

# Ontario Cereal Industry Research Council



Progress Report Sept 2007-April 2009

## Greetings!

### Thank you!

\* We would like to thank C.W. Brabender Measurements, Inc. for the generous donation of laboratory equipment. Please take the time to visit their website at [www.Brabender.Com](http://www.Brabender.Com)

Hello,

It has been very busy lately in the Cereal Science and Technology Laboratory here at Guelph. The arrival of new students allows for broader research themes to be explored by our laboratory group. In this newsletter you will be updated on the current research focus of Dr. Koushik Seetharaman's Cereal Science and Technology Laboratory group.



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The Cereal Science and Technology Research Group. Photo taken March, 2009.

**Standing from left:** Renuka Waduge, Falguni Chauhan, Brittany Huschka, Simarata Dhillon, Sanaa Ragaee, Neelam Dhull, Lida Ashrafi

**Sitting from left:** Avi Goldstein, Klevis Iliriani, Igor Guzar, Koushik Seetharaman

## News!

### Save these dates!

Industry Day: July 15, 2009

Fundamentals of Wheat Flour Properties  
Oct 12-15, 2009

### Congratulations!

Graduate students Falguni Chauhan and Brittany Huschka are finalists in the Mission Impulseible product development competition organized by Pulse Canada. Well done!

### MITACS scholarship winners

Ms. Carolyn Challacombe: Industrial partner – Kraft Inc

Ms. Brittany Huschka: Industrial partner – Coasun Inc



The Food Science building  
at the University of Guelph

## Research Grants

### In Progress (Total, \$529,000)

- 2009. Optimization of oat and barley  $\beta$ -glucan bioactivity in cereal-based bakery products. \$185,000
- 2008. NSERC. Understanding Starch Granular Architecture. \$44,000
- 2008. NSERC Instrumentation Grant. Acquisition of a Konica Minolta Multifunctional Top Port Spectrophotometer (Model CM-3500d) to investigate starch granule architecture. \$22,000
- 2008. OMAFRA. Exploration of soy isoflavone-enriched bread in relation to improved formulation and sensory attributes and cardiovascular disease risk. \$50,000
- 2008. OMAFRA. Understanding the behaviour of oil-water-monoglyceride nanostructures in baked food matrices and evaluating human health benefits following consumption of these products \$228,000

### Submitted (Total \$729,000)

- 2009. OMAFRA. Characterizing the sensory attributes of whole grain wheat-based products and the phenolics associated with these attributes \$191,500
- 2009. OMAFRA. Development of an oxidative process for reducing the surface pigmentation of red wheat. \$119,500
- 2009. NSERC-CRD Understanding granular architecture of starch to design structures in baked product matrices \$418,000



## Research Team

### Staff (OCIRC Funded)

Dr. Sanaa Ragaee

Dr. Ragaee received her PhD in the Department of Applied Microbiology and Food Science, at the University of Saskatchewan, Canada. Her expertise is in the area of non-starch polysaccharides and health. Dr. Ragaee is the Research Manager, responsible for supervising graduate students and manages research projects.

Dr. Neelam Dhull

Dr. Dhull is a new post doctorate scholar. She completed her Master's (Food Technology) and Ph.D. (Cereals) programs in India. She manages the grain quality program.

Mr. Igor Guzar

Igor has completed his BSc. in Food Science from the University of Guelph. He just started as a research assistant in the cereals program.

Ms. Lida Ashrafi

Lida has completed her MSc. degree in Food Quality and Safety from the University of Guelph. She works as a research assistant at the present time working on flour quality.

### Graduate Students (OCIRC funded)

Ms. Falguni Chauhan (MS)

**Thesis Title:** Exploring the chemistry of homoglucon polymer interaction with iodine at low moisture-contents.

**Brief outline of area of research:** Previous work to understand starch structure used iodine in solution together with potassium iodide. In Falguni's studies, she is using iodine vapor directly to react with starch structures at low moisture contents. The helical complex formation between iodine and a linear glucon polymer has been the cornerstone of research on starch in our laboratory. This reaction and resultant color/absorbance properties have been used to interpret many different properties and attributes of starch. The objective of her study is to investigate the interaction of iodine vapor with linear and branched homoglucon polymers. Using iodine as a tool provides a novel technique to investigate and understand starch structure-function relationships.

**Expected Completion Date:** December 2009

Ms. Simarata Dhillon (MS)

**Thesis title:** Use of iodine as a tool to understand the structure-function relationship of starches of different botanical origin

**Brief Description:** Simarata is studying the macromolecular physiochemical properties of starch by using iodine as a tool. The results obtained will be linked to the micro-structure of starch granules and the organisation of the polymers within the granule.

**Expected Completion Date:** August 2009

Mr. Komeine Nantanga (PhD)

Komeine started his PhD in May 2009. He completed his MSc. in Food Science at the University of Pretoria, South Africa. Prior to coming here, he worked as a research technician and instructor in the Biochemistry department at the University of Namibia. Komeine's research will focus on strategies to modulate the digestibility of starch in baked products.

**Expected Completion Date:** May, 2012

## Research Team Cont.

### Funded through other grants

Ms. Renuka Waduge (PhD; NSERC and Vitamin Scholarship)

Renuka Waduge is a Ph. D. Candidate. She is in the second year of her program and is studying the structural development of Canadian grown wheat starch granules during maturity. She obtained her Master's degree in Food Science from the Memorial University, Newfoundland, Canada, and the B. Sc. Honors degree in Chemistry from the University of Sri Jayewardenepura, Sri Lanka. She studied the annealing of barley starch as her M. Sc. Research. With a strong knowledge in cereal starches and experience in X-ray, SEM, DSC, Microscopic, spectroscopic, and chromatographic techniques, she brings an added value to our lab.

**Expected Completion Date:** Dec, 2011

Mr. Avi Goldstein (MS; OMAFRA)

**Thesis Title:** Investigating the role of monoglyceride-stabilized oil in water emulsion in sensory and textural attributes of baked food products.

**Brief Description :** Identify the role of monoglyceride – stabilized oil in water emulsions on final baked product attributes, and identify specifically how the emulsion interacts with major products components ( starch, water, gluten). In order to address the primary research focus a variety of food systems will be created with differing percentages of monoglyceride-stabilized oil and major product components. Food systems to be evaluated will be systems in which the roles of major product components are well understood. Systems studied will include puff pastries, cookies, and pound cakes.

**Expected Completion Date:** May, 2011

Ms. Brittany Huschka (MS; Industry funded)

**Thesis Title:** Understanding the behaviour of a monoglyceride- stabilized oil in water emulsion with multi-components of a baked food matrix.

**Brief Description:** Comparing the interaction of a monoglyceride-stabilized oil in water emulsion to other shortenings, oil, and oil, monoglyceride mixtures with flour, gluten and starch. This will be investigated by determining the thermal and rheological properties of the monoglyceride stabilized emulsion and the specific food matrix component following different hydro-thermal treatments.

**Expected Completion Date:** April ,2010

Ms. Carolyn Challacombe (MS; MITCAS)

**Thesis Title:** "Characterizing the sensory attributes of red and white wheat, their brans and whole grain products made using red or white wheats."

**Brief Description:** Red wheat is the predominant wheat grown in Ontario. However, red wheats impart an off-flavor to whole grain products. The purpose of this research is to gain knowledge of the sensory attributes including the nature and reasons of the off-flavours of red wheats compared to white wheats. The data collected will lead to developing strategies to formulate whole grain products with improved sensory and textural attributes.

**Expected completion date:** April ,2011.



## Research Team Cont.

### Full Time Research Assistants

Mr. John Melnyk (MITACS Funded)

**Brief Description:** A technique will be developed to classify wheat gluten protein quality at early stages of breeding with sample sizes as small as 20 grams. The tool that will be used for the study is known as a Gluten Peak Tester (GPT). The objectives of the study are to; define the measurement parameters and settings in the GPT to measure gluten properties; variables to be tested include water to flour ratio, temperature of measurement, and the rpm of the spindle; Validate the optimal settings using different control wheat varieties with known properties and functionality; Evaluate gluten protein quality on early generation breeding lines. The partner company, Hyland Seeds, will benefit from the internship because they will be able to screen for protein quality in earlier stages of breeding using smaller sample sizes. This will allow them to retain seeds that possess unique protein quality attributes for future development work.

Ms. Azadeh Samadi

Azadeh's research focuses on quantifying iodine in iodine-starch complexes.

Mr. Chris Muirhead

Chris assists the graduate students with starch isolation and other analytical techniques.

### Undergraduate research

Ms. Yuk- Fai Fung (USRA fellow)

Yuk-Fai is working in quantifying iodine in iodine-starch interactions on an NSERC-USRA fellowship.

### Visiting Scholar

Alessandra Marti: PhD Student from University of Milan

Alessandra Marti is a PhD Student in Food Biotechnology at the Department of Food Science and Technology at the University of Milan (Italy), with a thesis about "Physical and biotechnological approaches to improve the characteristics of gluten-free products". Her specialization is on formulation and optimisation of pasta made from durum wheat and gluten-free cereals. Particular attention is paid on the study of the pasta-making process by evaluating the performance of different gluten-free flours and the macromolecular modifications induced by different processing conditions and biotechnological actions. Since April 2009 she joined the Department of Food Science at the University of Guelph. The overall subject of her research is the investigation of starch behaviour both in rice and semolina pasta, prepared using different pasta-making processes.

## Research Focus

Research in our laboratory is focused on different aspects of cereal grains including grain quality, functionality in food products and health attributes derived from grains and grain-based foods. A significant focus of research is on Ontario grown wheats. Some of the current research foci are as follows.

### Starch Granular Structure & Architecture

- Explore starch granular architecture during starch synthesis
- Adapt new techniques to explore granular architecture of starches including X-ray Diffraction, Atomic Force Microscopy, Tip Enhanced Imaging with Raman Spectroscopy and Atomic Force Microscope etc.
- Understand structural differences in starches from different botanical sources

### Processing

- Design structures in baked products to improve shelf life and reduce glycemic response
- Develop tools to monitor polymobility in products to predict shelf life
- Develop a process map by monitoring polymer mobility during real time baking
- Adapting processes to create products with improved nutritional and textural attributes
- Investigate the relationship between product structure and starch digestibility following specific hydrothermal treatments

### Grain Quality

- Functional components in wheat
- Adapting functionality of Ontario-grown wheat for baked products

## Research Infrastructure

### Research Instrumentation present in Cereal Science and Technology Laboratory

High Performance Liquid Chromatography  
 UV-Vis Spectrophotometer  
 Rapid Visco Analyzer  
 Micro Visco Amylograph (Donated by Brabender)  
 Texture Analyzer  
 Gluten Peak Tester  
 Glutograph (Donated by Brabender)  
 Heavy duty modified Farinogram (Donated by Brabender)  
 Hybrid Oven  
 Milling and Baking Equipment

### Shared research instrumentation

X-Ray Diffractometer  
 Differential Scanning Calorimeter  
 Light Microscope  
 Scanning Electron Microscope  
 Confocal Scanning Laser Microscope  
 Rheometer



## Presentations by Research Group Members

Recently, members of the Cereal Science and Technology research group have presented their research at international food science research conferences. The presentations were very well received and we are looking forward to attending more conferences in the future!

### Presenters

#### Sanaa Ragaei

AACC, September 21-24, 2008, Honolulu, Hawaii : “Segmental mobility of polymers in heat-moisture treated normal and waxy potato starch granules”

AACC 2009 ,Effect of different sources of potential prebiotics on starch digestibility and pasting characteristics in a flour-water system

#### Simarata Dhillon

IFT, June 28-July 1, 2008, New Orleans, Louisiana (oral presentation): "Use of iodine as a tool to understand the pasting behaviour of different starch crystalline types"

AACC, September 21-24, 2008, Honolulu, Hawaii (poster): "Investigating the textural properties of starch gels treated with iodine"

#### Renuka Waduge

International wheat quality conference IV (IWQC IV), June 02 – June 06, Saskatchewan: “Use of iodine vapour as a tool to understand the structural development of starch granule during maturity”

#### Falguni Chauhan

IFT, June 28-July 1, 2008, New Orleans, Louisiana: “ Can iodine be used as a tool to detect polymer mobility in baked products?”

AACC, September 21-24, 2008, Honolulu, Hawaii - Pasting profiles of iodine exposed starches.

#### Avi Goldstein

IFT, June 6-9, 2009, Anaheim California : “Cellulosic fiber interaction with starch, gluten and wheat flour”



#### Brittany Huschka

American Oil Chemists’ Society (AOCS) May 3-6 ,2009.Orlando, Florida: “Time-temperature effects on the stability of a monoglyceride-oil-water shortening alternative”

International Food Technologists (IFT) June 6-9, 2009 Anaheim, California: “ Effect of monoglyceride-stabilized oil in water emulsion on dough rheological properties”

CIGR International Symposium on Food Processing, Monitoring Technology in Bioprocesses and Food Quality Management, August 31- September 2, 2009, Postdam, Germany: “Interactions of a novel monoglyceride-stabilized oil in water emulsion with wheat flour, starch and gluten”



## Recent Publications

Iodine-binding in granular starch: Different effects of moisture content for corn and potato starch

Author(s): Saibene, D; Zobel, HF; Thompson, DB, et al.

Source: **STARCH-STARKE** Volume: **60** Issue: **3-4** Pages: **165-173** Published: **2008**

Use of iodine as a tool to understand wheat starch pasting properties

Author(s): Saibene, D; Seetharaman, K

Source: **STARCH-STARKE** Volume: **60** Issue: **1** Pages: **1-7** Published: **2008**

A nutribusiness strategy for processing and marketing animal-source foods for children

Author(s): Mills, EW; Seetharaman, K; Maretzki, AN

Source: **JOURNAL OF NUTRITION** Volume: **137** Issue: **4** Pages: **1115-1118** Published: **2007**

Impact of microwave heating on the physico-chemical properties of a starch-water model system

Author(s): Palav, T; Seetharaman, K

Source: **CARBOHYDRATE POLYMERS** Volume: **67** Issue: **4** Pages: **596-604** Published: **FEB 19 2007**

Dielectric properties of starch slurries as influenced by starch concentration and gelatinization

Author(s): Motwani, T; Seetharaman, K; Anantheswaran, RC

Source: **CARBOHYDRATE POLYMERS** Volume: **67** Issue: **1** Pages: **73-79** Published: **JAN 2 2007**

## Outreach

Each year Dr. Seetharaman's Cereal Science and Technology Laboratory holds a workshop for members of the cereal industry. This year, the workshop titled 'Fundamentals of wheat flour properties' will be held between Oct 12-15 2009.