Development of Novel Food:

Rheological Properties of Tomato Juice Containing Soy Protein and Soy Germ

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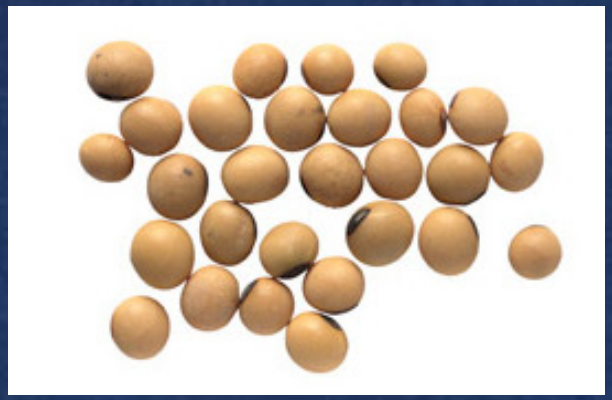
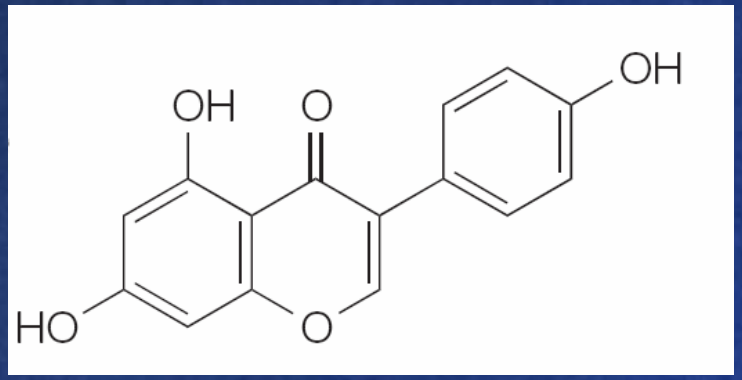
Overview

- ✓ Background
- ✓ Objectives
- ✓ Materials & Methods
- ✓ Results
- ✓ Conclusions

Background

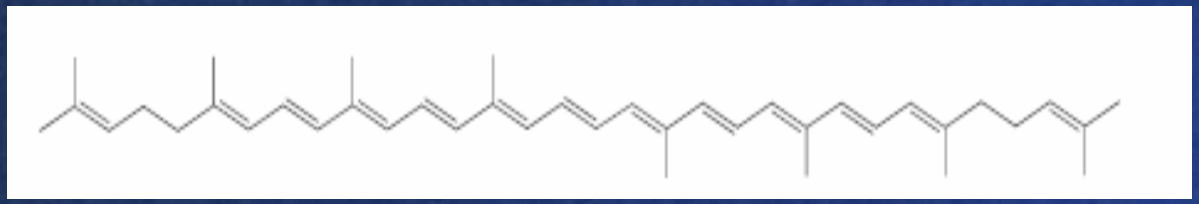


Isoflavones



The health promoting activity

Carotenoids



Objectives

Physico-chemical interactions of Tomato Juice and Soy Protein/Soy Germ evaluated by **Rheology**:

- ✓ **Steady Tests**
  (shear/time dependence at 25°C)
- ✓ **Dynamic Tests**
  (viscoelastic behavior at 25°C)
- ✓ **Dynamic Temperature Tests**
  (viscoelastic behavior vs. T)

Materials & Methods

Comparison of 3 products:

- ✓ Hot Break Tomato Juice (TJ) (lycopene 12mg/100g)
- ✓ TJ + 1% Soy Protein Isolate (TJSP) (isoflavones 1.8mg/100g)
- ✓ TJ + 1.5% Soy Germ (TJSG) (isoflavones 22mg/100g)

The homogenized product was retorted at ~100°C for 10 min.

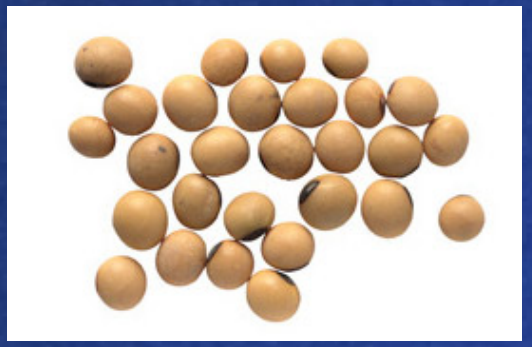
Denaturation of SP confirmed by DSC

Rheological experiments performed using a controlled strain RFS II Rheometrics system (Couette geometry)

Characterization of Hot Break Tomato Juice:

- ✓5.6% of solid content (Freeze Drier)
- ✓7.25% of water-soluble pectins on dry solid basis (Freeze Drier)
- ✓76.9% degree of esterification (Titrimetric Method)
- ✓0.06% of calcium (Atomic Absorption)

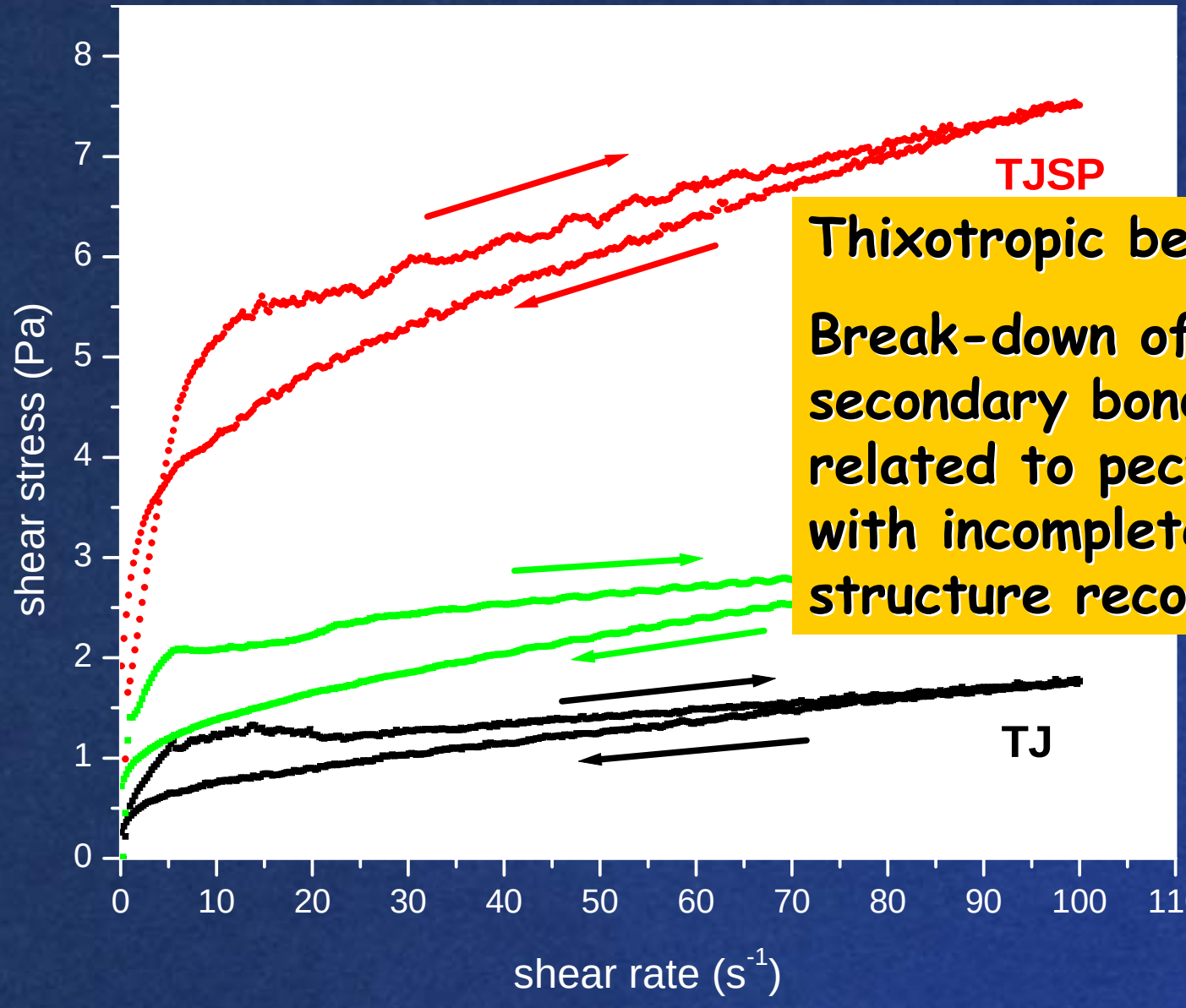
Characterization of Added Soy Products:



- ✓1% Soy Protein Isolate: solubility around 70% (Retorted at pH 4.2)
- ✓1.5% Soy Germ: soy protein content ten times lower than S.P.I.

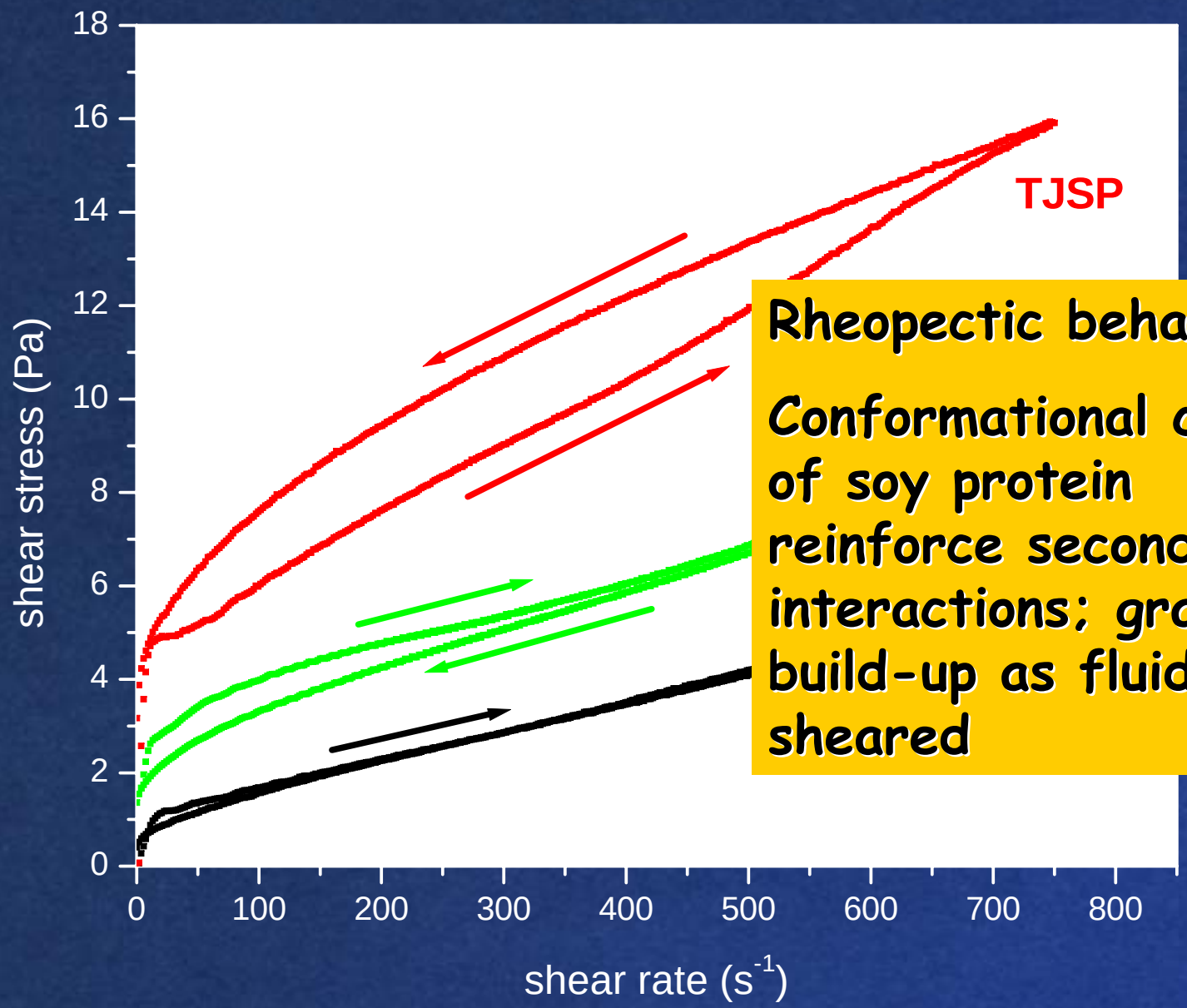
(replaced by carbohydrates, soluble fibers, and isoflavones)

Time Dependence: Loop Tests



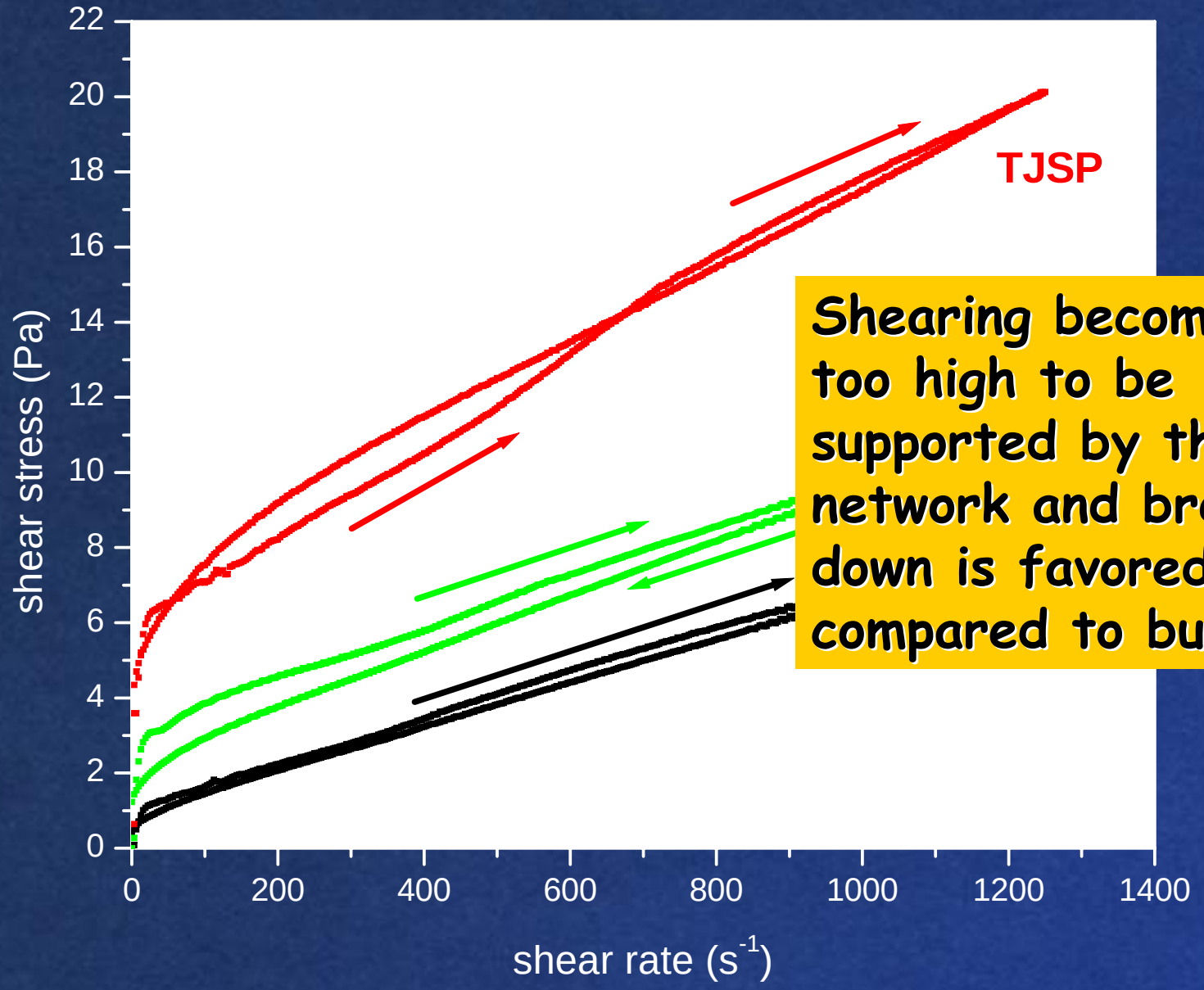
Thixotropic behavior

Break-down of secondary bonds related to pectic links with incomplete structure recovery

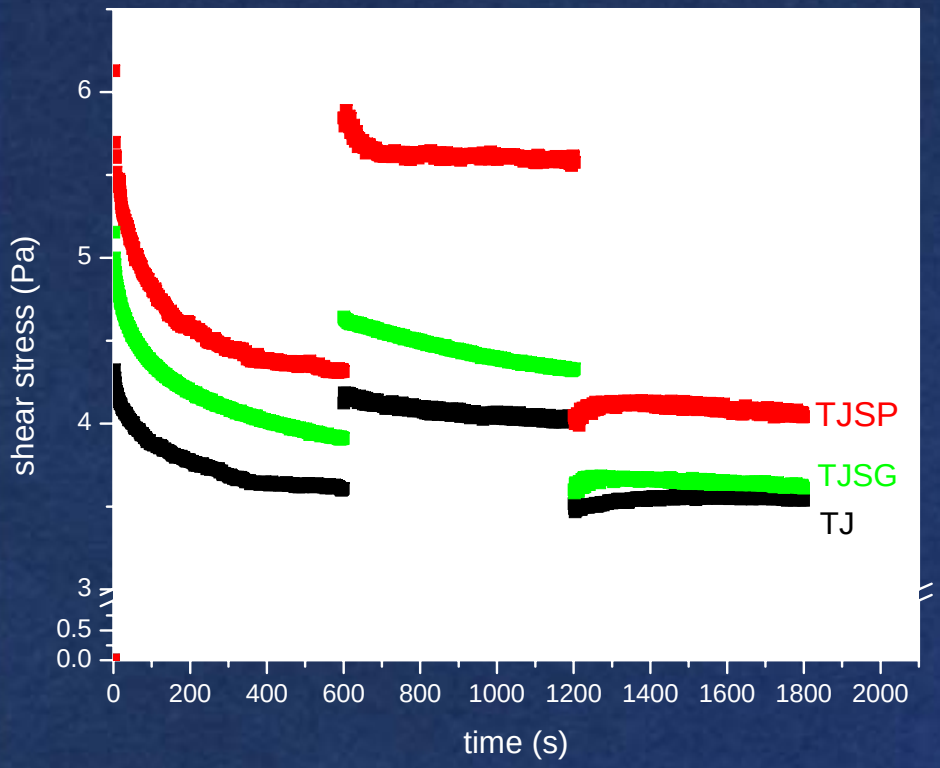


Rheopectic behavior

Conformational changes of soy protein reinforce secondary interactions; gradual build-up as fluid is sheared


shear stress (Pa)
shear rate (s-1)
0
2
4
6
8
10
12
14
16
18
20
22
0
200
400
600
800
1000
1200
1400
TJSP
Shearing becomes too high to be supported by the network and break-down is favored as compared to build-up

Time Dependence

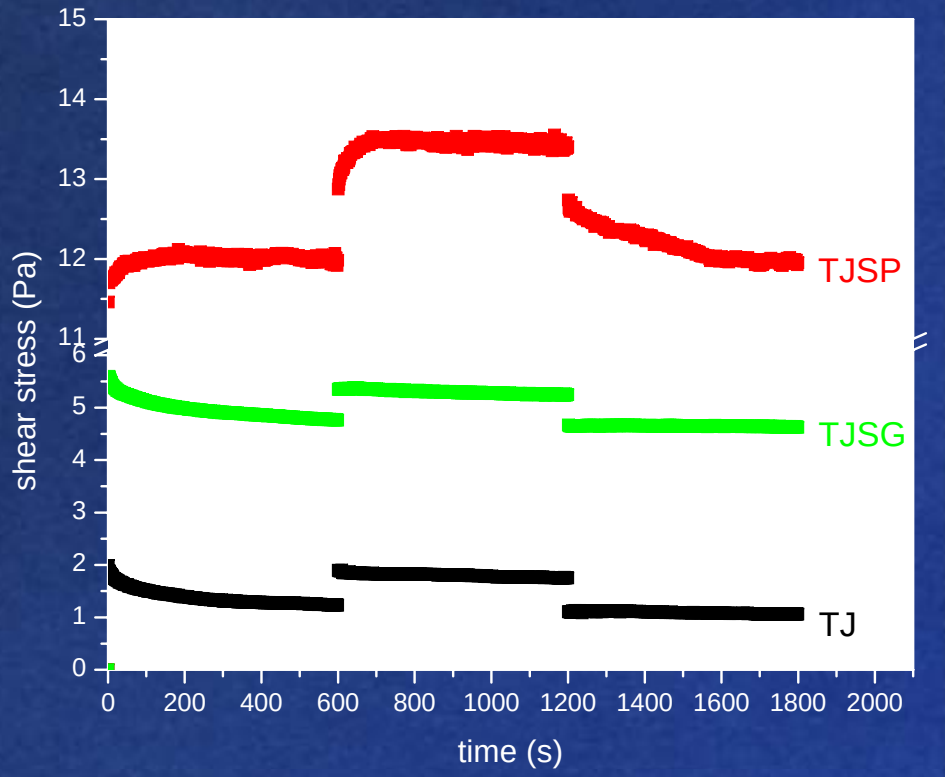


Stepwise sequence:

$100s^{-1}$-$200s^{-1}$-$100s^{-1}$

Stepwise sequence:

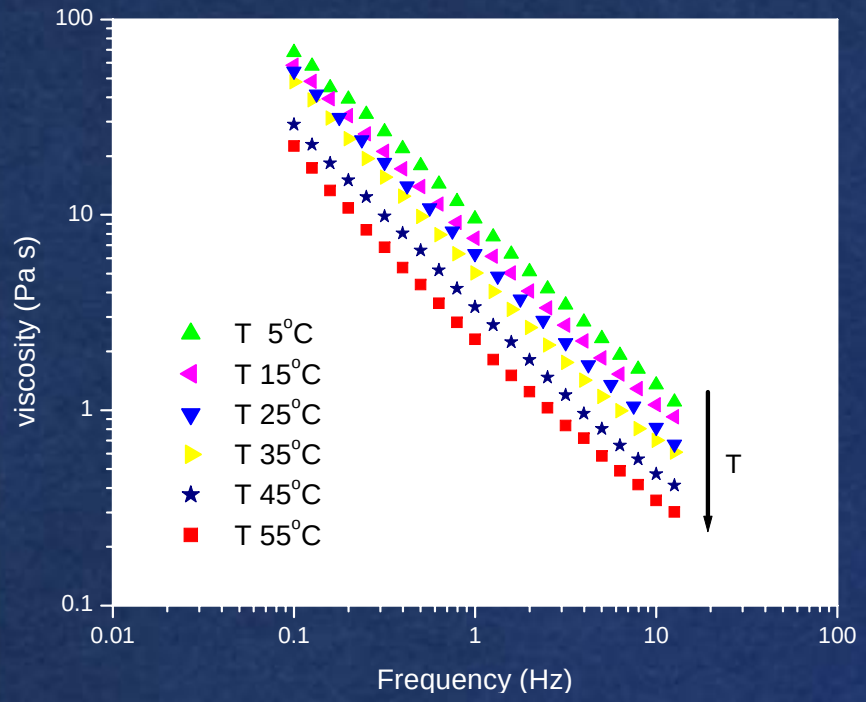
$500s^{-1}$-$600s^{-1}$-$500s^{-1}$



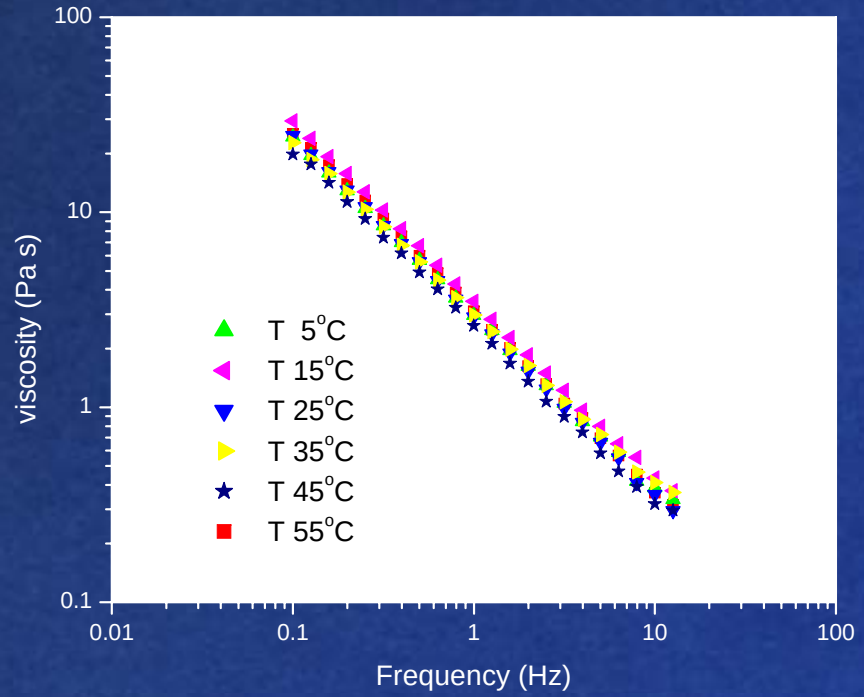
Time Dependence: Effect of Addition of Soy Protein to Tomato Juice

- ✓ **At low shear rates:** weak physical bonds are ruptured and the network breaks down into separate aggregates
- ✓ **At intermediate shear rates:** conformational changes (rearrangements) of soy protein facilitate reinforcement of secondary interactions
- ✓ **At high values of shear rates:** shearing becomes too high to be supported by the network and break-down is favored as compared to build-up

Temperature Effects: Dynamic Frequency Sweep Tests

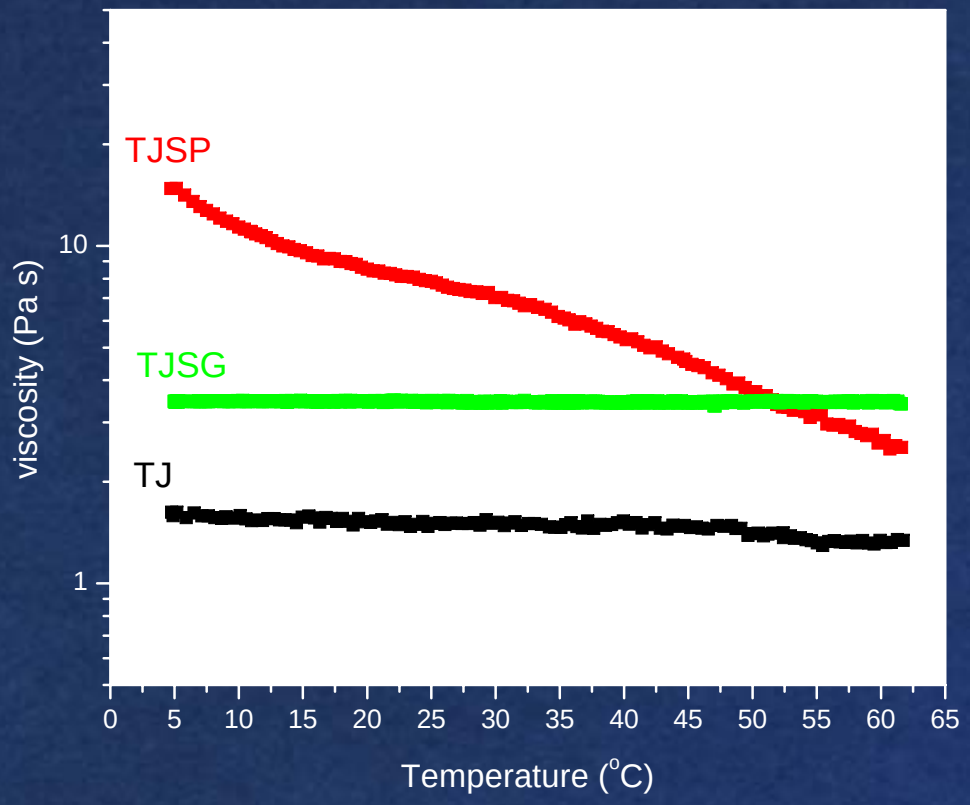


Tomato Soy Protein



Tomato Soy Germ

(Similar trend for Plain Tomato Juice)



Temperature dependence of viscosity (1°C/min) by Arrhenius type equation:

$$\eta = \eta_0 \exp\left(\frac{E_a}{2.303 \cdot RT}\right)$$

Samples	Ea (J/mole)	R^2
Tomato Soy Protein	139.56	0.99
Tomato Soy Germ	0.44	0.28
Tomato Juice	14.31	0.89

η: viscosity (Pa s)

η_o: viscosity (Pa s) at ref. Temp (K)

E_a: activation energy of flow (J/mol)

R: universal gas constant (8.3145 J/mol K)

Conclusions (1)

Addition of 1% Soy Protein to Tomato Juice:

- ✓ Increases the viscosity of tomato juice
- ✓ Affects the time-dependent behavior and temperature sensitivity due to conformational changes of the protein
- ✓ Avoids separation between serum and particles due to a reinforced network system

Conclusions (2)

Addition of 1.5% Soy Germ to Tomato Juice:

- ✓ Increases the viscosity of tomato juice
- ✓ Improve thermal stability of tomato juice
- ✓ Rheological qualitative characteristics of tomato juice are unaltered

S. Tiziani, and Y. Vodovotz. Rheological effects of soy protein addition to tomato juice. *Food Hydrocolloids* (in press)

Acknowledgements

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THANK YOU!