

# Effects of Inulin on Rheological Attributes of Processed Cheese

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## Low Fat High Fiber Cheese?

- Food producers are increasingly interested in developing food products that address nutritional issues related to “**Chronic Lifestyle Syndrome.**”
- A high fat diet increases the risk of Coronary Heart Disease, a major cause of death in U.S, which is about 26% of the total deaths.
- Various hydrocolloids are used as fat replacers in dairy products like starches, gum and fibers.
- **Inulin**, a fructo oligosaccharide derived from chicory roots, is a dietary fiber that forms a particle gel and behaves as a fat mimic in dairy foods (Fagan, *et al.* 2006).
- Numerous papers have established correlations with the material properties ( Yield values, Modulus) and texture in food. Compression and extension tests have been employed to characterize texture in cheese (Brown,J.A. 2003 and Lu,Y. 2008).

## Objective:

This research aims to develop a reduced fat, high fiber, process cheese using inulin as a fat replacer, and to develop a rheological method to measure textural characteristics related to fat content in process cheese.

## How are we achieving it?

Full fat (32%) processed cheese and reduced fat (27%) processed cheese with 0 - 3% added inulin were made, and resulting changes to texture were quantified. Protein content was similar for all cheeses.

### Process Cheese Manufacture:



**Ingredients**

- Shredding cheese.
- Weighing ingredients.



**Stephan Cooker**

- High Shear mixing @ 1200rpm
- Pasteurization 85°C for 3 min



**Filling & Storage**

- Storage @ 4°C

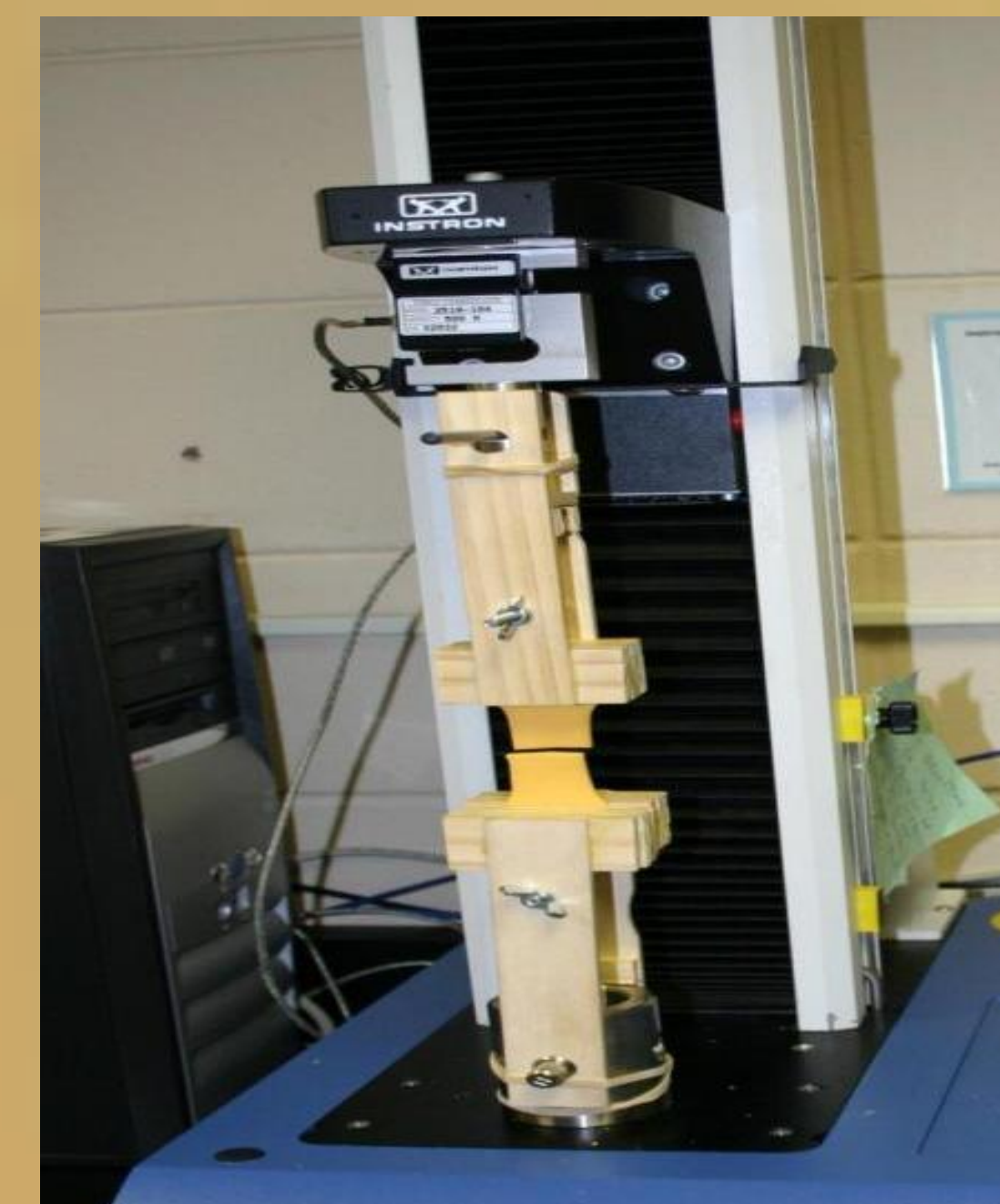
## Chemical Analysis:

- % Fat – Determined by Majonnier Method
- % Protein – By Kjeldahl Method
- % Moisture – Atmospheric Oven Method.

## Rheological Analysis:

Cheese samples were cut into uniform slices, and rheological properties were determined under extension at constant rate (10 mm/sec) on an **INSTRON® Universal Testing Machine** ( Model 3342, Canton, MA) at constant temperature of 4°C. Force and distance data were converted to stress/strain coordinates and plotted to determine yield stress values.

INSTRON® Universal Testing Machine conducting extension of dog bone shaped process cheese sample.



## Results & Discussion

Table 1. Chemical composition of full fat & reduced fat processed cheese

Parameter	FFC	RF	RF 1%	RF 2%	RF 3%
% Fat	32.1 <sup>a</sup>	27.5 <sup>b</sup>	26.8 <sup>b</sup>	26 <sup>b</sup>	27.2 <sup>b</sup>
%Protein	20.1 <sup>a</sup>	19.8 <sup>a</sup>	19.1 <sup>a</sup>	18.5 <sup>a</sup>	19.8 <sup>a</sup>
%Moisture	38.54 <sup>c</sup>	43.91 <sup>a</sup>	43.11 <sup>a</sup>	40.47 <sup>b</sup>	40.53 <sup>b</sup>
pH	5.80	5.83	5.75	5.60	5.60

<sup>a-c</sup>Means within a row with different letters differ significantly ( $P < 0.05$ ). Where FFC: Full fat control; RF: Reduced fat without inulin, RF 1%, 2% and 3% represent reduced fat process cheese with 1%, 2%, and 3% inulin respectively.

Proximate analysis revealed that reduced fat process cheese had 15% less fat than full fat(FFC), but there was no significant difference between the protein levels among the samples (Table 1).

## Stress Strain Curve- Process Cheese

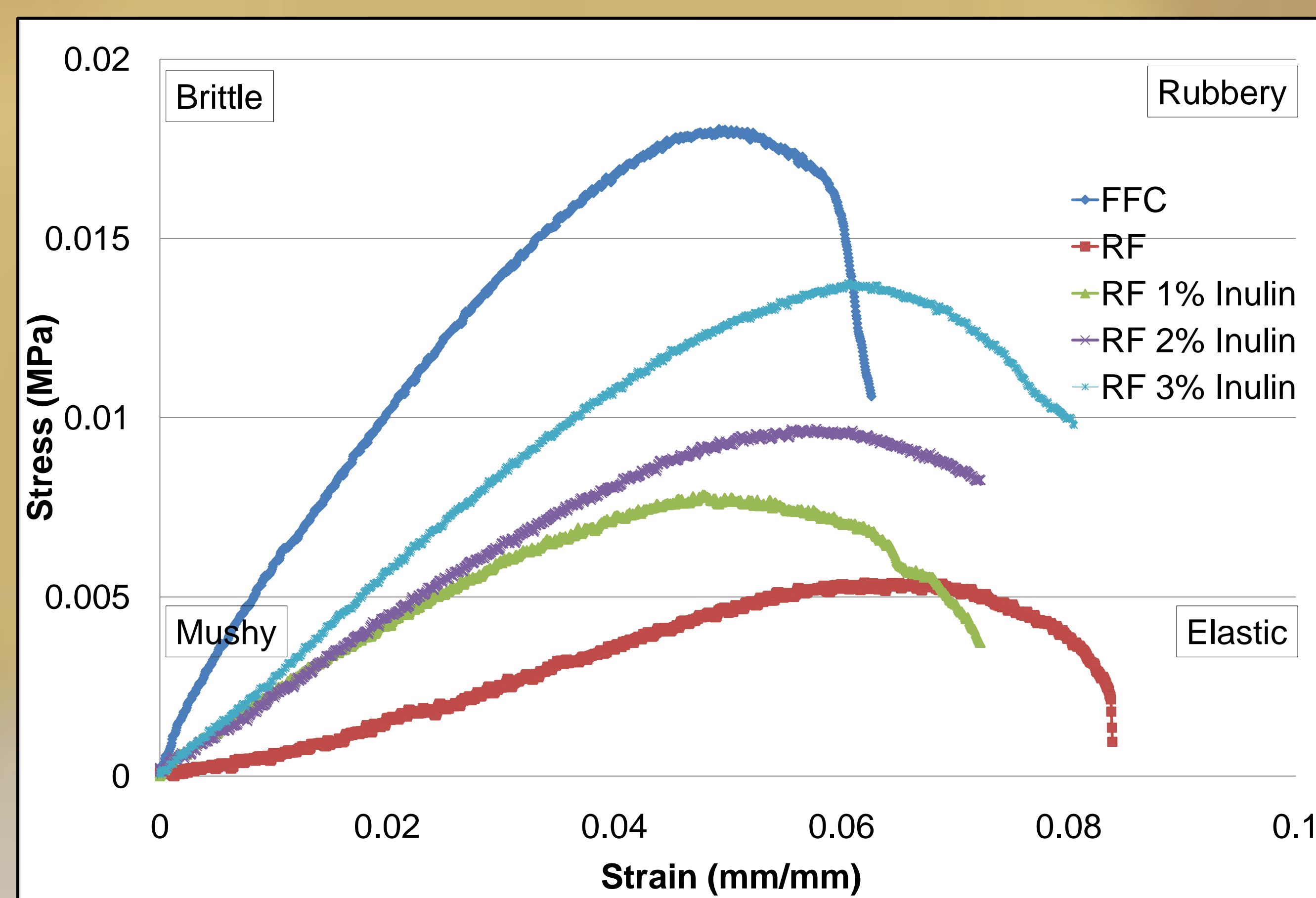


Figure 1 Stress vs. Strain graph of reduced fat processed cheese spread with different levels of inulin addition.

## Results & Discussion ( Cont.)

- Yield stress (point at which the material fails) derived from the process cheese stress- strain curves decreases from 18.5 kPa to 5.4 kPa when fat is lowered from 32% to 27%.
- Adding 1% - 3% inulin to reduced fat process cheese increases yield stress and at higher levels can approximate yield values of full fat cheese.
- Reduction in fat content makes the cheese more elastic. Adding inulin increase firmness corresponding to texture of full fat process cheese.
- Higher concentrations of inulin are better fat mimetics because they form a more compact particle gel(Phillips & Williams, 2000).

## Conclusion:

Fat in processed cheese contributes to its material and textural properties which can be characterized by stress/strain curves generated by tensile deformation. Resulting yield stress measurements can be an important dimension in characterizing texture changes resulting from fat reduction and may be a predictive tool in reformulating reduced fat process cheese to mimic textural qualities of its full fat counterpart.

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## References :

- Brown, J. A., Foegeding, E. A., Daubert, C. R., Drake, M. A., & Gumpertz, M. (2003). Relationships among rheological and sensorial properties of young cheeses. *Journal of Dairy Science*, 86(10), 3054-3067.
- Fagan, C. C., O'Donnell, C. P., Cullen, P. J., & Brennan, C. S. (2006). The effect of dietary fiber inclusion on milk coagulation kinetics. *Journal of Food Engineering*, 77, 261-268
- Lu, Y., Shirashoji, N., & Lucey, J. A. (2008). Effects of pH on the textural properties and meltability of pasteurized process cheese made with different types of emulsifying salts. *Journal of Food Science*, 73(8), E363-E369. doi:10.1111/j.1750-3841.2008.00914.x
- Phillips, G. O., & Williams, P. A. (2000). In Phillips G. O., Williams P. A. (Eds.), *Handbook of hydrocolloids*. Cambridge, England: Woodhead Publishing Limited