

1<sup>st</sup> International / 11<sup>th</sup> National

# FOOD ENGINEERING CONGRESS

7-9 November 2019 / Antalya, TURKEY



**PURDUE**  
UNIVERSITY

## Heat Induced Gelation Time Profile for Salep and Konjact Glucomannan

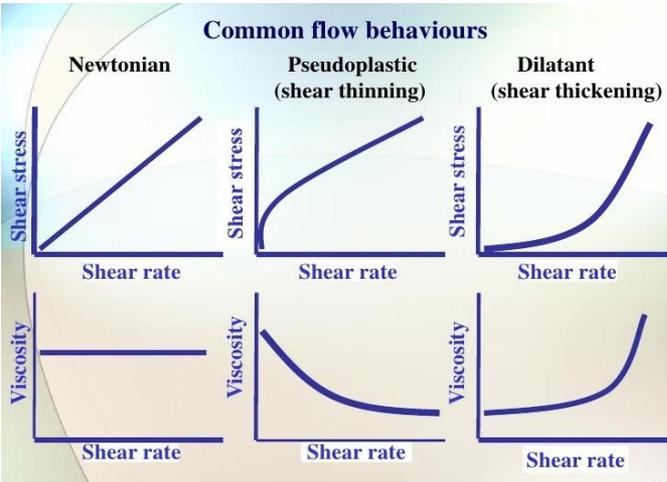
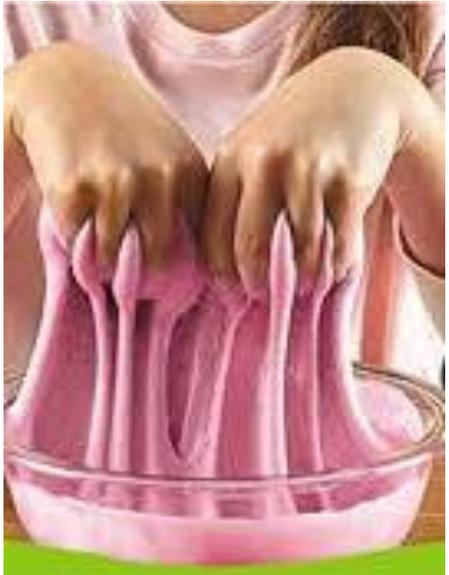
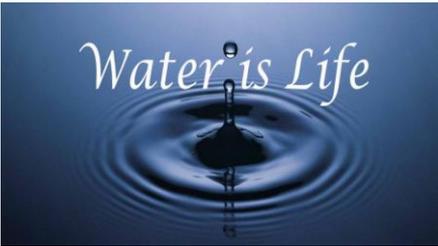
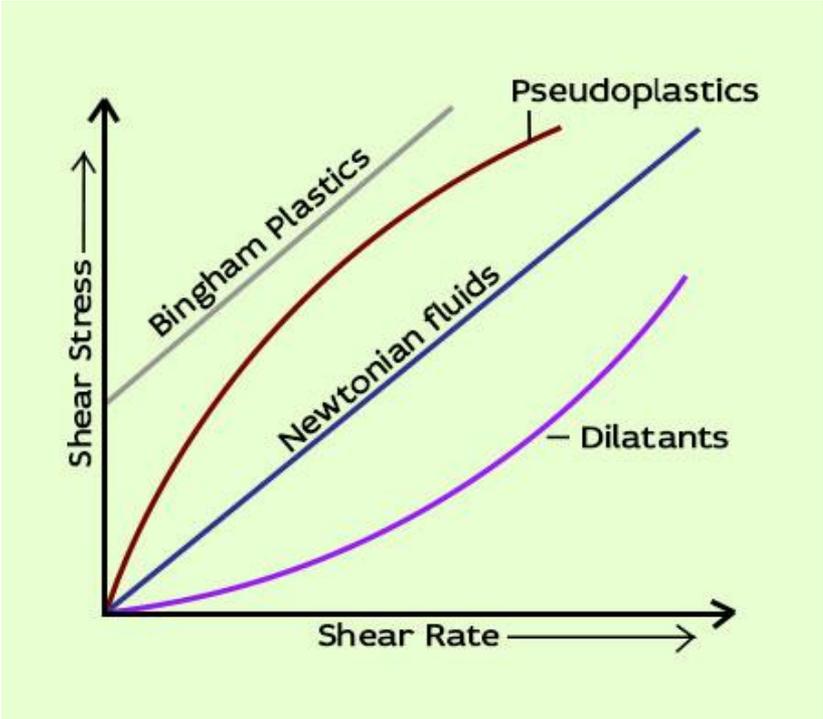
Senem YETGIN, Oswaldo Campanella

*UGMK 2019, November 9-11*

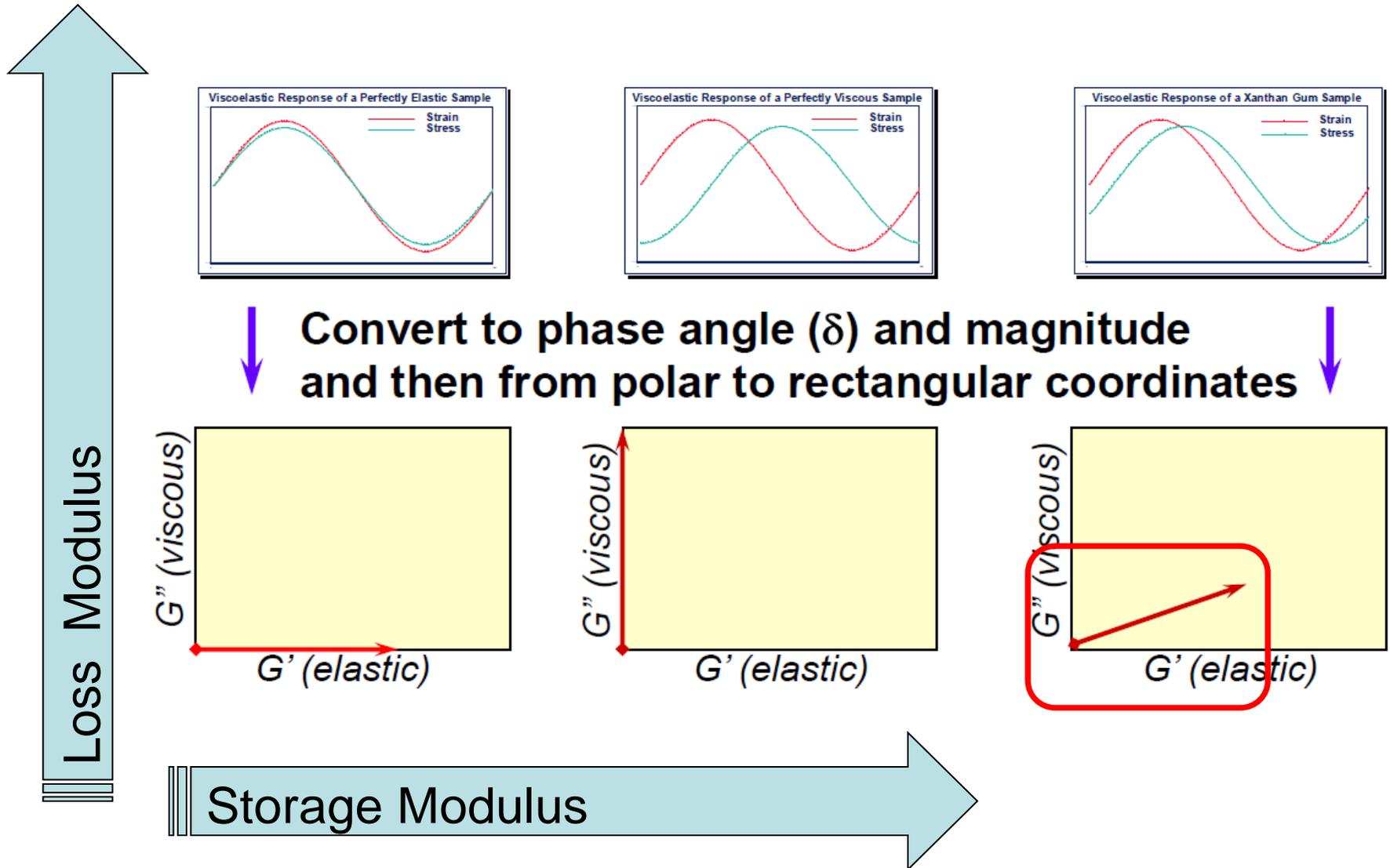
# Outline

- Introduction
  - Viscoelasticity
  - What is Hydrocolloids
  - Literature Review
  - Hydrocolloids
  - Celiac Disease
  - Why Not Salep?
- Background and Justification
- Objectives & Motivation
- Research Strategy (materials and methods)
- Results and Discussion
- Conclusion

# Dynamic Shear Rheology



# Foods



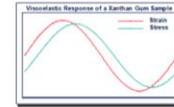
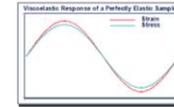
# Hydrocolloids

## thickening and gelling agents

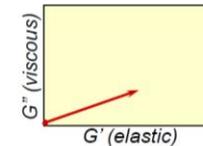
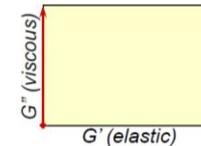
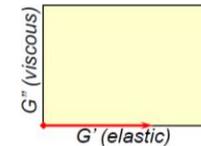
polysaccharides and proteins

Presence of a large number of hydroxyl (-OH) groups

Such as: **Whey Protein**



Convert to phase angle ( $\delta$ ) and magnitude and then from polar to rectangular coordinates



Baeza, Gugliotta, & Pilosof, 2003; Bertrand & Turgeon, 2007; Ikeda, 2003

- Heating

Famelart, Chapron, Piot, Brule, & Durier, 1998; Keim & Hinrichs, 2004

- High Pressure Treatment

Alting, Hamer, de Kruif, Paques, & Visschers, 2003; van den Berg, van Vliet, van der Linden, van Boekel, & van de Velde, 2007; Britten & Giroux, 2001

- Cold gelation process induced by acidification

Barbut, 1997; Marangoni, Barbut, McGauley, Marcone, & Narine, 2000

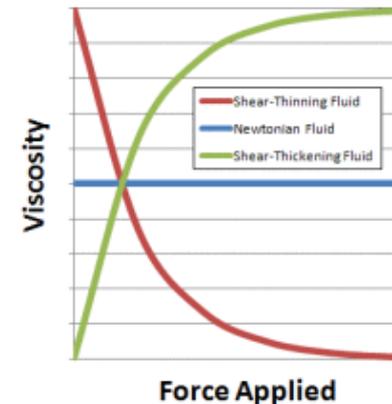
- Addition of salts to pre-denatured whey proteins

Truong, Clare, Catignani, & Swaisgood, 2004

- Coss-linking with transglutaminase

Doucet, Gauthier, & Foegeding, 2001; Ju & Kilara, 1998; Otte, Ju, Faergemand, Lomholt, Qvist, & 1996

- Enzymatic hydrolysis



# Usage of Hydrocolloids

- Hydrocolloids in Salad Dressings
- Hydrocolloids in Muscle Foods
- Hydrocolloids in Frozen Dairy Desserts
- Hydrocolloids in Cultured Dairy Products
- Hydrocolloids in Restructured Foods
- Hydrocolloids in Flavor Stabilization
- Hydrocolloids in **Bakery Products**
- Hydrocolloids in **Bakery Fillings**

# Bread

Bread is the most important and one of the oldest processed food!

**protein**



**starch**



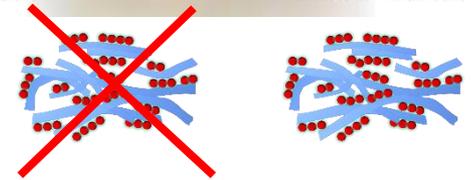
**fiber**



**vitamins  
& minerals**



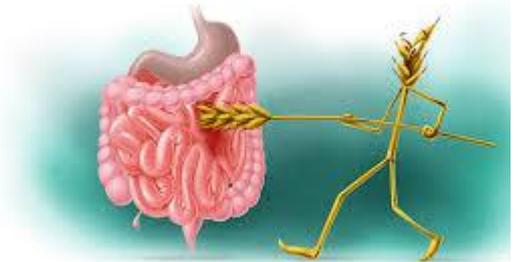
**Bread**



Moreover; Bread companies add additional gluten to make it

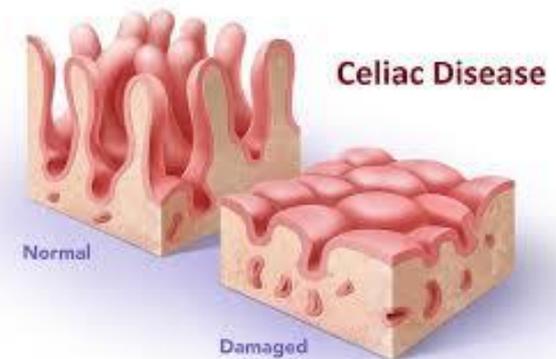
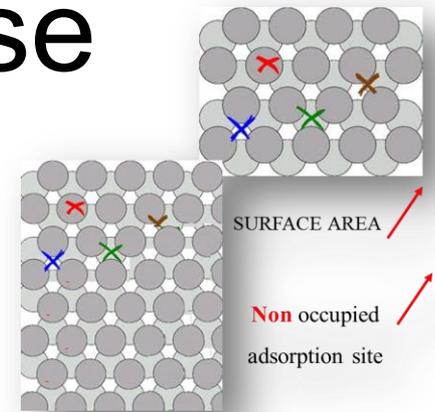
- rise faster
- and higher

!!!!baking quality is effected BUT;



# What is “Celiac Disease

- A genetic disease in children and adults
- Reaction to the food protein gluten
- Body attacks itself, auto-immune reaction
  - Destroys the villi, the lining of the small intestine
  - Scars the intestine and causes sickness



‘There is **NO “cure”** for celiac disease,

but **lifelong avoidance** of gluten is an effective treatment.!

# Estimated prevalence of celiac disease (CD)

| Source  | Ratio of prevalence |
|---|---------------------|
| <b>In the general population</b>                    | 1 in 133            |
| <b>In symptomatic children:</b>                     | 1 in 322            |
| <b>In symptomatic adults:</b>                       | 1 in 105            |
| <b>In first-degree relatives of people with CD</b>  | 1 in 22             |
| <b>In second-degree relatives of people with CD</b> | 1 in 39             |
| <b>In chronic disease (such as type 1 diabetes)</b> | 1 in 60             |
| <b>In African, Hispanic and Asian-Americans:</b>    | 1 in 236            |
| <b>World-wide prevalence</b>                        | 1 in 266            |



**Celiac disease dramatically increased; because of the better recognition and early diagnosis**



**1 in 250 in Italy**



**1 in 300 in Ireland**



**0.3% in Germany**



**1:80-1:251 in Australia**



**1:100-1:310 in India**



**2.4% in Finland**



**1:87- 1:166 in Middle east**



**1:18 - 1:355 in Africa**



**1:88 -1:262 in Europe**



**1:67 – 1:681 in South America**





It is estimated to affect  
**1 in 100 people** worldwide

<http://celiac.org>

3. How common is celiac disease?



Celiac disease affects 1 in 100 people worldwide with the number of people affected doubling every 15 years. If an immediate family member has celiac disease, then the risk is 1 in 10 that you will have it too.

So? **Hydrocolloid is good to use**



Success of  
bread making  
depends on  
**gluten**

**lifelong avoidance** of  
gluten is certain!!!



# Background and Justification

- Glucomannan
  - non-harmful
  - non-toxic properties
  - good biocompatibility properties
  - inherent gel forming properties

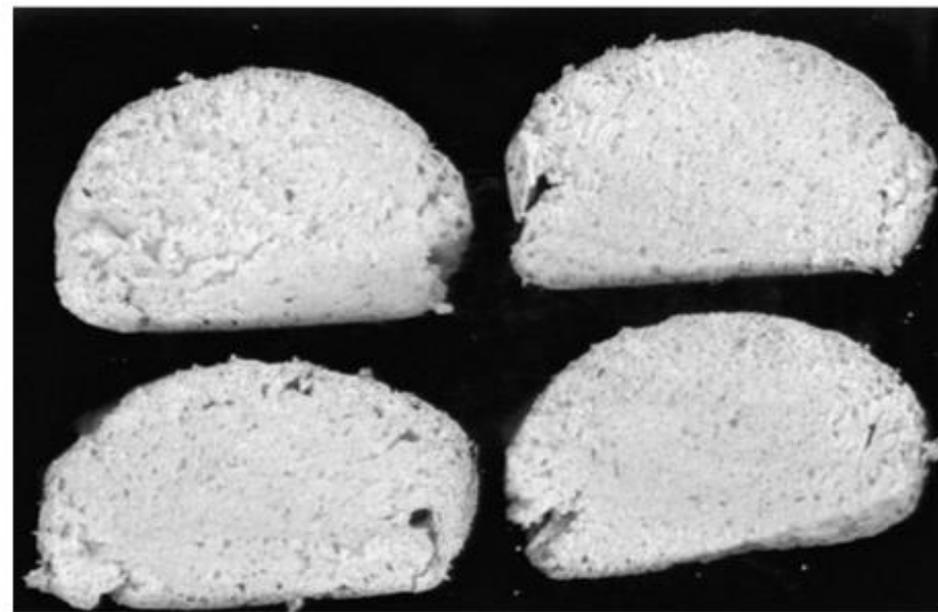


- These positive impact, on human health
  - plasma lipid
  - body weight,
  - fasting blood glucose (FBG)
  - blood pressure (BP)
- GM consumption of 2-4 g per day results in significant weight loss

Miracle Noodles-**white waterfall**

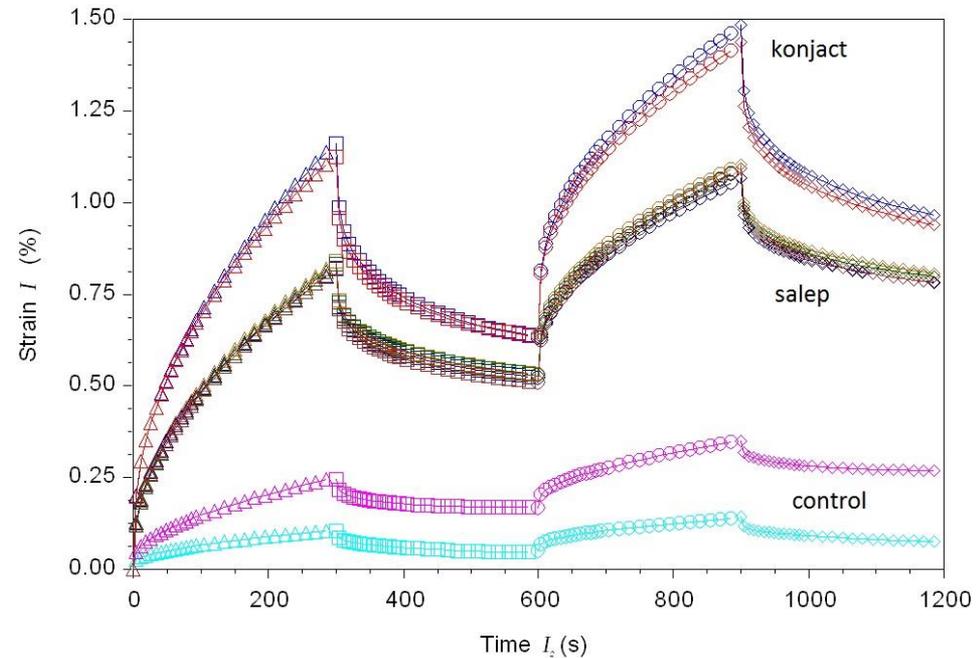
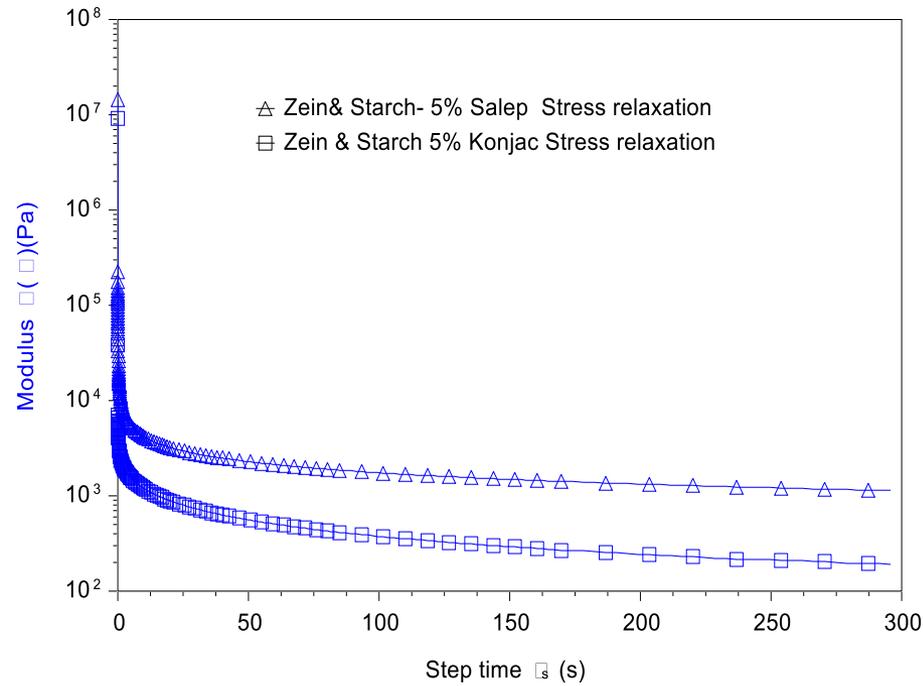


# Why not salep ?



| Basic Bread Formulation | % by Weight |
|-------------------------|-------------|
| Flour, all-purpose      | 58.01       |
| Water                   | 36.36       |
| Oil, canola             | 1.66        |
| Sugar, granulated       | 1.55        |
| Salt                    | 1.01        |
| Yeast, active dry       | 0.77        |
| Yeast, active dry       | 0.31        |
| Baking powder           | 0.17        |
| <i>Gum*</i>             | <i>0.16</i> |
|                         | 100%        |

# Yetgin S 2017: Rheological properties of gluten free dough systems



# Motivation of the Study



A growing demand for gluten-free (GF) products is observed

Hydrocolloids help the dough formulation to immobilize  
water inside on it

Control just for water interaction of Salep and Konjact



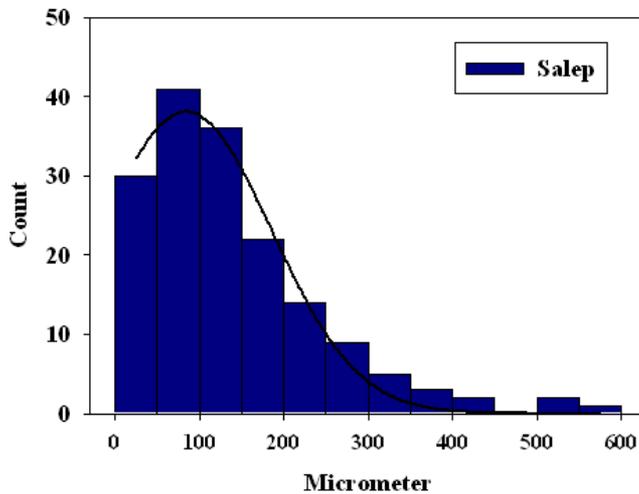
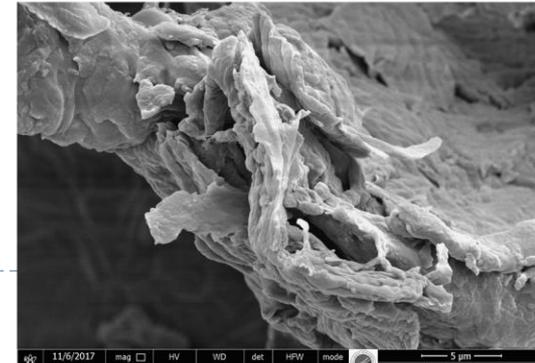
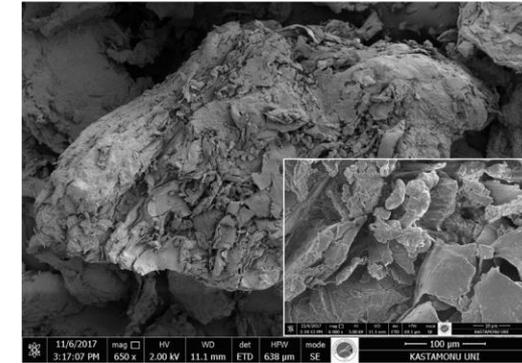
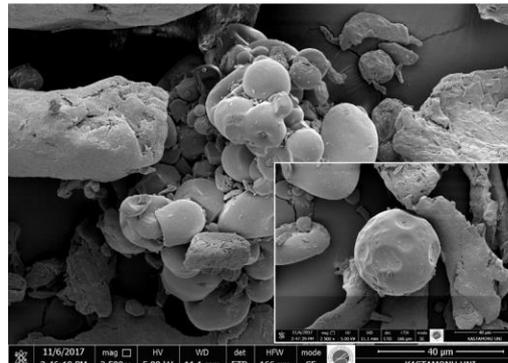
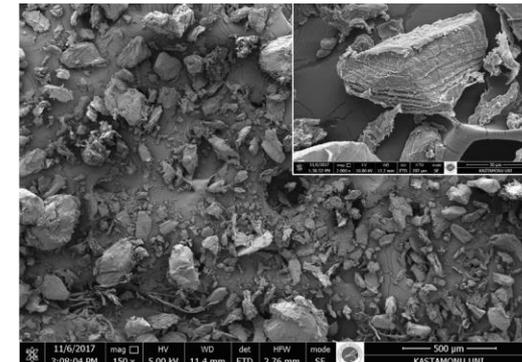
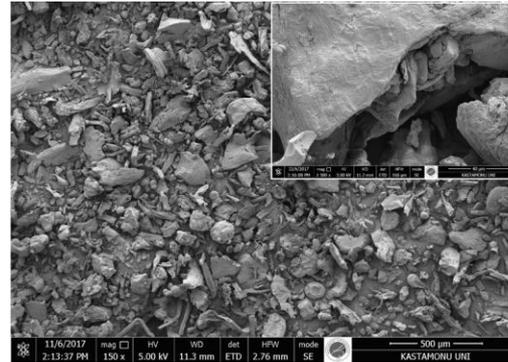
# Aim of the Study

The aim of this study is to investigate the gelation profile of GS rich CS or RS without the use of dairy product but water based on rheological test with heat induced gelation profile.



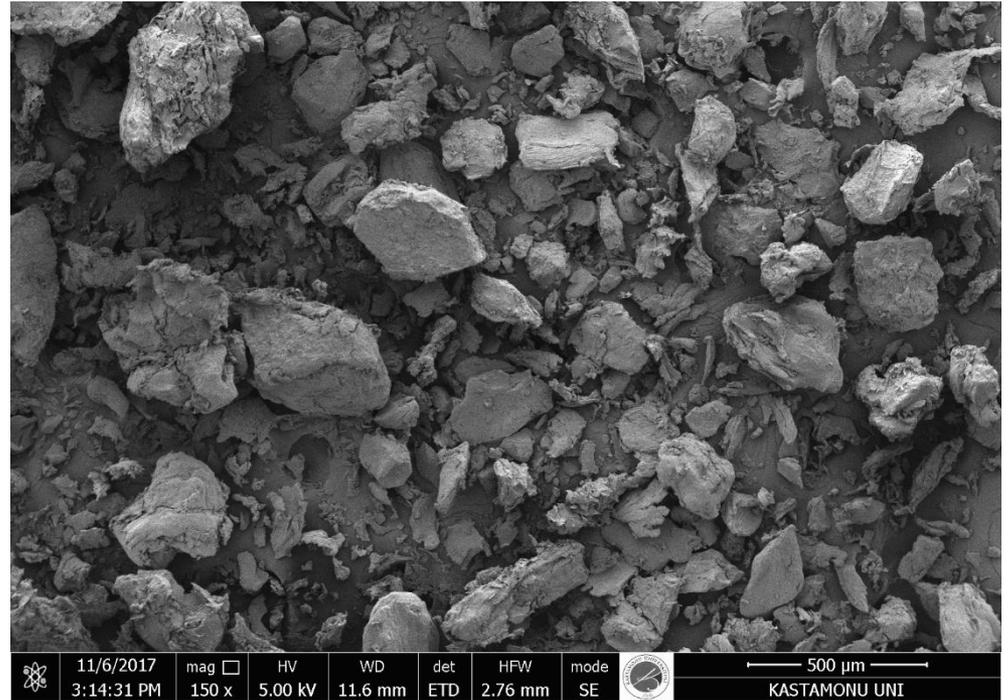
# Materials:

# Commercial Salep (C

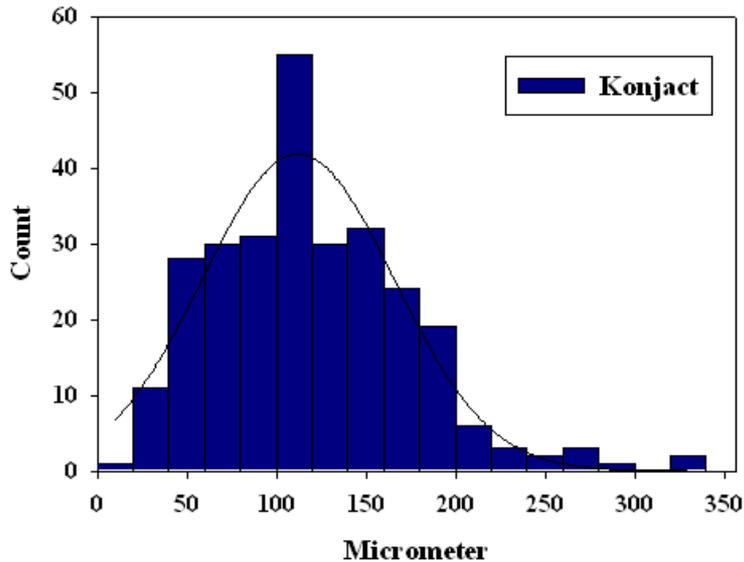
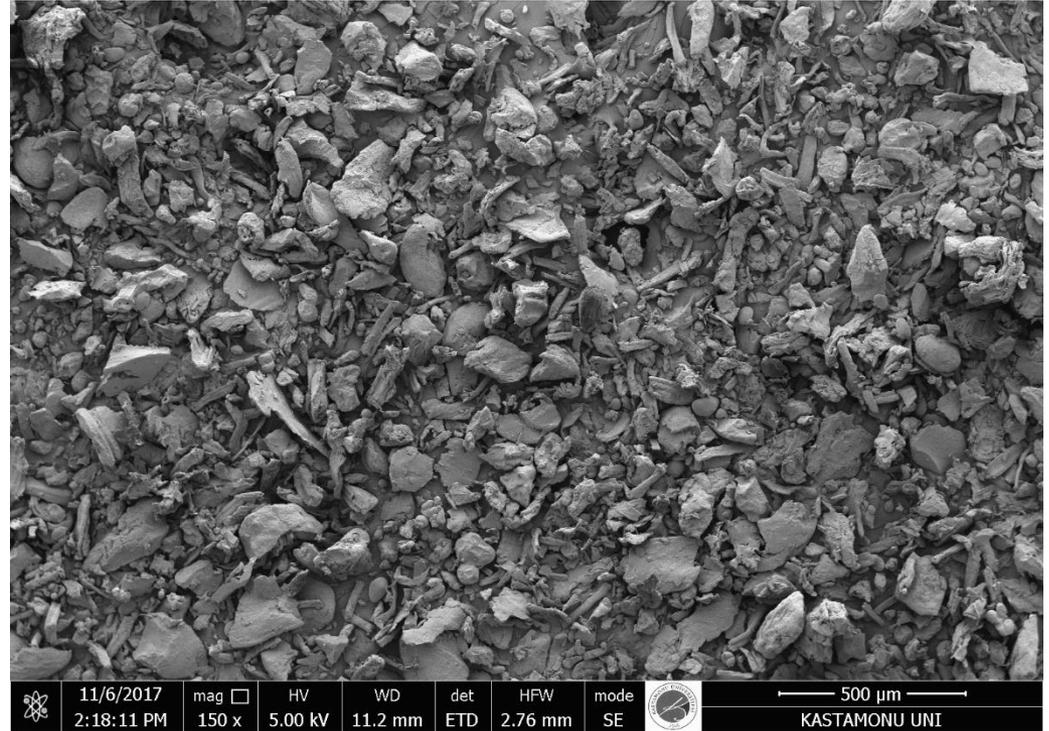
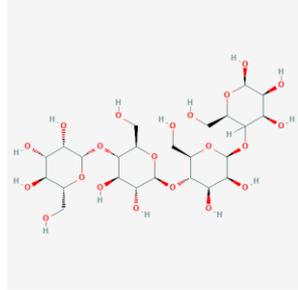


Materials:

# Graunded Salep (GS)



# Materials: Konjact Glucomanan(KG)



CS, RS and KG were used as received from a local market

# Methods

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- ▶ Salep Characterisation
- ▶ Rheology Analysis

40mm parallel plates geometry and 1mm gap  
25 to 95°C, holding at 95°C for 10 min

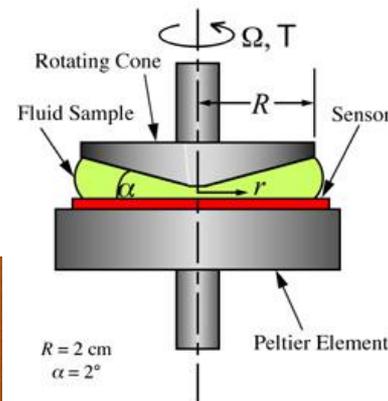
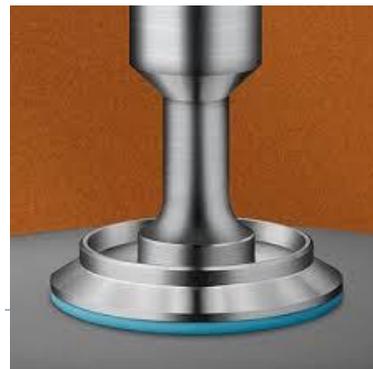


AR-G2 Model from TA Instruments



- ▶ The temperature of the bottom plate was controlled with a Peltier system.
- ▶ For the measurements, approximately 5 ml of each sample was placed in the cup and the surface of the sample covered with paraffin oil to avoid evaporation of

We



|                      |  |
|----------------------|--|
| Parallel plate       |  |
| Cone and plate       |  |
| Concentric cylinders |  |

such as oils or polymers

# All samples were analysed

---

- ▶ gelation time
  - ▶ creep test
  - ▶ frequency and temperature sweep analysis
- with respect to different weight percentages**

| Sample Name | Weight percentages |
|-------------|--------------------|
| KG          | 0.5 to 3.0 (w/w %) |
| CS          | 0.5 to 15 (w/w %)  |
| RS          | 0.5 to 15 (w/w %)  |



# Purification of GM from salep root

## 'Sevag Method'

### Initiation

- Natural roots were grinded
- the crude flour immersed in 50%(v/v) MeOH for 4 hour
- Dried 70 °C

### Removal of Oil & fat

- Raw Salep flour was extracted with Benzene& Absolute Alcohol (2:1)
- Least two times

### Removal of Protein

- Salep flour was extracted with Chloroform& Butanol (4:1)  
Least 5 times

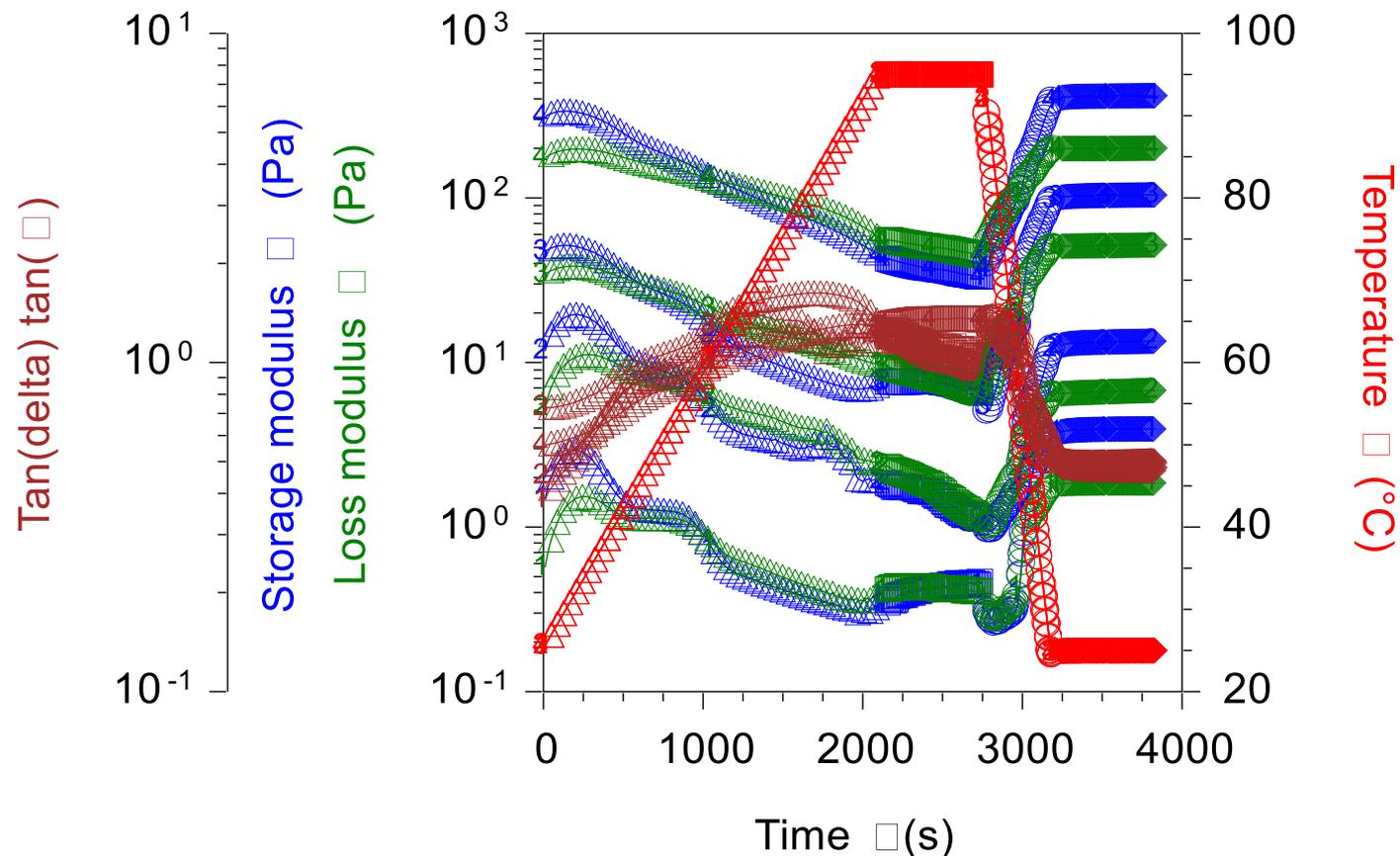
### Final

- Dissolved in DD water @40 °C for 2 hours  
After cooling room temperature centrifuged @ 10000rpm for 40 min  
Acetone was added to supernatant and stirred
- Filtered with 120 m sieve
- Then dried in freeze dryer



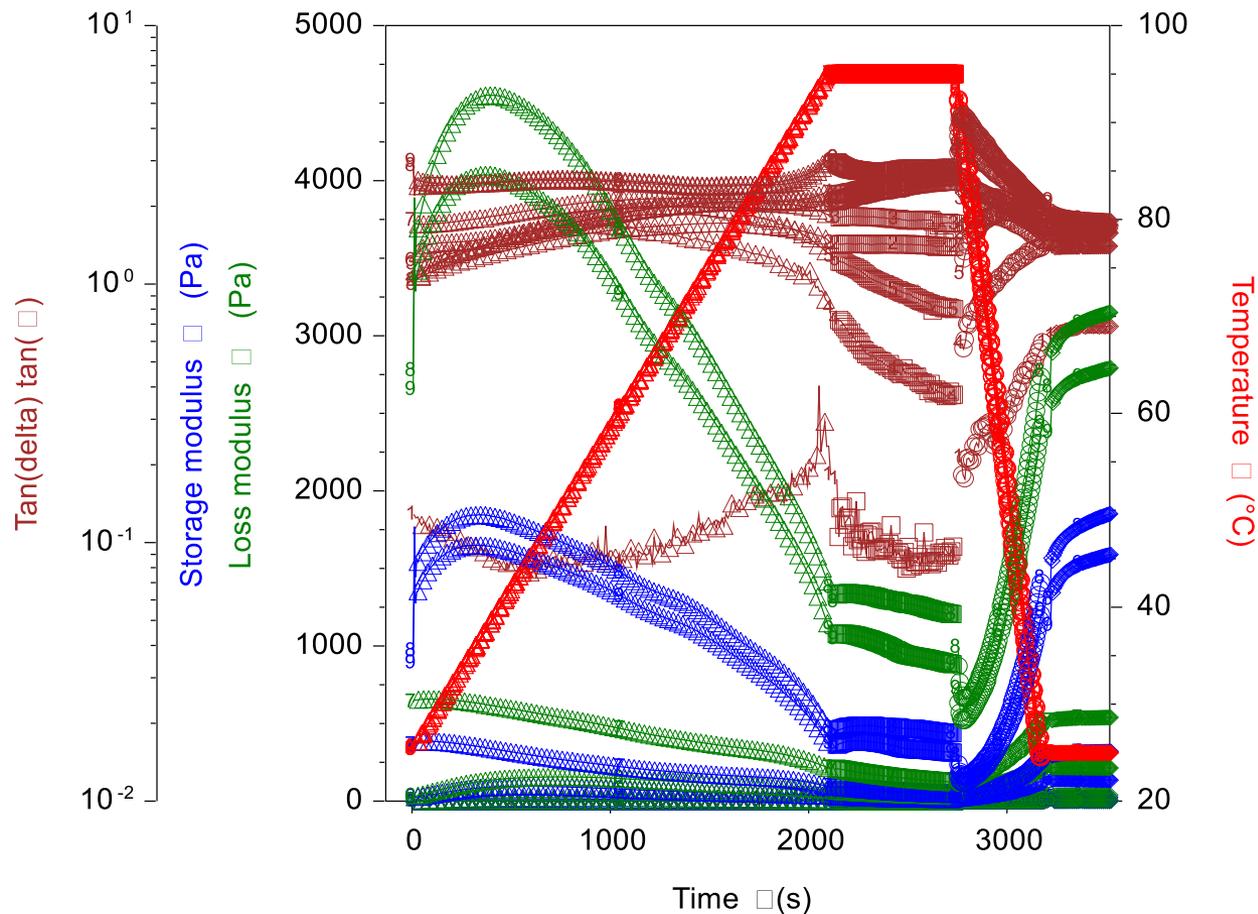
Rheological properties of KG 0.5 to 3.0 % a small amplitude oscillatory shear test during temperature increasing from 25 to 95° C, holding at 95° C for 10 min

# Konjact Glucomanan(KG)



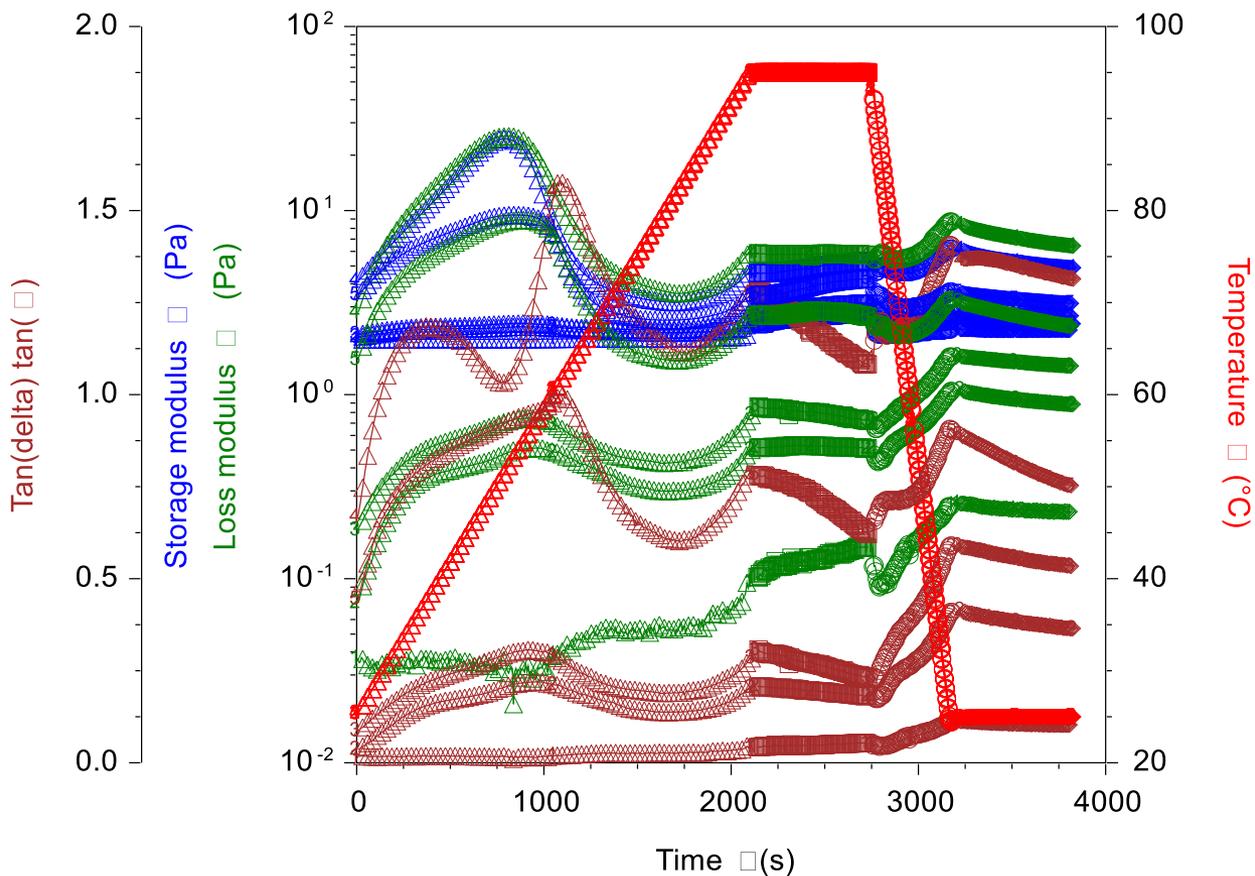
Rheological properties of CG 0.5 to 15 % a small amplitude oscillatory shear test during temperature increasing from 25 to 95° C, holding at 95° C for 10 min

# Commercial Salep (CS)



Rheological properties of RS 0.5 to 15 % a small amplitude oscillatory shear test during temperature increasing from 25 to 95° C, holding at 95° C for 10 min

# Graunded Salep (GS)



# Conclusion

- CS and RS 'weight percentages is about enough to get similar rheological properties or slightly increased in accordance with colloid system heat induced gelation profile data.
- Drinkability of GS and CS are still high after 95 C heating
- Fresh salep powder (GS) has greater gelation ability ( $G'$  greater than  $G''$  )
- Furthermore, as indicated before KG has an excellent gelation profile

# ACKNOWLEDGMENT

The Scientific and Technological Research Council of Turkey (**TUBITAK**) with project number **1059B191500937** for postdoctoral research in Purdue University Agriculture and Bioengineering and partly Food Science Department West Lafayette -USA



- **National Postdoctoral Research Scholarship Programme**

Scientists who perform research in Natural Sciences, Medical Sciences, Social Sciences and Humanities and Engineering and Technological Sciences in Turkey are supported.

- **International Postdoctoral Research Scholarship Programme**

Scientists who perform research in Natural Sciences, Medical Sciences, Social Sciences and Humanities and Engineering and Technological Sciences abroad are supported.

# Last and foremost

Prof Dr. Osvaldo Campanella & Dr Owen Jones and their groups

Also all Purdue Graduate Students and Post Docs



# Thank you

## Question?



1<sup>st</sup> International / 11<sup>th</sup> National  
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7-9 November 2019 / Antalya, TURKEY

**Heat Induced Gelation Time Profile for Salep and Konjact Glucomannan**

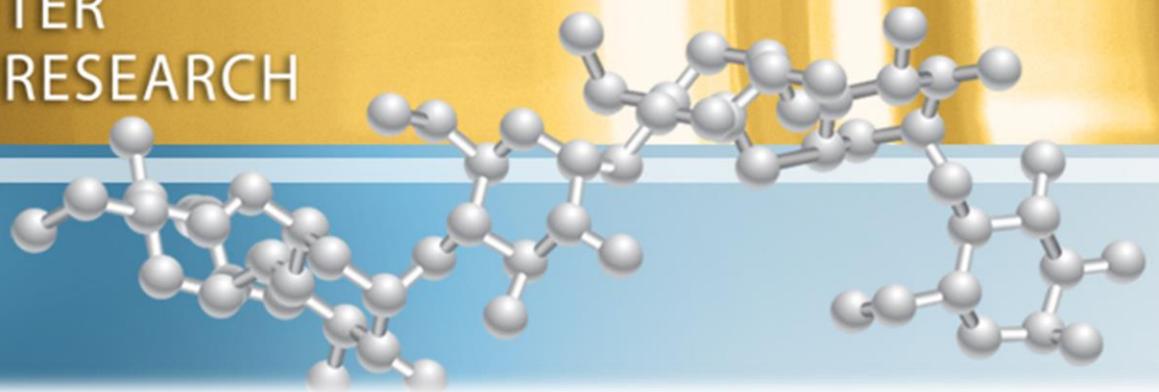
Presented by  
Senem YETGIN



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WHISTLER CENTER  
FOR CARBOHYDRATE RESEARCH

PURDUE  
UNIVERSITY



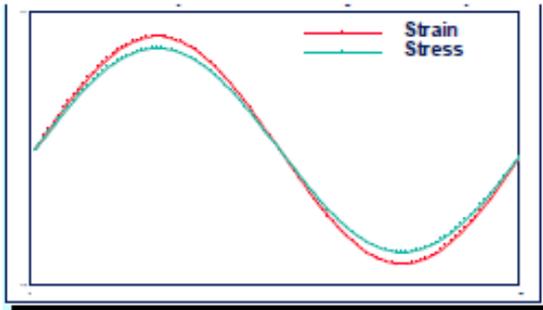
## Heat Induced Gelation Time Profile for Salep and Konjact Glucomannan

Presented by  
Senem YETGIN

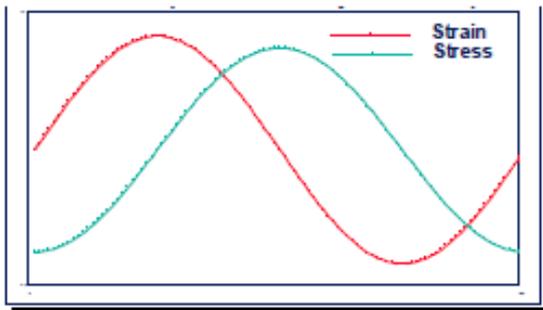


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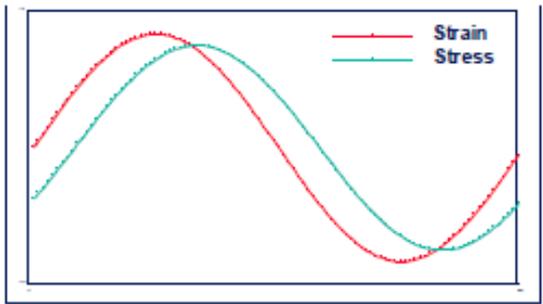
# Viscoelasticity measurement



**Elastic materials**, like a steel spring, will always have stress and strain when tested in dynamic test. This is because the material transfers the applied stress with no storage of the energy.



**Viscous materials**, like water or thin oils, will always have stress and strain shifted  $90^\circ$  from each other. This is because the most resistance to movement occurs when the rate of the movement is the greatest.



Most of the world is **viscoelastic** in nature and so shares characteristics of elastic and viscous materials. The phase shift ( $\delta$ ) will always be between  $0^\circ$  and  $90^\circ$ .

nd &

- Heating

1998;

- High Pressure Treatment

rs, 2003;

, van  
Giroux,

- Cold gelation process induced by acidification

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- Addition of salts to pre-denatured whey protein

2004

- Coss-linking with transglutaminase

Kilara,  
ist, &

- Enzymatic hydrolysis



## How to Prevent Celiac Disease

Mercola.com



©iStock.com / CharlieAJA



## Safe and Effective Celiac Disease Treatment Methods

Mercola.com



©iStock.com / MarsBars

Sip & Savor: A Gluten-Free Experience, Los Angeles, October 14, 2017. [Get Your Tickets Here](#)

**SOLVING CELIAC DISEASE TOGETHER**

**iCureCeliac®**  
ADD YOUR DATA TO FIND A CURE [COUNT ME IN](#)

Symptoms listed in word cloud: CONSTIPATION, BLOATING, MIGRAINES, IRRITABILITY, CHRONIC DIARRHEA, ITCHY SKIN RASH, SHORT STATURE, FAILURE TO THRIVE, ABDOMINAL PAIN, OSTEOPOROSIS, HEARTBURN, MUSCLE PAIN, ULCEER, WEIGHT LOSS, DEPRESSION, EDMA, FATIGUE, VOMITING, INFERTILITY, ARTHRITIS, JOINT PAIN, SKIN RASH.

More than 1 million people are affected by celiac disease and non-celiac gluten/wheat sensitivity *NOW*

[COMPLETE THE SYMPTOMS CHECKLIST](#)

[LEARN HOW TO LIVE GLUTEN-FREE](#)

[BROWSE THE MARKETPLACE](#)

Featured News



**JAMA's Review of Celiac Disease and Non-Celiac Gluten Sensitivity**

October 5, 2017

In the August 15, 2017 issue of the esteemed Journal of the American Medical Association, a spotlight was cast on celiac disease and non-celiac gluten sensitivity, with a comprehensive review of

WATCH THE "WHAT YOU NEED TO KNOW" VIDEO SERIES

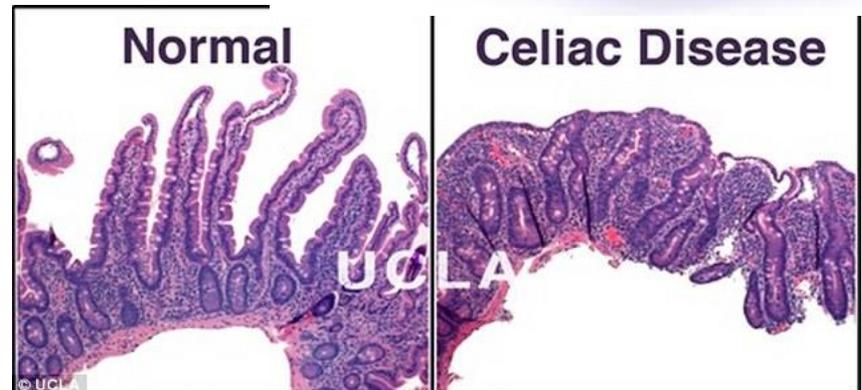
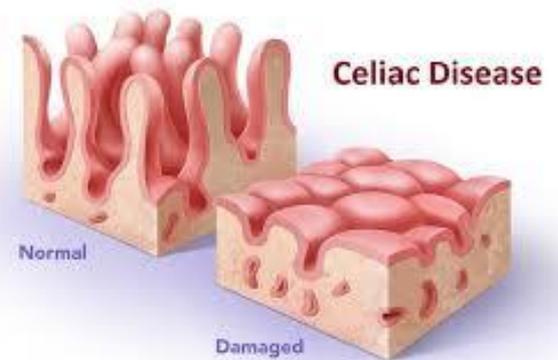
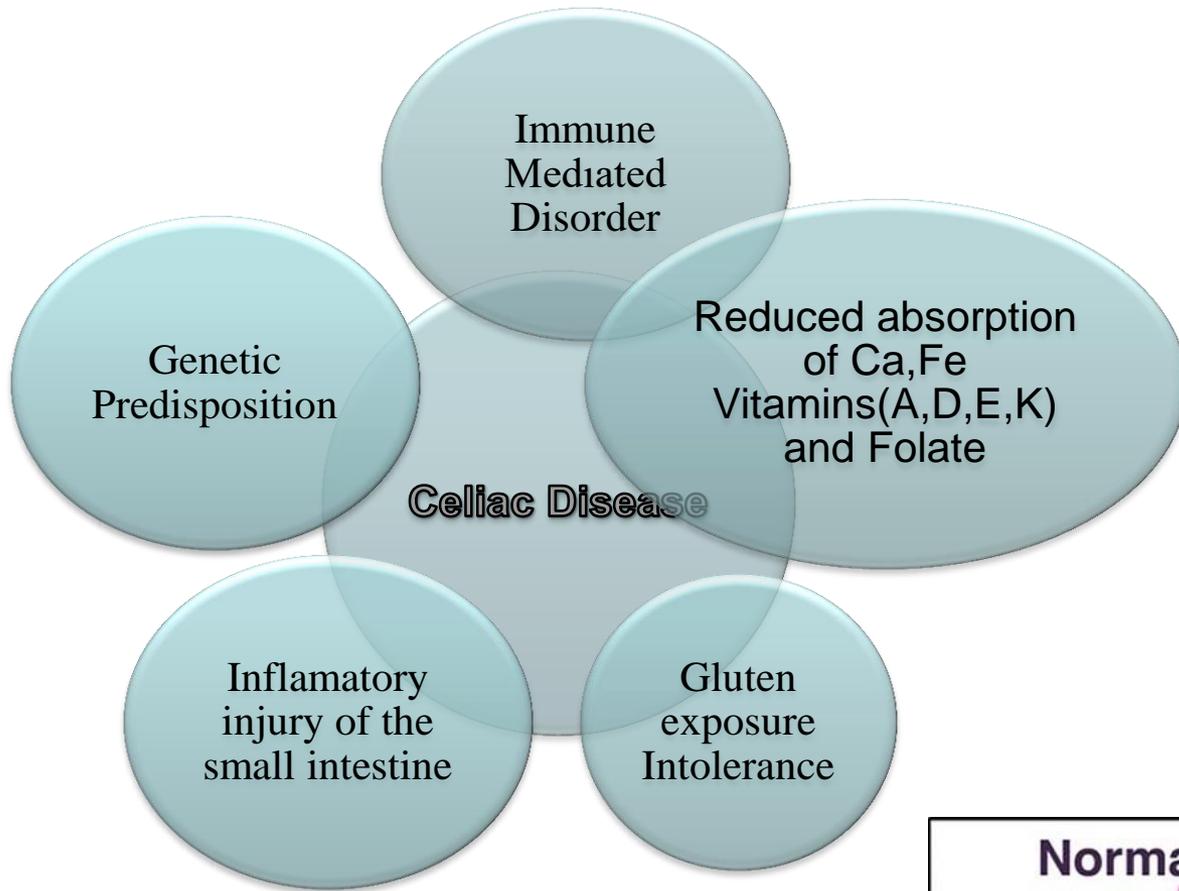
**Celiac Disease FOUNDATION**

What is **about?**

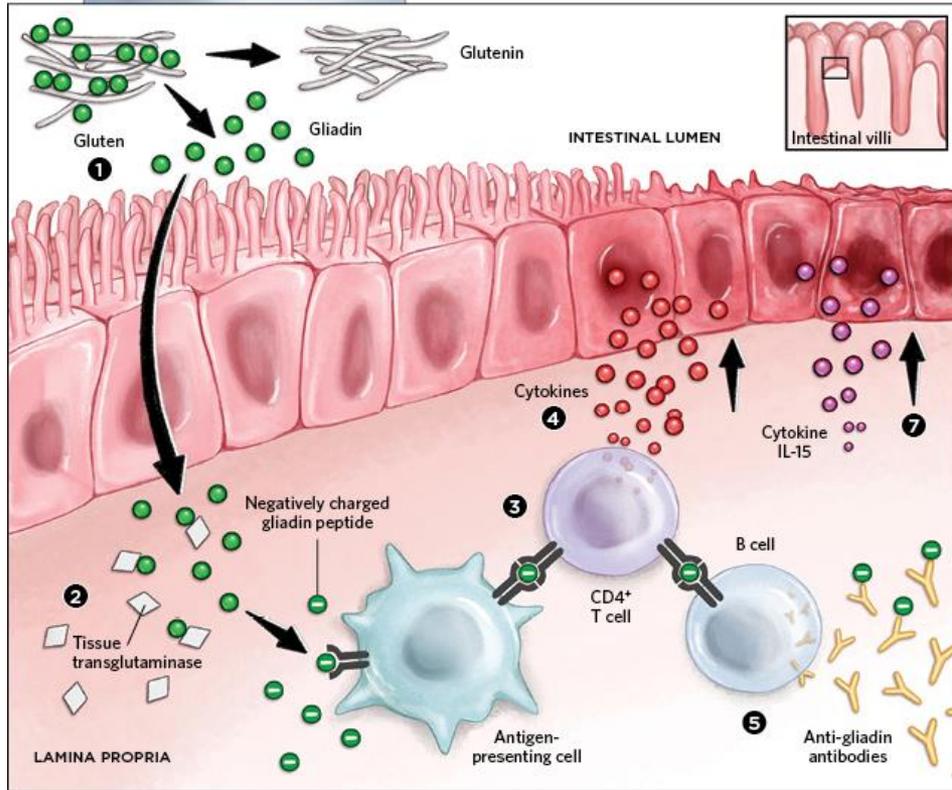
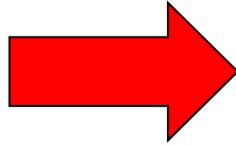
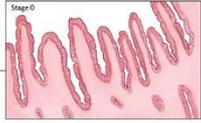
Peter H. R. Green, MD  
Celiac Disease Center,  
Columbia University

[celiac.org](http://celiac.org)

# Causative Factors in Celiac Disease

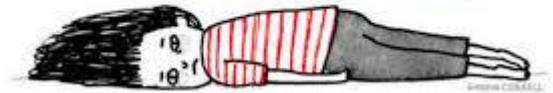


# Celiac pathonenesis



- Some people with celiac experience:
  - Depression
  - Irritability
  - Poor memory
  - Trouble concentrating

**NOPE.**



# CELIAC DISEASE SYMPTOMS AND CONDITIONS CHECKLIST

## General Conditions

### Anemia ⓘ

Yes  No  Unsure

### Fatigue or Chronic Fatigue Syndrome ⓘ

Yes  No  Unsure

### Failure to Thrive ⓘ

Yes  No  Unsure

### IgA Deficiency ⓘ

Yes  No  Unsure

### Malnutrition or Vitamin Deficiency ⓘ

Yes  No  Unsure

## Behavioral or Central Nervous System Conditions

### ADHD ⓘ

Yes  No  Unsure

### Anxiety ⓘ

Yes  No  Unsure

### Brain Fog or Foggy Mind ⓘ

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Depression ⓘ

Yes  No  Unsure

### Developmental Delay ⓘ

Yes  No  Unsure

### Headache or Migraine ⓘ

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Irritability ⓘ

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Lack of Muscle Coordination (Ataxia) ⓘ

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Seizure ⓘ

Yes  No  Unsure

# Continue... CELIAC DISEASE SYMPTOMS AND CONDITIONS CHECKLIST

## Gastrointestinal Conditions

### Abdominal Pain

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Acid Reflux (Heartburn)

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Bloating

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Constipation

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Diarrhea

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Gas

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Lactose Intolerance

Yes  No  Unsure

### Lymphoma or Intestinal Cancer

Yes  No  Unsure

### Pale, Foul-Smelling Stool

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Unexplained Liver Problem

Yes  No  Unsure

### Vomiting

Never  Daily  Weekly  Monthly  Once in a While  Unsure

### Weight Loss or Weight Gain

Yes  No  Unsure

## Muscular Skeletal Conditions

### Arthritis

Yes  No  Unsure

### Bone or Joint Pain

Yes  No  Unsure

### Fibromyalgia or Muscle Pain

Yes  No  Unsure

### Numbness or Pain in Hands and Feet (Peripheral Neuropathy)

Yes  No  Unsure

### Osteopenia or Osteoporosis

Yes  No  Unsure

### Short Stature

Yes  No  Unsure

## Reproductive Conditions

### Delayed Puberty

Yes  No  Unsure

### Infertility

Yes  No  Unsure

### Menstrual Irregularities or Missed Periods

Yes  No  Unsure

### Miscarriage

Yes  No  Unsure

# Continue... CELIAC DISEASE SYMPTOMS AND CONDITIONS CHECKLIST

## Muscular Skeletal Conditions

### Arthritis <sup>?</sup>

Yes  No  Unsure

### Bone or Joint Pain <sup>?</sup>

Yes  No  Unsure

### Fibromyalgia or Muscle Pain <sup>?</sup>

Yes  No  Unsure

### Numbness or Pain in Hands and Feet (Peripheral Neuropathy) <sup>?</sup>

Yes  No  Unsure

### Osteopenia or Osteoporosis <sup>?</sup>

Yes  No  Unsure

### Short Stature <sup>?</sup>

Yes  No  Unsure

## Reproductive Conditions

### Delayed Puberty <sup>?</sup>

Yes  No  Unsure

### Infertility <sup>?</sup>

Yes  No  Unsure

### Menstrual Irregularities or Missed Periods <sup>?</sup>

Yes  No  Unsure

### Miscarriage <sup>?</sup>

Yes  No  Unsure

## Skin and Dental Conditions

### Discolored Teeth or Enamel Loss <sup>?</sup>

Yes  No  Unsure

### Eczema <sup>?</sup>

Yes  No  Unsure

### Itchy Skin Rash (Dermatitis Herpetiformis) <sup>?</sup>

Yes  No  Unsure

### Loss of Hair from your Head or Body (Alopecia) <sup>?</sup>

Yes  No  Unsure

### Recurrent Mouth Canker Sores/Oral Ulcers (Aphthous Stomatitis) <sup>?</sup>

Yes  No  Unsure

## Other Conditions and Autoimmune Disorders

### Please mark any diagnosed conditions: <sup>?</sup>

- |   |  |
|---|--|
| <input type="checkbox"/> Autoimmune Hepatitis                           | <input type="checkbox"/> Addison's Disease                 |
| <input type="checkbox"/> Crohn's Disease; Inflammatory Bowel Disease    | <input type="checkbox"/> Chronic Pancreatitis              |
| <input type="checkbox"/> Down Syndrome                                  | <input type="checkbox"/> Idiopathic Dilated Cardiomyopathy |
| <input type="checkbox"/> IgA Nephropathy                                | <input type="checkbox"/> Irritable Bowel Syndrome (IBS)    |
| <input type="checkbox"/> Juvenile Idiopathic Arthritis                  | <input type="checkbox"/> Multiple Sclerosis                |
| <input type="checkbox"/> Non-Alcoholic Fatty Liver Disease              | <input type="checkbox"/> Primary Biliary Cirrhosis         |
| <input type="checkbox"/> Primary Sclerosing Cholangitis                 | <input type="checkbox"/> Psoriasis                         |
| <input type="checkbox"/> Rheumatoid Arthritis                           | <input type="checkbox"/> Scleroderma                       |
| <input type="checkbox"/> Sjogren's Disease                              | <input type="checkbox"/> Thyroid Disease                   |
| <input type="checkbox"/> Turner Syndrome                                | <input type="checkbox"/> Type I Diabetes                   |
| <input type="checkbox"/> Ulcerative Colitis; Inflammatory Bowel Disease | <input type="checkbox"/> Williams Syndrome                 |
| <input type="checkbox"/> None   |  |

## Family Member

1st Degree Relative with Celiac Disease (Parent, Sibling, or Spouse)  Yes  No  Unsure

2nd Degree Relative with Celiac Disease (Aunt, Uncle, Grandparent, Niece, Nephew, Cousin or Half-Sibling)  Yes  No  Unsure

## Diet

Currently Eating a Diet Containing Gluten (Wheat, Rye, Barley)  Yes  No  Unsure

## Submitted By

To receive a copy of your Symptom Checklist to share with your physician, please enter the information below. Once received, print from your email browser. IMPORTANT: Celiac Disease Foundation does NOT process your contact information to third parties. Please review our [Privacy Policy](#) and [Terms of Use](#) for additional information.

First Name \*

Last Name \*

Email \*

Zip Code \*

Email Sign Up

Check here to receive email updates.

## Verification

Please enter any two digits \*

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