WGC Funded

In conjunction with USDA-ARS
Western Wheat Quality Lab

Effective, Profitable Wheat and Flour Blending Dynamics

ADB wheat

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ADB WHEAT CONSULTING

Observations

- It was observed that at levels of 20 – 40% SWW in HRS, greater bread volume resulted than was present in either class by itself
- Greater bread volume is a quality attribute
- The ability to blend SWW with HRS is an economic advantage to the baker
- SWW = $7/bu; HRS = $9/bu. If 50:50 blend, cost = $8/bu for an equal or better product, plus saving $1/bu

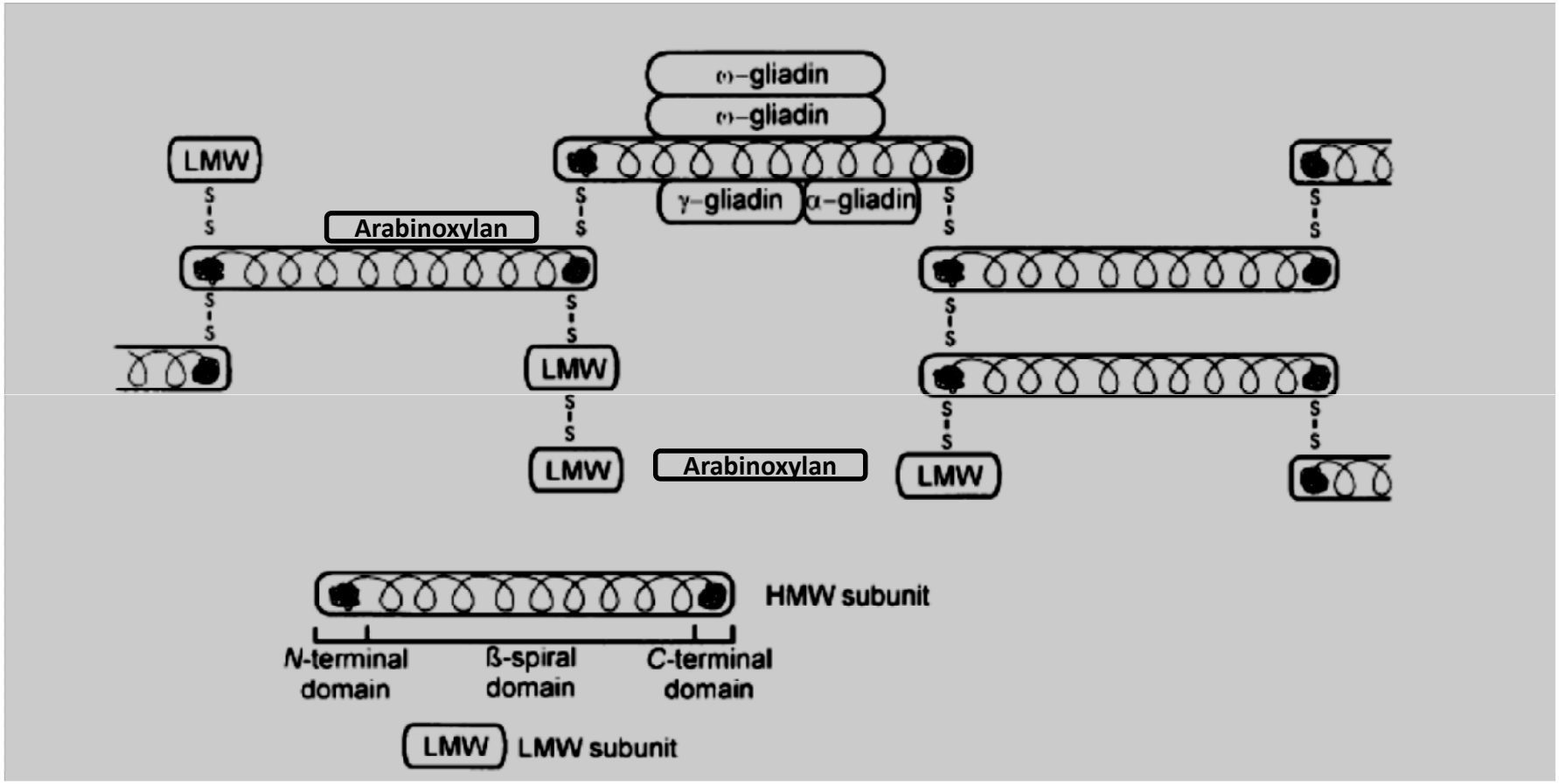
Why is this happening?

- Gluten is unique to wheat
- Gluten is the foundation of wheat flour functionality, especially in yeast leavened products (bread)
- In cookies and cakes, gluten formation is not good. Produces chewy, tough products. In bread, gluten holds leavening gas leading to larger, less dense products

Gluten Functionality

- Gluten, *per se*, does not exist in wheat
- Gluten is the result of mixing flour with water
- Gluten is a polymer composed of a range of smaller proteins and carbohydrates that together form the gluten and are responsible for functionality:
  - HMW-Glutenins; create dough elasticity
  - Gliadins, arabinoxylans; create extensibility and firmness
  - LMW-Glutenins; contribute to extensibility
- Ratio of the components, and the make-up of the components determines the functionality of the gluten
- Total gluten weight and large polymer composition is important.

Molecular Gluten

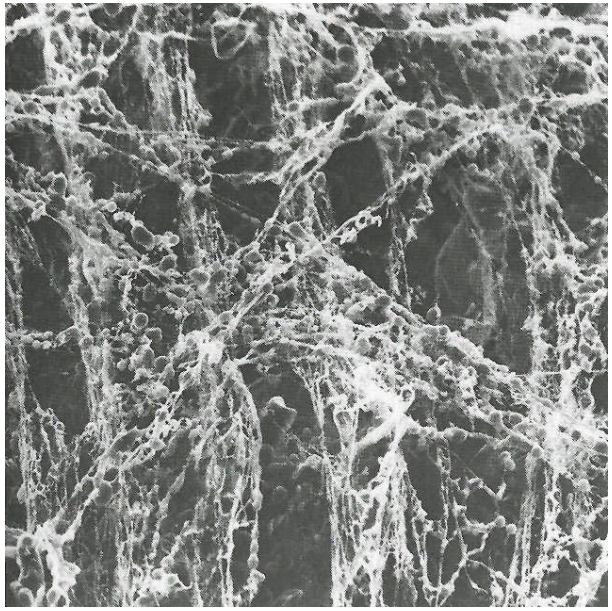


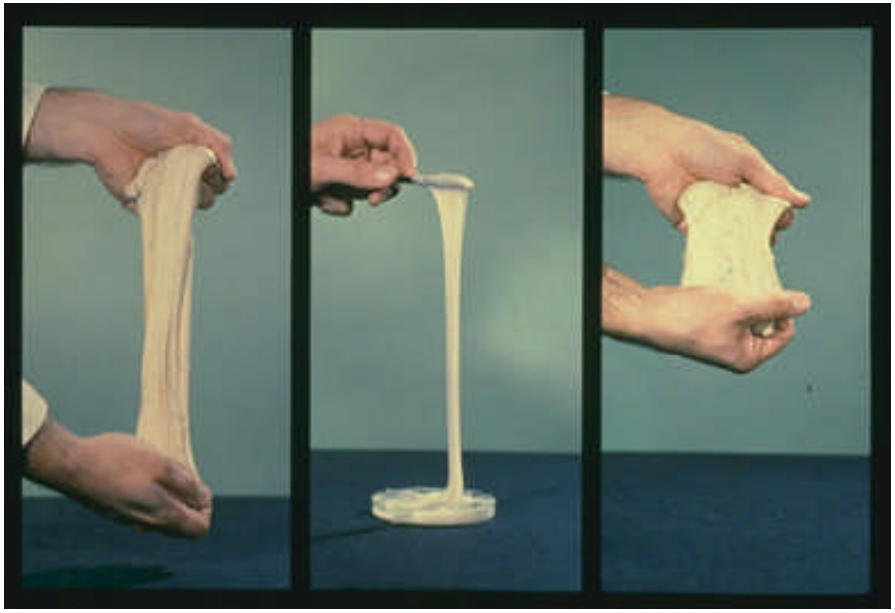
HMW-GS are postulated to form the backbone in a head-to-tail fashion with LMW-GS serving as chain terminators and gliadins interacting non-covalently.

Slide courtesy of K.Seetharaman, Univ. of Guelph, Canada

Shewry PR, Y Popineau, D Lafiandra, and P Belton. 2001. Wheat glutenin subunits and dough elasticity: findings of the EUROWHEAT project. *Trends Food Sci Technol* 11:433-441.

Glutenin/Gliadin Composition Causes Functional Differences





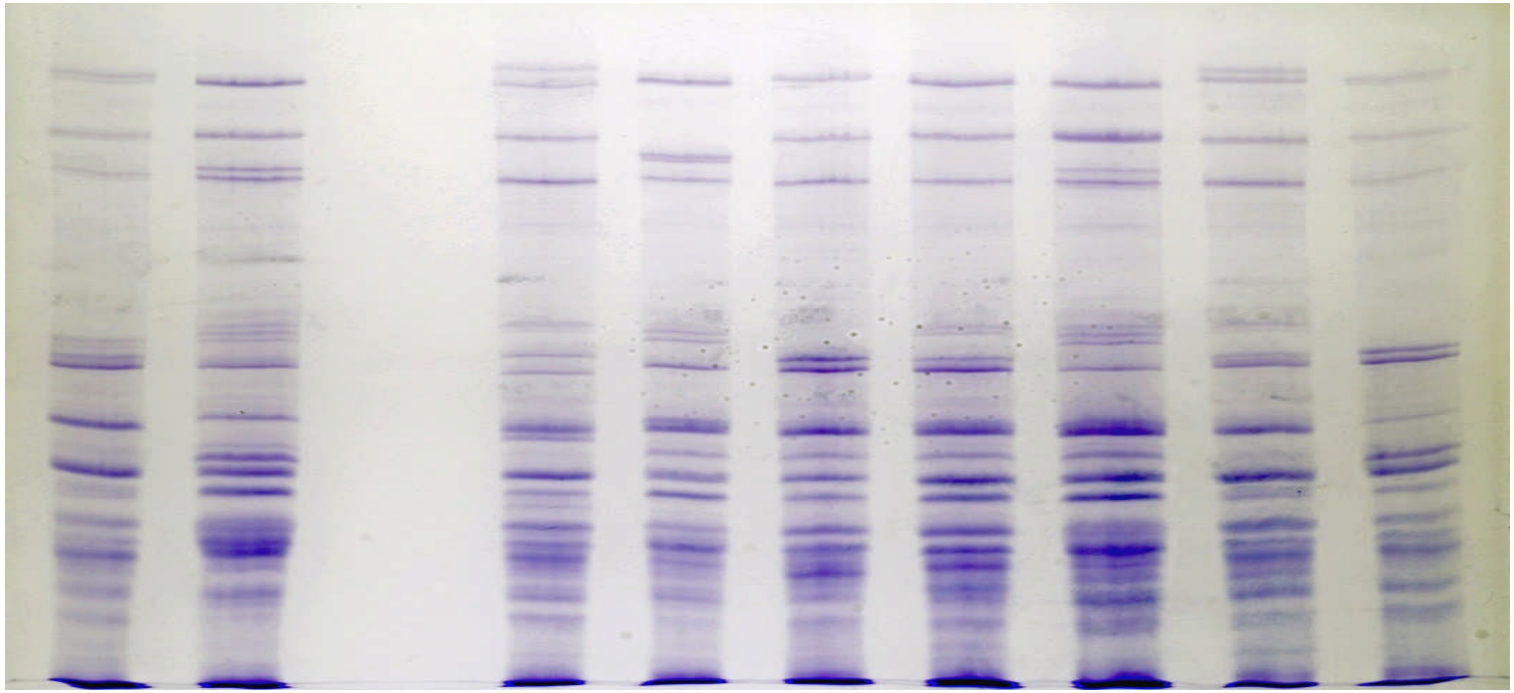
Gluten Functionality

- Two basic “families” of HMW-glutenin
  - “5+10” used for strong, elastic gluten products. Generally (not always) in hard wheat
  - “2+12” used for cookies, cakes. Always in soft wheat, never in hard wheat
- HMW-glutenin the primary quality determinant in gluten; modified by other components

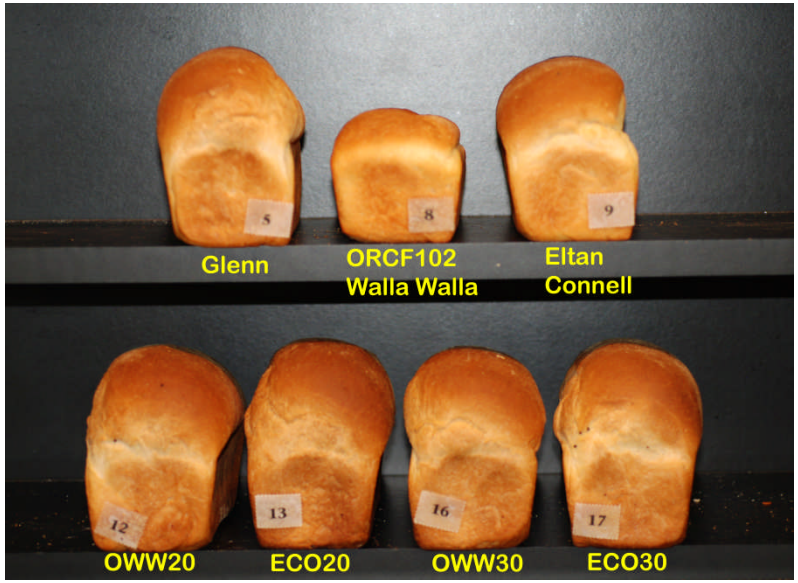
Why?

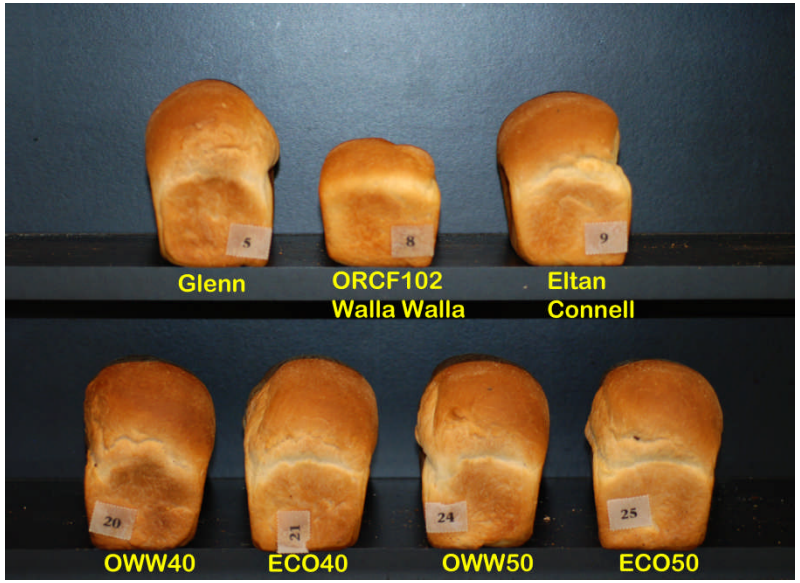
1	2	3	4	5	6	7	8	9	10
102	Jeffrsn	____	Eltan	Hank	Xerpha	AP700 CL	Buck Pronto	Brndge	Madsn
_/2+12/ 7	2*/5+10 /7+8		1/5+10/ 7+9	1/5+10/ 17+18	_/2+12/ 7+9	_/2+12/ 7	2*/5+10 /7+8	1/2+12/ 7+9	_/2+12/ 7+9

Total Protein Gel:
HMW + LMW
Glutenin
and Gliadin



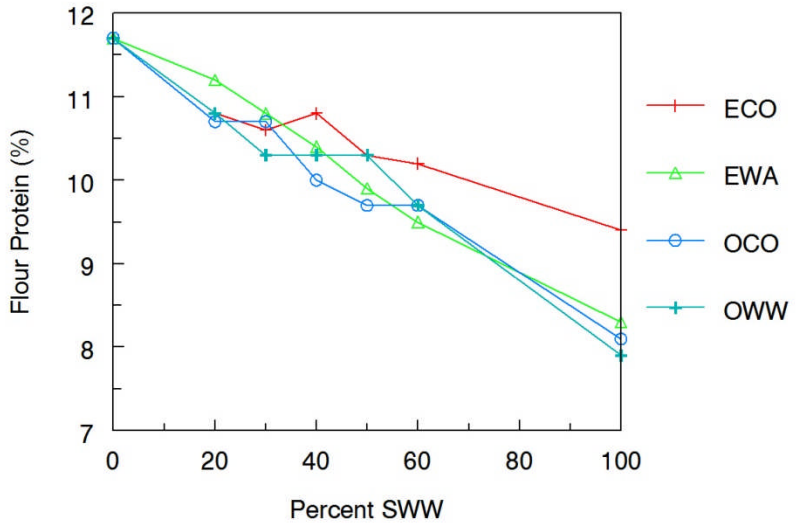
Bread Results

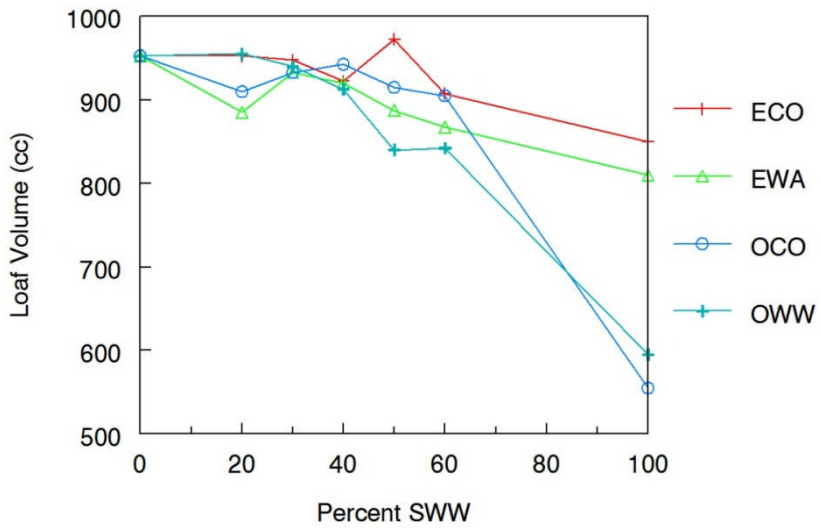




Glenn = HRS, strong, 5+10 ORCF102 = SWW, weak, 2+12 Eltan = moderate, 5+10

Bread Baking

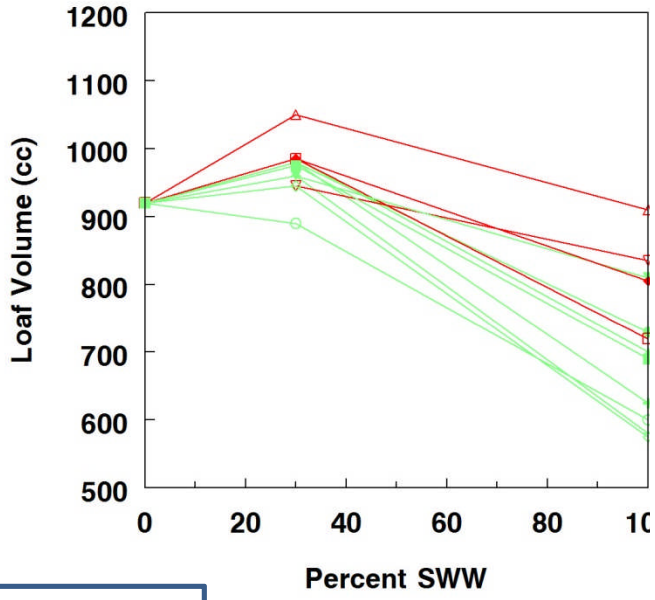




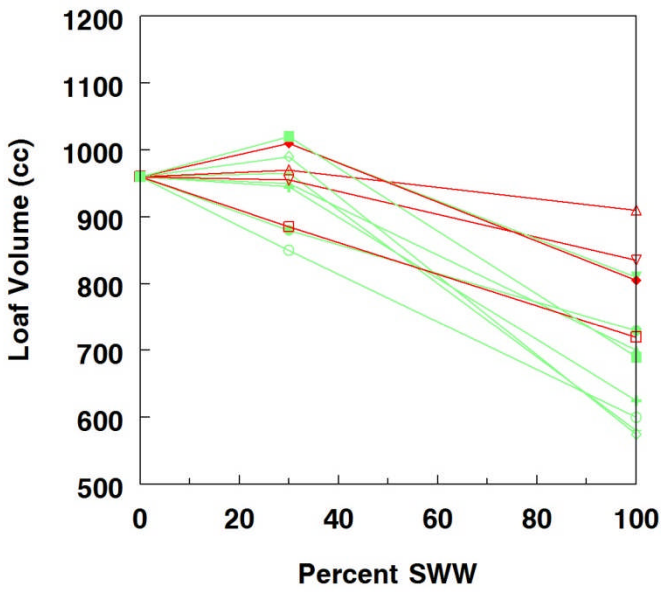
Blending with Top HR and SW Varieties

Jefferson HRS
Hank HRS
Buck Pronto HRS
Kelse HRS
Glenn HRS
Farnum HRW
ORCF102 SWW
Eltan SWW
Xerpha SWW
AP700CL SWW
Brundage 96 SWW
Madsen SWW
ORCF103 SWW
Stephens SWW
Louise SWS
Nick SWS
Alpowa SWS
Whit SWS

HMW Glutenins
5+10 2+12



Farnum (HRW)



Glenn (HRS)

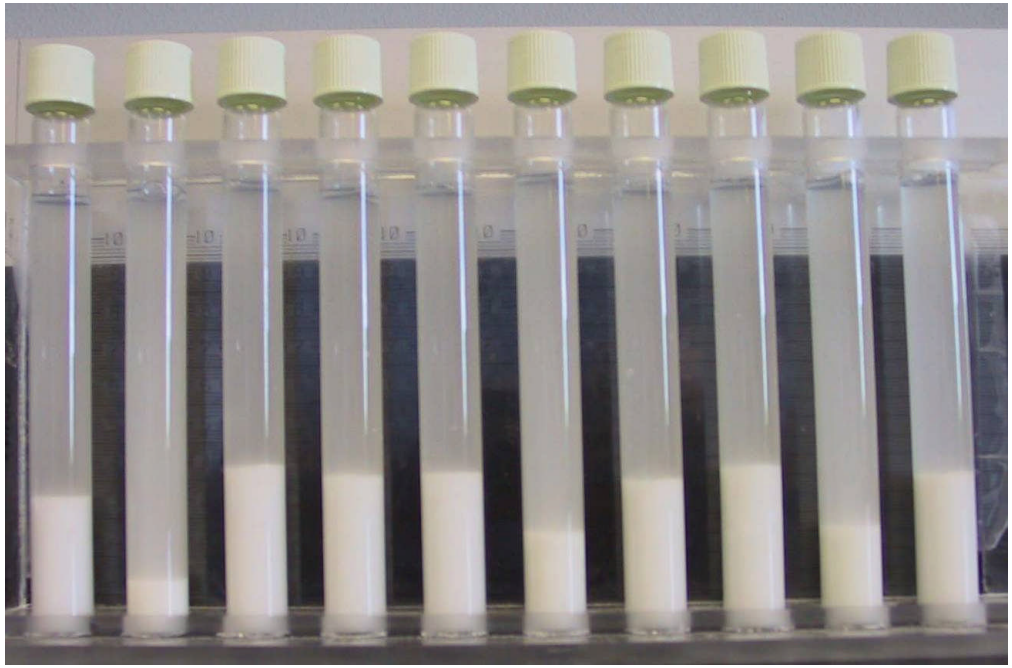
Indications

- Adding SW to HR leads to larger loaf volumes
- Between 30 and 60% SW can be used at great savings
- Due to more extensible gluten and greater gluten mass

Methods of Analysis

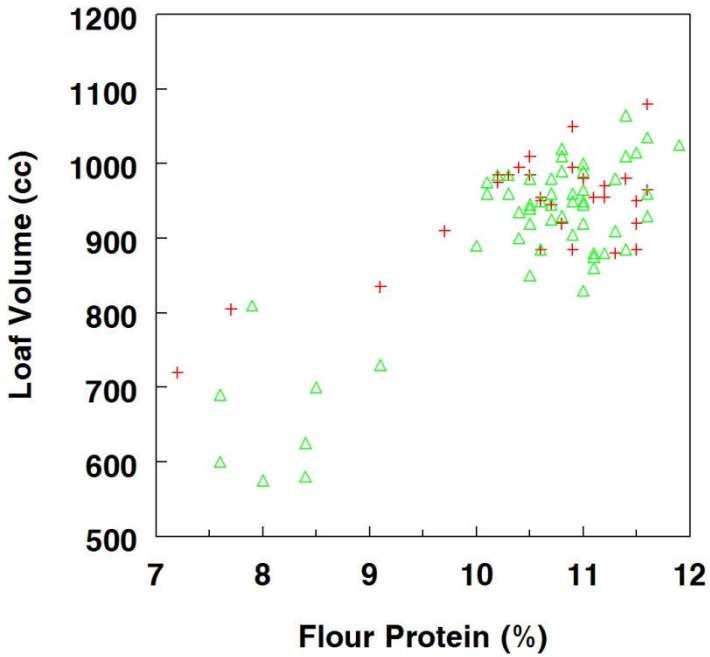
- Monitoring protein quantity is easy
- Estimating protein quality is difficult
- Methods exist to estimate quality

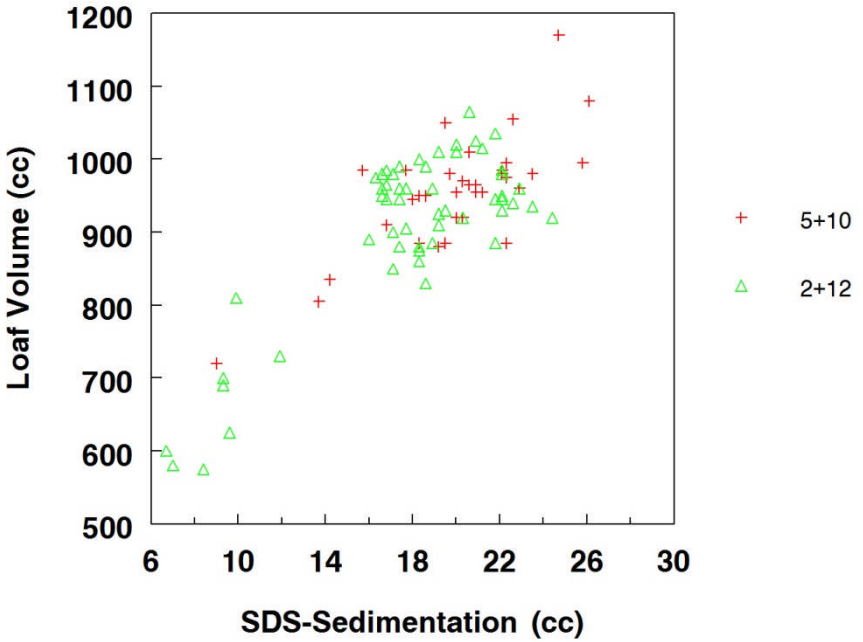
SDS-Sedimentation



Quick, inexpensive, easy: Hydrate flour, add SDS + lactic acid, wait, measure volume

Protein and SDS-Sedimentation vs Loaf Volume





Good Predictions are Possible

- Protein alone can predict bread loaf volume at r = 0.70
- SDS-Sedimentation volume alone can predict bread loaf volume at r = 0.80
- SDS-Sedimentation plus protein quantity can predict bread loaf volume at r = 0.92
- This test can provide information in marketing channels, rapidly and provide some assurance of end-use functionality

Conclusion

- Bread functionality can be maintained, or bettered, through blending US HRS or HRW and US SWS and SWW wheat
- 20 – 60% blends work well, depending on wheat market class and protein quality and quantity
- Cost differential between HR and SW determines profit
- Strong gluten in US HRS and HRW is advantageous
- Use of 5+10 HMW Glutenin types enhances the effect
- Flour yield is increased in SW (74-76% vs 70 -72% in HR at 0.50 ash)
- Blending SW/HR gives better control of product and gives more consistency than one wheat class alone

Conclusions

- Hard and soft wheats must be milled separately (tempering requirements and mill flow & sieving)
- Protein content that is too divergent minimizes functionality(eg. HR = 14.5% and SW = 8)
- Protein content that is closer between classes maximizes end-use functionality (eg. HR = 12% and SW = 10)
- Other components also have a role: non-starch carbohydrates (arabinoxylans) and puroindolines also participate in the “sweet spot” blending effect
- For more science in this area, participate with the AACC International scientific organization (Cereal Chemists).

THANK YOU

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