OCIRC Industry Day
August 17, 2009

Ingredient interactions

1. Structured monoglyceride-stabilized oil in water emulsion interactions with flour – Brittany Huschka
2. Cellulose fiber interactions with starch, gluten and flour- Avi Goldstein

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Funding sources

- Creafill Fiber supplied funding for cellulose fibre study
- Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)-- Grant #026587
  - Understanding the behaviour of oil-water-monoglyceride nanostructures in baked food matrices and evaluating human health benefits following consumption of these products
  - $228,000
- Mathematics of Information Technology and Complex Systems (MITACS) Internship program
  - Functionality of a zero-trans, low saturate shortening alternative
  - MITACS-$15, 000
  - Coasun Inc. - $15, 000

WHY STUDY INGREDIENT INTERACTIONS?

- Formulated foods are complex systems--their ingredient interactions dictate structure, texture and organoleptic properties.

  - Some ingredient interactions are desirable and improve food quality
  - Some are undesirable and adversely effect food quality

- Understanding their interactions is key to optimizing ingredient performance and obtaining quality food products

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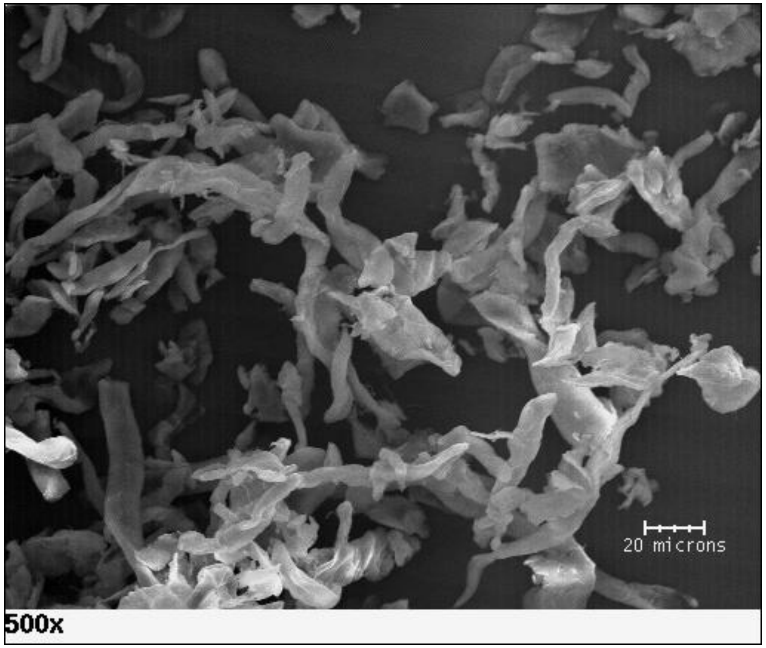
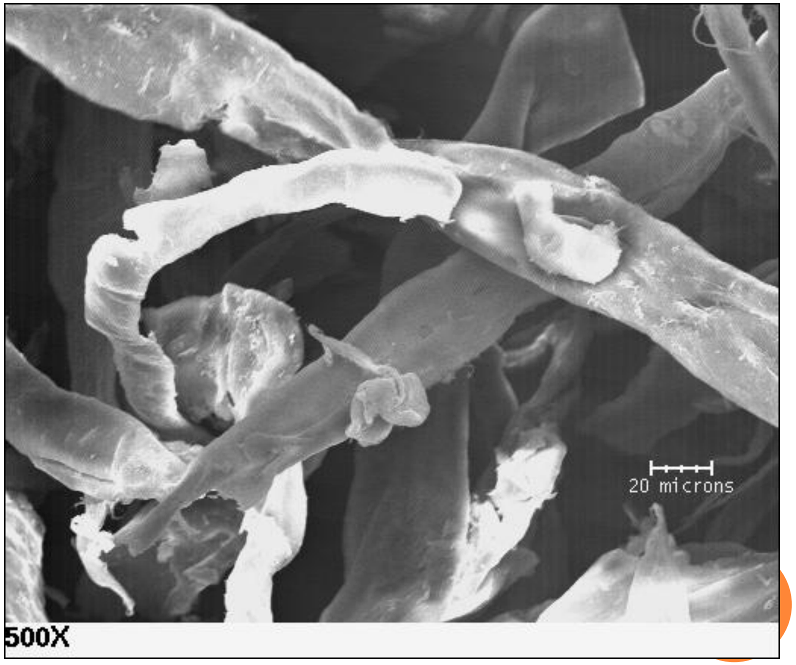
Cellulose fibre Interactions in starch, gluten, and flour systems

CREAFILL FIBRE

- Sc200 and Sc40 Fibre was used in this study
- Sc 40 (40 um) Sc200 (200 um)





RESEARCH GOALS

- Investigate the effect of cellulose fibre replacement on starch, gluten, and flour systems
- Determine if particle size (40 um vs. 200 um) of cellulose fibre replacement significantly affects systems studied
- Study the effect of flour type (hard vs. soft wheat) on cellulose fibre replacement

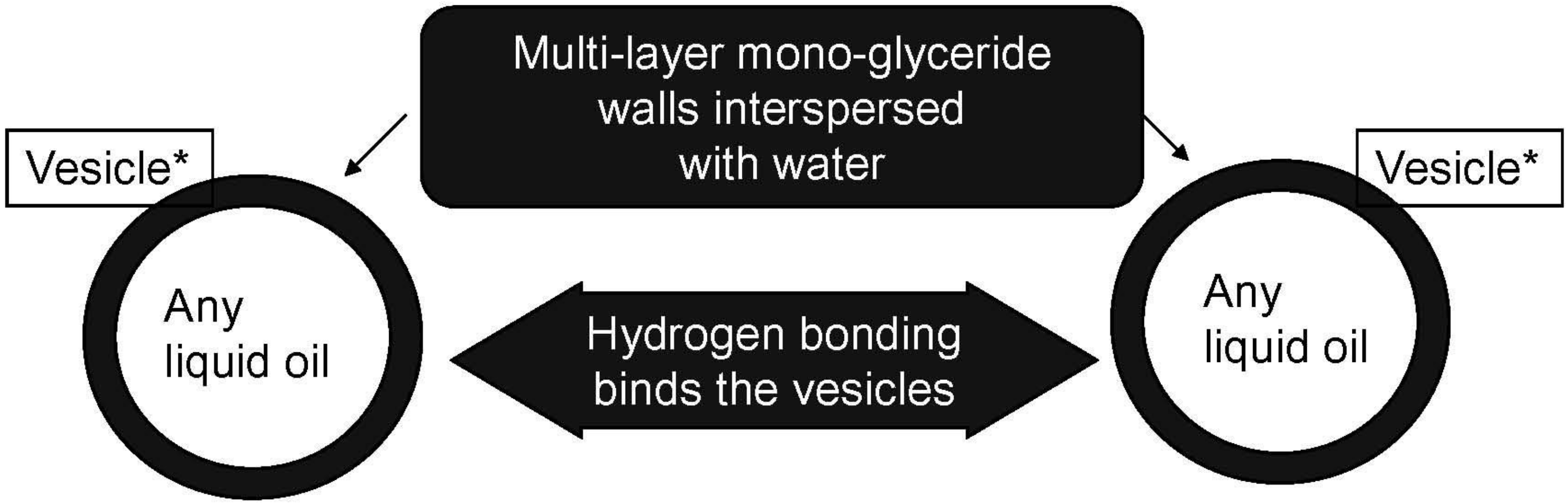
A STRUCTURED MONOGLYCERIDE-STABILIZED OIL IN WATER EMULSION INTERACTIONS WITH HARD AND SOFT WHEAT FLOUR

FIRST OFF, WHAT IS A STRUCTURED MONOGLYCERIDE-STABILIZED OIL IN WATER EMULSION A.K.A. MAG GEL?

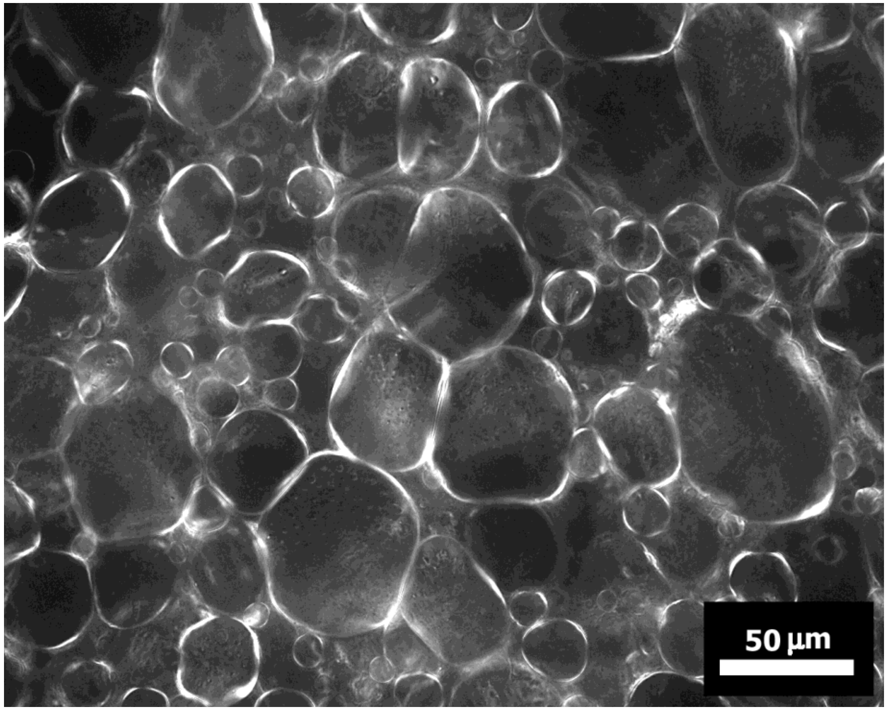
- Developed at the University of Guelph as an alternate shortening for the baking industry that is low in saturated fat and trans fat free

- Composed of 55.5% canola oil, 40% water, 4.5% monoglyceride (MG) and 0.22% stearic acid

■ The Fundamental CoaSun™ Technology



*Vesicle walls are crystalline in nature, with 8 to 9 MAG bilayers per wall thickness



MAG GEL UNDER POLARIZED LIGHT

PHOTO OF MAG GEL

Research Goals & Objectives

Goal: Understand behaviour of the MAG gel in a multi-component baked food matrix

Objective 1: Determine the difference in interactions of the MAG gel compared to a mixture of the gel components with hard and soft wheat flour

IDEA BEHIND THE PROJECT

- Limited use of the MAG gel in different baking applications.
  - It's high water content is hard to adjust and compensate for
  - Has unique properties different from a shortening during mixing and baking
  - Difficult to achieve products that are of the same quality and similar to existing products during replacement of standard shortenings

Industry Significance

- Understand the use of the MAG gel to develop healthful products with improved nutritional profiles for consumers
  - Contribute to alleviating issues related to obesity and type II diabetes
- Help the baking industry reformulate and develop products low in saturated fat and trans fat free
  - To meet consumer demands
  - To comply with regulations

Key Trends
Starch/Flour-Fibre Interactions

- Peak and final viscosity decreases with increasing percentage of cellulose fibre replacement.

- Trends for hard and soft wheat flour are supported by trends of wheat starch.

Key Trends
Starch/Flour-fibre interactions

- Decrease in firmness and gradient observed in starch/flour fibre samples.

- Soft wheat flour maintained gels with greater firmness/gradient values than hard wheat flour gels

Gluten Peak Tester

- Peak Max Time (PMT)
  - Time required for gluten to aggregate and exhibit maximum torque on the spindle, before breaking down
  - Starch by itself does not generate torque in the GPT even in the presence of lipids and monoglyceride
  - Effects are primarily due to the gluten proteins
  - In principle PMT values of control dough are similar to dough development time in a Farinograph

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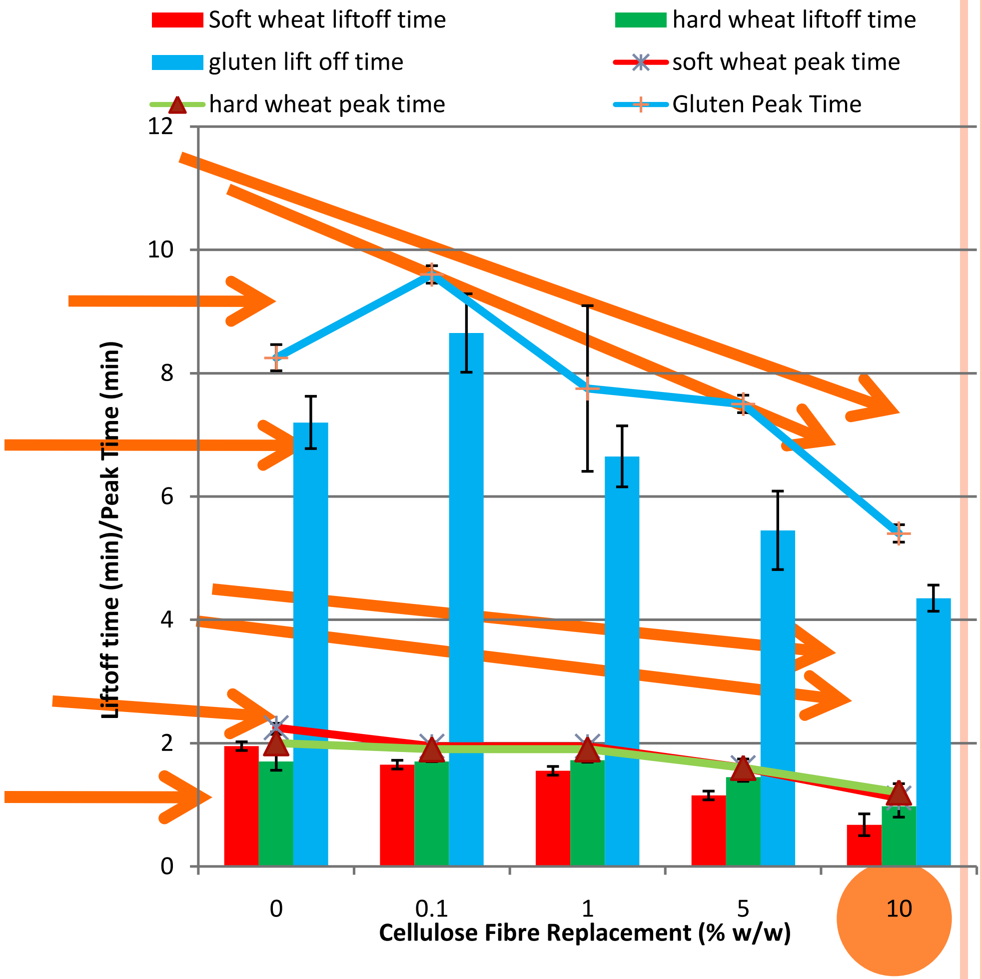
KEY TRENDS
GLUTEN-FIBRE INTERACTIONS

- Peak time and lift off time decreased with increasing cellulose fibre replacement.
- Decrease in peak/lift off times is indicative of the ability of fibre to enhance the kinetics of gluten aggregation.
- Peak torque values were not significantly different with increasing fibre replacement.



Key trends
Flour-Fibre Interactions

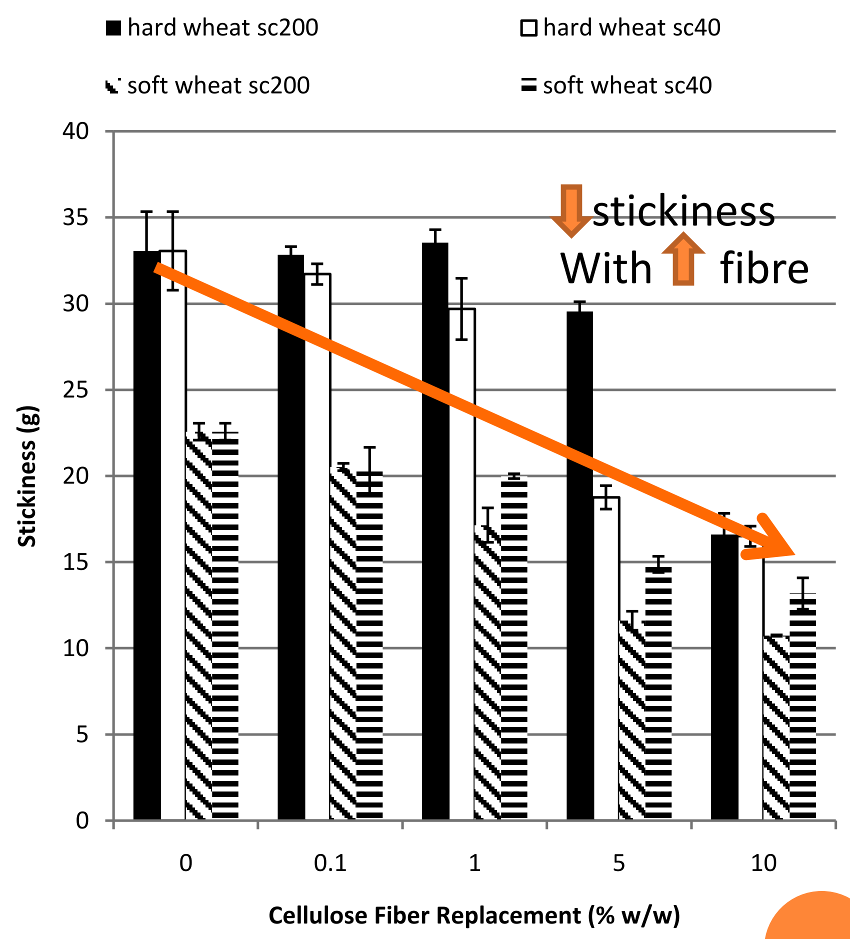
- Water absorption increased with increasing cellulose fibre replacement.
- Larger particle size leads to greater water absorption.
- Increase in water absorption by soft wheat flour was greater proportionally than for hard wheat flour.
- Ability to predict absorption requirements of flour-fibre systems.

Sample	Equation	R^2
Soft wheat flour with sc40 replacement	y = 0.602x + 56.24	0.99
Soft wheat flour with sc200 replacement	y = 0.419x + 56.16	0.94
Hard wheat flour with sc40 replacement	y = 0.315x + 69.61	0.98
Hard wheat flour with sc200 replacement	y = 0.257x + 69.24	0.85

Key Trends
Flour-Fibre Interactions

- Increasing cellulose fibre replacement resulted in decreased dough stickiness values

- Hard wheat flour maintained greater stickiness than soft wheat flour, due to greater amount of gliadin.



Key trends
Flour-Fibre interactions

- Energy required to break dough decreased with increasing fibre replacement.
- Hard wheat flour maintained greater energy values than soft wheat flour.
- Resistance/Extensibility (R/E) ratio increased with cellulose fibre replacement, indicating that dough becoming stiffer with fibre replacement.

How does the MAG gel affect water absorption and dough development for hard and soft wheat flour?

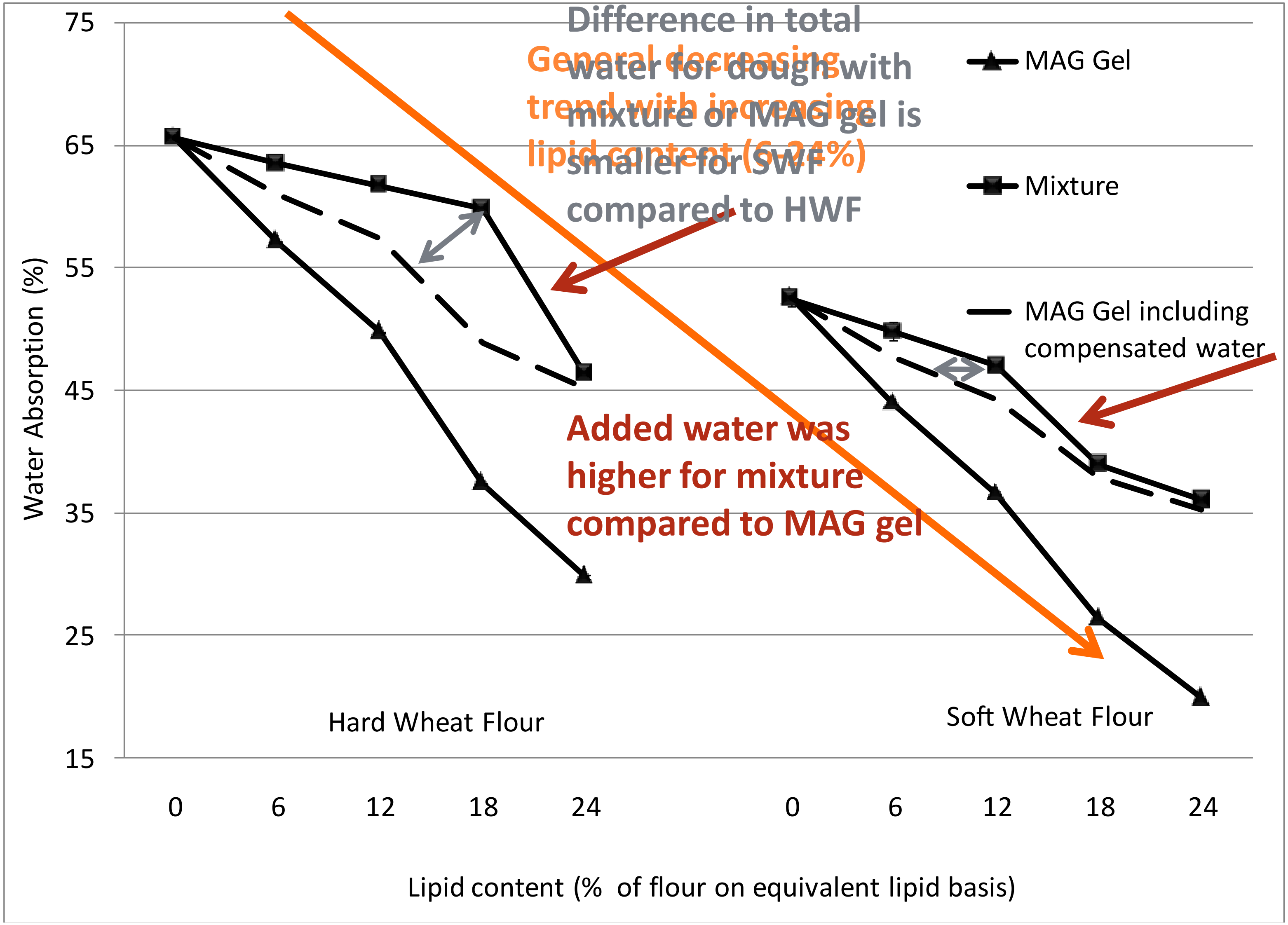


Figure 1: Water absorption required to reach the 500 BU line for hard and soft wheat flour following the addition of different levels of MAG gel or mixture. The solid lines for water absorption values represent the added water. The dotted lines are the total water in the dough, i.e., water present in MAG gel plus added water

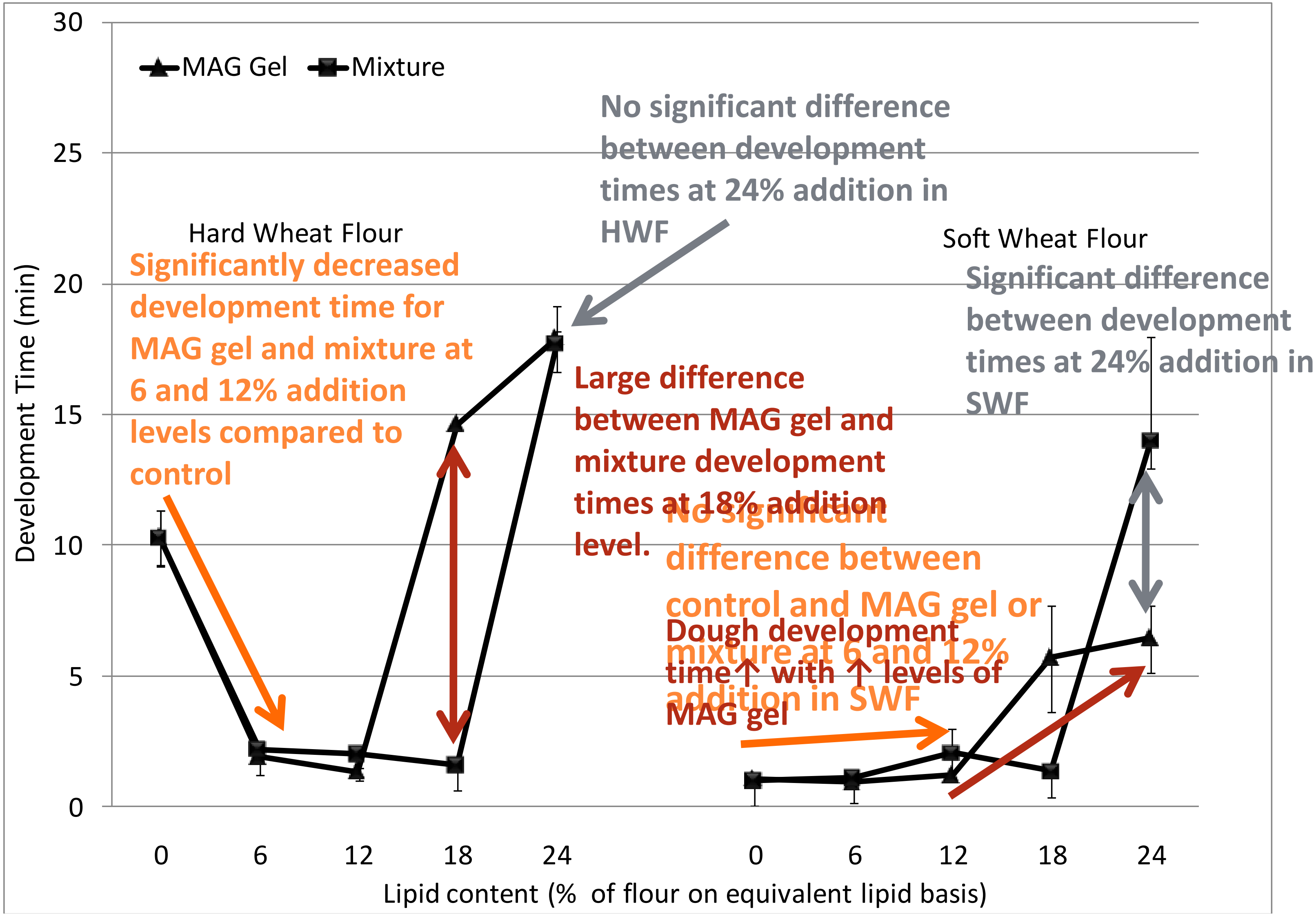


Figure 1: Development time to reach the 500 BU line for hard and soft wheat flour following the addition of different levels of MAG gel or mixture

How does the MAG gel affect the texture of hard and soft wheat dough?

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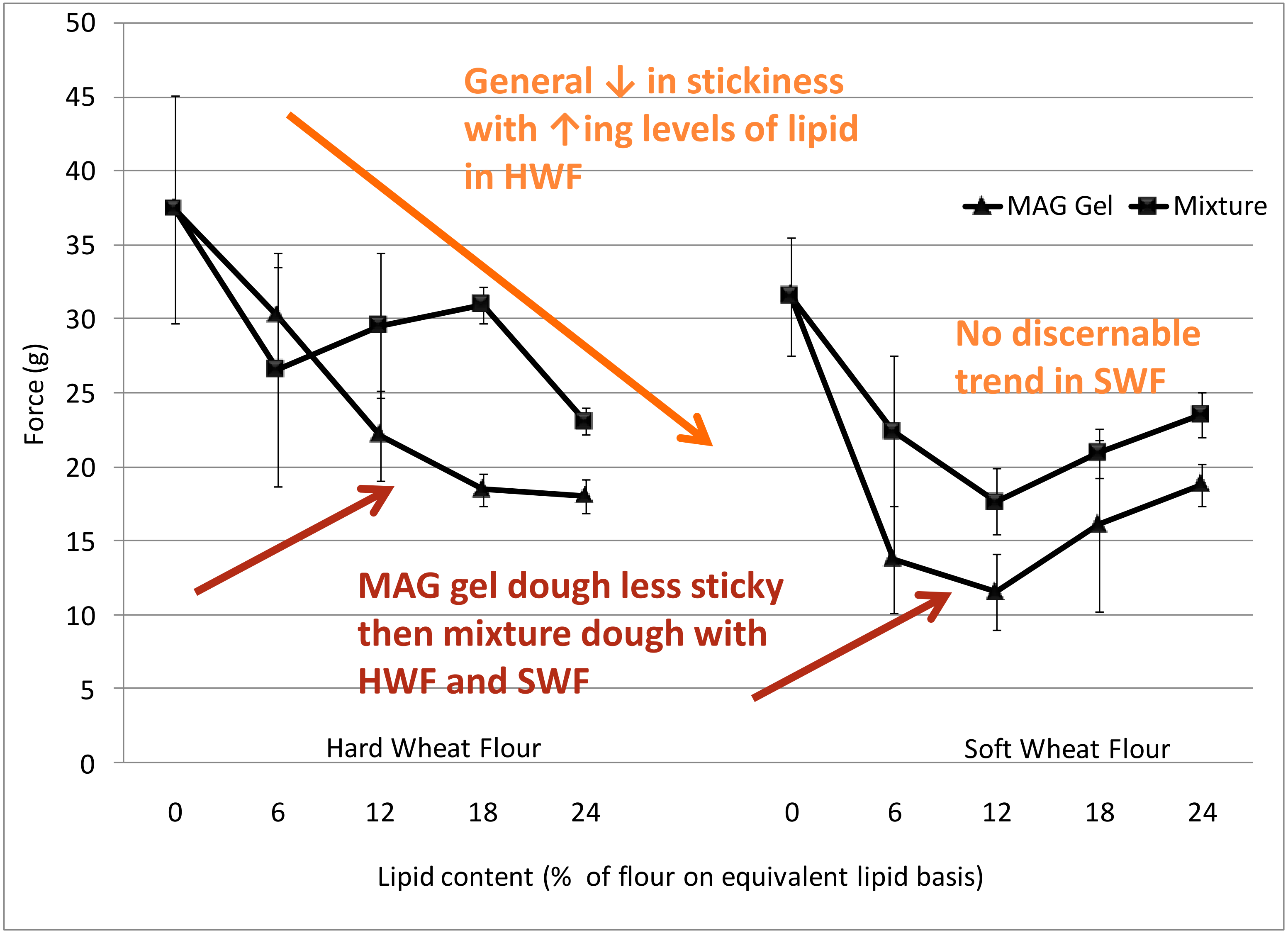

Figure 2: Stickiness values for hard and soft flour doughs with increasing levels of lipids.

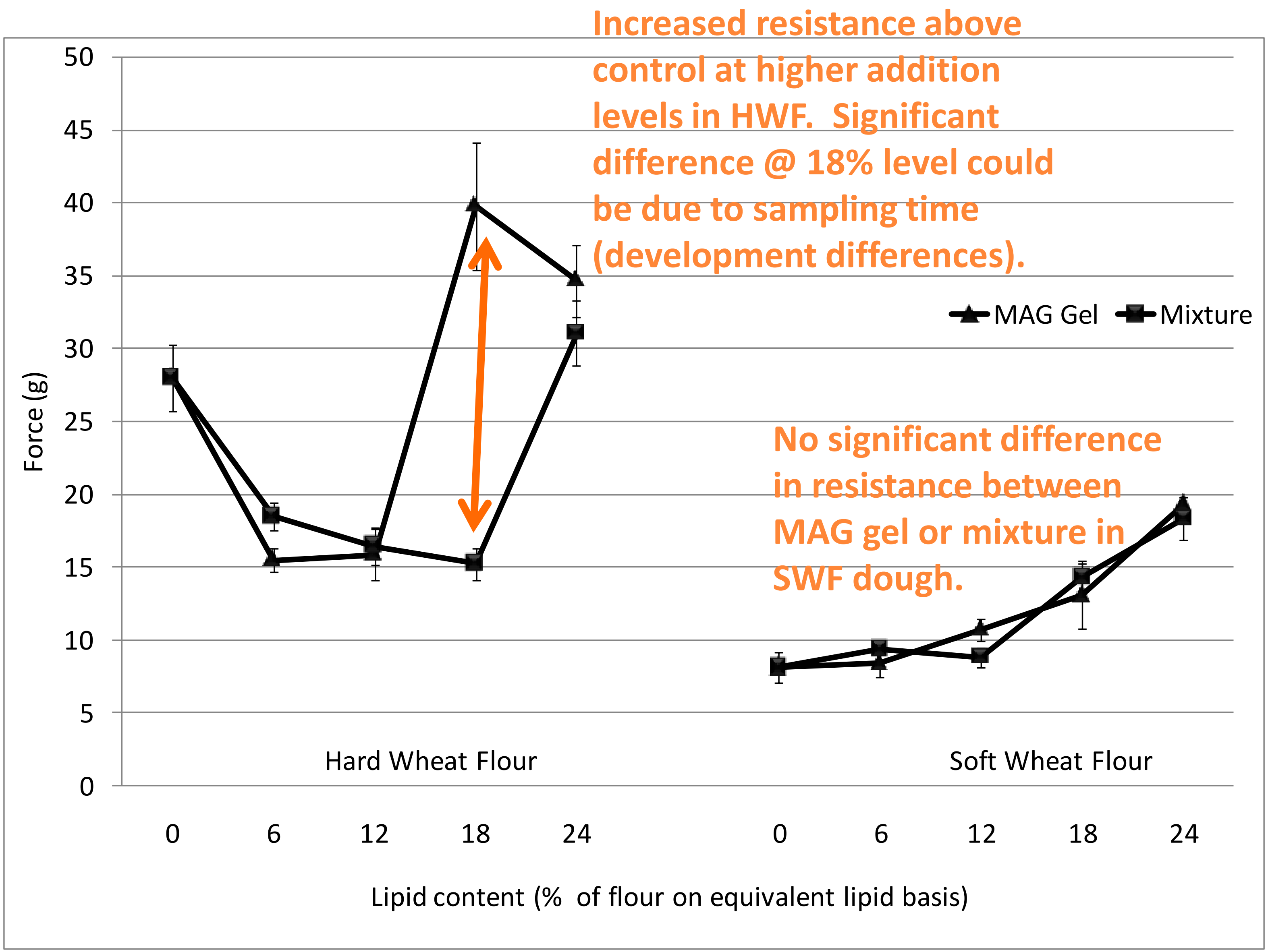

Figure 3: Resistance to extension of hard and soft flour dough's with increasing levels of lipids.

How does the MAG gel affect gluten development?

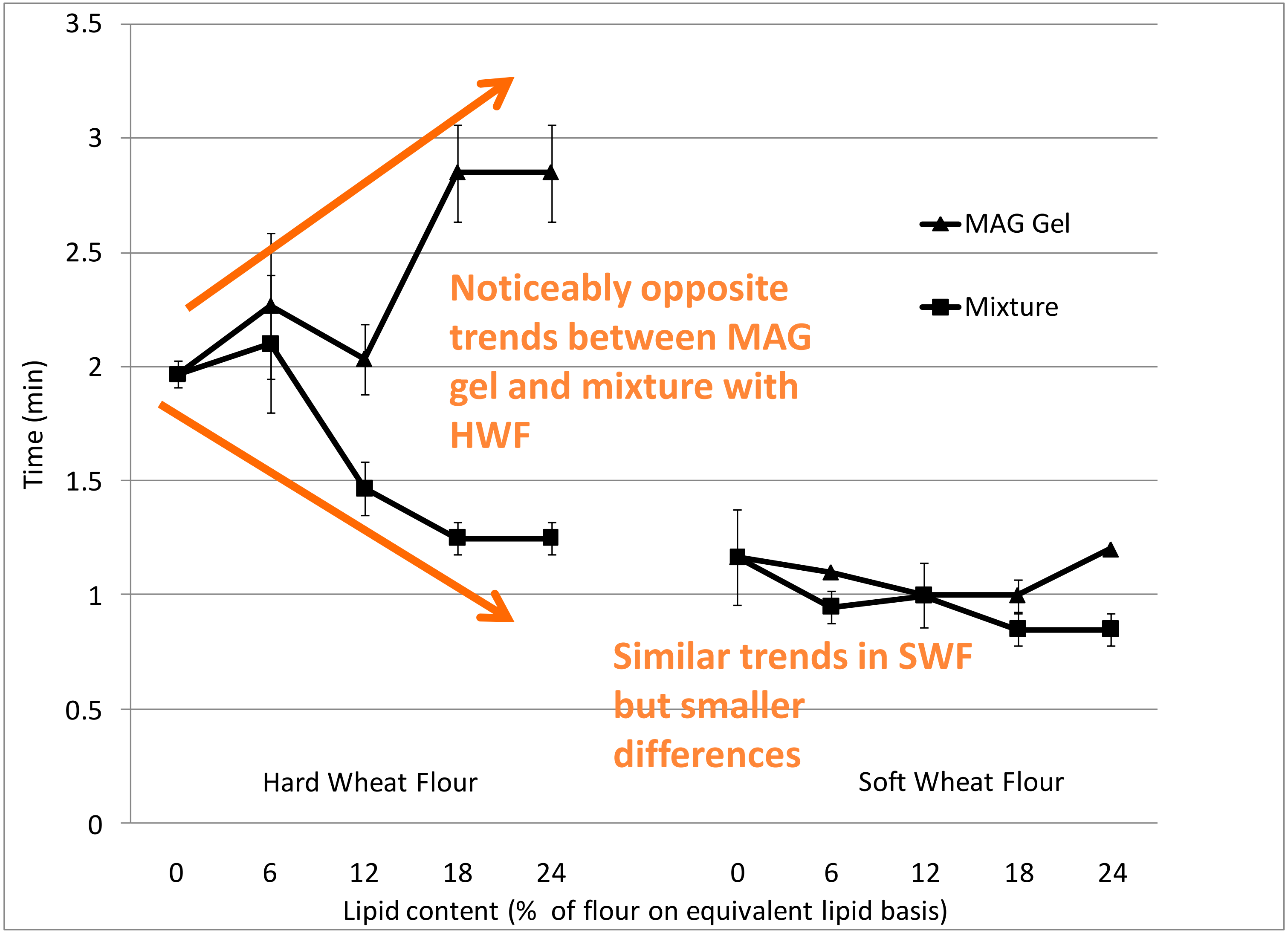

Figure 6: Peak maximum time values, as measured by using a Gluten Peak Tester, of hard and soft wheat dough with increasing levels of lipids added as MAG gel or mixture.

Take home points

- Functionality of the ***structured*** water, oil and MG components in the MAG gel is **not similar** to the same components in an ***unstructured form***
- Significantly different interactions between the MAG gel and HWF or SWF
- Also differences in the interaction of starch or gluten with the structured or unstructured lipids
- Further research is necessary to identify why the structured MAG gel behaves differently and how gluten and/or starch contribute to the variations observed in these behaviors

Concluding remarks on ingredient interactions

- Understanding the mechanisms of ingredient interactions are imperative to food product development

- Each ingredient has a functional role in a food product

- Assembling a reference of ingredient interactions will help food scientists and technologists better understand food systems and assist them with development and quality improvements