Variation of gluten quality- and quantity-induced changes via the gluten structure in relation to viscoelastic properties

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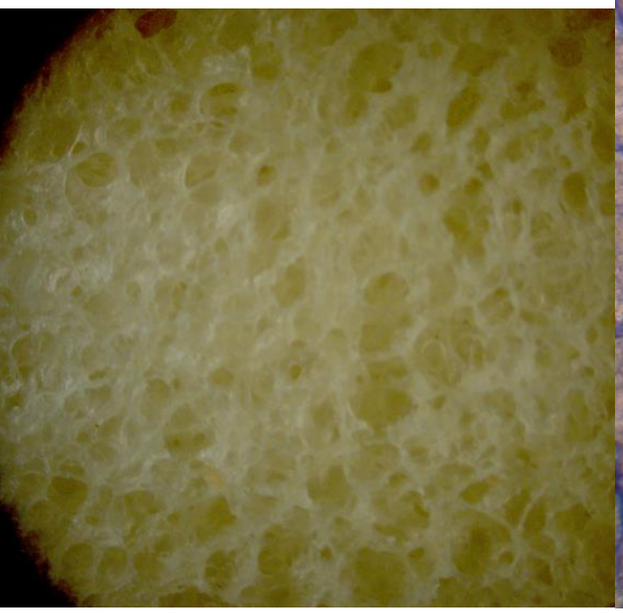
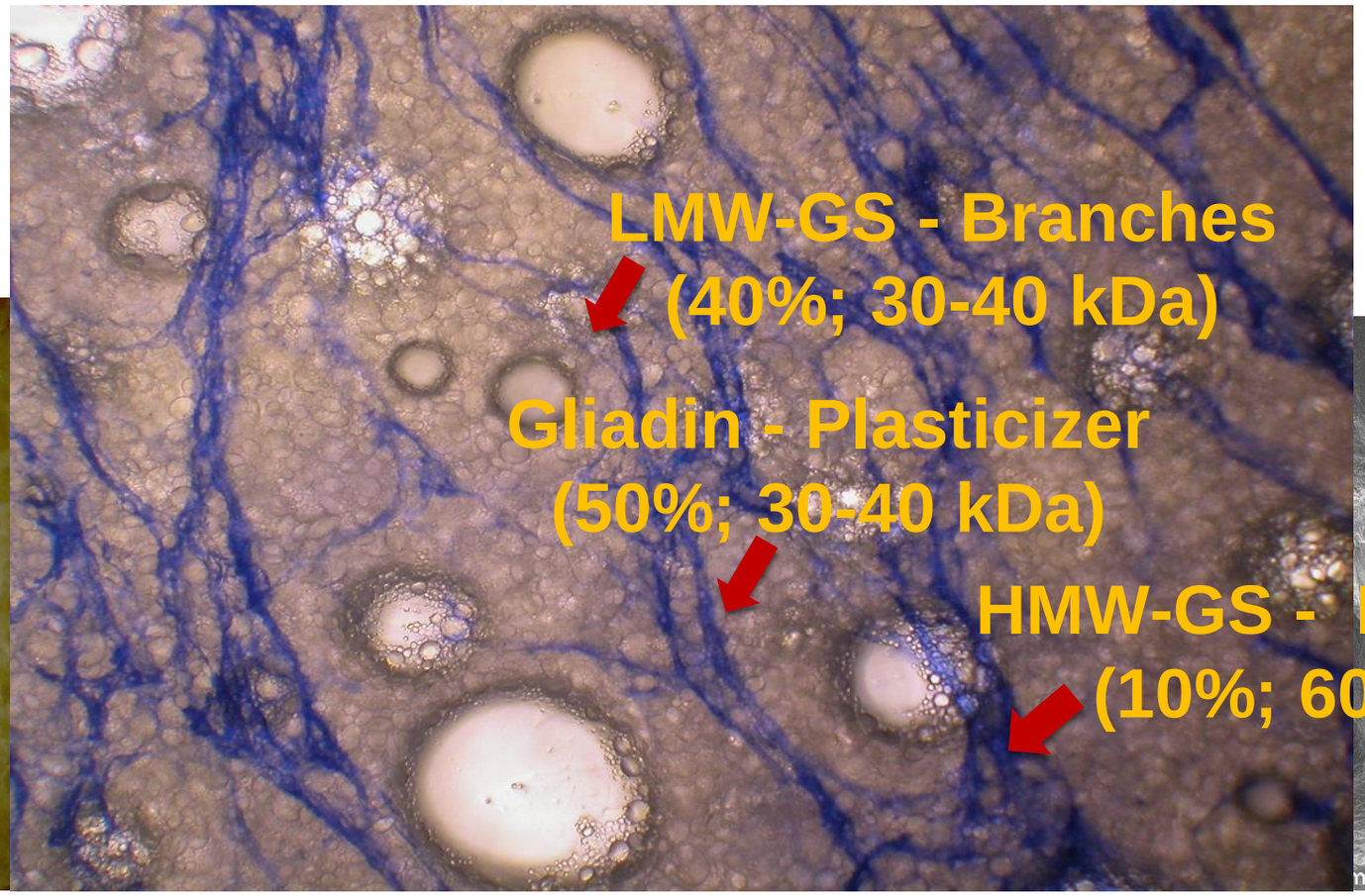
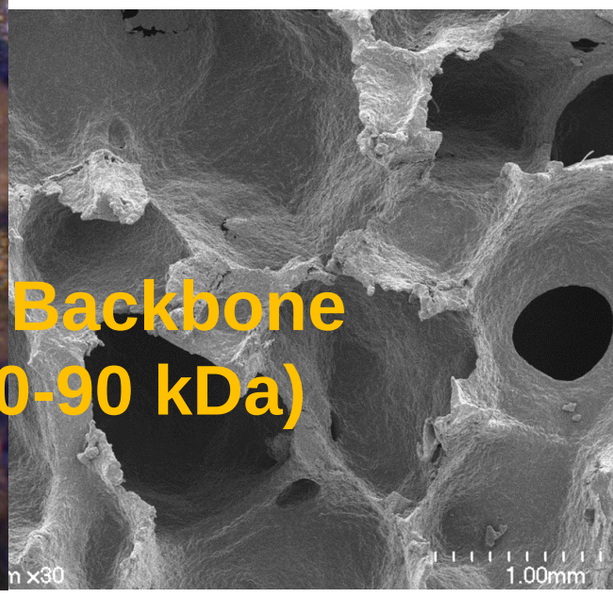
GLUTEN VISCOELASTIC NETWORK

Proteins in fully developed dough stained with Coomassie Blue







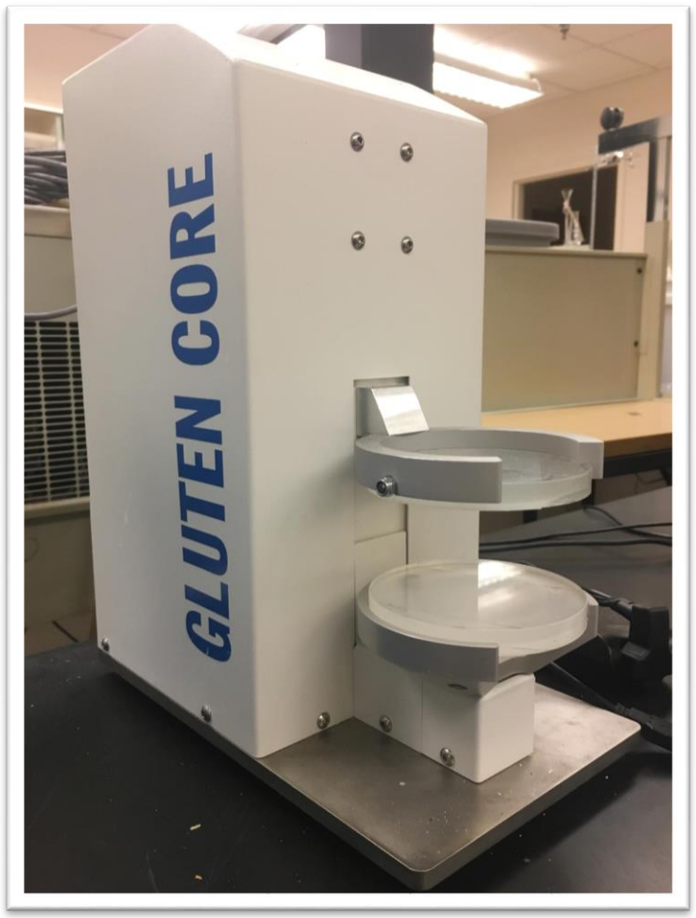
Crumb texture

Gas retention

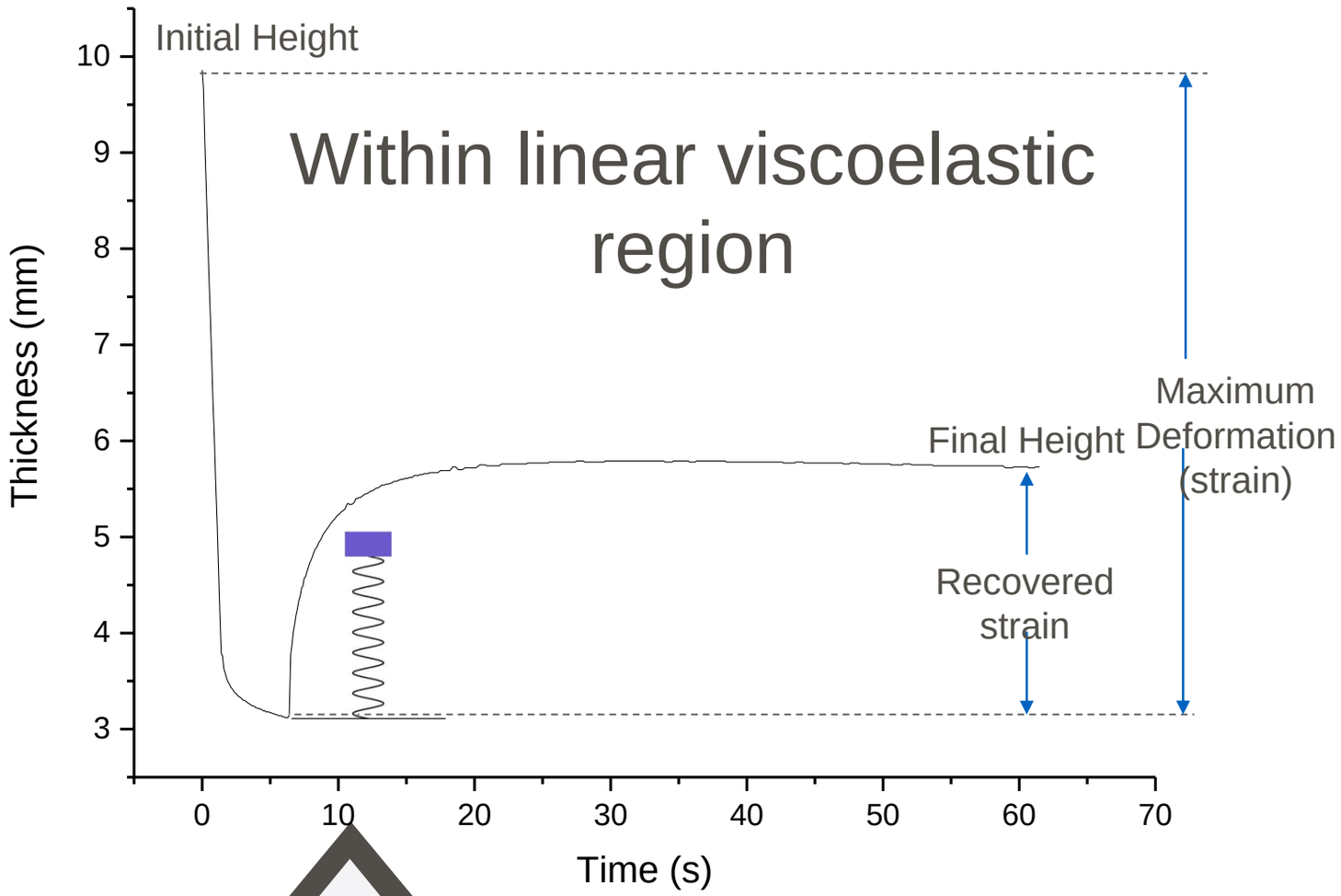
- Wheat industry uses gluten as an additive to adjust flour functionality
- For adjusting processing, texture and shelf life properties

COMPRESSION-RECOVERY ANALYSIS

Large deformation 8 N



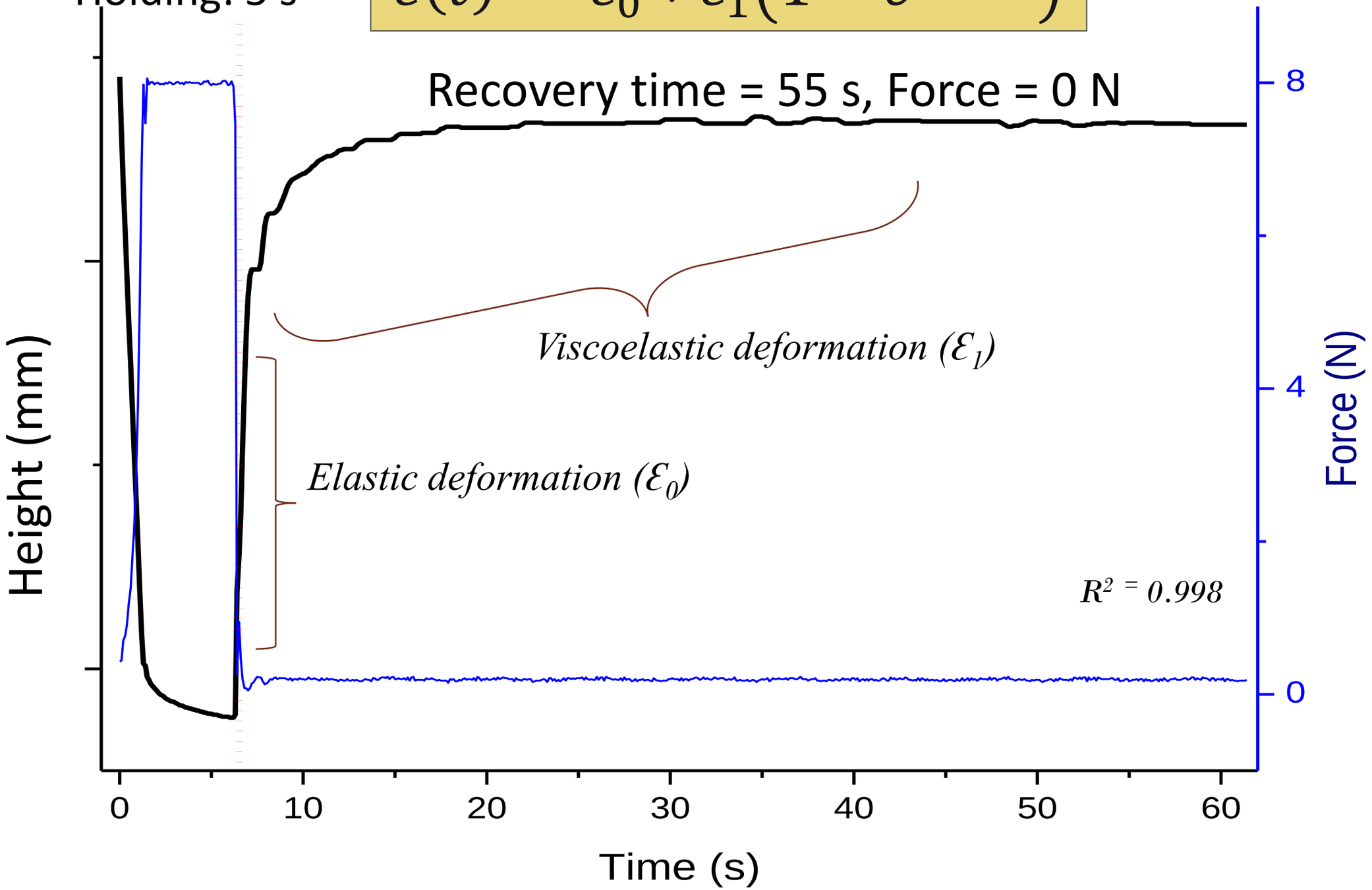
- Gluten compression recovery
- Novel, rapid and accurate method
- Uncomplicated equipment
- Axial deformation



COMPRESSION-RECOVERY TEST

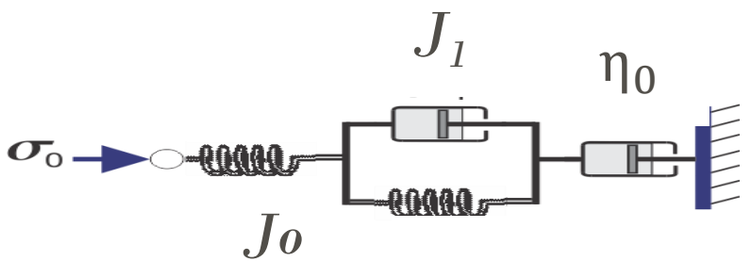
Compression
Force = 8 N
Holding: 5 s

$$\varepsilon(t) = \varepsilon_0 + \varepsilon_1\left(1 - e^{-t/\tau_1}\right)$$

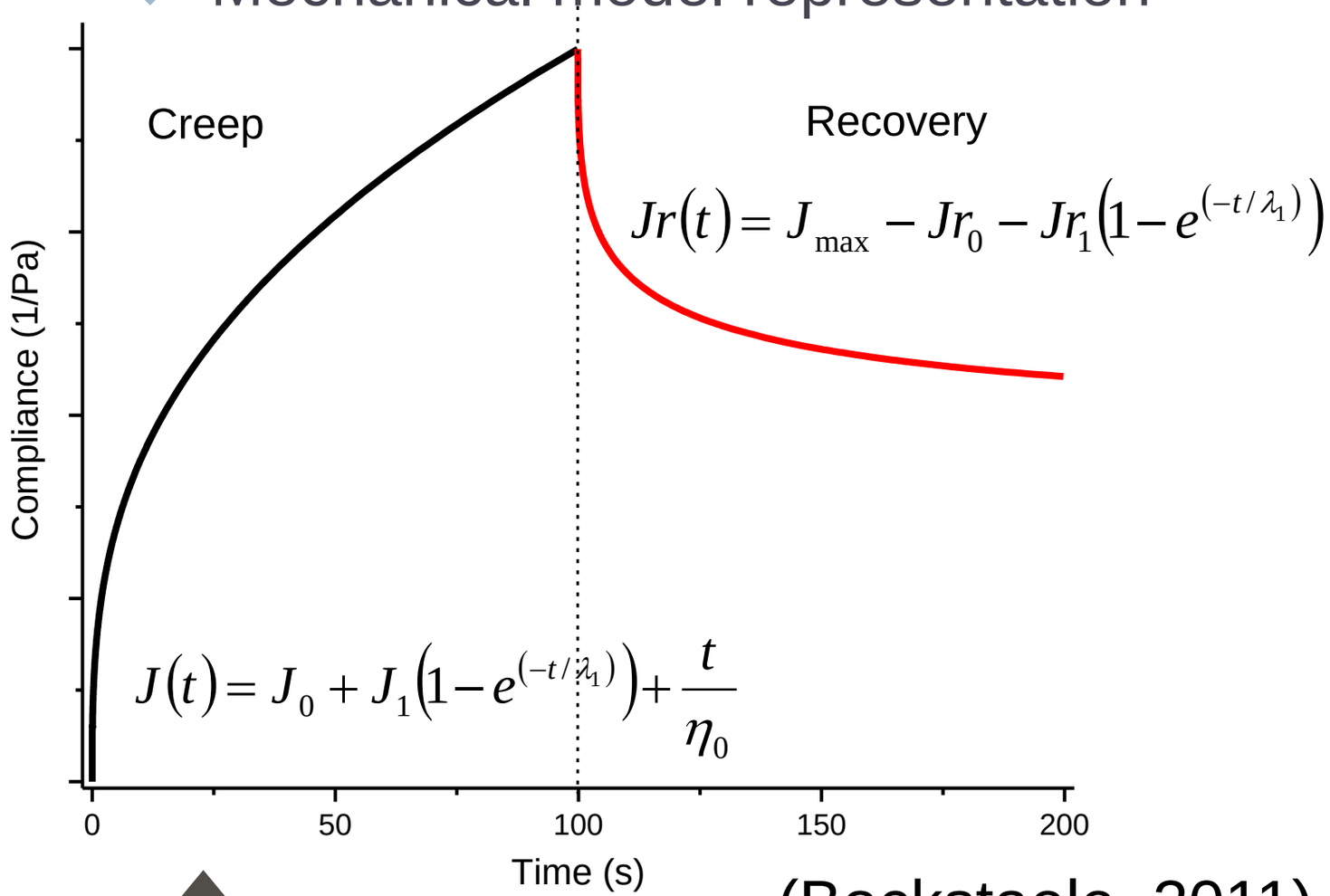


CREEP-RECOVERY ANALYSIS

Small deformation 100 Pa



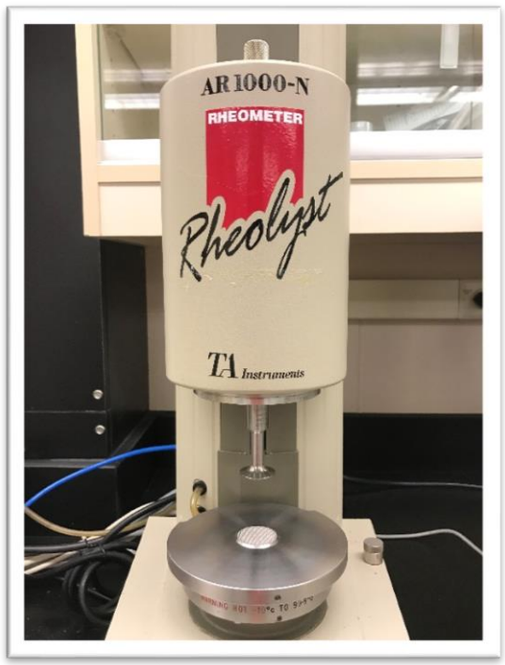
- Rheometer
- Accurate and sophisticated equipment
- Mechanical model representation

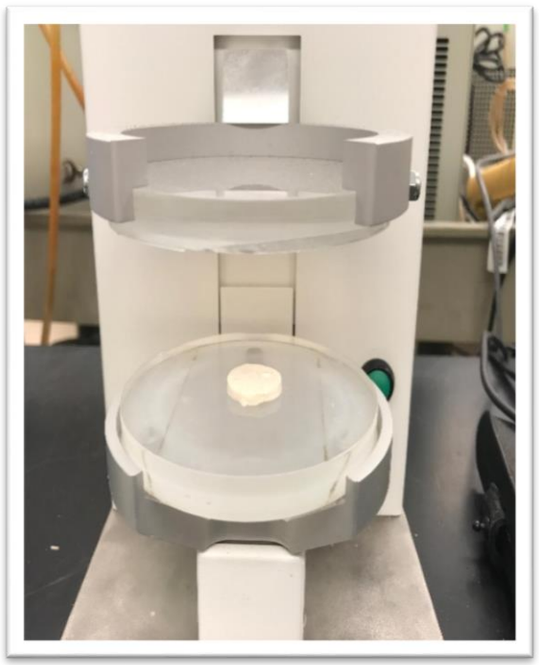


(Bockstaele, 2011)

OBJECTIVE

- **To investigate the effect of gluten products substitution on rheological properties of gluten from commercial flour**





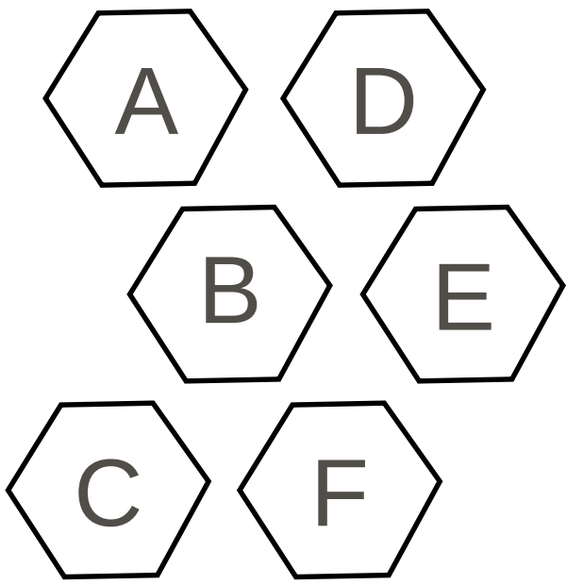
TREATMENTS

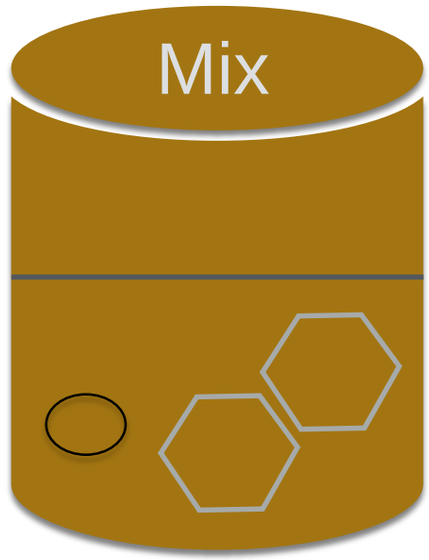
MATERIAL&METHODS

Four gluten products

Level substitution
3% and 6%
Ratio (w/w) 97:3 & 94:6
flour:gluten

Six commercial flours with 11% protein (14% mb)





Extract wet gluten

AACCI method 38-12-02
2% NaCl Solution

METHODS

Properties Measurement and Statistical Analysis

COMMERCIAL GLUTEN AND FLOURS

✓pH

Gluten composition

✓Capillary electrophoresis – polymeric proteins

✓RP-HPLC – monomeric proteins

RHEOLOGICAL TEST GLUTEN SUBSTITUTION AT 3 AND 6%

✓ Large Compression-recovery test (8N)

✓Small deformation Creep-recovery test (100Pa)

✓ Experimental data fitted into Burgers model

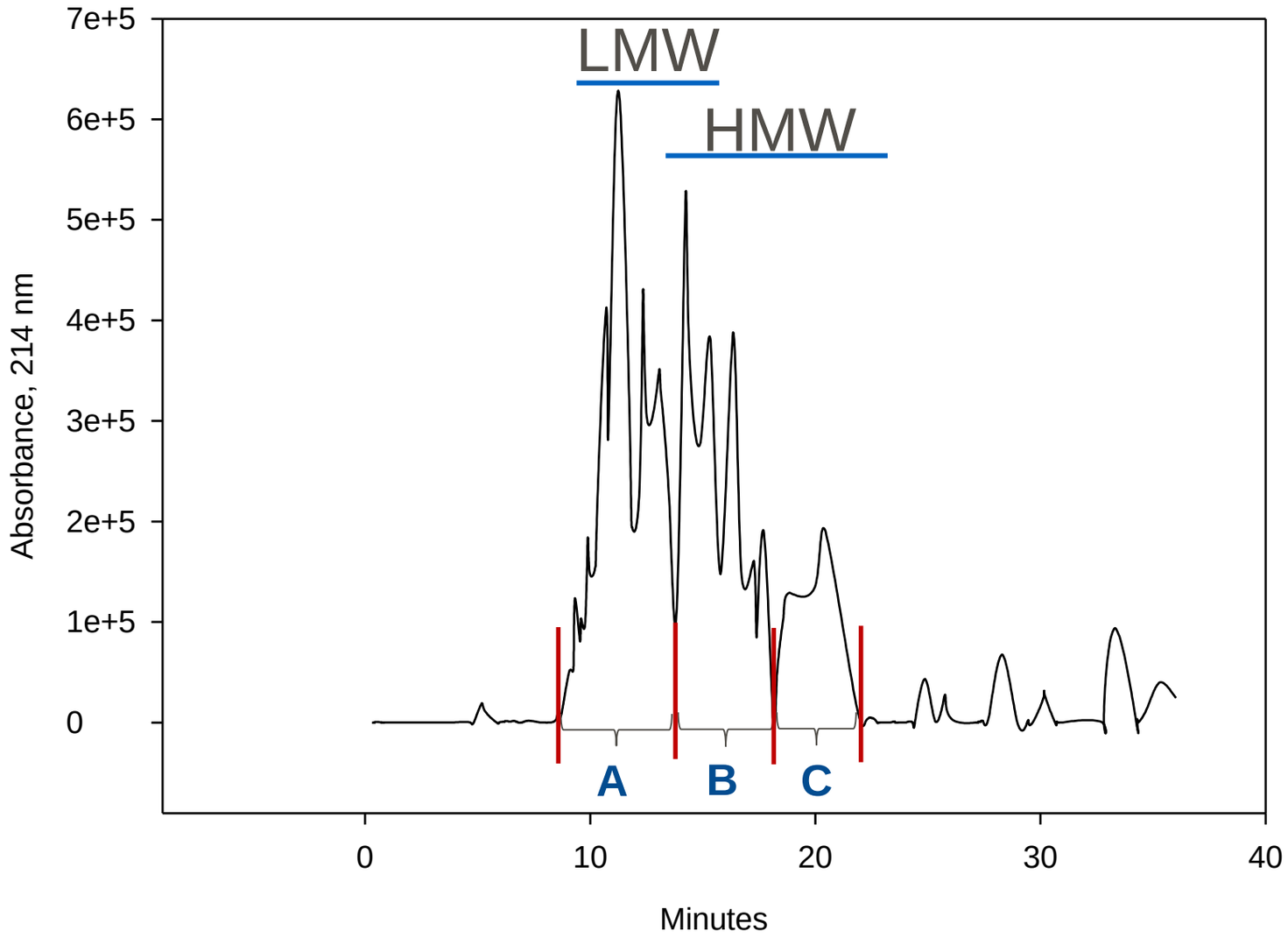
STATISTICAL ANALYSIS

✓ Multivariate test - Redundancy Analysis by ordination

RESULTS

Charge to mass ratio of polymeric protein - glutenin

Electropherogram form CE



A: LMW-GS

B: HMW-GS Y-type

C: HMW-GS X-type

Luccia et al. (2009)

RESULTS

Properties of gluten and commercial flours

Samples	pH	HMW-GS / LMW-GS / Y-Type / X-Type — *Capillary electrophoresis* — ***Area (%) of total glutenin fractions***			
		A	B	C	B/C
GA	5.2c	57.4a	17.9e	9.0c	2.0c
GB	4.2d	29.7d	47.6b	0.0e	n/a
GC	5.5b	13.9e	62.0a	13.1b	4.7b
GD	5.2c	48.0b	37.6c	7.5d	5.0a
Commercial flours	5.8a	46.1c	35.2d	18.7a	1.9c

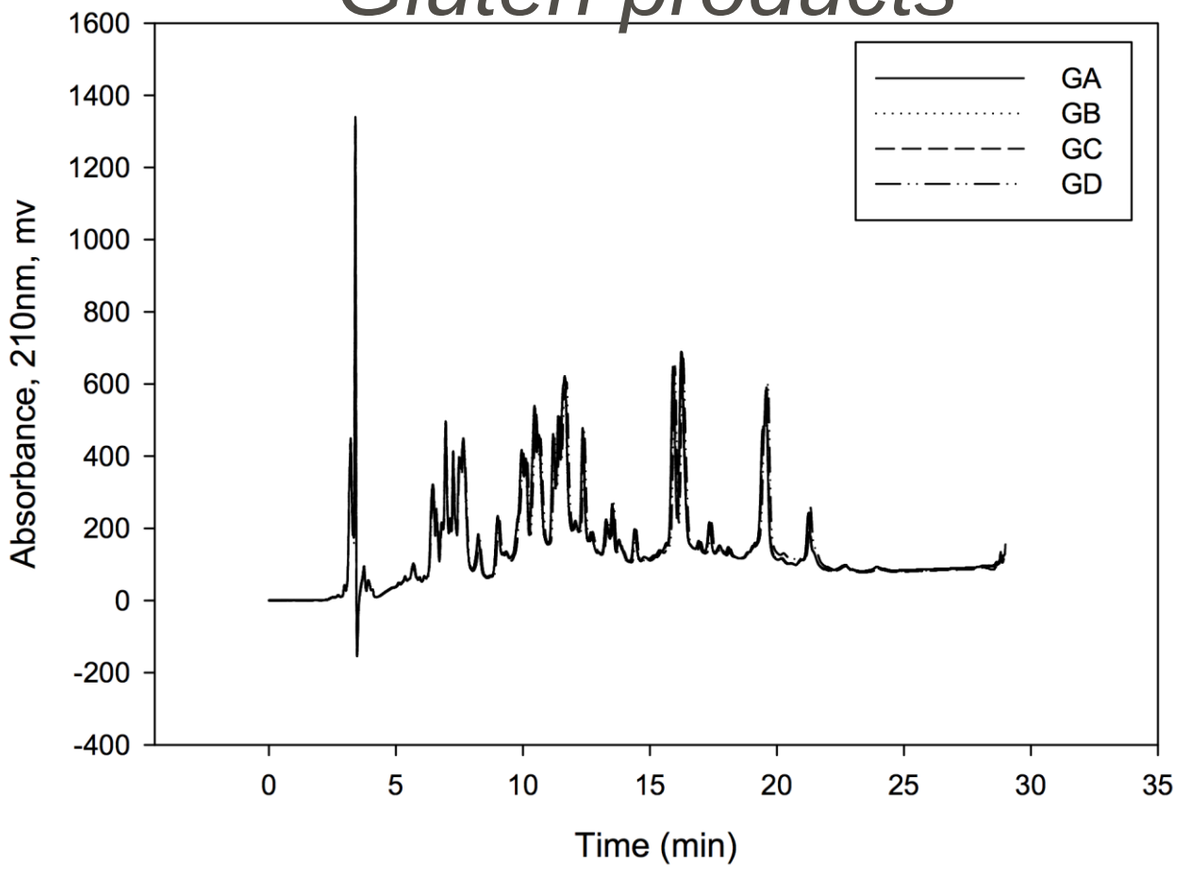
- ✓ GB had more acidity
- ✓ GA and GC had high in glutenin fraction
- ✓ GB and GD had low in x-type

RESULTS

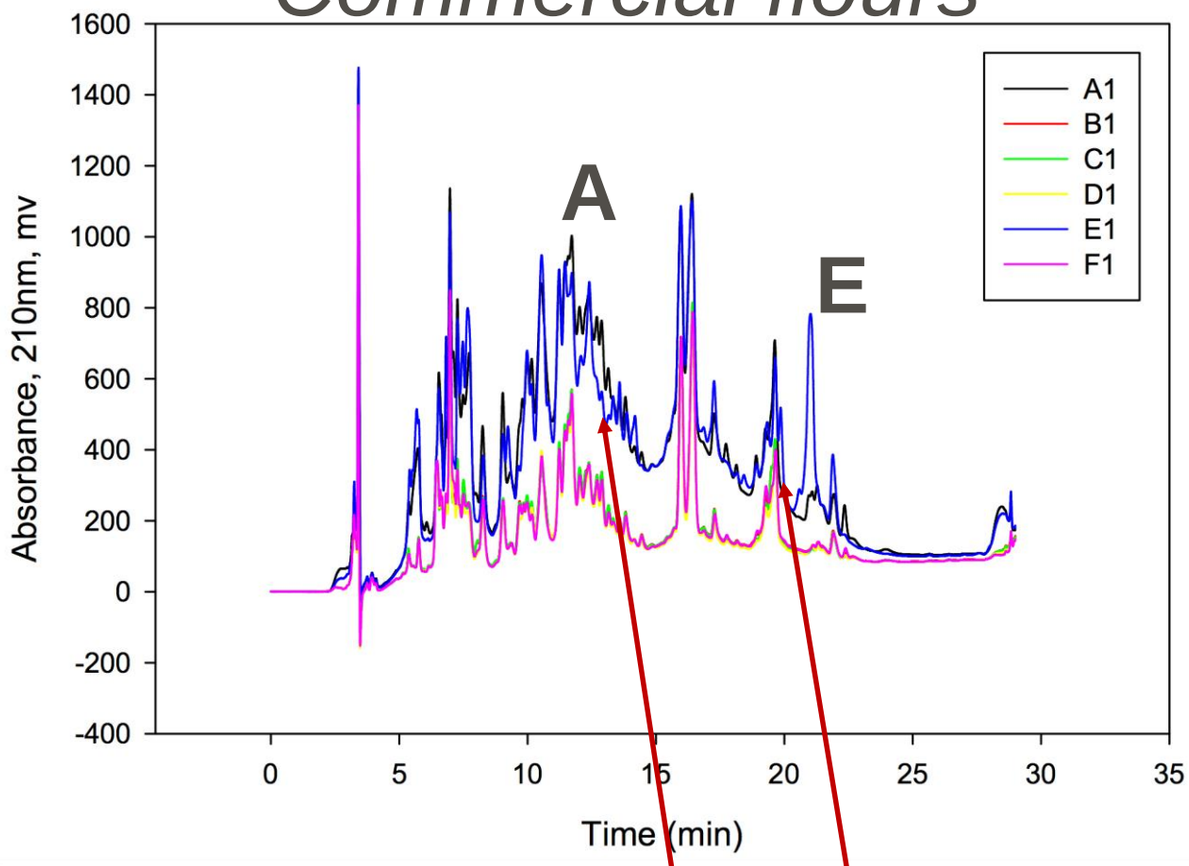
Surface hydrophobicity of Monomeric Proteins - Gliadins

Electropherogram form RP-HPLC

Gluten products



Commercial flours

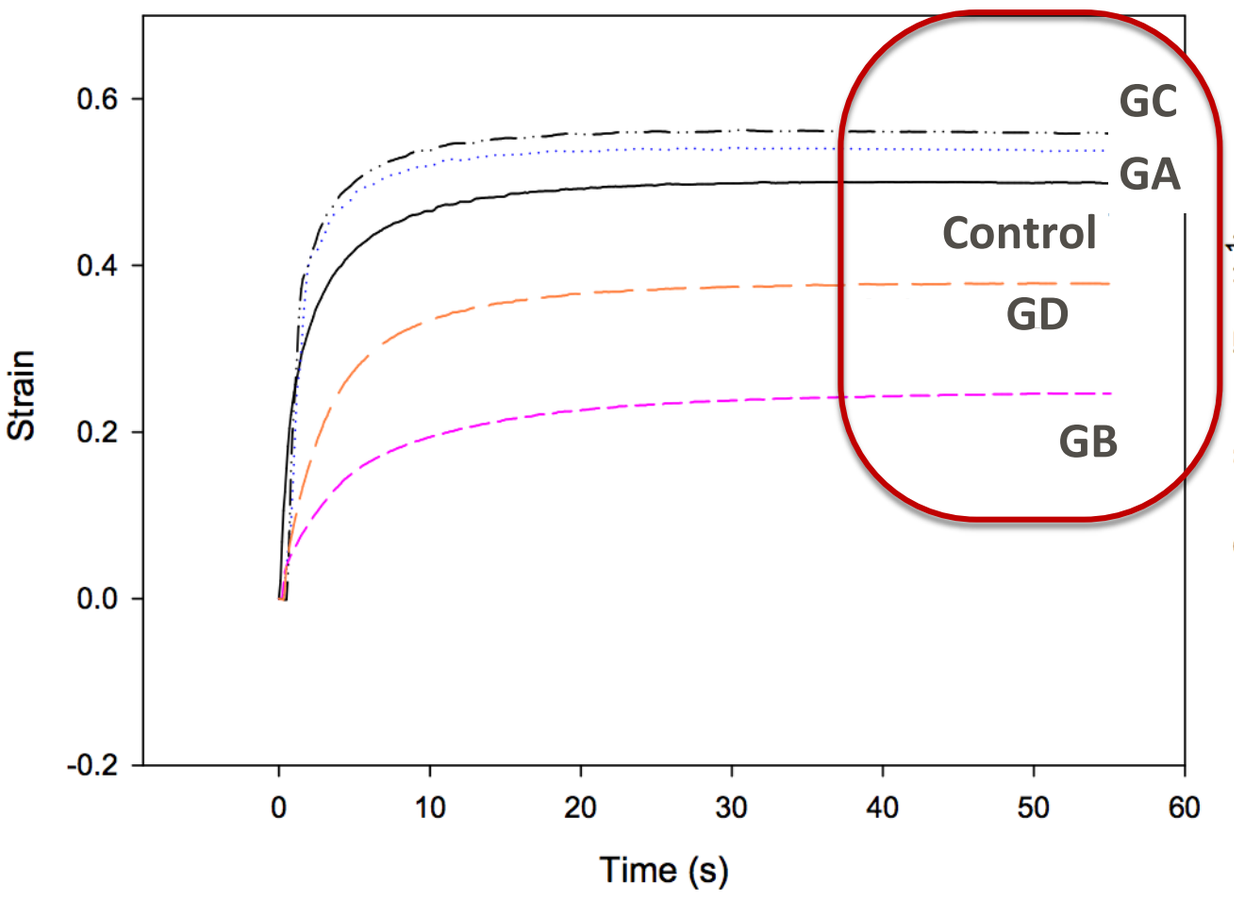


Flour A and E
53% higher in β & γ - gliadin

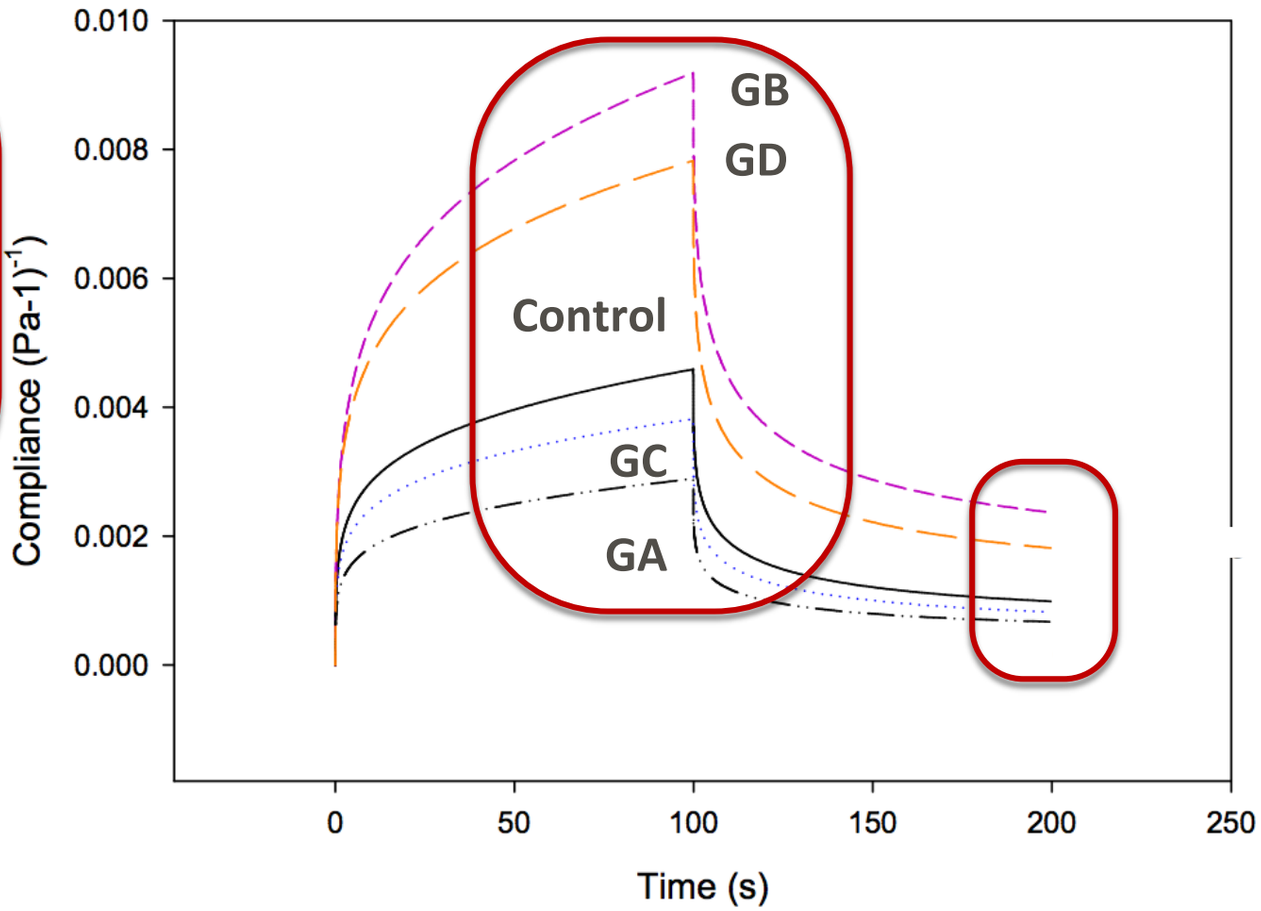
RESULTS

Compression-recovery (Large deformation) vs. Creep-recovery test (Small deformation)

As an example of 6% gluten substitution: Flour A



Recovery phase

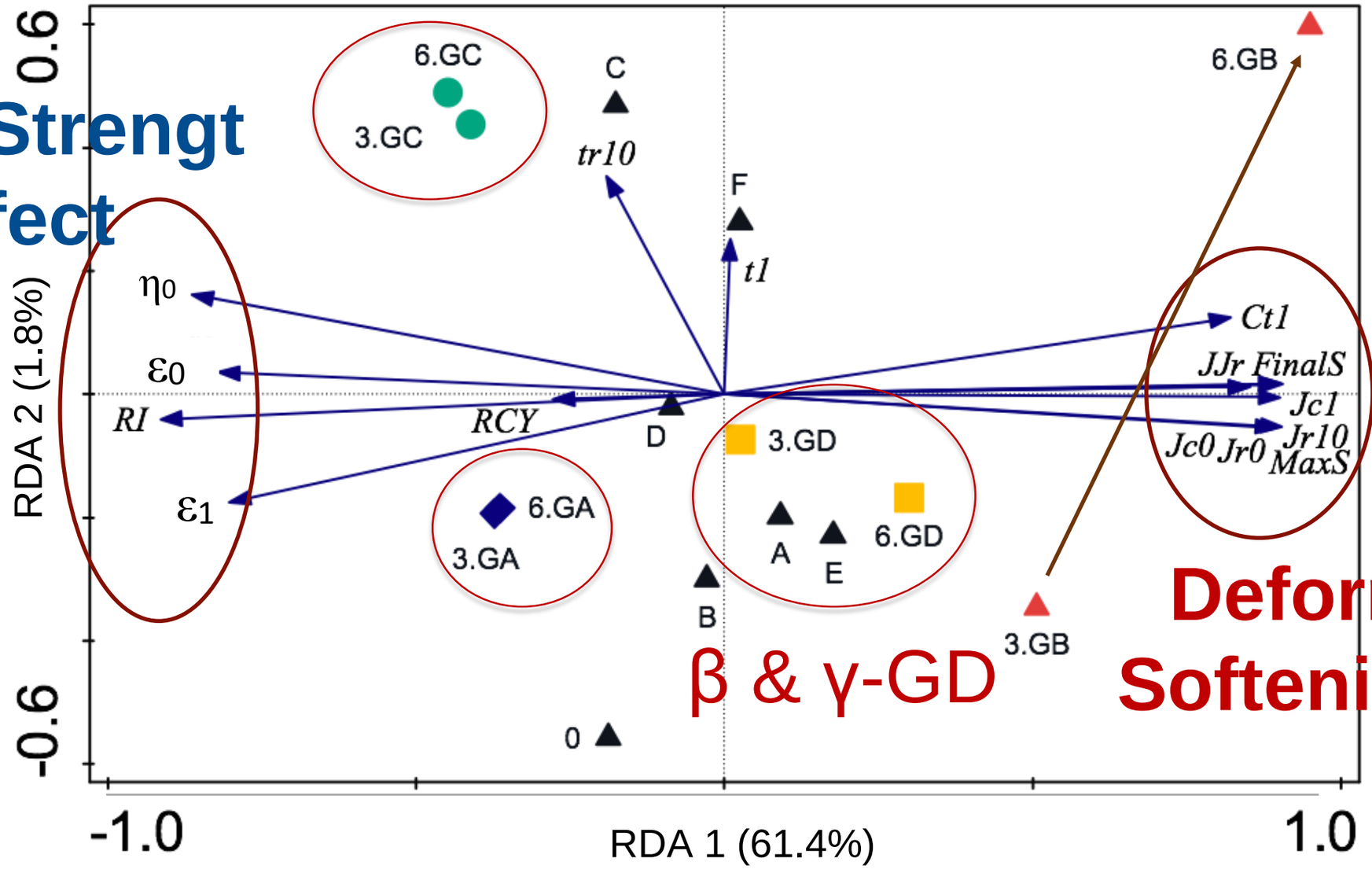


Creep-recovery test

RESULTS

Redundancy analysis (RDA)

Elastic/Strengt h effect



Deformation/ Softening effect

β & γ-GD

- ✓ **GA: high in LMW-GS**
- ✓ **GB: no x-type and pH**
- ✓ **GC: high in y-type**
- ✓ **GD: low in x-type**

CONCLUSION

- Substitution with different gluten products impacted **strength and softening effect.**
- Compression- recovery test was able to **discriminate better** based on **gluten strength**; small deformation separate better on **gluten extensibility**.
- Substitution with gluten (A and C) **high in LMW-GS and Y-type of HMW-GS** positively correlated with **strength effect**.
- Substitution with gluten (B and D) **low in X-type of HMW-GS** positively correlated with **softening effect**.
- Gluten **B with no in X-type of HMW-GS and lowest pH (pH 4.2)** increased **deformation** with level substitution (3 and 6%).


THANK
YOU
ASANTE
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TERMA KASIH
MAMANA
MATONDO
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MERCI
KIITOS
MOCHCHAKKERAM
CHOKRANE
MATONDO
MERCI
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DANKON
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