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# Whey protein – a realistic approach – designed products for the food industry


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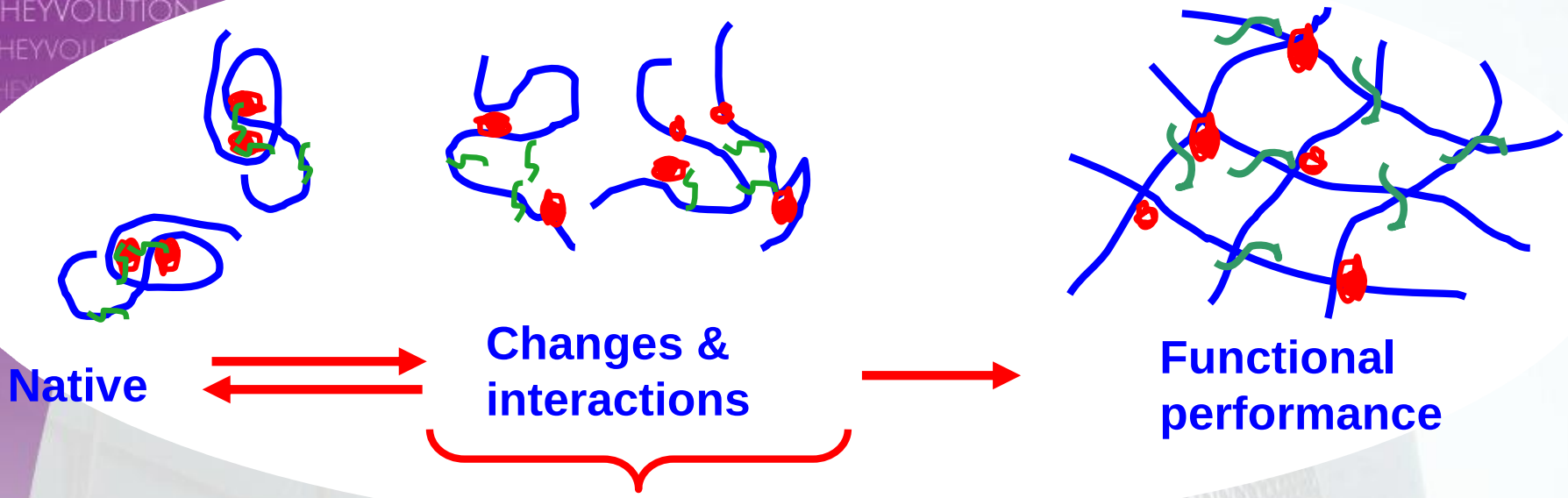
# Introduction

- Use of whey protein so far dominated by functional applications.
- Technology driven – made whey products (WPC) – find a way to use them.
- Industry demand – ability to tailor-make products.
- Research – accumulate knowledge
  - è Based on model systems, both pure and low protein
  - è Hard to translate to commercial reality and of limited commercial value

# Functions drive uses of whey protein

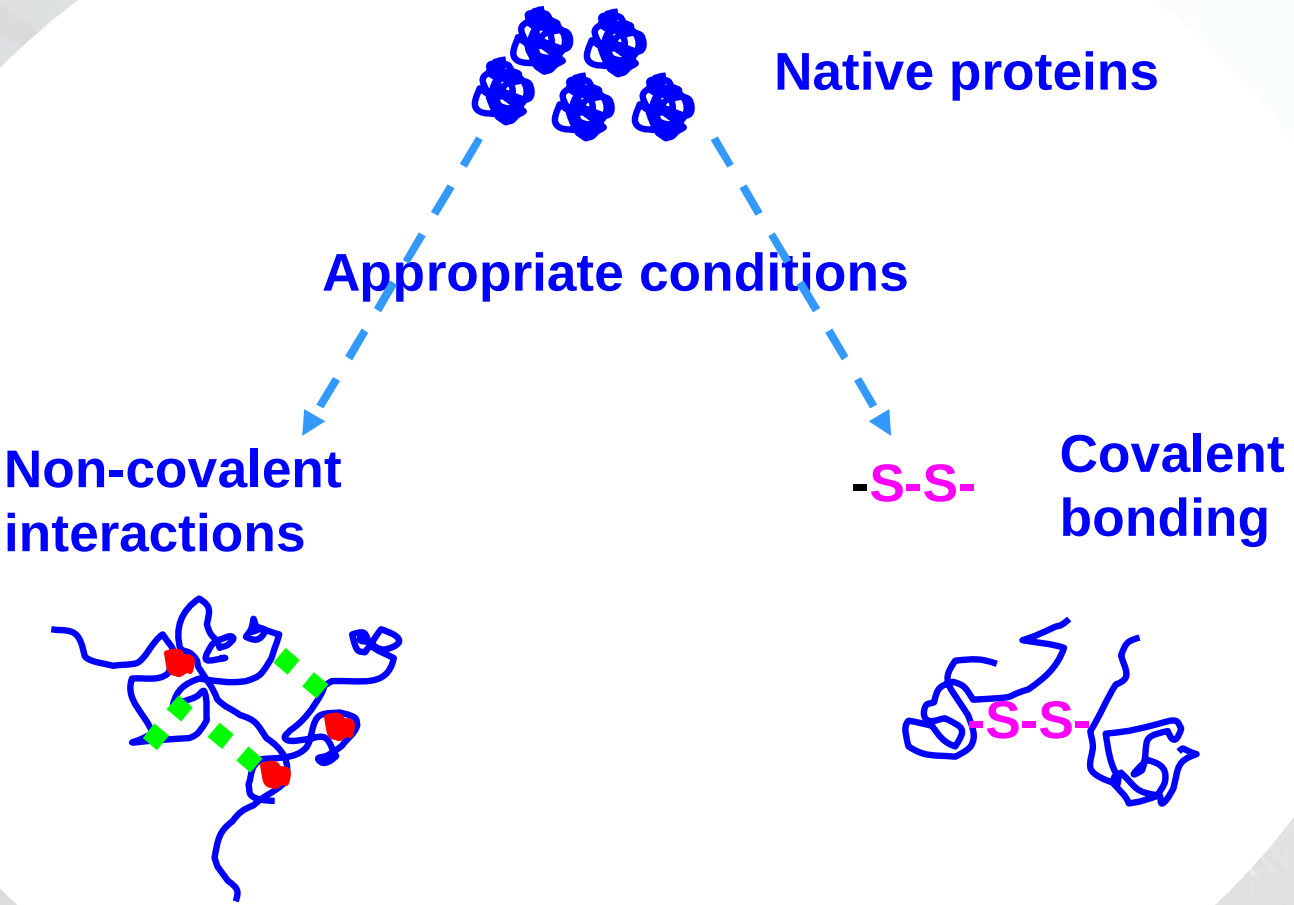
- Fundamental knowledge ×=Ø commercial reality
- Realistic approach – key requirements
  - è Controlled process
  - è Low cost
  - è Consistent delivery of the desired functions
- Functional performance – dictated by protein interactions in food systems.
- Current presentation – review protein interactions and the functional performance of whey proteins in food systems.

# Better understanding of protein interactions




- What happen here that produce the function?
- Can we control these for our advantage?

# Example – types of interactions



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# Two categories of protein interactions

- Two broad categories of interactions
  - **Covalent – (-S̃S-)** – strong, few per molecule, form slowly in a heated protein system.
  - **Non-covalent** (hydrophobic, ionic etc.) – weak, many reactive sites per molecule, form quickly.
- Experiments with heating under different conditions
  - **Control (water)** both covalent and non-covalent interactions.
  - **SDS (1%)** – covalent (disulphide bonds only).
  - **DTT (10 mM)** – no disulphide bonding, non-covalent only.
  - **NEM (1:1 molar ratio)** – no new disulphide bonds – only those pre-existing in the system, interactions are non-covalent only.

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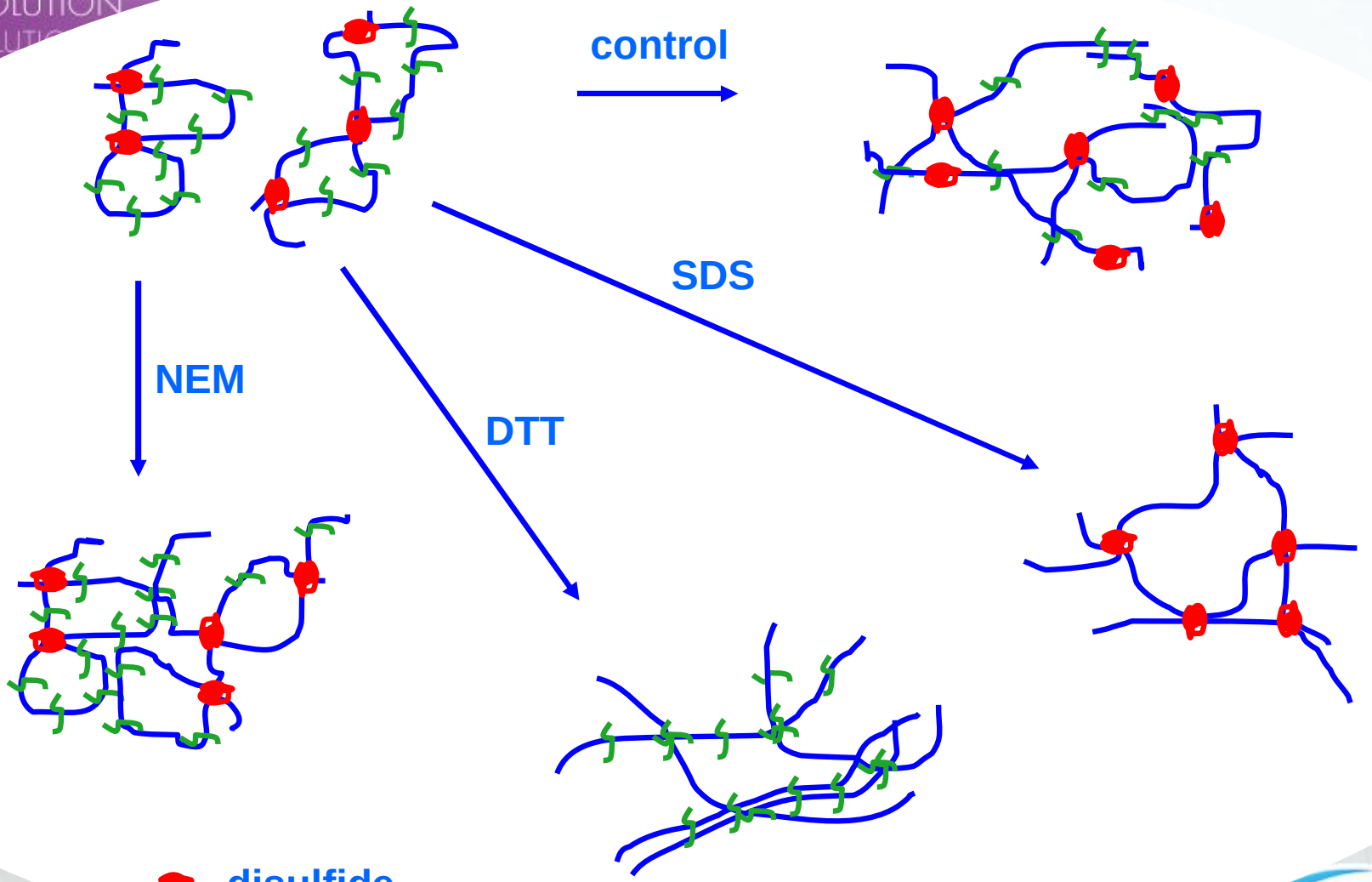
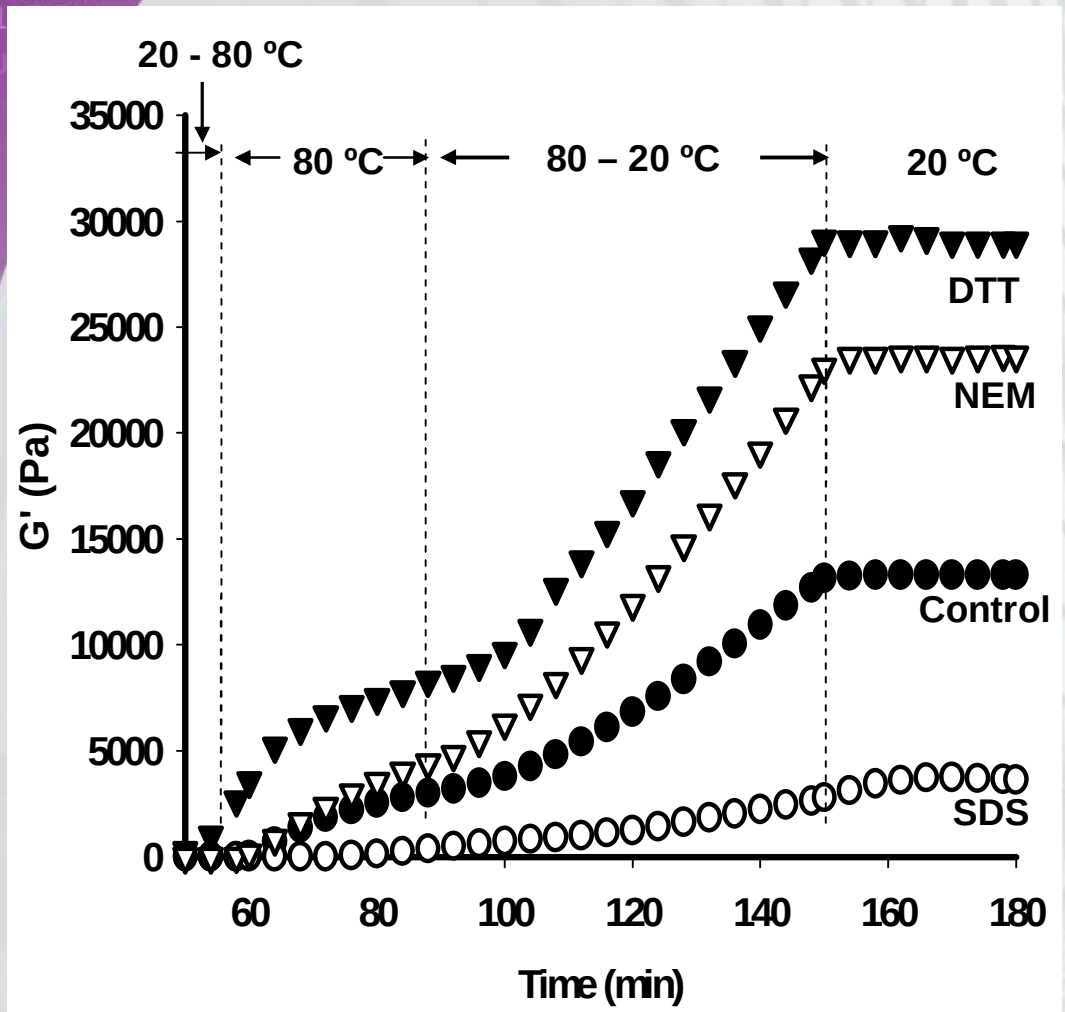
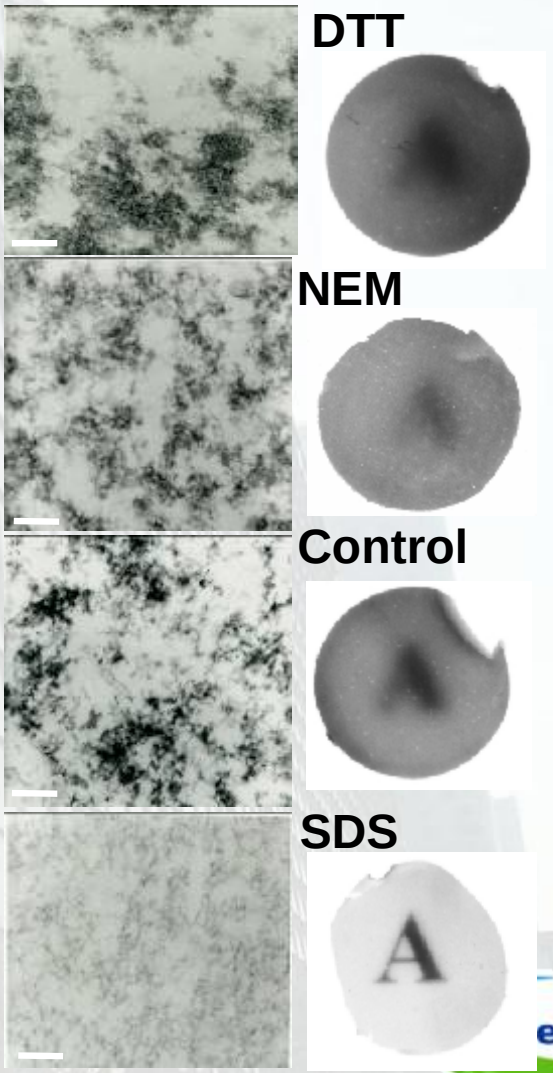
# Manipulation of protein interactions



# Protein interactions and gel properties




12% protein, pH 6.9, 80°C, 30 min



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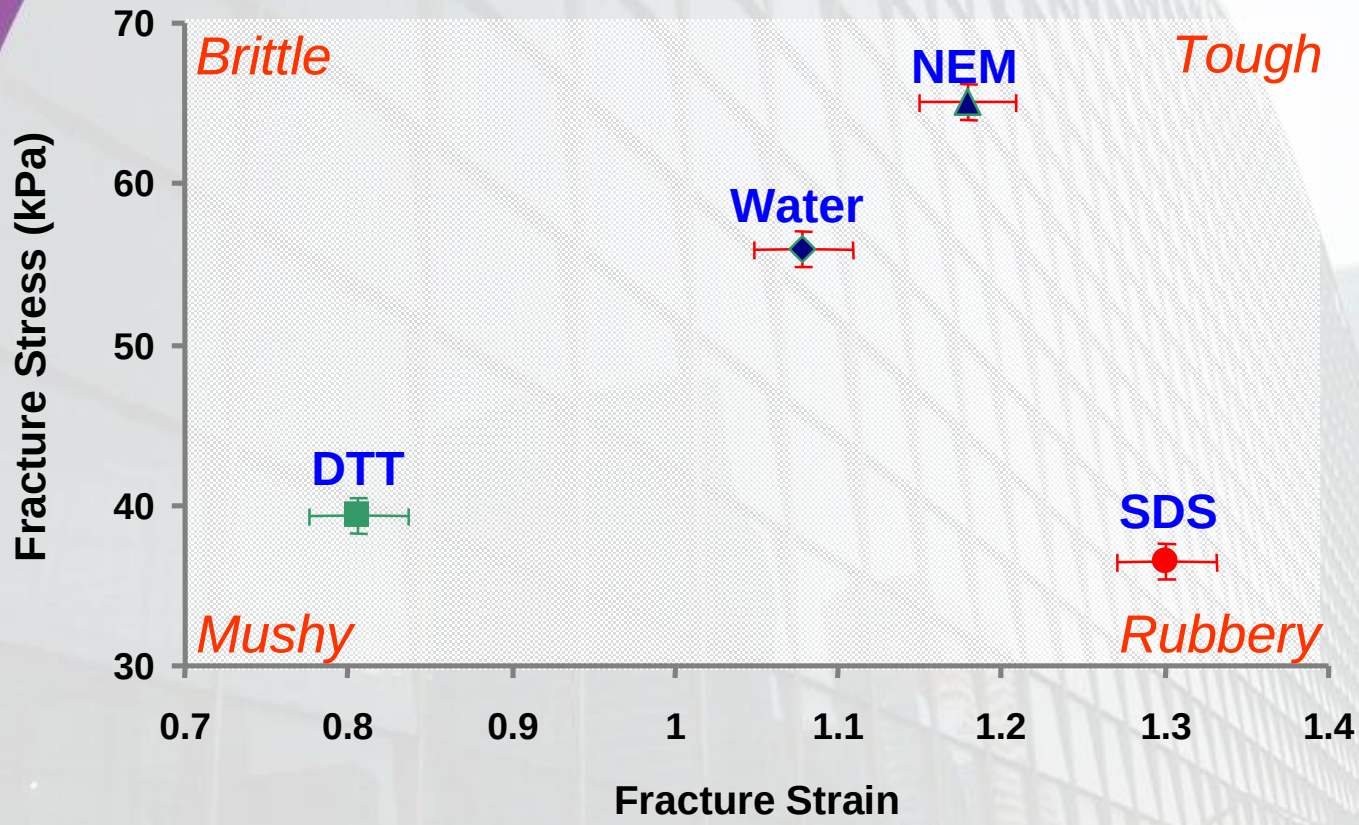
# Effect of protein interactions on texture

## Texture mapping




**12% protein, pH 6.9, 80ºC, 30 min**

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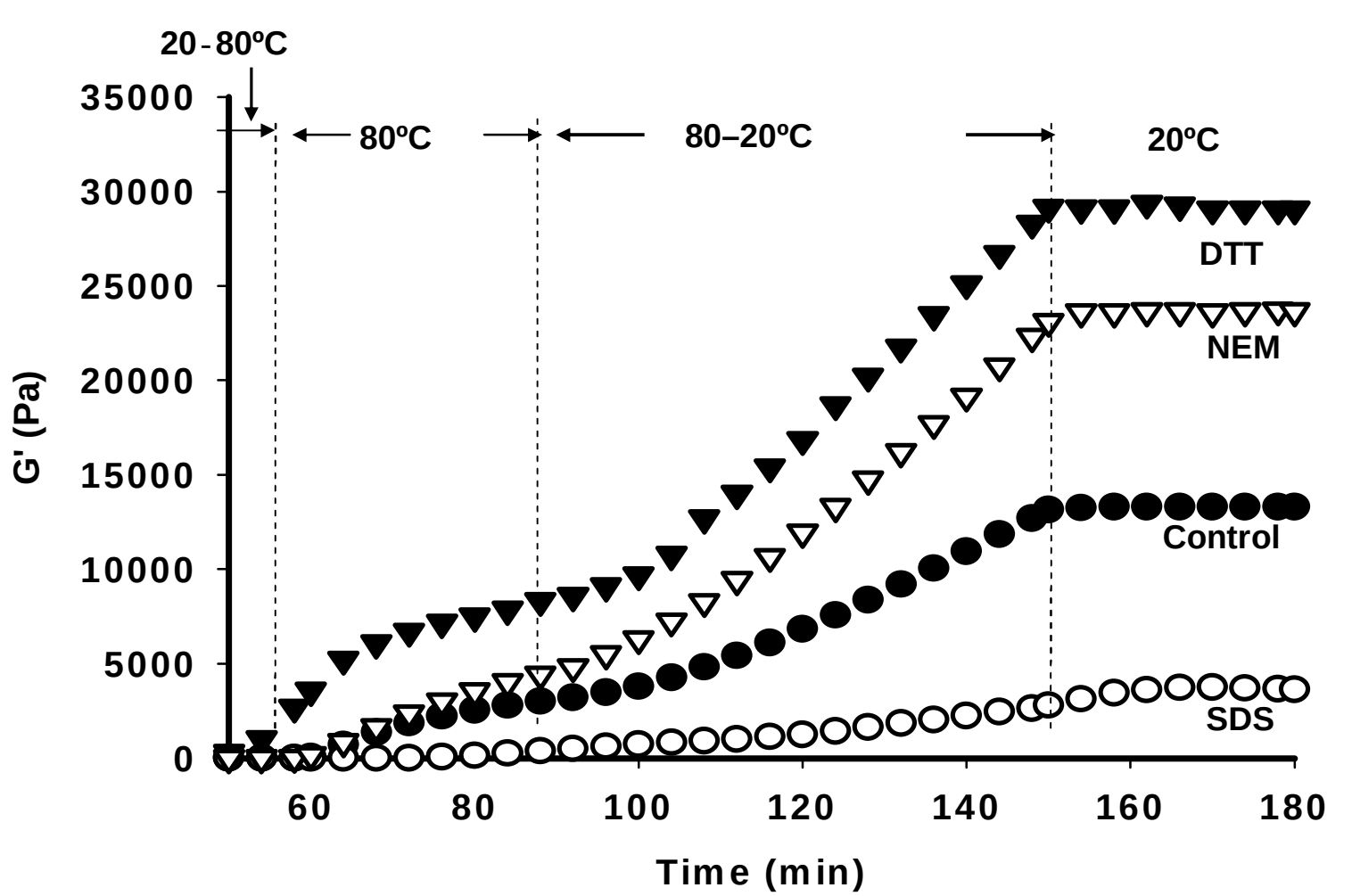
# Modifying target – -S̃S- interactions

- Manufacturing considerations
  - è Purity of protein – removal of lactose, salts (e.g. Ca2+) and other non-functional components (e.g. GMP).
  - è Influence of other factors in food systems to which whey protein is applied: other ingredients, processing conditions, pH, presence of salt.
  - è Room for tweaking – for more suitable selections.
- Modified whey protein products
  - è How are they processed (cold-gelling WPC)?
  - è How are required functional properties (thickening, water holding, emulsifying properties) preserved?

# Tweaking˜ Modified WPC80 (-S̃S- )

- Heating at low ionic strength
  - è Can achieve a variety of functional properties.
  - è Retain heat-gelling function and ability to form gels at low temperatures.
  - è May apply to products such as desserts.
  - è Protein functions – dominated by disulphide-linked interactions.

# Protein interactions and gel properties

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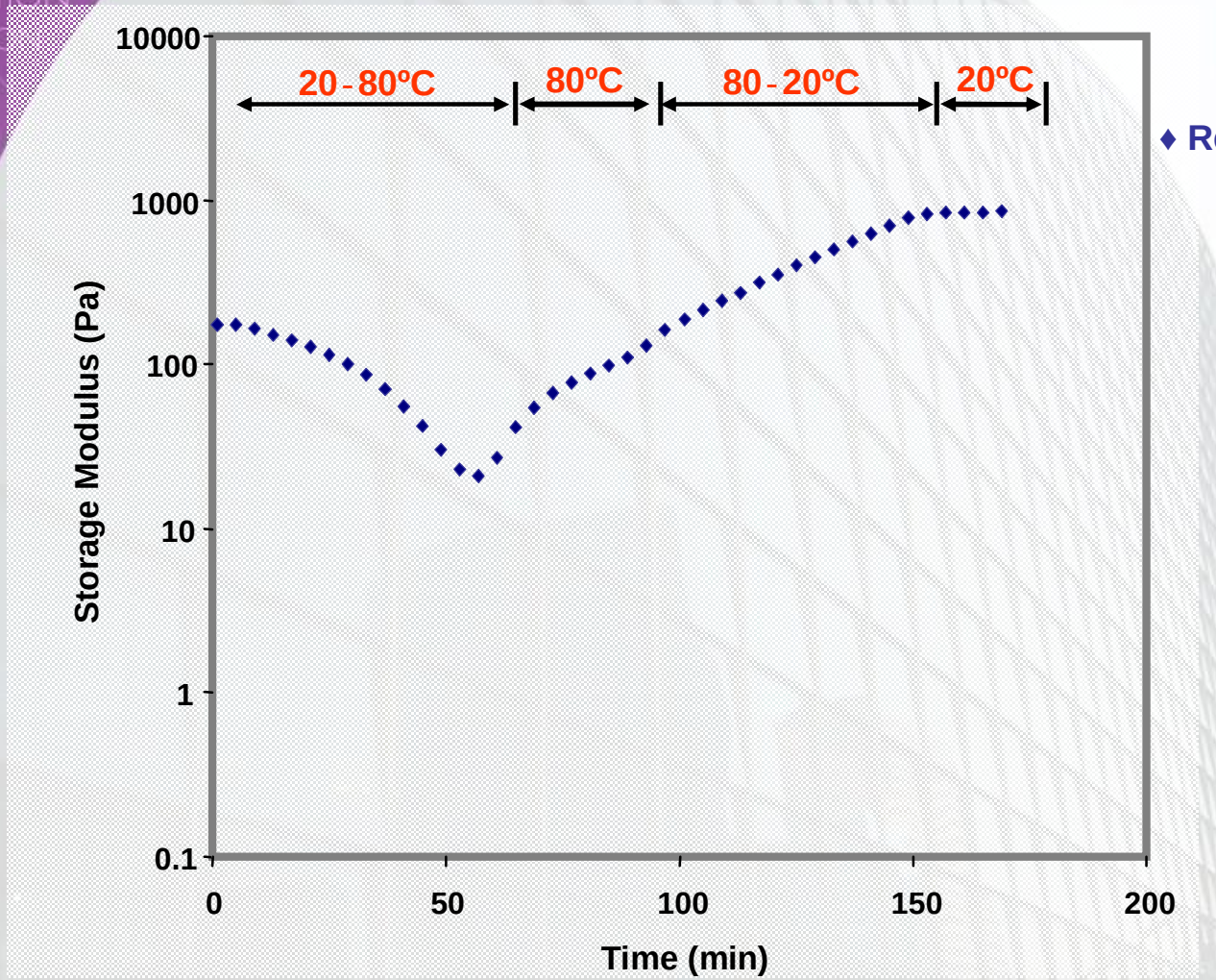
# Heating of CG WPC80




♦ Reconstituted in water

**12% protein, pH 6.9**

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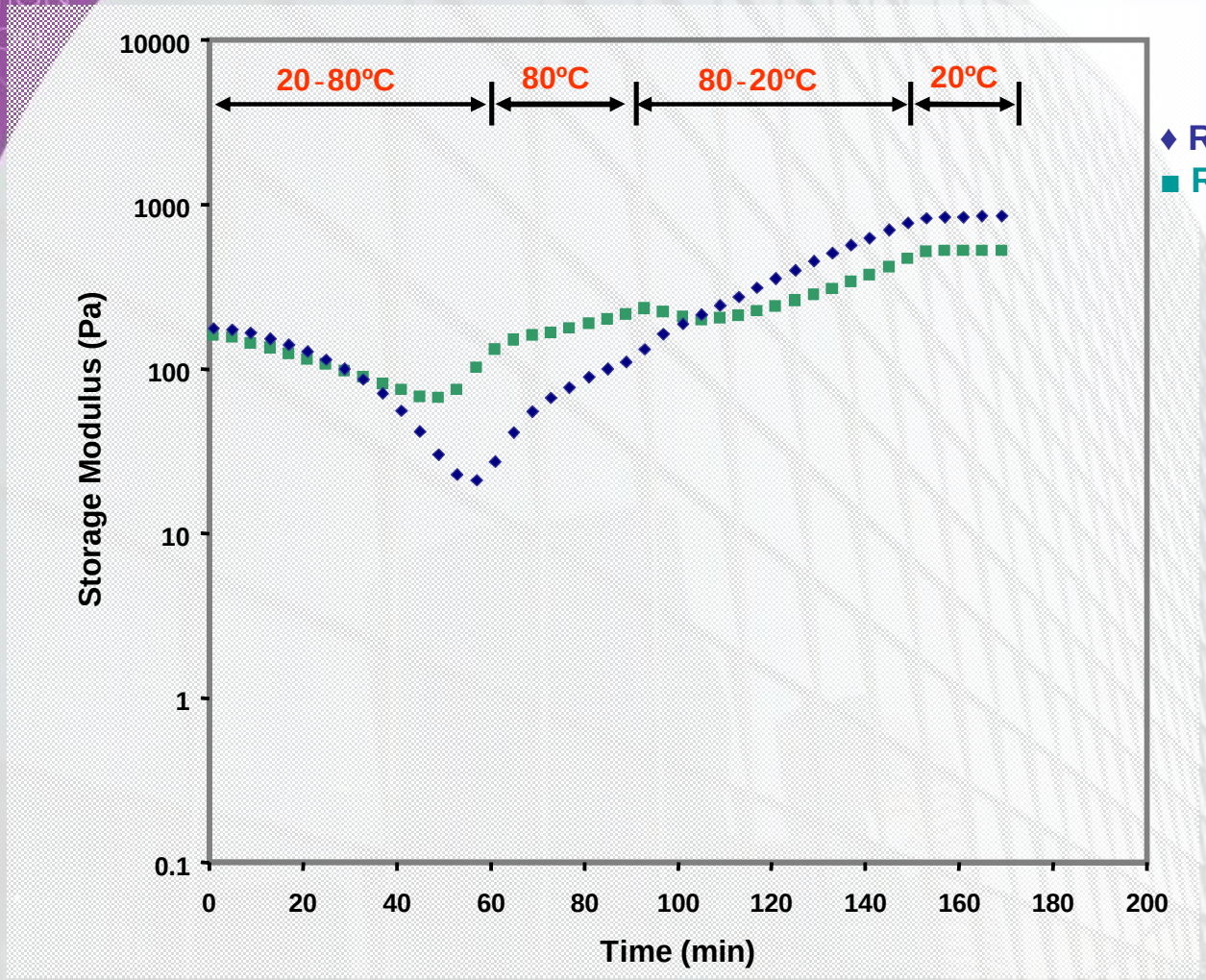
# Heating of CG WPC80




♦ Reconstituted in water
■ Reconstituted in NEM

**12% protein, pH 6.9**

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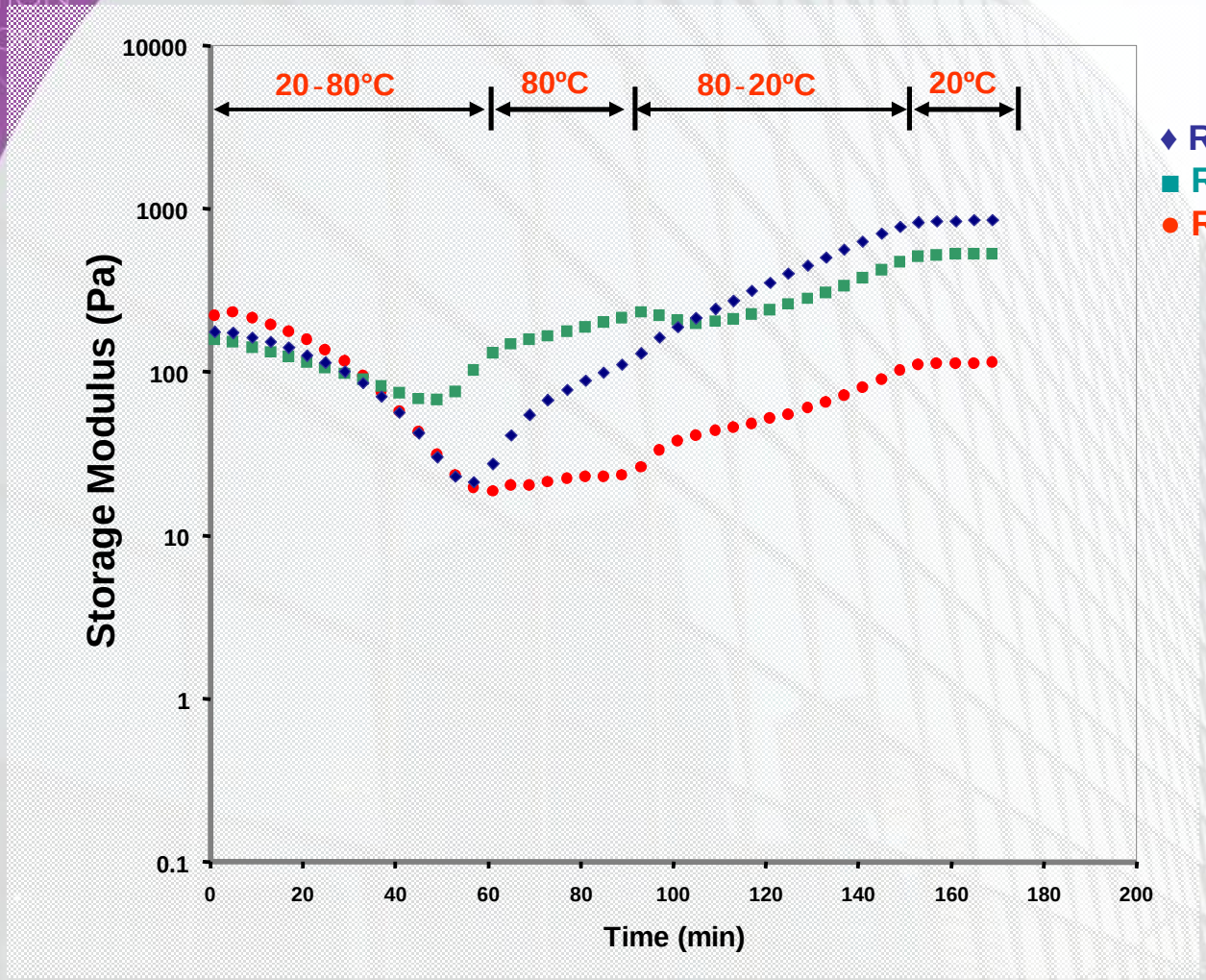
# Heating of CG WPC80




♦ Reconstituted in water
■ Reconstituted in NEM
● Reconstituted in SDS

**12% protein, pH 6.9**

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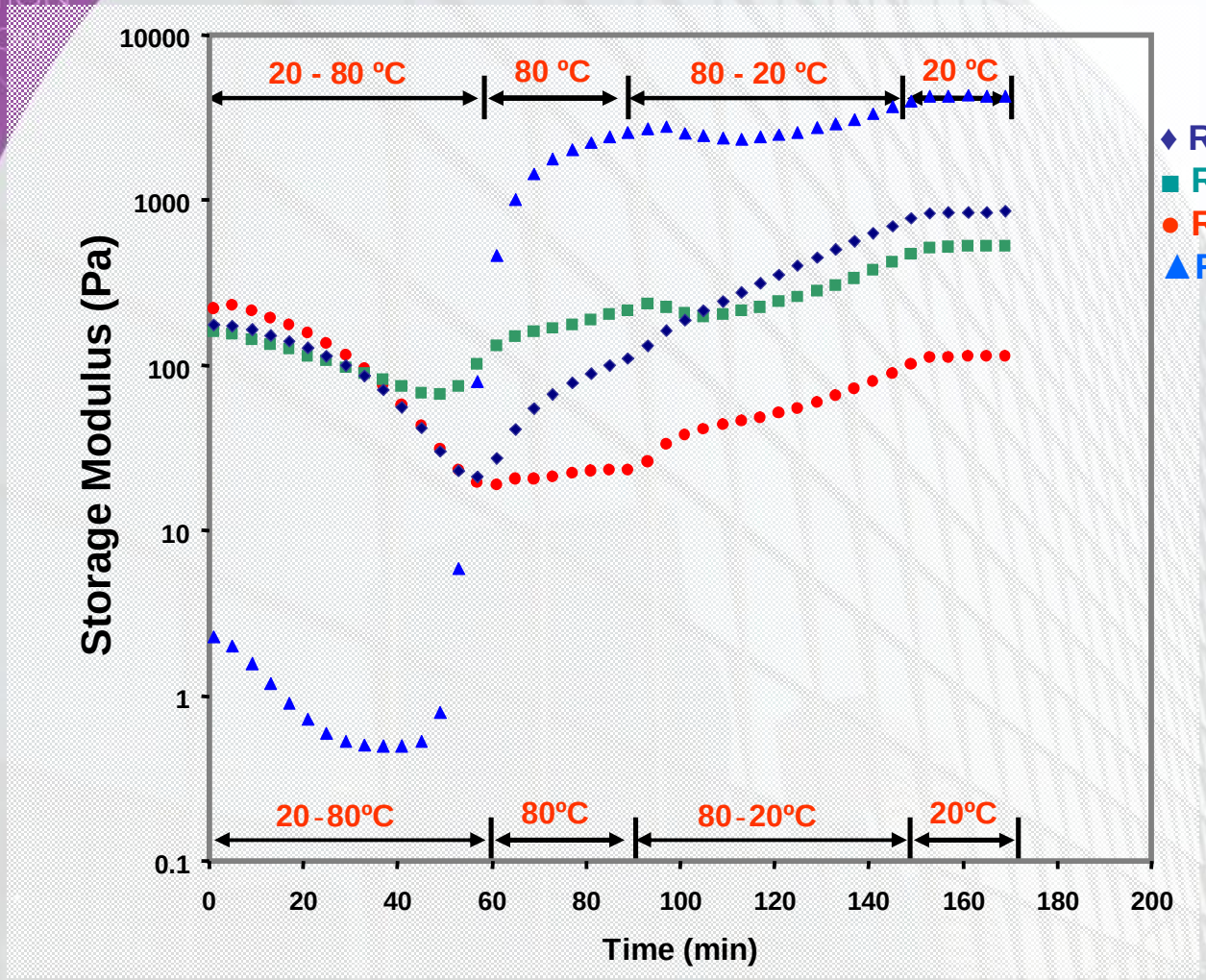
# Heating of CG WPC80




♦ Reconstituted in water
■ Reconstituted in NEM
● Reconstituted in SDS
▲ Reconstituted in DTT

**12% protein, pH 6.9**

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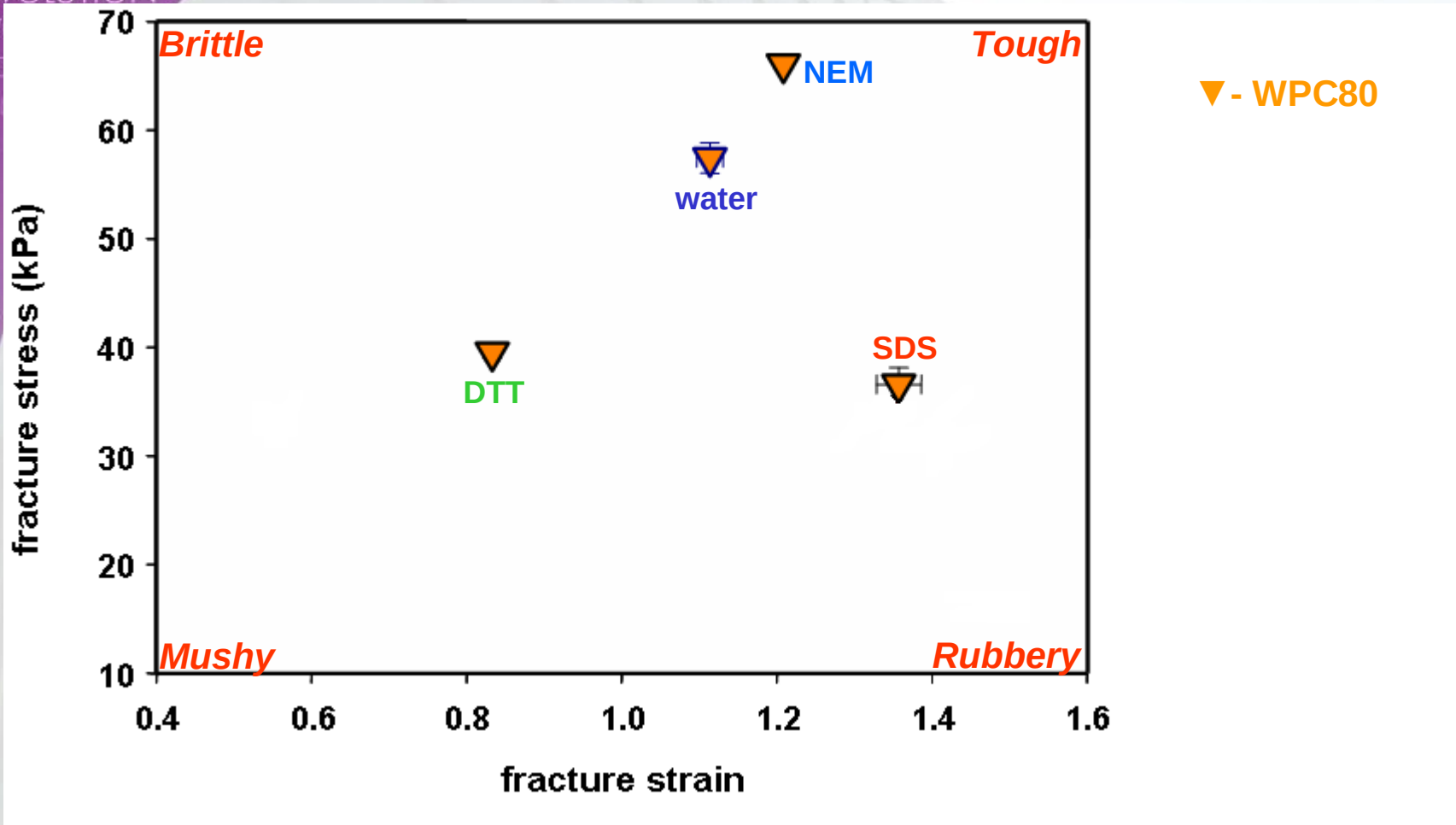
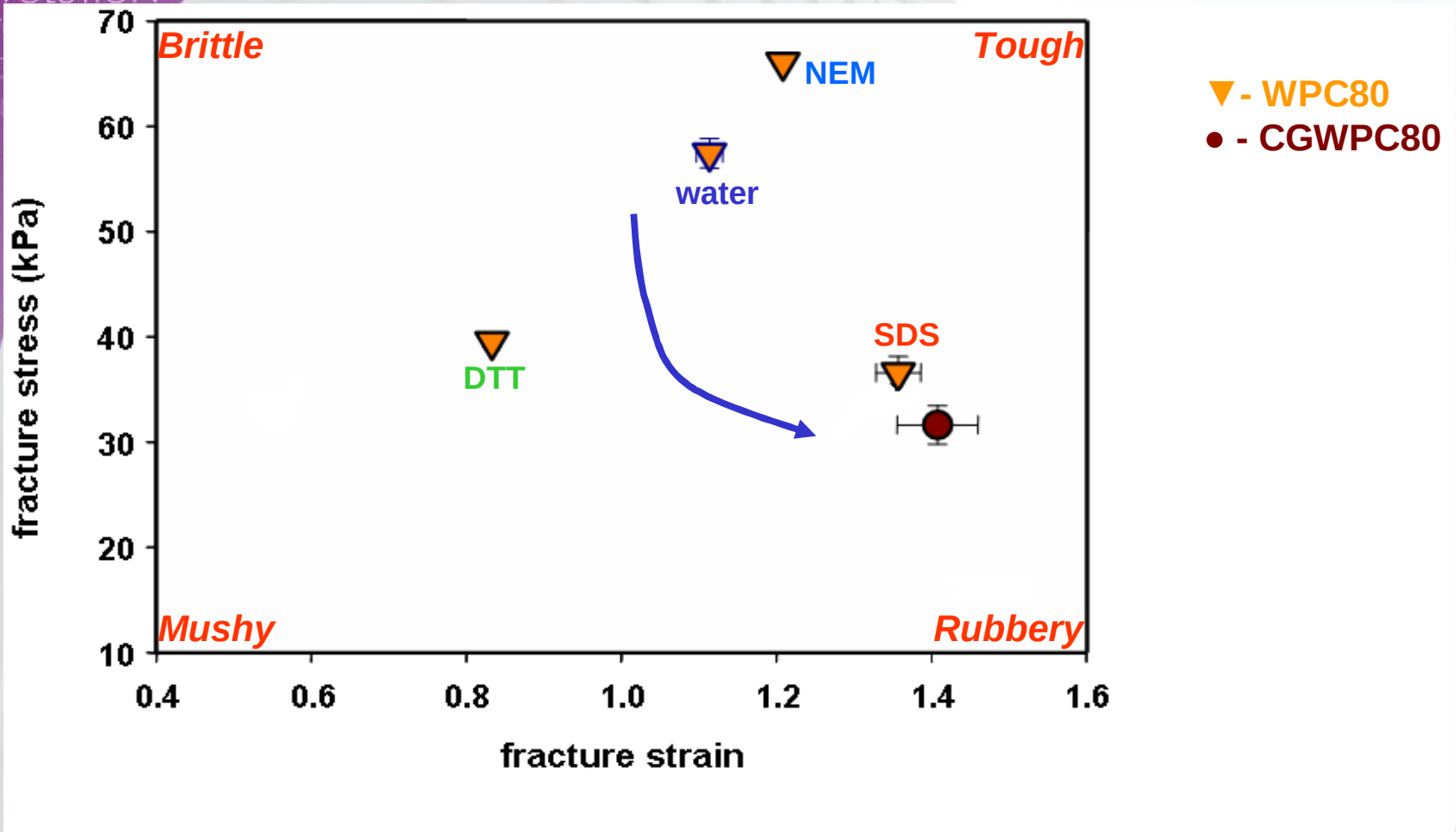
# Texture CG WPC80




12% protein, pH 6.9, 80°C, 30 min

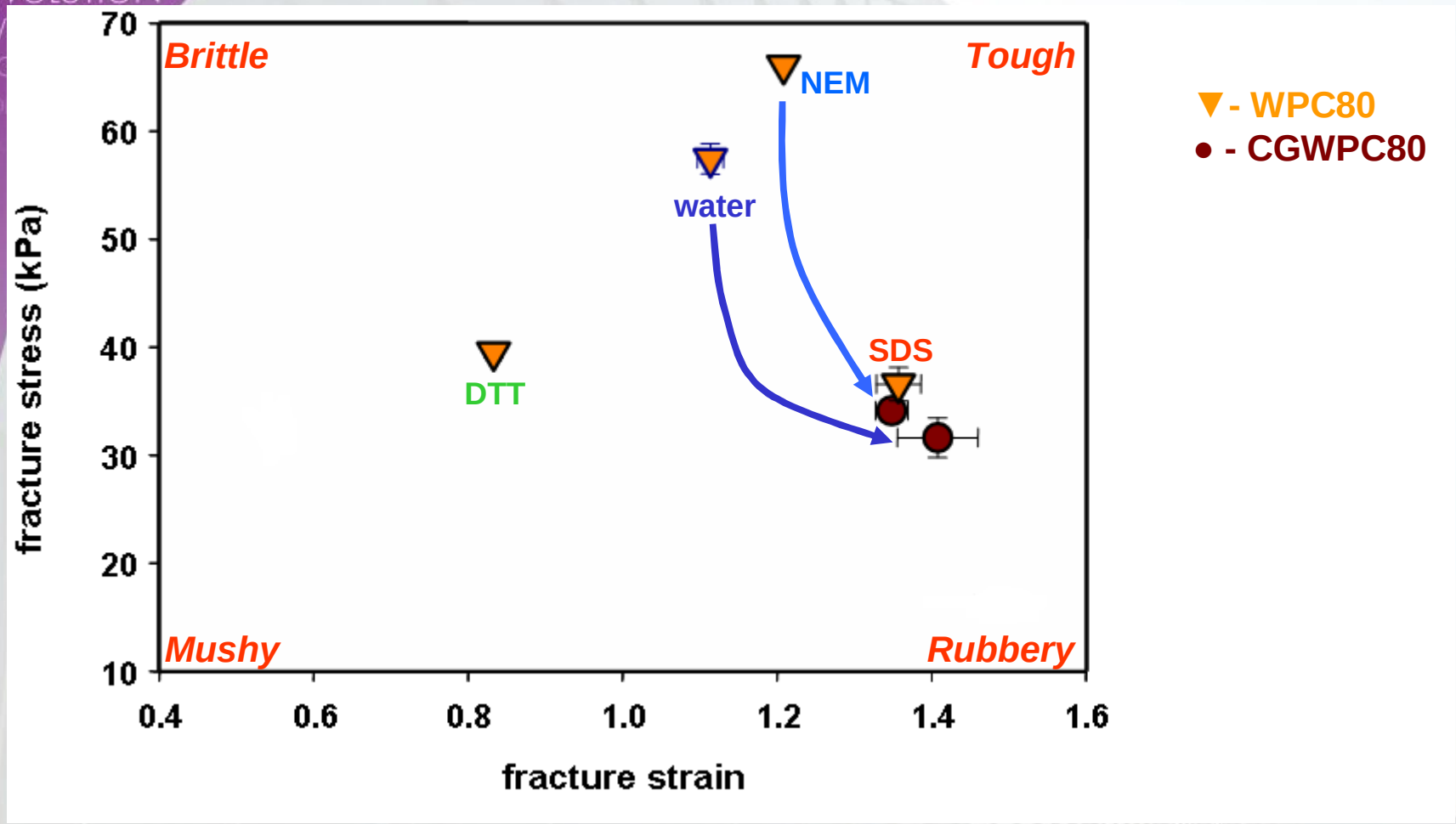
# Texture CG WPC80




▼ - WPC80
● - CGWPC80

12% protein, pH 6.9, 80ºC, 30 min

# Texture CG WPC80

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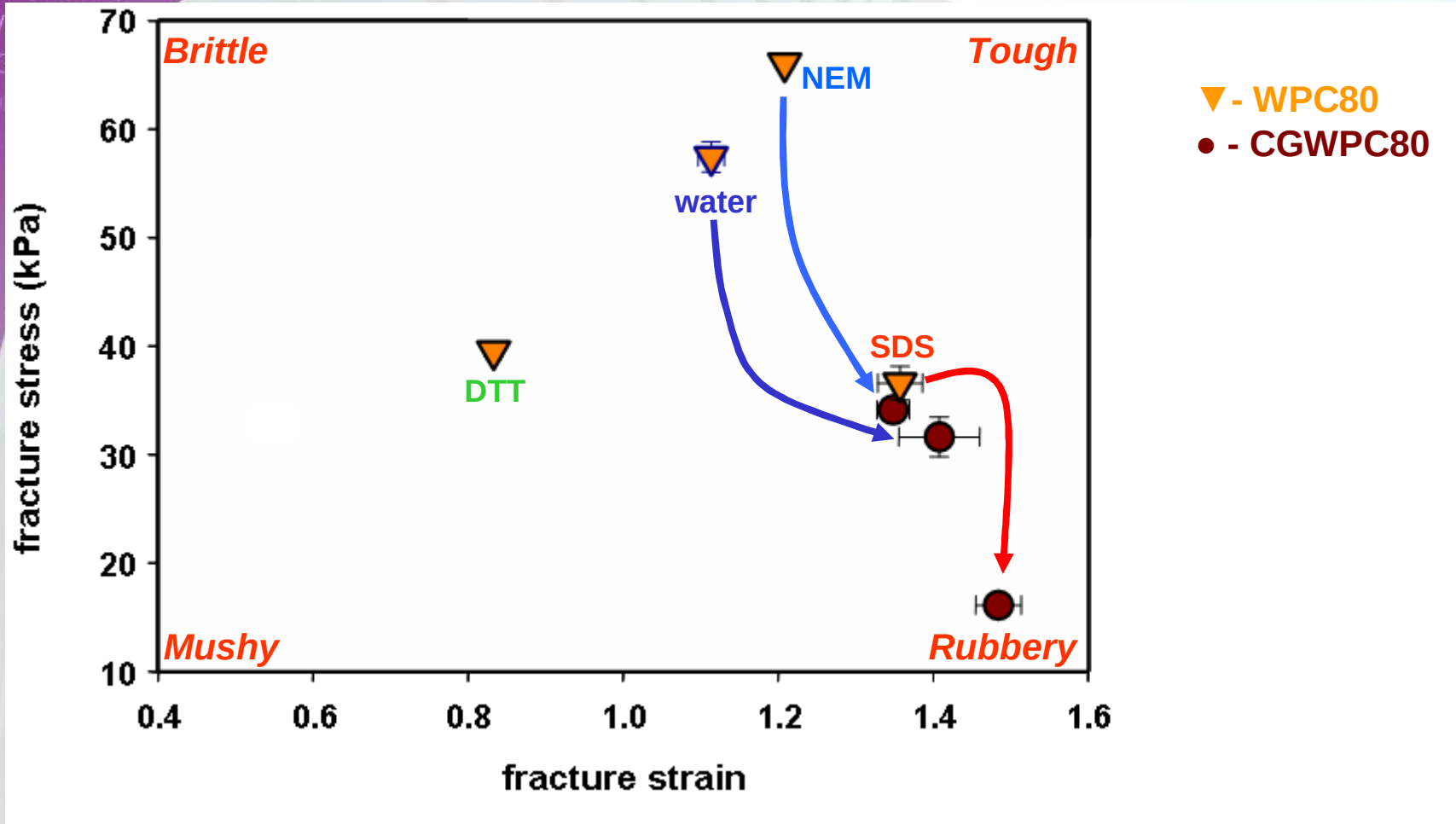
# Texture CG WPC80

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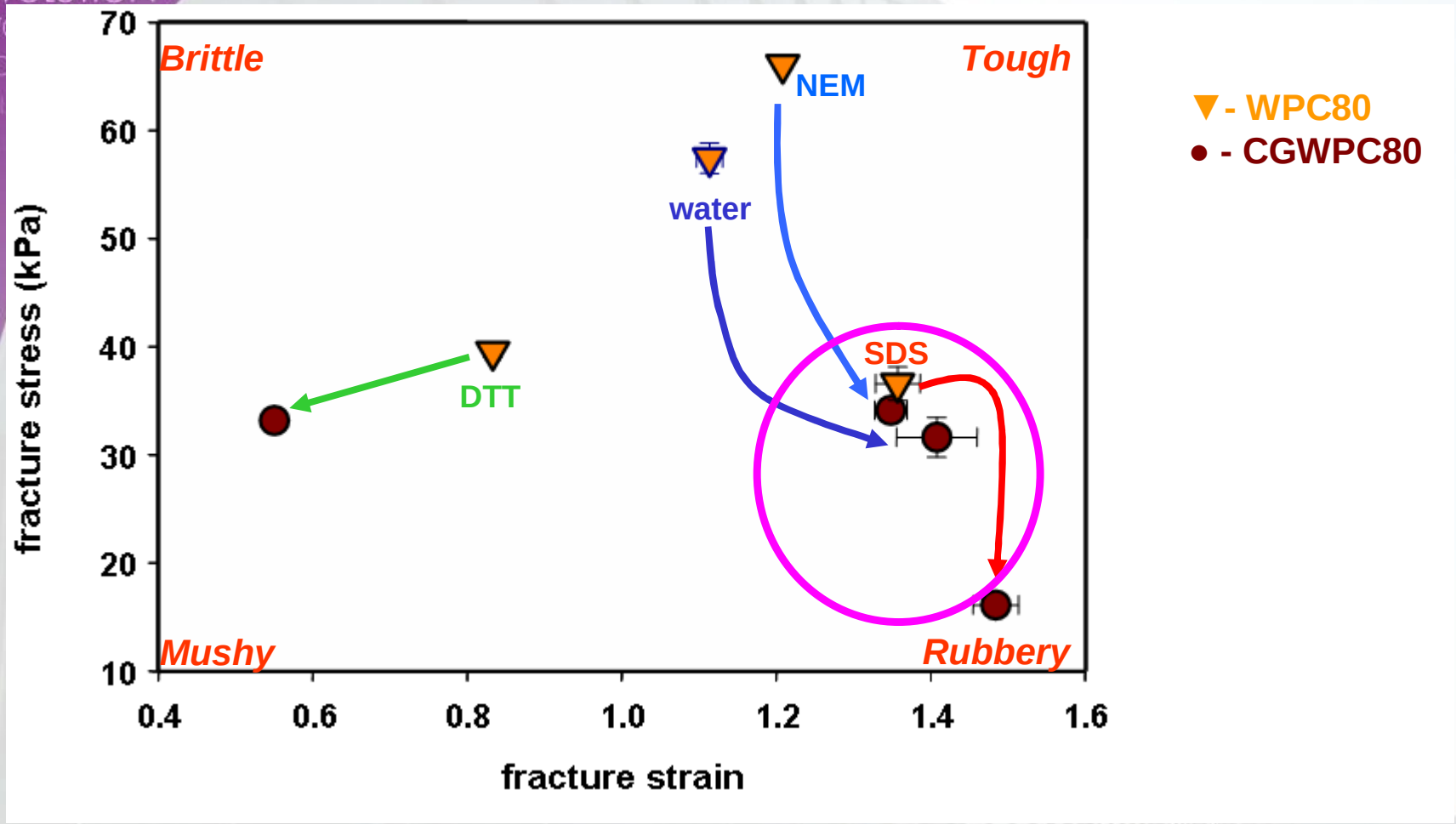


▼ - WPC80
● - CGWPC80

**12% protein, pH 6.9, 80°C, 30 min**

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# Target – optimised non-covalent interactions

- Manufacturing considerations
  - è Retention of salts (e.g. Ca2+) that have a major influence on functional properties.
  - è Influence of other factors in food systems to which whey protein is applied: other ingredients, processing conditions, pH, presence of salt.
- Modified whey protein products
  - è Manipulation of processing conditions so that, upon application, interactions of protein are dominated by non-covalent associations (MWPC).
  - è Main functional properties (soft-textured gels and limited emulsifying properties).
  - è Protein fortification applications.

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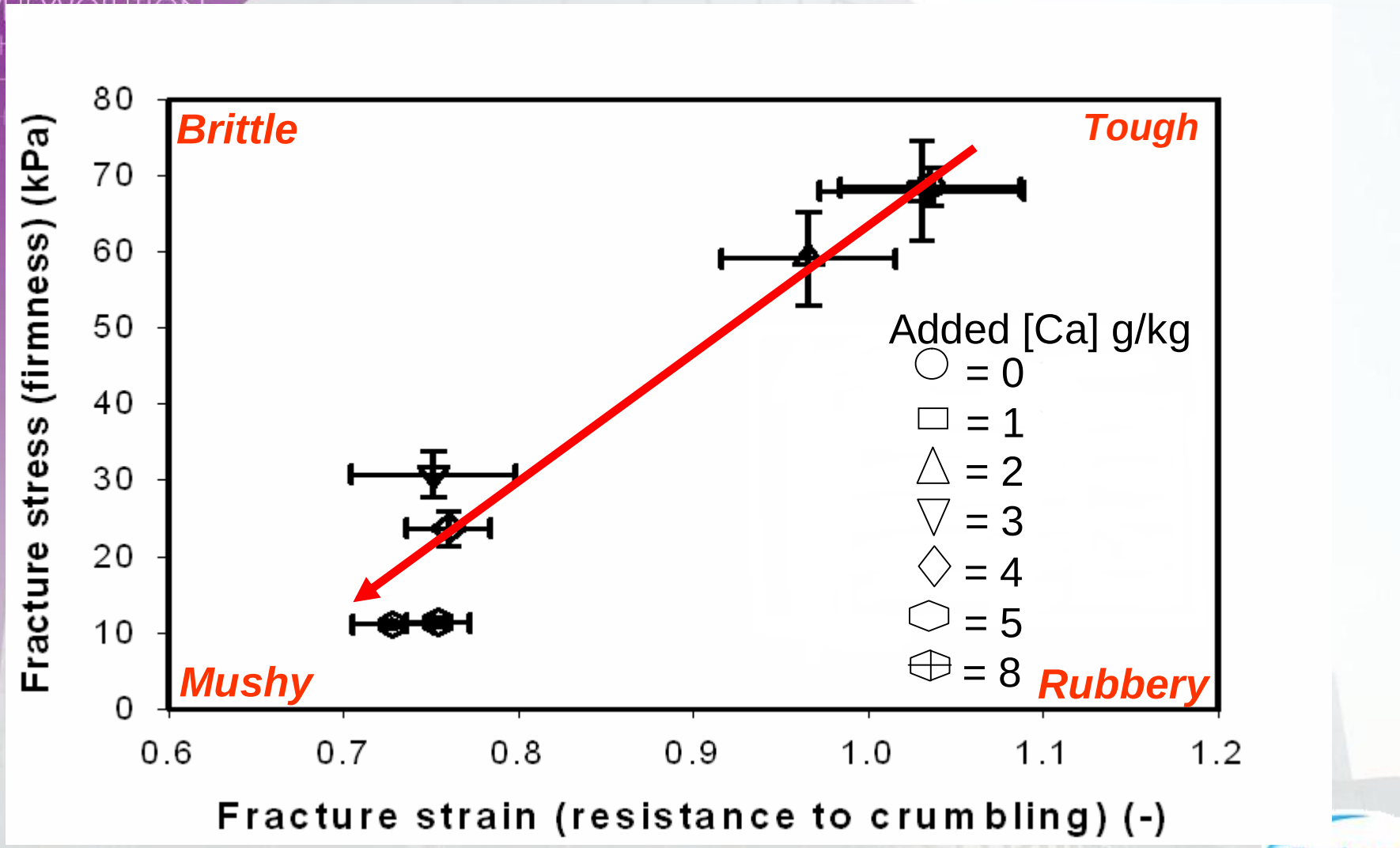
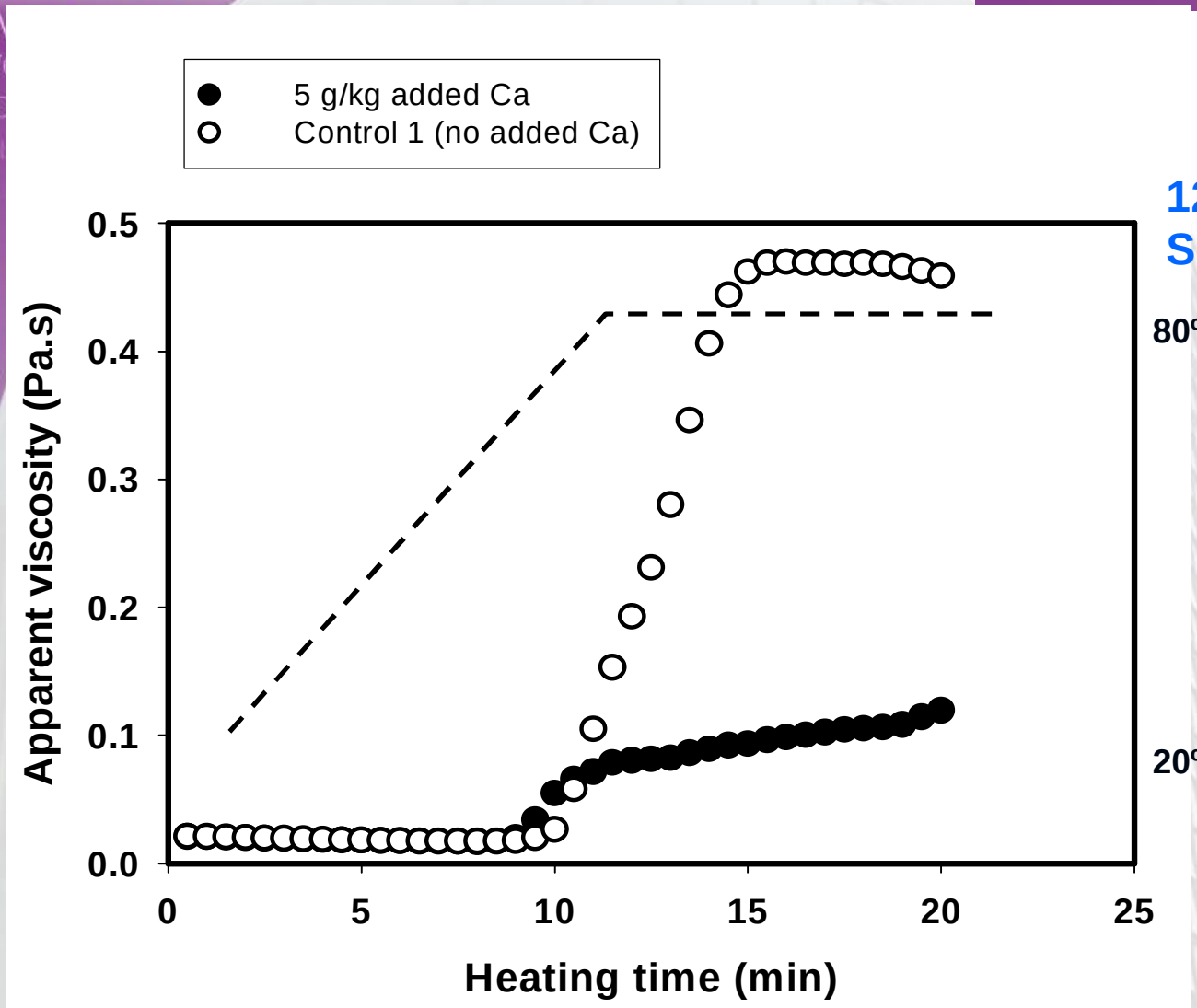
# Effect of added [Ca] on texture



# Effect of added [Ca] on viscosity



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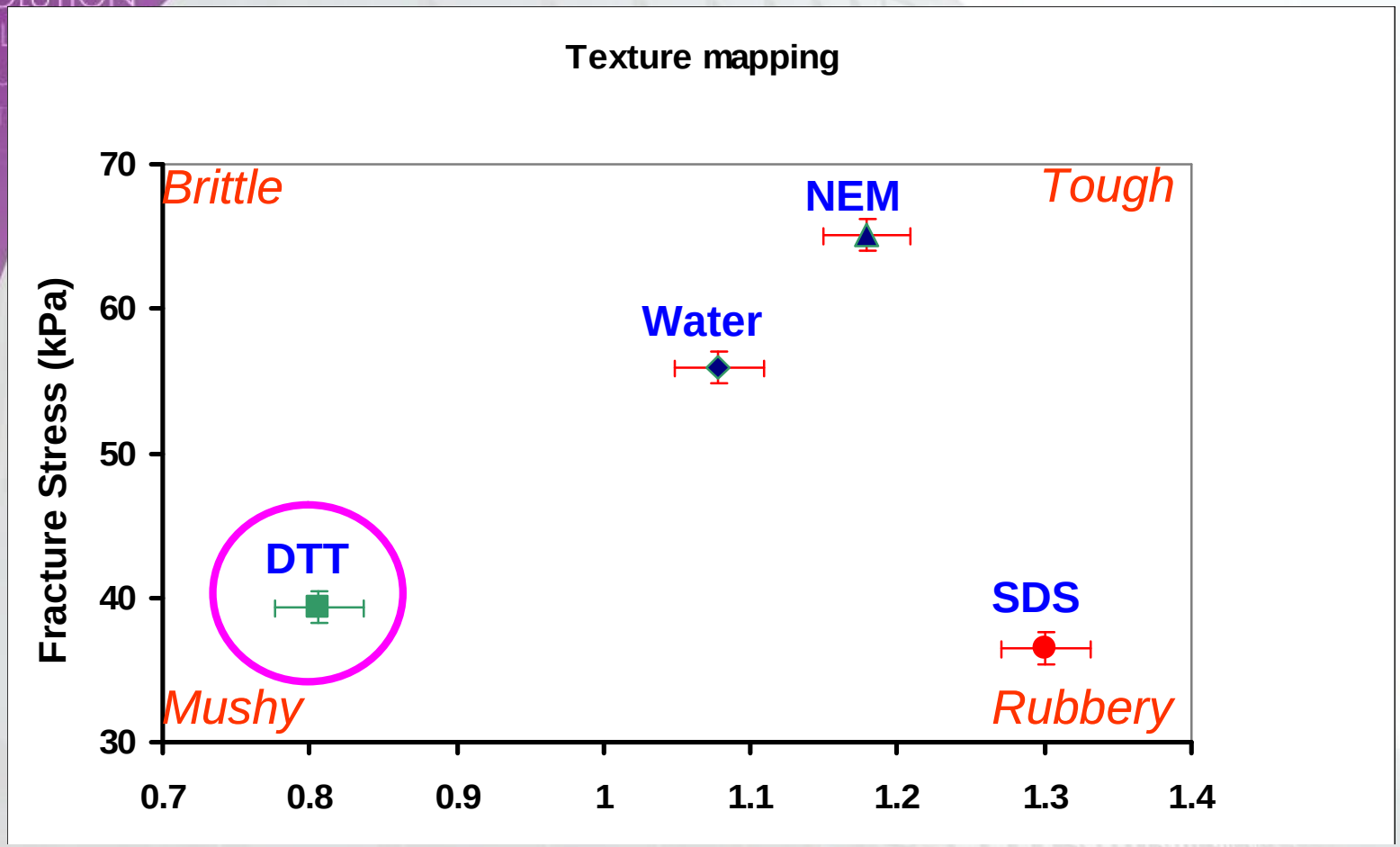


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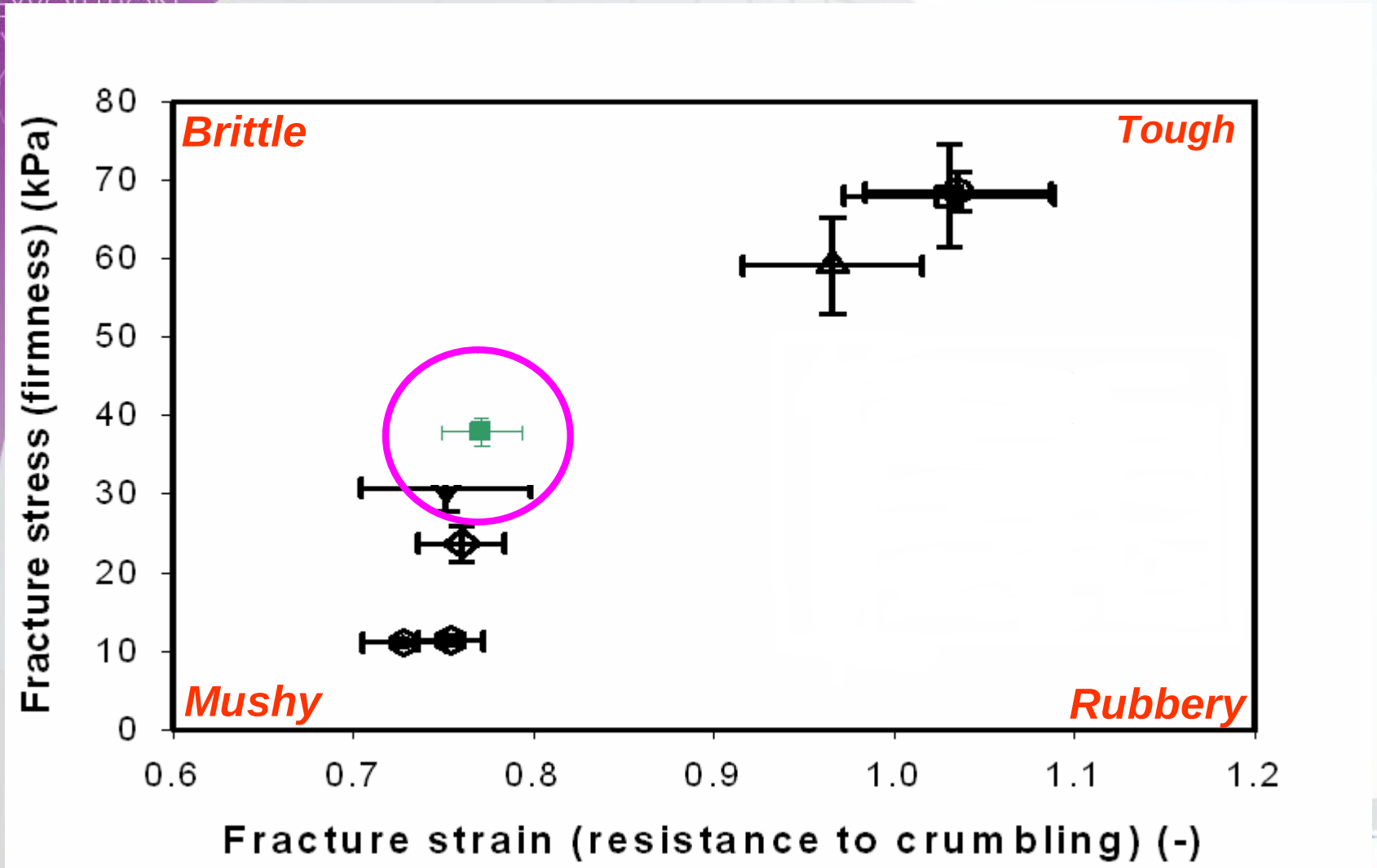

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# Discussion and conclusions

- Whey protein – complex system, not easy to translate fundamental knowledge to industrial reality.
- Data presented – demonstrate effect of protein interactions on the functional properties of whey protein gels.
- A better understanding of protein interactions and how they relate to functional properties in food systems is required.
- May be able to manipulate the processing conditions to make products with target properties suitable for specific applications.

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# Acknowledgement


- Scott Mackay – for doing the work
- Fonterra Research Centre (Steve Taylor)
- IWC-2008 – for the opportunity to participate


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