Playing with proteins



James K Carson Senior Lecturer School of Engineering University of Waikato j.carson@waikato.ac.nz



My Background

- 1994-1998: B.E. (Hons), M.E. in Chemical Engineering, University of Canterbury
- 1999-2002: PhD, Modelling thermal conductivity of porous foods, Massey University
- 2002-2005: Research Engineer, Refrigeration and Energy Group, AgResearch (government research organisation)
- 2005-Present: Lecturer/Senior Lecturer, Department of Engineering, University of Waikato

- 1999-2007: Modelling heat and mass transfer in foods government funded
- Since 2007:
 - NZ Chestnut drying

Chestnut cultivar '1015'



Dried at 40°C

Dried at 30°C

- 1999-2007: Modelling heat and mass transfer in foods government funded
- Since 2007:
 - NZ Chestnut drying
 - Amaranth starch extraction using ultrafiltration

- 1999-2007: Modelling heat and mass transfer in foods government funded
- Since 2007:
 - NZ Chestnut drying
 - Amaranth starch extraction using ultrafiltration
 - NZ Oolong tea characterisation

New Zealand Oolong tea

- Came from Taiwan
- 13 years growing history
- Pure oolong tea
- Low acerbity and high aroma





- 1999-2007: Modelling heat and mass transfer in foods government funded
- Since 2007:
 - NZ Chestnut drying
 - Amaranth starch extraction using ultrafiltration
 - NZ Oolong tea characterisation
 - Guar gel films

Guar gel films



- 1999-2007: Modelling heat and mass transfer in foods government funded
- Since 2007:
 - NZ Chestnut drying
 - Amaranth starch extraction using ultrafiltration
 - NZ Oolong tea characterisation
 - Guar gel films
 - Development of high protein/low CHO desserts
 - Replacement of gluten in bread by meat protein

- Since '06/'07 I have been involved with a lot of small food research projects, with minimal funding – often on the edge (or outside) of my field of expertise
- In most cases the students have been working in the field and simply need a supervisor to help them write a thesis
- I value this opportunity to meet with experts in the fields in which my students are studying – particularly those familiar with structural functionality of proteins

High protein/low carbohydrate/low fat desserts

- Student: Sean Nixon commencing M.E. 2011
- Sean is a director of a small company that produces high-protein foods and nutritional supplements for athletes and bodybuilders
- Recently has become interested in high protein/low carbohydrate, low fat desserts (similar to ice cream) made solely from ingredients considered to be 'natural'

High protein/low carbohydrate desserts

- Commercial sensitivity prevents me from providing details of ingredients and experiments so far, however he has managed to produce a dessert which had similar consumer acceptability to a commercial brand of ice cream
- However, we would like to reduce the calorie count further
- We would be interested in meeting and potentially collaborating with experts in the field of food structure and rheology, particularly anyone with experience using proteins as structural replacements for carbohydrates

Meat proteins in bread

- Student: Karam Wadi
- Collaborator: Dr Mustafa Farouk, Senior Meat Scientist, AgResearch Ltd (Government research organisation)
- Aim: Reduce gluten content of bread by replacement with meat protein
- Rationale:
 - Some meat cuts have low market value; but high nutritional value
 - Many people are gluten-intolerant but would like to eat bread

Meat proteins in bread - method

- Freeze dried meat fibres ground into fine powder (flour)
- Differing amounts (2.5%, 5%, 10%, 20%) added to highgrade wheat flour to make bread dough
- Bread dough prepared according to standard recipe with dry active yeast (without improvers or shortenings)
- Loaves were prepared to have the same weight and basic shape
- Dough left to stand for 1 hour at 30°C
- Bread baked in oven at 180°C for ½hour, along with control sample (i.e. no meat protein)

Meat proteins in bread – texture and sensory tests

- Dough stress and strain: DV-I digital viscometer
- Density cubic sample (cut with high-speed bandsaw) was weighed
- 20mm Compression: performed using TA-HDi texture analyser
- Colour: whiteness index (L, b, a)
- Consumer acceptability: colour and aroma acceptability were assessed by people from a variety of ethnicities

Meat protein in bread





Meat protein in bread – change in dimensions



Meat protein in bread – change in density



Meat protein in bread – change in vane stress



Meat protein in bread – change in vane strain



Meat protein in bread – 20mm compression test





Meat proteins in bread – Results

- Bread recipe did not produce high porosity bread...
- ...however, the 2.5% and 5% meat substituted breads were as acceptable to the consumer as the control
- Higher concentrations of meat had negative affects on the bread porosity (due to the poorer structural contributions of the meat proteins) and colour (due to darkening caused by myoglobin)
- Higher concentrations of meat also had increased aroma, but it did not result in a strongly negative consumer response

Meat proteins in bread – Conclusions

- Initial results are promising, with low concentrations of meat protein having negligible influence on the texture and sensory aspects of the bread – higher concentrations are still "acceptable"
- One disadvantage of this study was that the meat protein was not food grade, and so taste tests could not be performed
- Future studies will focus on improved bread-making procedures and food-grade protein

Summary

- I have two projects involving the substitution of carbohydrates, fats or proteins with different proteins to achieve nutritional targets
- Replacing the structural contributions of the removed components seems to be a greater challenge than maintaining desirable taste, colour and aroma attributes
- Any advice or suggestions greatly appreciated