Advancing our industry through evidence-based research

Research summary overview

Our Research Grant Program actively supports 30 research projects in a variety of fields at universities across Canada. Each research project is linked to one or more of Egg Farmers of Canada (EFC) research priorities that help inform continuous on-farm improvements and enhancements to our policies and programs. Below is an introduction to these research projects as well as their ongoing status.

2018 EFC GRANT PROGRAM RESEARCH SUMMARY

PROJECT NAME	PAGE	RESEARCH PRIORITY AREA ADDRESSED								
		Animal care science	Food safety	Human nutrition and health	End of flock management	Non-food uses of eggs	Environment and sustainability	Bird nutrition and health	Public policy and economics	Research gaps identified by the Code of Practice
Role of egg whites in increasing antioxidants in the aged heart	4			X						
Evaluation of rapid diagnostic assay for avian influenza at the point of care setting	4	X						X		
Control of avian pathogenic Escherichia coli through prophage induction	4		X					X		
Reducing the economic impact of Marek's disease on egg production through the use of floor pens as hen housing	5							X		
Efficiency and safety of using black soldier fly larvae in laying hen feed in Canada	5							X		

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Developing an integrated method of preparing bioactive peptides from end of lay hens for functional food, nutraceutical and cosmetic applications	6					X				
Precision feeding layers for improved uniformity, production and sustainability	6							X		
Developing valuable egg components for niche market applications	6			X		X				
Assessing methods for on-farm euthanasia of turkeys, chickens, breeders and layers	6	X								
Development and assessment of vitamin enriched granule extracts from egg yolk	6			X						
In ovo vaccination platform to reduce *Salmonella* and other food safety relevant bacteria in poultry	6		X							
The role of shell protein in controlling bacterial movement through chicken eggs	7		X							
Antihypertase activity of cooked egg yolk digest	7			X						
Adaptation to the pullet rearing environment by providing lighting during embryo development	7	X								
Behaviour of pullets following the provision of lighting during embryo development	7	X								
Investigating the influence of a range of exposure conditions during simulated transport on pullet and end of lay physiology, welfare and meat quality	7	X								
Effect of finishing space allowance in standard and enriched rearing cages on performance, health and welfare of layer pullets	8	X								X
Understanding feather pecking in laying hens: the gut-microbiome-brain connection	8	X								
Development of strategies for control of avian influenza virus transmission	8							X		
Use of a novel mobile anaerobic digestion vessel for layer hen mortality disposal	9						X			
Nano-textured eggshell scaffolds for bone regeneration	9					X				
Practical dietary strategies to reduce the carbon footprint and ammonia emission intensity of table egg production	9						X			
Egg production for a complete cycle feeding of dietary seaweed	9		X							

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		Animal care science	Food safety	Human nutrition and health	End of flock management	Non-food uses of eggs	Environment and sustainability	Bird nutrition and health	Public policy and economics	Research gaps identified by the Code of Practice
Investigating the role of limestone particle size on skeletal development and performance of pullets reared in conventional and aviary housing and subsequent performance, bone health, calcium metabolism and welfare of hens in enriched housing	9							X		X
Implications of free run egg production on ammonia and particulate matter generation	10						X			
Toward an understanding of beautiful feather cover in laying hens	10	X								
Prevalence of focal duodenal necrosis in Saskatchewan layer flocks and its effect on egg production	10							X		
Determining the impact of gizzard size on feed efficiency, gut health, and the incidence of focal duodenal necrosis in pullets and layers fed diets with different calcium sources and levels	10							X		
The role of omega-3 fatty acids in bone development in pullets: investigating epigenomic response to breeder and perinatal nutrition	11							X		X
An egg a night to keep glucose tight	11			X						
Eggshell membrane nano-particles for biomedical applications	11					X				
Cuticle proteins in diverse lines of chickens	11		X							
Developing a new application of egg protein ovotransferrin as a functional food ingredient on bone health	12			X						
How much omega-3 fatty acids do hens require for optimal health and productivity?	12							X		
Accelerating speed to market of an egg derived natural health product: clinical efficacy and safety assessment of egg peptides in the management of high blood pressure	12			X						

Completed research 2017–2018

Role of egg whites in increasing antioxidants in the aged heart

Dr. Sanjoy Ghosh, University of British Columbia – Okanagan

Objective:

Oxidative damage in the heart is a major reason behind the development of heart disease. Age-related loss of antioxidants, like glutathione, in the geriatric heart has been recognized as a major cause for elevated oxidative damage. This research project aimed to determine if dietary intervention with egg whites, which contain high levels of cysteine that can increase heart glutathione, would improve cardiac glutathione levels in aged mice hearts, and thereby reduce age-related oxidative damage in the heart.

Results:

The study found that feeding egg whites to aged mice improved blood cysteine levels, which resulted in higher cardiac glutathione and enzymes that utilize glutathione to combat oxidative damage. Additionally, specific enzymatic pathways that make heart glutathione also increased with egg white diets. This was the first in vivo study to show that egg white could be a viable alternative in old age to reduce oxidative damage to the heart and increase cardiac antioxidants like glutathione.

Evaluation of rapid diagnostic assay for avian influenza at the point of care setting

Dr. Suresh Neethirajan, University of Guelph

Objective:

Prompt detection and identification of avian influenza (AI) is critical to managing outbreaks. This research project sought to create a rapid, on-site test for AI, using a colorimetric system enabled by nanotechnology. Colorimetric analysis can help identify the presence of disease-related pathogens through colour changes.

Results:

A bio-sensing, diagnostic assay, based on colorimetry and enhanced using nanotechnology was developed as part of a portable device for rapid, diagnosis of AI in the barn. The developed assay was tested for performance and showed promising colour and sensitivity when tested with positive AI blood samples, and when compared to commercial AI detection kits showed superior detection sensitivity and turnaround time. More validation and optimization research is required to further the development and commercialization of this technology.

Control of avian pathogenic Escherichia coli through prophage induction

Dr. Lawrence Goodridge, McGill University

Objective:

This preliminary, proof of concept study aimed to develop a new phage therapy approach, called prophage induction, to control *Salmonella* Enteritidis (SE) and avian pathogenic E. coli (APEC) in laying hens. Phage therapy is the use of bacteriophages to treat pathogenic bacterial infection. In this approach, the induction of prophages from the bacteria's own chromosome leads to growth of the phages and death of the bacterial cells.

Results:

Following the screening of more than 500 compounds of a natural compound library to identify prophage inducing agents, rosemary tea was selected to evaluate its ability to reduce concentrations of APEC and SE in pure culture. The rosemary tea reduced concentrations of 6 of 7 APEC strains tested and 5/5 SE strains tested. These results demonstrated the potential use of rosemary as an antimicrobial to reduce the presence of APEC and SE in laying hens.

Reducing the economic impact of Marek's disease on egg production through the use of floor pens as hen housing

Dr. Troy Day, Queen's University

Objective:

One challenge brought on by the intensification of egg production is the evolution of disease and development of highly virulent disease strains that resist vaccine. Marek's disease is an example of such a disease, and its evolution is impacted by husbandry practices and housing system. This research used mathematical modelling to evaluate the ability of free run (aviary), enriched colony and conventional housing systems to inhibit the transmission and evolution of Marek's disease between hens in one flock, and between subsequent laying hen flocks, and the subsequent impact that disease prevalence has on egg production. The model assumed 100% vaccination coverage of flocks.

Results:

The study found that free run housing was best at eliminating Marek's disease from a flock and between flocks. Conventional housing was best at mitigating the evolution of the Marek's disease virus towards more deadly strains. Due to higher stocking density, conventional barns had the lowest egg production loss as a result of Marek's disease.

Efficiency and safety of using black soldier fly larvae in laying hen feed in Canada

Dr. Kimberly Cheng, University of British Columbia

Objective:

This project aimed to investigate the feasibility and safety of the use of dried black soldier fly larvae (DBSFL) in laying hen diets in Canada. A 13-week long feeding trial with three experimental diets of 0%, 10% or 18% chopped DBSFL was conducted to evaluate the efficiency and safety of using DBSFL to partially or completely replace soybean meal and soybean oil in free range laying hen diets.

Results:

The study found that hens fed the 10% and 18% treatment diets gained appropriate weight, maintained a 90% egg production rate and produced large eggs with internal quality equal to those laid by the control group. The 18% group did gain weight more slowly, and laid fewer and smaller eggs than the control group, likely due to less efficient feed conversion. The study concluded that if the digestibility of DBSFL can be improved, DBSFL in the form of defatted DBSFL meal may replace soybean meal as a source of protein in laying hen diets while maintaining hen health, safety and production.

Research in progress

Developing an integrated method of preparing bioactive peptides from end of lay hens for functional food, nutraceutical and cosmetic applications

Dr. Jianping Wu, University of Alberta

Objective:

Develop an integrated method to prepare bioactive peptides from end of lay hens for use as value-added ingredients in products in the functional food, nutraceutical and cosmetic industries.

Precision feeding layers for improved uniformity, production and sustainability

Dr. Martin Zuidhof, University of Alberta

Objective:

Use precision feeding to improve the uniformity of free run pullets and laying hens by feeding through an optimal diet based on real-time body weight readings and reducing body size and frame size variation at the point of sexual maturity.

Developing valuable egg components for niche market applications

Dr. Jianping Wu, University of Alberta

Objective:

Develop functional bioactive peptides from egg white and demonstrate additional beneficial properties of these egg peptides against metabolic syndrome to expand their applications; fractionate valuable egg yolk components for use as value-added ingredients and or products in the functional food, nutraceutical, nutritional, aquaculture, cosmetic and pharmaceutical industries.

Assessing methods for on-farm euthanasia of turkeys, chickens, breeders and layers

Dr. Tina Widowski, University of Guelph

Objective:

Assess and compare the efficacy and humaneness of various on-farm euthanasia methods, including manual and mechanical cervical dislocation, non-penetrating captive bolt devices and gaseous methods, in turkeys, chickens, breeders and layers of different ages.

Development and assessment of vitamin enriched granule extracts from egg yolk

Dr. James House, University of Manitoba

Objective:

Scale-up dilution, centrifugation and high-hydrostatic pressure processing to improve egg yolk fractionation and produce a folate-enriched egg fraction, and determine the bioavailability of the folate-enriched egg fraction using both in vitro and in vivo systems.

In ovo vaccination platform to reduce *Salmonella* and other food safety bacteria in poultry

Dr. Wolfgang Koester, University of Saskatchewan

Objective:

Develop an in ovo delivery, subunit vaccine directed against *Salmonella* Enteritidis to prevent colonization and infection of poultry. Conduct a proof of principle, experimental challenge trial with vaccinated birds using an oral infection chicken model to assess vaccine immunogenicity and efficacy.

The role of shell protein in controlling bacterial movement through chicken eggs

Dr. Bruce Rathgeber, Dalhousie University

Objective:

Assess the presence of antimicrobial proteins in the shell of eggs from a wide range of genetic backgrounds to determine if the increased protection from *Salmonella* penetration in some chickens is related to increased presence of antibacterial proteins in the egg shell.

Antihypertase activity of cooked egg yolk digest

Dr. Jianping Wu, University of Alberta

Objective:

Determine the ability of egg yolk, when digested, to lower blood pressure in spontaneously hypertensive rats and determine the major egg yolk components responsible for the blood pressure lowering effects.

Adaptation to the pullet rearing environment by providing lighting during embryo development

Dr. Bruce Rathgeber, Dalhousie University

Objective:

Determine the optimal photoperiod during incubation that will best enable newly hatched chicks to adapt to their rearing environment. The influence of LED lights marketed for pullet rearing will be compared to LED lights determined to have an impact on the timing of broiler chicken hatching eggs.

Behaviour of pullets following the provision of lighting during embryo development

Dr. Karen Schwean-Lardner, University of Saskatchewan

Objective:

Assess the behaviour of pullets incubated with both light and dark periods from hatching, through brooding and rearing to determine if providing lighting during incubation has health and welfare benefits on pullets and laying hens. A variety of measures will be taken, such as feeding, drinking, preening, dustbathing, feather pecking, activity and mortality.

Investigating the influence of a range of exposure conditions during simulated transport on pullet and end of lay physiology, welfare and meat quality

Dr. Karen Schwean-Lardner, University of Saskatchewan

Objective:

Investigate the response of pullets and end of lay white and brown hens to a range of exposure conditions (temperature and humidity), durations and feather covers during simulated transport. Data from this project will support the development of evidence-based transportation limits for pullets and end of lay hens in regulations and/or Codes of Practice.

Effect of finishing space allowance in standard and enriched rearing systems on performance, health and welfare of layer pullets

Dr. Tina Widowski, University of Guelph

Objective:

Determine the effects of finishing space allowance in standard and enriched rearing systems on growth, feeding behaviour and welfare of growing pullets and their subsequent performance in the layer barn, in both research and commercial barns. Data from this project will support the development of best practices for rearing and management of pullets.

Understanding feather pecking in laying hens: the gut-microbiome-brain connection

Dr. Alexandra Harlander, University of Guelph

Objective:

Test if social stress induced by large, densely populated groups of laying hens in free run systems contributes to feather pecking and or influences changes in gut microbiota, the immune system, the enteric nervous system, or metabolic pathways. Assess whether changes in gut microbiota and their metabolites alter specific pathways, and if these are the mechanisms that contribute to feather pecking. Following these results, the researchers will develop probiotics to mitigate the gut flora changes associated with stress and consequent feather pecking behaviour.

Development of strategies for control of avian influenza virus transmission

Dr. Shayan Sharif, University of Guelph

Objective:

First, develop vaccine formulations that can effectively control avian influenza (AI) virus shedding and can be administered in ovo or in feed, water or spray. The mucosal delivery vaccine platform that will be established in this research will have far reaching implications and could also be used for other types of poultry vaccines. Secondly, this research will combine expertise in vaccine development and computer modelling to model the transmission of AI from vaccinated poultry to susceptible poultry, and create a decision support system for control of AI.

Use of a novel mobile anaerobic digestion vessel for layer hen mortality disposal

Dr. Brandon Gilroyed, University of Guelph – Ridgetown

Objective:

Design, build and test a biosecure, mobile, anaerobic digestion vessel that will dispose of poultry mortalities and produce a renewable biogas that could be used for heat and power production. The vessel design aims to facilitate convenient and rapid disposal of mortalities (routine or catastrophic), prevent environmental contamination, and alleviate time pressures in the event of a disease outbreak.

Nano-textured eggshell scaffolds for bone regeneration

Dr. Maxwell Hincke, University of Ottawa

Objective:

Develop nano-textured eggshell surfaces from breaking plant eggshell waste to create eggshell scaffolds that can be used as a bone graft substitute in orthopedic reconstructive medical procedures to provide mechanical support and promote bone regeneration. Ultimately, this research aims to create high value biomedical material from a low value waste product.

Practical dietary strategies to reduce the carbon footprint and ammonia emission intensity of table egg production

Dr. Eduardo Beltranena, Alberta Agriculture and Forestry

Objective:

Evaluate the effectiveness of different feed ingredients and dietary manipulation strategies in reducing the ammonia emissions and carbon footprint associated with egg production, while also comparing production, product quality and economic returns. The research aims to identify practical dietary strategies that will allow egg producers to reduce ammonia emissions by 25% and carbon footprint by 10%.

Egg production for a complete cycle feeding of dietary seaweed

Dr. Bruce Rathgeber, Dalhousie University

Objective:

Evaluate the use of dietary red seaweed in laying hen diets over an entire production cycle to confirm the safe, long term use of red seaweed as a dietary ingredient, and determine if the established beneficial impact of red seaweed supplementation on hen intestinal health and protection from pathogen colonization is sustained over the production cycle.

Investigating the role of limestone particle size on skeletal development and performance of pullets reared in conventional and aviary housing and subsequent performance, bone health, calcium metabolism and welfare of hens in enriched housing

Dr. Elijah Kiarie, University of Guelph

Objective:

Evaluate the effects of limestone (a dietary calcium source) particle size on calcium digestibility and metabolism in laying hens and pullets, and the performance and skeletal development of pullets reared in different housing systems. This research will follow pullets through to the laying phase, and assess the subsequent effects of limestone particle size on egg mass, quality and internal characteristics, bone health and welfare in hens housed in enriched colonies. Ultimately, this research serves to explore nutritional means to enhance gut health and function and skeletal integrity and to optimize feed utilization in pullets and laying hens.

Implications of free run egg production on ammonia and particulate matter generation

Dr. Bill Van Heyst, University of Guelph

Objective:

Measure and quantify the emission rates of ammonia and size fractionated particulate matter from free run barns on two commercial egg farms over the period of one year; compare the emission levels of ammonia and particulate matter from free run systems with those from conventional housing systems, and identify opportunities to utilize control technologies or strategies in free run barns to mitigate emissions.

Toward an understanding of beautiful feather cover in laying hens

Dr. Alexandra Harlander, University of Guelph

Objective:

Develop a user-friendly feather cover scoring system and illustrated guide. Conduct a farmer survey to collect data on feather cover in laying hen flocks in Canada and identify and quantify management, environmental and genetic associations with feather pecking and feather loss in alternative housing systems on commercial farms. Survey results will be analyzed and used to create a Canadian Feather Management Plan to help farmers with decisions related to maintaining feather cover and managing feather pecking in their flocks.

Prevalence of focal duodenal necrosis in Saskatchewan layer flocks and its effect on egg production

Dr. Henry Classen, University of Saskatchewan

Objective:

Perform surveillance and data collection on eight laying hen flocks in Saskatchewan to determine the prevalence of focal duodenal necrosis (FDN), an intestinal condition of laying hens associated with decreased egg weight and egg production, and its effect on egg production; identify factors associated with increased incidence of FDN and determine if Clostridial organisms are associated with FDN lesions in the gut. This research serves to gain a better understanding of, and contribute to, the scientific literature on FDN in laying hens, and direct further investigation into the etiology of FDN.

Determining the impact of gizzard size on feed efficiency, gut health, and the incidence of focal duodenal necrosis in pullets and layers fed diets with different calcium sources and levels

Dr. Henry Classen, University of Saskatchewan

Objective:

Investigate the incidence of focal duodenal necrosis (FDN) in a pullet and layer flock throughout production; compare the effects of providing a pre-lay ration for one week versus four weeks on gastrointestinal and determine production parameters, and FDN occurrence; determine if calcium source and level has an impact on gizzard size, gut health, feed efficiency, production and the occurrence of FDN in pullets and laying hens.

The role of omega-3 fatty acids in bone development in pullets: investigating epigenomic response to breeder and perinatal nutrition

Dr. Elijah Kiarie, University of Guelph

Objective:

Investigate the epigenetic, long-term effects of feeding breeders (parent stock) diets enriched with omega-3 fatty acids on embryonic bone development, and subsequent effect on skeletal development and performance in pullets and laying hens, and on pullet behaviour when subjected to stressors.

An egg a night to keep glucose tight

Dr. Jonathan Little, University of British Columbia – Okanagan

Objective:

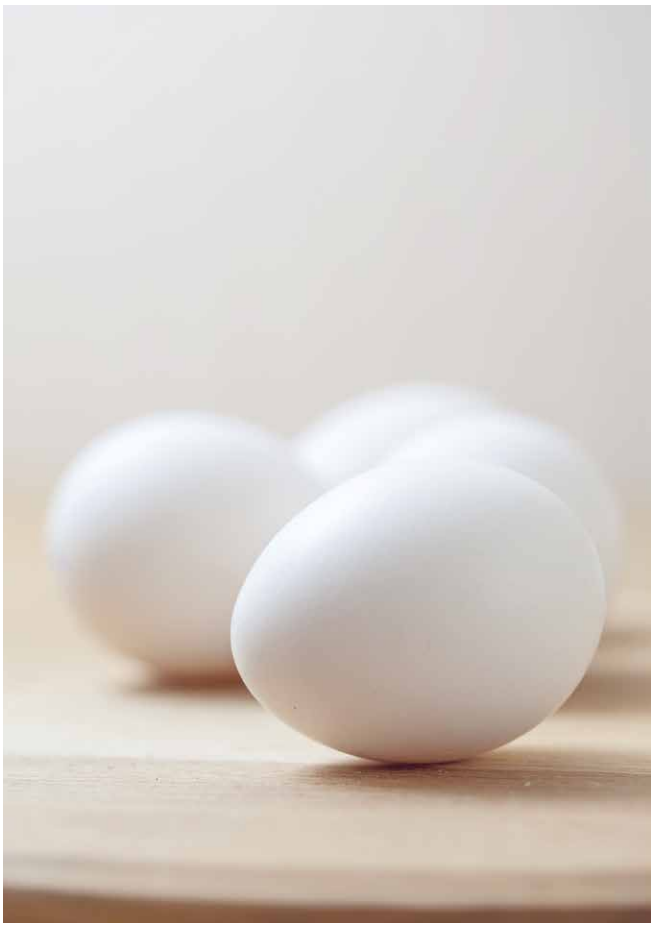
Determine whether eggs consumed as a bedtime snack will reduce next day fasting glucose, reduce next day post breakfast glucose control and help identify what the potential mechanisms are, and reduce 24 hour average glucose levels in people with type 2 diabetes. This research aims to help identify a potential benefit of eggs for people with type 2 diabetes and provide high-quality scientific evidence for a novel egg consumption strategy to improve glucose control.

Eggshell membrane nano-particles for biomedical applications

Dr. Maxwell Hincke, University of Ottawa

Objective:

Produce and characterize eggshell membrane nano-particles and evaluate their applications as therapeutic agents against cancer, microbial infection and inflammatory disease conditions, with an enhanced emphasis on skin applications such as cosmetics and skin cancer.



Cuticle proteins in diverse lines of chickens

Dr. Bruce Rathgeber, Dalhousie University

Objective:

Determine the presence of antimicrobial proteins in the cuticle layer of egg shells from a wide range of genetic backgrounds, from both commercial and heritage breeds, to identify if the increased protection from *Salmonella* penetration in some chickens is related to increased presence of antibacterial proteins. Determine if there is a relationship with the cuticle proteins and the shell matrix proteins that would allow for selection of overall complement of shell proteins based on the cuticle protein profile.

Upcoming research projects

Developing a new application of egg protein ovotransferrin as a functional food ingredient on bone health

Dr. Jianping Wu, University of Alberta

Objective:

Develop a new application for ovotransferrin, a natural bioactive protein derived egg white protein, as a functional food ingredient for use in bone health products, as an alternative, long-term approach for the prevention and mitigation of osteoporosis to the standard treatment course of pharmacological drugs.

How much omega-3 fatty acids do hens require for optimal health and productivity?

Dr. James House, University of Manitoba

Objective:

Define omega-3 requirements for optimal health and performance in pullets and laying hens; identify whether the type and levels of the omega-3 fatty acids in the diet impacts birds' health and productivity and determine the optimum quantity and type of omega-3 fatty acids to enhance immunity in pullets and laying hens to overcome an immune challenge induced by lipopolysaccharide, an inflammation causing component of the cell wall of gram negative bacteria widely used to model bacterial infection experimentally.

Accelerating speed to market of an egg derived natural health product: clinical efficacy and safety assessment of egg peptides in the management of high blood pressure

Dr. Jianping Wu, University of Alberta

Objective:

Conduct a clinical trial to assess the safety and efficacy of an egg-derived peptide in the management of blood pressure through a randomized, placebo controlled trial. The primary objective of the trial is to assess the impact of the egg peptide product in subjects' 24 hour systolic, diastolic and mean ambulatory blood pressure for six weeks.

Visit **eggfarmers.ca** or contact us at **research@eggs.ca** for more information about Egg Farmers of Canada or our research program.

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