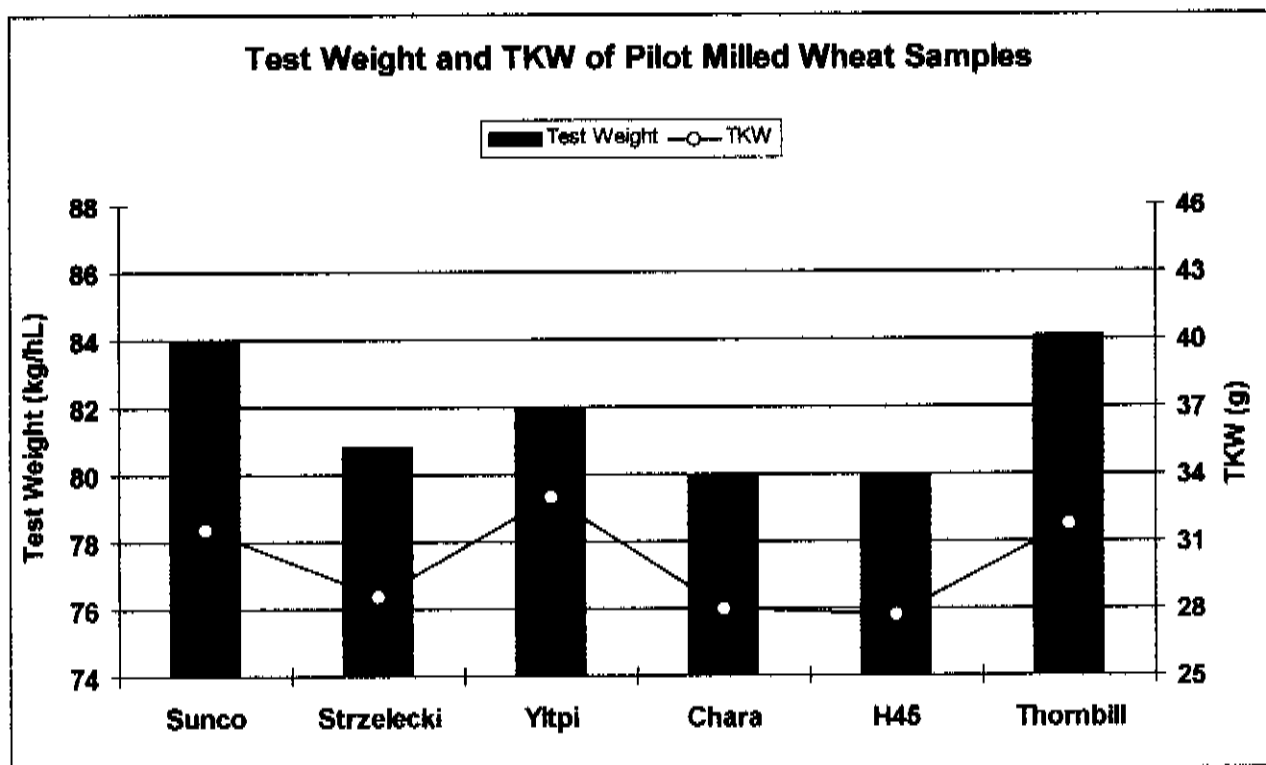
NSW	Victoria	Qld	SA	WA
Chara		Sunco	Yitpi	
H45		Strzelecki		
Thornbill				

Wheat Quality Data:

1. Test Weight and Thousand Kernel Weight:

The Test Weights and Thousand Kernel Weights of the Pilot Milled samples are shown in Fig. 1. All samples tested had a Test Weight greater or equal to 80 kg/hL and a Thousand Kernel Weight greater than 27 g. The range for Test Weight was from 80.0 kg/hL for Chara and H45 to 84.1 kg/hL for Thornbill. Thousand Kernel Weights ranged from 27.7 g for H45 to 33.0 g for Yitpi. Generally, the samples had high Test weights but were on the light side for Thousand Kernel Weight indicating that the smaller grains were packing closely together in the chondrometer.

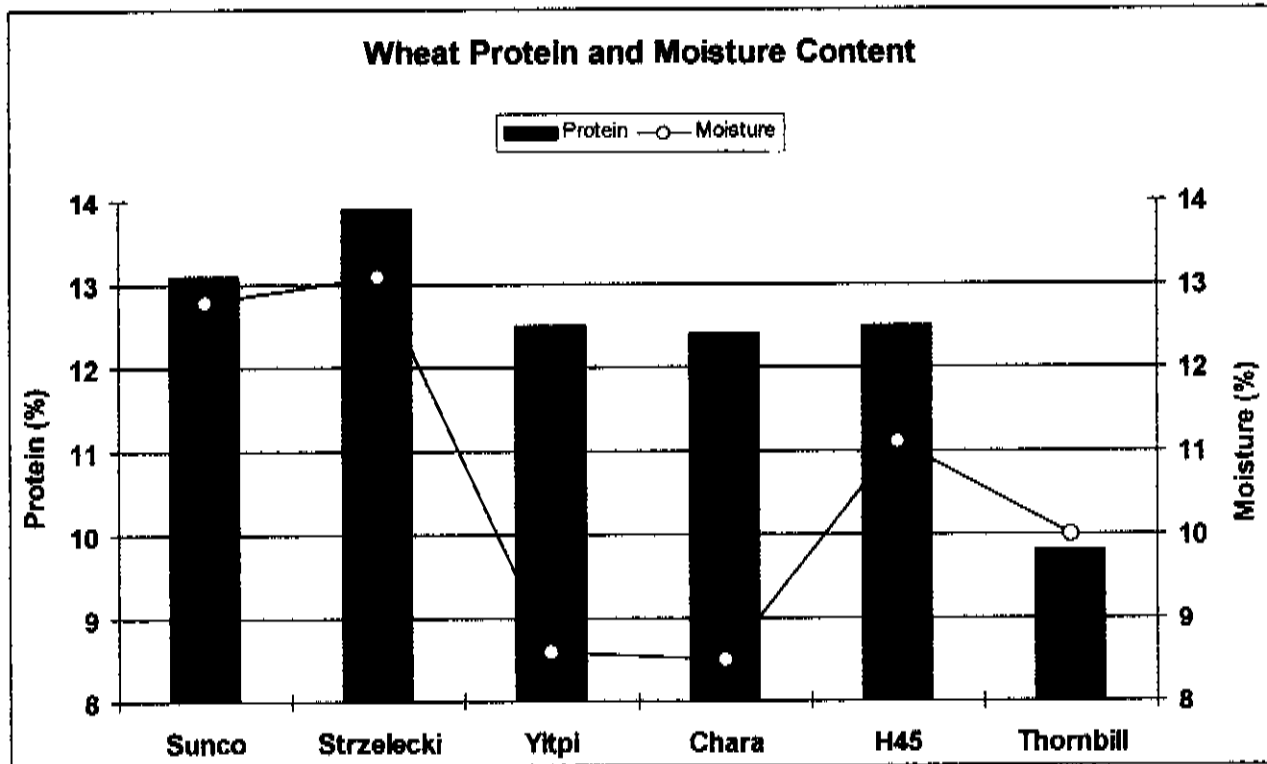
Fig. 1



2. Wheat Protein Content

Infratec NIR wheat protein values (Fig. 2) indicated that there were two samples with protein contents greater than 13% i.e. Prime Hard category (Sunco and Strzelecki), three samples with protein contents above 11.5% i.e. Australian Hard category (Yitpi, Chara and H45). The soft wheat sample shown in Figure 2 had the lowest protein content as expected with the Thornbill sample at 9.8% protein.

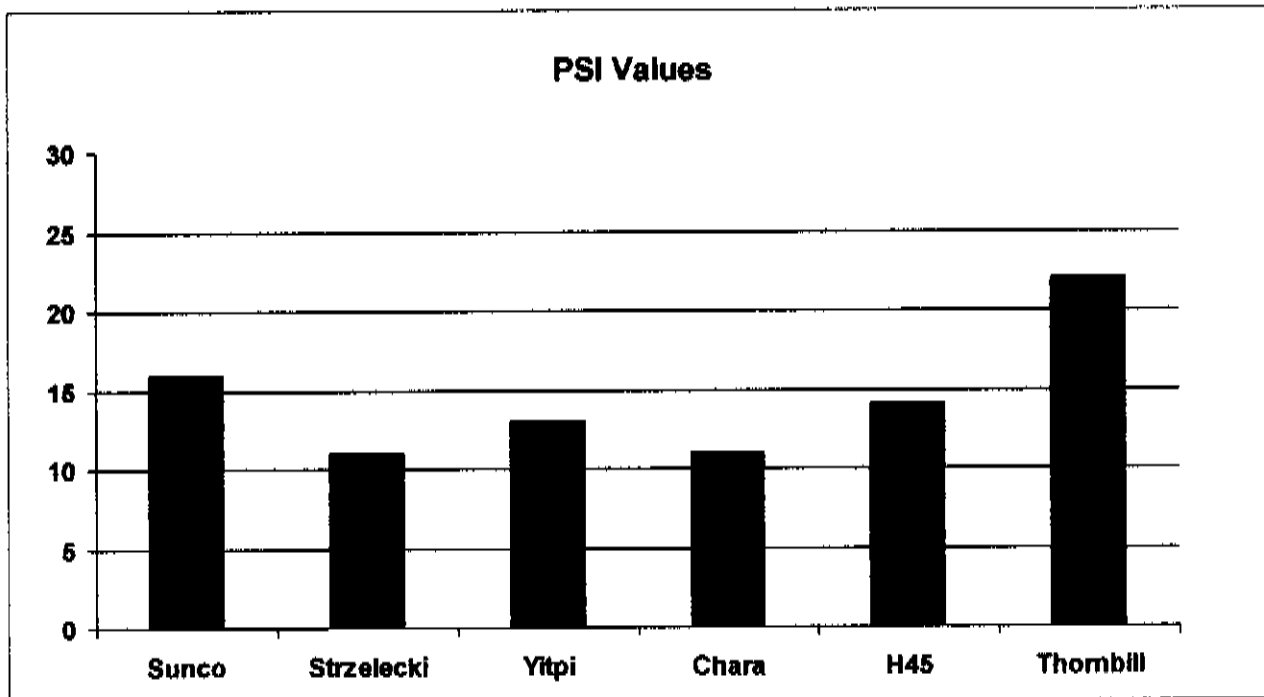
Fig. 2



3. Kernel Hardness

Grain Hardness was measured by the Particle Size Index (PSI) method. The hardest samples are those with the lowest values while the softest samples have the higher values. Typically, hard Australian milling wheat samples will have PSI values ranging from 10 to 18 as for Sunco, Strzelecki, Yitpi, Chara and H45 while soft wheats such as Thornbill will have values greater than 20 (Fig. 3).

Fig. 3

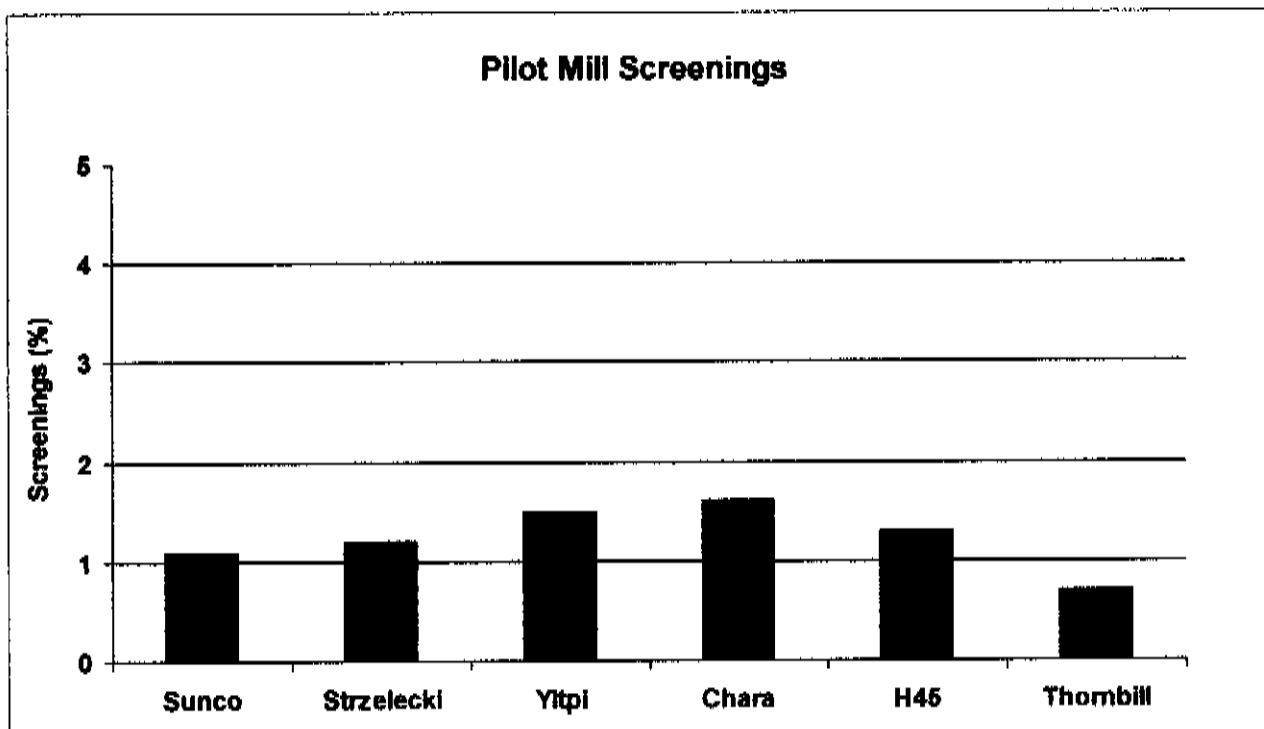


Milling Quality Data:

4. Screenings

All samples tested had less than 5% screenings as measured by the Pilot Mill screenroom. These samples were quite low in screenings. Chara, which had one of the lowest Thousand Kernel Weights had the highest level of screenings, whereas Thornbill with one of the greatest Thousand Kernel Weights had the least amount of screenings.

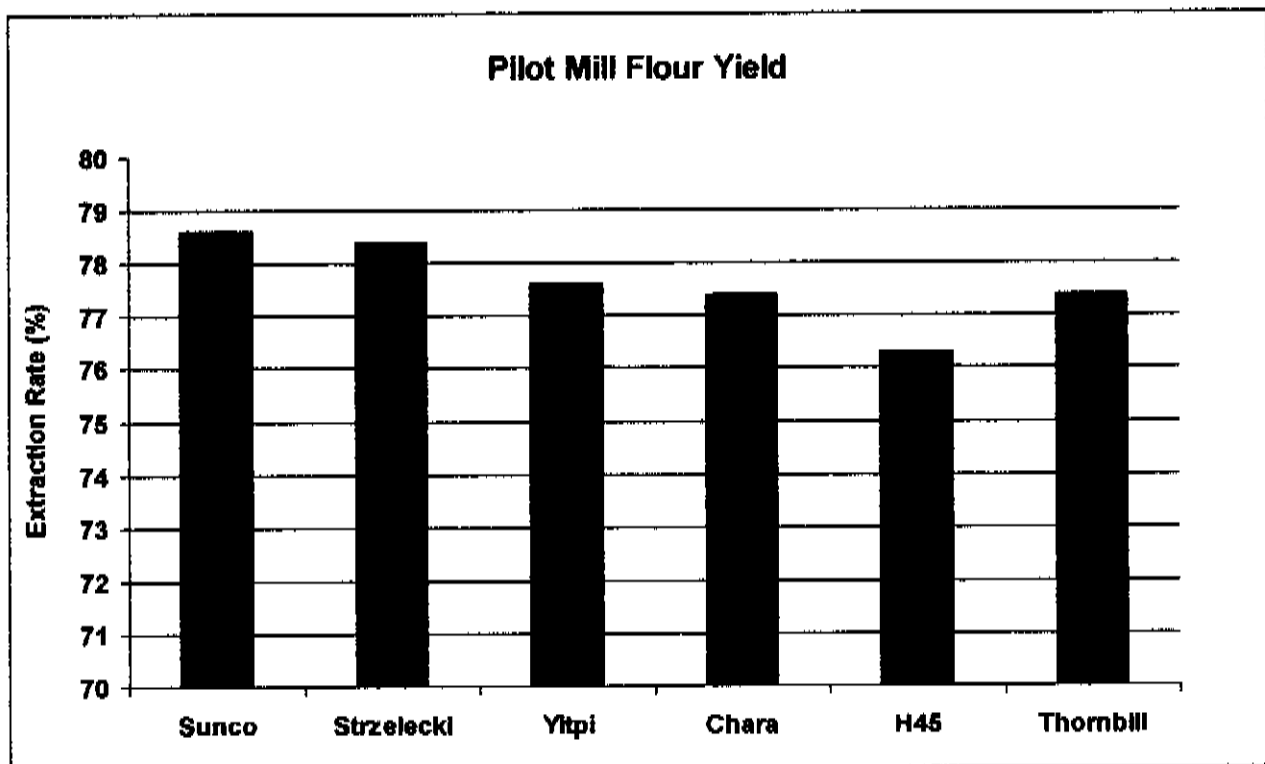
Fig. 4



5. Extraction Rate

Flour yields ranged from 76.3% for H45 to 78.6% for Sunco (Fig. 5). The correlation of flour yield with Test Weight was low ($r^2 = 0.22$) as it was for Thousand Kernel Weight ($r^2 = 0.14$) although the samples with a combination of relatively high Test Weight and relatively high Thousand Kernel Weight also had high Flour Yields (see Sunco and Thornbill).

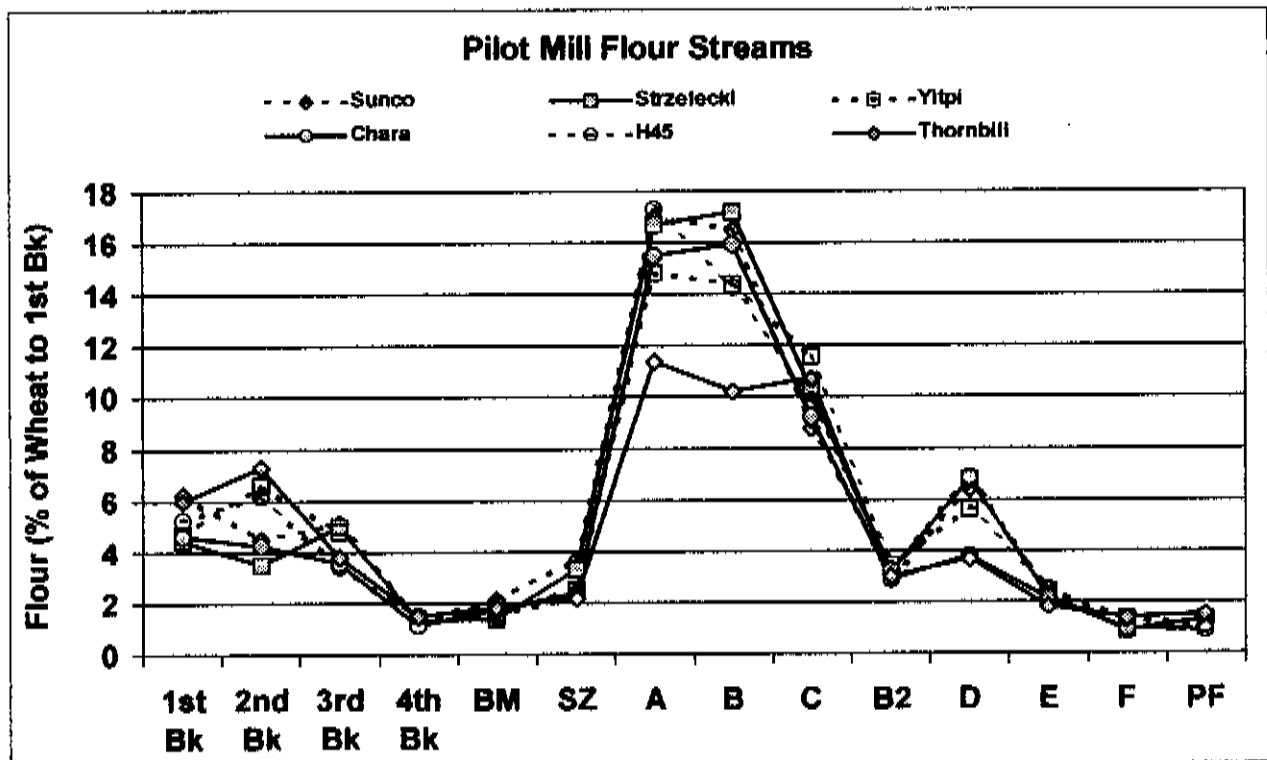
Fig. 5



6. Mill Streams

The **Pilot Mill Flour Streams** are summarised in Fig. 6. The soft wheat Thornbill released more flour from 1st bk and 2nd bk rolls than the other samples. This was accompanied by a much lower quantity of flour produced on the head reduction rolls, A and B, compared with the other samples which produced significantly more flour on A and B rolls. Interestingly, Strzelecki and Chara which had the hardest endosperm as measured by Particle Size Index also produced the least flour on 1st break roll. Therefore, as expected, grain hardness appears to influence milling quality and stock quantities. Sunco which had the highest flour yield produced less flour on the break passage and generally more flour on A, B and D rolls compared with the other samples. This appears to be a feature of good quality milling wheat which maximises semolina production on the break passages and therefore flour production on the reduction passages to provide cleaner flour and higher yield.

Fig. 6

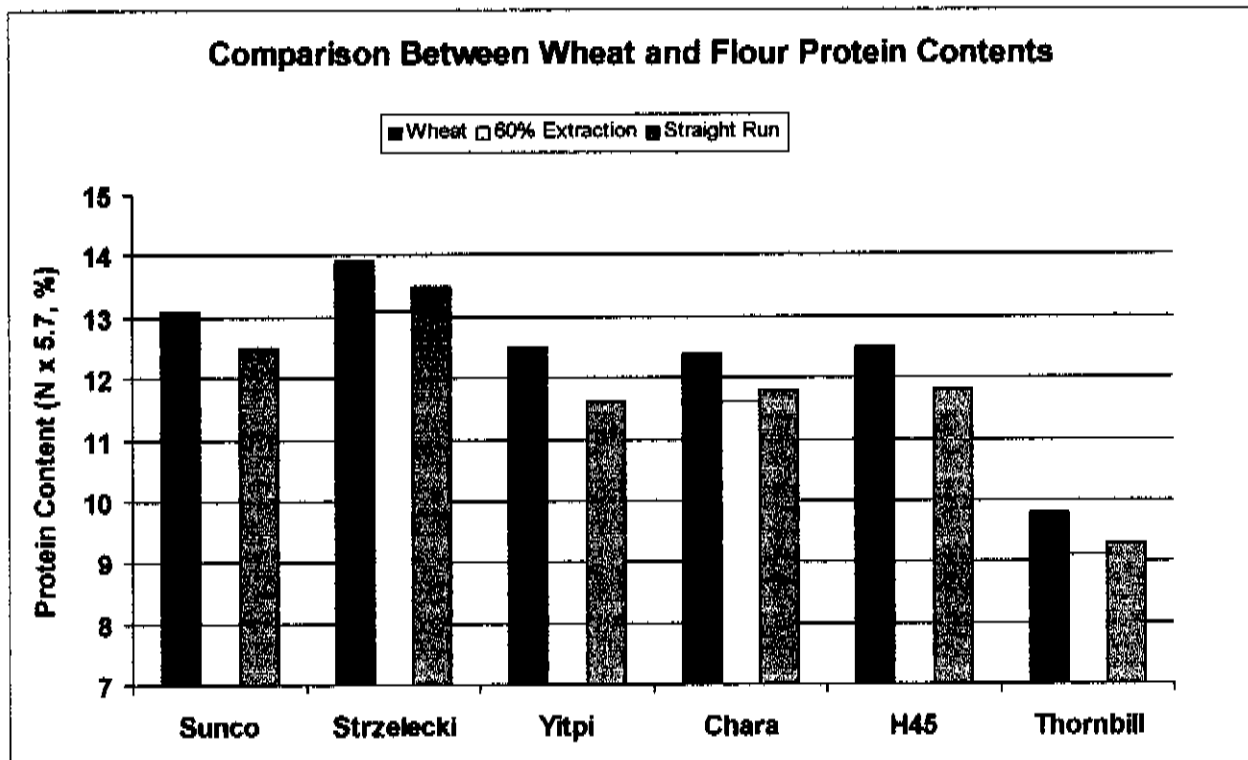


Flour Quality Data:

7. Flour Protein Content

The protein content of wheat, 60% extraction flour and straight run flour as measured by Kjeldahl analysis is summarised in Fig. 7. The protein loss range after milling was 0.4% for Strzelecki to 0.9% for Yitpi. As expected the 60% extraction flours had slightly lower protein contents than the straight run flours. The 60% extraction flour protein contents were 0.2% to 0.4% below the straight run extraction flours.

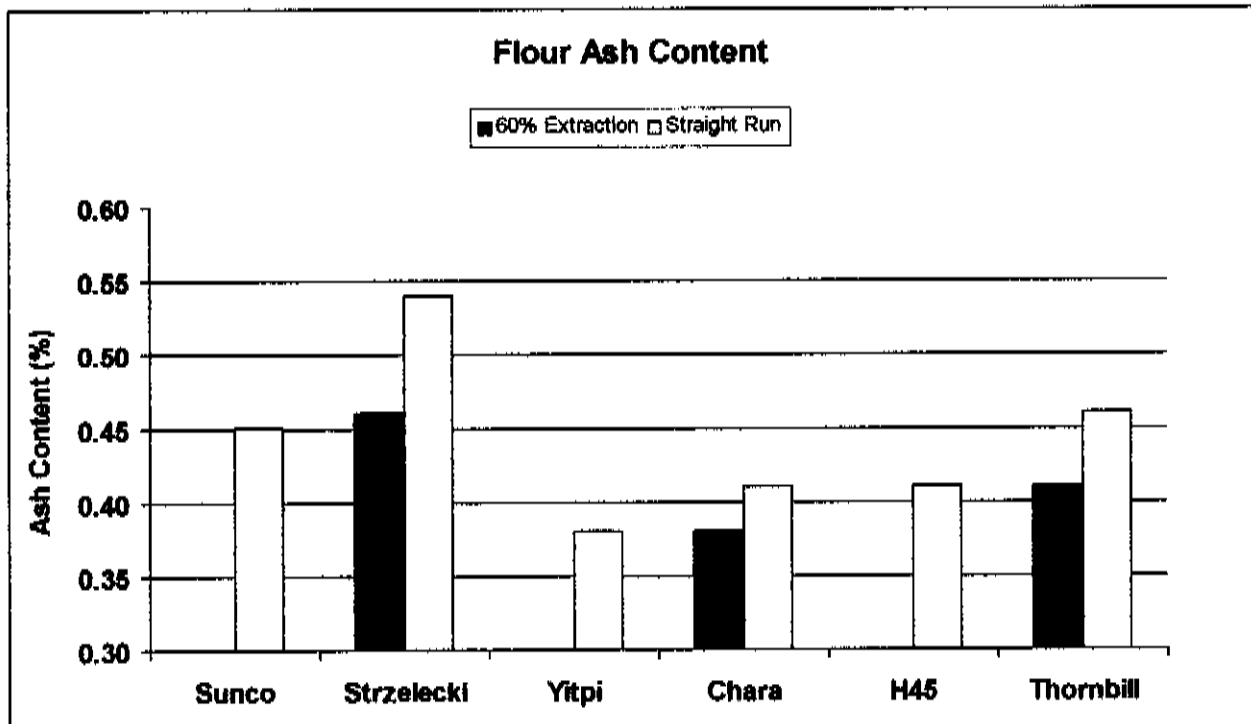
Fig. 7



8. Flour Ash Content

Flour ash content varied from 0.38% for Yitpi to 0.54% for Strzelecki (Fig. 8). Similar to protein content, the 60% extraction flours had a lower ash content than their equivalent straight run flours. The difference in ash content between straight run and 60% extraction flours ranged from 0.03% for Chara to 0.08% for Strzelecki.

Fig. 8



9. Starch Damage

Starch Damage was least for the soft wheat Thornbill 60% extraction flour (Fig. 9) and greatest for straight run extraction Strzelecki. There was good correlation between Starch Damage and PSI (Fig. 10, $r^2 = 0.82$).

Fig. 9

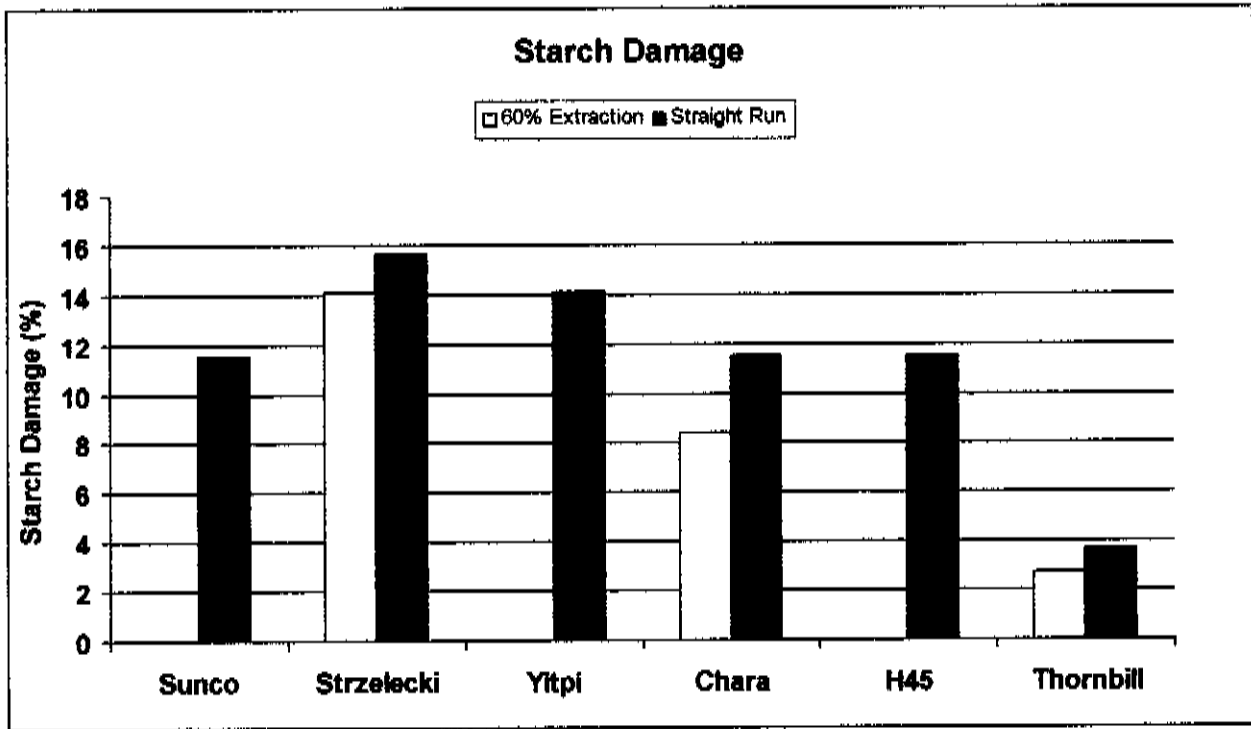
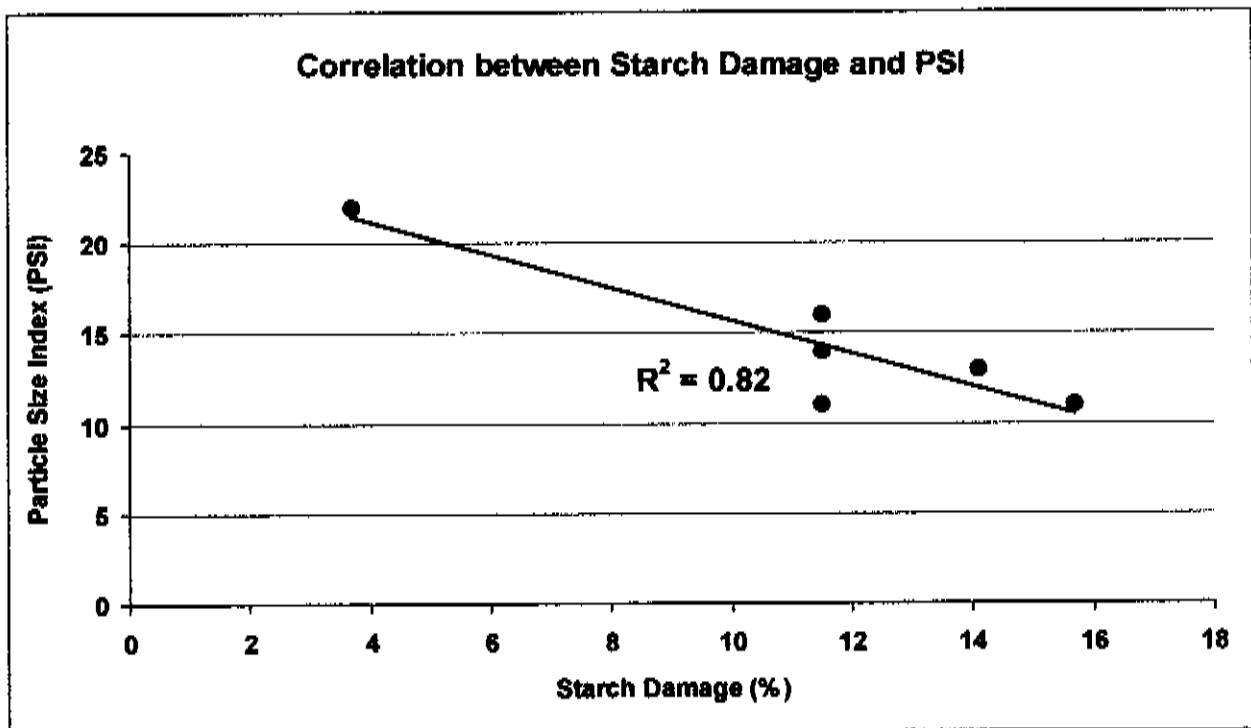


Fig. 10

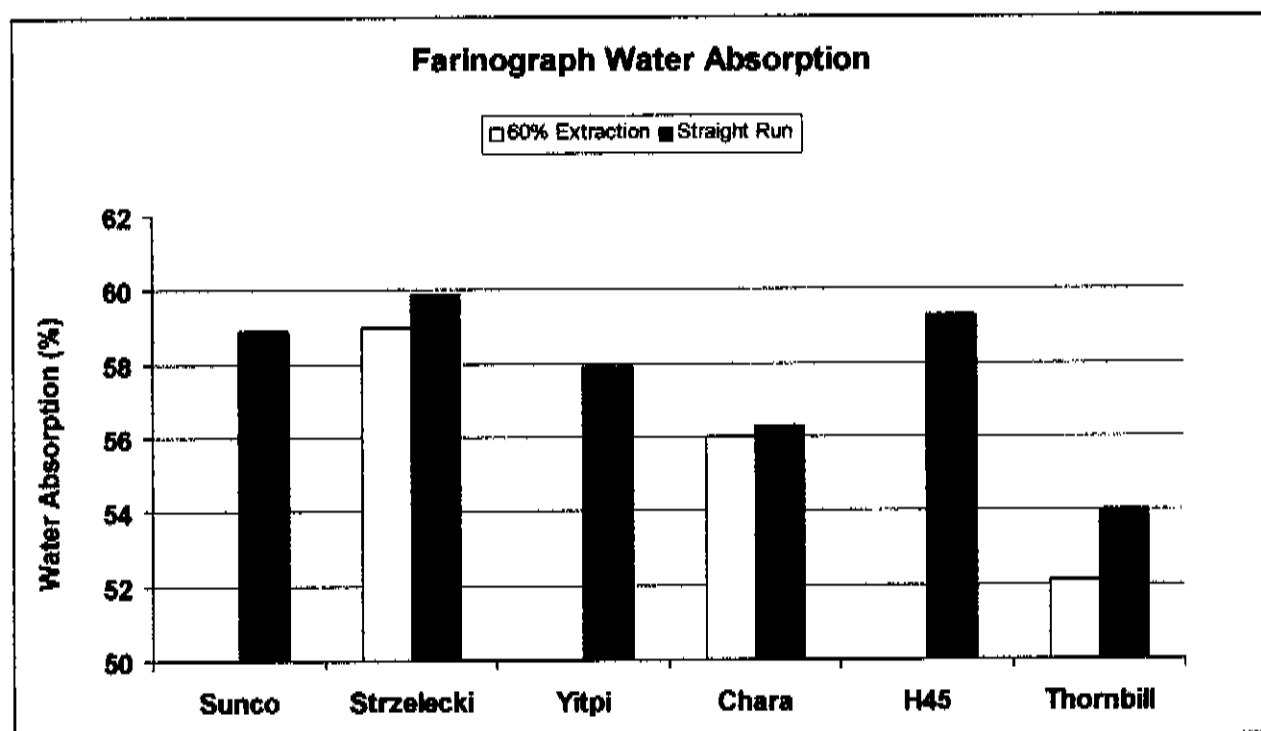


Rheology Data:

10. Farinograph

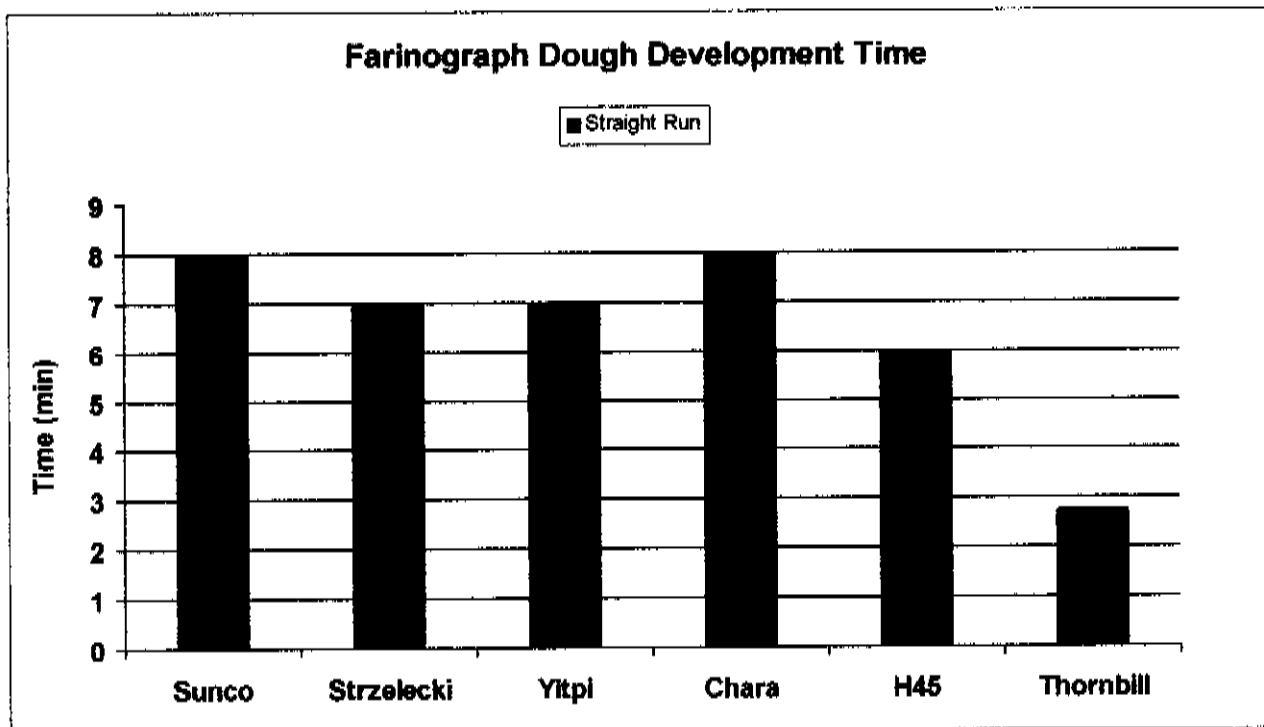
Fig. 11 shows the wide range of **Farinograph Water Absorption** values measured for these samples. Values ranged from 52.1% for 60% extraction Thornbill flour to 59.9% for straight run Strzelecki flour. Generally, water absorption was higher for straight run flours than for 60% extraction flours. These results reflect the effect of bran on water absorption. As flour yield is increased, the quantity of bran increases as does the amount of starch damage and higher water absorption values result. The correlation of water absorption with starch damage was reasonably good ($r^2 = 0.72$) as with flour protein content ($r^2 = 0.80$). Correlation of water absorption with PSI grain hardness was much lower ($r^2 = 0.43$). These results indicate that protein, starch damage and to an extent grain hardness all contribute to water absorption.

Fig. 11



Dough Development Time ranged from 2.8 mins for straight run Thornbill flour to 8.0 min for Straight run Sunco and Chara (Fig. 12). Most of these samples had suitable dough development times for the domestic industry. There was a reasonably good correlation between dough development time and protein content for these samples ($r^2 = 0.67$).

Fig. 12



11. Extensograph

Fig. 13

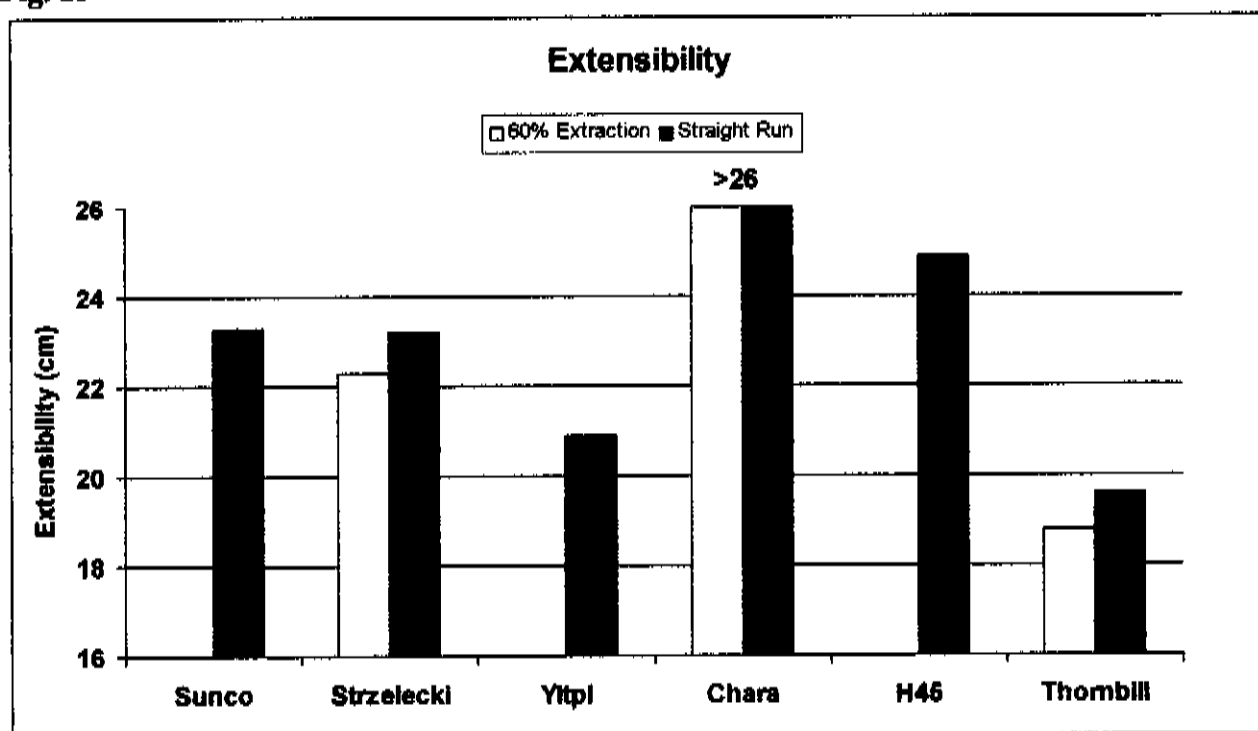
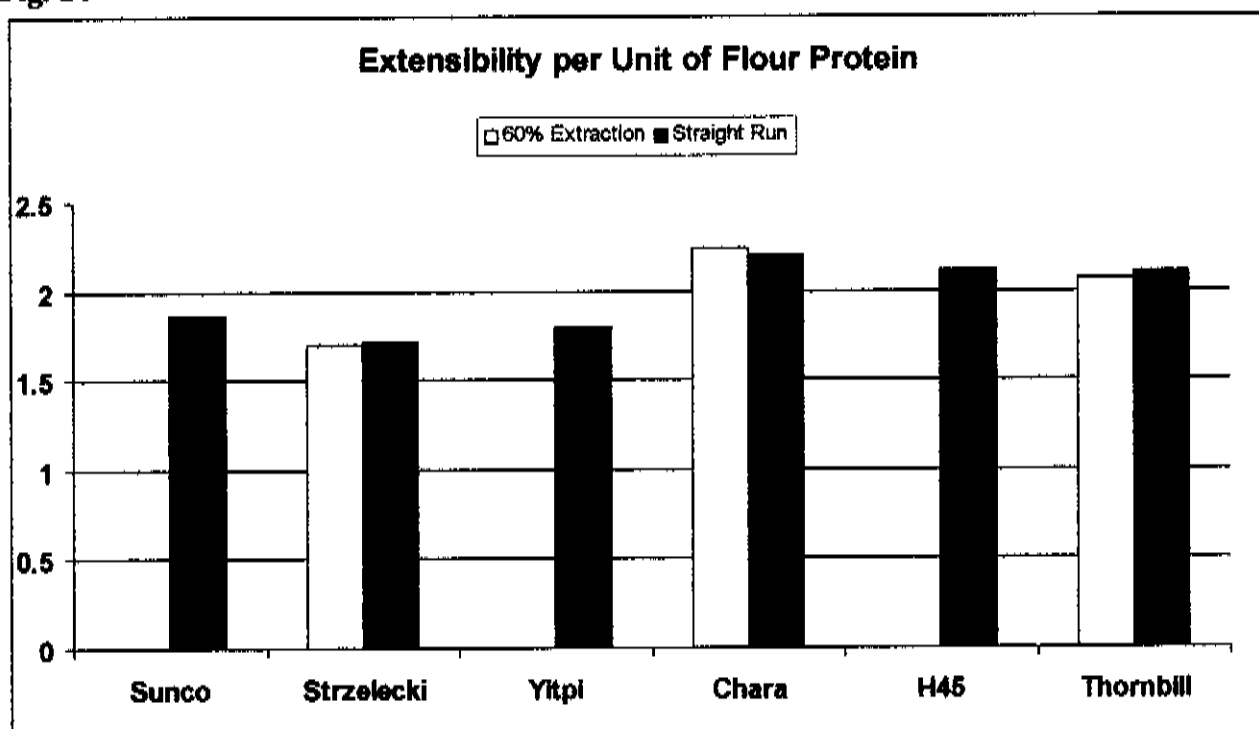
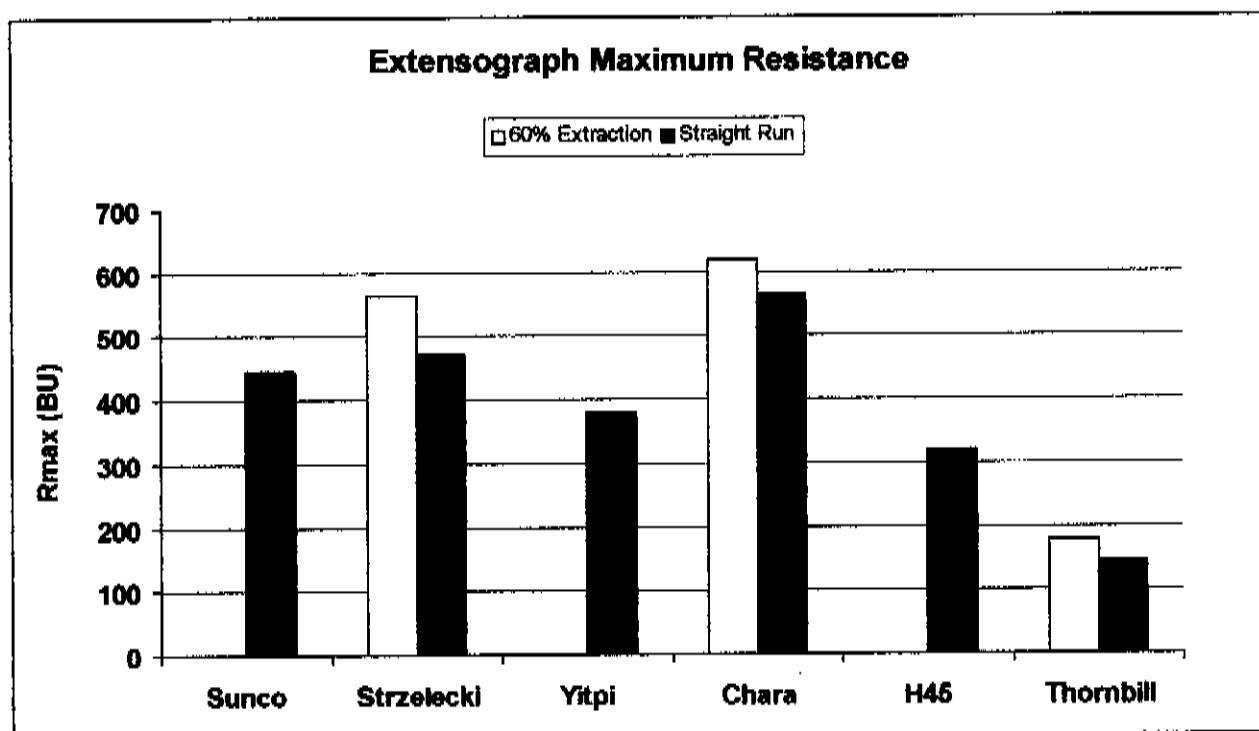


Fig. 14



Extensibility ranged from 18.8 cm for 60% extraction Thornbill flour to >26 cm for both 60% extraction and straight run Chara. Because protein content influences extensibility, the same samples were graphed showing the extensibility per unit of protein (Fig. 13). Chara, H45 and Thornbill appear to be the most extensible when expressed on a constant protein content basis.

Fig. 15



Strzelecki and Chara had high dough strength (>500 BU) for their respective straight run flours when measured as Extensograph **Maximum Resistance** (Fig. 15). High dough strength and good extensibility were a feature for Chara. The correlation of Rmax with flour protein content was moderate ($r^2 = 0.61$) indicating that dough strength is a co-function of protein quality (glutenin polymer size etc.) as well as protein quantity although the environment can have a large influence on dough strength.

**FLOUR MILLERS COUNCIL OF VICTORIA
WHEAT TECHNICAL COMMITTEE
TEST MILLING**

#	102	103	104
DATE	22/03/01	22/03/01	22/03/01
Variety	H45	YITPI	CHARA
Source	FMCV	FMCV	FMCV
<u>Grain Quality</u>			
Wheat Protein (%)	12.5	12.8	12.5
Wheat Moisture (%)	10.8	9.5	9.2
FN (secs)	508	548	408
UM (%)	4.8	2.0	4.8
Kg/HI	81.0	83.5	82.3
TKW (g)	28	36	29
Milling Extraction (%)	65.1	67.2	67.3
<u>Flour Quality</u>			
Flour Protein (%)	11.1	10.7	11.2
Flour moisture (%)	14.7	14.6	14.3
Ash (%)	0.42	0.34	0.38
Minolta L-b	84.1	84.3	83.1
Water Abs %	63.4	61.7	60.8
Dev Time (mins)	9.5	> 20	9.0
MTI (BU)	0	0	0
E1 (cm)	27.8	24.0	26.3
H1 (BU)	331	483	571
RVA Peak Visc (cP)	4108	4328	3476
<u>Test Bake</u>			
Water Addn (%)	61.0	59.0	59.5
Mixing time (mins)	8:20	9:30	10:00
Bake Volume (cm)	18.0	17.5	16.8
Appearance (x/10)	8.5	7.0	6.5
Texture (x/10)	6.5	9.0	8.0
Loaf score	33.0	33.5	31.3
<u>COMMENTS</u>			
Grain Quality:	Good	Good	Good
Milling Quality:	Good	High protein drop	Good
Flour Quality:	OK	OK	OK
Mixing Requirements:	High	Excessive	High
Strength:	High	V. High	V. High
Extensibility:	Good	Good	Good
Baking Quality:	Good	Good	Poor
Other Comments:			

WHEAT QUALITY ASSESSMENT
FLOUR MILLERS COUNCIL OF VICTORIA
WHEAT TECHNICAL COMMITTEE
BRI Pilot Milled Flours for CRC 2001

VARIETY : **THORNBILL**
 (M5635)

Sample Source: Unknown

LABORATORY	Lab A	Lab B	Lab C
GRAIN QUALITY			
Protein (%)			
Moisture (%)			
Test Weight (Kg/hi)			
Falling No. (sec)			
Extraction (%)			
FLOUR QUALITY			
Protein Nx5.7 (%)	9.0	8.7	9.1
Moisture (%)	13.0	13.6	13.1
Colour Grade L		92.9	
Colour Grade b		8.1	
Colour Grade (L-b)	84.1	84.8	
Ash (%)	0.5	0.51	
Water Absorbion (%)	56.5	55.2	56.7
Development Time (min)	2.0	2.7	2.4
Max. Resistance (Bu)	170	154	155
Extensibility (cm)	17.8	19.7	17.3
RVA Peak Visc		4439	
Amylograph (BU)			
BAKE QUALITY			
Mixing Time (min)			
Baking Score			
Volume (cc)			
Appearance			
Texture			

COMMENTS

Grain Quality :	Satisfactory		
Milling Quality :	Satisfactory		
Flour Quality :	Satisfactory		Balanced biscuit
Mixing	Good	Short	Short

Requirements :			
Strength :	Acceptible	Weak	Weak/suitable
Extensibility :	Acceptible	Good	Sood
Baking Quality :	n/a	n/a	
Other Comments :		No control	No control

SUMMARY

ie suitability for
domestic market

Suitable for Soft

Produces good biscuit flour

Suitable as a biscuit wheat

First view of this
variety

AUTHORITY

Compiled by :

M Wright-Neville

A Briggs

D Hogan

Date :

Jun-01

WHEAT QUALITY ASSESSMENT

**FLOUR MILLERS COUNCIL OF VICTORIA
WHEAT TECHNICAL COMMITTEE
BRI Pilot Milled Flours for CRC 2001**

VARIETY : YITPI

Sample Source: Commercially grown crop 00/01 season from Vic Mallee, Sth NSW area

LABORATORY	Lab A	Lab B	Lab C
GRAIN QUALITY			
Protein (%)	12.4		
Moisture (%)	10.1		
Test Weight (Kg/hi)	79.5		
Falling No. (sec)	432		
Extraction (%)	81.4		
FLOUR QUALITY			
Protein Nx5.7 (%)	11.5	11.5	11.5
Moisture (%)	13	14	13.3
Colour Grade L		91.7	
Colour Grade b		9.7	
Colour Grade (L-b)	81.2	82.0	
Ash (%)	0.41	0.43	
Water Absorption (%)	62.4	61.1	61.5
Development Time (min)	7.0	8.2	7.4
Max. Resistance (Bu)	350	361	335
Extensibility (cm)	25.1	24.3	26.1
RVA Peak Visc		4210	
Amylograph (BU)			
BAKE QUALITY			
Mixing Time (min)		10.3	9.0
Baking Score		33.5	77
Volume (cc)	1550	18.0	2580
Appearance		7.5	
Texture	7.6	8.0	

COMMENTS

Grain Quality :	Satisfactory		
Milling Quality :	Satisfactory		
Flour Quality :	Satisfactory	Low ash	Balanced bread flour
Mixing Requirements :	Long	High	Long
Strength :	Satisfactory	Strong	Strong
Extensibility :	Good	Very good	Very good
Baking Quality :	Slightly below standard	Good	Acceptable

Other Comments :

No control

No control

SUMMARY

ie suitability for domestic market

Acceptable AH on dough characteristics.

Acceptable AH but long mix time may be a concern

Acceptable AH quality

Similar quality to that previously observed from Buhler test milling flour sampl

AUTHORITY

Compiled by :

M Wright-Neville

A Briggs

D Hogan

Date :

Jun-01

WHEAT QUALITY ASSESSMENT

**FLOUR MILLERS COUNCIL OF VICTORIA
WHEAT TECHNICAL COMMITTEE
BRI Pilot Milled Flours for CRC 2001**

VARIETY : H 45 (Galaxy)

Sample Source: Commercially grown crop 00/01 season from Vic Mallee, Sth NSW area

LABORATORY	Lab A	Lab B	Lab C
GRAIN QUALITY			
Protein (%)	12.4		
Moisture (%)	10.2		
Test Weight (Kg/hi)	79.5		
Falling No. (sec)	394		
Extraction (%)	78.0		
FLOUR QUALITY			
Protein Nx5.7 (%)	11.7	11.7	11.5
Moisture (%)	13.4	13.8	13.5
Colour Grade L		92.1	
Colour Grade b		9.3	
Colour Grade (L-b)	81.7	82.8	
Ash (%)	0.46	0.51	
Water Absorbtion (%)	62.5	62.8	63.1
Development Time (min)	5.5	7.0	5.7
Max. Resistance (Bu)	300	274	280
Extensibility (cm)	26.5	25.0	27.2
RVA Peak Visc		4163	
Amylograph (BU)			
BAKE QUALITY			
Mixing Time (min)		8.3	7
Baking Score		30.4	78
Volume (cc)	1534	17.4	2673
Appearance		6.5	
Texture	2.07	6.5	

COMMENTS

Grain Quality :	Satisfactory		
Milling Quality :	Satisfactory		
Flour Quality :	Satisfactory	Balanced	Balanced
Mixing Requirements :	Satisfactory		Standard
Strength :	Satisfactory		Average
Extensibility :	Good		Good
Baking Quality :		Average	Acceptable

Other Comments :

No control

No control

SUMMARY

ie suitability for domestic market

Further evaluation required for AH classification

Suitable, possible AH, if not APW

Acceptable AH from these results

First view of this variety. It performed surprisingly well

AUTHORITY

Compiled by :

M Wright-Neville

A Briggs

D Hogan

Date :

Jun-01

WHEAT QUALITY ASSESSMENT

FLOUR MILLERS COUNCIL OF VICTORIA
 WHEAT TECHNICAL COMMITTEE
 BRI Pilot Milled Flours for CRC 2001

VARIETY : CHARA VI 341

Sample Source: Commercially grown crop 00/01 season from Vic Mallee, Sth NSW area

LABORATORY	Lab A	Lab B	Lab C
GRAIN QUALITY			
Protein (%)	12.4		
Moisture (%)	10.2		
Test Weight (Kg/hi)	79.5		
Falling No. (sec)	394		
Extraction (%)	78.0		
FLOUR QUALITY			
Protein Nx5.7 (%)	11.7	11.5	11.5
Moisture (%)	13.4	14.0	13.4
Colour Grade L		92.1	
Colour Grade b		10.1	
Colour Grade (L-b)	80.9	82.0	
Ash (%)	0.45	0.47	
Water Absorbion (%)	59.4	58.9	59.9
Development Time (min)	7.5	10.2	7.7
Max. Resistance (Bu)	470	467	390
Extensibility (cm)	26.8	28.3	27.6
RVA Peak Visc		3415	
Amylograph (BU)			
BAKE QUALITY			
Mixing Time (min)		11.3	10.0
Baking Score		30.8	72
Volume (cc)	1519	17.8	2592
Appearance		6.5	
Texture	9.5	6.5	

COMMENTS

Grain Quality :	Satisfactory		
Milling Quality :	Satisfactory		
Flour Quality :	Satisfactory	Low water abs	
Mixing Requirements :	Long	Excessive	Excessive
Strength :	Excessive	Very strong	Very strong
Extensibility :	Good	Excellent	Very good
Baking Quality :		Average	Poor/average

Other Comments : A very strong variety which may cause a problem when associated in an uncontrolled blend with standard Vic. AH varieties.

SUMMARY

ie suitability for domestic market

Not compatible with other Vic AH varieties. Interest if separately segregated

Similar quality to that previously observed from Buhler test milling flour samples

AUTHORITY

Compiled by :

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Date :

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CRC PILOT MILLING STUDIES 3.1.3 FLOUR REPORT 2001

Straight run flours from the 2001 Pilot Milling Studies Project were analysed by Goodman Fielder Mills at Summer Hill.

The new Queensland PH variety Strzelecki was similar in quality to Sunco, with higher water absorption and slightly more extensibility.

Thornbill, a new soft wheat from NSW Agriculture, exhibited low water absorption and extensible dough properties. Dough properties may be stronger than traditional biscuit wheats.

Yitpi (SA), H45 (NSW) and Chara (Vic) were all strong wheats with extensible dough properties. The water absorption of Chara was low for breadmaking, and H45 was the least strong of the three wheats.

Di Miskelly



	Sunco	Strzelecki	Thornbill	Yitpi	H45	Chara
Moisture %	14.5	14.2	14.1	14.2	14.1	14.1
Protein (14 mb) %	11.5	12.3	8.1	10.7	10.8	10.8
Ash %	0.51	0.55	0.48	0.40	0.43	0.44
Farinograph						
Water Absorption %	60	61.5	54.2	59.2	60.5	58.6
Development Time min	6.5	5.5	2	6	5	5.5
Extensograph						
Maximum ht BU	24.9	25.7	18.5	24.2	25.5	26.3+
Extensibility cm	425	445	135	375	325	420

Report

Pilot milled samples 2001

Samples pilot milled in the 2001 pilot milling program included

- Strzelecki, a Queensland prime hard wheat.
- Sunco ex. Queensland prime hard.
- Chara is a very strong variety from Victoria accepted as PH in NSW.
- Yitpi is south Australian prime hard, sourced in Victoria.
- H45 is NSW AH wheat sourced from Victoria.

Flour Analysis

Flour analysis was performed on straight run and 60% extraction flour. Victory, Sunco and rosella were used as protein match control for evaluation of these new wheat varieties. The results are presented in table 1.

Discussion:

From the results it appears that Chara, yitpi and H45 had low farino water absorption as compared to the victory. This could be due to less starch damage in the pilot milled samples. Chara had the highest extensograph height, indicating highest dough strength of the three samples. Chara is the most extensible flour of all the straight run flour assessed.

Strzelecki had the highest protein content but otherwise similar to sunco in flour properties. Strzelecki had the highest ash content and the lowest lightness index.

Thornbill is very similar to rosella except that it has lower extensograph height. The difference in the ash content between rosella and Thornbill could be due to difference in the extraction level as rosella is the base flour from our mill for UNP. The ash values for 60% extracted Thornbill are more similar to Rosella.

Test baking

The straight run flour from the pilot milled samples were test baked in duplicates using a commercial formulation.

Amount of water added to each flour varied and was calculated as per the Farinograph water absorption value. The dough was mixed to an optimum level as assessed by the baker.



The results of the test bake were averaged for the duplicates and are presented in table 2.

Discussion:

From the results it appears that Chara, yitpi and H45 had a good average volume as compared to victory. All the three flour tested had brighter crumb colour as compared to Victory. Chara felt tough and bucky.

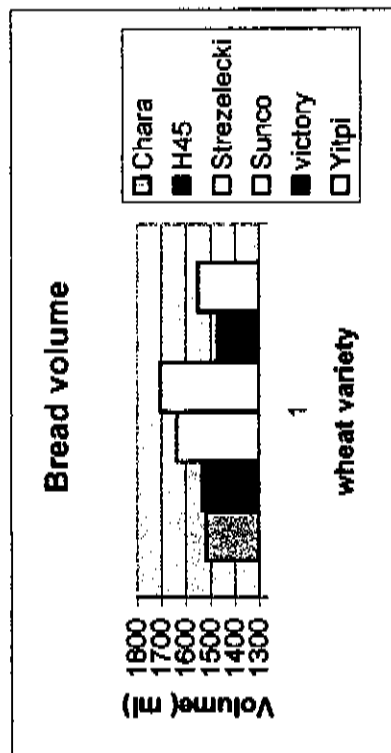
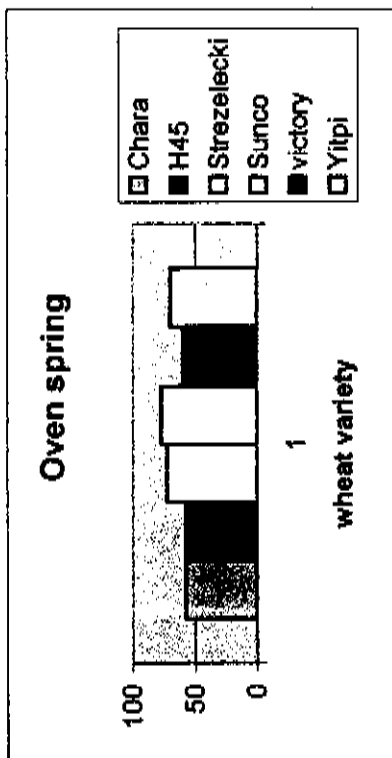
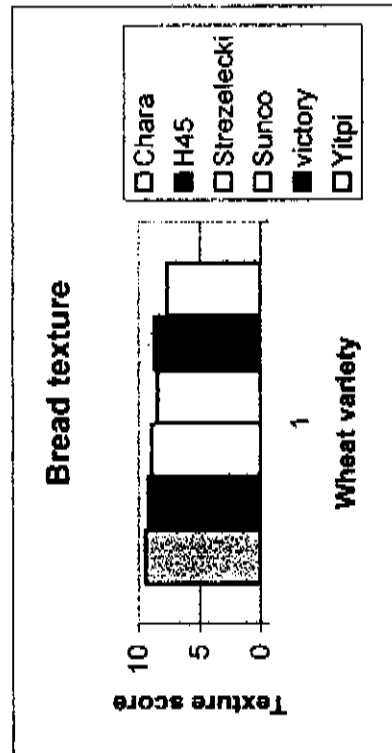
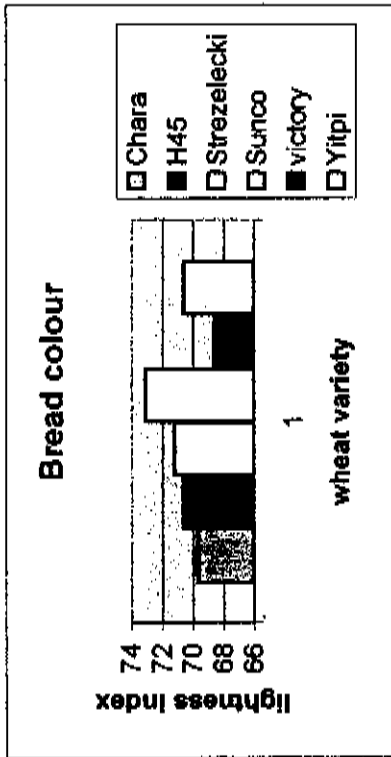
Sunco and Strzelecki are not much different to each other. Sunco on its own had a very good oven spring, colour, volume amongst all the wheats tested. Strzelecki and yitpi produced the softest loaves.

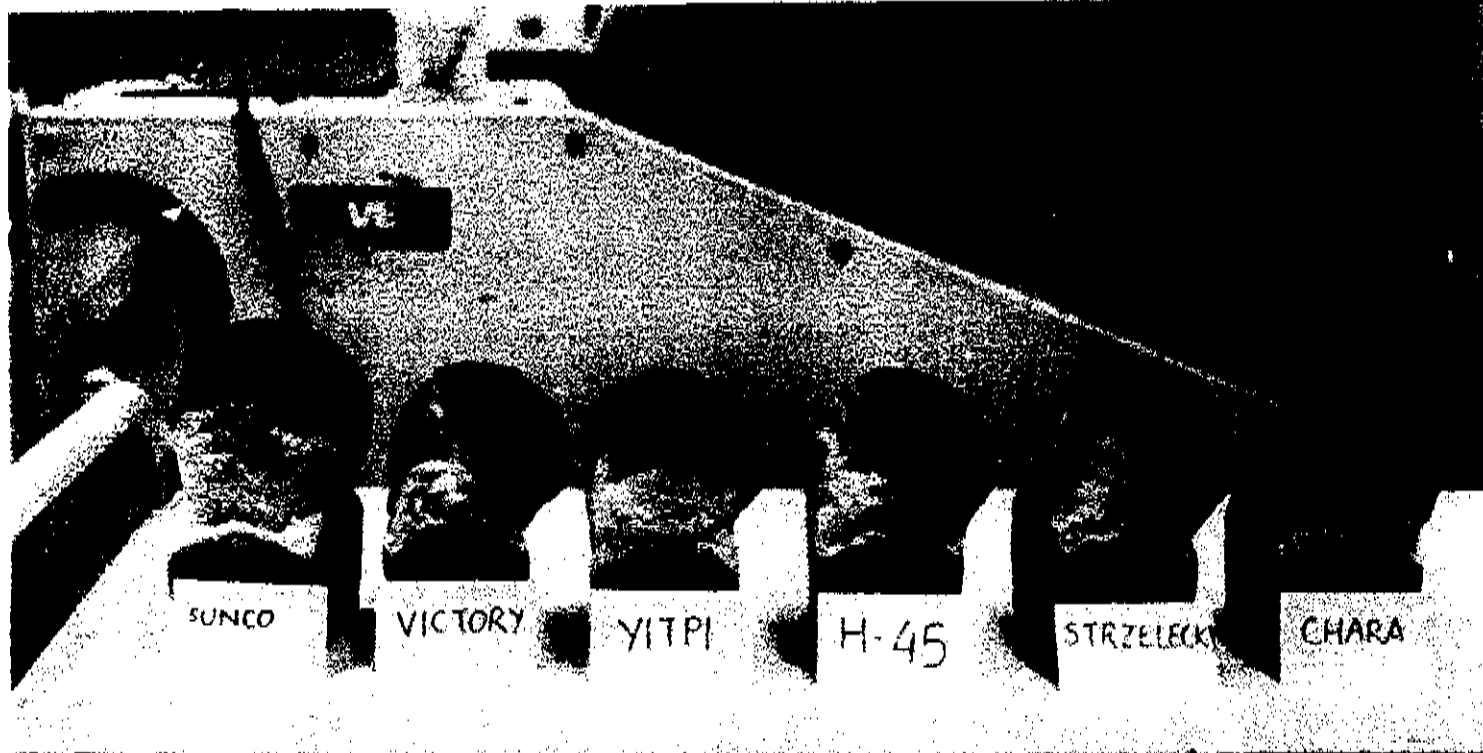
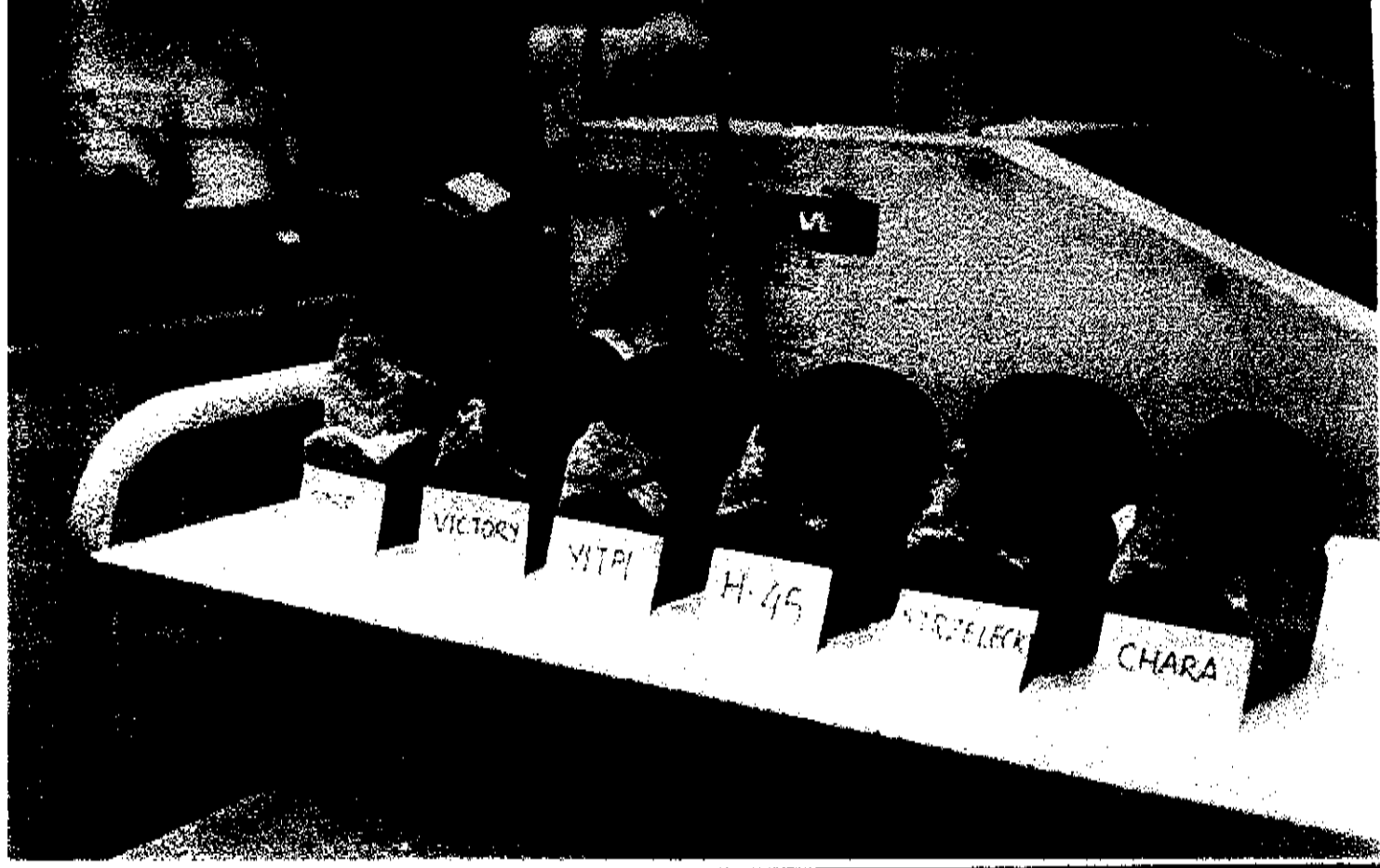
Flour analysis

	H45	Strzelecki	Thornbill	Sunco	Chara	Yitpi	victory	rosella	Chara	Thornbill	Strzelecki
									60%	60%	60%
protein	11.8	13.5	9.3	12.5	11.8	11.6	12.1	9.3	11.6	9.1	13.1
moisture	14.1	14	13.2	14.2	14.1	14.3	14	13	14.1	13.5	14.1
lightness index	82.07	80.42	84.07	82.55	81.25	81.48	81.69	84.51	81.85	84.97	80.98
farino absorption	59.3	59.9	54	58.9	56.3	57.9	65.5	54.2	56	52.1	59
development time	6	7	2.75	8	8	7	5.5	2.75	26	3.25	7.5
extenso absorption	56.9	57.4	52.4	56.3	53.7	55.1	62.5	52.9	53.5	51.9	56.2
Extenso height	320	470	145	445	565	380	345	225	620	180	565
Extensibility	24.9	23.2	19.6	23.3	26+	20.9	19.8	18.8	26+	18.8	22.3
starch damage	11.5	15.7	3.7	11.5	11.5	14.1	24		8.4	2.7	14.1
ash	0.41	0.54	0.46	0.45	0.41	0.38		0.38	0.38	0.41	0.46
Peak (SNU)									194.75	280.8	252.5
Temp. of peak									65.3	67.9	66.25
Setback									103.92	106.42	97.25

Test baking

	Volume	over spring	colour	Texture	softness	SD
CLM	1492.5	50	69.39	10.19	2.9	0.21
CLM	1546	65	70.01	8.7	2.22	0.26
AV	1519.25	57.5	69.7	9.445	2.56	
CLM	1511.5	55	70.45	10.52	2.06	0.19
CLM	1557.5	60	70.82	7.84	2.11	0.25
AV	1534.5	57.5	70.635	9.18	2.085	
CLM	1656.5	70	70.57	8.66	1.82	0.3
CLM	1619.5	75	71.87	9.14	1.66	0.27
AV	1638	72.5	71.22	8.9	1.74	
CLM	1679.5	85	73.08	8.42	2.03	0.44
CLM	1730	70				
AV	1704.75	77.5				
CLM	1471.5	60	68.62	8.71	1.85	0.23
CLM	1482	65	69.82	9.27	1.96	0.26
AV	1619	75	71.45	6.03	1.48	0.3
AV	1550.5	70	70.635	7.65	1.72	





Assessment of Thornbill Flour from QWCRC

Summary

The Trial Thornbill wheat produced flour suitable for biscuits with a better tolerance to changes in water addition than any other variety assessed by this methodology.

Introduction

Thornbill is a new wheat variety targeted at the soft biscuit flour market. A sample of this wheat was test milled at BRI as part of the QWCRC pilot milling project. The Arnotts Flour Assessment process assessed the flour from this test milling. This process assess flour on a range of tests:

- **Mixing Tests** – the flour is mixed as part of a model plain sweet biscuit dough in the Test Mixer. The water level is adjusted to give the best possible biscuit for the flour under assessment. The Test Mixer measures the power consumed during mixing and various parameters are determined from the power-time curve and compared to flour of known quality.
- **Dough test** – the dough from the Mixing Test is measured in a double compression test which gives a measure of dough hardness, springiness and adhesiveness.
- **Baking Test: Forming**– the dough is then sheeted and cut into biscuit pieces and the pieces baked.
- **Baking Tests: Biscuits** – the baked pieces are measured for important characteristics such as circularity, weight and thickness (packet length). The biscuits are then packed in sealed containers for a week and the final texture, colour and moisture determined.

Methods and Materials

The Thornbill flour was compared to the current (2001) standard Arnotts NSW Soft Flour milled by Goodman Fielder Milling. The Arnotts Flour Assessment process was followed except for the water addition.

The standard flour was mixed with the addition of 95, 97 or 98 millilitres of water, which is a commonly observed range, and gave consistent results for the water addition range. However the Thornbill was mixed with 80 to 110 millilitres of water, all giving a similar dough and biscuit. This is a very large range, and indicates flour with very good tolerance to changes in water addition.

Results and Discussion

The average results are tabulated in Table 1; the full data set is given in Appendix 1.

Basic Flour Tests

The Thornbill had higher protein (8.7%) than the 2001 Standard (8.1%) and this was reflected in higher Rmax (160 BU compared to 125 BU). Flour such as this is, usually considered, on the high side of acceptable.

Solvent Retention Capacity

The Sucrose solution retention was similar indicating that the Thornbill has similar pentosan levels to the 2001 standard. The Thornbill did have slightly higher Lactate retention (indicative of Glutenin level) and lower Carbonate (level of damage starch) than the 2001 standard although the distilled Water retention, which is a general measure of flour quality, was similar.

Mixing Tests

The water addition given in Table 1 is an average of the water added during a series of baking tests. Acceptable dough and biscuits were made with the 2001 Standard soft and a water addition range of 95 -- 98mls and with the Thornbill and a water addition range of 80 --110mls. This large water addition range is highly desirable and indicates much better processing tolerance than the 2001 standard (or any other flour tested in the last 4 years). The Thornbill gave a lower time to mixing peak and this peak was higher than the 2001 standard – this is to be expected because of the higher flour protein. The bandwidth at peak and the final consistency were similar. The gradient (which is like the Farinograph Breakdown) was more for the Thornbill than the standard, which is surprising given Thornbill's higher protein.

Double Compression Test

The two flours gave similar doughs as tested by the double compression test and the variations seen between Thornbill doughs (see appendix 1) were most probably due to the water addition changes.

Baking Tests: Forming

Both flours gave similar results indicating that the water addition to the Thornbill was accurate. There are small differences between the Thornbill tests but they are only small which is indicative of the observed tolerance of the flour.

Baking Tests: Biscuits

In general the Thornbill produced similar biscuits to the 2001 standard with slight blistering, a slightly higher packet length and slightly harder (TPB – Three Point Bend test) texture as to be expected with the higher protein.

Conclusion

The Trial Thornbill wheat produced flour suitable for biscuits with a better tolerance to changes in water addition than any other variety assessed by this methodology.

Table 1: Average Flour Assessment results for 2001 Standard Soft and Thornbill

	Variety	2001 Std	Thornbill	
Basic Flour Tests	Flour protein content (%)	8.1	8.7	
	Flour Moisture (%)	13.0	13.5	
	constant moisture protein	8.1	8.7	
	% Water Absorption	55.0	54.4	
	Extension (cm)	18.2	18.3	
	Rmax (BU)	125	160	
Solvent Retention Capacity	Water	56	54	
	Sucrose	99	101	
	Lactate	77	82	
	Carbonate	77	73	
Mixing Tests	Water addition (g)	97	95	
	Mixing Time (sec)	320	328	
	Time to Peak (sec)	182	174	
	Peak Power (W)	494	557	
	Work/Time (kJ/sec)	2.7	3.2	
	Peak Bandwidth (W)	71	65	
	Peak Bandwidth (mm)	6.3	5.9	
	Total Work (kJ)	112.5	118.7	
	Final Power (W)	380	471	
	Gradient	-0.29	-0.59	
	Final Consistency (W)	38	33	
	Final Consistency (mm)	3.3	3.1	
	Double Compression Test	DCT - Hardness(g)	14011	14537
		- Springiness	0.93	0.92
- Adhesiveness(gs)		-20.05	-22.13	
Baking Tests: Forming	Raw Dough Weight (g) 20bisc	137.1	136.4	
	Dough Thickness (mm)	2.85	2.86	

Baking Tests: Biscuits	Bake Time (min.)	12.0	12.0
	Blisters	none	slight
	Baked Dough Wgt (g) 20 bisc	107.68	106.95
	Packet Length (mm) 20bisc	123.3	126.2
	PL:BDW	1.14	1.18
	Biscuit Circularity	1.005	1.018
	Checking (x/20)	1.7	0.1
	TPB test - Force/ht (g/mm)	816.4	918.6
	TPB test - Area/ht(g)	175.6	210.4
	Probe Test - Force/ht(g/mm)	403.1	397.7
	Probe Test - Area/ht(g)	795.5	701.8
	Biscuit Colour - L*	73.1	71.9
	- a*	5.4	6.6
	- b*	29.7	30.2
	Biscuit Crumb Colour(L*+a*-b*)	48.8	48.3
	1/L* + a* + b*	35.1	36.9
Biscuit Moisture (%)	1.9	2.0	

Appendix 1: Raw Data for Flour Assessment – Thornbill and 2001 Standard

Variety	2001			2001			2001			2001			2001			2001			2001			2001			Thornbill	Ave
	STD	A1	A2	STD	B1	B2	STD	B3	B4	STD	B5	STD	A1	B1	C1	Thornbill	D1	E1	F1	G1	H1	I1	Thornbill			
Test Number	8.1	13.0	8.1	13.0	8.1	13.0	8.1	13.0	8.1	13.0	8.1	13.0	8.7	13.5	8.7	13.5	8.7	13.5	8.7	13.5	8.7	13.5	8.7	13.5		
Flour protein content (%)	8.1	13.0	8.1	13.0	8.1	13.0	8.1	13.0	8.1	13.0	8.1	13.0	8.7	13.5	8.7	13.5	8.7	13.5	8.7	13.5	8.7	13.5	8.7	13.5		
Flour Moisture (%)	8.1	13.0	8.1	13.0	8.1	13.0	8.1	13.0	8.1	13.0	8.1	13.0	8.7	13.5	8.7	13.5	8.7	13.5	8.7	13.5	8.7	13.5	8.7	13.5		
constant moisture protein	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4		
% Water Absorption	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3		
Extension (cm)	125	125	125	125	125	125	125	125	125	125	125	125	160	160	160	160	160	160	160	160	160	160	160	160		
Rmax (BU)	95	95	98	98	98	98	98	98	98	98	98	98	80	85	90	93	95	96	96	98	105	110	110	95		
Water addition (g)	321	287	302	340	350	340	350	321	320	320	320	281	291	299	311	317	316	316	330	357	357	445	328			
Mixing Time (sec)	191	174	191	173	180	173	180	180	182	182	182	195	189	167	173	171	188	188	173	164	164	150	174			
Time to Peak (sec)	564	508	427	498	504	498	504	463	494	494	494	573	573	541	564	581	581	581	593	509	509	498	557			
Peak Power (W)	2.95	2.92	2.23	2.89	2.80	2.89	2.80	2.57	2.7	2.7	2.7	2.94	3.03	3.23	3.27	3.41	3.10	3.10	3.44	3.11	3.11	3.32	3.2			
Work/Time (k.J/sec)	47.5	50.0	42.0	42.0	42.5	42.0	42.5	39.0	43.8	43.8	43.8	54.0	54.0	51.0	47.5	49.0	49.0	49.0	50.0	48.0	48.0	47.0	49.9			
Peak Power (mm)	83	71	61	71	71	71	71	71	71	71	71	74	90	74	71	71	56	56	56	48	48	42	65			
Peak Bandwidth (W)	7.0	7.0	6.0	6.0	6.0	6.0	6.0	6.0	6.3	6.3	6.3	7.0	8.5	7.0	6.0	6.0	5.0	5.0	5.0	4.5	4.5	4.0	5.9			
Peak Bandwidth (mm)	115.2	96.2	104.7	122.2	125.0	122.2	125.0	111.7	112.5	112.5	112.5	104.3	112.3	109.2	111.6	117.9	114.1	114.1	119.3	125.4	125.4	153.8	118.7			
Total Work (kJ)	522	468	0	427	421	427	421	439	380	380	380	536	530	483	486	504	467	467	456	403	403	371	471			
Final Power (W)	-0.32	-0.36	0.00	-0.42	-0.49	-0.42	-0.49	-0.17	-0.29	-0.29	-0.29	-0.43	-0.17	-0.44	-0.56	-0.53	-0.88	-0.88	-0.87	-0.55	-0.55	-0.90	-0.59			
Gradient	47	31	31	36	36	36	36	47	38	38	38	42	42	42	36	30	22	22	22	32	32	32	33			
Final Consistency (W)	4.0	3.0	3.0	3.0	3.0	3.0	3.0	4.0	3.3	3.3	3.3	4.0	4.0	4.0	3.0	2.5	2.0	2.0	2.0	3.0	3.0	3.0	3.1			
Final Consistency (mm)	15013	14195	13265	13459	14085	13459	14085	14050	14011	14011	14011	18820	17614	15914	14065	14887	14193	14193	13465	11708	11708	10168	14537			
DCT - Hardness(g)	0.92	0.94	0.92	0.95	0.93	0.95	0.93	0.93	0.93	0.93	0.93	0.93	0.91	0.94	0.91	0.92	0.93	0.93	0.91	0.91	0.91	0.94	0.92			
- Springiness	-18.68	-18.94	-17.79	-23.92	-18.49	-23.92	-18.49	-22.46	-20.05	-20.05	-20.05	-21.55	-25.40	-17.66	-24.02	-25.66	-24.40	-24.40	-17.60	-19.78	-19.78	-23.12	-22.13			
- Adhesiveness(gs)	136.5	140.9	138.8	133.8	135.3	133.8	135.3	137.1	137.1	137.1	137.1	144.6	143.7	139.2	137	135	137.4	137.4	132.3	132.5	128.1	128.1	136.4			
Raw Dough Weight (g)	2.89	2.96	2.87	2.75	2.81	2.75	2.81	2.86	2.85	2.85	2.85	3.05	2.96	2.92	2.94	2.82	2.82	2.82	2.79	2.79	2.68	2.68	2.86			
20bisc	12	12.25	12	11.75	12	11.75	12	12	12.0	12.0	12.0	12.5	12.5	12	12	12	12	12	11.75	11.75	11.5	11.5	12.0			
Dough Thickness (mm)	none	neg	none	none	none	none	none	none	none	none	none	none	neg.	none	neg.	neg.	neg.	neg.	slight	sl-small	sl-small	sl-small	slight			
Bake Time (min.)	107.12	110.89	108.57	104.70	106.18	104.70	106.18	108.63	107.68	107.68	107.68	116.01	113.78	109.59	107.06	105.87	107.69	107.69	102.95	102.95	96.97	96.97	106.95			
Blisters	21.52	21.30	21.78	21.78	21.53	21.78	21.53	20.77	21.45	21.45	21.45	19.77	20.82	21.27	21.85	21.57	21.62	21.62	22.18	22.57	23.10	23.10	21.64			
Baked Dough Wgt (g) 20 bisc	121.5	126.5	126.5	120.0	121.0	120.0	121.0	124.0	123.3	123.3	123.3	134.0	132.0	128.0	127.0	124.0	126.0	126.0	121.5	124.5	119.0	119.0	126.2			
% moisture loss	1.13	1.14	1.17	1.15	1.14	1.15	1.14	1.14	1.14	1.14	1.14	1.16	1.16	1.17	1.19	1.17	1.17	1.17	1.18	1.21	1.23	1.23	1.18			
Packet Length (mm)	1.012	1.010	1.015	1.002	0.999	1.002	0.999	0.994	1.005	1.005	1.005	1.013	1.015	1.016	1.016	1.018	1.016	1.016	1.016	1.021	1.021	1.026	1.018			
PL:BDW																										
Biscuit Circularity																										

Appendix 1 (cont): Raw Data for Flour Assessment – Thornbill and 2001 Standard

Checking (x/20)	2	1	3	1	2	1	1.7	0	0	1	0	0	0	0	0	0	0	0.1
TPB test - Force/ft (g/mm)	923.0	764.5	846.6	878.5	722.6	763.3	816.4	949.7	1122.5	843.7	935.0	912.4	1032.4	869.6	770.3	832.3	918.6	
TPB test - Area/ft(g)	176.3	160.7	181.9	219.6	241.1	74.0	175.6	232.5	295.9	194.0	213.8	198.0	224.4	170.3	164.5	199.9	210.4	
Probe Test - Force/ft(g/mm)	418.8	436.6	371.7	384.1	408.0	399.2	403.1	378.5	362.9	397.4	381.4	437.3	409.5	471.7	386.6	354.4	397.7	
Probe Test - Area/ft(g)	706.7	713.5	664.0	651.8	631.0	1405.9	795.5	643.0	674.2	735.9	690.3	696.7	657.7	770.3	691.8	726.2	701.8	
Biscuit Colour - L*	71.5	71.9	72.4	74.6	74.6	73.3	73.1	71.4	72.0	72.7	71.1	73.6	71.8	72.6	71.0	70.6	71.9	
- a*	7.3	1.9	5.9	5.3	4.8	7.5	5.4	6.4	6.8	5.3	7.1	6.3	7.1	7.2	6.5	6.9	6.6	
- b*	29.6	32.0	29.7	29.3	28.7	28.9	29.7	29.7	31.5	30.0	30.2	29.4	30.1	30.3	31.2	29.6	30.2	
Biscuit Crumb Colour[L*+a*- b*]	49.3	41.8	48.6	50.6	50.7	51.9	48.8	48.2	47.3	48.0	48.0	50.5	48.8	49.6	48.3	48.0	48.3	
1/L* + a* + b*	36.9	33.8	35.6	34.6	33.5	36.4	35.1	36.1	38.3	35.4	37.3	35.7	37.2	37.5	37.8	36.5	36.9	
Biscuit Moisture (%)	1.9	1.9	1.6	1.6	1.7	2.8	1.9	2.0	2.0	1.9	1.9	2.0	2.0	2.1	2.0	2.0	2.0	

Wheat Quality CRC – 2000/2001 Pilot Mill



Our Sample Number		S00.036049	S00.036050	S00.036051	S00.036052	S00.036053
Sample Type		Flour				
Your Reference		Strzelecki	Strzelecki	Thornbill	Thornbill	Sunco
		S/R	60%	S/R	60%	S/R
Moisture	(%)	14.5	14.7	13.9	14.5	14.5
Diastatic Activity	(mg)	161	135	145	111	140
Colour Grade	(KJ)	-0.7	-2.2	-1.4	-3.2	-2.1
Starch Damage	(%)	7.1	6.6	3.7	3.2	5.6
Minolta Flour	L*	91.59	92.20	93.39	93.78	92.16
	a*	-1.92	-2.07	-2.03	-2.13	-1.72
	b*	10.34	10.17	8.11	7.74	8.56
Zeleny Sedimentation	Volume (ml)	38.0	43.0	16.0	15.0	55.0
Amylograph	Peak (B.U.)	1040	1200	950	950	590
Farinograph	Water absorption (%)	60.4	58.4	52.4	51.4	59.4
	Development time (min)	6.3	6.8	1.4	1.9	8.7
	Stability (min)	13.0	>15	2.7	3.1	13.2
	Breakdown (B.U.)	50	40	125	100	0
Extensograph 45min	Extensibility (cm)	26.5	23.1	18.4	16.9	>26.0
	Max. height (B.U.)	442	532	165	220	445
	Area (sq.cm.)	165	166	48	56	>167
Extensograph 90min	Extensibility (cm)	24.3	23.7	17.5	16.2	23.9
	Max. height (B.U.)	515	650	210	255	540
	Area (sq.cm.)	170	208	57	62	170
Extensograph 135min	Extensibility (cm)	23.4	22.3	16.2	16.0	23.1
	Max. height (B.U.)	538	656	215	290	540
	Area (sq.cm.)	171	197	54	68	168
Alveograph	G	27.6	26.6	22.1	23.0	24.8
	W	349	357	75	89	306
	P	74	76	35	37	73
	P/L	0.48	0.53	0.35	0.34	0.59
	L	154	143	99	108	125
Protein	(%) (N x 5.7) (14%mb)	13.0	12.4	8.6	8.2	12.2
Ash	(%) (14%mb)	0.54	0.46	0.45	0.40	0.45
Wet Gluten	(%)	34.3	34.9	23.8	23.6	29.7
Gluten Index	(%)	99	99	88	86	99

Wheat Quality CRC – 2000/2001 Pilot Mill



Our Sample Number		S00.036054	S00.036055	S00.036056	S00.036057	S00.036058	
Sample Type		Flour					
Your Reference		Sunco	Chara	Chara	Yitpi	Yitpi	H45
		60%	S/R	60%	S/R	82%	S/R
Moisture	(%)	14.6	14.4	14.5	14.5	14.0	14.4
Diastatic Activity	(mg)	130	135	126	166	182	135
Colour Grade	KJ	-3.4	-0.8	-2.5	-0.3	4.5	-0.8
Starch Damage	(%)	5.5	5.9	5.7	6.6	6.4	5.6
Minolta Flour	L	92.61	92.25	92.79	91.94	90.60	92.36
	a	-1.85	-2.29	-2.43	-2.03	-1.64	-2.00
	b	8.36	10.05	9.93	9.65	9.18	9.21
Zeleny Sedimentation	Vol (ml)	60.0	49.5	59.5	55.0	43.5	54.5
Amylograph	peak (B.U.)	700	490	540	860	860	620
Farinograph	Water absorption (%)	57.8	55.7	55.3	58.0	59.4	59.0
	Development time (min)	7.7	72	>15	7.2	5.2	5.7
	Stability (min)	>15	>15	>15	12.8	6.1	7.3
	Breakdown (B.U.)	25	25	0	40	60	60
Extensograph 45min	Extensibility (cm)	24.7	>26.0	>26.0	24.4	20.5	>26.0
	Max. height (B.U.)	525	565	555	500	380	365
	Area (sq.cm.)	177	>208	>203	168	113	>139
Extensograph 90min	Extensibility (cm)	23.1	>26.0	>25.9	21.1	19.7	25.9
	Max. height (B.U.)	600	673	710	590	455	415
	Area (sq.cm.)	182	>239	>249	168	124	149
Extensograph 135min	Extensibility (cm)	23.0	25.9	22.5	20.8	18.6	25.1
	Max. height (B.U.)	670	690	775	570	455	440
	Area (sq.cm.)	206	243	225	161	119	154
Alveograph	G	25.2	26.1	28.5	26.1	18.7	29.2
	W	333	298	396	289	172	259
	P	73	64	67	70	73	65
	P/L	0.57	0.46	0.41	0.50	1.03	0.37
	L	129	138	165	138	71	173
Protein	(%) (N x 5.7) (14%mb)	11.7	11.5	11.0	11.5	11.7	11.6
Ash	(%) (14%mb)	0.35	0.44	0.36	0.40	0.56	0.46
Wet Gluten (%)	(%)	29.9	26.1	25.6	29.6	27.5	31.0
Gluten Index (%)	(%)	99	100	100	96	88	97

Wheat Quality CRC – 2000/2001 Pilot Mill

Our Sample Number	S00.037582	S00.037583
Sample Type	Wheat	
Your Reference	H45	Thornbill
Test weight (Kg/ha)	78.5	84.5
Screenings (%) (2.00mm)	3.7	1.1
Foreign Material (%)	<0.1	Not Detected
1000 Kernel Weight (g)	26.6	31.4
Oven Moisture (%)	10.4	9.9
Protein (%) (11%mb) (N x 5.7)	12.5	10.2
Ash (%) (11%mb)	1.09	1.26
Falling Number (sec)	612	359