EGG FARMERS OF CANADA

LES PRODUCTEURS D'ŒUFS DU CANADA

Research Grant Program

Applicant Information Package

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1. EFC's Call for Letters of Intent process

Researchers are invited to complete and submit an online research application during Egg Farmers of Canada's (EFC) call for Letters of Intent (LOI). Following each call, submissions are evaluated by the Research Committee of EFC's Board of Directors. In early April, selected projects will be invited to submit a full proposal, to be completed within approximately three weeks. All applicants will be notified of the Committee's decision regarding their proposal.

2. How to apply for research funding

Researchers are invited to complete and submit a LOI through EFC's website (https://www.eggfarmers.ca/research/) during the call for LOIs. The online LOI form will only be accessible during EFC's call for LOIs. To be considered for funding, research projects must align with EFC's research priorities and have a practical application within the industry. Please note that the LOI application in progress cannot be saved. A template is provided below for you to prepare your application.

3. Applicant eligibility

To be considered for funding, the principal investigator (PI) must work full-time at a Canadian institution or organization. There are no specifications or requirements regarding the faculty or academic status of the PI. The PI, co-investigators and/or collaborators for each research project will be evaluated holistically to assess the strength of the research team and the expertise each member brings to the project.

4. What type of research does EFC fund?

EFC funds research at universities across the country to address the issues and opportunities that matter to the egg industry (learn more in EFC's Research Grant Program fact sheet). EFC's current research priorities can be found here.

5. Funding requirements: minimum and maximum limits

Currently, there is no minimum or maximum limit to the amount of funds a PI can request for a research project. Total amount of funds requested is taken into consideration along with other important criteria, including alignment of the project with EFC's research priorities and their practical application to the industry and consumers. EFC reserves the right to fund all projects in part. Project proposals with other funding sources will be given priority consideration.

6. Submitting more than one project

There is no limitation to the number of LOIs a researcher can submit. Researchers are welcome to submit applications for multiple projects that align with EFC's research priorities at the same time and for projects that overlap with an existing project. When overlapping with previous funded projects exists, researchers must explain how is the new proposal different and unique.

7. Duration of project

EFC understands that sound research takes time. There is no limitation to the length or duration of a project funded through EFC's research program. Past projects have ranged from one to as many as four years. Regardless of length, timeliness is considered at the evaluation phase, and clear milestones and deadlines must be outlined for each project.

8. Overhead costs

EFC does not offer funding to cover overhead or indirect costs associated with a research project. EFC's focus is to maximize the resources directly associated to and available for the research project.

Egg Farmers of Canada Research Priorities

EFC is dedicated to supporting researchers and industry experts who conduct proactive research across a range of priorities. EFC's 2024 Call for Letters of Intent has placed emphasis on **environment and sustainability** and **end of flock management**

EFC's Research Priorities for 2024 include:

1. Environment and Sustainability

Environment and sustainability research aims to ensure the long-term viability of egg farm operations in Canada. Example research areas include genetics, reducing the carbon footprint of egg farms, green technologies, precision agriculture, circular economy, efficiencies in egg production and alternative uses for manure and other waste streams. Some specific questions to consider under this research priority area are:

- What are the key areas where egg farming can gain environmental efficiencies and improvements while still ensuring eggs remain affordable for Canadians?
- What opportunities are there for circular economy and what could increase the number of these opportunities? (e.g. waste valorization and economic analyses, such as economic analysis of the process and use of laying hen manure as fertilizer pellets)
- Solar panels are one example of a green technology that could be adopted on Canadian egg farms. What other green energy sources/green technologies could be utilized on egg farms?
- What are viable waste streams from human food production that could be included in laying hen rations, and how could hen rations be optimized?
- What opportunities are there in Canada for sustainable production and/or processing of alternative feedstuffs and ingredients (e.g. waste streams from other food industries)?
- What practices or processes might support EFC's goal of working towards net-zero greenhouse gas emissions by 2050?

2. End of flock management

End of flock management research aims to improve the care of animals at the end of their production cycle. Example research areas include handling, catching and loading of pullets and end-of-lay hens, improving the removal of end-of-lay hens from alternative housing systems, uses for end-of-lay hens, transportation, composting, disposal and depopulation methods (emergency and planned).

3. Innovative uses of eggs

Innovative uses of eggs research aims to find alternative uses of eggs outside of the table and processing markets. Example research areas include using eggs and/or egg components for the

biomedical, functional food, nutraceutical, health, cosmetic and pharmaceutical industries, among others.

4. Animal care science

Animal care science research aims to improve on-farm practices to better animal welfare. Example research areas include feather pecking, air quality, euthanasia and other production management practices that relate to hen care and welfare. Other example areas can be found under research priority "Research gaps identified by the Code of Practice for the Care and Handling of Pullets and Laying Hens".

5. Food safety

Food safety research aims to ensure that eggs continue to be safe and produced according to the highest possible standards. Example research areas include development of vaccinations, biosecurity practices and pest control.

6. Human nutrition and health

Human nutrition and health research aims to explore the health benefits of egg consumption. Example research areas include adding health-promoting nutrients to eggs to improve human health (e.g. omega 3 fatty acids), and the role of eggs in preventing or reducing the risk of diseases.

7. Bird nutrition and health

Bird nutrition research aims to understand the nutritional needs of laying hens, while bird health research aims to understand, prevent and treat illnesses (e.g. *Escherichia coli* infections, infectious bronchitis virus, focal duodenal necrosis, avian influenza, etc.) and injuries in laying hens. Example research areas include exploring the impact of new diets, ingredients, supplements and different feeding methods on hen health, sustainable feed, alternatives to antimicrobials, vaccinations, health treatment options, biosecurity practices, gut health and bone health.

8. Public policy and economics

Public policy and economics research aims to better understand agricultural policies such as supply management, and explores the economic impact of supply management and sustainable egg farming. Example research areas include current opportunities and challenges for the Canadian egg industry, the effect of agricultural policies on rural communities and/or Canada's food systems, the effects of supply management on the adoption of sustainable farming practices, and how the adoption of sustainable practices can have a positive impact on farm operating costs.

9. Research gaps identified by the Code of Practice for the Care and Handling of Pullets and Laying Hens

Research gaps have been identified for laying hens and pullets during the development of the 2017 *Code of Practice for the Care and Handling of Pullets and Laying Hens.* A list of these gaps can be found here.

Furthermore, during the Five Year Code review in 2022, more areas of welfare research were identified. These areas include:

- Perching - what constitutes an acceptable perch? Perch requirements for pullets
- Maximum number of tiers / levels in an aviary and distance to litter
- Nesting - enclosure to provide privacy and shading, and nest curtain length

Egg Farmers of Canada Letters of Intent questions

To prepare principal investigators applying to EFC's call for LOI questions can be found below. EFC will only accept LOI's submitted through the online template, which can be found **here.** Please be aware the online application cannot be saved while working on it.

1. Project title
2. Please identify which EFC research priority this project aligns with
    - Animal care science
    - Bird nutrition and health
    - End of flock management
    - Environment and sustainability
    - Food safety
    - Human nutrition and health
    - Innovative uses of eggs
    - Public policy and economics
    - Research gaps identified by the Code of Practice
3. Name
4. Salutation
5. Position
6. Institution or organization
7. Mailing address
8. Telephone
9. Email
10. List principal investigator's relevant experience as it relates to this study (*1500 characters includes spaces)*
11. Are there other collaborator(s)?
12. Please list all names, titles, organization or university and role of collaborator(s)
13. List collaborator's expertise as it relates to this research area (*1500 characters)*
14. Start date *All applicants are notified of EFC's funding decision in August of each year. Please consider other funding application timelines (e.g. NSERC) when determining project start date. ** Please be as accurate as possible. The start date of the project is considered when making the funding decision
15. End date
16. Project summary (*2000 characters)*
17. List of keywords *(Maximum of five)*
18. Project's main and specific objective(s) (*1500 characters, please use point form)*
19. Hypotheses (1500 characters)
20. Methodology (*2500 characters)*
21. Significance of this project to your organization (*1500 characters)*
22. Significance of this project to the egg industry (*1500 characters)*
23. Plans for knowledge and technology transfer (*1500 characters)*
24. Is this project a continuation of previously-funded EFC research? If yes, please indicate which project.
25. Are you aware of any overlap with EFC previously funded research? If yes, please explain how your proposal is novel and unique (Please review the EFC Research Library in Appendix B of the Applicant Information Package and EFC Research Summary issues available here.)

26. Total funding request from EFC
27. Do you have other sources of funding?
28. If yes, please list other sources of funding, indicate if the funding is being provided in cash or in kind, and if the funding has been confirmed or is pending. *Other sources of funding are considered an asset.*
29. Describe any product that might result from this project (if applicable)
30. Who is expected to have ownership of the intellectual property rights in the research created as part of the project?
31. Have any rights of first refusal relating to the output of the research, including the potential commercialization of such research or the ability to register intellectual property rights (such as patents), been granted or are intended to be granted to third parties? If so, over what part of the project?
32. If funded, all researchers and institutions are expected to negotiate with EFC the right of first refusal with respect to the intellectual property arising from the project, in priority to other parties, including the right to commercialize the research and/or obtain the ability to register intellectual property rights (such as patents) or obtain a licence with respect to such intellectual property rights, on the terms set out in Appendix A. Please indicate if the researcher or institution foresees any obstacles agreeing to Appendix A.

Appendix A – Intellectual Property Ownership and Right of First Refusal

1. Ownership of Intellectual Property Rights; Representations and Grant of License

a. Any Background Intellectual Property owned by EFC, Research Institution or Researcher remains the exclusive property of such Party.

b. Research Institution covenants, represents and warrants that: (i) Research Institution has secured or will secure the rights, or has the right to use, all of the Background Intellectual Property required to carry out the Project and grant the rights set out in this Agreement; (ii) any Foreground Intellectual Property resulting from the Project will be owned by Research Institution, except as otherwise disclosed to EFC prior to the Effective Date; and (iii) Research Institution has or will secure all consents and waivers of moral rights from third parties, including the Researcher, to grant the licenses and rights set out in this Agreement;

c. Research Institution covenants, represents and warrants that: (i) the objectives of the Project and the Project will not be materially modified without the approval of EFC; and (ii) the EFC funding will only be used for the purposes of the Project.

d. Research Institution hereby grants EFC a perpetual, non-exclusive, world-wide, royalty-free license to translate, reproduce or publish, but not to modify, the whole or part of any report or other documents submitted by Research Institution or the Researcher under this Agreement, and to include such material in any report or other document relating to the Project that may be prepared, reproduced or published by or for EFC, but may not charge any fees in connection with any such translation, reproduction or publication.

2. Commercialization of Foreground Intellectual Property and Right of First Refusal

a. Before any licensing or other form of commercial exploitation of the Foreground Intellectual Property is made by Research Institution or Researcher, Research Institution must provide EFC, in writing, on an ongoing basis during the course of the Project and upon completion of the Project, information as to the scope of the Foreground Intellectual Property.

b. Research Institution will provide EFC written notice of any application of Foreground Intellectual Property that, in Research Institution's reasonable opinion, is commercially viable (each, a "**Notice of Application**") during the Term and continuing after the termination or expiry of the Agreement (the "**ROFR Period**").

c. Research Institution hereby grants to EFC a right of first refusal in the Foreground Intellectual Property during the ROFR Period as follows:

(i) EFC will have a first right to negotiate with Research Institution and the Researcher, for a period of 120 days (or such other period agreed upon by the Parties) after the date that EFC receives a Notice of Application (the "**Negotiation Period**"), for an exclusive or non-exclusive license to enable EFC to commercially exploit the Project Intellectual Property;

(ii) EFC and Research Institution will negotiate in good faith the provisions of such license agreement or an IP transfer agreement during the Negotiation Period; and

(iii) if the Parties fail to agree on the terms of a license agreement or IP transfer agreement, Research Institution may commercialize the Foreground Intellectual Property itself or grant a license of or transfer the Foreground Intellectual Property

to a third party to commercialize the Foreground Intellectual Property, without having to account further to EFC, but only if, where the Foreground Intellectual Property is licensed or assigned to a third party, the terms offered to the third party when considered as a whole in the circumstances of the offer, are not materially more advantageous to the third party than the terms offered to EFC.

d. EFC may, with the consent of Research Institution (not to be unreasonably withheld, conditioned or delayed), assign the rights in this Section, including the right of first refusal, to one or more of EFC's members or partners or any other third parties for purposes of the commercial exploitation of the Foreground Intellectual Property.

Project title	Principal Investigator	Institution	Collaborators	Year of approval	Project start date	Project end date	Project length (y)	Status	Research priorities	Objectives	Keywords	Funding agencies	Peer reviewed articles
The impact of egg consumption on indices of vascular health in patients with peripheral arterial disease	Dr. James House	University of Manitoba	Dr. R. Guzman; Dr. O. Karmin; Dr. G. Sevenhuysen; Dr. C. Taylor; Dr. P. Zahradka	2008	Jan-09	Nov-13	5	Complete	HNH	Determine the impact of consuming six eggs per week on primary end-points and other modifiable risk factors in patients with peripheral arterial disease	eggs; omega-3 fatty acids; peripheral arterial disease; hyperlipidemia	Egg Farmers of Canada ARDI	
Antihypertensive activity of laying hen eggs	Dr. Jianping Wu	University of Alberta	Dr. Susan Jacobs-Kaufman	2010	Jan-10	Mar-14	4	Complete	HNH	To study the antihypertensive activity of boiled and fried eggs and their digests in spontaneously hypertensive rats and determine their effect on the oxidative stress and activity of angiotensin converting enzyme in various organs in vivo	Egg cooking method; antihypertensive activity; antioxidative activity; angiotensin converting enzyme; blood pressure; rats	Egg Farmers of Canada Agriculture & Food Council CAPP Egg Farmers of Alberta	Jahandideh F, Chakrabarti S, Majumder K, Li Q, Panahi S, Morton JS, Davidge ST, Wu J. (2016). Egg white protein hydrolysate reduces blood pressure, improves vascular relaxation and modifies aortic angiotensin II receptors expression in spontaneously hypertensive rats. Journal of Functional Foods 27, 667-673. Jahandideh F, Majumder K, Chakrabarti S, Morton JS, Panahi S, Kaufman S, Davidge ST, Wu J. (2014). Beneficial Effects of Simulated Gastro-Intestinal Digests of Fried Egg and its Fractions on Blood Pressure, Plasma Lipids and Oxidative Stress in Spontaneously Hypertensive Rats. Plos One 9(12): e115006. Majumder, K., Panahi, S., Kaufman, S. & Wu, J. (2013). Fried egg digest decreases blood pressure in spontaneously hypertensive rats. Journal of Functional Foods 5: 187-194. Majumder K, Wu J. (2009). Angiotensin I converting enzyme inhibitory peptides from simulated in vitro gastrointestinal digestion of cooked eggs. Journal of Agricultural and Food Chemistry. 57 (2): 471-477.
Development of a Complementary Energy Decision Support Tool (CEDST) for objective selection of green energy systems in intensive farming operations	Dr. Bill Van Heyst	University of Guelph	Dr. Mike Collins Dr. Goretty Dias Dr. Animesh Dutta Ms. Colleen Fitzgerald-Hubble Dr. David Lubitz Dr. Rob Nicol Ms. Sarah Thomson Dr. Alfons Weersink	2010	May-10	May-13	3	Complete	ES	To develop a software tool that can help poultry farm operators make clear and objective decisions about installing alternative energy generation capacity on their farms in Ontario	Sustainability; software tool; alternative energy technology; farm energy calculators; life-cycle assessments	Egg Farmers of Canada Egg Farmers of Ontario Poultry Industry Council OMAFRA	
Antioxidants in laying hen eggs	Dr. Jianping Wu	University of Alberta	Ms. L.A.C.K. Nimalaratne Dr. Jiapei Wang	2010	Jan-13	Feb-16	3	Complete	HNH	To stablish evidence that eggs are a rich source of antioxidants	Eggs; antioxidants; aromatic amino acids; carotenoids; cooking method; digestion	Egg Farmers of Canada Burnbrae Farms Agriculture and Food Council Food and Health Innovation Initiative NSERC-CRD	Nimalaratne C, Wu J. (2019). Chicken Egg: Wholesome Nutrition Packed with Antioxidants, In Eggs as Functional Foods and Nutraceuticals for Human Health, Ed Wu J, Royal Society of Chemistry (publisher), Chapter 9, p 154-172. Nimalaratne C, Schieber A, Wu J. (2016). Effects of Storage and Cooking on the Antioxidant Capacity of Laying Hen Eggs. Food Chemistry 194, 111-116. Nimalaratne C, Lopes-Lutz D, Schieber A, Wu J. (2016). An isocratic fast liquid chromatographic method for quantifying xanthophylls and their stereoisomers. Journal of Separation Science. 38(24):4166-4172. Nimalaratne C, Wu J. (2015). Hen egg as an antioxidant food commodity: a review. Nutrient 7(10), 8274-8293. Nimalaratne C, Bandara N, Wu J.* (2015). Purification and characterization of antioxidant peptides from enzymatically hydrolysed chicken egg white. Food Chemistry 188(1): 467-472. Nimalaratne C, and Wu J. (2015). Egg derived bioactive compounds in heart health. In Handbook of Eggs in Human Function, Eds Watson RR, Fabien DM, Wageningen Academic Publishers, Wageningen, the Netherlands, p 261-280. Nimalaratne C, Savard P, Gauthier SF, Schieber A, Wu J. (2015). Bioaccessibility and digestive stability study of carotenoids in cooked eggs using a dynamic in vitro gastrointestinal model. Journal of Agricultural and Food Chemistry 63 (11), 2956-2962 Nimalaratne C, Wu J, Schieber A. (2013). Egg Yolk Carotenoids: Composition, Analysis, and Effects of Processing on Their Stability, in Carotenoid Cleavage Products, Eds Winterhalter P, Ebeler SE. ACS Symposium Series 1134; American Chemical Society, Washington, DC, p 219-225. Nimalaratne C, Lopes-Lutz D, Schieber A, Wu J. (2012). Effect of domestic cooking methods on egg yolk xanthophylls. Journal of Agricultural and Food Chemistry. 60(51): 12547-52. Nimalaratne C, Lopes-Lutz D, Schieber A, Wu J. (2011). Free aromatic amino acids in egg yolk show antioxidant properties. Food Chemistry. 129: 155-161.
The impact of space allowance and group size in furnished cage housing: measures of laying hen performance and well-being	Dr. Tina Widowski	University of Guelph	Dr. John Cranfield Dr. Steve Leeson Dr. Stephanie Torrey Dr. Michele Guerin Ms. Leanne Cooley	2011	Jun-11	Jan-15	3.5	Complete	ACS	To compare the production performance of hens in two sizes of large furnished cages stocked at 520 vs. 748 cm^2/hen and to compare performance to a population of hens in conventional cages (465 cm^2/hen)	Large furnished colony cages; performance; stocking density; group size	Egg Farmers of Canada OMAFRA Burnbrae Farms Clark Ag Systems Ltd. Poultry Industry Council	Widowski, T.M., Caston, L.J., Hunniford, M.E., Cooley, L. and Torrey, S., 2017. Effect of space allowance and cage size on laying hens housed in furnished cages, Part I: Performance and well-being. Poultry Science, 96(11), pp.3805-3815. Widowski, T.M., Caston, L.J., Casey-Trott, T.M. and Hunniford, M.E., 2017. The effect of space allowance and cage size on laying hens housed in furnished cages, Part II: Behavior at the feeder. Poultry Science, 96(11), pp.3816-3823. Hunniford, M.E., Torrey, S., Bédécarrats, G., Duncan, I.J. and Widowski, T.M., 2014. Evidence of competition for nest sites by laying hens in large furnished cages. Applied Animal Behaviour Science, 161, pp.95-104.
Water quality effects on laying hen performance	Dr. Derek Anderson	Dalhousie University	Ms. Janice MacIsaac Dr. Bruce Rathgeber	2012	Feb-13	Sep-16	3.5	Complete	BNH	To describe the range of water quality being provided to hens across Canada. To determine the effect of water pH on production performance, egg quality, metabolic changes, and end of cycle bone quality of laying hens. To evaluate the effects of specific ions in water (chlorides, sufphates, calcium and sodium) on pullet growth and laying hen production perfromance, egg quality, metabolic changes during the laying cycle, and end of cycle bone quality	Water quality; egg quality; production performance; nutrient balance	Egg Farmers of Canada Nova Scotia Department of Agriculture CAAP Egg Farmers of Nova Scotia Nova Scotia Technology Development	
Exploration of the prevalence of Vitamin B12 deficiency among individuals with risk factors and the determination of novel risk factors for B12 deficiency	Dr. Colleen Gobert	Brescia University College - Western University	Dr. Janet Madill Ms. Mary Donnelly-Vanderloo Ms. Norine Foley	2013	Apr-13	Dec-14	2	Complete	HNH	To explore the prevalence of B12 deficiency in hospitalized patients and develop a predictive model to identify those patients at greatest risk for vitamin B12 deficiency	Vitamin B12/cobalamin; B12 deficiency; protom-pump inhibitors; metformin; dementia	Egg Farmers of Canada Dietitians of Canada - Gerontology Network Brescia University College	
Effects of pullet rearing environment on bone biology, behaviour, productivity and welfare of laying hens in enriched cages	Dr. Tina Widowski	University of Guelph	Dr. Alexandra Harlander Dr. Michelle Guerin Dr. Stephanie Torrey Dr. Doug Korver	2014	Aug-14	Oct-16	2	Complete	ACS	To compare the effects of rearing in standard pullet cages versus a pullet rearing aviary on the production, bone health, behaviour and welfare of hens subsequently housed in enriched colony cages To identify rearing systems that result in strong, healthy birds and that optimize the production, health, and welafre of laying hens housed in a variety of housing systems	Pullet rearing; enriched cages; bone strength; keel bones; behaviour; productivity; health; welfare	Egg Farmers of Canada Poultry Industry Council NSERC-CRD OMAFRA	Casey-Trott, T., Heerkens, J.L.T., Petrik, M., Regmi, P., Schrader, L., Toscano, M.J. and Widowski, T., 2015. Methods for assessment of keel bone damage in poultry. Poultry science, 94(10), pp.2339-2350. Casey-Trott, T.M. and Widowski, T.M., 2016. Behavioral differences of laying hens with fractured keel bones within furnished cages. Frontiers in veterinary science, 3, p.42. Casey-Trott, T.M., Korver, D.R., Guerin, M.T., Sandilands, V., Torrey, S. and Widowski, T.M., 2017. Opportunities for exercise during pullet rearing, Part II: Long-term effects on bone characteristics of adult laying hens at the end-of-lay. Poultry Science, 96(8), pp.2518-2527. Casey-Trott, T.M., Korver, D.R., Guerin, M.T., Sandilands, V., Torrey, S. and Widowski, T.M., 2017. Opportunities for exercise during pullet rearing, Part I: Effect on the musculoskeletal characteristics of pullets. Poultry Science, 96(8), pp.2509-2517. Casey-Trott, T.M., Guerin, M.T., Sandilands, V., Torrey, S. and Widowski, T.M., 2017. Rearing system affects prevalence of keel-bone damage in laying hens: A longitudinal study of four consecutive flocks. Poultry science, 96(7), pp.2029-2039. Casey-Trott, T.M., 2018. Validation of an accelerometer to quantify inactivity in laying hens with or without keel-bone fractures. Animal Welfare, 27(2), pp.103-114. Hunniford, M.E. and Widowski, T.M., 2016. Rearing environment and laying location affect pre-laying behaviour in enriched cages. Applied Animal Behaviour Science, 181, pp.205-213. Hunniford, M.E., Woolcott, C., Siegford, J. and Widowski, T.M., 2017. Nesting behavior of Hy-Line hens in modified enriched colony cages. Poultry science, 96(6), pp.1515-1523. Hunniford, M.E. and Widowski, T.M., 2017. Nest alternatives: Adding a wire partition to the scratch area affects nest use and nesting behaviour of laying hens in furnished cages. Applied Animal Behaviour Science, 186, pp.29-34. Hunniford, M.E., Mason, G.J. and Widowski, T.M., 2018. Laying hens' preferences for nest surface type are affected by enclosure. Applied Animal Behaviour Science, 201, pp.7-14. Hunniford, M.E. and Widowski, T.M., 2018. Curtained nests facilitate settled nesting behaviour of laying hens in furnished cages. Applied Animal Behaviour Science, 202, pp.39-45. Neijat, M., Casey-Trott, T.M., Robinson, S., Widowski, T.M. and Kiarie, E., 2019. Effects of rearing and adult laying housing systems on medullary, pneumatic and radius bone attributes in 73-wk old Lohmann LSL lite hens. Poultry science, 98(7), pp.2840-2845. Petrik, M.T., Guerin, M.T. and Widowski, T.M., 2013. Keel fracture assessment of laying hens by palpation: inter-observer reliability and accuracy. Veterinary Record, pp.vetrec-2013. Petrik, M.T., Guerin, M.T. and Widowski, T.M., 2015. On-farm comparison of keel fracture prevalence and other welfare indicators in conventional cage and floor-housed laying hens in Ontario, Canada. Poultry Science

Project title	Principal Investigator	Institution	Collaborators	Year of approval	Project start date	Project end date	Project length (y)	Status	Research priorities	Objectives	Keywords	Funding agencies	Peer reviewed articles
Salmonella Enteritidis challenge study for laying hens fed red seaweed	Dr. Bruce Rathgeber	Dalhousie University	Dr. Balakrishnan Prithiviraj Dr. Martine Boulianne Ms. Garima Kulshreshtha Dr. Franklin Evans	2014	Nov-14	Oct-15	1	Complete	BNH	To investigate the effect of two red seaweed species on the growth performance, egg production, cecal microbiota, short chain fatty acids and serum IgA production.	Salmonella enteriditis; red seaweed; challenge study; digestive tract microbiota; next generation sequencing; immune function	Egg Farmers of Canada	Kulshreshtha, G., B.M. Rathgeber, G. Stratton, N. Thomas, F. Evans, A. Critchley, J. Haftin and B. Prithiviraj 2014. Feed supplementation with red seaweeds, Chondrus crispus and Sarcodiotheca gaudichaudii, affects performance, egg quality, and gut microbiota of layer hens. Poultry Science 93:2991-3001. Kulshreshtha, G. M., T. Borza, B.M. Rathgeber, G. Stratton, N. Thomas, A. Critchley, J.Hafting, and B. Prithiviraj, 2016. Red seaweeds Sarcodiotheca gaudichaudii and Chondrus crispus down regulate virulence factors of Salmonella Enteritidis and induce immune responses in Caenorhabditis elegans. Frontiers in Microbiology 7:421. Kulshreshtha, G. M., B.M. Rathgeber, J. MacIsaac, M. Boulianne, L. Brigitte, G. Stratton, N. Thomas, A. Critchley, J.Hafting, and B. Prithiviraj, 2017. Feed supplementation with red seaweeds, Chondrus crispus and Sarcodiotheca gaudichaudii, reduce Salmonella Enteritidis in laying hens. Frontiers in Microbiology 8:567. Kulshreshtha, G., A. Critchley, B.M. Rathgeber, G. Stratton, A. H. Banskota, J. Haftin and B. Prithiviraj 2020. Antimicrobial effects of selected, cultivated red seaweeds and their components in combination with tetracycline, against poultry pathogen Salmonella Enteritidis. Journal of Marine Science Engineering 8:511 doi:10.3390/jmse8070511.
Project 1- Developing an integrated method of preparing bioactive peptides from spent hens for functional food/nutraceutical and cosmetic applications	Dr. Jianping Wu	University of Alberta	Dr. Sandy Davidage	2014	Sep-15	Aug-19	4	Complete	IUE	To develop an integrated method of preparing bioactive peptides from spent hen for functional food/nutraceutical and cosmetic applications	Spent hen; hydrolysis; antihypertensive peptides; collagen peptides; hypertension; animal study; skin health; cell culture; valeu-added processing; Canadian egg industry	Egg Farmers of Canada NSERC Burnbrae Farms Ltd.	Wang X, Hong H, Wu J. (2019). Hen collagen hydrolysate alleviates UVA-induced damage in human dermal fibroblasts. Journal of Functional Foods 63, 103574: 10.1016/j.jff.2019.103574 Hong H., Fan H., Chalamaiah M., Wu J. (2019). Preparation of Low-Molecular-Weight, Collagen Hydrolysates (Peptides): Current Progress, Challenges, and Future Perspectives. Food Chemistry Dec 15;301:125222. doi: 10.1016/j.foodchem.2019. Gu Y, Liang Y, Bai J, Wu W, Lin Q, Wu J. (2019). Spent hen-derived ACE inhibitory peptide IWHHT shows antioxidative and anti-inflammatory activities in endothelial cells. Journal of Functional Foods 53, 85-92. Fan H, Xu Q, Hong H, Wu J. (2018). Stability and transport of spent hen-derived ACE-inhibitory peptides IWHHT, IWH, and IW in human intestine Caco-2 cell monolayers. Journal of Agricultural and Food Chemistry 66(43):11347-11354. Offengenden M, Chakrabarti S, and Wu J. (2018). Chicken Collagen Hydrolysates Differentially Mediate Protective Effects on Human Dermal Fibroblasts. Food Science and Human Wellness 2018 7(2), 138-147. Hui H, Roy BC, Chalamaiah M, Bruce HL, Wu J. (2018). Pretreatment with formic acid enhances the production of small peptides from highly cross-linked collagen of spent hens. Food Chemistry (258): 174-180. Hui H, Shreyak C, Meram C, Bimol R, Heather B, and Wu J. (2017). Removing Cross-linked Telopeptides Enhances the production of low-molecular-weight collagen peptides from spent hens. Journal of Agricultural and Food Chemistry. 65(34): 7491-7499
Precision feeding layers for improved uniformity, production and sustainability	Dr. Martin Zuidhof	University of Alberta	None	2014	Dec-15	Mar-23	7	Complete	BHN	To use a precision feeding approach to improve the uniformity of free-run pullets and laying hens. To feed free run hens an optimal diet based on real-time body weight readings. To reduce body weight and frame size variation at the point of sexual maturity.	Precision feeding; pullet uniformity; eggshell quality; free run housing; innovation	Egg Farmers of Canada Egg Farmers of Alberta University of Alberta Alberta Agriculture and Forestry Xanantec Technologies, Inc. Truow Nutrition	van der Klein, S.A.S., Kwakkel, R.P., Ducro, B.J., and Zuidhof, M.J. 2020. Multiphasic nonlinear mixed growth models for laying hens. Poultry Science, 99(11): 5615-5624. https://doi.org/10.1016/j.psj.2020.08.054 van der Klein, S.A.S., Zuidhof, M.J., and Bedecarrats, G.Y. 2020. Diurnal and seasonal dynamics affecting egg production in meat chickens: A review of mechanisms associated with reproductive dysregulation. Animal Reproduction Science, 213:106257. https://doi.org/10.1016/j.anireprosci.2019.106257 Afrouziyeh, M., R. P. Kwakkel, and M. J. Zuidhof. 2021. Improving a nonlinear Gompertz growth model using bird-specific random coefficients in two heritage chicken lines. Poult. Sci. 100:101059. doi 10.1016/j.psj.2021.101059 Hanlon, C., Ramachandran, R., Zuidhof, M.J., and Bedecarrats, G.Y. 2020. Frontiers in Physiology 11:707. https://doi.org/10.3389/fphys.2020.00707
Project 2- Developing valuable egg components for niche market applications	Dr. Jianping Wu	University of Alberta	Dr. Feral Temelli Dr. Catherine Chan Dr. Sandy Davidge Dr. Spencer Proctor	2015	Jan-16	Aug-19	3.5	Complete	IUE	To diversify egg uses by developing valuable egg components for applications in functional food, nutritional, aquaculture, cosmetics and pharmaceutical industries	Ovotransferrin; metabolic syndrome; adipocyte differentiation; adipocyte inflammation; oxidative stress; vascular function; rats	Egg Farmers of Canada Alberta Agriculture & Forestry NSERC Affinity Life Sciences Inc.	Jahandideh F, de Campos Zani SC, Son M, Proctor SD, Cathy CB, Davidge ST, Wu J. (2019). Egg white hydrolysate enhances insulin sensitivity in high fat diet induced insulin resistant rats via AKT activation. British Journal of Nutrition 10.1017/S0007114519000837. Wang X, Son M, Meram C, Wu J. (2019). Mechanism and Potential of Egg Consumption and Egg Bioactive Components on Type-2 Diabetes. Nutrient 11(2). pii: E357. doi: 10.3390/nu11020357. Xu Q., Hong H., Wu J., Yan X. Bioavailability of bioactive peptides derived from food proteins across the intestinal epithelial membrane: A review. Trends in Food Science and Technology 86, 399-411. Son M, Wu J.(2018). Egg white hydrolysate and peptide reverse insulin resistance associated with TNF-α stimulated mitogen-activated protein kinases (MAPKs) pathway in Skeletal Muscle Cells. European Journal of Nutrition doi: 10.1007/s00394-018-1753-7 Zani SCDC, Wu J, Chan CB. (2018). Egg and soy derived peptides and hydrolysates: a review of their physiological actions against diabetes and obesity. Nutrient 10, 549; doi:10.3390/nu10050549. Meram, C Yu W, Wu J. (2018). Immunomodulatory and anticancer protein hydrolysates (peptides) from food proteins: a review. Food Chemistry 245, 205-222. Jahandideh F, Wu J. (2018). Purification and identification of adipogenic differentiating peptides from egg white hydrolysate. Food Chemistry 259, 25-30. Meran C, Wu J. (2018). Physicochemical and functional properties of leftover egg yolk granules after phosvitin extraction. Food Chemistry 369-377 Jahandideh F, Chakrabarti S, Davidge S, and Wu J. (2017). Egg white hydrolysate shows insulin-mimetic and sensitizing effects in 3T3-F442A pre-adipocytes. PLoS One 12(10):e0185653. https://doi.org/10.1371/journal.pone.0185653. Meram C, Yussef, E., Feral, T., and Wu, J. (2017). Physicochemical and functional properties of livetins (IgY) fraction from hen EY. Food Bioscience, 18, 38-45. Meram C, Wu J. (2017). Anti-inflammatory capacity of hen EY livetins fraction (α, β & γ livetins) and its enzymatic hydrolysates in lipo-polysaccharide (LPS) induced RAW 264.7 macrophages. Food Research International, Article in Press. Available online:doi.org/10.1016/j.foodres.2017.07.032. Jahandideh F, Chakrabarti S, Majumder K, Li Q, Panahi S, Morton JS, Davidge ST, Wu J. (2016). Egg white protein hydrolysate reduces blood pressure, improves vascular relaxation and modifies aortic angiotensin II receptors expression in spontaneously hypertensive rats. Journal of Functional Foods 27, 667-673. Jahandideh F, Chakrabarti S, Davidge S, Wu J. (2016). Antioxidant peptides identified from ovotransferrin by the ORAC method did not show anti-inflammatory and antioxidant activities in endothelial cells. Journal of Agricultural and Food Chemistry 64 (1), 113–119.
Assessing methods for on-farm euthanasia of turkeys, chickens, breeders and layers	Dr. Tina Widowski	Univeristy of Guelph	Dr. Stephanie Torrey Dr. Karen Schwean-Lardner Dr. Suzanne Millman Dr. Patricia Turner Dr. Jenny Fricke Ms. Penny Lawlis Ms. Tenille Knezacek	2015	Jul-15	May-19	4	Complete	ACS	To develop restraining devices for on-farm euthanasia methods To test efficacy of physical methods of euthanasia including manual and mechanical cervical dislocation To test efficacy of non-penetrating captive bolt devices To test aversiveness to and efficacy of gaseous methods of euthanasia	On-farm euthanasia; manual cervical dislocation; mechanical cervical dislocation; non-penetrating captive bolt; gas; restraining devices	Egg Farmers of Canada Canadian Poultry Research Council Poultry Industry Council Hybrid Turkeys Ontario Broiler Hatching Egg & Chick Commission Bock Industries Chicken Farmers of Saskatchewan NSERC	Bandara RMAS, Torrey S, Turner PV, Schwean-Lardner K and Widowski TM (2019). Anatomical Pathology, Behavioral, and Physiological Responses Induced by Application of Non-penetrating Captive Bolt Devices in Layer Chickens. Front. Vet. Sci. 6:89. Hernandez, E., F. James, S. Torrey, T. M. Widowski, K. Schwean-Lardner, G. Monteith and P.V. Turner, P.V. (2019). Evaluation of brain death during cervical dislocation methods in laying hens, Frontiers Vet Sci 6:297 Bandara, R.M.A... S. Torrey, P.V. Turner, A. zur Linden, A. Bolinder, K. Schwean-Lardner, T.M. Widowski (2019) Efficacy of a Novel Mechanical Cervical Dislocation Device in Comparison to Manual Cervical Dislocation in Layer Chickens, Animals, 9, 407
Role of egg whites in increasing antioxidants in the aged heart	Dr. Sanjoy Ghosh	University of Britsh Columbia-Okanogan	None	2015	Jan-16	May-17	1.5	Complete	HNH	To investigate if addition of egg white to the diet of 2-year old geriatric mice can augment sulphur amino acid availability and cardiac GSH with beneficial outcomes	Glutathione; aging; antioxidant; inflammation; cytokines	Egg Farmers of Canada	Ye, J, Botta A, Simtchouk S, Winkler J, Renaud L, Dadlani H, Rasmussen B, Elango R, Ghosh S. Egg white supplementation increases GSH and lowers oxidative damage in 110-week old geriatric mice hearts. Journal of Nutritional Biochemistry 76:108252, 2019
Development and assessment of vitamin enriched granule extracts from egg yolk	Dr. James House	University of Manitoba	Dr. Alain Doyen Dr. Yves Pouliot Dr. Nassim Naderi	2015	Jan-16	Sep-18	2.5	Complete	HNH	To develop and optimize high-throughput technologies for the extraction and concentration of high value egg bioactives from enhanced egg yolk To measure folate bioaccessibility and bioavailability using novel in vitro and in vivo approaches	Egg yolk; 5-methyl-tetrahydrofolate; extraction and concentration techniques; folate; bioavailability	Egg Farmers of Canada Mitacs Burnbrae Farms	Naderi, N., House, J.D., and Pouliot, Y. 2014. Scaling-up a process for the preparation of folate-enriched protein extracts from hen egg yolks. J. Food Eng. 141:85-92. Naderi, N., Doyen, A., House, J.D., and Pouliot, Y. 2016. Effect of selected pretreatments to increase the folate content of granule suspensions prepared from hen egg yolk. Food Sci. Tech. 68: 341-348. Naderi, N., Doyen, A., House, J.D., and Pouliot, Y. 2017. The use of high hydrostatic pressure to generate folate-enriched extracts from the granule fraction of hen's egg yolk. Food Chem. 232: 253-262. Naderi, N., House, J.D., Pouliot, Y., and Doyen, A. 2017. Review: Effects of high hydrostatic pressure processing on hen egg compounds and egg products. Comp. Rev. Food Sci. Food Safety 16: 707-720. Naderi, N, Pouliot, Y., House, J.D. and Doyen, A. 2017. Effect of freezing, thermal pasteurization, and hydrostatic pressure on fractionation and folate recovery in egg yolk. J. Agric. Food Chem. 65: 7774-7780.
In ovo vaccination platform to reduce Salmonella and other food safety relevant bacteria in poultry	Dr. Wolfgang Köster	VIDO, University of Saskatchewan	Dr. Brenda Allan Dr. Arshud Dar Dr. Jan Van der Hurk Dr. Colette Wheler	2015	Oct-15	Dec-18	3	Complete	FS	Production and purification of antigens (components exposed on the surface of Salmonella Enteriditis) previously identified by our group Formulation of subunit vaccines containing those antigens together with combinations of adjuvants developed at VIDO Immunization of eggs with the aim to demonstrate immunogenicity and efficacy Proof of principle trials: experimental challenge of vaccinated birds using an oral infection chicken model	Salmonella Enteriditis; eggs; vaccine adjuvants; immune response; embryo; chick; in-ovo vaccination	Egg Farmers of Canada The Saskatchewan Ministry of Agriculture - Agriculture Development Fund The Saskatchewan Chicken Industry Development Fund	Wellawa DH, Allan B, White AP, Köster W. (2020) Iron-Uptake Systems of Chicken-Associated Salmonella Serovars and Their Role in Colonizing the Avian Host. Microorganisms. 2020 Aug 7;8(8):1203. doi: 10.3390/microorganisms8081203. PMID: 32784620; PMCID: PMC7465098.

Project title	Principal Investigator	Institution	Collaborators	Year of approval	Project start date	Project end date	Project length (y)	Status	Research priorities	Objectives	Keywords	Funding agencies	Peer reviewed articles
The role of shell protein in controlling bacterial movement through chicken eggs	Dr. Bruce Rathgeber	Dalhousie University	Ms. Janice MacIssac	2015	Oct-15	Oct-19	4	Complete	FS	To determine 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 prenetration in some chickens is related to increased presence of antibacterial proteins in the egg shell.	Eggshell proteins; chicken lines; resistance to bacterial penetration; Salmonella enteriditis; E. coli; eggshell strength	Egg Farmers of Canada	
Antihypertase activity of cooked egg yolk digest	Dr. Jianping Wu	University of Alberta	Dr. Susan Jacobs-Kaufman	2015	Jan-17	Mar-19	2	Complete	HNH	To study the antihypertensive activity of boiled and fried eggs and their digests in spontaneously hypertensive rats and determine their effect on the oxidative stress and activity of angiotensin converting enzyme in various organs in vivo	egg; cooking method; boiled whole eggs; fried whole eggs; digestion; aintihypertensive activity; antioxidative activity; angiotensin converting enzyme; in vivo study; spontaneous hypertensive rats; blood pressure	Egg Farmers of Canada Agriculture & Food Council though CAAP Egg Farmers of Alberta	Jahandideh F, Chakrabarti S, Majumder K, Li Q, Panahi S, Morton JS, Davidge ST, Wu J. (2016). Egg white protein hydrolysate reduces blood pressure, improves vascular relaxation and modifies aortic angiotensin II receptors expression in spontaneously hypertensive rats. Journal of Functional Foods 27, 667-673. Jahandideh F, Majumder K, Chakrabarti S, Morton JS, Panahi S, Kaufman S, Davidge ST, Wu J. (2014). Beneficial Effects of Simulated Gastro-Intestinal Digests of Fried Egg and its Fractions on Blood Pressure, Plasma Lipids and Oxidative Stress in Spontaneously Hypertensive Rats. Plos One 9(12): e115006. Majumder, K., Panahi, S., Kaufman, S. & Wu, J. (2013). Fried egg digest decreases blood pressure in spontaneously hypertensive rats. Journal of Functional Foods 5: 187-194. Majumder K, Wu J. (2009). Angiotensin I converting enzyme inhibitory peptides from simulated in vitro gastrointestinal digestion of cooked eggs. Journal of Agricultural and Food Chemistry. 57 (2): 471-477.
Adaptation to the pullet rearing environment by providing lighting during embryo development	Dr. Bruce Rathgeber	Dalhousie University	Dr. Karen Schwean-Lardner Ms. Janice MacIsaac Dr. Miriam Gordon	2015	Feb-16	Jul-18	2.5	Complete	ACS	To determine the optimal photoperiod during incubation that will best enable the newly hatched chicks to adapt to their rearing environment	Incubation; production performance; photoperiod; wavelength; LED light; hatch window; chick quality	Egg Farmers of Canada Egg Farmers of New Brunswick Nova Scotia Department of Agriculture	
Behaviour of pullets following the provision of lighting during embryo development	Dr. Karen Schwean-Lardner	University of Saskatchewan	Dr. Bruce Rathgeber Ms. Janice MacIssac Dr. Miriam Gordon	2015	May-16	Jan-19	2.5	Complete	ACS	To determine the optimal photoperiod during incubation that will best enable the newly hatched chicks to adapt to their rearing environment	Lighting; LED; wavelength; embryo development; behaviour	Egg Farmers of Canada	
Evaluation of rapid diagnostic assay for avian influenza to the point of care setting	Dr. Suresh Neethirajan	University of Guelph	Dr. Xuan Weng Dr. Gordon Hayward Dr. Davor Ojkic	2016	Jan-16	Aug-17	1.5	Complete	ACS FS	To design, develop, and evaluate the technical potential of the electrochemical-based diagnostic-sensing assay for avian influenza detection	Avian influenza; surveillance; rapid test on-farm; low-cost; colorimetry	Egg Farmers of Canada Ontario Minitry of Agriculture, Food and Rural Affairs (OMAF) - Catalyst Engagement Fund OMAFRA Mitacs Canadian Poultry Research Council Poultry Industry Council	Ahmed, S.R., Corredor, J.C., Nagy E., and Neethirajan, S. 2017. Amplified visual immunosensor integrated with nanozyme for ultrasensitive detection of avian influenza virus. Nanotheranostics, 1(3): 338-345
Investigating the influence of a range of exposure conditions during simulated transport on pullet and end-of-cycle (EOCH) physiology, welfare and meat quality	Dr. Karen Schwean-Lardner	University of Saskatchewan	Dr. Trever Crowe	2016	Jan-17	Feb-21	4	Complete	ACS FS	To investigate the response of pullets, end-of-cycle white hen strains and end-of-cycle brown hen strains to a range of exposure conditions (temperature and humidity), durations, and feather cover during simulated transport	Simulated transport; feather cover; spent hens; pullets; core body temperature; blood parameters; behaviour; meat quality	Egg Farmers of Canada Maple Lodge Farms Olymel LP NSERC-CRD	K. Beaulac, T.G. Crowe and K. Schwean-Lardner. 2020. Simulated transport of well- and poor-feathered brown-strain end-of-cycle hens and the impact on stress physiology, behavior, and meat quality. Poultry Science Vol. 99 Pages 6753-6763 https://doi.org/10.1016/j.psj.2020.09.051 Lalonde, S., K. Beaulac, T.G. Crowe and K. Schwean-Lardner. 2020. The effects of simulated transport conditions on the muscle tissue characteristics of white-strain layer pullets. Poultry Science Vol. 100 Pages 103-109 https://doi.org/10.1016/j.psj.2020.09.064 Lalonde, S., K. Beaulac, T.G. Crowe and K. Schwean-Lardner. 2020. The effects of simulated transportion conditions on the core body and extremity temperature, blood physiology, and behaviour of white-strain layer pullets. Poultry Science Vol. 100 Pages 697-706 https://doi.org/10.1016/j.psj.2020.10.077 Frerichs, C., K. Beaulac, T.G. Crowe, and K. Schwean-Lardner. 2021 The effects of simulated transport on the muscle characteristics of white-feathered end-of-cycle hens. Poultry Science Vol. 100:101280. https://doi.org/10.1016/j.psj.2021.101280 Frerichs, C., K. Beaulac, T.G. Crowe, and K. Schwean-Lardner. 2022. The influence on behavior and physiology of white-feathered end-of-cycle hens during simulated transport. Poultry Science Vol. 101: 101599. https://doi.org/10.1016/j.psj.2021.101599
Effect of finishing space allowance in standard & enriched rearing cages on performance, health & welfare of layer pullets	Dr. Tina Widowski	University of Guelph	Dr. Leanne Cooley Dr. Helen Anne Hudson Ms. Linda Caston	2016	Sep-16	Jan-20	3.5	Complete	ACS	To determine the effects of finishing density/space allowance in standard rearing cages on growth, perching and feeding behaviour and welfare of growing pullets and their subsequent performance in the layer barn	Rearing cages; performance; welfare; density; space allowance; pullets; conventional; enriched; strain; behaviour	Egg Farmers of Canada OMAFRA	Fawcett, D.L., Casey-Trott T.M., Jensen,L., Caston, L.J., Widowski, T.M., 2020. Strain differences and effect of different stocking densities during musculoskeletal development of pullets. Poultry Science 99(9):4153-4161
Understanding feather pecking in laying hens: the gut-microbiome-brain connection	Dr. Alexandra Harlander	University of Guelph	Dr. Paul Forsythe Dr. Wolfgang Kunze	2016	Sep-16	Aug-20	4	Complete	ACS HNH	To test whether social stress induced by large, densely-populated groups of laying hens housed in non-cage housing systems contributes to feather pecking and/or influences changes in gut microbiota, the immune system, the enteric nervous system, or metabolic pathways To assess whether changes in gut microbiota and their metabolites alter kynurenine/melatonin pathway of tryptophan/amino avid metabolism and whether these are the mechanisms that contribute to feather pecking To develop a strategy fo therapeutic enrichment of the gut microbiota using probiotics to reduce feather pecking associated changes in gut function, immunity and metabolism with the aim of reducing feather-pecking behaviour	Feather pecking; gut microbiome-brain connection; social stress; microbiome; amino acid metabolism; immune system; gut motility; enteric nerve activity profile	Egg Farmers of Canada OMAFRA NSERC-CRD	van Staaveren, N., Krumma, J., Forsythe, P. et al. Cecal motility and the impact of Lactobacillus in feather pecking laying hens. Sci Rep 10, 12978 (2020). https://doi.org/10.1038/s41598-020-69928-6 Birkl P, Chow J, McBride P, Kjaer JB, Kunze W, Forsythe P and Harlander-Matauschek A (2019) Effects of Acute Tryptophan Depletion on Repetitive Behavior in Laying Hens. Front. Vet. Sci. 6:230. doi: 10.3389/fvets.2019.00230 Birkl P, Chow J, Forsythe P, Gostner JM, Kjaer JB, Kunze WA, McBride P, Fuchs D and Harlander-Matauschek A (2019) The Role of Tryptophan-Kynurenine in Feather Pecking in Domestic Chicken Lines. Front. Vet. Sci. 6:209. doi: 10.3389/fvets.2019.00209 Birkl, P., A Bharwani, J.B. Kjaer, W Kunze, P McBride, P Forsythe, A Harlander-Matauschek, Differences in cecal microbiome of selected high and low feather-pecking laying hens, Poultry Science, Volume 97, Issue 9, 2018, Pages 3009-3014, ISSN 0032-5791, https://doi.org/10.3382/ps/pey167
Development of strategies for control of avian influenza virus transmission	Dr. Shayan Sharif	University of Guelph	Dr. Zvonimir Poljak Dr. Rozita Dara Dr. Michael Von Massow Dr. Yohannes Berhane	2016	Sep-16	Juin-23	7	Complete	HNH	To develop a vaccination strategy to reduce shedding of avian influenza virus from mucosal tissues To assess efficacy of novel vaccine formulations in disrupting virus transmission To model transmission of virus from vaccinated poultry to susceptible poultry and to create a decision support system from control of avian influenza virus	Avian influenza; vaccination; mucosal tissues; transmission; econmic impact	Egg Farmers of Canada Canadian Poultry Research Council Chicken Farmers of Saskatchewan University of Guelph's Food from Tought Initiative NSERC-CRD	Raj, Sugandha, Ayumi Matsuyama-Kato, Mohammadali Alizadeh, Nitish Boodhoo, Eva Nagy, Samira Mubareka, Khalil Karimi, Shahriar Behboudi, and Shayan Sharif. "Treatment with Toll-like Receptor (TLR) Ligands 3 and 21 Prevents Fecal Contact Transmission of Low Pathogenic H9N2 Avian Influenza Virus (AIV) in Chickens." Viruses 15, no. 4 (2023): 977. Raj, Sugandha, Mohammadali Alizadeh, Bahram Shoojadoost, Douglas Hodgins, Éva Nagy, Samira Mubareka, Khalil Karimi, Shahriar Behboudi, and Shayan Sharif. "Determining the Protective Efficacy of Toll-Like Receptor Ligands to Minimize H9N2 Avian Influenza Virus Transmission in Chickens." Viruses 15, no. 1 (2023): 238. Raj, Sugandha, Jake Astill, Nadiyah Alqazlan, Nitish Boodhoo, Douglas C. Hodgins, Éva Nagy, Samira Mubareka, Khalil Karimi, and Shayan Sharif. "Transmission of H9N2 Low Pathogenicity Avian Influenza Virus (LPAIV) in a Challenge-Transmission Model." Vaccines 10, no. 7 (2022): 1040. Alqazlan, N., Astill, J., Raj, S., & Sharif, S. (2022). Strategies for enhancing immunity against avian influenza virus in chickens: A review. Avian Pathology, 51(3), 211-235.
Use of a novel mobile anaerobic digestion vessel for layer hen mortality disposal	Dr. Brandon Gilroyed	UoG - Ridgetown	Dr. Tim Reuter Dr Rob Nicol Ms. Kim Van Overloop	2016	May-16	Apr-19	3	Complete	FS ES	To investigate the carcass reduction capabilities of two static batch anaerobic digestion systems operated under mesophilic and psychrophilic temperatures with three different carcass loading rates	Anaerobic digestion; biogas production; packing density; temperature; Campylobacter; Salmonella; fertilizer; economic analysis	Egg Farmers of Canada OMAFRA NSERC-Discovery	Arias, J.Z., Reuter, T., Sabir, A., Gilroyed, B.H. 2018. Ambient alkaline hydrolysis and anaerobic digestion as a mortality management strategy for whole poultry carcasses. Waste Management 81: 71-77.
Nano-textured eggshell scaffolds for bone regeneration	Dr. Maxwell Hincke	University of Ottawa	Dr. Isabelle Catelas Dr. Tamer Ahmed	2016	May-16	Jan-19	2.5	Complete	IUE	To take a waste product of the egg-breaking industry (eggshell) and repurpose it into a bone regenerative biomaterial.	eggshell; scaffold; bone regeneration; in-vitro; nano-textured surface; osteoblast regeneration; osteogenic differenciation; chitosan	Egg Farmers of Canada Burnbrae Farms	

Project title	Principal Investigator	Institution	Collaborators	Year of approval	Project start date	Project end date	Project length (y)	Status	Research priorities	Objectives	Keywords	Funding agencies	Peer reviewed articles
Practical dietary strategies to reduce the carbon footprint and ammonia emission intensity of table egg production	Dr. Eduardo Beltranena	Alberta Agriculture & Forestry (MFRG)	Mr. Matt Oryschak	2016	Sep-16	Jun-19	3	Complete	ES	To compare the effect of acidifying the diet, the influence of dietary crude protein level, and a total of nine commercial feed additives for their effect on hen productivity, objective egg quality, and ammonia emssions intensity	Gas emissions; ammonia; diet; protein level; Western Canada; performance; limestone; gypsum	Egg Farmers of Canada Alberta Agriculture and Forestry Egg Farmers of Alberta SHAC Solutions Inc. CBS Canadian Bio-Systems Novagreen Canadian Zeolite	M.A. Oryschak, E. Beltranena, Reconsidering the contribution of Canadian poultry production to anthropogenic greenhouse gas emissions: returning to an integrated crop–poultry production system paradigm, Poultry Science, Volume 99, Issue 8, 2020, Pages 3777-3783, ISSN 0032-5791, https://doi.org/10.1016/j.psj.2020.05.004.
Egg production for a complete cycle feeding dietary seaweed	Dr. Bruce Rathgeber	Dalhousie University	Dr. Balakrishnan Prithiviraj Ms. Janice Malcssac Dr. Rex Newkirk	2016	May-16	Jan-21	4.5	Complete	FS HNH BNH	To evaluate the use of dietary seaweed in laying hen diets on a larger scale over an entire production cycle to confirm the safe long use of this dietary ingredient that provides substantial benefit to intestinal health and protection from pathogen colonization. To further investigate incorporation of this feed ingredient in laying hen diets, steam explosion of the seaweed, prior to incorporation into the diet, will be performed in attempt to improve its function and nutrient availability	Seaweed; complete lay cycle; health; chondrus crispus; salmonella; prebiotic; steam explosion; extrusion; performance; egg quality; omega 3: omega 6 ratio; gut microbiota; environmental stress	Egg Farmers of Canada Atlantic Poultry Research Institute Pan Atlantic Research and Innovation Iniative	Borzouie, S., B. Rathgeber, C. Stupart, J. MacIsaac, and L. MacLaren, 2020. Effects of dietary inclusion of seaweed, heat stress and genetic strain on performance, plasma biochemical and hematological parameter in laying hens. Animals 10:1570 doi: 10.3390/ani10091570 Bourzouie, S. B. Rathgeber, and L. MacLaren, 2022. Application of metabolomics to assess the intestinal response to dietary supplementation. CABI Rev. 17: doi:10.1079/cabireviews202217004.
Control of avian pathogenic Escherichia coli through prophage induction	Dr. Lawrence Goodridge	McGill University	None	2016	Sep-16	Mar-18	1.5	Complete	BNH	To identify and evaluate natural products to reduce the presence of avian pathogenic E. coli in hens	Avian pathogenic E. coli control; natural; in vitro; phage therapy; prophage induction; terpenoids; alkanoids; flavonoids; S. enteriditis	Egg Farmers of Canada	
Investigating the role of limestone particle size on skeletal development and performance of pullets reared in conventional and aviary housing systems and subsequent performance, bone health, calcium metabolism and welfare hens housed in furnished cages	Dr. Elijah Kiarie	University of Guelph	Dr. Tina Widowski Dr. Gregoy Bedecarrats	2016	Jan-17	Aug-20	3.5	Complete	BNH	To determine baseline calcium concentration in bones and correlation with indices of bone health in pullets and layers raised in different housing systems Evaluate the effects of limestone particle size on performance and skeletal development of pullets reared in different housing systems and subsequent effects on egg mass, quality and internal characteristics, bone health, and welfare in layers housed in furnished cages Evaluate the effects of limestone particle size on calcium digestibility and metabolism in pullets and layers	Althernative housing systems; hypocalcemia; bone quality; skeletal development; diet; pullets; calcium nutrition	Egg Farmers of Canada Egg Farmers of Ontario NSERC Canadian Poultry Research Council Ontario Agri-Food Innovation Alliance Wallestein Feeds & Supply Canada First Research Excellence Fund	Akbari Moghaddam Kakhki, R.*, T. Heuthorst*, A. Wornath-Vanhumbeck*, M. Neijat* and E. Kiarie. 2019. Interactive effects of calcium and top-dressed 25-hydroxy vitamin D3 on egg production, eggshell quality, and medullary bones attributes in aged Lohmann LSL-lite layers. Poult. Sci. 98: 1254–1262. https://doi.org/10.3382/ps/pey446 Akbari Moghaddam Kakhki, R.*, T. Heuthorst*, A. Wornath-Vanhumbeck*, M. Neijat* and E. Kiarie. 2018. Medullary bone attributes in aged Lohmann LSL-lite layers fed different levels of calcium and top-dressed 25-hydroxy vitamin D3. Can. J. Anim. Sci. 99: 138-149. https://doi.org/10.1139/cjas-2018-0062 Neijat, M.*, T. M. Casey-Trott, S. Robinson, T. M. Widowski, and E. Kiarie. 2019. Effects of rearing and adult laying housing systems on medullary, pneumatic and radius bone attributes in 73-week old Lohmann LSL lite hens. Poult. Sci. 98: 2840–2845. https://doi.org/10.3382/ps/pez086 Mwaniki*, Z. and E. Kiarie. 2018. Standardized ileal digestible amino acids and apparent metabolizable energy content in defatted black soldier fly larvae fed to broiler chickens. Can. J. Anim. Sci. https://doi.org/10.1139/CJAS-2018-0111. Mwaniki*, Z., Neijat*, M. and E. Kiarie. 2018. Egg production and quality responses of adding up to 7.5% defatted black soldier fly larvae meal in a corn-soybean meal diet fed to shaver white leghorns from wk 19 to 27 of age. Poult. Sci. 97: 2829–2835. https://doi.org/10.3382/ps/pey118 Khanal, T.*, T. Widowski, G. Bedecarrats, E. Kiarie. 2019. Effects of pre-lay dietary calcium (2.5 vs. 4.0%) and pullet strain (Lohmann Brown vs. Selected Leghorn LSL-Lite) on calcium utilization and femur quality at 1st through to the 50th egg. Poult. Sci. 98:4919-4928. https://doi.org/10.3382/ps/pez245 Mwaniki*, Z. N., Shoveller, A. K., Huber, L., and Kiarie, E. 2020. Complete replacement of soybean meal with defatted black soldier fly larvae meal in Shaver White hens feeding program (28 to 43 week of age): impact on egg production, egg quality, organ weight and apparent retention of components. Poult. Sci. 99: 959–965. https://doi.org/10.1016/j.psj.2019.10.032 Tanka Khanal*, Tina Widowski, Gregoy Bédécarrats and Elijah Kiarie. 2020. Rearing cage type and dietary limestone particle size: I, Effects on growth, apparent retention of calcium and long bones attributes in Lohmann Selected Leghorn-Lite pullets. Poult. Sci. https://doi.org/10.1016/j.psj.2020.05.029 Tanka Khanal*, Tina Widowski, Gregoy Bédécarrats and Elijah Kiarie. 2020. Rearing cage type and dietary limestone particle size: II, Effects on egg production, eggshell and bone quality in Lohmann Selected Leghorn-Lite hens. Poult. Sci. 99.11 (2020): 5763-5770. A. Pereira, R. Akbari Moghaddam Kakhki, and E. G. Kiarie. Eggshell and bone quality in 72 weeks old Lohmann Brown and Dekalb White hens reared at differing spacing allowances (247 vs. 299 cm2/bird) in enriched cages. Can. J. Anim. Sci. (2021) https://doi.org/10.1139/CJAS-2020-0124 Tanka Khanal*, Gregoy Bédécarrats and Elijah Kiarie. Cage type and mineral nutrition had independent impact on skeletal development in Lohmann LSL-Lite pullets from hatch to 16 weeks of age. Anim. Nutr. (2021) 7(3): 631-640
Implications of cage-free egg production on ammonia and particulate matter generation	Dr. Bill Van Heyst	University of Guelph	None	2016	Jan-17	Jul-19	2.5	Complete	ES	To develop emission factors for $PM_{2.5}$, PM_{10}, and ammonia while also illustrating how emissions can vary between different barn styles and locations	Free run aviaries; Ontario; Saskatchewan; ammonia; particular matter; emission factors; seasonal and diurnal fluctuations	Egg Farmers of Canada Canadian Poultry Research Council OMAFRA	
Toward an understanding of beautiful feather cover in laying hens	Dr. Alexandra Harlander	University of Guelph	Dr. Tina Widowski Dr. Olaf Berke Dr. Chirstine Baes	2016	Jan-17	Dec-18	2	Complete	ACS	To develop a Canadian Feather Pecking Management Plan to help egg farmers prevent/reduce feather damage, as a consequence of feather pecking, in laying hen flocks kept in furnished cages and non-cage housing systems	Feather damage; feather pecking; alternative housing systems; management practices; survey; factors associated with feather pecking	Egg Farmers of Canada Mitacs University of Guelph	Decina, C., O. Berke, N. van Staaveren, C. F. Baes, T. Widowski and A. Harlander-Matauschek. 2019. A cross-sectional study on feather cover damage in Canadian laying hens in non-cage housing systems. BMC Veterinary Research, 15:435, doi: 10.1186/s12917-019-2168-2 Decina, C., O. Berke, N. van Staaveren, C. F. Baes, and A. Harlander-Matauschek. 2019. Development of a scoring system to assess feather damage in Canadian laying hen flocks. Animals, 9(7):436, doi:10.3390/ani9070436 Decina, C., O. Berke, N. van Staaveren, C. F. Baes, T. Widowski and A. Harlander-Matauschek. 2019. An investigation of associations between management and feather damage in Canadian laying hens housed in furnished cages. Animals, 9(4):135, doi.org/10.3390/ani9040135 van Staaveren, N., C. Decina, C.F. Baes, T.M. Widowski, O. Berke and A. Harlander-Matauschek. 2019. Housing and management practices on 33 pullet farms in Canada. Animals, 9(2):49, doi: 10.3390/ani9020049 van Staaveren, N., C. Decina, C.F. Baes, T.M. Widowski, O. Berke and A. Harlander-Matauschek. 2018. A description of laying hen husbandry and management practices in Canada. Animals, 8(7):114, doi:10.3390/ani8070114
Reducing the economic impact of Marek's disease on egg production through the use of floor pens as hen housing	Dr. Troy Day	Queens University	Dr. Carly Rozins Dr. Scott Greenhalgh	2016	Sep-16	Mar-17	0.5	Complete	HNH PP	Refinement and parameterization of the mathematical model (Rozins & Day, 2016) to properly model the spread of Marek's disease on an industrial egg farm. To establish a quantitive link between Marek's disease, egg production and economic performance	Marek's disease; economic; egg production; all-in-all-out; aviary; conventional; enriched	Egg Farmers of Canada	Rozins, Carly, Troy Day, and Scott Greenhalgh. "Managing Marek's disease in the egg industry." Epidemics 27 (2019): 52-58.
Prevalence of focal duodenal necrosis in SK layer flocks and its effect on egg production	Dr. Hank Classen	University of Saskatchewan	Dr. Stephanie Derbawka Dr. Jenny (Fricke) Nicholds Ms. Tennille Knezacek Dr. Eugenia Herwig Dr. Karen Schwean-Lardner	2016	Sep-16	Jul-20	4	Complete	BHN	To assess the incidence of focal duodena necrosis, identify factors associated with with it, and determine if Clostridium spp are associated with lesions characteristic of this disease	Focal duodenal necrosis; production cycle; management; diet; egg production; downgraded eggs at peak production; Clostridium perfringens	Egg Farmers of Canada Saskatchewan Egg Producers NSERC University of Saskatchewan Poultry Extension	

Project title	Principal Investigator	Institution	Collaborators	Year of approval	Project start date	Project end date	Project length (y)	Status	Research priorities	Objectives	Keywords	Funding agencies	Peer reviewed articles
Determining the impact of gizzard size on feed efficiency, gut health, and the incidence of focal duodenal necrosis (FDN) in pullets and layers fed diets with different calcium sources and levels	Dr. Hank Classen	University of Saskatchewan	Ms. Dawn Abbott Dr. Stephanie Derbawka Dr. Jenny (Fricke) Nichols Dr. Eugenia Herwig Ms. Tennille Knezacek	2016	Sep-16	Nov-19	3	Complete	BNH	To determine if focal duodenal necrosis lesions were present in layers at 30, 41, 52 and 62 weeks of age To determine if calcium source and level, along with length of pre-lay ration exposure, had an impact on gastrointestinal and production parameters, and the incidence of focal duodenal necrosis in lay hens To gain a better understanding of focal duodenal necrosis and contribute to the scientific literature pertaining to this intestinal condition in laying hens To direct further investigation into the etiology of focal duodenal necrosis in laying hens	Focal duodenal necrosis; calcium sources; pre-lay period; calcium levels; performance; gastrointestinal parameters; Clostridium perfringens; duodenum morphology	Egg Farmers of Canada Saskatchewan Egg Producers NSERC University of Saskatchewan Poultry Extension	
Efficiency and safety of using black soldier fly larvae in laying hen feed in Canada	Dr. Kim Cheng	University of Britsh Columbia	Dr. Masoumed Bejaei	2016	Mar-17	Dec-17	1	Complete	BNH FS ES	To investigate the efficiency and safety of the use of dried BSFL in laying hen diets, partially or completely replacing soybean meal and soybean oil	Alternative source of protein and metabolizable energy; black soldier fly; pre-pupate larvae; food and animal safety	Egg Farmers of Canada Mitacs Accelerate Scholarship Enterra Feed Corporation UBC Avian Research Centre Kwantlen Polytechnic University - Sustainable Agriculture and Food Systems Program UBC Centre for comparative Medicine	Bejaei, M., & Cheng, K. M. (2020). The effect of including full-fat dried black soldier fly larvae in laying hen diet on egg quality and sensory characteristics. Journal of Insects as Food and Feed, 6 (3): 305-314. https://doi.org/10.3920/JIFF2019.0045
Project 3- Develop new application of egg protein ovotransferrin as a functional food ingredient on bone health *	Dr. Jianping Wu	University of Alberta	Dr. Michael Doschak	2016	Mar-20			Ongoing	HNH	Contact: jianping.wu@ualberta.ca	Ovotransferrin; osteoblast cell; osteoclast cell; bone; osteoporosis	Egg Farmers of Canada Global Egg Corporation NSERC	
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	Dr. Tina Widowski Dr. Neil Karrow	2017	Jan-18	Jan-23	5	Complete	BNH ACS	To investigate long-term effects of feeding pullet breeders' diets enriched omega-3 fatty acids on embyonic bone development and subsequent effects on skeletal development and performance in pullets and hens To investigate long-term effects of feeding pullet breeders' diets enriched omega-3 fatty acids on pullets behaviour when subjected to stressors	Bone health; skeletal development; epigenetics; offspring; omega-3 fatty acids; lipid mediators; pullet behaviour and welfare	Egg Farmers of Canada NSERC-CRD Alltech Canada O&T Farm Ltd Egg Farmers of Ontario OMAFRA CRCEF Emergency funds transfer-Covid 19 relief	*Kakhki, R & Kiarie, E. (2021, November). Effect of Escherichia coli lipopolysaccharide challenge on eggshell, tibia, and keel bone attributes in ISA brown hens exposed to dietary n-3 fatty acids prior to onset of lay. Poultry Science, 100(11). *Kakhki, R, Ma, D W, Price, K R, Moats, J, Karrow, N A & Kiarie, E G. (2021, January). Impact of feeding n-3 fatty acids to layer breeders and their offspring on concentration of antibody titers against infectious bronchitis, and Newcastle diseases and plasma fatty acids in the offspring. British Poultry Science, 62(2), 270-277. *Kakhki, R & Kiarie, E. (2020, September). Effects of feeding ISA brown and Shaver white layers breeder with sources of n-3 fatty acids on hatching eggs profile, apparent embryonic utilization of egg components and body composition of day-old chicks. Canadian Journal of Animal Science, 101(1), 168-176. Kakhki, R, * Shouldice, V, Price, R, Moats, J & Kiarie, E. (2020, August). n-3 fatty acids fed to ISA brown and Shaver white breeders and their female progeny during rearing: Impact on egg production, eggshell and select bone attributes from 18 to 42 weeks of age. Poultry Science, 99(8), 3959–3970. *Kakhki, R, Price, K R, Moats, J, Bédécarrats. G Y, Karrow, N A & Kiarie, E G. (2020, April). Impact of feeding microalgae (Aurantiochytrium limacinum) and co-extruded mixture of full-fat flaxseed as sources of n-3 fatty acids to ISA brown and Shaver white breeders and progeny on pullet skeletal attributes at hatch through to 18 weeks of age. Poultry Science, 99(4), 2087–2099. *Kakhki, R, Ma, D W, Price, K R, Moats, J, Karrow, N A & Kiarie, E G. (2020, February). Enriching ISA brown and Shaver white breeder diets with sources of n-3 polyunsaturated fatty acids increased embryonic utilization of docosahexaenoic acid. Poultry Science, 99(2), 1038-1051. Kakhki, R. A. M., Lu, Z., Thanabalan, A., Leung, H., Mohammadigheisar, M., & Kiarie, E. (2019). Eimeria challenge adversely affected long bone attributes linked to increased resorption in 14-day-old broiler chickens. Poultry science, 98(4), 1615-1621. Thanabalan* A., J. Moats and E. G. Kiarie. 2020. Effects of feeding broiler breeder hens a co-extruded full fat flaxseed and pulses mixture without or with multi-enzyme supplement. Poult. Sci. 99:2616–2623. http://dx.doi.org/10.1016/j.psj.2019.12.062 R. Akbari Moghaddam Kakhki*, D.W.L. Ma, K. R. Price, J. Moats, N. A. Karrow, and E. G. Kiarie. 2020. Impact of feeding n-3 fatty acids to layer breeders and their offspring on concentration of antibody titers against infectious bronchitis, and Newcastle diseases and plasma fatty acids in the offspring. Brit. Poult. Sci. https://doi.org/10.1080/00071668.2020.1847254
An egg a night to keep glucose tight	Dr. Jonathan Little	UBC - Okanagan	None	2017	Aug-17	Sep-19	2	Complete	HNH	Help identify a potential benefit of eggs for people with type 2 diabetes Test the health benefits of eggs consumed at a time other than breakfast Provide high-quality scientific evidence for a novel egg consumption	Type 2 diabetes; bedtime snack; morning hyperglycemia; eggs;	Egg Farmers of Canada	Abbie, Erica, et al. "A low-carbohydrate protein-rich bedtime snack to control fasting and nocturnal glucose in type 2 diabetes: A randomized trial." Clinical Nutrition 39.12 (2020): 3601-3606.
Eggshell Membrane Nano-Particles (ESM-NPs) for biomedical applications *	Dr. Max Hincke	University of Ottawa	Dr. James Harden Dr. Chantal Matar Dr. Tamer Ahmed Dr. Garima Kulshreshtha	2017	Feb-18	Feb-22	4	Complete	IUE	To produce eggshell membrane nano-particles and to evaluate their applications as therapeutic agents against cancer, microbial infection, inflammation disease conditions, with an enhanced emphasis on skin applications	Eggshell membrane; nanoparticles; therapeutic efficacy; skin applications;	Egg Farmers of Canada Burnbrae Farms NSERC-CRD	Ahmed, T.A.E., Kulshreshtha, G. and Hincke, M.T. (2019) Value Added Uses of Eggshell and Eggshell Membranes. Chapter 19 In: Eggs as Functional Foods and Nutraceuticals for Human Health (Ed. J. Wu) Royal Society of Chemistry. Pp. 359-97. Kulshreshtha, G., Ahmed, T. A. E., Wu, L., Diep, T., and Hincke. M.T. (2020) A novel eco-friendly green approach to produce Particalized Eggshell Membrane (PEM) for skin health applications. Biomater. Sci. 8:5346–5361. Ahmed, T.A.E., Younes, M., Wu, L., and Hincke M.T. (2021) A Survey of Recent Patents in Engineering Technology for the Screening, Separation and Processing of Eggshell. Front Bioeng Biotechnol. 9: 677559. Ahmed, T. A E., Wu, L., Younes, M., and Hincke, M. T. (2021). Biotechnological Applications of Eggshell: Recent Advances. Frontiers in Bioengineering and Biotechnology, 9, 548. Kulshreshtha, G., Diep, T., Hudson, H. A., and Hincke, M. T. (2022). High value applications and current commercial market for eggshell membranes and derived bioactives. Food Chemistry, 132270.
How much omega-3 fatty acids do hens require for optimal health and productivity?	Dr. James House	University of Manitoba	Dr. Harold Aukema	2017	Nov-18	Apr-23	4.5	Complete	ACS HNH BNH	To define omega-3 requirements for optimal health and performance in pullets and laying hens To identify whether the type and level of the omega-3 fatty acid in diet can make a difference with regards to birds' health and productivity To determine the optimum quantity and type of omega-3 fatty acids for the expression of optimal immunomodulatory effects in pullets	Omega 3 PUFA; performance; immunology; LPS challenge; pullets; laying hens; oxylipin	Egg Farmers of Canada Manitoba Egg Farmers NSERC-CRD	Neijat, M., Zacek, P., Picklo, M. J., & House, J. D. (2020). Lipidomic characterization of omega-3 polyunsaturated fatty acids in phosphatidylcholine and phosphatidylethanolamine species of egg yolk lipid derived from hens fed flaxseed oil and marine algal biomass. Prostaglandins, Leukotrienes and Essential Fatty Acids, 161, 102178. Neijat, M., Habtewold, J., Li, S., Jing, M., & House, J. D. (2020). Effect of dietary n-3 polyunsaturated fatty acids on the composition of cecal microbiome of Lohmann hens. Prostaglandins, Leukotrienes and Essential Fatty Acids, 162, 102182.
Cuticle proteins in diverse lines of chickens	Dr. Bruce Rathgeber	Dalhousie University	Ms. Janice MacIssac Dr. Solomon Demeke Dr. Maxwell Hincke Dr. Nick Anthony	2017	Jan-18	May-22	4	Complete	FS HNH BNH	To dermine the presence of antimicrobial proteins in the cutitcle layer of egg shells 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 To determine if there is a relationship between the cuticle proteins and the shell matrix proteins that would allow for selection of overall complement of shell ptoteins based on the cuticle protein profile	Egg shell proteins; antibacterial protection; genetics; cuticle; shell matrix proteins; salmonella	Egg Farmers of Canada Egg Farmers of New Bunswick Pan Atlantic Partnership	
Circular economy- Application to egg production in Canada	Dr. Maurice Doyon	Laval	Dr. Ibrahima Bocoum Dr. Nathan Pelletier	2018	Oct-18	Mar-20	1.5	Complete	ES	To develop quatifiable and objective circular economy indicators for egg production, which are evaluated by industry stakeholders To test the indicators on three to four farms with different production systems	Circular economy; sustainability; greenhouse gas emissions; value chain; indicators; technology	Egg Farmers of Canada EFC Egg Industry Research Chair Fund	Rukundo, R.; Bergeron, S.; Bocoum, I.; Pelletier, N.; Doyon, M. A Methodological Approach to Designing Circular Economy Indicators for Agriculture: An Application to the Egg Sector. Sustainability 2021, 13, 8656. https://doi.org/10.3390/su13158656
A novel non-antibiotic strategy for controlling avian pathogenic Escherichia coli in laying hens	Dr. Dongyan Niu	University of Calgary	Dr. Yuxi Wang Dr. Faizal Careem Dr. Tim McAllister Dr. Martin Zuidhof Dr. Martin Nyachoti	2018	Oct-18	Sep-23	5	Complete	FS LR	To evaluate the effects and feasibility of tannins and/or in combination with phages, in management of colibacilosis on egg farms	Colibacilosis; APEC; alternative to antibiotics; antimicrobial strategy; feed additive; tanins; bacteriophages	Egg Farmers of Canada Alberta Agriculture and Forestry AAFC	

Project title	Principal Investigator	Institution	Collaborators	Year of approval	Project start date	Project end date	Project length (y)	Status	Research priorities	Objectives	Keywords	Funding agencies	Peer reviewed articles
Importance of eggshell cuticle quality for reducing bacterial adherence in table eggs	Dr. Maxwell Hincke	University of Ottawa	Dr. Alejandro Rodriguez Navarro Dr. Tamer Ahmed Dr. Garima Kulshreshtha	2018	Oct-18	Mar-23	4.5	Complete	FS	To evaluate the effect of differences in cuticle quality related to hen age, strain and egg washing on bacterial adhesion to the eggshell surface To evaluate the effect of cuticle plugs in limiting/blocking bacterial adhesion and trans-shell penetration through respiratory pores in the eggshell To identify the active components of good quality cuticle that limit bacterial adhesion To identify the mechanisms of action of cuticle components that modulate bacterial load on the eggshell surface	Food safety; eggshell cuticle; Samonella enteriditis; Bacillus cereus; cuticle chemical composition; bacterial load	Egg Farmers of Canada Burnbrae	Kulshreshtha, G., Rodriguez-Navarro, A., Sanchez-Rodriguez, E., Diep, T. and Hincke, M.T. (2018) Cuticle and pore plug properties in the table egg. Poultry Science 97(4):1382-1390. https://doi.org/10.3382/ps/pex409 Kulshreshtha, G., Benavides-Reyes, C., Rodriguez-Navarro, A.B., Diep, T. and Hincke, M.T. (2021) Impact of different layer housing systems on eggshell cuticle quality and Salmonella adherence in table eggs. Foods, 10 (11), 2559. https://doi.org/10.3390/foods10112559 Kulshreshtha, G., D'Alba, L.D., Dunn, I.C., Rehault-Godbert, S., Rodriguez-Navarro, A.B., and Hincke, M.T. (2022) Properties, genetics and innate immune function of the cuticle in egg-laying species. Frontiers in Immunology, 13: 838525. https://doi.org/10.3389/fimmu.2022.838525 Kulshreshtha, G., Diep, T., Hudson, H.A., and Hincke, M.T. (2022) High value applications and current commercial market for eggshell membranes and derived bioactives. Food Chemistry, 382: 132270. https://doi.org/10.1016/j.foodchem.2022.132270
Assessment of the impact of Canadian infectious bronchitis virus (IBV) variants on egg production and fertility in chickens	Dr. Faizal Careem	University of Calgary	Dr. Martine Boulianne Dr. Susan Cork Dr. Susantha Gomis Dr. David Hall Dr. Eva Nagy Dr. Davor Ojkic Dr. Rob Renema	2018	Jan-19	Jan-23	4	Complete	BNH LR	Isolation of variant IBV strains originating from broiler and layer flocks in Canada Determine whether the isolated Canadian variant IBV strains cause abormalities in the reproductive tract leading to lower egg production and fertility problems Estimate the ecnomic impact of IBV on the Canadian poultry industry Formulate possible disease mitigation strategies suggesting potential vaccine candidate strains and communicate to target communities with a view of minimizing the impact of variant IBV on egg production and fertility	Infectious bronchitis virus; vaccines; new variants; outbreaks; reproductive performance; egg production and quality; economic impact	Egg Farmers of Canada Agriculture and Agri Food Canada (via CPRC) Poultry Health Services	Hassan MSH, Ojkic D, Coffin CS, Cork SC, van der Meer F, and Abdul-Careem MF. 2019. The Delmarva (DMV/1639) Infectious Bronchitis Virus (IBV) Variants Isolated in Eastern Canada Show Evidence of Recombination. Viruses, Nov 13;11(11). pii: E1054. doi: 10.3390/v11111054. Najimudeen SM, Hassan MSH, Cork SC, and Abdul-Careem MF. 2020. Pathogenesis of infectious bronchitis coronavirus infection in chickens: Multiple system disease with immune suppression. Pathogens 9 (10), 779. Hassan MSH, and Abdul-Careem MF. 2020. Avian Viruses That Impact Reproductive Performance. Animals Sep 25;10(10):1747. doi: 10.3390/ani10101747 Najimudeen SM, Hassan MSH, Goldsmith D, Ojkic D, van Marle G, Cork SC, van der Meer F, and Abdul-Careem MF. 2021. Molecular characterization of 4/91 infectious bronchitis virus leading to studies of pathogenesis and host responses in laying hens. Pathogens 10(5):624. doi: 10.3390/pathogens10050624. Hassan MSH, Ali A, Buharideen SM, Goldsmith D, Coffin CS, Cork SC, van der Meer F, Boulianne M, and Abdul-Careem MF. 2021. Pathogenicity of the Canadian Delmarva (DMV/1639) Infectious Bronchitis Virus (IBV) on female reproductive tract of chickens, Viruses, 13(12), 2488; https://doi.org/10.3390/v13122488 Najimudeen SM, Barboza-Solis C, Ali A, Buharideen SM, Hassan MSH, Isham IM, Ojkic D, van Marle G, Cork SC, van der Meer F, Boulianne M and Abdul-Careem MF. 2021. Pathogenesis and host responses in lungs and kidneys following Canadian 4/91 Infectious bronchitis virus (IBV) infection in chickens. Virology, 566:75-88. doi: 10.1016/j.virol.2021.11.013. Hassan MSH, Najimudeen SM, Ali A, Altakrouni D, Goldsmith D, Coffin CS, Abdul-Careem, MF. 2021. Immunopathogenesis of the Canadian Delmarva (DMV/1639) infectious bronchitis virus (IBV): Impact on the reproductive tract in layers. Microb Pathog, 166:105513. Ali A, Ojkic D, Elshafiee EA, Shany S, El-Safty MM, Shalaby AA, Abdul-Careem MF. Genotyping and In Silico Analysis of Delmarva (DMV/1639) Infectious Bronchitis Virus (IBV) Spike 1 (S1) Glycoprotein. Genes (Basel). 2022 Sep 9;13(9):1617. doi: 10.3390/genes13091617. PMID: 36140785;
Determination of the metabolic triggers responsible for sexual maturation in layer chickens and their relation to rearing environment and nutrition	Dr. Gregoy Bedecarrats	University of Guelph	Dr. Elijah Kiarie Dr. Tina Widowski	2018	Jan-19			Ongoing	ACS BNH LR	Determine the body weight and body composition thresholds responsible for initiating sexual maturation in two strains of layers (brown and white) reared under different environments mimicking industry practices	Photostimulation; reproduction; metabolic cues; pullet; body composition; rearing environment; sexual maturation	Egg Farmers of Canada NSERC-CRDPJ OMAFRA CFREF-fFt	
Precision pullet rearing strategies for optimal reproductive body condition.	Dr. Martin Zuidhof	University of Alberta	Dr. Gregoy Bedecarrats Dr. Leluo Guan	2018	Jan-21			Ongoing	ACS BNH LR	To add value to an existing project that can provide important insights into the effect of body composition and metabolic status on reproductive performance To tailor the type and the amount of feed we provide to pens or individual free run individuals based on their treatment-specific nutrient requirements, estimated in the precision feeding treatment at the time feed is provided To determine the effect of dietary energy levels on body composition, metabolic status, and activation of the reproductive endrocrine axis To compare the performance and efficiency of ad libitum and strategic feed restriction on body composition, metabolic status and activation of the reproductive endocrine axis To link changes in signalling molecules and receptors over time with the timing of sexual maturation, persistency of lay and lifetime reproductive efficiency	Sexual maturity; growth strategies; diet; pullets; reproductive efficiency; metabolic and physiology signals; precision feeding	Egg Farmers of Canada Truow Nutrition, Inc. University of Alberta University of Guelph	
Egg yolk lecithin supplementation to improve pulmonary health: Implications for healthy individuals and individuals with Chronic Obstructive Pulmonary Disease	Dr. Mathieu Morissette	Institut universitaire de cardiologie et de pneumologie de Québec - Université Laval	Dr. François Maltais Dr. Ynuk Bosse	2018	Jan-19	Apr-23	4	Complete	HNH	Setting the foundation stone in the new field of nutrition and pulmonary health, with emphasis on egg yolk lecithin supplementation in healthy individuals and individuals with chronic obstructive pulmonary disease or COPD	Eggyolk lecithin supplementation; phosphatidylcholine ; respiratory health; COPD; clinical trial	Egg Farmers of Canada	
A novel egg white-based biomaterial for 3D tissue engineering *	Dr. Simon Tran	McGill University	Dr. Joseph Matt Kinsella Dr. Allen J. Ehrlicher Dr. Anthony Zeitouni Dr. Michel El-hakim	2019	Oct-19	Mar-20	0.5	Complete	IUE	Partial characterization of physical properties of egg white alginate (EWA) in addition to the complete establishment of the protocol for creating EWA Comparison of cellular behaviour and growth in EWA and Matrigel Obtain evidence that salivary gland cultures grown on EWA aPPar normal as opposed to abnormal/cancerous/dysfunctional Proof that EWA produces comparable results to cells grown on Matrigel and from the native tissue	Tissue engineering and regenerative medicine; organoid 3D cell culture; scaffold; egg white alginate; salivary tissue	Egg Farmers of Canada NSERC	Zhang, Yuli, et al. "The Optimization of a Novel Hydrogel—Egg White-Alginate for 2.5 D Tissue Engineering of Salivary Spheroid-Like Structure." Molecules 25.23 (2020): 5751.
Modified eggshell membrane formulations as a novel supplement to maintain gut health *	Dr. Maxwell Hincke	University of Ottawa	Dr. Chantal Matar Dr. Riadh Hammami Dr. Tamer Ahmed Dr. Garima Kulshreshtha Dr. Walid Mottawea	2019	Jun-20			Ongoing	HNH IUE ES	Contact: mhinke@uottawa.ca	Eggshell membrane; Egg quality; proteomics; immunomodulatory effects; prebiotic; skin;	Egg Farmers of Canada LRIC Burnbrae Farms	
Optimization of vaccination strategies for table egg layers controlling egg production problems induced by currently circulating infectious bronchitis virus (IBV) variants	Dr. Faizal Careem	University of Calgary	Dr. Susan Cork Dr. Susantha Gomis Dr. Davor Ojkic	2019	Sep-20			Ongoing	BNH LR	To determine the protective efficacy of IBV vaccines against shell-less egg syndrome and drop in egg production induced by the variant IBV Mass type isolated from Western Canadian layer flocks To determine the protective efficacy of IBV vaccines against false layer syndrome and drop in egg production induced by variant IBV DMV type isolated from Eastern Canadian layer flocks Formulate possible disease mitigation strategies suggesting potential vaccine strains and communicate to both Western and Easter Canadian poultry industries with a view of minimizing the impact of variant IBV on egg production	Vaccination strategies; infectious bronchitis virus; false layer syndrome; shell-less egg syndrome; Delmarva variant; Massachusetts variant	Egg Farmers of Canada Egg Farmers of Alberta Alberta and Agriculture Forestry University of Calgary NSERC-Alliance	
The fermentation of spent hen hydrolysate (from thermal hydrolysis) to produce pathogen free microbiological rich plant nutrient solutions.	Mr. Marc Legault	Alberta Forestry	Mr. Randy Andrews Dr. Yamily Zavala	2019	Nov-20	Dec-22	2	Complete	GTF ES	Demonstrate the value-added potential for spent hens by aerobically digesting (fermenting) spent hen hydrolysate to produce an organic based plant nutrient solution. Demonstrate the merit of these solutions by growing plants using commercial greenhouse techniques Investigate crop productivity and the soil health impact from using spent hen hydrolysate and fermented spent hen dydrolysate amendments	Spent hens; spent hen hydrolysate; plant nutrient solution; thermal hydrolysis; plant growth trials; fermentation	Egg Farmers of Canada BC Sustainable Poultry Farming Group Biosphere Technologies Chinook Applied Research Association Alberta Agriculture and Forestry	

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The beneficial effect of egg-derived phosphatidylcholine on the obesity-related immune dysfunction.	Dr. Caroline Richard	University of Alberta	Dr. Rene Jacobs	2019	Nov-19	May-23	3.5	Complete	HNH	To understand the mechanisms (direct and indirect) by which egg phosphatidylcholine can counteract the negative effect of a high-fat diet and obesity on T-cell function	Obesity; immune function; T cell function; dietary fatty acids; phosphatidylcholine; digestive tract	Egg Farmers of Canada NSERC	Azarcoya-Barrera J, Wollin B, Veida-Silda H, Makarowski A, Goruk S, Field CJ, Jacobs RL, Richard C*. Egg-phosphatidylcholine attenuates T-Cell dysfunction in high-fat diet fed male Wistar rats. Frontiers in Nutrition. 2022; Feb 2;9:811469. eCollection 2022. PMID: 35187037. T. Rusnak, J. Azarcoya-Barrera, B. Wollin, A. Makarowski, R. Nelson, C.J. Field, R.L. Jacobs, C. Richard, A physiologically relevant dose of 50% egg-phosphatidylcholine is sufficient in improving gut permeability while attenuating immune cell dysfunction induced by a high-fat diet in male Wistar rats, The Journal of Nutrition, https://doi.org/10.1016/j.tjnut.2023.08.010
Get cracking for diabetes: An egg-based breakfast for improving blood glucose control in type 2 diabetes	Dr. Jonathan Little	University of British Columbia- Okanogan	Dr. Monique Francois	2019	May-20	Jun-22	2	Complete	HNH	To detemine whether a low-carbohydrate egg-based breakfast, compared to a standard control low-fat breakfast: -reduces haemoglobin A1c in individuals with type 2 diabetes; -improves satiety and consequently lower daily caloric intake in individuals with type 2 diabetes; -reduces body weight and body fat mass in individuals with type 2 diabetes; -improves blood lipid profile and inflammation biomarkers in individuals with type 2 diabetes	Type 2 diabetes; breakfast; carbohydrates; eggs; glycemic control; satiety; cardiometabolic health; body composition	Egg Farmers of Canada Egg Nutrition Centre USA	Oliveira BF, Chang CR, Oetsch K, Falkenhain K, Crampton K, Stork M, Hoonjan M, Elliott T, Francois ME, Little JP*. Impact of a Low-Carbohydrate Compared with Low-Fat Breakfast on Blood Glucose Control in Type 2 Diabetes: A Randomized Trial. Am J Clin Nutr. 2023 Jul;118(1):209-217. doi: 10.1016/j.ajcnut.2023.04.032
Animal implant studies with nano-textured eggshell-based constructs for bone regeneration. *	Dr. Maxwell Hincke	University of Ottawa	Dr. Isabelle Catelas Dr. Tamer Ahmed Dr. Eric A. Lehoux	2019	May-21			Ongoing	HNH IUE	Contact: mhinke@uottawa.ca	Bone repair; bone grafting; eggshell; biomaterials	Egg Farmers of Canada	
Use of 3D kinematics and genomics to evaluate perching biomechanics in commercial and heritage strains of enriched-housed pullets and laying hens	Dr. Clover Bench	University of Alberta	Dr. Doug Korver Dr. Nigel Cook Dr. Graham Plastow	2019	Feb-20	Nov-23	3.5	Complete	ACS BNH LR	To assess the biomechanics of perching behaviour in pullets and laying hens using 3D kinematics in order to determine which optimal phenotypes are associated with specific genomic markers, stronger bones and better keel and foot health for layers housing in enriched cages	Perching; 3D kinematics; pullets; laying hens; genetics; bone health; keel bone damage; foot health; colony cages	Egg Farmers of Canada Alberta Agriculture and Forestry Egg Farmers of Alberta	DePaoli, E., Korver, D., Bench., C. (2023a). The effect of laying hen strain on perching biomechanics and keel bone damage. Poultry Science. Submitted Sept 2023 Manus ID PSJ-D-23-01446 DePaoli, E., Korver, D., Bench., C. (2023b). Effect of rearing environment, strain and perch shape on perching behaviour, perching biomechanics, and keel bone damage in enriched-housed laying hens. Applied Animal Behaviour Science. Submitted Sept.28.2023 Submission ID PSJ-D-23-01446.
Mining the chicken gastrointestinal microbiome for novel anti-infective probiotics to reduce the incidence of bacterial infections	Dr. Jennifer Ronholm	McGill University	None	2019	Oct-19	Apr-22	2.5	Complete	FS ES BNH	Create a culture collection of commensal Proteobacteria isolates from fecal samples from several health laying hens that is representative of the total diversity Proteobacteria in the laying hen intestine Characterize the ability of each isolate to antagonize laying hen bacterial pathogens of interest in the reductionist co-culture environment	Antibiotic resistance; alternatives to antibiotics; microbiome; probiotis; exclusion by competition	Egg Farmers of Canada McGill Sustainability Systems Iniatiative	
Impact of alternative housing systems on layers health and egg production	Dr. Martine Boulianne	University of Montreal	Dr. Stephane Godbout Dr. Alexandra Harlander Dr. Caroline Duchaine	2019	Jan-20	Apr-23	3	Complete	ACS HNH BNH	To understand the effect of two different housing systems, enriched cages and aviaries, on laying hens' health, air and egg production parameters	Aviaries; enriched colonies; on-farm environmental sampling; bacterial pathogens; welfare	Egg Farmers of Canada Fédération des producteurs d'œufs du Québec	
Egg as a strategy to maintain retina health in diabetes	Dr. Miyoung Suh	University of Manitoba	Ms. Tiffany Nicholson	2019	Dec-19			Ongoing	HNH	To investigate the effect of lutein and DHA enriched eggs consumption on retina health in individuals with diabetes	Diabetes; retinopathy; eye health; egg yolk; carotenoids; fatty acids	Egg Farmers of Canada Burnbrae University of Manitoba	
Functional feedstuffs to bolster performance and immunocompetence of pullets reared at different rearing densities in furnished cages	Dr. Elijah Kiarie	University of Guelph	Dr. Moussa S. Diarra	2020	Jan-21			Ongoing	BNH LR	Assess the impact of functional feedstuff to pullets housed at two densities in furnished cages on growth, mortality, biomarkers for health and abundance of avian pathogenic E. coli in the gastrointestinal and respiratory systems Egg production, egg quality, livability, biomarkers for health and abundance of avian pathogenic E. coli in gastrointestinal and respiratory systems of hens reared on functional feedstuffs	Alternative housing; antimicrobial use; feedstuff that bolster immunocompetence; omega 3 fatty acids; yeast metabolites; pullet rearing; stress; performance	Egg Farmers of Canada Canadian Biosystems Inc O&T Farms Ltd Livestock Research Innovation Corporation/Egg Farmers of Ontario NSERC Ontario Agri-Food Innovation Alliance - Tier II	
Optimization of environmental and hen welfare outcomes in Canadian egg production using predictive analytics (machine learning) techniques	Dr. Nathan Pelletier	University of British Columbia- Okanogan	Dr. Davoud Heidari Dr. Tina Widowski	2020	Dec-20			Ongoing	ES	Identification of best-fit machine learning techniques for sustainability optimization in the egg industry Application of the identified techniques to the Canadian egg industry farm level data set collected in 2019 Integration of results in the housing system-specific Canadian life cycle inventory models Life cycle impact assessment, including animal welfare impact assessment Identification of housing system-specific sustainability best management practices and technologies for the Canadian egg industry across resource, environmental and animal welfare criteria Assessment of the impact mitigation potential of industry-wide application of the identified sustainability best practices	Life cycle assessment; sustainability best practices; resource and environmental indicators; welfare indicators; alternative housing systems; predictive analytics; resource efficiency	Egg Farmers of Canada NSERC/EFC IRC CFI JELF	
Determination of ideal perch space allowance for pullets	Dr. Karen Schwean-Lardner	University of Saskatchewan	None	2020	Dec-20			Ongoing	ACS LR	To determine the minimum perch space requirement for white and brown feathered pullets at different ages until 18 weeks of age	Perching; pullets; space allowance; floor pens; behaviour; keel bone damage; strain; stress; welfare	Egg Farmers of Canada Clark's Poultry Inc	
Egg white-alginate based biomaterial for 3D tissue engineering *	Dr. Simon Tran	McGill University University	Dr. Anthony Zeitouni Dr. Michel El-Hakim Dr. Joseph Matt Kinsella Dr. Jose Gil Munguia-Lopez	2020	Oct-20	Sep-22	2	Complete	IUE	Contact: simon.tran@mcgill.ca	Three dimensional cell culturing; tissue engineering; scaffolds; egg white; alginate; salivary tissue	Egg Farmers of Canada	
The role of eggs in improving choline and DHA nutrition during development	Dr. Angela Devlin	University of Britsh Columbia	Dr. Alejandra Wiedeman Dr. Rajavel Elango	2020	Dec-20	Dec-22	2	Complete	HNH	To determine the contribution of eggs to dietary intakes and status of choline and DHA at critical time points during development	Diet; growth and development; phosphatidylcholine; toddlers and children; eggs	Egg Farmers of Canada	Wiedeman AM, Dhillon A, Wu BT, Innis SM, Elango R, Devlin AM. School-aged children in Vancouver, Canada do not meet dietary choline recommendations but meet recommendations for folate and vitamin B12. J Nutr 2022; accepted, in press
Sustainable composites from waste eggshells for practical applications *	Dr. Duncan Cree	University of Saskatchewan	Dr. Lee D. Wilson Dr. Edmund Mupondwa	2020	Sep-21			Ongoing	ES	Contact: duncan.cree@usask.ca	Sustainable composites; eggshell; thermal and mechanical properties; fillers; production processes; technoeconomic analysis; life cyle assessment	Egg Farmers of Canada Egg Solutions EPIC Inc Star Egg Company Limited Burnbrae Farms Ltd NSERC	

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Assessing hatchery related well-being	Dr. Karen Schwean-Lardner	University of Saskatchewan	Dr. Trever Crowe Dr. Andrew Van Kessel	2020	May-21			Ongoing	ACS BNH PP LR	Determine if the current head-holding device for infrared beak treatment results in stress of newly-hatched leghorn chicks. Determine if additional support improves welfare Assess the impact of space allowance for leghorn chicks in boxes during transport on stress and nutrient absorption Assess the impact of long-term transport (24h) on chick health and welfare Determine if early post-hatch feeding, interrupted early post-hatch feeding, or no early feeding affect leghorn chick health, performance, and welfare during and after transport	Hatchery; beak treatment holding device; space allowance; transport boxes; early post-hatch feeding; transport	Egg Farmers of Canada Nova-Tech Clark's Hatchery Calpis America Inc Saskatchewan Egg Producers Steinbach Hatchery Canadian Poultry and Egg Processors Council Mitacs	
Development of novel and alternative approaches using small-RNA based immune-stimulant molecules for control of avian infectious bronchitis virus *	Dr. Neda Barjesteh / Dr. Faizal Careem	University of Montreal / University of Calgary	Dr. Martine Boulianne Dr. Carl A. Gagnon	2020	Jan-21			Ongoing	BNH	Contact: mfabdulc@ucalgary.ca	infectious bronchitis virus; disease control strategies; small-RNA; immune system; performance	Egg Farmers of Canada Canadian Poultry Research Council LRIC NSERC-Discovery	
Effect of LED flicker on the welfare, health, and production of pullets reared to 16 weeks and further impacts on hen performance and egg production and quality	Dr. Karen Schwean-Lardner	University of Saskatchewan	Dr. Trever Crowe	2020	May-21	Nov-23	2.5	Complete	ACS ES	Determination of the impact of flickering LED lights on pullet activity levels, fear response, chronic stress and general production traits Determine if pullets exposed to flickering light are impacted during the hen phase	Lighting programs; flickering light; behaviour; light emitting diode; productivity; welfare; health; pullets	Egg Farmers of Canada Clark's Poultry Inc Saskatchewan Egg Producers Egg Farmers of Alberta	
Impact on metabolic health of new ingredients enriched with active components derived from egg yolk *	Dr. Alain Doyen	Universite Laval	Dr. Guillaume Brisson Dr. Andre Marette	2020	Jan-21	Jan-23	2	Complete	HNH IUE	Contact: alain.doyen@fsaa.ulaval.ca	Intestinal dysbiosis; eggs; egg yolk; digestibility; bioavailability	Egg Farmers of Canada Mitacs	
Understanding the social representations of meat, eggs and animal proteins replacement products and their impact on food habits	Dr. Laurence Godin	Universite Laval	Dr. Maurice Doyon Dr. Madeleine Pastenelli	2020	Jan-21	Aug-23	2.5	Complete	PP	Mapping the social representations of alternatives to meat, eggs and other animal proteins, and the tensions between them, in Canada. Understanding the role of these social representations for reducing meat consumption, in relation to sustainability and health. Examining the implications of these findings for the consumption of animal products with lower environmental impacts such as eggs and dairy.	Diet; sustainability; animal-based proteins; challenges; social representations; health; culture; society;	Egg Farmers of Canada Egg Indutry Chair Department of EAC	
Whole eggs for reducing inflammation and promoting muscle repair in adults with obesity.	Dr. De Lisio	University of Ottawa	None	2020	Sep-21			Ongoing	HNH	To determine if short-term increased whole egg consumption restores muscle regeneration in adults with obesity to a level comparable to lean adults	Obesity; chronic disease; muscle; protein ingestion; muscle regeneration; egg yolk	Egg Farmers of Canada Ontario Early Research Award	
Surveillance of egg yolk peritonitis and causative Escherichia coli in egg farms, Alberta	Dr. Dongyan Niu	University of Calgary	Dr. Faizal Careem Dr. Frank Marshall Dr. Teryn Girard Dr. John Fairbrother	2020	Apr-21			Ongoing	BNH	To survey magnitude of egg yolk peritonitis in pullets and layers farms, in Alberta, assess effects of inherent and environmental factors on disease development as well as identify primary pathogenic traits of etiological agents	Egg yolk peritonitis; avian pathogenic Escherichia coli; housing; multifactorial disorder	Egg Farmers of Canada Egg Farmers of Alberta Major Innovation Fund University of Calgary Marshall Swine & Poultry Health Services Results Driven Agriculture Research	
From eggshell wastes to key components in green energy storage and conversion *	Dr. Zhi Li	University of Alberta	Dr. Ken Cadien	2021	Feb-22			Ongoing	IUE	Contact: zhi.li@ualberta.ca	High performance electrochemical energy storage system; supercapacitors; eggshell membrane	Egg Farmers of Canada	
A detailed characterization of particular matter in Canadian Egg Farms	Dr. Ran Zhao	University of Alberta	Dr. Martin Zuidhof Dr. Valerie Carney Dr. Martine Boulianne	2021	Sep-21			Ongoing	ES BNH	To evaluate and optimize the use of low-cost air quality sensors in egg farms To understand the trend of dust and particulate matter in Canadian egg farms, particularly those with enriched cages and aviary housings To identify factors impinging on the concentration of dust and particulate matter To understand the chemical composition and toxicological effect of particulate matter in egg farms	Air pollutants; dust; particulate matter; egg farms; low-cost air quality sensors	Egg Farmers of Canada Poultry Research Centre University of Alberta-Environmental Canada and Climate Change Canada Foundation of Innovation Agriculture Funding Consortium ELITE Program for Black Youth	
Long-life layers - An environmental, economic, and animal welfare cost/benefit analysis	Dr. Nathan Pelletier	University of British Columbia- Okanogan	Dr. Maurice Doyon	2021	Sep-21			Ongoing	ES PP	To investigate and quantify the potential effects of extending lay cycle lenghts on the environmental, animal welfare, and economic performance of egg production in Canada	Lay cycle extension; economy; environment; welfare; sustainability; quantification; predicitive models	Egg Farmers of Canada NSERC/EFC IRC in Sustainability Economic Egg Industry Research Chair PRISM LAB Department of Ag Economics, Laval University Egg Farmers of Alberta Results Driven Agriculture Research	
The use of pecking blocks as foraging enrichment for improvement of feather condition in enriched colonies	Dr. Tina Widowski	University of Guelph	Dr. Alexandra Harlander	2021	Dec-21			Ongoing	ACS LR	Determine the effect of pecking blocks on foraging behaviour, feather pecking, feather damage and beak shape Determine the most effective placement of the pecking block within an enriched colony Determine pecking block use and soiling and how it influences the use and soiling of scratch mats Identify individual differences in frequency and duration of pecking behaviour and ingestion of pecking block material among hens to help match the behaviour to health outcomes Assess pecking block use on keel fracture, feather damage prevalence, eggshell quality, etc Determine if the attraction to pecking blocks is related to a specific aPPtite, e.g. calcium or pecking block composition	Feather pecking; substrates; enriched colonies; pecking blocks; calcium aPPtite; preference; location	Egg Farmers of Canada Protekta Inc Probiotech Intl Inc Egg Farmers of Ontario Ontario Agri-Fod Innovation Alliance	
Pre-hatch sexing for chickens based on chorioallantoic membrane (CAM) immuno-interrogation *	Dr. Maxwell Hincke	University of Ottawa	None	2021	May-22			Ongoing	ACS ES	Contact: mhinke@uottawa.ca	Pre-hatch sex identification;-W chromosome; chorioallantoic membrane	Egg Farmers of Canada Canadian Poultry Research Council NSERC-Alliance	
Egg versus whey protein as the optimal supplement for fitness-conscious people	Dr. Philip Chilibeck	University of Saskatchewan	Dr. Carren Candow Dr. Gordon Zello	2021	Sep-21	Sep-23	2	Complete	HNH IUE	To evaluate the effectiveness of whole-egg protein powder supplementation compared to whey protein supplementation in a group of male and females (aged 18-35 years old) who are currently engaged in exercise training	Whey protein; resistance-training; whole egg protein; protein synthesis; glycemic index	Egg Farmers of Canada University of Saskatchewan University of Regina Mitacs	

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Cold plasma pasteurization of liquid whole eggs*	Dr. Kevin Keener	University of Guelph	None	2021	Sep-21			Ongoing	FS	Contact: kkeener@uoguelph.ca	Egg products; liquid eggs; Salmonella spp; heat pasteurization; quality and functional properties of eggs; high voltage atmospheric cold plasma technology	Egg Farmers of Canada Barrett Family Foundation Chair	
Manipulation of maturity with light during incubation	Dr. Bruce Rathgeber	Dalhousie University	Dr. Karen Schwean-Lardner Dr. Doug Korver Ms. Janice MacIsaac	2021	Mar-22			Ongoing	BNH	Determine the impact of photoperiod length during incubation of hatching eggs on hatch success and timing of hatch; early post-placement feed and water intake; recovery from long distance transportation; age at first egg; overall performance over a production period;egg numbers and egg size; bone health long term	Light; incubation; daylength; performance; sexual maturity; hatch; bone health	Egg Farmers of Canada	
Evaluation of hemp seed products to ameliorate fatty liver disease and reduce cannibalism in laying hens	Dr. Stephanie Collins	Dalhousie University	Dr. Michael Cockram Ms. Janice MacIsaac Dr. Bonita McCuaig	2021	Apr-22			Ongoing	ACS HNH BNH	To determine, in laying hens, the effect of feeding hemp by-products on: production performance, mortality rate, incidence of fatty liver disease, egg yolk cbd and fatty acid profile, feather pecking behaviour and incidence of cannibalism, gut microbial populations	Fatty liver disease; hemp; gut microbiome; omega 3 fatty acids; cbd; behaivour; feather pecking; cannibalism; housing systems	Egg Farmers of Canada Atlantic Egg Farmers APRI Mitacs	
Supplementation strategies in vitamin D to protect layers from vitamin D deficiency and immunological stress	Dr. Marie-Pierre Letourneau-Montminy	Universite Laval	Dr. Lucie Galiot Dr. Angel Rene Alfonso Dr. Antony Vincent Dr. Agnes Narcy Dr. Roselina Angel Dr. Martine Boulianne Dr. Mariela Segura Dr. Doug Korver	2021	May-22			Ongoing	HNH BNH	To test the addition of a vitamin D in a more active form to the maximum allowed up to 90 weeks of laying in terms of: production performance; phosphorus, calcium, magnasium and vitamin D status; indicators of the immune system; gut microbiota; bone mobilization	Vitamin D; micronutrients; immune system; gut microbiota; bone health	Egg Farmers of Canada Fédération des producteurs d'œufs du Québec DSM Agri-Marche Mitacs NSERC	
Use of full-body imaging scans on live chickens to develop a model describing the impact of body composition on sexual maturation	Dr. Gregoy Bedecarrats	University of Guelph	Dr. Elijah Kiarie Dr. Adronie Verbrugghe Dr. Jennifer Ellis Dr. Martin Zuidhof Dr. Tina Widowski	2021	Sep-21			Ongoing	BNH LR	Development of a standard operating procedure for the use of full-body imaging scans on live chickens. Monitor body composition changes during the growth of layer pullets with a specific focus on adipose accumulation and bone characteristics. Determine the precise relationship between changes in body composition and the onset of sexual maturation throughout the development of pullets. Develop a model describing the physiological processes governing the impact of body composition on reproductive capacity and fitness.	Environmental and metabolic cues; laying; sexual maturation; adipose tissue; rearing; full body imaging; live chicken; mathematical model	Egg Farmers of Canada NSERC	
Expanding opportunities for Western Canadian fava bean (Vicia faba) as a feedstuff for laying hens	Dr. Doug Korver	University of Alberta	None	2022	Sep-22			Ongoing	ES BNH	To identify knowledge or perceptual barriers to increased usage of faba bean in poultry diets; To characterize the ranges in metabolizable energy, nutrient and antinutritionalfactor content in Western Canadian faba bean cultivars; To demonstrate the potential for faba bean to reduce reliance of the egg industry on imported soybean meal; To determine the potential for incorporating faba beans into laying hen diets to reduce the GHG intensity of table egg production; and, To investigate the impact of known antinutritional factors in faba beans (e.g., tannins, vicine/convicine) on the productivity and health of laying hens; To communicate the results of the project to all stakeholders to facilitate commercial application of the results in Western Canada.	Feedstuff; faba beans; GHG footprint; anti-nutritional factors; nutrient content	Egg Farmers of Alberta Alberta Pulse Growers Commission Poultry Innovation Partnership Alberta Chicken Producers Saskatchewan Pulse Growers Commissions Results Driven Agricultural Research	
Perching requirements for pullets and laying hens: Preferences for grasping and elevation	Dr. Tina Widowski	University of Guelph	None	2022	Sep-22			Ongoing	ACS LR	Determine the preferences of hens for perching structures that allow grasping versus those that do not Determine how hens prioritize seeking elevation versus their ability to grasp a structure Determine the relationship between ability to grasp and ability to balance on different perch structures Determine the relationship between ability to grasp and relaxed sleeping postures Determine the development of grasping in relation to perch and elevation preferences in growing chicks and pullets Determine whether preference for different perch structures is affected by aging or conditions such as bumblefoot and keel fractures Compare differences between white- and brown-feathered strains on all of the above	Laying hens; pullets; perches; design; elevation	Egg Farmers of Canada Ontario-Innovation Alliance Tier II	
EGGS-sactly what's required: eggs as an aPPaling way to restore nutritional status after cancer treatment.	Dr. Vera Mazurak	University of Alberta	Dr. Wendy Wismer Dr. Caroline Richard Dr. Vickie Baracos Dr. Sunita Ghosh	2022	Sep-22			Ongoing	HNH	To determine if consumption of 2 eggs per day beginning immediately after the completion of their chemotherapy will increase protein intake compared to the usual diet, when normalized by body weight in kilograms (kg BW). To evaluate the following measures between the two groups after the first 4 weeks and again at 8 weeks for all participants. • Energy intake - Cumulative energy intake (kcal /kg BW) • Changes in body weight (kg) • Plasma levels of key nutrients contained in eggs (choline, Vitamin D, zinc and essential fatty acids). • Systemic inflammation (C-reactive protein (CRP), interleukin 6, tumor-necrosis-factor-α) • Immune function (cytokine production, immune cell numbers) • Quality of life – overall quality of life self-reported in 8 dimensions of health (SF-36) • Presence of symptoms that interfere with food intake - Patient Generated – subjective Global Assessment (PG-SGA) • Quality of life related to malnutrition - Functional Assessment of Anorexia-Cachexia Therapy (FAACT) 5 Question Anorexia/Cachexia Subscale (FAACT A/CS)	cancer; clinical trial; weight loss; quality of life; immunology	Egg Farmers of Canada Burnbrae Farms Ltd	

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Building a usable surveillance and monitoring tool for avian influenza outbreaks in Canada *	Dr. Rozita Dara	University of Guelph	Dr. Shayan Sharif Dr. Zvonimir Poljak	2022	Nov-22			Ongoing	BNH	Contact: drozita@uoguleph.ca	Avian influenza outbreak; Surveillance System; Decision Support Systems; early detection; prediction	Egg Farmers of Canada CFREF (Food for Thought) OMAFRA Alliance	
Understanding feather pecking in laying hens: the gut-microbiome-brain connection II	Dr. Alexandra Harlander	University of Guelph	Dr. Paul Forsythe Dr. Nienke van Staaveren	2022	Dec-22			Ongoing	ACS BNH	To determine the effect of a GOS prebiotic on 1. Feather pecking behaviour and feather cover condition to determine its potential as a nutraceutical 2. Bacterial cecal composition (bacterial community profiling) to assess whether Lactobacillus growth is supported 3. Blood parameters linked to neurotransmitter precursors, regulatory T-cells, and cytokines to determine its neuro- and immune-modulatory effects To determine optimal supplementation strategies by providing GOS in a preventative or curative protocol	feather pecking; gut-microbiome; galacto oligosaccharides; immune response; amino acids; nervous system;	Egg Farmer of Canada International Dairy Ingredients Inc. OMAFRA	
Towards circular manufacturing strategies for the egg industry using eggshells as value-added mortar filler material for large-scale additive manufacturing*	Dr. Lucas Hof	École de Technologie Supérieure	Dr. Claudiane Plamondo-Ouellet Dr. Duncan Cree	2022	Jan-23			Ongoing	ES IUE	Contact: lucas.hof@etsmtl.ca	Circular economy; sustainable manufacturing; additive manufacturing; eggshell waste valorization; construction engineering	Egg Farmers of Canada Supreme Egg Products Siemens-Energy	
Including egg protein as part of a plant-based dietary pattern improves cardiometabolic health by ameliorating fatty liver disease (FLD).	Dr. Carla Taylor	University of Manitoba	Dr. Peter Zahradka	2022	Jan-23			Ongoing	HNH	To assess hepatic steatosis and liver function by liver/body weight ratio, hepatic lipid accumulation, lipid droplet size and number, and markers of hepatic injury, oxidative stress, inflammation and fibrosis. To determine adiposity and adipose function by whole body composition (fat and lean body mass), adipose fat pads/body weight ratios, adipocyte size and number, macrophage infiltration, and circulating pro- and anti-inflammatory adipokines. To evaluate insulin resistance as determined by fasting insulinemia and glycemia, the homeostatic model assessment index-insulin resistance (HOMA-IR), oral glucose tolerance, and pancreatic islet cell size. To measure cardiovascular risk factors: blood pressure and lipidemia (circulating triglycerides, free fatty acids, LDL-cholesterol, HDL-cholesterol). To analyze the gut microbiome by profiling rRNA in fecal samples to determine the relative abundance of different bacterial taxa. To investigate relationships among hepatic function and the cardiometabolic parameters associated with obesity, adipose function, insulin resistance, and cardiovascular disease as well as the gut microbiome.	egg protein; non-alcoholic fatty liver disease; adipose tissue; insulin resistance	Egg Farmers of Canada	
Role of omega-3 eggs in reducing pro-oxidative and inflammatory effects of omega-6 PUFA in diabetic and geriatric hearts	Dr. Sanjoy Ghosh	University of British Columbia- Oakanogan	Dr. Deanna Gibson	2022	Sep-22			Ongoing	HNH	Can eggs promote antioxidants like GSH, attenuate oxidative damage and cell death in young diabetic mice hearts? Can egg nutrition reduce mitochondrial damage and cell death in aging normoglycemic and diabetic mice hearts? Does egg nutrition promotes a healthy microbiome and curb systemic/cardiac inflammation under a high n-6 PUFA diet?	Polyunsaturated fats; heart; oxidative stress; diabetes; geriatrics	Egg Farmers of Canada	
Egg residue depletion of oral topical formulations of Fluralaner (BravetoTM) in laying hens.	Dr. Patricia Dowling	University of Saskatchewan	Dr. Karen Schwean-Lardner Mr. Shurmer Dr. Ron Johnson	2022	May-23			Ongoing	ACS FS BNH	To determine if canine or feline formulations of fluralaner, given orally or applied topically respectively, would have similar residue depletion in eggs to the soon to be approved poultry formulation Exholt™ and therefore would be suitable for small flock use to treat and control red mites.	fluralaner; Dermanyssus gallinae; egg; residues	Egg Farmers of Canada Canadian Food Inspection Agency	
Antimicrobial peptides: A better alternative to antibiotics in egg farms*	Dr. Inanc Birol	Michael Smith Genome Sciences Centre	Dr. Caren Helbing Dr. Martine Boulianne Dr. William Cox	2022	Sep-22			Ongoing	BNH	Contact: ibirol@bcgsc.ca	Antibiotic resistance; antibiotic alternatives; antimicrobial peptides; nutritional	Egg Farmers of Canada Genome Canada Genome British Columbia	
A preliminary human study on bioavailability and efficacy of bioactive peptide IRW in egg white hydrolysate.	Dr. Jianping Wu	University of Alberta	Dr. Caroline Richard	2022	Sep-22			Ongoing	IUE HNH	To investigate the bioavailability of IRW in egg white hydrolysate in healthy subjects and those with the metabolic syndrome. To investigate the efficacy of IRW in egg white hydrolysate at lowering blood pressure and blood glucose in individuals with metabolic syndrome.	Egg peptide IRW; preliminary human study; bioavailability; acute efficacy	Egg Farmers of Canada	
Aggressive and severe feather pecking in brown and white feathered leghorn pullets – Will blue light during brooding and rearing cycle improve future egg production?	Dr. Karen Schwean-Lardner	University of Saskatchewan	Dr. Trever Crowe Dr. Carolin Adler Dr. Bruna Remonato-Franco	2022	Jan-23			Ongoing	ACS ES LR	To determine if blue light alters behaviour in brown and white feathered leghorn pullets resulting in reductions in aggressive pecking compared to birds reared under white light. To deterine whether the utilization of blue light during the brooding and rearing period close to the age of sexual maturation has a lingering effect on egg production when birds are transitioned onto white light at either 15 or 17 weeks of age.	Wavelength; light spectrum; aggression; affect; pullets	Egg Farmers of Canada NSERC	
An integrated process for recovery of calcium carbonate and collagen/collagen amino acids from waste shells*	Dr. Duncan Cree	University of Saskatchewan	Dr. Takuji Tanaka Dr. Lucas Hof	2022	Dec-22			Ongoing	ES HNH IUE	Contact: duncan.cree@usask.ca	Calcium carbonate eggshell; collagen; protein; amino acids; enzyme	Egg Farmers of Canada NSERC Discovery Grant Star Egg Company Limited	
From potential to implementation: Evaluating alternatives to antibiotics in layers through coordinated in vivo experimental studies and barn-level surveillance with industry partners.	Dr. Nicole Ricker	University of Guelph	Dr. Elijah Kiarie Dr. Grazieli Maboni	2022	Jan-22			Ongoing	BNH	Identify changes in cecal microbiota and SCFA production in response to acidification administered through either feed or water additives Identify fecal biomarkers that correlate with cecal changes from objective 1 Implement surveillance at the barn level with industry partner to validate use of biomarkers with the introduction of feed or water modifications to layer flocks Evaluate effectiveness of water acidification and protected feed acidifier on APEC shedding and colonization	Layers; acidification; antibiotic alternatives; gut microbiota; resilience	Egg Farmers of Canada Burnbrae Farms Food for Thought JEFO	
Canadian phytobiotics as natural alternatives to antibiotics to control Avian E. Coli (APEC)*	Dr. Sophie Kernéis-Golsteyn	Lethbridge College	Dr. Roy Golsteyn Dr. Douglas Korver	2023	Sep-23			Ongoing	FS BNH	Contact: sophie.kerneis@lethbridgecollege.ca	Phytobiotics; APEC; cage free run chicken; antibacterial; gut health.	Egg Farmers of Canada Canadian Poultry Research Council Lethbridge College University of Lethbridge	

Project title	Principal Investigator	Institution	Collaborators	Year of approval	Project start date	Project end date	Project length (y)	Status	Research priorities	Objectives	Keywords	Funding agencies	Peer reviewed articles
Valorization of spent hens for a sustainable egg industry	Dr. Jianping Wu	University of Alberta	Dr. Marleny Aranda Saldana Mr. Ty Diep Dr. Liang Li Dr. Tony Kiang	2023	Apr-24			Approved	ES GTF	To develop an enzyme-aided aqueous method of recovering fat and muscle protein from spent hen carcass To develop a protocol to prepare low molecular weight hydrolyzed collagen from spent hen residue after preparing muscle protein hydrolysate To characterize hydrolyzed muscle protein and collagen in terms of degree of hydrolysis, molecular weight distribution, amino acid composition, taste profiles To determine the effect of different collagen peptide preparations on the key biomarkers of OA using chondrocytes To scale up the process of reclaiming fat, hydrolyzed muscle protein and collagen directly from spent hen carcass To determine the bioavailability of hydrolyzed collagen peptides	Spent hens; valorization; circular economy; sustainability; emissions reduction	Egg Farmers of Canada Burnbrae Farms	
Bioprinting of eggshell membrane-based biomaterials for promotion of wound healing*	Dr. Maxwell Hincke	University of Ottawa	Dr. Eric Lanteigne	2023	Jan-24			Ongoing	HNH IUE ES	Contact: mhincke@uottawa.ca	Eggshell membrane; biomaterial; bioprinting; wound healing; skin	Egg Farmers of Canada NSERC Burnbrae Farms Ltd.	
Evaluation of hemp seed products to ameliorate fatty liver disease and reduce cannibalism in laying hen in a modern group housing system and generation of efficacy and safety data	Dr. Stephanie Collins	Dalhousie	Dr. Rex Newkirk Ms. Janice MacIsaac	2023	Sep-23			Ongoing	AC HNH BNH LR	To determine, in laying hens, the effect of feeding hemp by-products on production performance; egg quality; mortality rate; incidence of fatty liver disease via liver color scores, fat content of livers, expression of inflammatory genes of interest, and histological evidence of fatty liver disease; egg yolk CBD, vitamin E and fatty acid profiles; feather pecking behaviour and incidence of cannibalism; and gut microbial populations.	Hempseed; bone health; fatty liver disease; feather pecking; egg composition	Egg Farmers of Canada Atlantic Egg Farmers	
The impact of synchronizing photoperiod with body weight and metabolic thresholds to optimize sexual maturation in cage-free layers	Dr. Gregoy Bedecarrats	University of Guelph	Dr. Charlene Hanlon Dr. Bethany Baker-Cook	2023	Sep-23			Ongoing	AC BNH LR	To identify the relationship between metabolic and photoperiodic cues in laying hens, and determine the minimum thresholds to achieve optimal entry into lay. To establish the influence of cage-free environments on activity levels and its impact on body composition and bone quality as it relates to the timing of sexual maturation in laying hens	Pullets; cage-free systems; keel bone; sexual maturation	Egg Farmers of Canada Egg Industry Center	
Additional daily intake of eggs from improving metabolic outcomes and choline levels in overweight and obese individuals: Phase I study	Dr. Clara Cho	University of Guelph	Dr. Mathieu Morissette	2023	Sep-23			Ongoing	HNH	Determine the effect of additional daily intake of eggs on metabolic outcomes (liver density and enzymes, circulating lipids and glucose levels, body mass index and body fatness) Assess the effects of additional daily intake of eggs on levels of choline and downstream metabolites including TMAO Determine the relation between outcome variables in response to additional daily intake of eggs and metabolic modifiers including the gut microbiota composition and genetic polymorphism	Egg; choline; overweight; obesity; metabolic health	Egg Farmers of Canada University of Guelph	
Phage therapy to decrease E. coli mortality in laying hens*	Dr. Martine Boulianne	Universite de Montreal	Dr. Antony Vincent	2023	Feb-24			Approved	ES BNH	Contact: martine.boulianne@umontreal.ca	colibacillosis; alternative to antimicrobials; phage therapy; pathogenesis of peritonitis/salpingitis; Escherichia coli infection in layers	Egg Farmers of Canada SynbioLab Inc.	
Nutraceuticals for hens and humans through polyphenol enriched feeds and eggs	Dr. Deborah Adewole	University of Saskatchewan	Dr. Trust Beta	2023	Aug-24			Approved	HNH BNH	To determine the capacity of varying levels of dietary Red osier dogwood extract (ROD) and grape pomace (GP) to enrich table eggs with polyphenols To determine the ability of varying levels of dietary ROD and GP to extend shelf life of table eggs To assess the effect of polyphenol enrichment on sensory evaluation – taste, visual, olfactory, and functionality of the eggs To determine the effect of varying levels of dietary ROD and GP on laying hens' antioxidant capacity, gut microbiome, and nutrient and energy digestibility To determine the effect of varying levels of dietary ROD and GP on the emission of noxious gases, including ammonia, hydrogen sulfide and methane into the environment.	Polyphenols; table eggs; PUFA; laying hens; health; welfare	Egg Farmers of Canada Red Dog Enterprises Ltd.	
Functional nutrients to support calcium metabolism and egg production in a context of extending laying period in modern hens	Dr. Angel René Alfonso Avila	CRSAD	Marie-Pierre Létourneau-Montminy Agnes Narcy Haitham Yakout Bertrand Medina	2023	Sep-23			Ongoing	AC ES BNH	Validate vitamin K role on Ca and energy metabolism Evaluate Mg implications on Ca metabolism and oxidative status index. Assess the additive effects of vitamin K and Mg as functional nutrients to support Ca metabolism and performances during a normal egg cycle production (18 to 70 weeks). Estimate the additive effects of vitamin K, Mg and phytogenic products (epicatechins and catechin) as immunonutrition strategy to maintain bone health and eggshell quality in an extended laying hen cycle (70 to 100 weeks). Determine the impact of increasing fat deposition in aging hens on plasma vitamin K availability.	Calcium metabolism; metabolic health; extending laying period; funtional nutrients; egg fortification	Egg Farmers of Canada CRSAD Probiotech	
Development of 3D printable self-powered biosensors for glucose monitoring from natural egg white*	Dr. Wen Zhong	University of Manitoba	None	2023	Sep-23			Ongoing	IUE	Contact: wen.zhong@umanitoba.ca	Biosensors; glucose monitoring; egg white; 3D printing; non-invasive	Egg Farmers of Canada	
Developing a vaccine against Avian Pathogenic E. coli (APEC)*	Dr. Aaron White	VIDO, University of Saskatchewan	Wolfgang Köster Yejun Wang	2023	Sep-23			Ongoing	FS HNH	Contact: aaron.white@usask.ca	Avian pathogenic E. coli; hypervariable regions; outer membrane proteins; vaccine; colibacillosis	Egg Farmers of Canada Chicken Farmers of Saskatchewan VIDO University of Saskatchewan	

Project title	Principal Investigator	Institution	Collaborators	Year of approval	Project start date	Project end date	Project length (y)	Status	Research priorities	Objectives	Keywords	Funding agencies	Peer reviewed articles
Metagenomic Assessment of Risk of Salmonella (MARS): validation of a rapid diagnostic workflow to support Salmonella control and surveillance programs in egg farming	Dr. Anatoliy Trokhymchuk	University of Saskatchewan Prairie Diagnotic Services	Dr. Musangu Ngeleka Dr. Dele Ogunremi Dr. Simon Otto	2023	Jan-24			Approved	ES FS	Develop and validate rapid metagenomics-based diagnostic workflow to support Salmonella detection, characterization, risk profiling, and surveillance in egg production systems. Establish a regional Salmonella sequences reference database. Implement the novel diagnostic workflow in a pilot diagnostic laboratory setting (Prairie Diagnostic Services). Perform a Canada-wide Salmonella laboratory diagnostic services environmental scan.	Salmonella detection; metagenomics; Salmonella control; Salmonella risk assessment; Salmonella surveillance	Egg Farmers of Canada Mitacs Prairie Diagnostic Services	
Sustainable and resilient management of egg supply chains using Internet of Things*	Dr. Armin Jabbarzadeh	École de Technologie Supérieure	Susantha Gomis Mustapha Ouhimmou Mohammad Yavari Lokman Sboui Lucas Hof	2023	Dec-23			Approved	FS HNH GTF ES	Contact: Armin.Jabbarzadeh@etsmtl.ca	Egg Supply Chain Management; Sustainability; Resilience; Internet of Things (IoT); Optimization	Egg Farmers of Canada NSERC RRECQ - Quebec Circular Economy Research Network	
Global warming: Impact of cooling strategies on the air quality inside livestock buildings and environmental emissions of gas and bioaerosols	Dr. Stéphanee Godbout	IRDA	Caroline Duchaine Martine Boulianne Sébastien Fournel Émilie Bédard	2023	Oct-23			Ongoing	AC FS HNH ES	Establish the state of knowledge: Complete a literature review to determine the impact of water-based cooling strategies on air quality and health; and Inventory the actual use in Canadian layer facilities, evaluate tendencies and implementation of cooling strategies for the future; Investigate the effects on air quality of an experimental evaporative pad cooling system: Install and validate a cooling pad system in the controlled experimental facility "Sol-Air Laboratory, IRDA" using a 6''commercial cooling pad to conduct experimental trials; Evaluate the airborne shedding and biofilm formation of that cooling pad artificially contaminated by a bacterial indicator; Determine the suitability of using ATP colorimetric tests for monitoring and following up water quality throughout the use of that experimental cooling pad. Complete a comparison the air quality in Canadian layer barns (n=10) while using or not WBCS, focusing on gas and bioaerosols emissions and on the level of contamination of the water and biofilms present in the cooling systems	Climate change, human health, animal health, water-based cooling strategies, waterborne pathogens	Egg Farmers of Canada IRDA NSERC Discovery Grant Program NSERC Discovery Frontier Program CRIUCPQ MAPAQ Swine Innovation Porc CDPQ Université Laval Université de Montréal Polytechnique Montréal PSCI INSPQ	
Modelling of alternative ventilation designs in layer houses	Dr. Syeda Tasnim	University of Guelph	Dr. Bill Van Heyst Dr. Shohel Mahmud Dr. David Lubitz Dr. Tina Widowski Daniel Ward Al Dam	2023	Dec-23			Approved	ES	Develop and implement simulation models using TRNSYS software and CFD to evaluate the performance of conventional and alternative ventilation designs for layer houses in Canada or more specifically in Ontario	Alternative ventilation design; air inlets; dust particulate; energy efficiency; carbon footprint	Egg Farmers of Canada NSERC Discovery Grant Elmwood Farms	
Effects of microclimate on the airborne dust concentration in layer houses in Ontario	Dr. Syeda Tasnim	University of Guelph	Dr. Bill Van Heyst Dr. Shohel Mahmud Dr. David Lubitz Dr. Tina Widowski Daniel Ward Al Dam	2023	Dec-23			Approved	LR	Characterize the microclimate of layer houses in Ontario, with an emphasis on understanding its effects on the concentrations of airborne dust	Microclimate; airborne dust particulates; layer house; ventilation design; greenhouse gas emission	Egg Farmers of Canada NSERC Discovery Grant Elmwood Farms	

Last updated December 2023

ACS: Animal Care Science; BNH: Bird Nutrition and Health; GTF: End of Flock Management; ES: Environment and Sustainability; FS: Food Safety; LR: Research LR identified by the code of practice; HNH: Human Nutrition and Health; IUE: Innovative uses for eggs; PP: Public Policy and Economics

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