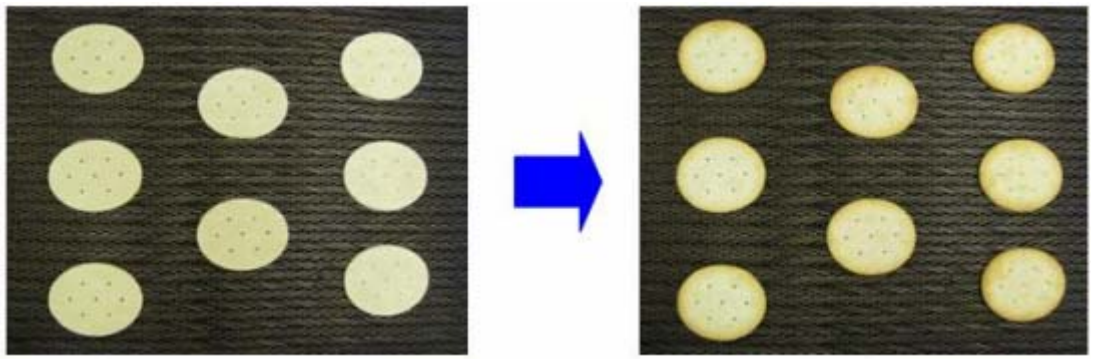
Chemically-leavened cracker bench-top baking method



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Comparison of ingredients

Ingredient	Cookie	Cracker
Sucrose	high	low
Fat	high	low
Water	low	low
Flour	unchlorinated	unchlorinated (requires gluten strength)
TS	high	low
%S	very high	low

Objective

Develop a bench-top baking method to predict contribution of gluten functionality and performance to overall flour performance for chemically-leavened crackers

What are the hurdles in developing a cracker baking method?

- Difficulty to find ideal diagnostic flours that differ only in gluten functionality (same SRC values, except SRC-LA)
- Absence of a suitable two zone bench-top oven.
- Absence of a powerful bench-top mixer like a commercial plant-scale cracker mixer to enable gluten development with low TS and %S formulas.
- Absence of a powerful 2-4 roll sheeter and reduction system to enable gluten development during machining.

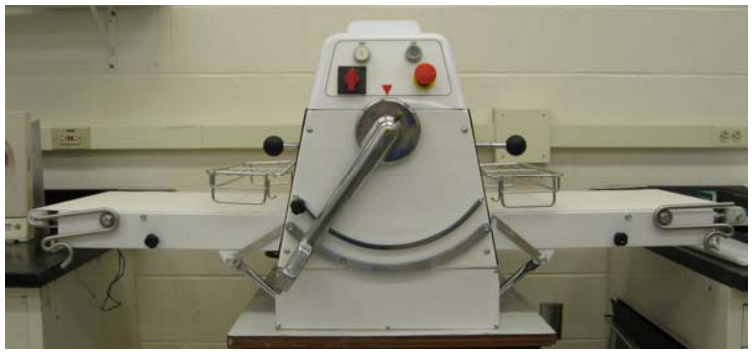
In spite of the hurdles, if we want to develop a cracker baking method, what will still be the criteria?

- The method should be simple and user-friendly.
- The method should be reliable in terms of reproducibility and accuracy.
- The method should be diagnostic for gluten functionality of flour samples.

Equipment used for experiments

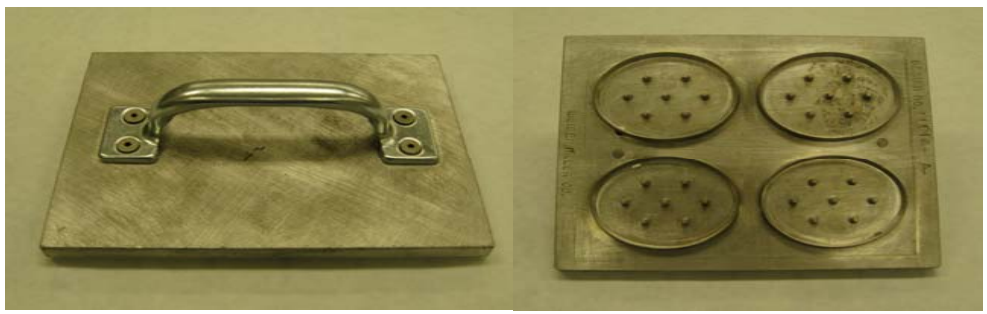
Mixer: Pin mixer with 100g mixing bowl

Oven: Standard National lab baking oven



Univex sheeter

Baking rack

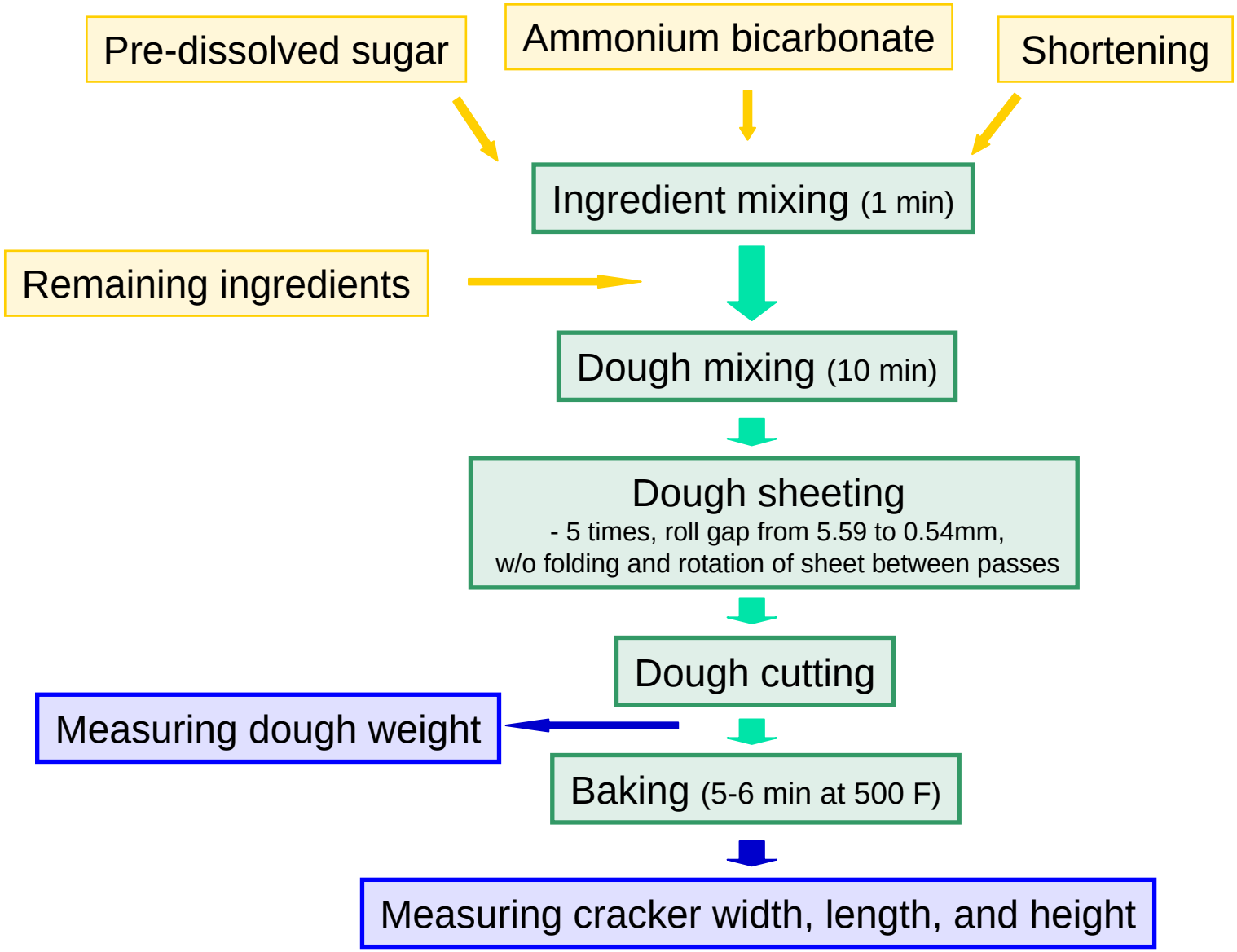


Hand cutter (2.25 x 1.65 inch, 7 docker pins)

Basic ingredients and formula

Ingredient	Formula (g)
Flour	100.0
FG Sugar	9
Salt	0.75
Sodium bicarbonate	1.25
Ammonium bicarbonate	1.25
Monocalcium phosphate	1.25
Shortening	12.0
Water	29.0
TS	38
% S	23.7

Cracker-making procedure



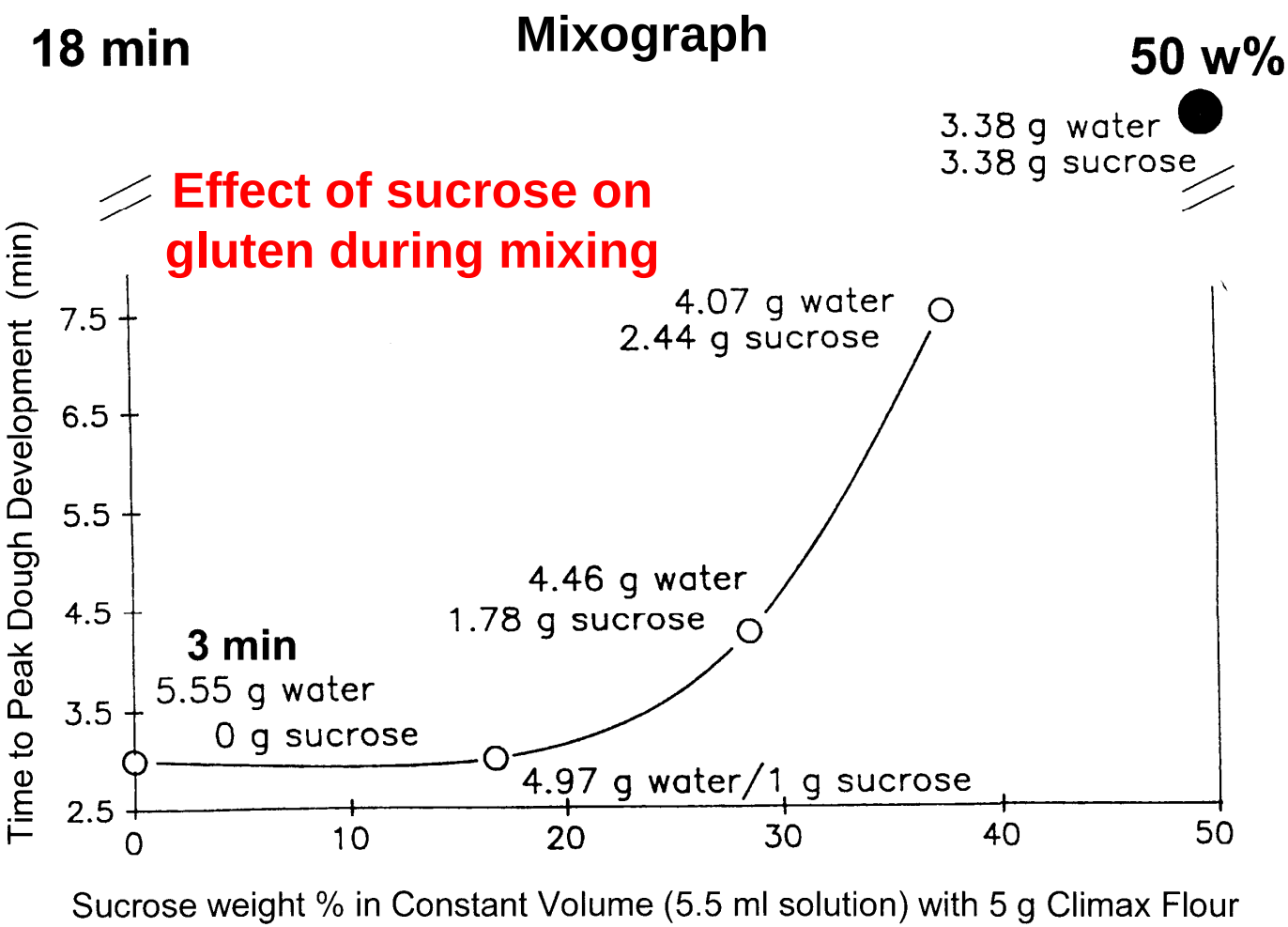
Flour used
for developing the formula and procedure

Flour	SRC			
	Water	LA	SC	Suc
Branson	46.9	94.8	60.7	86.9

Gluten performance ratio:

SRC LA/(SC+Suc) = 0.644

Can we use very low sugar concentration for faster gluten development in a cracker baking method?

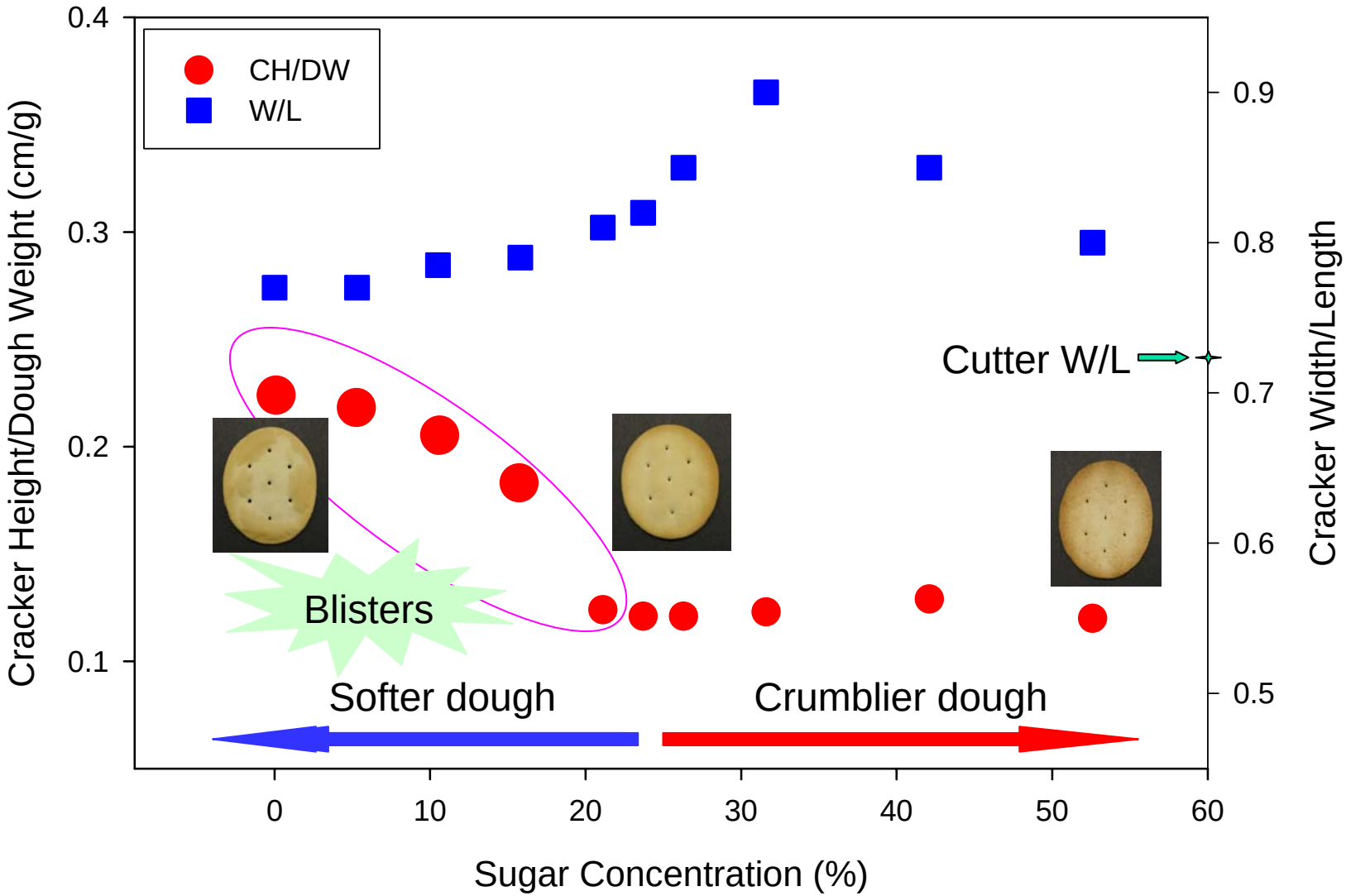


One Sugar Type: Different Concentrations

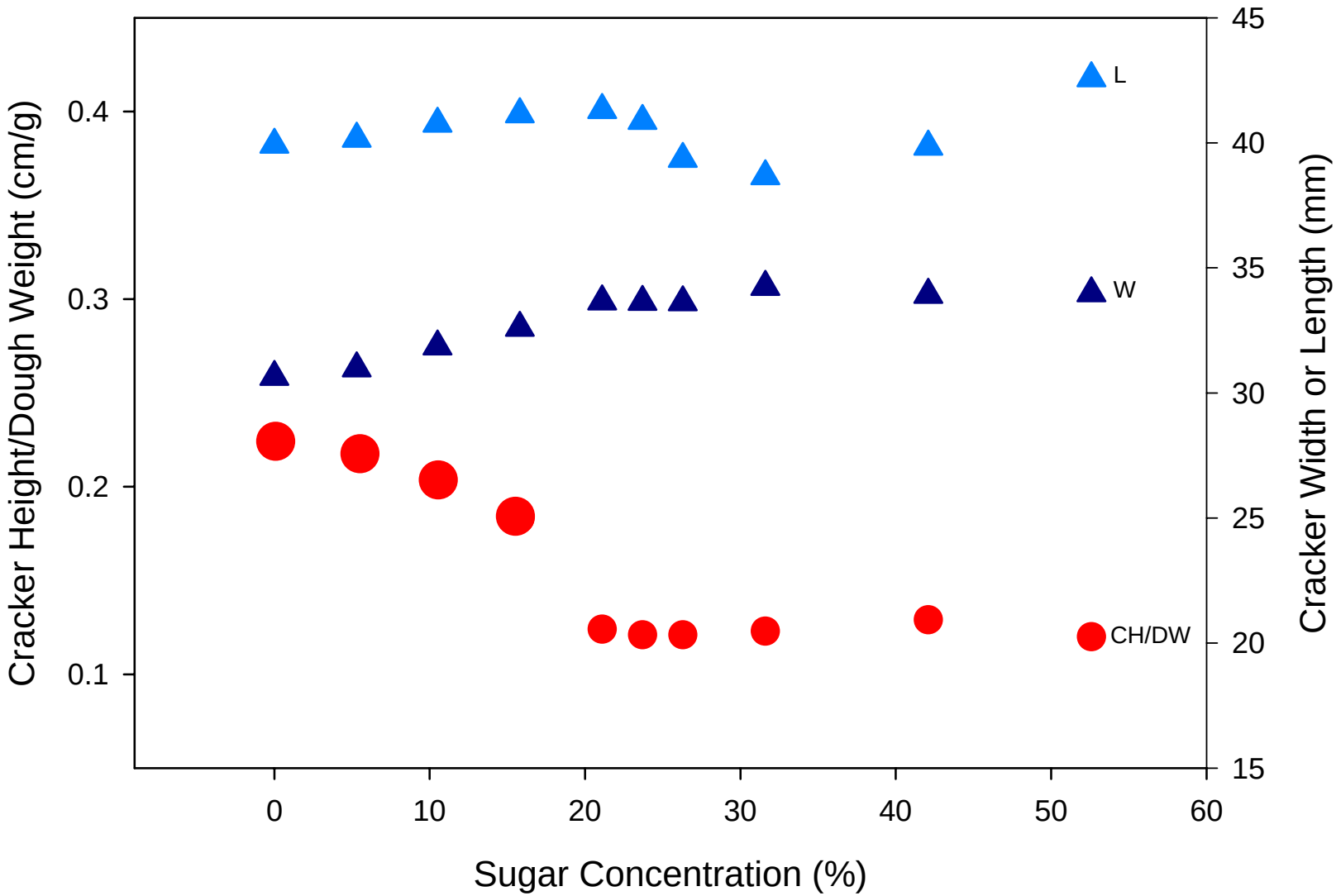
(Used with permission from Louise Slade)

Cracker geometry at various %S, 38TS

Crackers baked with too much water (lower %S at constant TS) resulted in blisters

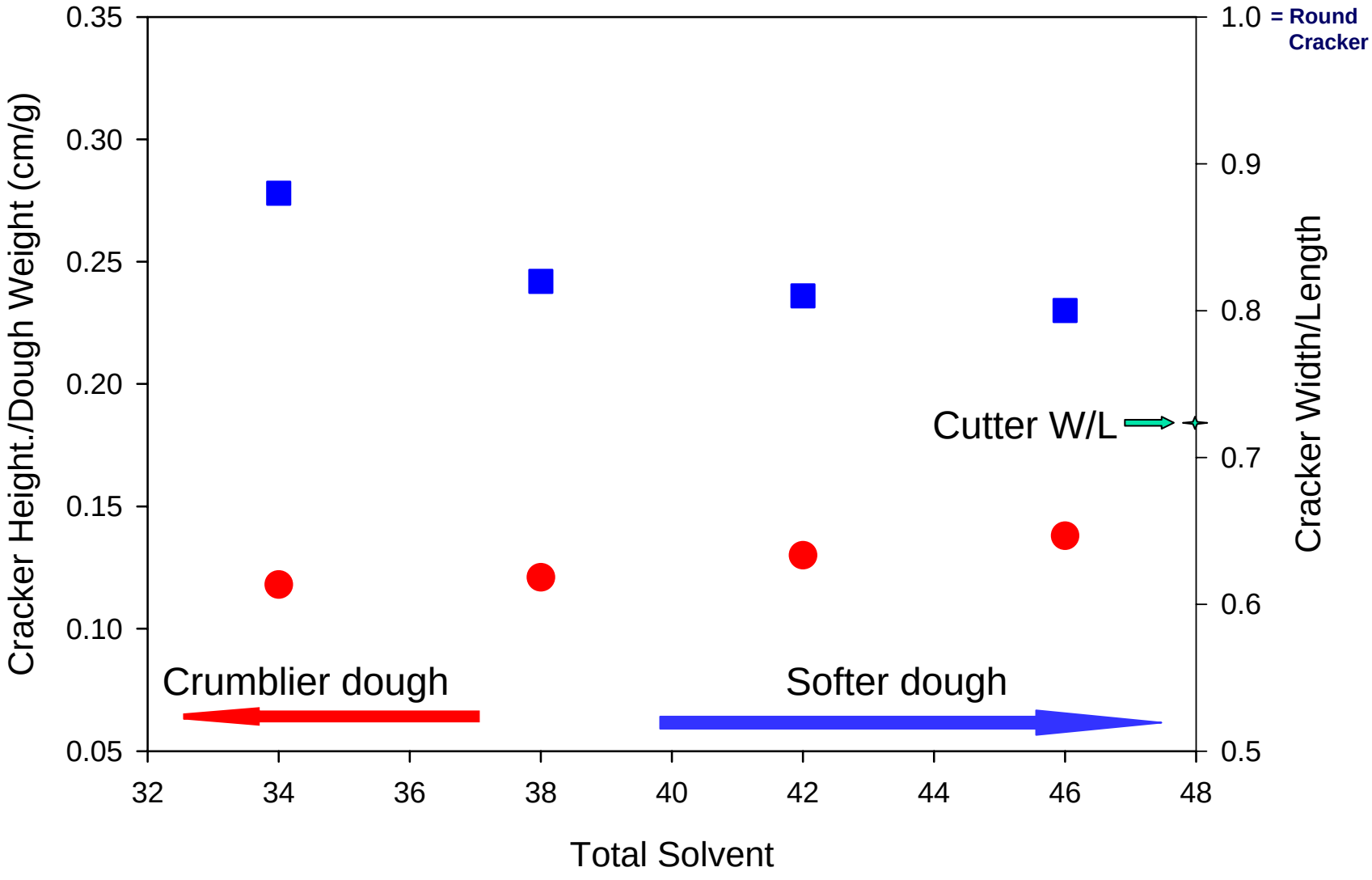


Cracker geometry at various %S, 38TS

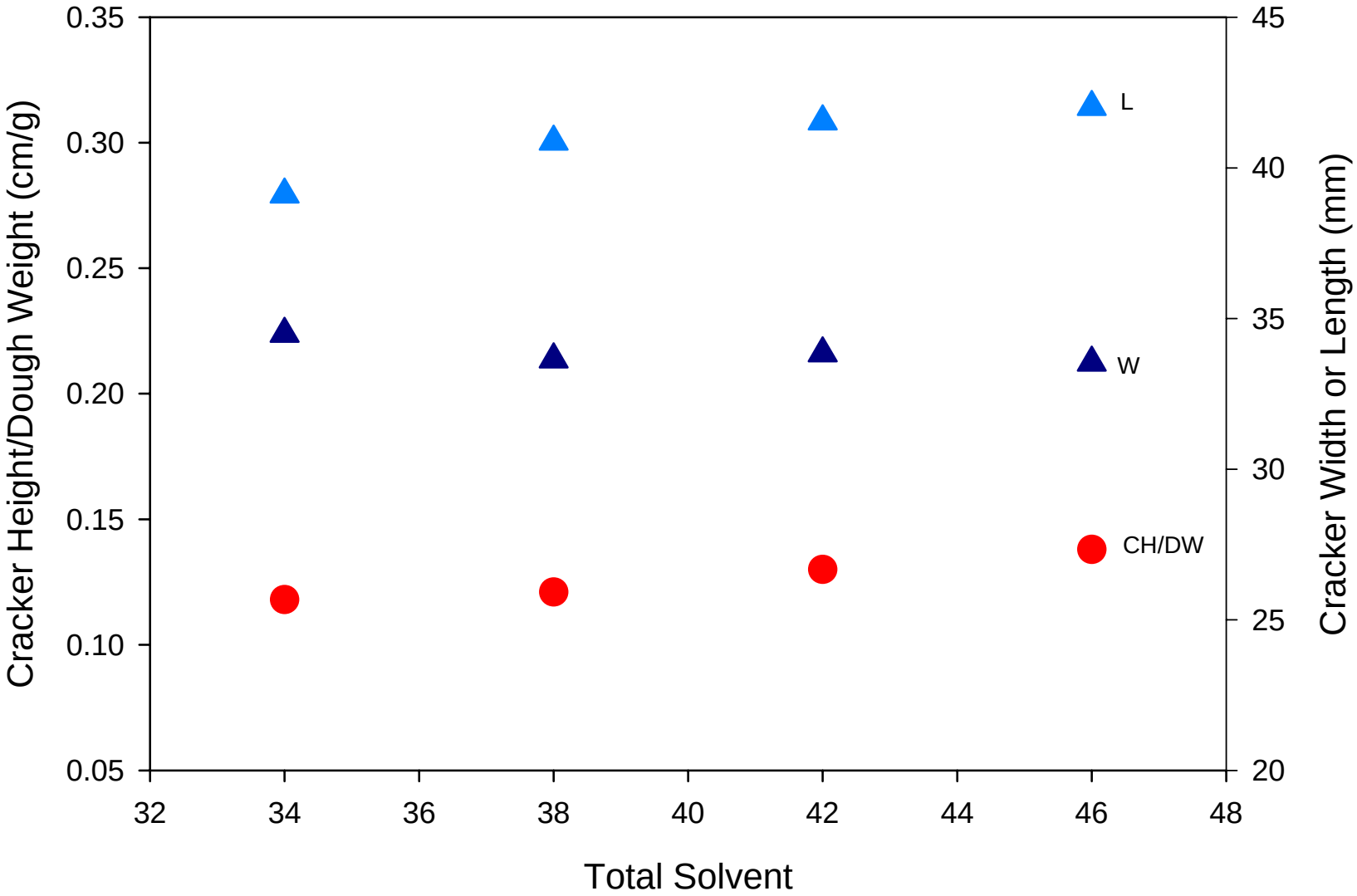


Cracker geometry at various TS, ≈ 23.7%S

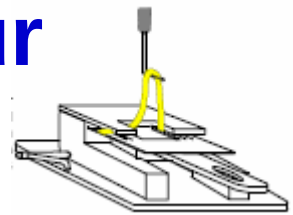
The formula with 23.7%S, 38TS was chosen for testing various flours



Cracker geometry at various TS, ≈ 23.7%S

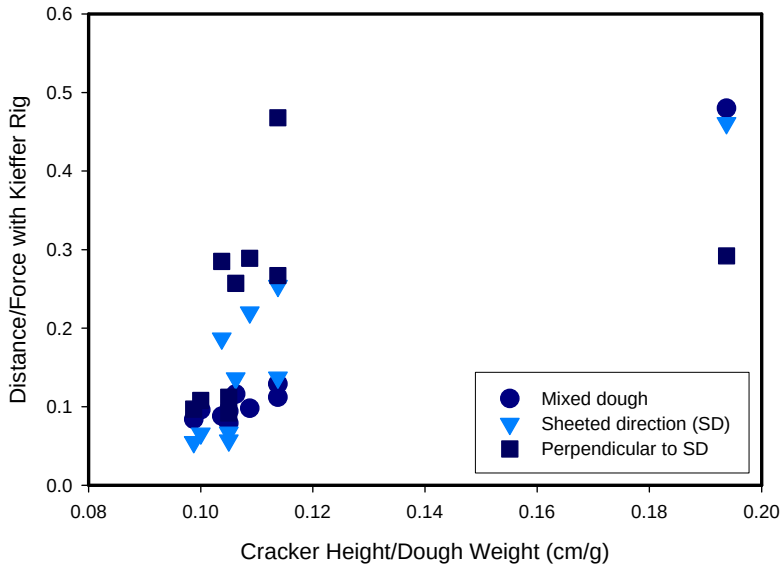


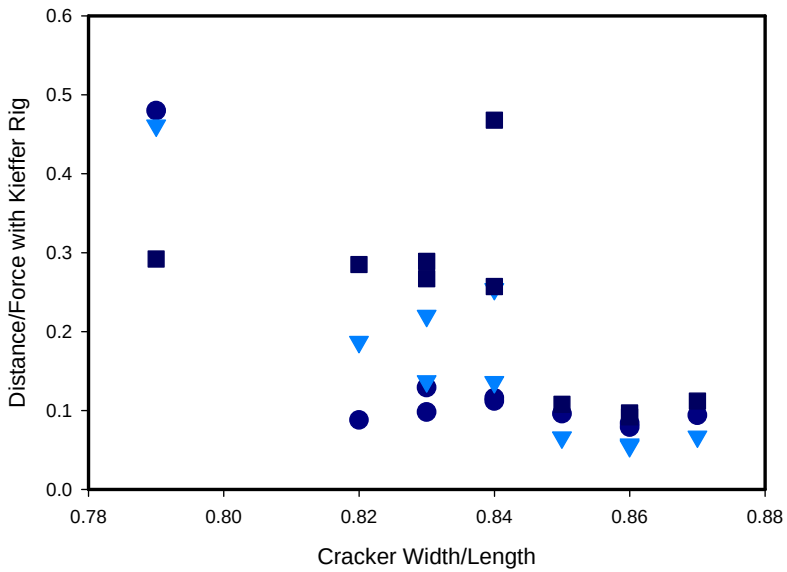
Rheological Test for 2007 QEC flour



(Used Kieffer Rig with TAXT)

Evaluate extent of gluten development during mixing and machining
- Distance/Force of dough in the direction of sheeting was related to both cracker height/dough weight and cracker width/length.





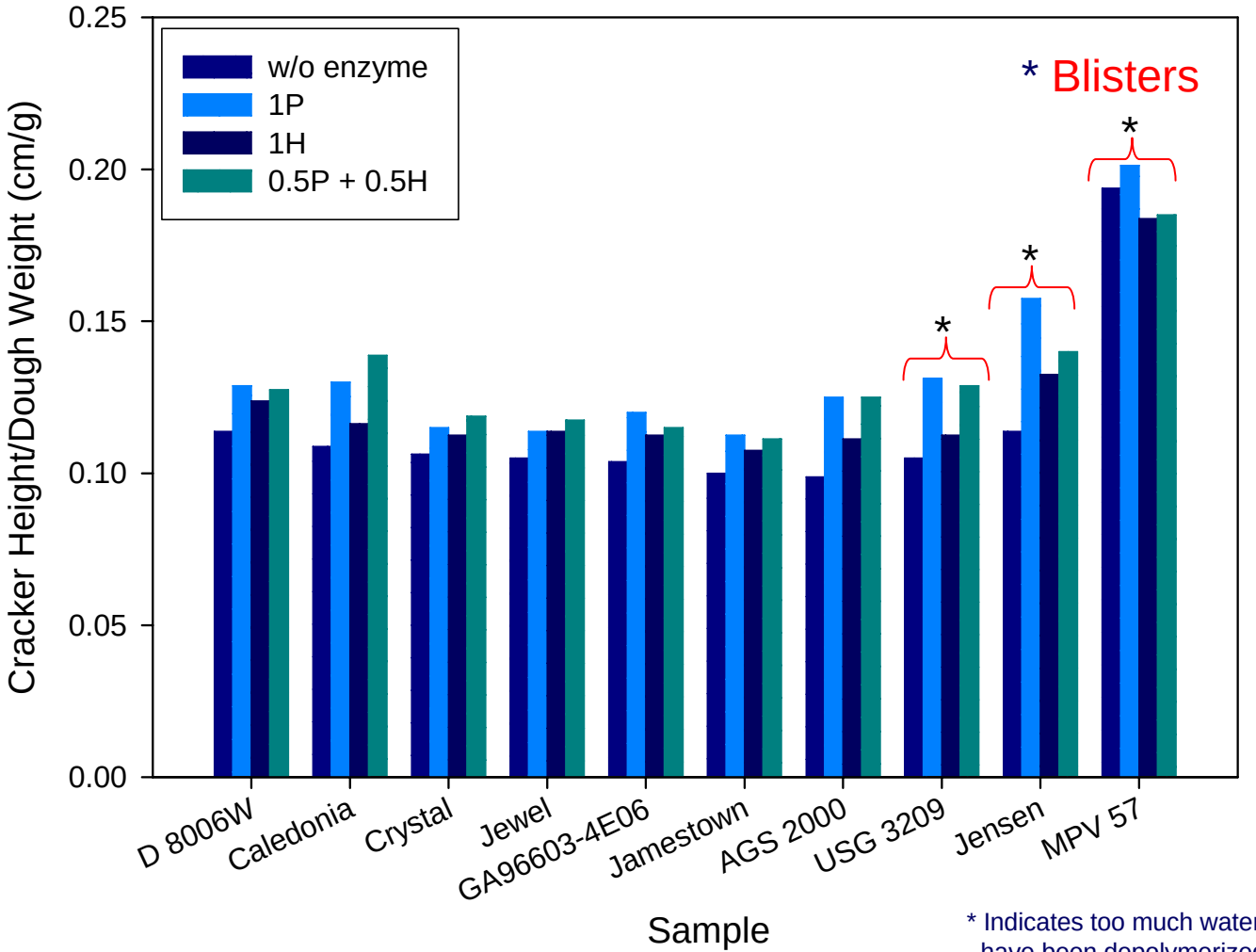
Effect of enzyme treatment on water SRC

Used Histra (alpha-amylase) and Pen III (pentosanase) enzymes

Cultivar	w/o enz.	1P	1H	0.5P + 0.5H
D8006W	48.5	44.9	48.5	46.8
Caledonia	47.1	43.9	47.0	45.6
Crystal	47.2	44.8	47.1	46.1
Jewel	51.1	47.7	51.1	49.3
GA96603-4E16	49.2	46.3	49.5	47.9
Jamestown	51.9	46.9	51.6	49.3
AGS 2000	52.4	46.7	52.0	49.1
USG 3209	55.8	48.6	55.9	51.8
Jensen	48.7	44.9	48.8	47.0
MPV 57	47.9	43.3	48.0	45.5

These very soft wheats did not generate damaged starch during milling, so Histra was not needed.

Effect of enzyme treatment on cracker baking



* Indicates too much water, when pentosans have been depolymerized. Reduction in water and sucrose is typically required.

Cracker baking with flour blend

(GA 96603-4E16:MPV 57=1:1)

GA 96603-4E16 | GA+MPV | MPV 57

Flour	SRC				LA/	Cracker	
	Water	LA	SC	Suc	(SC+Suc)	CH/DW	W/L[1]
GA 96603-	49.2	105.9	64.4	96.0	0.66	0.104	0.817
1G+1M	48.5	89.5	63.5	94.9	0.56	0.119[2]	0.823
MPV 57	47.9	73.0	62.7	93.8	0.47	0.194[2]	0.790

Notes: [1] Cutter W/L was 0.73.

[2] Crackers with blisters. But, the crackers with flour blend showed much smaller and fewer blisters.

Cracker baking with flour blend

(Envoy:Bess =1:1)

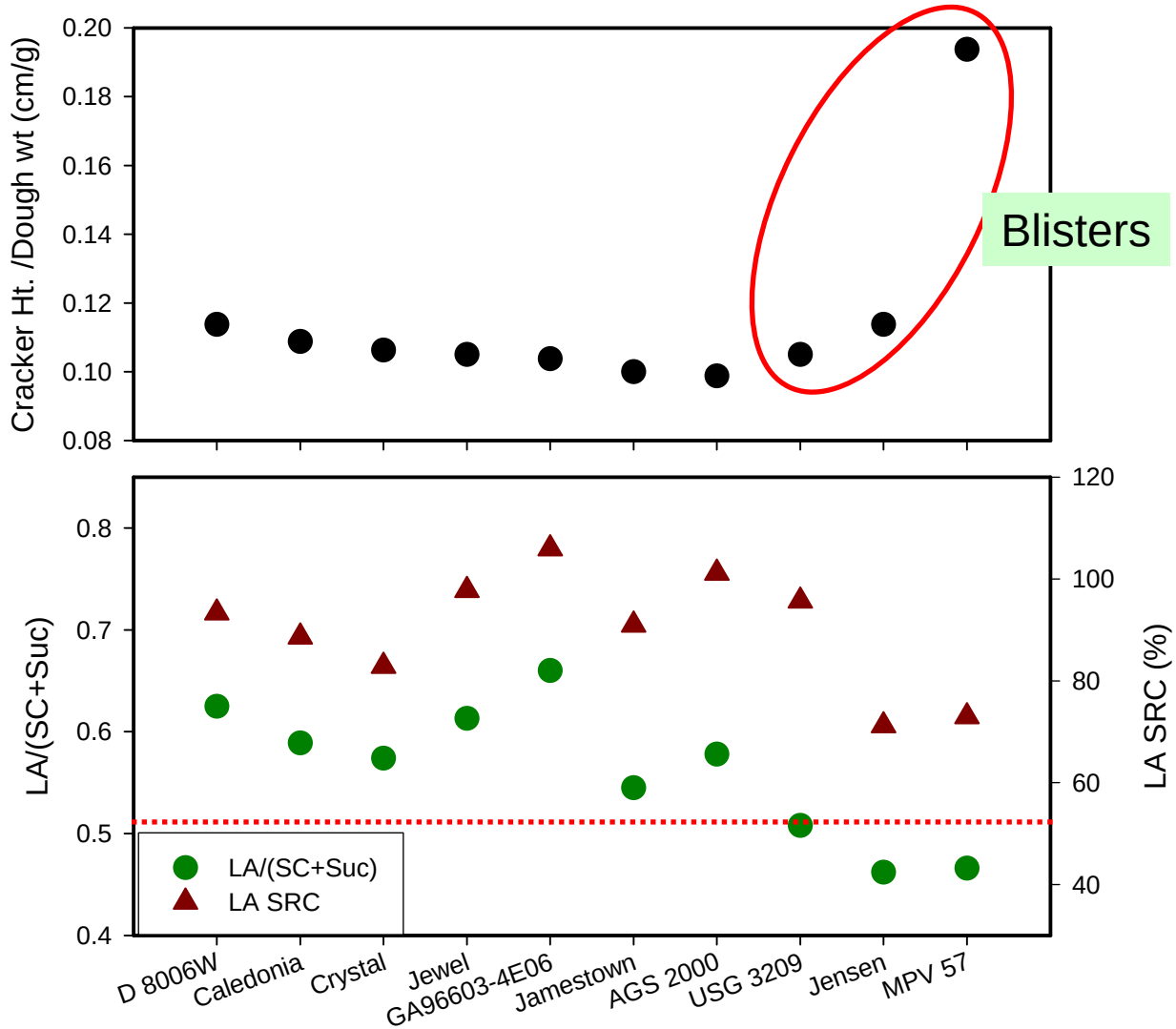
Envoy | Envoy+Bess | Bess

Flour	SRC				LA/ (SC+Suc)	Cracker	
	Water	LA	SC	Suc		CH/DW	W/L[1]
Envoy	52.8	110.7	67.4	90.2	0.70	0.102	0.850
1E+1B	50.2	94.3	67.7	88.6	0.60	0.110	0.845
Bess	47.6	77.9	68.0	87.5	0.50	0.129[2]	0.800

[1] Cutter W/L was 0.73.
[2] Crackers with small blisters.

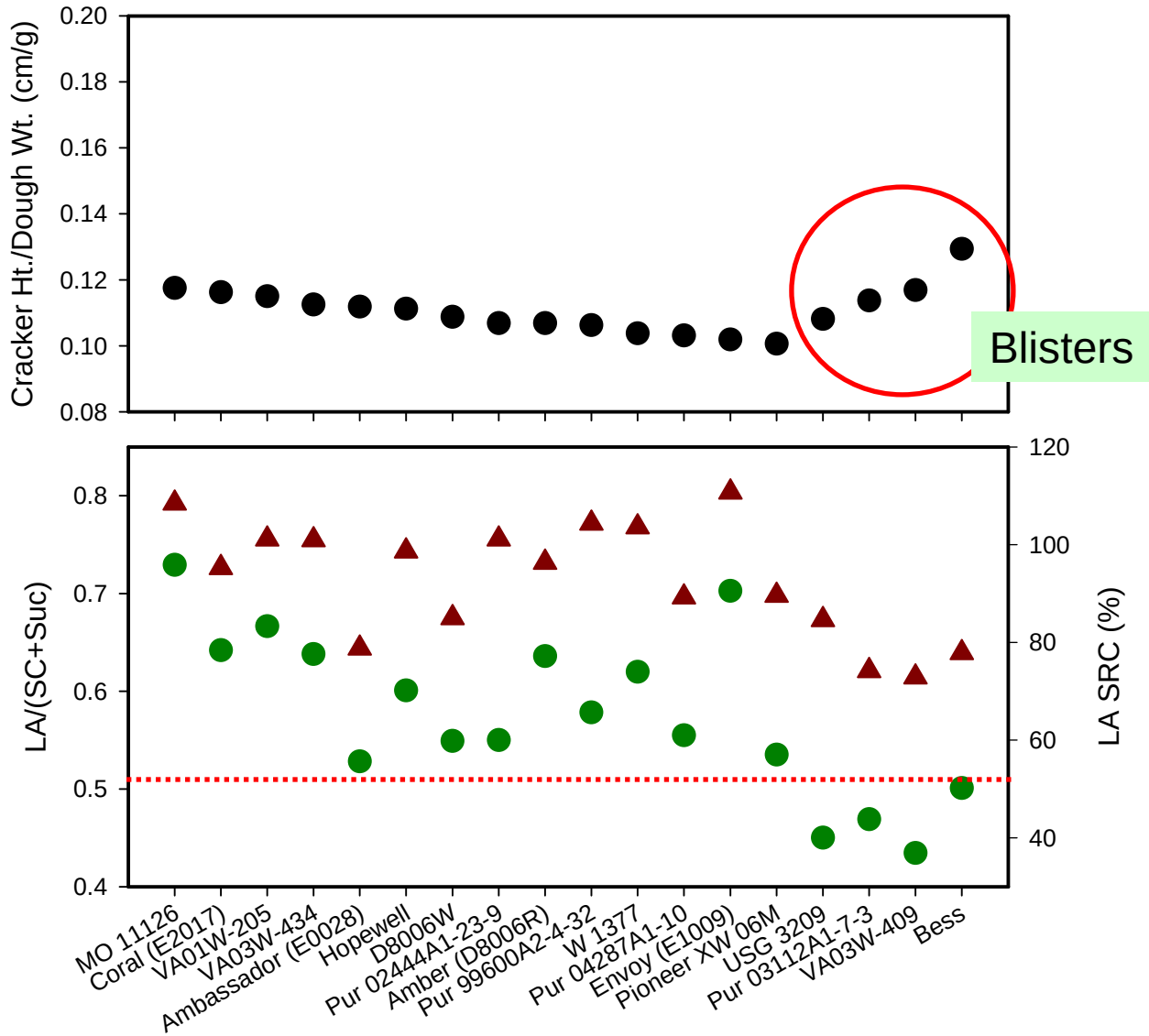
Cracker baking with 2007 QEC flours

The gluten performance ratio, SRC LA/(SC+Suc), accounted for the ratio of cracker height to dough weight, but gluten functionality alone, individual SRC LA, did not.



Cracker baking with 2008 QEC flours

The gluten performance ratio, SRC LA/(SC+Suc), accounted for the ratio of cracker height to dough weight, but gluten functionality alone, individual SRC LA, did not.



Cracker baking with 100% whole wheat flour

Flour	SRC (%)		Cracker baking			
	Water	NaCO3	23.8%S, 42TS		23.9%S, 46TS	
			CH/DW	W/L[1]	CH/DW	W/L[1]
Soft-1	61.88	74.57	0.095	0.80	0.095	0.77
Soft-2	62.94	76.81	0.096	0.81	0.095	0.78
Hard	68.82	85.42	0.086	0.83	0.085	0.81

[1] Cutter W/L was 0.73.
If the cracker snaps back to the desired round shape, W/L increases to 1.0.

Conclusions

- Based on preliminary investigation of the effects of total solvent and sugar concentration, 38TS and 23.7%S were selected as a diagnostic formula to distinguish differences in gluten functionality or performance and overall flour performance for chemically-leavened crackers.
- The gluten performance ratio of SRC LA/(SC + Suc) was a better predictor of cracker geometry than the individual gluten functionality value of LA SRC alone. Flours with a gluten performance ratio smaller than 0.52 resulted in blistering.
- Use of alpha-amylase and pentosanase demonstrated the effect of enzymes on improved cracker baking performance, as a result of decreased crumbliness of dough and increased height of cracker.
- Cracker dough rheology in the direction of sheeting showed a positive relationship with the ratio of cracker height to dough weight, but a negative relationship with the ratio of cracker width to length.

Acknowledgements

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- Edward Souza

"That's
all
folks!"

Thank you!