OMAFRA-University of Guelph Partnership 2016 Product Development Research Day

List of Product Development Research Posters on Display at Today's Event

Student Poster Contest - Poster Titles

1. Development of a Vaccine Against Parasitic Abortion in Sheep
2. Supplementing Natural Zeolite in Poultry Feed
3. Gluten-Free Yeast Donut Made From Canadian Pulses
4. Antimicrobial Effect of Berry Products
5. Airlift Pumps for Sustainable Aquaculture
6. High Hydrostatic Pressure Processing of Tigernut Milk
7. Fate of Neutraceutical Constituents of Wheatgrass Juice Following Non-Thermal Pasteurization
8. Bioactivity of Milk MicroRNA from High Immune Responder Cows
9. Developing Enzymes to Increase the Reactivity of Starch
10. Lake Phosphorus: From Pollutants to Fertilizer
11. Comparative Analysis of Sour Beer
12. Treatment to Improve Nutritive Value of Feather Meal
13. Brewery Wastewater Treatment by Anaerobic Membrane Reactor
14. Process Water from the Hydrothermal Carbonization of Wet Biomass
15. A Novel Approach for Purification of Lignin from Wastes of Pulp and Paper Industry
16. Protein and Fibre Extraction from Asparagus Base
17. Snacking on New Grounds
18. A Peachy Tale of Packing
19. Accelerating the Aging Process of Whisky
20. Microemulsions as Extracting and Delivery Systems for Nutraceuticals
21. Gain Muscle and Strength While You Age
22. Synthesis of Carboxymethyl Cellulose (CMC)
23. Food Processing and Wash-Waters
24. Physicochemical Properties of Torrefied Poplar
25. Cost-Effective Fractionation of Cornstalk into Lignin & Cellulose Products
26. Growing Willow for Bioenergy Production

Non-Contest Posters

Ontario Hops Benchmarking Project

Enhanced Detection of *Listeria monocytogenes* in Food

Niagara College - Open for Innovation - Changing the Game for Game Meats

Niagara College - Open for Innovation - Creamy Cooking Sauce - Applications for Food Service

Niagara College - Open for Innovation - Farmlife Foods Category Extension with Chicken Sausage

Niagara College - Open for Innovation - Consumer Application Development for Jal Gua, a Nutritious Beverage Mix

Niagara College - Open for Innovation - Diversifying the Offerings for Organic Poultry

High Protein Ontario Quinoa: Quinta's Niche Innovation

#PDresearchDay

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A program of the OMAFRA – U of G Partnership
Mobilizing Agri-Food and Rural Research Knowledge

Posters

The posters for today's event are located in the area outside of the Conference Centre doors. There is a ballot in your attendee package for you to vote on your three favourite posters. The poster presenters are here today and at their poster to talk to you about their product.

Research to Go

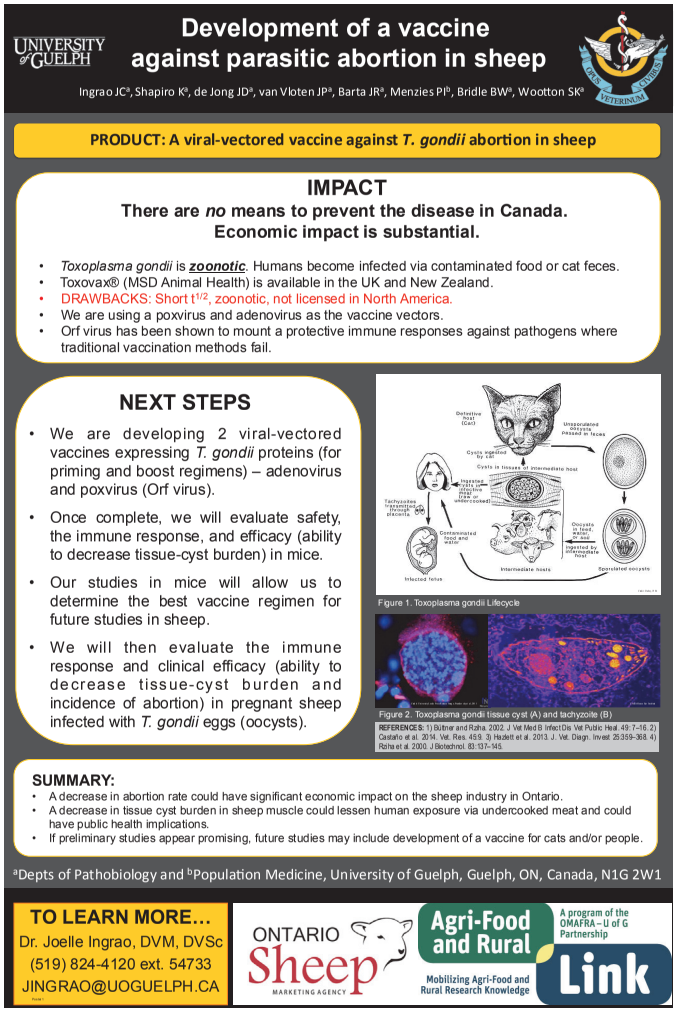
Summaries of current research funded by the Ministry of Agriculture, Food, and Rural Affairs-University of Guelph Partnership can be viewed at this website:
http://www.uoguelph.ca/omafra_partnership/ktt/en/aboutourresearch/Research_to_GO.asp

Scan Research & Innovation Project Summaries for information about projects funded since 1996 at:
http://www.omafra.gov.on.ca/english/research/index.html

Post-event

Look for today's presentations click on the Calendar of Events box at www.uoguelph.ca/ktt.

Contest Poster 1



UNIVERSITY of GUELPH

Development of a vaccine against parasitic abortion in sheep

Ingrao JC[a], Shapiro K[b], de Jong JD[a], van Vloten JP[a], Barta JR[a], Menzies PI[b], Bridle BW[b], Wootton SK[a]

PRODUCT: A viral-vectored vaccine against *T. gondii* abortion in sheep

IMPACT

There are *no* means to prevent the disease in Canada.
Economic impact is substantial.

- *Toxoplasma gondii* is ***zoonotic***. Humans become infected via contaminated food or cat feces.
- Toxovax® (MSD Animal Health) is available in the UK and New Zealand.
- DRAWBACKS: Short $t^{1/2}$, zoonotic, not licensed in North America.
- We are using a poxvirus and adenovirus as the vaccine vectors.
- Orf virus has been shown to mount a protective immune responses against pathogens where traditional vaccination methods fail.

NEXT STEPS

- We are developing 2 viral-vectored vaccines expressing *T. gondii* proteins (for priming and boost regimens) – adenovirus and poxvirus (Orf virus).
- Once complete, we will evaluate safety, the immune response, and efficacy (ability to decrease tissue-cyst burden) in mice.
- Our studies in mice will allow us to determine the best vaccine regimen for future studies in sheep.
- We will then evaluate the immune response and clinical efficacy (ability to decrease tissue-cyst burden and incidence of abortion) in pregnant sheep infected with *T. gondii* eggs (oocysts).

Figure 1. Toxoplasma gondii Lifecycle

Figure 2. Toxoplasma gondii tissue cyst (A) and tachyzoite (B)

REFERENCES: 1) Büttner and Rolha. 2002. J Vet Med B Infect Dis Vet Public Heal. 49:7–16. 2) Castaño et al. 2014. Vet. Res. 45:9. 3) Hudelet et al. 2013. J. Vet. Diagn. Invest. 25:359–368. 4) Rolha et al. 2000. J Biotechnol. 83:137–145.

SUMMARY:

- A decrease in abortion rate could have significant economic impact on the sheep industry in Ontario.
- A decrease in tissue cyst burden in sheep muscle could lessen human exposure via undercooked meat and could have public health implications.
- If preliminary studies appear promising, future studies may include development of a vaccine for cats and/or people.

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ONTARIO Sheep MARKETING AGENCY

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Contest Poster 2

Supplementing Natural Zeolite in Poultry Feed

Syed Salman Bukhari, Sohrab Rohani[a]

Product: **Poultry Feed fortified with Clinoptilolite**

Poultry feed supplemented with 2-4% clinoptilolite, which is an abundant and low cost resource and can result in improved growth

Impact:

- There have been multiple studies that suggest supplementing clinoptilolite in the broiler chickens feed causes them to gain weight faster and have a higher body weight at the end of the growing period. Furthermore, egg laying hens produce more eggs of higher quality
- If these findings are corroborated through this study it would have significant economic impact in the poultry industry
- Zeolite supplemented feed can result in more productive poultry farms and increase the output of both meat and eggs

Next Steps:

- Fortified feed would be given to the non-control group
- Measured variables would include weight, growth of intestinal villi, bone mass, egg production, yolk: albumen content

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Funded by

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Contest Poster 3

Not available at time of print. Full size poster is with all of the posters in the area outside of the Conference Centre doors.

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Contest Poster 4

Antimicrobial Effect of Berry Products

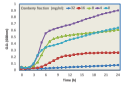
Quail Das[ab], MA Goube[b], MR Islam[b], J McCallum[b], K Ross[b], MF Marcone[a] and MS Diarra[b]

Product: Berry fruits extracts as alternatives to traditional antibiotics in poultry productions to breakdown the emergency and antibiotic resistant foodborne pathogens.

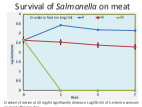
Impact: Address issues in animal production, including the increasing need for viable alternatives to antibiotics as growth promoters.

- Antibiotic resistance is an important food safety and public health concerns. Consumers are requesting more naturally produced foods.
- Berries such as cranberries and blueberries have long been used in human nutrition and have been reported to have various health benefits due to their high content of phenolic and antioxidant compounds. These berries extracts may be promising natural treatment against pathogenic bacteria in livestock and poultry productions.
- We recently identified fractions of cranberry and blueberry juice and waste (pomaces) products having interesting biological activities against pathogenic bacteria such as *Salmonella* spp and *Clostridium perfringens* that would limit the growing problem of antibiotic resistance while reducing animal health problems.
- Berries products could be also developed as natural antimicrobial agents to control pathogenic bacteria in food processing and packaging industries. Berry processing industries generate large amount of pomaces which can be an excellent source of natural bioactive compounds.

Growth of *Salmonella*



Survival of *Salmonella* on meat



Next Steps:

Use of berry pomaces and pomace extracts as feed supplement in organic broiler chickens to boost immunity and to improve overall bird health and productivity. The anticipated results could be advantageous for both producers and consumers. Healthier birds could reduce production costs for farmers, while meeting consumer demand for high quality, antibiotic-free poultry products.

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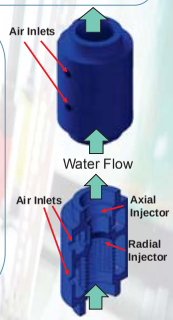
Contest Poster 5

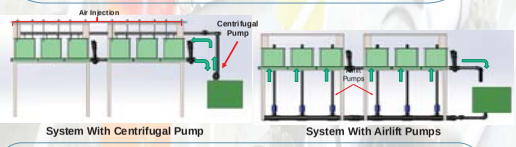
Airlift Pumps For Sustainable Aquaculture

Eric Chadwick and Wael Ahmed

Product:
The new technology of airlift pumps can be used in Recirculating Aquaculture System (RAS) to supply both oxygen and water, while also removing carbon dioxide at low energy cost.

Impact:
The airlift pump is designed for anyone seeking to pump, aerate, and even cool water using low amounts of energy. This device requires no moving parts, no lubrication and is low maintenance. Due to its low energy requirements the airlift pumps are suitable for remote aquaculture applications. It can also be very effective for delivery water from wells to communities such as native reserves in Ontario. This particular product has been proven to achieve energy savings of 40-60% when compared to a traditional centrifugal pump.





Next Steps:
Research on the performance of airlift pump prototype will be conducted in the summer of 2016 in order to evaluate different pump designs. The possibility of operating the pump using solar energy will also be explored experimentally.

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Contest Poster 6

High Hydrostatic Pressure Processing of Tigernut milk

Asma Elbrhami[a], Keith Warriner[a], Tatiana Koutchma[b], Vladimir Popovic[b]

Tigernut

- is a type of starchy tuber called *chufa*.
- is a highly valued food with associated health benefits.
- Low acid (PH 6.3-6.8), and susceptible to microbial spoilage.
- Beverage of the year in 2015 (The Guardian, Daily Mail)

Service

HHP tigernut milk with enhanced food safety, extended shelf-life and colloidal stability compared with raw product.

Impacts

-Significance: HHP treatment regimes to facilitate pathogen reduction, shelf-life extension, reduce phase separation, and improve nutritional quality.

-Beneficiaries: The research is of interest to cold pressed beverage processors, regulators, nutritionists, product developers, health food retailers and consumers.

-Market impact: Hitherto, tigernut milk has been restricted to juice bars due to a shelf-life of 1-2 days. The research has delivered a HHP process to support up to 15 day shelf-life. Estimated demand for the product is 150,000 units per week

Next steps:

-Evaluate different formulation hurdles to maintain quality and shelf-life.
-Obtain regulatory approval for high pressure processed tigernut milk.
-Evaluate other non-thermal processing of low-acid beverages.

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Contest Poster 7

Fate of Neutraceutical Constituents of Wheatgrass Juice Following Non-Thermal Pasteurization

Nagwa Ali[a], Keith Warriner[a], Tatiana Koutchma[b] Vladimir Popovic[b]

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Product: Wheatgrass juice rich in chlorophyll, antioxidants, enzymes and other neutraceutical constituents.

Impact

Deliverable: Food regulations stipulate that all juices sold across Canada or abroad must be pasteurized to support 5 log reduction of pathogens. Because juice constituents are heat sensitive a non-thermal treatment is required to improve safety. A comparative study was performed to assess changes in nutrient composition following High Hydrostatic Pressure (HHP) or other non-thermal treatments.

Beneficiaries: Juice producers (especially low acid), regulators, product developers, process engineers, consumers.

Estimated market size: Natural Food Market - $3bn per year, with 10% growth per year.

Next Steps:

Results to date have confirmed the utility of HHP to inactivate microbes while preserving nutrients and enzyme content. Next steps are to compare high pressure with thermal and other non-thermal treatments such as UV light.

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Contest Poster 8

Bioactivity of Milk MicroRNA from High Immune Responder Cows

Mikayla Ross[a], Heba Atalla[a,b], and Bonnie Mallard[a,b]

Product

- Cow milk contains bioactive components that benefit calf and human health.
- MicroRNAs (miRNAs) in cow milk have implications in regulating gut and immune system development in humans.

Impact

This project addresses a need for the development of milk products that promote the health of individuals.

Impacts two specific groups:

Dairy Industry

Producers may selectively breed for presence of specific miRNA in milk.

↓

Develop novel milk products that support human and calf health.

Consumers

Project will give insight into how milk affects human health.

↓

Consume novel milk products to support health.

Potentially increase revenue to the dairy industry.

Next Steps

- Research on how milk miRNAs affect the human gut is ongoing.
- Future work will assess how milk miRNAs affect calf intestinal cells.

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Contest Poster 9

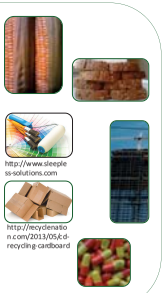
Developing enzymes to increase the reactivity of starch

Jessica White, Lily Nasanovsky, Ian Tetlow
Department of Molecular & Cellular Biology, University of Guelph, Guelph, Ontario, Canada, N1G 2W1

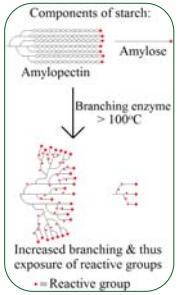
Extending uses for Ontario crops

- Starch is water-insoluble & unreactive
- Branching enzymes branch starch, increasing its reactivity & thus ways in which it can be chemically modified & used post-harvest

Benefit for local farmers & consumers



- 54 billion kilograms of starch is harvested annually for many food & non-food applications
  - ➢ Bread, paints, cement, cardboard, pharmaceuticals
- Starch is often chemically modified to increase functionality
  - ➢ Requires extreme heat to make starch soluble & reactive (especially difficult for Ontario-grown starches)
- Branching enzymes increase the branching frequency & thus reactivity & end-uses of starch
  - ➢ Increased market for local farmers (raw material)
  - ➢ Decreased transportation of international starches
    - ✓ Reduced costs & carbon emissions



Methods

1) Hybrid enzymes created using specific domains from:
   a) Thermo-tolerant bacterial enzymes to withstand high processing temperatures
   b) Maize starch branching enzymes to enhance starch branching, solubility, reactivity & thus modification
2) Analyze hybrid enzyme folding (circular dichroism) & thermo-tolerance (enzyme assays)
3) Analyze glucan products (anion exchange chromatography)
4) Produce enzymes for large-scale industrial settings

To know more
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Acknowledgements

Dr. Ian Tetlow (supervisor)
- Project development, guidance & encouragement

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- Project feedback

Lily Nasanovsky (mentor)
- Development of hybrid enzymes, patience & encouragement while training me within & outside lab

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- Training, support & feedback in lab

Ontario — Ministry of Agriculture, Food and Rural Affairs — Agri-Food and Rural — Link

Contest Poster 10

Lake Phosphorus: From Pollutant to Fertilizer

Renaldo Belfon and Paul Voroney
School of Environmental Sciences, University of Guelph, Ontario Canada

Our Aim: To develop iron oxide nanoparticles that can bind with Phosphorus. This will facilitate magnetic removal of phosphorus in lakes and re-use as a plant fertilizer.

Impact: By converting excess phosphorus –a water pollutant- into fertilizer we hope to improve the economic performance of Ontario's rural farmers. This will also improve water quality, benefiting both the fisheries and tourism sectors.

Figure 1. Phosphorus affected lake

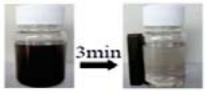

Figure 2. Magnetic removal of Phosphorus

Figure 3. Testing fertilizer effects on plant growth

What's next: We are currently looking for industry partners to collaborate with in conducting mescocosm and field testing of this technology.

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Contest Poster 11

Comparative Analysis of Sour Beer

Abigail Clement[a], Alison Gowman[a] and Rachel Vincent[a]

Sour Beer:

Beer that has a sour taste due to the presence of lactic acid.

Impact:

The purpose of this project is to quantify the amount of lactic acid and other chemical compounds that the bacteria responsible for souring the beer produces. This will allow brewers to have a better understanding of the bacteria and the flavours it could produce. This study addresses the need for more experimental research related to the brewing industry to be performed. The study will ensure that multiple strains of *lactobacillus* bacteria are tested and that the resulting concentrations of lactic acid are quantifiable and can be replicated in the industry.

Next Steps:

Further testing will be done to ensure that all data is accurate. Since only 19L batches are being produced, scale up would be recommended to allow for further testing.

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Contest Poster 12

Treatment to Improve Nutritive Value of Feather meal

Guillaume Pfeuti and Dominique P. Bureau[a]

Product:

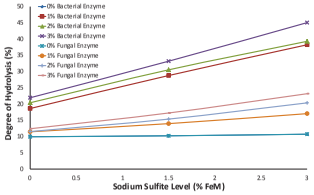
Enzymatic pre-treatment to improve the nutritive value of feather meal

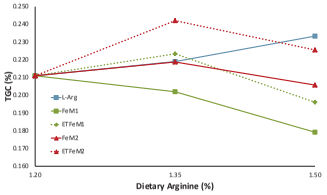
Impacts:

- Significantly improves the digestibility and bio-availability of amino acids (up to 15%) of feather meal to rainbow trout.
- Better valorization of significant by-product (raw feather and hog hair) of poultry and pork processing plants
- Could enable a substantial increase in incorporation of feather meal in fish and other animal feeds thereby improving their nutritive value, safety and cost-effectiveness.
- Reduce solid and dissolved waste outputs associated with feeding high feather meal feeds.

Next Steps:

- Scaling up of processing treatment.
- Trials with other livestock species (poultry, swine)
- Identifying reliable indicators of nutritional quality of amino acids for feather meals for quality assurance (QA/QC) programs





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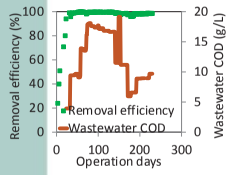
Contest Poster 13

Brewery W astewater Treatment by Anaerobic Membrane Bioreactor

Richard Chen[1], Sheng Chang[1], Ping Wu[2]

Anaerobic membrane bioreactor (AnMBR) is a state-of-the-art technology to purify high organic wastewater and recovery energy. The AnMBR can produce high quality effluent to enhance non-product related water reuse within the brewery industries and generate renewable energy in the form of methane gas.



Impact:

- Currently 62 micro-breweries in Ontario and growing.
- Many brewers are seeking reliable on-site treatment methods due to the expensive wastewater compliance bills
- 230 days of continuous operation demonstrated an excellent organic removal efficiency (98%) and great stability under loading shocks.
- Substantial impact on the commercial-scale AnMBR with the involvement of our industrial collaborator, GE Water and Process technologies.
- Bring significant environment and economic benefits to the food and beverage industries through pollution reduction, elimination of discharge surcharge, safe water reuse and energy recovery.

Next Steps:

- Developing an integrated UASB-AnMBR-RO technology for higher treatment efficiency.
- Optimizing the technology in terms of treatment performance and cost.
- Seeking interested local brewery for pilot testing.

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GUELPH ENGINEERING

Contest Poster 14

Process water from the hydrothermal carbonization of wet biomass: a waste or a valuable product?

Subhash Paul[1] and Animesh Dutta[2]

Product: Biogas

Wet crop biomass releases half of its dry matter into hydrothermal process water, which has potential to enhance biogas production

Impact:

- Wet/undervalued biomass residues consumes low energy to produce biocoal in hydrothermal (HTC) process compared to conventional dry torrefaction process
- Acidic HTC process water contains half of biomass dry matter can be used as AD feedstock
- By integrating HTC and AD, biocoal and biogas can be produced from the same source while nutrient will be available with AD digestate
- Determination of optimum HTC process condition to minimize AD inhibitors in process water is important

Fig. 1 Corn residue with cobs

Fig. 2 HT reactor

Table1 Wet crop Biomass HTC products

HTC (°C) for 30 min	HTC (biocoal)		HT liquid (aqueous)		
	Dry Biomass (%)	Energy MJ/Kg	Dry Biomass (%)	Furfural (% TS)	Phenolics (% TS)
Raw_{ab}	N/A	18.13	N/A	N/A	N/A
200	56	20.68	44	42.80	12.38
220	52	21.80	48	40.67	15.15
240	47	23.01	53	17.47	17.14
260	37	24.70	63	6.16	26.52

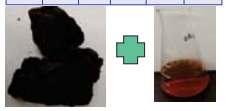

Fig. 3 Hydrothermal products

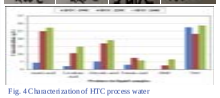

Fig. 4 Characterization of HTC process water

Next Steps:

- Anaerobic digestion of hydrothermal process water for biogas production in laboratory

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Contest Poster 15

A novel Approach for Purification of lignin from Wastes of Pulp and Paper Industry

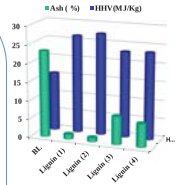
Zainab Al-Kaabi[a], Ranjan Pradhan[b], Andrew Gordon[a], Animesh Dutta[b]

Product/Service:

Purified industrial lignin: a valuable environmentally friendly feedstock for bioenergy and biorefinery applications.

Impact:

- Black liquor is the main byproduct of pulp and paper industry, which is currently used for process heat generation.
- Black liquor contains 65-85% solid content and 10-50% lignin by weight with high ash content while, the accepted ranges of ash for industrial applications should be less than 10% (power generation, steel making).So, purification is very important step to reduce the ash content of lignin from the black liquor.
- Our research has shown that oxidation using hydrogen peroxide with other chemicals has proved to be very efficient method to purify lignin.
- Physico-chemical characteristics of purified lignin in terms of ash content and higher heating value (HHV) have significantly improved.



BL: Dried black liquor
Lignin (1): purified lignin using (H_2O_2 + H_2SO_4)
Lignin (2): Purified lignin using (H_2O_2 + CH_3CO_2H + H_2SO_4)
Lignin (3): Purified lignin using (CH_3CO_2H)
Lignin (4): Purified lignin using (H_2SO_4)

Figure 1: Ash content & HHV of black liquor and purified lignin

Figure 2: Dried purified lignin

Figure 3: Black liquor

Next Steps:

- Purified lignin will be used to produce bio-black (a replacement of PCI coal) using slow pyrolysis and Hydrothermal carbonization processes.

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Contest Poster
16

Protein and Fibre Extraction from Asparagus Base

Andrea DiNardo[a,b]

Advisors: Ping Wu, P.Eng[a,b] and Sheng Chang, Ph.D., P.Eng[a]

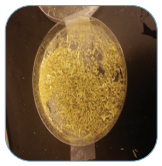
Service:
Process developed to extract protein and polysaccharides from discarded asparagus bases to incorporate into new food products.

Impact:

Discarded asparagus bases are typically mixed into manure piles since they have no market value. Ontario fruit and vegetable growers will benefit from this process as it will generate a new source of revenue for products which do not have any commercial value. Ontario home consumers will also benefit as their foods could be fortified with asparagus fibre and protein. By incorporating wasted asparagus bases into new food products Ontario's agri-food sector can reduce its environmental footprint, the amount of food waste each year, and the cost of manufacturing new food products.

Next Steps:

Further research is required to make this process universal for more fruits and vegetables. Research is also required to determine functional properties of new food products after incorporating the asparagus.



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Contest Poster
17

Not available in print.
Full size poster is with all of the posters in the area outside of the Conference Centre doors.

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Contest Poster
18

A Peachy Tale of Packing

Andrew McCuaig

Sunnydale Farms' Quest for Increased Productivity

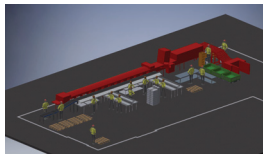
Goal: Increase the rate of fruit packaging to match the demand from the increased yields, due to denser planting methods after replanting from the Plum Pox Virus Eradication Program.

Problem:
Sunnydale Farms, to meet the packaging demands, would run the sorting machine at a faster pace than what the packers could pack. This meant that they would have to periodically stop the machine, to allow the packers to catch up, and then start the process again. The packers would also have other duties and would have to retrieve their own clamshells and boxes.

The packers were therefore taken away from the duties for which they were trained, and the farm faced the discontinuous operation of the sorting machine.

Solution:
By conducting a productivity assessment, it was determined to slow down the machine. This allowed for a steady pace that alleviated the overflow of peaches to the packers. It was proposed to have a worker bring the packers the empty boxes and containers. A conveyor system was also proposed to facilitate the movement of the full boxes of containers of peaches. By having the empty containers brought to the packers and the full ones taken away, workers will be able to pack more peaches in the same amount of time, increasing the amount of peaches shipped per day by as much as 20%.

This project was made possible thanks to a Niagara Region Productivity Voucher



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Contest Poster 19

Accelerating the Aging Process of Whisky

Sheldon Amichand, Geoffrey Beamish, Bryan Melchior [a]

Product:

Utilizing a bioreactor to accelerate the aging process of whisky to improve both the flavor and texture of young whiskies.

Impact:

This method will utilize mass transfer principles to allow both small and large distilleries to accelerate the aging of whisky and create a product at a much faster rate than typical barrel aging. By utilizing this method, smaller distilleries who are just starting up will be able to create a quick turnaround on some of their early product. This process will also allow for the growing Ontario whisky market to increase its production and relevance in the global market.

Next Steps:

The next steps of this product will to be first to continue the testing for longer periods of time to simulate different aged whiskies. Following this, scaling up the size or creating a bioreactor with better materials to ensure a more pure product would be the next logical steps.

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Contest Poster 20

Microemulsions as Extracting and Delivery Systems for Nutraceuticals

Mehdi Nouraei, Professor E. Acosta, Professor L. Diosady [a]

Fully- dilutable, lecithin-linker Microemulsions

Mixtures of lecithin, lipids and ethyl ester oils that produce single phases upon dilution with water. Oil and water coexist in thermodynamic equilibrium in environments of 10-100 nm that penetrate plant tissues for extraction (and epithelial tissues for delivery) of drugs, nutraceuticals, flavours or fragrances.

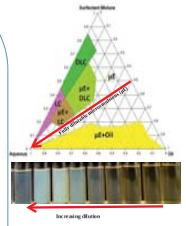
Impact:

Poorly soluble natural bioactives, such as carotenoids, have a low bioavailability because the body cannot easily solubilize them from raw foods in a way that can be absorbed by the intestine. While procedures such as stir-fry cooking or steam extraction can improve the extraction of lipophilic components from plants, these procedures affects the structure of the extracted material.

Our lecithin-linker formulas contain food-grade lipids and oils that are very efficient in extracting oil and water-soluble components from plant material, including fruit peals and vegetables. The extract can then be processed, without additional separation, to produce a variety of liquid, gel and powder forms that can be used for food fortification, targeted-delivery of nutraceuticals, and delivery of flavouring agents or fragrances at room temperature and pressure.

The formulas have been tested for extraction of by-products of juice production, including carrot pulp, apple and tomato pomace. Extraction of microalgae carotenoids have also been shown to have superior recovery to that of hexane extraction.

This novel process can turn agri-food wastes and by-products into highly value-added products.



Fully dilutable µEs can be diluted with water without experiencing phase separation. These systems can be used to deliver lipophilic components via 10-100 nm drops that absorb/penetrate epithelial tissues, including intestine.

Left: Carrot pulps in water: no extraction
Right: A 3% microemulsion has extracted almost all carotenoids from carrot pulp

Next Steps:

In-vivo tests for delivery currently ongoing with promising results. Currently seeking partners interested in using plant byproducts for food, pharmaceutics or cosmetics.

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Contest Poster 21

Gain muscle and strength while you age!

Kirsten Bell[1], Tim Snijders[1], Michael Yorfido[1], Adrienne Morgan[1], Michael Zulyniak[2], Dinesh Kumbhare[3], Jennifer Heisz[1], Gianni Parise[1] & Stuart Phillips[1]

Product: **A protein-based multi-ingredient nutrition supplement for older adults**

This twice daily beverage combines ingredients that have independently been shown to improve lean mass (i.e. muscle mass) and strength in older adults: **whey protein**, **creatine**, **calcium**, **vitamin D** and **omega-3 fatty acids**.

Impact:

As we age, we lose muscle mass and strength at rates of 1-3% per year. Low muscle mass and strength (together termed *sarcopenia*) can lead to an increased risk of falls/fractures, the development of metabolic disorders like type 2 diabetes, and a greater demand for assisted living. With the growing number of seniors in Ontario, this puts a significant strain on the healthcare system. Ingredients of certain foods have ability to increase strength and muscle mass. These effects are greatly enhanced when combined with resistance exercise training. This study is the first to evaluate the combined effect of all these ingredients in a single nutrition supplement, with and without the effects of 12 weeks of exercise training, in a group of sedentary older men.

Next Steps:

This study is still underway, however preliminary results from 19 subjects suggest that the supplement can stimulate gains of 1kg of lean mass (i.e. muscle mass) and 15kg of strength over 6 weeks in the absence of exercise. We anticipate even greater gains in muscle and strength with the addition of exercise training.

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McMaster University — Labarge Optimal Aging Initiative

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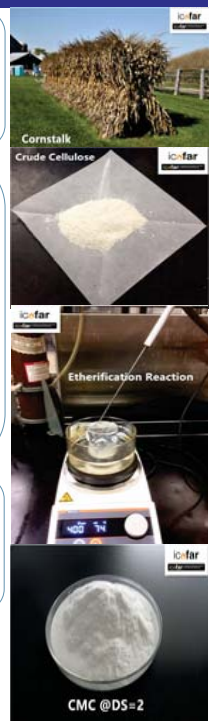
Contest Poster 22

Synthesis of Carboxymethyl Cellulose (CMC) Using Bleached Crude Cellulose Derived from Cornstalk via Organosolv Fractionation

Gang Chen[a], Tao Shui[a], Shanghuang Feng[a], Zhongshun Yuan[a], Takashi Kuboki[b], Chunbao (Charles) Xu[a*]

Product:

The sodium salt of CMC is readily soluble in water to form **highly viscous solutions**, which can be applied as adhesives, colour agglutinants, thickening and emulsifying agents in food & beverage industries, pharmaceutical & cosmetics production, oil drilling & exploration activities.



Impact:

Agriculture residues (i.e. cornstalk) are very abundant in Ontario, but have been paid little attention due to their limited applications. This project aims to obtain the optimum reaction conditions to produce CMC using bleached crude cellulose derived from cornstalk. The future commercialization of this process would offer double dividend benefit to agriculture sector by realizing valorization of crop residues for value-added bioproducts and addressing the long-standing challenge in disposal of crop residues. Also, it enhances the sustainability of the current CMC manufacture industry by replacing high purity cellulose with crop residues as the feedstock.

Future Work:

- Conducting further experiments and analysis to find an optimum ratio of alkali/etherifying agent.
- Upscaling the process for commercialization.
- Seeking industrial partners for the technology development and commercialization.

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Contest Poster 23

Food Processing and Wash-Waters

G. Mundi[1], R. Zytner[1] and K. Warriner[2]

Research: Vegetable and Fruit Wash-Water Treatment

Water used in vegetable and fruit washing and processing require adequate treatment before and after its use. Water management, pollution prevention, by-product use and water reuse are vital.

Impact

Ontario Farmers, producers & processors of vegetable and fruit commodities require sound decision making tools for their water and wash-water treatment needs.

Findings generated from research, lab testing of wash-waters and treatment technologies highlight: 1) Current practices exist for water reuse, 2) Solids such as soils and organic matter (cuttings and peels) are the main parameters to address, 3) Practical treatment technologies are simple settling to advanced membrane bioreactors depending on operation type and size.

Potential Wash-Water Treatment Train

- Primary Screening Mesh Screen (Reduce total solids)
- ↓ Main Treatment (Reduce suspended solids, <30 NTU)
- ↓ Polishing (Reduce dissolved solids, <2 NTU)
- ↓ Disinfection UV Irradiation (E.Coli eliminated at low dosages of 10-30 mJ/cm^2)
- ↓ Water Reuse

Next Steps

Research on the development of decision making tools is ongoing. Working versions expected to be competed by the end of year with calibration and testing scheduled for next year.

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Contest Poster 24

Physicochemical properties of torrefied poplar

Bharat Regmi[a], Ranjan Pradhan[a], Animesh Dutta[a]

Product/Service: Torrefied biomass -- a value added product

Impact:

- To produce renewable bio-product, raw poplar wood is torrefied at different temperatures of 250, 260 , 270 & 280°C in inert atmosphere at slow heating rate.
- The product exhibits improved physico-chemical characteristics in terms of heating value, carbon content, and combustion kinetics making it suitable for co-firing with coal. Mass yield and energy yield are satisfactory making process worthy.
- Burning profiles of torrefied poplar shows a shorter period of volatile combustion with narrow temperature range making beneficial during combustion .

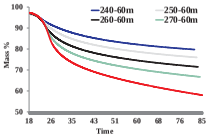
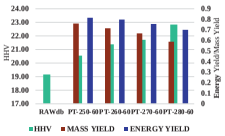


Fig. Mass loss curve for torrefaction



Next Steps:

Modeling of torrefaction to optimize operating parameters in relation product characteristics. Design of continuous type industrial torrefaction reactor on basis of optimization results.

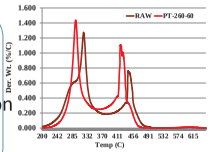


Fig. DTG curve for raw and torrefied wood

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Contest Poster 25

Cost-effective Fractionation of Cornstalk into Lignin & Cellulose Products

[a]Tao Shui, Shanghuan Feng, Zhongshun Yuan, Takashi Kuboki, Chunbao (Charles) Xu

Summary

Crude cellulose at a yield of 60% with 80% purity, and lignin at a yield of approximate 40% with over 50% purity, have been obtained from cornstalk employing a newly developed organic fractionation process operating under the mild conditions.

Impact:

Around 2,035,000 acres of grain corn are estimated to be harvested in Ontario, Canada (2015). However, cornstalk has been paid little attention due to their limited applications as organic fertilizer, silage for livestock and source for heat and electricity. Furthermore, cornstalk, containing approximately 35 wt% cellulose and 20 wt% lignin, can be a good source for the production of cellulose and lignin, precursors for high-value bioproducts such as cellulose acetates, carboxymethyl cellulose (CMC) and polyurethane resins, respectively. This newly invented fractionation process makes it possible to convert the low-cost widely available agricultural residues into cellulose and lignin in a cheaper, greener and more effective way. It would greatly benefit both agricultural sector and the emerging bioeconomy.

Ongoing Work:

- Producing cellulose acetates and carboxymethyl cellulose (CMC) from the cornstalk-derived cellulose;
- Preparing bio-based polyurethane materials from the crude lignin derived from the cornstalk;
- Seeking industrial partners for commercialization.

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Crude Lignin Product

Crude Cellulose Product

Bleached Cellulose Product

Contest Poster 26

Growing Willow for Bioenergy Production

Deanna Walter[1], Naresh Thevathasan, Andrew Gordon

Willow for Bioenergy Production:

Short rotation woody coppice (SRWC) crops, such as willow, are purposefully grown as feedstock for bioenergy production. Energy from these SRWC can be accessed through direct combustion or converted into biogas, biodiesel, or bio-oil.

Impact:

SRWC willow is a fast growing renewable energy feedstock that can be harvested every 3 years, and can be grown on marginal agricultural land, avoiding competition with food production. Growth and production provides environmental benefits such as reducing soil erosion, reducing nutrient runoff into surrounding waterways, and increasing biodiversity. Due to their inherent nutrient cycling characteristics, in most cases there is no need for external application of fertilizers to these biomass crops. Any reduction in fertilizer application directly results in greenhouse gas emission reduction from these production systems, and economically benefits the growers. Therefore, it is essential to understand the nutrient cycling dynamics in these short rotation woody coppice systems.

Next Steps:

By quantifying the nutrient dynamics within SRWC bioenergy production systems, sustainability can be assessed both environmentally and economically, and external fertilization can be limited, ultimately leading to reduced greenhouse gas emissions and reduced costs to growers.

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Funded by BioFuelNet

To know more

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Non-Contest Poster

Ontario Hops Benchmarking Project

David Ly, Darcy Devereaux, Robert Doyle and Jose Gabrie

Determination of Hop Characteristics

Determination of Moisture content (%), Alpha and Beta-acids content (%), and Hops Storage Index (H.S.I.) of Ontario grown hops.

Impact:

What is an Ontario hop? What are the characteristics of key commercial hop varieties grown in Ontario?

The determination of hop characteristics is for growers, farmers, and individuals enthusiastic about their hops. This service addresses a need for hop growers looking to identify peak harvest times and hop profiles. Testing of moisture content (%), alpha and beta-acids content (%), and Hops Storage Index (H.S.I.) will help hop growers establish ideal harvesting periods. Assessing the characteristics of hops grown in different geographical regions (central, southwest, and eastern Ontario) will provide baseline data for benchmarking hop varieties grown in Ontario.

Hop Varieties

- Cascade
- Centennial
- Chinook
- Fuggles
- Hallertauer
- Mount Hood
- Nugget
- Saaz
- Willamette

Next Steps:

Collaboration will continue with hop growers and farmers to generate a larger and more diverse data pool of samples. Further exploration of differences in hop varieties, harvest seasons, and crop locations will help to better understand the characteristics of hops grown in Ontario. Future projects will look to expand on the scope of testing to include total essential oils content, and alpha and beta-acids content by HPLC.

NSERC CRSNG

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Note on back page 1

Non-Contest Poster

Enhanced detection of *Listeria monocytogenes* in food

Adrienne T. Wakabayashi[a], Allana Murphy[a], Anne Maki[a], Anna Majury[b,c] and Gustavo V. Mallo[a,d]

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Product

Currently, the Canada reference method Microbiology Food Health Protection Branch-30 (MFHPB-30) is used to detect *L. monocytogenes* in food samples. Here, we propose a **molecular-based workflow** which uses real-time polymerase chain reaction (PCR) to detect the bacteria sooner (Figure 1), and more accurately.

Impact

The Challenges: The current culture-based method (MFHPB-30) for detecting *L. monocytogenes* in food is mostly dependent on a colour change of the culture media in which the bacteria is growing (Figure 1). *L. monocytogenes* will turn the media from yellow to black; however, our previous research[1] indicates this colour change does not happen in all positive samples, meaning samples containing *L. monocytogenes* were reported as "*L. monocytogenes* not detected". In addition, other non-pathogenic *Listeria* species that are naturally present in (and not added to) food samples can interfere with *L. monocytogenes* detection. Previous work in this laboratory has shown that food samples spiked with different amounts of a slow-growing *L. monocytogenes* strain and a faster-growing *L. innocua* strain, followed by testing with both the MFHPB-30 method and real-time PCR[2], resulted in decreased sensitivity of the MFHPB-30 method for *L. monocytogenes* when higher amounts of other faster-growing *Listeria* species were present in the food[1] (Table 1).

The Proposed Solution: The new workflow (Figure 1) proposes to detect DNA specifically from *L. monocytogenes* using real-time PCR. This method has a molecular basis and is not dependent on the culture media colour change. Using the new workflow results in more rapid detection of *L. monocytogenes* as real-time PCR can be performed after only 20 hours of culture.

The sensitivity and specificity of both the MFHPB-30 method and the real-time PCR[3] workflow were evaluated using 50 food samples that were determined to be free of naturally-occurring *Listeria* species, and were spiked with *L. monocytogenes*. When samples did not contain other naturally-occuring *Listeria* species, the specificity and sensitivity of both detection methods was the same (Table 2).

To compare the performance of the new workflow to the MFHPB-30 method, 50 food samples from local grocery stores were spiked with *L. monocytogenes* and were analyzed by both testing methods. The real-time PCR[2] workflow detected *L. monocytogenes* in 48 samples while the MFHPB-30 method detected *L. monocytogenes* in 38 samples[1] (Table 3). Of the ten samples where *L. monocytogenes* was detected by the real-time PCR workflow, but not by MFHPB-30 method, eight of these samples presented the challenges mentioned above; at least one other *Listeria* species was detected in six of the samples, and two of the samples did not change the colour of the second culture media using the MFHPB-30 method (*L. monocytogenes* was also not detected in the first culture).

This proposed new workflow using real-time PCR allows **faster detection** of *L. monocytogenes* while maintaining similar testing sensitivity and specificity; thereby **improving efficiency** and reducing turnaround times.

[1] Zittermann et al. 2016. *J Food Prot.* 79(1):138-143
[2] Rodriguez-Lázaro et al. 2004. *Appl. Environ. Microbiol.* 70(3):1366-1377
[3] Applied Biosystems MicroSEQ® *Listeria monocytogenes* Detection Kit (AOAC RI 011002)

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Note on back page 2

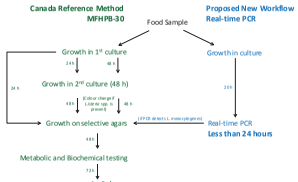

Figure 1. Flow chart of the testing methods to detect *L. monocytogenes* in food samples. On the left is the current method, MFHPB-30, that includes two culture growth steps. Testing only proceeds to growth on selective agar and metabolic testing if the 2nd culture turns from yellow to black, indicating presence of *L. monocytogenes*. On the right is the proposed new workflow with one culture step prior to PCR testing. Samples positive by real-time PCR proceed to growth in the 2nd culture, growth on selective agar, and metabolic and biochemical testing for confirmation of *L. monocytogenes* presence.

Table 1. *L. monocytogenes* is detected by real-time PCR at lower ratios than by MFHPB-30.[1]

Ratio (*L. mono*/*L. inno*)[a]	MFHPB-30 Reported as:	Real-time PCR Reported as:
0.2 (3/13)	-	-
0.6 (3/5)	-	+[b]
0.7 (15/22)	-	+
1.4 (30/22)	-	+
2.3 (30/13)	-	+
2.7 (60/22)	-	+
6.0 (30/5)	+	+
6.8 (150/22)	+	+
33.6 (300/22)	+	+

[a] Raw ground pork samples were spiked with different ratios of a fast-growing strain of *L. innocua* mixed with a slower-growing strain of *L. monocytogenes* and were tested by real-time PCR and by MFHPB-30
[b] For all samples positive by real-time PCR, the presence of *L. monocytogenes* was confirmed by metabolic and biochemical testing
[c] Table adapted from Zittermann et al. (2016)[1]

Table 2. Both the real-time PCR workflow and MFHPB-30 method have similar sensitivity and specificity for samples that do not contain other *Listeria* species.

	MFHPB-30 method	Real-time PCR workflow
Types of food samples[a]	(d, f/v, s)[b]	(d, f/v, s)[b]
Number of *L. monocytogenes*-spiked samples	50	50
Number of positive samples reported positive	50	50
Number of positive samples reported negative	0	0
Number of control (negative)-spiked samples	21	21
Number of negative samples reported negative	21	21
Number of negative samples reported positive	0	0
Sensitivity[c] (%)	100	100
Specificity[d] (%)	100	100

[a] Food samples were spiked with either *L. monocytogenes* or a non-pathogenic *Listeria* species (*L. innocua*, *L. seeligeri*, or *L. welshimeri*) as a negative control, then were tested by the real-time PCR workflow and by the MFHPB-30 method
[b] d – dairy, f/v – fruits/vegetables, s – seafood
[c] Sensitivity = (number of positive samples reported positive/number of *L. monocytogenes*-spiked samples) x 100
[d] Specificity = (number of negative samples reported negative/number of control-spiked samples) x 100

Table 3. The real-time PCR workflow detects *L. monocytogenes*, even in samples with competing *Listeria* species.[1]

	MFHPB-30 method	Real-time PCR workflow
Number of food samples[a]	50	50
Number samples reported positive with another *Listeria* species (%)[b]	5 (45)	11 (100)
Total number samples reported positive	38	48
Total samples reported positive (%)	76	96

[a] Different type of food were purchased from local grocery stores, separated into 5 samples, spiked with *L. monocytogenes*, and analyzed by the real-time PCR workflow and MFHPB-30 method
[b] Eleven of 11 samples (22%) showed evidence of another naturally *Listeria* species present
[c] Table adapted from Zittermann et al. (2016)[1]

Ontario

Non-Contest Poster

Niagara College - Open For Innovation

Year 3 Culinary Innovation and Food Technology

Changing the Game for Game Meats

Increasing consumers' ease of use for game meat products

Impact:

Black Angus Meats is a Thornbury Ontario based federal meat establishment that focuses on fabrication of locally raised wild game meat products. For many Ontario consumers, there is a barrier to selection of wild game meats; in particular, subprimal case ready cuts, as there is a notion that wild game is difficult to prepare and requires different processing methods. With this idea in mind, the students in Year 3 Culinary Innovation and Food Technology were challenged to develop "heat and eat" -style game meat entrees, where most of the processing was done through federally registered meat product co-packers. Frozen pies, dumplings, stews, and a variety of products have been developed to add value to the game meat, and to make inclusion of game meats much easier in a "heat and eat" consumer lifestyle. Students were challenged to work with meat products that they were not familiar with to create a sense of familiarity with the end product.

BLACK ANGUS FINE MEATS & GAME

Next Steps:

Prototype products are being completed presently, and will be evaluated for consumer preference using sensory analysis panels. Formulations are being completed, along with associated FSEP HACCP plans, Nutrition Facts Tables, costing, and processing information for the co-packers.

Ontario Centres of Excellence — Where Next Happens

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Niagara College - Open For Innovation

Year 3 Culinary Innovation and Food Technology

Creamy Cooking Sauce – Applications for Food Service

Increasing potential for uptake of a novel vegan product

Impact:

Bunge is one of the world's largest commodity processors, and within its Canadian division in Oakville and Hamilton, it has focused on oil products. One new food service product, Creamy Cooking Sauce, is a vegan and lactose-free cream substitute, for savoury and sweet applications. There has been a good level of curiosity over the product, however the barrier to uptake is how to successfully integrate the product into the food service environment. Students in Year 3 Culinary Innovation and Food Technology were challenged with the development of food service ready formulations, complete with nutrition and allergen information related to the product. From dairy free cheese-style sauces and creamy house-made salad dressings, to fresh and frozen non-dairy desserts, a wide variety of food service ready formulations were developed to help Bunge Canada reposition this food service product for a North American audience. Students refined their skills in food service formulation, while finding on-trend solutions to meet consumer needs.

Next Steps:

Food service ready formulations are being finalized, along with Nutrition Facts Tables, allergen and ingredient information. This will be published into a food service application guide by Bunge Canada.

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Year 1 Culinary Innovation and Food Technology

Farmlife Foods Category Extension with Chicken Sausage

Using open innovation, generate large volume of sausage prototypes ready for prioritization, scale-up and commercialization.

Impact:

Farmlife Foods is a Niagara Falls-based poultry producer that focused on whole carcass and fryer portions, but with increased processing, a large quantity of trim was being produced which provided the opportunity for value addition to the chicken trim. In our class open innovation challenge, students in Year 1 Culinary Innovation and Food Technology were tasked to develop products using the chicken trim, and by consensus, fresh-frozen sausage was the product chosen. Each student was challenged to develop a prototype, from which the top 5 prototypes were selected by a panel of culinary professionals, members of the general public, and the owners of Farmlife Foods. Through open innovation, a wide variety of prototypes were developed, from which the best options could be selected, while providing students with the opportunity to participate and learn about the product development and innovation cycle.

Next Steps:

The top five selected products are being scaled up for commercial production at Niagara Sausage, a Welland-based provincial free-standing meat processor. Students are finalizing a commercialization package, including process flow, labour and ingredient costing, and Nutrition Facts Tables for product.

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Year 1 Culinary Innovation and Food Technology

Consumer application development for Jal Gua, a nutritious beverage mix

Driving sales for a locally produced product with global implications for health and peace

Impact:

Jal Gua is a nutritious beverage mix developed by Toronto-based international recording artist and peace activist, Emmanuel Jal. Through collaboration with Research & Innovation, Jal Gua was commercialized as a dry powder blend with Fergus-based Pilling Foods. However. consumers are unsure what to use the product for, besides putting it into a breakfast smoothie. Using an open innovation approach, the first year students are developing 40 consumer recipes, using a group ideation approach to ensure diversified products. These recipes range from beverages, bakery, soups, and condiments. The recipes are being integrated into the social media strategy that promotes sales of Jal Gua and in-store product demonstrations in Sobeys across southern Ontario, which aims to increase sales of the product.

Next Steps:

Students are completing their product concepts and providing consumer ready recipes, photographs, and Nutrition Facts Tables to support the social media strategy for Jal Gua.

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Niagara College - Open For Innovation

Year 3 Culinary Innovation and Food Technology

Diversifying the Offerings for Organic Poultry

Turning low value cuts into desirable frozen and fresh product

Impact:

Yorkshire Valley Farms is a Peterborough-based organic poultry producer, with production facilities across southern Ontario. Organic poultry faces certain barriers to uptake, including high desirability for certain cuts, with low uptake of other cuts because of price point competitiveness against conventional poultry. With value addition, transformation of low desirability cuts into consumer-ready packaged product and food service product for finishing in restaurant was the end goal. In our Year 3 lab, students were challenged to find consumer-friendly formulations that could be feasibly manufactured in the Ontario federally registered poultry processing establishments, and rethermed at the household or food service level. Approximately 10 prototype products have been developed, along with FSEP HACCP plans and production specifications, and these prototypes are being evaluated by Yorkshire Valley Farms for feasibility and market readiness. Students have focused on finding imaginative ways to make the cheap poultry cuts into exciting and valuable products.

Next Steps:

Yorkshire Valley Farms will be evaluating the market feasibility on products prototyped, and best options will be taken to copacking by Ontario-based federally inspected meat processors.

Yorkshire Valley Farms — Organically Grown, Close to Home

Ontario Centres of Excellence — Where Next Happens

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Non-Contest Poster

High Protein Ontario Quinoa: Quinta's Niche Innovation

Quinta — Katan Kitchens

QUINTA Nutritional Profile

High in protein, fibre & zinc
Excellent source of iron & magnesium
Good source of calcium

About Quinoa: A Superfood

A broadleaf, pseudo-cereal grain crop originally grown in Andean Region of South America. Quinoa contains the most complete protein profile in the plant kingdom. Frost & drought tolerant, it matures in 90 – 120 days and requires specialized processing to remove saponins. Currently, there is a large market for the conventional seed, and the North American demand outstrips South America supply

About QUINTA Quinoa

- First high quality, high protein quinoa produced and processed in Ontario
- Seed variety developed through four years of natural breeding with a local network of contract farmers and researchers
- Variety developed specifically for Ontario's soil and climate conditions
- Early maturing variety
- Superior nutritional profile and quality
- Competitive yields across Southwestern and Northern Ontario

Network & Collaborators

Katan Kitchens has harvested over 100 acres with a network of contract farms. Their success on commercializing a high quality quinoa seed is largely in partnership with a dynamic network of industry & academic collaborators.

Growth: Past & Projected

- 2013/2014 — 25 trial acres
- 2015 — 100 commercial acres
- 2016 — 500 commercial acres
- 2020 — 10 000 commercial acres

Major Impacts

Katan Kitchen has spent 4 years developing the Local Ontario Value Chain for Quinoa with the following impacts:

- **Introduction** of a new and favourable crop alternative to Canada's agricultural system
- **Producer's adoption** of Quinta as a new, sustainable crop rotation is diversifying Ontario agriculture
- **Local job growth** in the agri-food sector facilitated by the developing value-chain
- **Response to high demand** for quinoa in North America by off-setting dependency on global supply
- **Access** to a consistent, high-quality and locally sourced superfood for purchasers in Ontario
- **Customized processing technology** for removal of saponins from quinoa developed through collaborative research for commercial scale up

Jamie Draves: CEO, Katan Kitchens
Quinta is a personal & professional endeavor for Jamie. He's adopted a diet rich in quinoa & is committed to developing a local value-chain for Quinta Quinoa in Ontario

Next Steps

Quinta is currently developing capacity, scaling up and growing their network of industry partners

- **Expanding** to approx. 500 ac. in 2016 & 10 000 ac. over the next five years to meet growing market demand
- **Development** of customized processing lines
- **Designing** on-going marketing strategy and branding system
- **Seeking** the commercialization of healthiy, value-added quinoa products
- **Arranging** connections with international distribution networks

SEDRD University of Guelph — **Department of Capacity Development and Extensions**

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