

Proteins: At The Core of Malting, Brewing and Beer

Charlie Bamforth

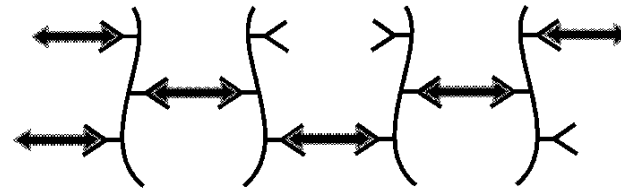


Types of proteins

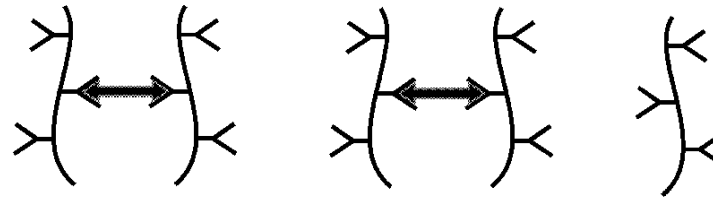
- Albumins
- Hordeins (gliadins)

Enzymes

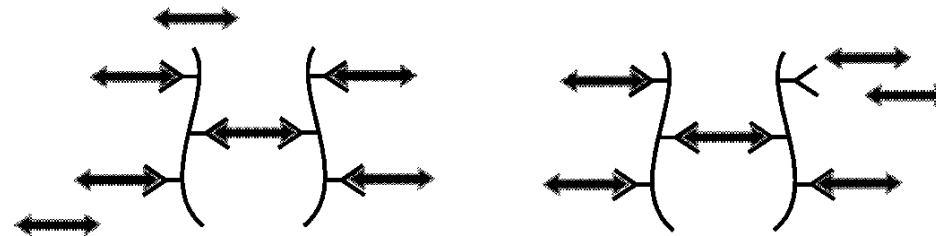
Haze



[Polyphenol] = [Protein]

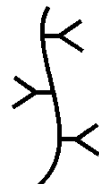


[Polyphenol] < [Protein]



[Polyphenol] > [Protein]

 Polyphenol molecule



Protein molecule with fixed number of polyphenol binding sites (i.e. haze-active)

Karl Siebert

Gliadin intolerance



- Natural process losses
- Prolyl endoproteinase

Beer		Problematic protein (mg/liter)
Alcohol Free		6.5 ± 0.14
American Lager		7.1 ± 0.39
American Lager		12.3 ± 0.68
American Light Lager		6.1 ± 0.11
American Light Lager		12.2 ± 0.18
American Light Lager		3.9 ± 0.10
American Low Carb Lager		12.1 ± 0.61
American India Pale Ale		11.8 ± 0.57
American India Pale Ale		19.3 ± 0.1
American India Pale Ale		14.3 ± 0.34
American Pale Ale		14.6 ± 0.33
American Pale Ale		15.3 ± 0.53
American Pale Wheat Filtered		145.8 ± 0.69
American Porter		28.5 ± 1.28
Czech Pilsner		14.9 ± 0.64
Dunkelweizen		98.2 ± 0.092
English Brown Ale		8.0 ± 0.17
English Pale Ales		7.17 ± 0.32
European Pale Lager		8.26 ± 0.39
Irish Dry Stout		18.9 ± 0.38
Sweet Stout		17.1 ± 0.61

Codex Alimentarius Standard
<20mg/liter is "Gluten-free"

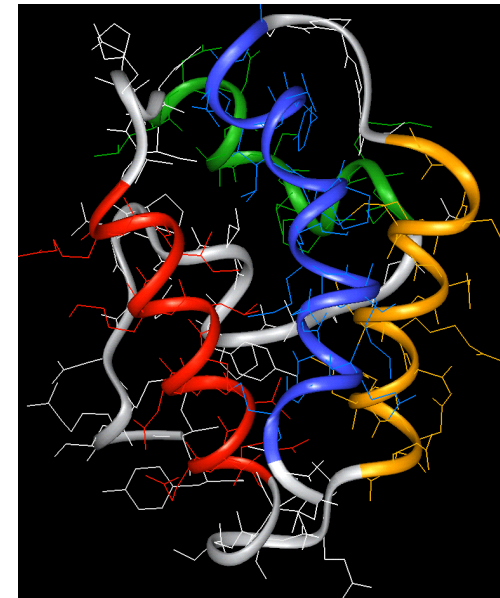
Foam

Which Polypeptides?

- Discrete polypeptide hypothesis
- Generalized amphipathic polypeptide hypothesis

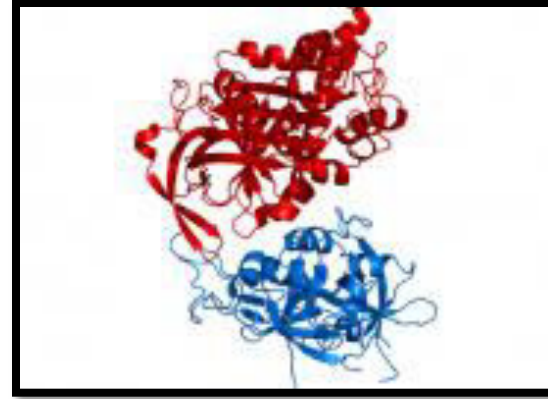
Some Proposed Foaming Proteins

Lipid Transfer Protein (LTP1)

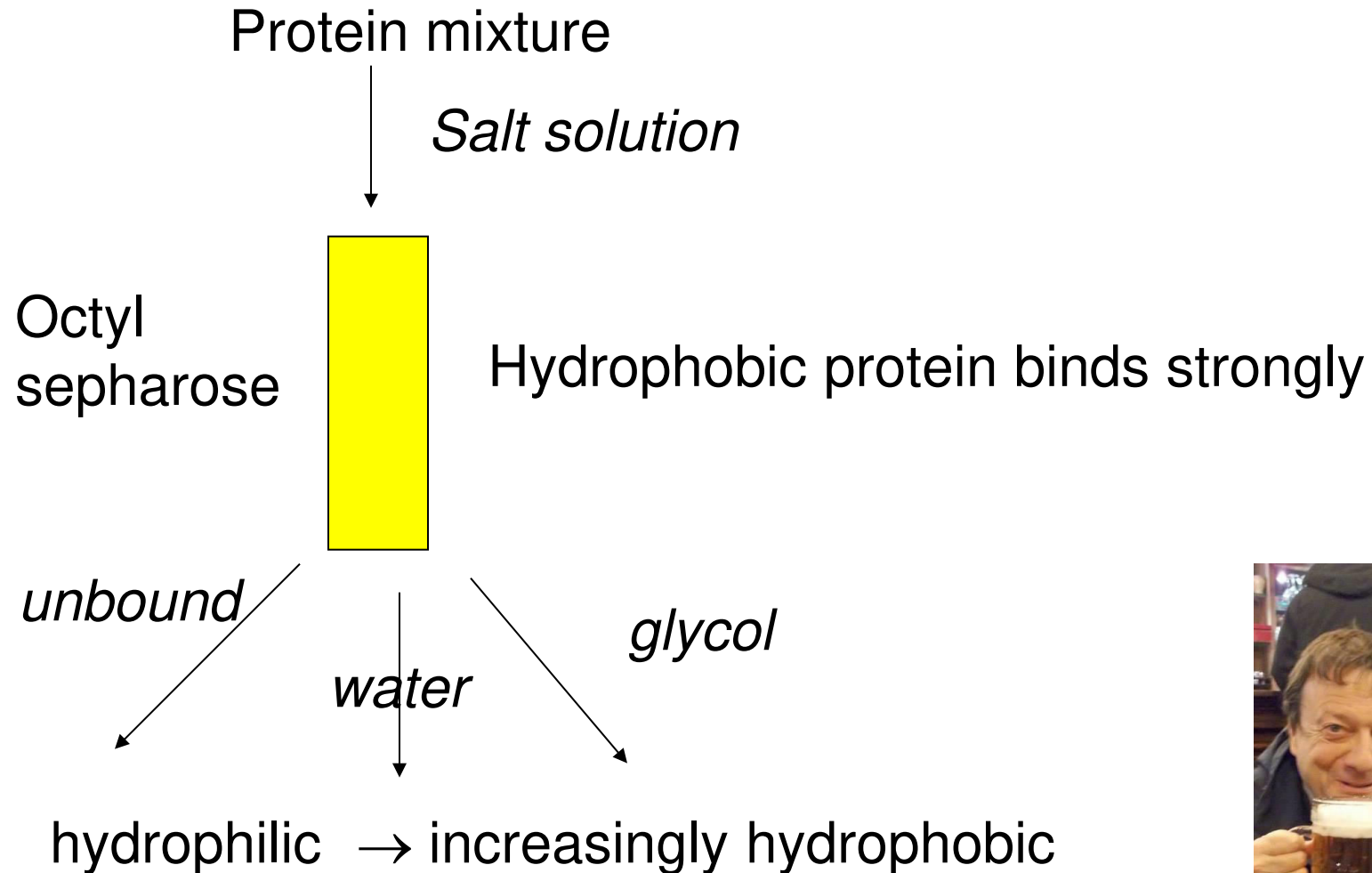


Protein Z (40kD protein)

- serpin from barley

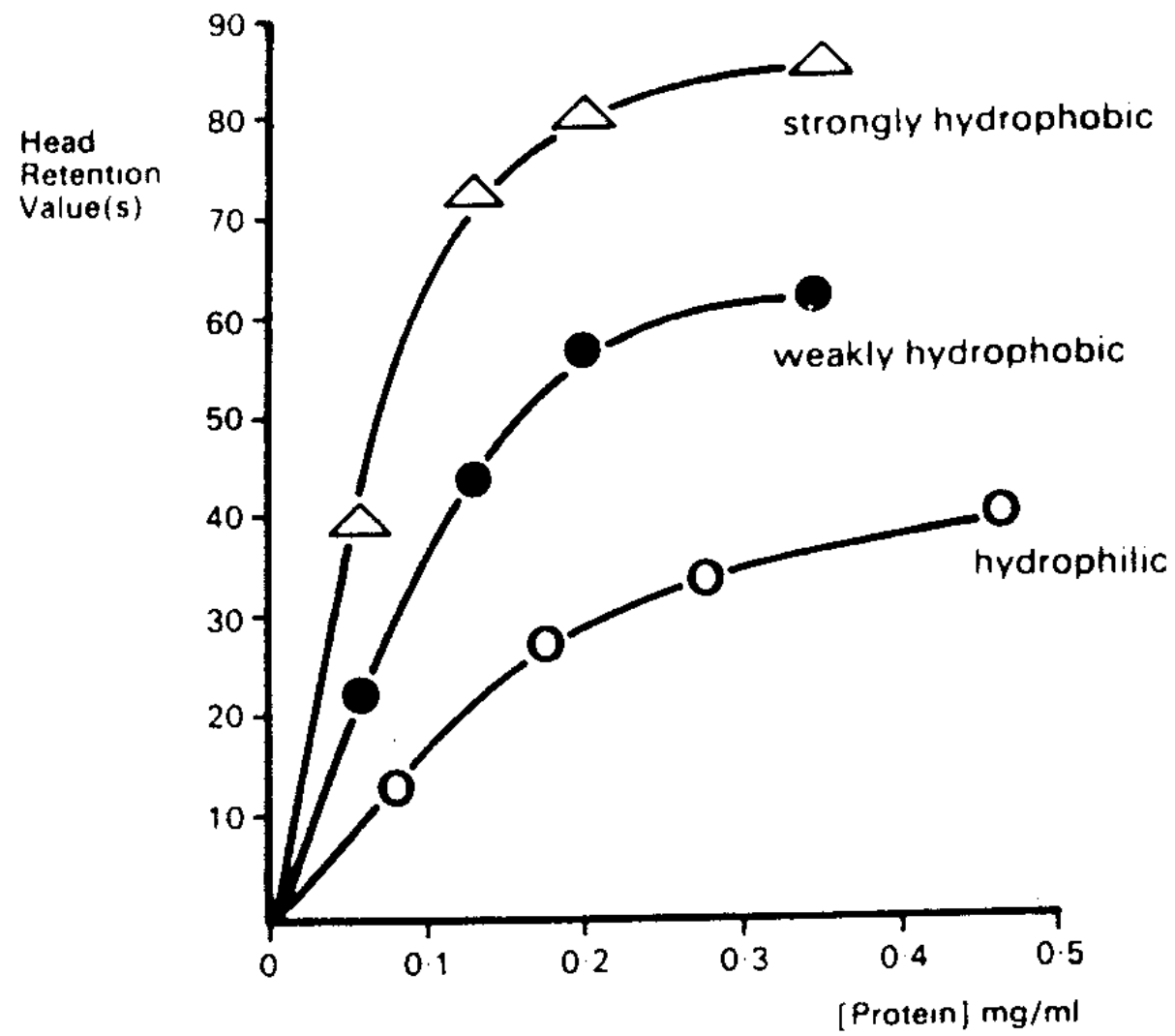


The Generalized Amphipathic Polypeptide Hypothesis



Slack & Bamforth, *J. Inst. Brew.*, 1983





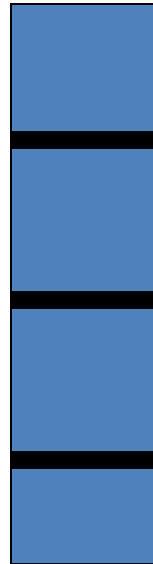
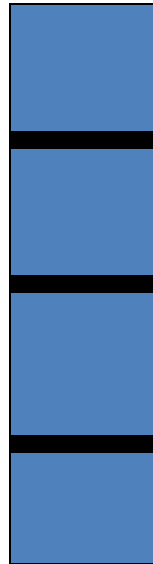
Beer Polypeptides

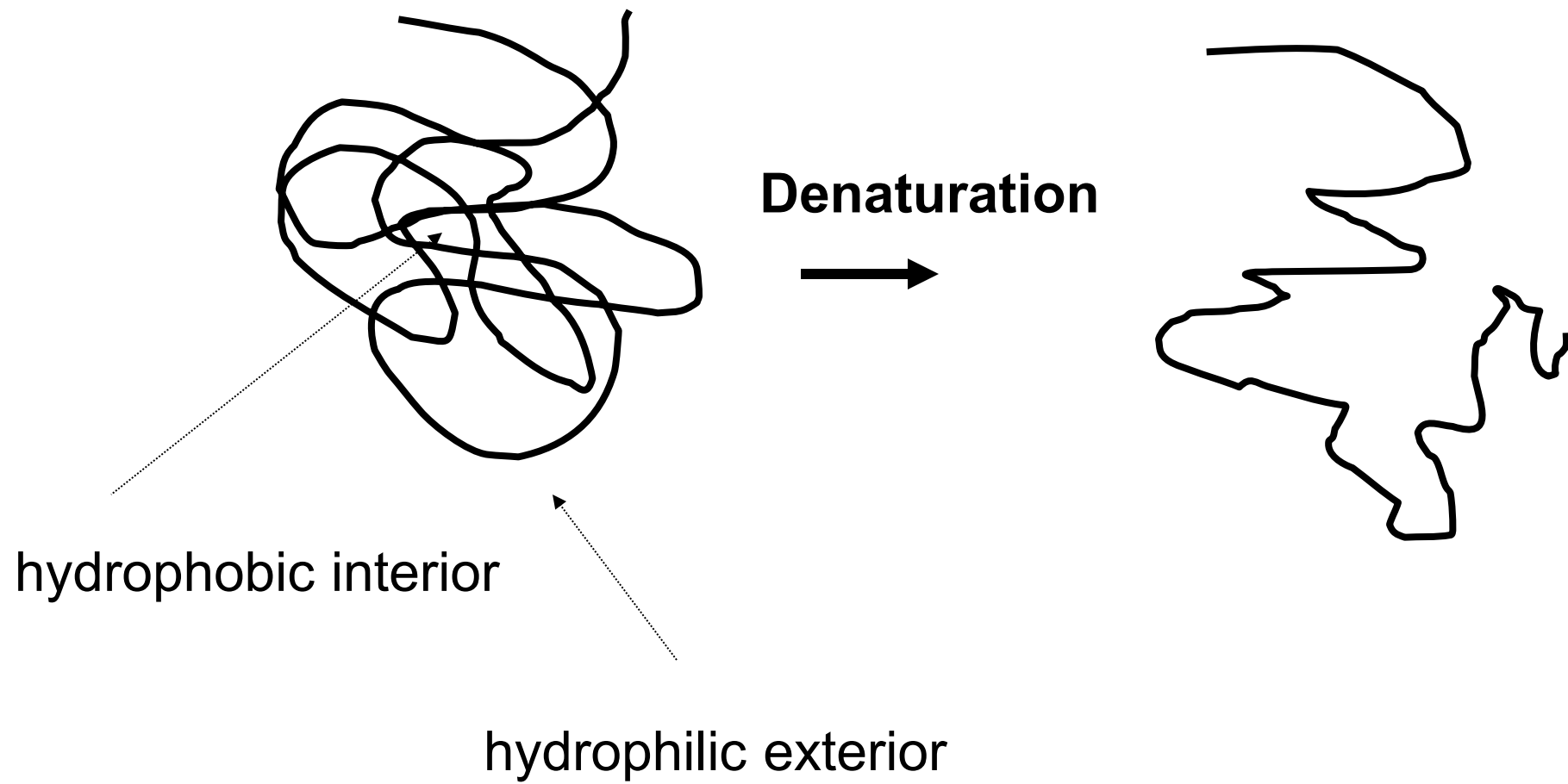
Hydrophobic

Mod. Hydrophobic

Hydrophilic

*Decrease
In mol.wt.*





Proteins in barley

Water soluble

Not water soluble

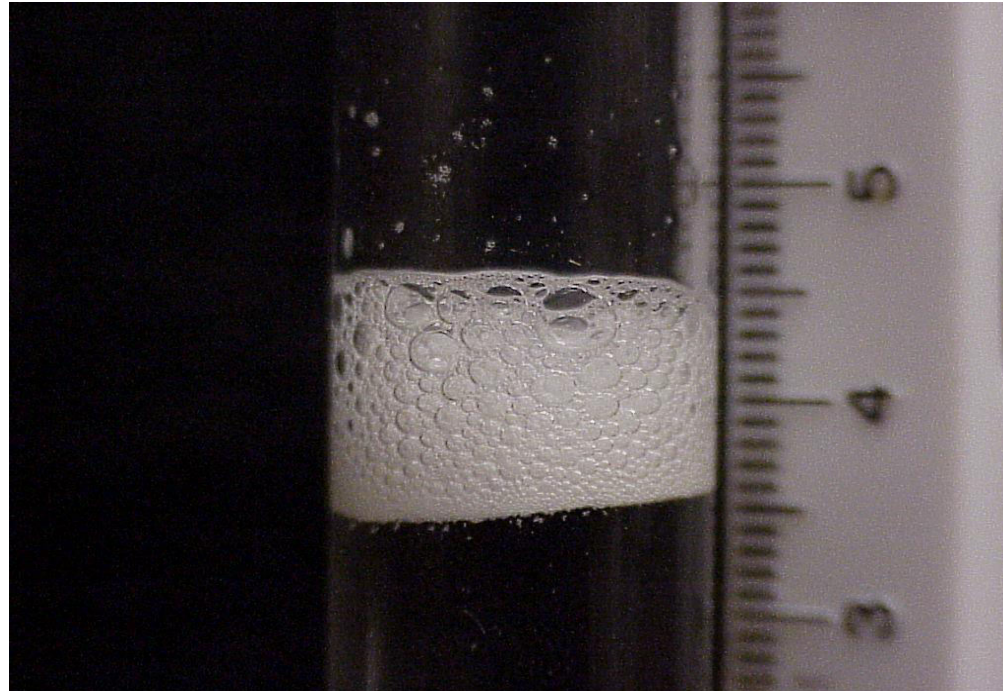
Albumins

Hordeins

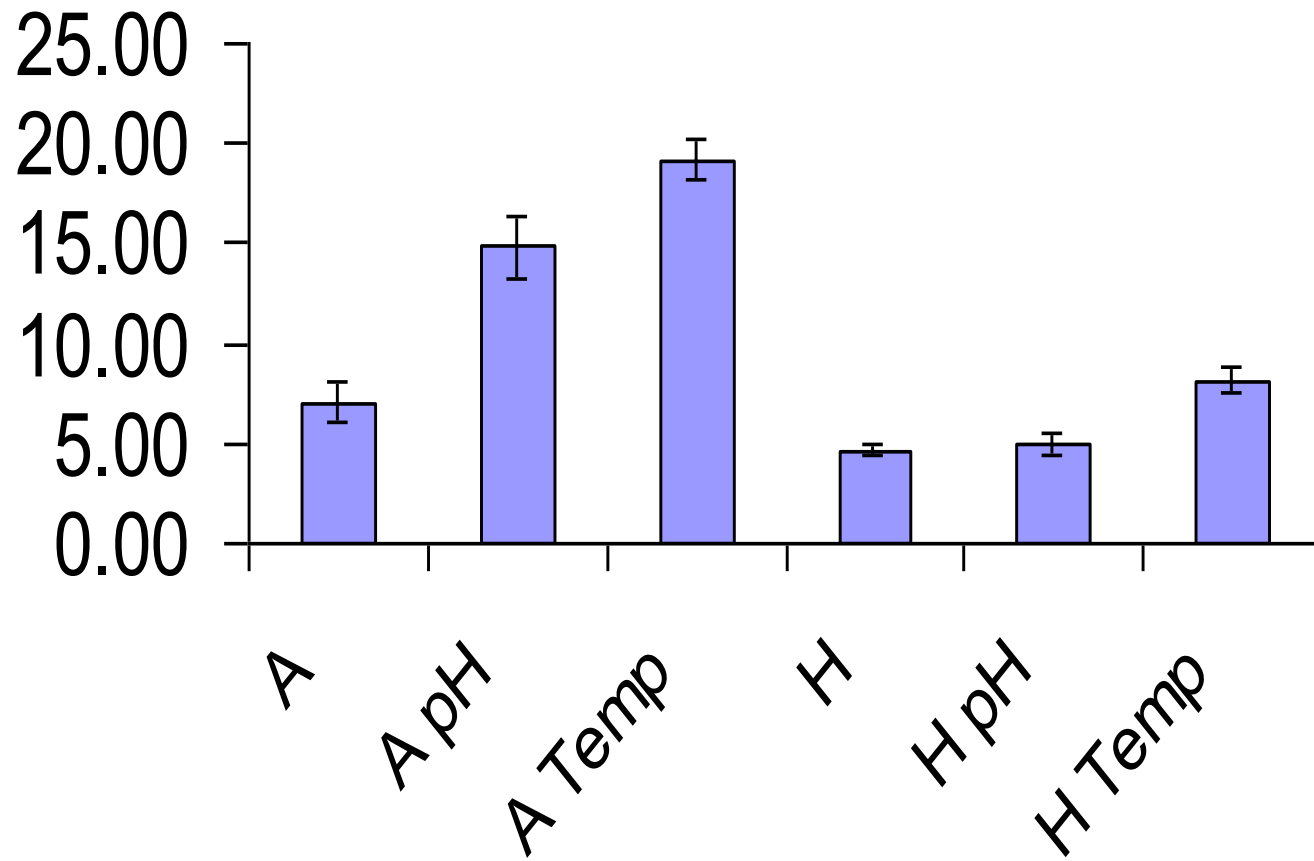


Shaking procedure

- Shake 10x, 15" arch, within 3 seconds
- Measure liquid and foam height

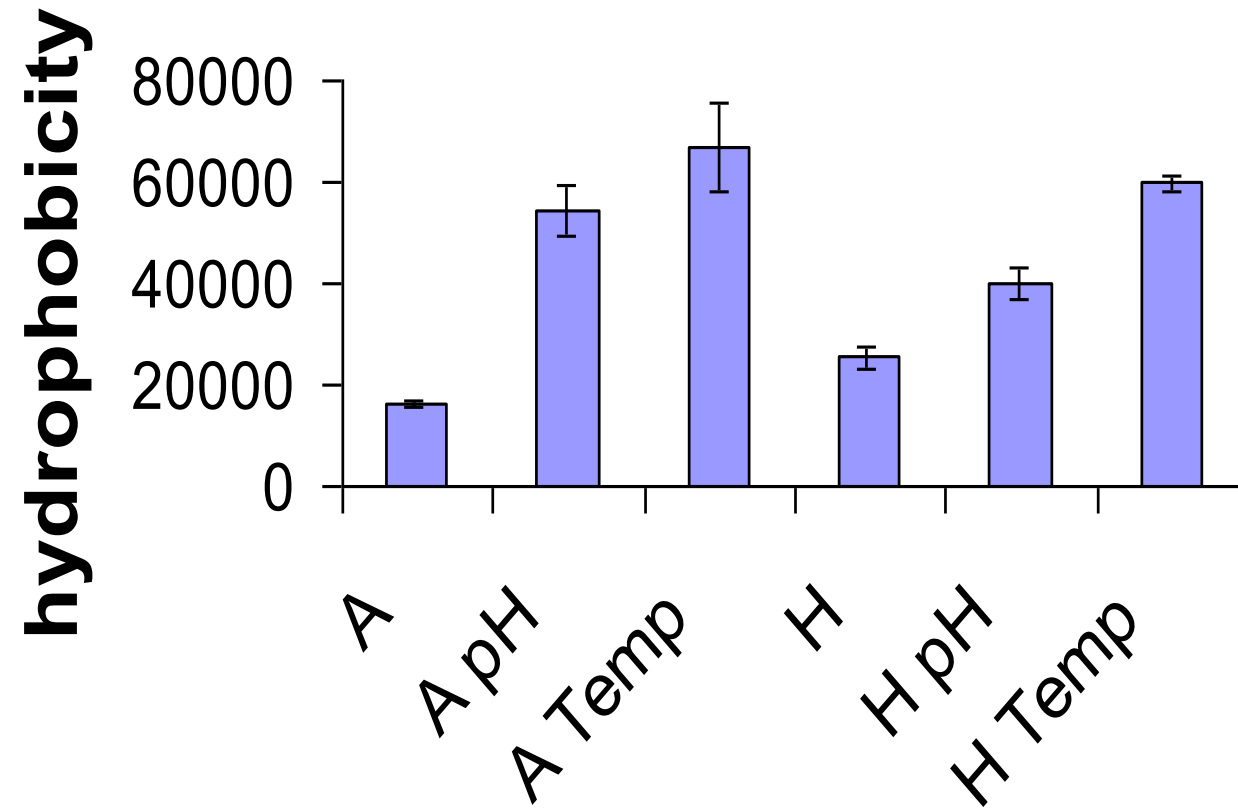


**Foam Height at 30 min
(mm)**



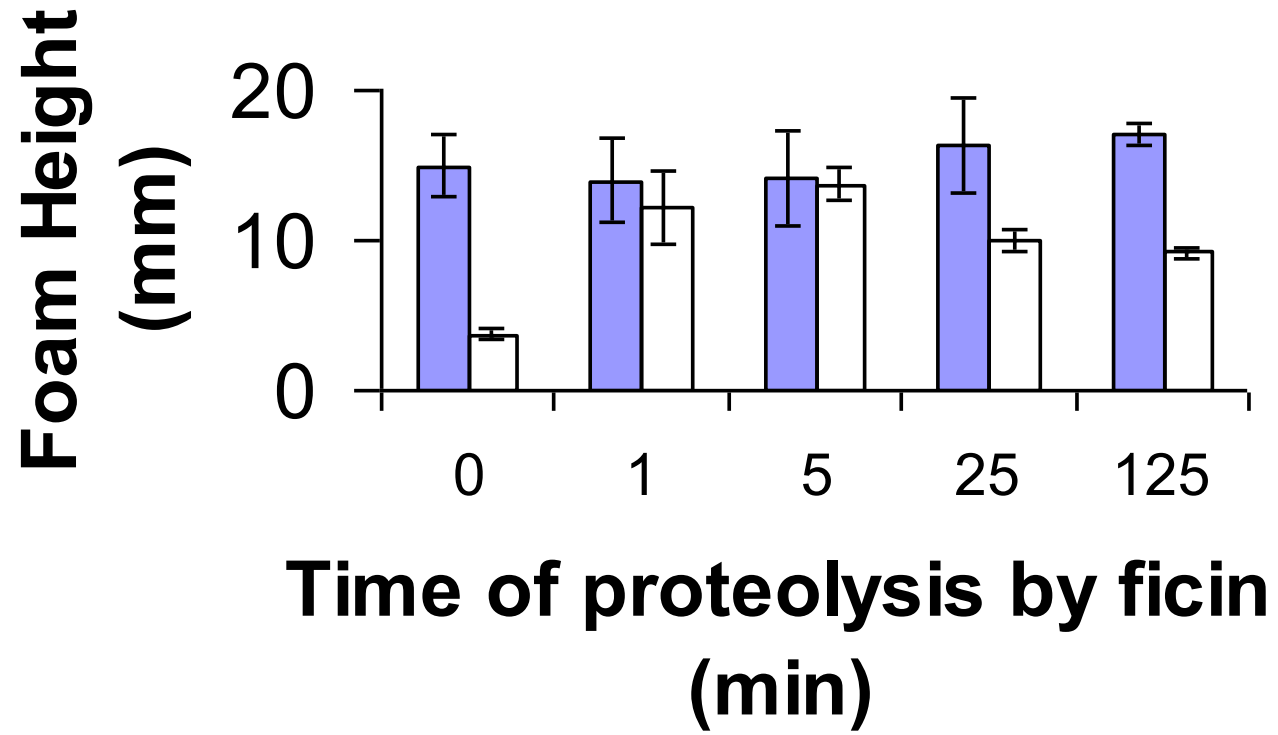
A = albumin

H = hordein



A = albumin

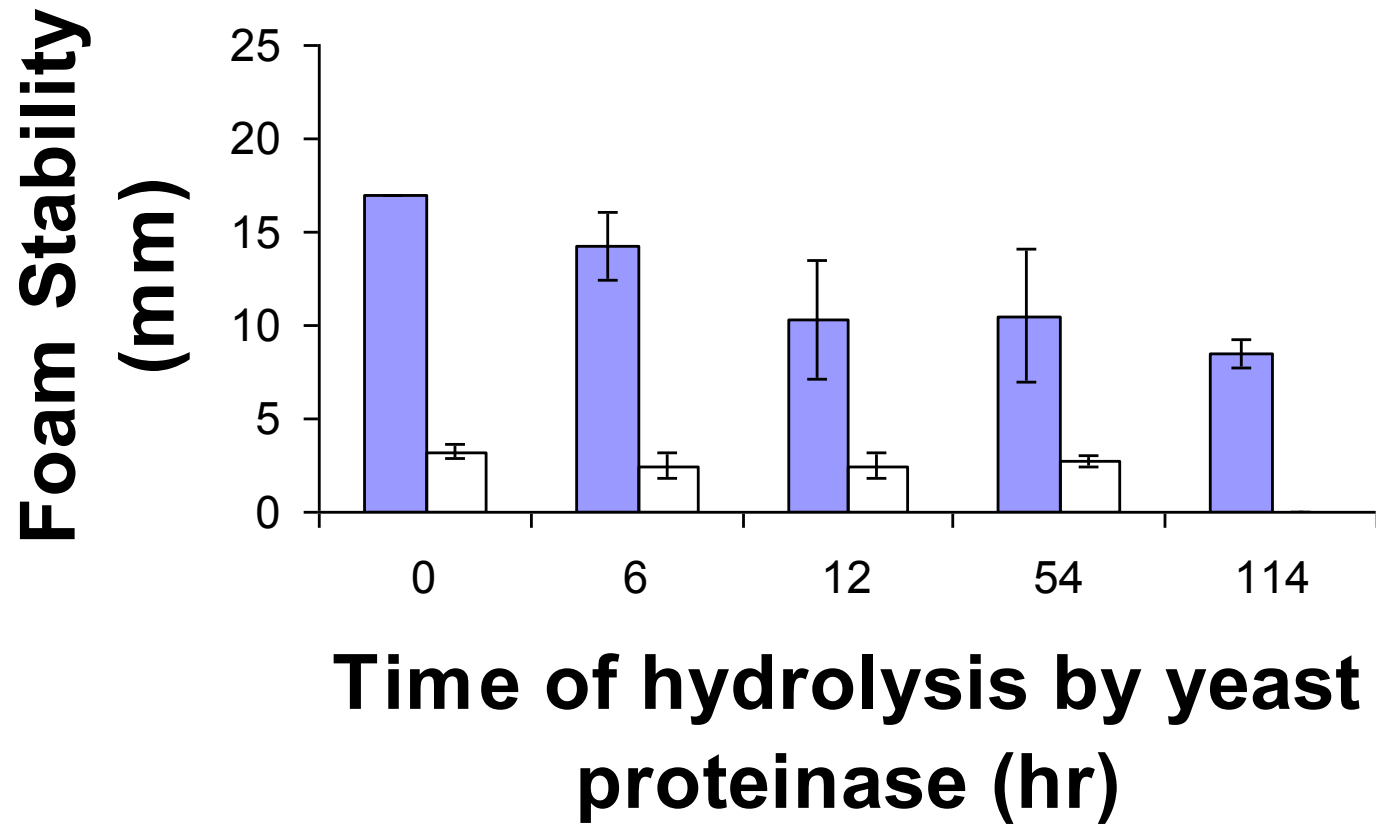
H = hordein



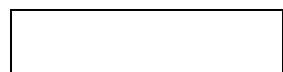
Albumin

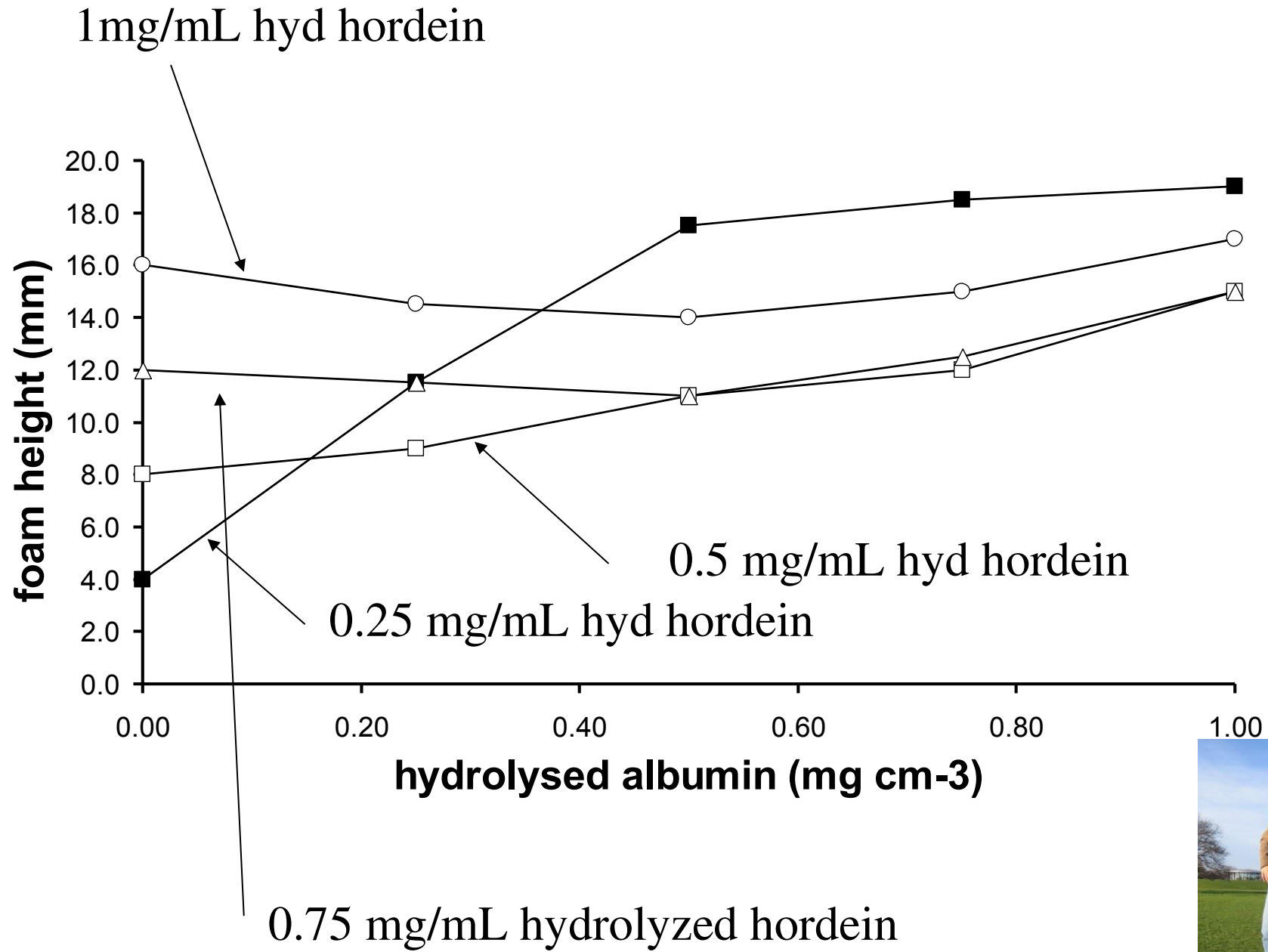


Hordein

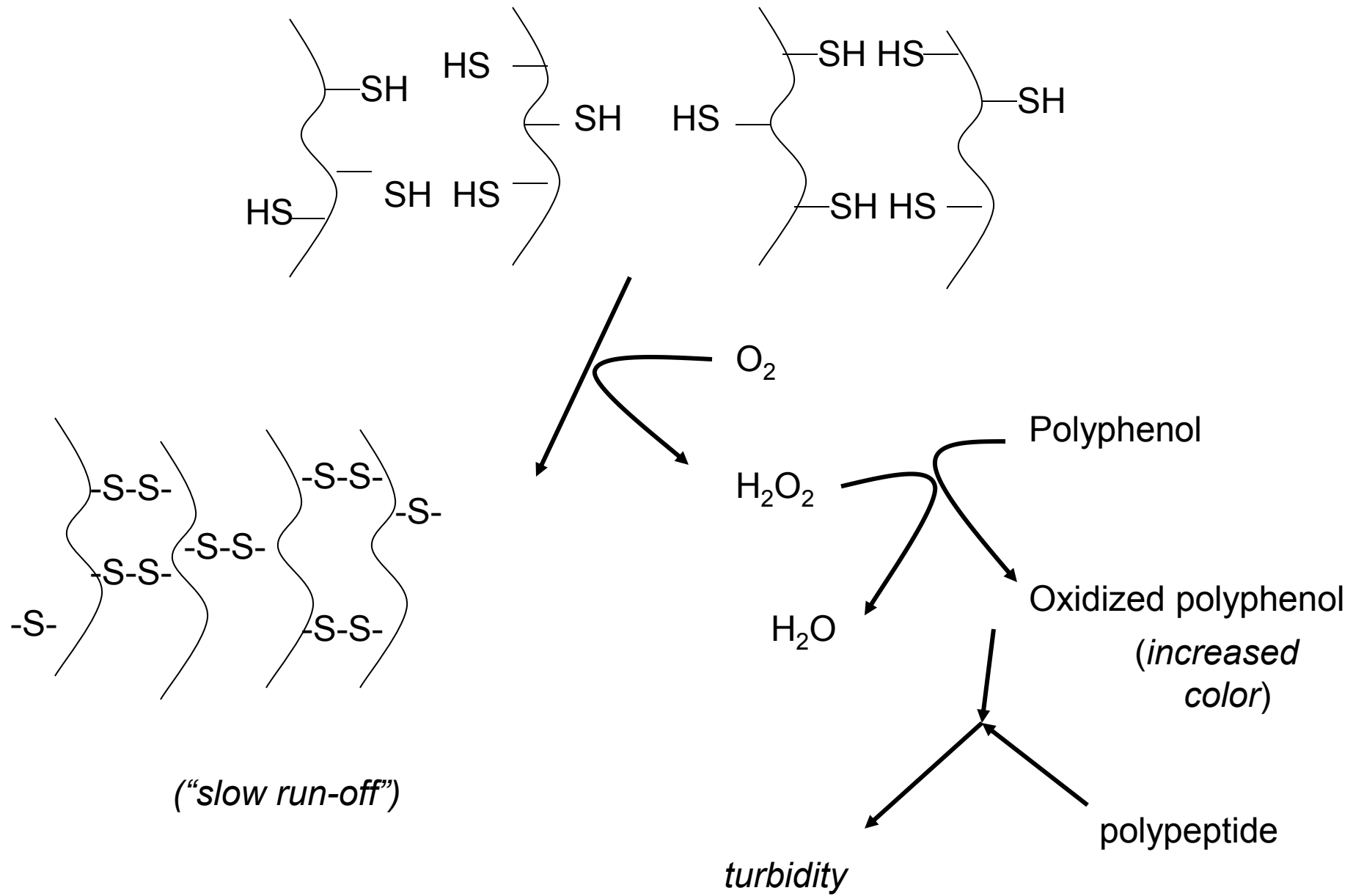


 Albumin

 Hordein



Redox



Ascorbic acid oxidase



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