Annual Report
2008

Canadian Poultry Research Council
Le Conseil De Recherches Avicoles Du Canada

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About the CPRC

The Canadian Poultry Research Council (CPRC) was formed in 2001 in response to declining numbers of poultry scientists in Canada (especially those working in government laboratories) and an identified need for a national body to coordinate poultry research, education and technology transfer.

The founding members are:

- Chicken Farmers of Canada
- Egg Farmers of Canada
- Canadian Turkey Marketing Agency
- Canadian Hatching Egg Producers
- Canadian Poultry and Egg Processors Council

Each Member elects annually a representative to serve on the CPRC Board of Directors.

2008 Board of Directors

Chris den Hertog (CHEP)
Chair

Jacob Middelkamp (CFC)
Vice Chair

Erica Charlton (CPEPC)

Ingrid DeVisser (CTMA)

Helen Anne Hudson (EFC)

CPRC Staff

Roger Buckland
Consultant

Gord Speksnijder
Executive Director

Our mission

CPRC's mission is to address its Members' needs through dynamic leadership in the creation and implementation of programs for poultry research in Canada, which may also include societal concerns.

This mission focuses on:

- The coordination and enhancement of a more efficient Canadian poultry research effort.
- Securing additional and matching funding.
- Facilitating the establishment of national poultry research priorities.

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Canadian Poultry Research Council
Le Conseil De Recherches Avicoles Du Canada

Chair's report

CPRC's activities continued to increase through 2008 as more items in its strategic plan were implemented.

In an effort to reach out to industry stakeholders, the CPRC is now publishing a monthly update in Canadian Poultry magazine. These updates highlight results obtained from CPRC-supported research and outline recent activities. An electronic newsletter designed to reach a wider audience is also in development. Look for it in your "inbox" early in 2009.

Three more projects previously approved for support by the CPRC Directors secured matching funds in 2008 and were added to the Avian Gut Microbiology research program. These projects bring CPRC's total direct support for research to $1.2 million. A fourth project may also be added to the program if it is successful in securing a match of CPRC funds.

This year's Call for Letters of Intent covered two of CPRC's priority research areas. Solicited proposals were to build on the broad environmental research program already supported by CPRC. Our Directors approved three new projects for which matching funds are being sought. The CPRC also recognized an emerging need for research on the use of feedstuffs alternative to current grains (especially corn), which are anticipated to increase in price due to demands from the energy sector. Many interesting proposals pertaining to "novel feedstuffs" were received, with three ultimately approved for CPRC support. Matching funds for these projects are also being sought. CPRC's continuous efforts to match industry dollars with non-industry sources, especially those provided through federal government funding programs, are essential to maximizing the impact of our investment in research.

The CPRC is also looking for other ways to enhance the impact of our research investment. In October, various organizations across Canada were invited to discuss the current state of poultry research funding in Canada. As you will read later in this report, the participants came to a consensus that CPRC can play a vital role in improving our national poultry research program.

In the fall CPRC staff reinitiated, in a more simplified fashion, its meetings with staff of the AAFC research branch. This resulted in AAFC providing guidance as to how Canada's poultry sector can best collaborate with AAFC through the growing forward program.

Another postgraduate scholarship supplement was awarded in 2008 as part of CPRC's continuing efforts to increase the number of new scientists entering the poultry sector. Megan MacDonald, at the University of Alberta was this year's recipient. Details of the supplement program and Megan's impressive list of accomplishments are included later in this report.

Efforts towards a Canadian poultry welfare cluster also continued through 2008. An agreement between CPRC, the Poultry Industry Council, AAFC and the University of Guelph was signed in January 2009. As detailed later in this report, an AAFC scientist will be moving to Guelph as part of the agreement to work with the many animal behaviour and welfare experts already there. This new position marks the beginnings of a "critical mass" of poultry welfare science that will attract more people in the discipline to work at Guelph and participate in a network of welfare-related scientists across the country.

In all, 2008 has been a successful year for CPRC. Activities have been on the rise as more items in our strategic plan are implemented. We received some very good feedback on how CPRC could work with other organizations across Canada to improve our national research program. There is a clear need and desire for a stronger national organization to service poultry research in Canada - CPRC is now at a "crossroads" and needs to decide the extent to which it will fill this role. I am encouraged by what was accomplished in 2008 and look forward with interest to see what 2009 will bring. threats of the CPRC, as well as members' expectations for the organization. A strategy implementation plan is being developed and should be finalized early in 2008. This new plan will set the course for continued, directed development of the CPRC.

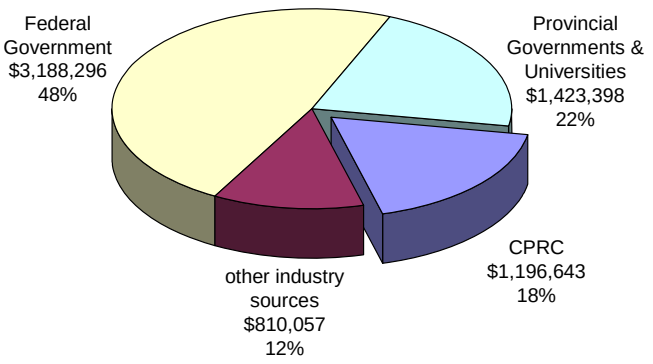
In all, 2007 has been a busy year for the CPRC and I am pleased to have had the opportunity to serve as Chair through this interesting time. I wish the CPRC the best of luck in 2008 and beyond, and hope that I can continue to contribute to its ongoing efforts to enhance poultry research in Canada.

Respectfully submitted,

Chris den Hertog, Chair

Support for research

Funding sources for CPRC projects



One of CPRC's main goals is to help build Canada's capacity for poultry research. To date, CPRC Members have committed almost $1.2 million in support of 23 research projects at universities and federal government laboratories across Canada. Although CPRC's contribution is significant, it only represents a fraction of the overall support for these projects; funds from other sources total about $5.4 million. That is to say, CPRC dollars have been matched or "leveraged" 4.5:1. Helping secure matching dollars is a large part of CPRC's funding process. Industry dollars (such as those from CPRC) are eligible for matching by a number of sources, such as the Natural Sciences and Engineering Research Council (NSERC) and Agriculture and Agri-Food Canada (AAFC). As a prerequisite for CPRC funding, a project must secure matching funds from these or other sources. In addition to the funding quoted above, the CPRC has committed up to $425,000 for 7 proposals that are currently under consideration for matching. These projects will only be funded by the CPRC if they are successful in securing matching funds. These projects could be leveraged for up to a total of $1.7 million.

Funding workshop

The CPRC organized a workshop focused on poultry research challenges in Canada. The stated objectives of the workshop were:

- To clarify the scope and orientation of current poultry research funding in Canada.
- To clarify the current mix/balance of public/private research investment in Canada.
- To identify opportunities for collaboration and increased leverage of funding for poultry research.
- To identify gaps in funding poultry research priorities.
- To discuss how funding gaps might be filled.
- To clarify the role CPRC and other agencies could play in ensuring appropriate collaboration/leveraging.

The workshop included approximately 30 participants from across Canada representing a variety of organizations with an interest in poultry research. A full report of the event can be found at http://www.cp-rc.ca/events.html.

Among the key messages arising from the workshop was that there is opportunity to increase the impact of the poultry industry's collective investment in research. Improved efficiencies through collaborative relationships among funders and increased leverage with non-industry sources were both identified as ways to make the most of industry dollars. The Dairy Farmers of Canada have been highly successful in achieving this goal and were at the workshop to share some of their experiences.

Participants concluded that the Canadian poultry industry and its consumers would realize the maximum benefit from Canadian poultry research if there was a national organization that could speak with one voice on behalf of Canadian poultry research community, and that would serve as a "one stop shop" for all partners who wish to support poultry research at the national level. There was a strong consensus among the group that CPRC should take on this role. Detailing how best to fill this role was beyond the scope of the workshop, however there are models from which the Canadian poultry sector can learn. The CPRC will consider these models as well as further input solicited from funders of poultry research across Canada when defining its future role.

Poultry welfare cluster for Canada

The CPRC, in conjunction with AAFC, agreed to facilitate development of a cluster of poultry welfare and behaviour expertise in Canada. The centre will consist of a cluster of welfare experts at the University of Guelph that will communicate and collaborate with animal and poultry welfare scientists across the country. A four-way agreement, signed by the Poultry Industry Council (PIC), Agriculture and Agri-Food Canada (AAFC), the University of Guelph and CPRC, includes assignment of an AAFC research scientist, Dr. Stephanie Torrey, to the Department of Animal and Poultry Science at Guelph, which represents a significant step forward in AAFC's support of the poultry sector. Each of the four signing partners will be represented on an Advisory Committee that will help develop the cluster and provide advice regarding its overall research strategies.

Dr. Stephanie Torrey will be joining the Behaviour and Animal Welfare group at the University of Guelph

Dr. Torrey's new position will add to the breadth of behaviour and welfare expertise already at Guelph. Her position also marks the beginnings of a "critical mass" of poultry welfare science that will attract more people in the discipline to work at Guelph and participate in a network of welfare-related scientists across the country. The idea is to build the intellectual capacity in Canada to tackle the myriad of issues relating to poultry welfare. In addition to her duties as a research scientist, Dr. Torrey will also teach and play a coordination role to improve communication and collaboration among the varied welfare-related expertise across Canada.

Postgraduate scholarship supplement

The future of Canada's poultry sector depends upon a strong, world-class research community. Training future researchers is essential to meet this need. The Canadian Poultry Research Council (CPRC) supports this endeavour in 2 ways. First, nearly all research grants awarded by CPRC incorporate graduate student support. Second, the CPRC has created, in conjunction with the Natural Sciences and Engineering Council (NSERC), a "Postgraduate Scholarship Supplement". The supplement is $7,500 per year. To be eligible, a student must be studying (or planning to study) some aspect of poultry science and hold a NSERC scholarship at the Masters (eligible for one year) or Doctoral level (eligible for up to two years). Applications are due May 1 each year.

NSERC postgraduate scholarships are available on a competitive basis to Canada's best postgraduate students. The purpose of the CPRC Postgraduate Scholarship Supplement is to attract these students to consider a career in poultry science.

The specific objectives of the program are:

- to encourage and support graduate students to carry out research in an aspect of poultry science;
- to build Canada's intellectual capacity in poultry science; and
- to promote graduate research in poultry science at Canadian universities.

Megan MacDonald was awarded the 2008 supplement and holds an NSERC Post Graduate Scholarship. Megan is studying, under the supervision of Dr. Katherine Edens Magor, innate immune responses to influenza virus infection. Specifically, she is interested in why ducks can survive as asymptomatic carriers of several strains of Avian Influenza that cause severe disease in chickens. Previous research suggests there are differences between ducks and chickens in certain receptors that recognize viral genetic material. These receptors (known as immune detectors), when stimulated, participate in a cascade of immune system responses. Megan's work led to the discovery of a new influenza detector, RIG-1, that is present in ducks but not in chickens. She hypothesizes that this difference relates to why ducks are resistant and chickens susceptible to a number of viruses.

Megan has already published two papers, and has made four poster/oral presentations. Megan was one of only three students worldwide selected to present a paper at an immunology conference in France in 2006.

For more information on the scholarship supplement, including how to apply, please contact the CPRC office, or visit the NSERC website at www.nserc-crsng.gc.ca and look in the "Postgraduate Programs" section under "Program Guide for Students and Fellows".

Granting procedures

The CPRC calls for Letters of Intent (LOIs) for priority areas of research each April. This year, researchers were invited to submit grant applications relating to environmental impacts of poultry production and the issue of rising feed costs.

Calls for LOIs generally pertain to 2 research priority areas at a time. The priority areas for planned for 2009 through 2011 are as follows:

2009:
- Food Safety & Quality
- Poultry Welfare & Behaviour

2010:
- Avian Gut Microbiology
- Environment

2011:
- Food Safety & Quality
- Poultry Welfare & Behaviour

With input from academe, government and industry, the CPRC will continually review its research priority list and, if necessary, adjust it to reflect existing and emerging issues of importance to its members. Provided they remain of high importance, individual priority areas will be the subject of future Calls at regular intervals so as to promote continuity in existing research programs.

The CPRC Scientific Advisory Committee (SAC) reviews all LOIs and makes recommendations to the CPRC Directors. If approved for CPRC support, NSERC-eligible applicants are instructed to submit applications to the NSERC-CRD program through their respective university Research Grants Offices. AAFC scientists are instructed to submit their approved applications through the appropriate AAFC channels.

2008 Scientific Advisory Committee

Joshua Gong
Agriculture and Agri-Food Canada, Food Research Program

Doug Korver
University of Alberta, Dept of Agricultural, Food and Nutritional Science

Steve Leeson
University of Guelph, Dept of Animal & Poultry Science

Bogdan Slominski
University of Manitoba, Dept. of Animal Science

Supplementary reviewers:

Derek Anderson, Nova Scotia Agricultural College

Claude Laguë, University of Ottawa, Faculty of Engineering

Research programs

To date, the CPRC is supporting research projects in four program areas:

Avian Gut Microbiology: The first projects funded under the Avian Gut Microbiology Network (AviMicroNet) program are complete. The resulting research provided many interesting insights into the dynamics of gut microbes in the presence or absence of antibiotics and other feed additives. Results are being shared among industry stakeholders in an effort to improve the understanding of the physiological impact of antibiotics and what the repercussions of reducing their use might be, both for our poultry and the industry as a whole. Three new projects have been added to the program as detailed below.

Environmental issues: Four projects were supported by CPRC that dealt with a wide array of environmental issues ranging from land incorporation of poultry manure, to calcium and phosphorus flow in layers, to workplace exposures to pollutants, to environmental contamination from veterinary pharmaceuticals. An additional three projects are under review with potential funding partners.

Food Safety and Poultry Health: Four projects are underway covering the following subjects: immunization of broiler chickens against necrotic enteritis, immune responses to avian influenza virus in the chicken, development of RNA interference constructs against avian influenza virus, and novel multivalent vaccines for avian health. These projects have produced some interesting results. Final reports are expected through in 2009

Poultry Welfare and Behaviour: Within this program area, five projects are underway covering the impact of ammonia on the welfare of laying hens, improving transport conditions for broilers, alternative methods of euthanizing turkeys, effects of lighting programs on leg weakness in broilers, and improving welfare for beak trimmed hens. Results are expected by the end of 2010.

Novel feedstuffs : There is an emerging need for research on the use of feedstuffs alternative to current grains (especially corn), which are anticipated to increase in price due to demands from the energy sector. The CPRC responded to this situation by calling for LOIs relating to "Novel Feedstuffs" in 2008. Three proposals are being reviewed by potential funding partners.

Ad hoc : The CPRC also has a mechanism in place whereby it can accept research proposals that do not fit into the main research categories above. Two projects were supported under this program by CPRC as a whole, and one, as detailed below, was supported solely by CTMA. The ad hoc program allows CPRC Members the flexibility to take advantage of scientific opportunities should they arise and to address acute industry issues as they emerge.

CPRC-supported projects

Individual projects within each of the above programs are underway, as well as those funded under the ad hoc program. They are:

Avian Gut Microbiology

AMN001
Identification of gut bacteria affected by dietary antibiotics and their roles in the gut immunity of broiler chickens.
Joshua Gong, Agriculture Canada and Shayan Sharif, University of Guelph

AMN002
Molecular epidemiology of necrotic enteritis.
Patrick Boerlin, University of Guelph

AMN003
Carbohydrase enzyme supplements as growth promoters and modulators of the intestinal microflora of the chicken: The prebiotic and probiotic effect of enzyme hydrolysis products.
Bogdan Slominski, University of Manitoba

AMN004
Understanding how Campylobacter jejuni colonizes poultry
Brenda Allan, VIDO

AMN023
The use of cyclic-di-GMP, a novel immunotherapeutic and antibacterial molecule in chickens
Moussa Diarra, AAFC

AMN024
Investigation into cell-cell signaling in Clostridium perfringens infection for developing a novel disease-control strategy
Joshua Gong, AAFC

AMN025
Engineered antibodies and phage products for food safety applications
Christine Szymanski, University of Alberta

Environment

ENV006
Distribution uniformity and emission reduction potential of a precision applicator for surface and sub-surface land application of poultry manure
Claude Lague, University of Saskatchewan (now at University of Ottawa)

ENV007
Development of a dynamic model of Ca and P flows in layers
James France, University of Guelph

ENV008
Activity-specific workplace exposures of poultry barn workers
Ambikaipakan Senthilselvan, University of Alberta

ENV009
Reducing pollution from veterinary pharmaceuticals in agricultural runoff from poultry manure
Shiv Prasher, McGill University

Food Safety & Poultry Health

FSQ011
Immunization of broiler chickens against necrotic enteritis
John Prescott, University of Guelph

FSQ012
Immunology of T cell-mediated immune response to avian influenza virus in the chicken
Shayan Sharif, University of Guelph

FSQ014
Development of second generation RNA interference constructs against avian influenza virus
Serguei Golovan, University of Guelph

FSQ015
Novel multivalent vaccines for avian health
Eva Nagy, University of Guelph

Poultry Welfare & Behaviour

PWB017
Engineering, animal welfare and meat quality considerations of broiler transportation in a heated and ventilated vehicle
Trever Crowe, University of Saskatchewan

PWB018
Improving welfare for beak trimmed hens through reducing variability and technology transfer
Hank Classen, University of Saskatchewan

PWB019
Effect of lighting programs on leg weakness and bird welfare in modern commercial broilers
Hank Classen, University of Saskatchewan

PWB020
Evaluation of alternative methods of euthanasia for cull turkeys
Tina Widowski, University of Guelph

PWB021
Impact of ammonia on welfare of laying hens, and implications for the environment
Steve Leeson, University of Guelph

CPRC-supported projects (continued)

Ad hoc

UAB005
The impact of timing of protein intake and growth patterns on reproductive efficiency in broiler breeder females.
Frank Robinson, University of Alberta

AGA010
Cryopreservation of Canada's remaining avian germplasm
Fred Silversides, Agriculture & Agri-Food Canada

CTM022
Use of dietary thyroxine as an alternative molting procedure in turkey breeder hens
Grégoy Bédécarrats, University of Guelph

Project status summary

The following table summarizes the status of CPRC-supported projects underway, as well as applications approved by the CPRC Directors and for which matching funds are being pursued. Status reports for each project are shown in the Appendix.

Project leader	CPRC #	CPRC match confirmed	start date	interim report rec'd	final report rec'd	web summary posted	expected end	status
Gong/Sharif	AMN001	y	Nov-04	y	y	y	Nov-06	complete
Boerlin	AMN002	y	Nov-04		y	y	Nov-06	complete
Slominski	AMN003	y	Jan-05	y		y	Mar-08	overdue*
Allan	AMN004	n/a	Nov-04	y	y	y	Dec-07	complete
Robinson	UAB005	y	May-04		y	y	Apr-06	complete
Lague	ENV006	y	Nov-05	y	y	y	Oct-07	complete
France	ENV007	y	Nov-05	y	y	y	Oct-07	complete
Senthilselvan	ENV008	y	Feb-06		y	y	Jun-08	complete
Prasher	ENV009	y	Jan-06		y	y	Feb-07	complete
Silversides	AGA010	y	Sep-06		y	y	Mar-08	complete
Prescott	FSQ011	y	Sep-06	y		y	Aug-09	in progress
Sharif	FSQ012	y	Mar-07	y		y	Feb-09	in progress
Golovan	FSQ014	y	Nov-06				Oct-08	in progress
Nagy	FSQ015	y	Dec-06	y			Nov-09	in progress
Crowe	PWB017	y	Jan-07	y		y	Dec-10	in progress
Classen (beak)	PWB018	y	Apr-07	y		y	Mar-10	in progress
Classen (leg)	PWB019	y	Mar-07	y		y	Feb-10	in progress
Widowski	PWB020	y	Apr-07	y			Dec-09	in progress
Leeson	PWB021	y	Jan-08	y			Dec-10	in progress
Bedecarrats	CTM022	y	Jun-07	y		y	May-09	in progress
Gong	AMN024	y	Aug-08				Mar-12	In progress
Szymanski	AMN025	y	Agreement with University of Alberta being finalized					
Olkowski	1047-07	Submitted an LOI in 2008 as an addendum						under review
Classen	1062-08							under review
Slominski	1064-08							under review
Anderson	1066-08							under review
Van Heyst	1067-08							under review
Van Heyst	1069-08							under review
Wu	1070-08							under review

* project AMN003 past anticipated completion date but progressing well

THE CANADIAN POULTRY RESEARCH COUNCIL

Financial Statements

For the Year Ended December 31, 2008

AUDITORS' REPORT

To the Members of **The Canadian Poultry Research Council**:

We have audited the statement of financial position of **The Canadian Poultry Research Council** as at December 31, 2008 and the statements of fund operations and changes in fund balances and cash flows for the year then ended. These financial statements are the responsibility of the Organization's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we plan and perform an audit to obtain reasonable assurance whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation.

In our opinion, these financial statements present fairly, in all material respects, the financial position of the Organization as at December 31, 2008 and the results of its operations, changes in its fund balances and cash flows for the year then ended in accordance with Canadian generally accepted accounting principles.

Guelph, Ontario
February 9, 2009

LICENSED PUBLIC ACCOUNTANTS

THE CANADIAN POULTRY RESEARCH COUNCIL

Statement of Financial Position as at December 31, 2008

	Operating Fund	Research Fund	Scholarship Fund	Total 2008	Total 2007
ASSETS					
Current					
Cash	$ 20,123	$ 71,632	$ 2,433	$ 94,188	$ 248,478
Research contributions receivable		388,247		388,247	156,952
Prepaid expenses					1,197
Interest receivable	461	664	350	1,475	8,545
Short-term investments (Note 5)	103,509	123,220	64,904	291,633	287,366
	124,093	583,763	67,687	775,543	702,538
LIABILITIES AND FUND BALANCES					
Liabilities					
Accounts payable and accrued liabilities	5,195			5,195	8,909
Research grants payable -current(Note 7)		321,284		321,284	430,567
	5,195	321,284		326,479	439,476
Research grants payable - long term(Note 7)		38,000		38,000	
Deferred Contributions (Note 6)	4,091	186,738	67,687	258,516	124,986
	9,286	546,022	67,687	622,995	564,462
Fund Balances					
Externally restricted for					
Internally restricted for research (Note 8)		37,741		37,741	37,741
Unrestricted	114,807			114,807	100,335
	114,807	37,741		152,548	138,076
	124,093	583,763	67,687	775,543	702,538

THE CANADIAN POULTRY RESEARCH COUNCIL

Statement of Fund Operations and Changes in Fund Balances
For the Year Ended December 31, 2008

	Operating Fund	Research Fund	Scholarship Fund	Total 2008	Total 2007
REVENUE					
Membership fees	$ 110,000	$	$	$ 110,000	$ 110,000
Interest	1,493			1,493	1,719
Contributions		144,002		144,002	384,811
Contributions (Note 6)			7,567	7,567	398,904
	111,493	144,002	7,567	263,062	895,434
EXPENSES					
Workshops	14,581			14,581	
Meetings	14,929			14,929	11,326
Insurance	1,197			1,197	1,436
Interest and bank charges	118		67	185	186
Consultants	21,794			21,794	23,617
Office	1,216			1,216	1,682
Overhead	3,999			3,999	3,906
Per diems	2,250			2,250	875
Professional fees	2,050			2,050	2,200
Management fees	31,333			31,333	28,094
Telephone	289			289	332
Network development					7,748
Website	259			259	561
Translation	3,006			3,006	1,313
Poultry Welfare and Behaviour project					278,778
Avi Micro Net projects		144,002		144,002	198,627
Cryopreservation project					12,060
Food Safety and Quality project					215,731
Turkey Molting project					39,495
Robinson Project					11,400
Environment project					36,024
Scholarship			7,500	7,500	15,000
	97,021	144,002	7,567	248,590	890,391
EXCESS OF REVENUE OVER EXPENSES	14,472			14,472	5,043
FUND BALANCE - Beginning of Year	100,335	37,741		138,076	133,033
FUND BALANCE - End of Year	114,807	37,741		152,548	138,076

SUBJECT TO REPORT ATTACHED

THE CANADIAN POULTRY RESEARCH COUNCIL

Statement of Cash Flows
For the Year Ended December 31, 2008

	2008	2007
CASH FLOWS FROM OPERATING ACTIVITIES		
Excess of revenue over expenses	$ 14,472	$ 5,043
Net change in non-cash working capital:		
Research contributions receivable	(231,295)	(141,952)
Prepaid expenses	1,197	3,201
Interest receivable	7,070	(3,436)
Accounts payable and accrued liabilities	(3,714)	(6,963)
Research grants payable	(71,283)	430,567
Deferred contributions	133,530	(384,802)
	(150,023)	(98,342)
CASH FLOWS FROM FINANCING AND INVESTING ACTIVITIES		
Purchase of investments	(649,255)	(457,365)
Redemption of investments	644,988	500,000
	(4,267)	42,635
DECREASE IN CASH	(154,290)	(55,707)
CASH - BEGINNING OF YEAR	248,478	304,185
CASH - END OF YEAR	94,188	248,478

SUBJECT TO REPORT ATTACHED

THE CANADIAN POULTRY RESEARCH COUNCIL

Notes to the Financial Statements
For the Year Ended December 31, 2008

1. PURPOSE OF THE ORGANIZATION

The Organization is incorporated under the provisions of the Canada Corporations Act and was formed to support the Canadian research effort in Canada's poultry sector. The Organization is exempt from tax under Section 149 (1)(e) of the Income Tax Act.

2. CHANGE IN ACCOUNTING POLICY

The Organization has changed its method of recording research revenue and research expenditures. The Organization recognizes the liability and expense for research as the Organization commits to fund researchers in the poultry field. The liability is reduced as payments are made to the researchers. As members commit to fund this research, the Organization recognizes the revenue and contribution receivable. Previously, research expenditures were recognized as funds were distributed to the researchers when milestones in the agreement were fulfilled. Research contributions were recognized annually as received.

The Organization has applied the changes retroactively and prior periods have been restated. The effects of the restatement on prior period financials are presented below.

Statement of Fund Operations
Research Funds

Research contributions before change	$ 349,488
Change in accounting policy	419,167
Research contributions after change	$ 768,655
Research expenditures before change	$ 361,548
Change in accounting policy	430,567
Research expenditures after change	$ 792,115
Deficiency of revenue over expenses before change	$ (12,060)
Change in accounting policy	(11,400)
Deficiency of revenue over expenses after change	$ (23,460)

Statement of Financial Position
Research Fund

Research contributions receivable before change	$
Change in accounting policy	156,952
Research contributions receivable after change	$ 156,952
Research payable before change	$
Change in accounting policy	430,567
Research payable after change	$ 430,567
Deferred contributions before change	$ 313,449
Change in accounting policy	(262,215)
Deferred contributions after change	$ 51,234

THE CANADIAN POULTRY RESEARCH COUNCIL

Notes to the Financial Statements
For the Year Ended December 31, 2008

3. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Fund Accounting

Revenues and expenses related to program delivery and administrative activities are reported in the Operating Fund.

Revenues and expenses related to research activities are reported in the Research Fund.

Revenues and expenses related to scholarship activities utilizing the Canadian Vitamins Settlement proceeds are reported in the Scholarship Fund.

Revenue Recognition

The Organization uses the deferral method of accounting for contributions.

Restricted contributions are recognized as revenue in the year in which the related expenses are incurred. Unrestricted contributions are recognized as revenue when received or receivable if the amount can be reasonably estimated and collection is reasonably assured.

Restricted investment income is recognized as revenue in the year in which the related expenses are incurred. Unrestricted investment income is recognized as revenue when earned.

Membership fees are included in income over the membership term.

Short-term investments

Given the short term nature of the cash investments held, book value approximates market value and they have been classified as held for trading. Financial assets held for trading are acquired or incurred principally for the purpose of selling or redeeming them in the near term. They are recognized at fair value based on market prices. Gains and losses are reflected in operation for the period in which they arise.

4. FINANCIAL RISK MANAGEMENT OBJECTIVES AND POLICIES

The Organization's principal financial instruments consist of cash and investments. The main purpose of these financial instruments is to finance and maintain the Organization's operations and research funding. The financial organization has other financial assets and liabilities such as research contributions receivables, interest receivable, accounts payables and accrued liabilities, research grants payable and deferred contributions which arise directly from its operations. The main risks arising from the Organization's financial instruments are interest rate and credit risk.

a) Interest Rate Risk Exposure

The Organization's exposure to the risk of changes in market interest rate relates primarily to cash and investments. Financial assets with variable rates expose the Organization to cash flow interest rate risk. All other financial assets and liabilities are non-interest bearing.

b) Credit Risk Exposure

Credit risk from cash has a maximum exposure of the carrying amount of this instrument.

THE CANADIAN POULTRY RESEARCH COUNCIL

Notes to the Financial Statements
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Fair Value of Financial Instruments

The carrying value of cash, research contributions receivable, interest receivable, guaranteed investment certificates, accounts payable and accrued liabilities, research grants payable and deferred contributions approximate fair values due to the short-term maturities of these instruments.

5. SHORT TERM INVESTMENTS

	2008	2007
Operating Fund		
Cashable guaranteed investment certificate, interest 2.05%, maturing September 26, 2009	$ 53,509	$ 50,904
Cashable guaranteed investment certificate, interest 1.83%, maturing October 23, 2009	50,000	
	103,509	50,904
Research Fund		
Cashable guaranteed investment certificate, interest 2.05%, maturing September 26, 2009	123,220	173,721
Scholarship Fund		
Cashable guaranteed investment certificate, interest 2.05%, maturing September 26, 2009	64,904	62,741
	291,633	287,366

6. DEFERRED CONTRIBUTIONS

Deferred contributions relate to the unspent portion of funding received that is restricted for specific purposes and the unspent portion of the Canadian Vitamins Class Actions National Settlements. Changes in the deferred contributions balance are as follows:

	Canadian Vitamins Settlement	Research Contributions	Other	2008	2007
BALANCE - BEGINNING OF YEAR	$ 73,752	$ 51,234	$	$ 124,986	509,788
Amount recognized as revenue in the year	(7,567)			(7,567)	(398,904)
Amount received related to subsequent years		135,504	4,091	139,595	
Investment income	1,502			1,502	14,102
BALANCE - END OF YEAR	67,687	186,738	4,091	258,516	124,986

THE CANADIAN POULTRY RESEARCH COUNCIL

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7. RESEARCH GRANTS PAYABLE

Research grants payable in the amount of $ 359,284 (2007- $ 430,567) represent the outstanding amount committed by the Organization to fund researchers in the poultry field. The liability is recorded in the year the grants are awarded by the Organization and is reduced as funds are distributed to the researchers when milestones in the agreement have been fulfilled.

8. INTERNALLY RESTRICTED FUND BALANCES

Internally restricted research funds represent the unspent portion of funds transferred from the operating fund to the research fund by the board of directors. These internally restricted amounts are not available for purposes other than research without approval of the board of directors.

9. COMMITMENTS

The Organization has an agreement with the Poultry Industry Council to provide management services. This agreement automatically renews at the end of each calendar year for a subsequent one year term, unless terminated.

The Organization also has commitments to fund various research projects from its research fund. The timing of fulfillment of these commitments is based upon the researcher obtaining matching funding for each research project, and are estimated to be as follows:

2009	$149,895
2010	137,606
2011	134,338

Appendix - Research project summaries

The following projects supported by CPRC are at various stages of completion (see Table 1 for status). These summaries are posted on the CPRC website and are updated as research results come in (http://www.cp-rc.ca/research_programs.html).

AMN001
Identification of gut bacteria affected by dietary antibiotics and their roles in the gut immunity of broiler chickens
Principal investigators: Joshua Gong, Agriculture and Agri-Food Canada, Shayan Sharif, University of Guelph
Co-investigators: Huaijan Zhou, Texas A&M University, Parvis Sabour, Agriculture and Agri-Food Canada, Babek Sanei, Ontario Ministry of Agriculture, Food and Rural Affairs, Jennifer Brisbin, University of Guelph (PhD candidate)

Funding: $260,000 (CPRC $100,000, PIC $30,000, MII $55,000, NSERC $75,000)
Start date: November 2004
Expected end: November 2006
Interim report received: December 13, 2006
Final report received: April 2008

Background:
There are increasing concerns over the development of bacterial resistance to antibiotics. While it is not clear if the use of antibiotics to prevent infection and promote growth in poultry is a contributing factor, it is clear that antibiotics do have an effect on microbial populations in the chicken gut. It has also been shown that antibiotic use affects development of the chicken's immune system. The objectives of this research project, therefore, were to determine which microbes in the gut are most affected by antibiotics and to determine how these microbial changes affect the immune system.

Research progress:
An experiment was set up in which birds were fed either non-medicated diets or those supplemented with bacitracin (4.4 or 55 ppm) or virginiamycin (11 or 22 ppm). Samples were taken from various regions of the gut at 3, 7, and 14 days and microbial populations were compared. Genetic analysis revealed that many bacterial groups were affected by the presence of the antibiotics used in this study. Effects were most pronounced with virginiamycin. This antibiotic was then used in a trial during which birds fed medicated or non-medicated feed were immunized with several potent antigens designed to elicit an immune response. In most cases, the presence of virginiamycin in the feed did not affect the immune response of the birds, but there were a few specific cases for which immune response was increased. This result is surprising and may provide some insight as to why subtherapeutic levels of antibiotics can improve broiler chicken performance.

Several species of Lactobacillus bacteria were affected by the presence of virginiamycin in this study. Lactobacillus acidophilus has been linked to increased immune response in chickens. Components of this bacterium were therefore used to stimulate chicken immune system cells in the laboratory. The cells responded by increasing expression of several genes relating to immune function. It has been hypothesized that a decreased population of L. acidophilus in the gut due to antibiotic use could have a negative effect on immune function in the bird. Results from this research project suggest, however, that the use of antibiotics such as virginiamycin does not negatively affect immune function in broiler chickens.

Future work:
Work is ongoing to further characterize changes in immune system gene expression in response to antibiotics. This information will be crucial to finding ways to improve the chicken's immune function, both to enhance the effectiveness of currently antibiotics and to perhaps reduce the need for them in the future.

AMN002
Molecular epidemiology of necrotic enteritis
Principal investigator: Patrick Boerlin, University of Guelph
Co-investigators: John Prescott, Bruce Hunter, Wayne Martin, Gabhan Chalmers (MSc student), University of Guelph

Funding: $107,000 (CPRC $70,000, PIC $37,000)
Start date: January 2005
Expected end: November 2006
Interim report received: n/a
Final report received: April 2008

Background:
Clostridium perfringens is a bacterium commonly found in the gut of a variety of healthy animals, including chickens. However, it is also linked to necrotic enteritis (NE). There is relatively little information on how NE develops, especially in terms of the role that C. perfringens plays and why certain strains of the bacterium can cause the disease. The main objectives of this project were to look at the C. perfringens strains present in chickens and compare their diversity both within individual birds and among different birds on commercial broiler farms, and to see if that diversity changes in birds suffering from NE.

Research progress:
The techniques traditionally used to determine strain diversity are very laborious. Dr. Boerlin's team therefore developed techniques that are less work intensive and can be largely automated. These new techniques were used throughout the current project and will part of related studies in the future.

In the first phase of the project, Dr. Boerlin's team looked at the diversity of C. perfringens strains in two barns in a commercial broiler farm. It was unexpectedly low. Similar studies in Europe, where antimicrobial use is restricted, show higher strain diversity. Dr. Boerlin suggests that the use of bacitracin on the farms in his study may have skewed the C. perfringens population towards a few resistant strains.

Strains isolated from field cases of NE (these birds did not receive antimicrobials) were then compared to those from flocks with no known history of the disease. C. perfringens strains from the same NE-positive birds, or from different healthy birds from the same barn, were generally the same genetic type. However, different NE outbreaks were associated with genetically diverse strains. Almost all these isolates tested positive for the NetB toxin, which was recently implicated as a contributing factor in NE. Collectively, these results suggest that an element(s) that can be transferred from one strain to another (such as the netB gene) can affect a strain's ability to cause NE.

Samples were also taken from a different research project during which birds were challenged with C. perfingens to artificially cause NE. All the strains tested were netB positive, but the degree to which they caused disease varied. The implication here is that netB may only contribute to NE and that other factors (such as management practices) are involved in development of the disease. Further studies are being planned to determine the effects of different management practices on C. perfringens populations.

AMN003
Carbohydrase enzyme supplements as growth promoters and modulators of the intestinal microflora of the chicken: The prebiotic and probiotic effect of enzyme hydrolysis products
Bogdan Slominski and Gregory Blank, University of Manitoba

Funding: $327,800 (CPRC $82,900, CBS $78,000, CBS (in kind) $6,000, ARDI $160,900)
Start date: January 2005
Expected end: March 2008
Interim report received: August 2005, November 2007
Final report received:

Background:
Common poultry diets based on corn, soybean, wheat and other plant-based ingredients have a number of constituents that are poorly digested. The presence of these indigestibles in the gut can serve as a substrate for a range of deleterious organisms. A significant proportion of these indigestibles are referred to as non-starch polysaccharides (NSP). The objective of this project is to use a new generation of carbohydrase enzymes to increase the hydrolysis of NSP and to see if their hydrolysis products promote the proliferation of beneficial bacteria in the gut and help protect poultry from Clostridium perfringens (the causative organism of necrotic enteritis). If successful, the use of carbohydrase supplements could offset the use of antibiotics in poultry feeds.

Research progress:
A carbohydrase enzyme mix was tested at a range of concentrations and was shown to significantly depolymerize NSP of soybean meal, canola meal and flax. The ability of the enzymes to decrease the viscosity of flax-based products was also confirmed (high viscosity digesta has been linked to proliferation of pathogenic bacteria in the gut). The NSP hydrolysis products have been characterized. Drs. Slominski and Blank also looked at the effect of enzyme products on the proliferation of *C. perfringens* in the lab. These lab results did not demonstrate any clear effects, however experiments are now underway to test the effect of the enzyme supplement on the bacterium in the gut. Previous experiments suggest that when birds are fed diets without antibiotics or coccidiostats, enzyme supplementation results in an increase in feed efficiency. The enzymes may also slightly reduce the number of Enterbacteriacea and coliform bacteria in the small intestine and may increase the ratio of lactic acid bacteria to E. coli in the gut (it is hypothesized that carbohydrase hydrolysis products increase acidity in the gut making conditions more suitable to beneficial bacteria such as lactobacilli thereby allowing them to out compete other deleterious bacteria such as E. coli). These results, although promising, likely do not demonstrate the true value of the enzyme supplement. More dramatic benefits of enzyme supplementation are shown when birds are challenged with *C. perfringens*. Preliminary results indicate that when birds are fed a wheat-based diet, feed efficiency is increased during the grower-finisher phase compared to challenged birds that did not receive the supplement. Overall weight gain was improved for birds on corn-based diets. Similar challenge studies are now underway using a 'hot' field strain of *C. perfringens* known to cause necrotic enteritis in the field.

Notes:
Project overdue, but progressing well.

AMN004
Understanding how Campylobacter jejuni colonizes poultry
Brenda Allan, Vaccine & Infectious Disease Organization

Funding: $100,000 (CPRC)
Start date: November 2004
Expected end: December 2007
Interim report received: April 18, 2007
Final report received: January 2009

Background:
Campylobacter jejuni is the leading cause of bacterial gastroenteritis in humans in North America. In poultry, the bacterium resides in the gut without detriment to the bird. Poultry products contaminated with the bacterium are implicated as a source of human infection. The long-term goal of this research program is to decrease or eliminate the level of *C. jejuni* in poultry by vaccination. The first step towards achieving this goal is to better understand the mechanism by which this bacterium colonizes the avian gut.

Research Progress:
It has been shown that some strains of *C. jejuni* are more adept at colonizing the avian gut than others. The proposed research aims to identify the factors which contribute to these differences. One approach is to introduce random genetic mutations into lab strains of the bacterium and test for their virulence. Differences in ability to colonize can then be correlated with specific genetic differences. The researchers first proposed the use of Sequence Tagged Mutagenesis (STM) to introduce and assess the mutants. However, during the planning stage, another group of scientists began a very similar project using the same technology. Rather than duplicate this effort, Dr. Allan decided to utilize Recombination-based In-Vivo Expression Technology (RIVET), which, at least in other organisms, can detect genes missed by STM. Unfortunately, Dr. Allan's group was unable to clear some technical hurdles (mainly associated with plasmid construction) necessary to make use of the RIVET method. As a result, the project took a different tack: to screen cattle, poultry and human samples for *C. jejuni* and compare isolates for the relative frequencies of various genes thought to be involved in virulence.

Forty-nine samples from cattle and 50 from humans were screened for the presence of 14 putative virulence genes (as indicated in the literature). Results of this screen were compared to results on poultry samples tested under a different project.

Results:
All putative virulence genes were detected in 20% of the samples. Approximately 60% of the samples were positive for all the genes, except for *virB11*. No differences were found between cattle and human samples. Although several genes were found less often in poultry samples, there were no clear differences in gene frequency among cattle, human or poultry samples. These results suggest that cattle may serve as a reservoir for strains of Campylobacter that colonize both poultry and humans.

Future work:
Some *C. jejuni* isolates have many putative virulence genes, while others have few. These 2 classes of strains will be tested for their ability to colonize chicks. Two animal models will be used:

In the *Standard Model, all* birds will be orally challenged with the appropriate dose of *C. jejuni* in a 0.5 mL volume. Colonization of the birds will be monitored by culturing cloacal swabs on Karmali Medium (Bacto) and growing under microaerophilic conditions. Five birds in each group will be tested for colonization by *C. jejuni* before the group was challenged. Birds will be maintained for seven days after challenge then euthanized by cervical dislocation. Ceca will be aseptically collected for quantitative assessment of colonization on day 7. The *Horizontal Transfer Model will* assess the ability of *C. jejuni* to colonize orally challenged birds and unchallenged birds that are placed in contact with them. Only 20% of the birds will be challenged and marked for identification. All birds will be treated as described above. The use of the two models assesses the full range of colonization potential and will discriminate between different mutants.

This work may lead to information useful in determining what factors are involved in gut colonization by C. jejuni.

Notes:
The final report for this project was received in January 2009, however, the above summary does not reflect new results reported.

UAB005
The impact of timing of protein intake and growth patterns on reproductive efficiency in broiler breeder females
Principal investigator: Frank Robinson, University of Alberta
Research team: Rob Renema, Martin Zuidhof, Ali Pishnamazi (PhD), Nicholas Wolanski (MSc), Felicity Dennis, Nigel Davidson (technicians)

Funding: $149,400 (CPRC $19,000, AARI $90,000, Aviagen $35,000, Aviagen (in kind) $5,400)
Start date: May 2004
Expected end: April 2006
Interim report received: n/a
Final report received: June 2008

Background:
There is a large variation in laying performance of commercial broiler breeder chickens, both among strains and among different producers. Careful management decisions are required, especially during sexual maturation, to maximize egg production. This project builds on years of work done at the University of Alberta towards a better understanding of the interaction between protein intake and reproductive efficiency in broiler breeders. This work has been especially enlightening as it creates profiles of these interactions for individual birds rather than looking at whole flock responses.

The overall objective of this research program is to determine the impact of varying protein intake patterns of broiler breeder females during the growth phase on carcass traits and reproductive potential and use this information to create a growth profile that can help predict future performance.

Specific Objectives are:
- To examine how the timing of increases or reductions in dietary protein affect growth and breast muscle deposition. This will determine if more heavily fleshed birds maintain breast muscle tissue at the expense of egg production.
- To characterize the physiology of the reproductive response (reproductive maturation, egg production traits, duration of fertility and hatchability) under normal and alternative protein intake conditions.
- To use early and standard photostimulation ages to identify how protein intake patterns during rearing impact reproductive readiness.
- To identify early indicators of metabolic and reproductive dysfunction. Can markers such as relative chick body weight, breast muscle fleshing, age at sexual maturity, and ovarian morphology be used to effectively predict reproductive potential?
- To trace changes in weight and fleshing measurements of all birds in commercial broiler breeder flocks and to relate these changes to the health, livability and reproductive status of birds at the end of lay. Is there an ideal juvenile growth profile for long-term reproductive effectiveness in a commercial setting?

Research progress:
The main research flock related to this experiment consisted of 600 Ross 308s and 600 708s. During their growth phase, the birds were fed either a standard breeder ration or one that was 3% higher or 3% lower in dietary balanced protein (rations were balanced in the top 14 amino acids to avoid confounding results from limiting amino acids). The high or low protein rations were fed over 1 of 4 time periods: 1-7, 7-13, 13-19 or 19-25 weeks. Feed allocation was the same in the three feeding treatments. Birds were fed ad libitum for 2 weeks, then were on a 5 of 7-day feed restriction program, then fed daily from 17 weeks of age on. Various measures were taken throughout the experiment (body weight, external carcass characteristics, breast yield, fad pad weight, liver weight, reproductive development). As expected, the 308s were heavier overall and the 708s produced a higher percentage of breast yield. There were only minor diet effects on the birds prior to sexual maturity. At 17 weeks, a subset of birds was moved to individual cages. The 308s reached sexual maturity earlier. It was unexpected that changes to dietary protein during the 1 to 7 wk period (when early frame size set) and during the 19 to 25 wk period (when reproductive tract developing) did not affect reproductive or carcass traits at sexual maturity. Carcass traits at sexual maturation were most affected by changes in dietary protein during the 13 to 19 wk period. The 7 to 13 wk dietary protein level influence on subsequent ovary traits at sexual maturity is the earliest demonstration of nutrition on the ovary – which is normally immune to changes prior to 14 wk of age.

Although statistically significant, the differences were not large. The importance of the results exist in the fact that a 3% change in dietary protein can continue to have an effect long after the point in rearing it was given. These results suggest that feeding a high protein diet during the growth phase may not be necessary for good reproductive development.

The true impact of a treatment is on the long-term reproductive traits – egg and chick production. Dietary protein levels had minor effects on egg production. Neither the total eggs laid nor the number of settable eggs was significantly influenced by diet. Feeding the LOW diet to young pullets (1-7 wks) led to production of the most small eggs. Feeding the HIGH diet later on (13-19 wks), especially close to sexual maturity (19-25 wks), resulted in the lowest fertility. Both the 308s and the 708s performed well on the standard diet. Ultimately chick production was reduced by altering the dietary protein during rearing. This effect was most pronounced early in lay. Hatchability in early production (31 to 42 wk of age) was 89% in control birds vs. 82% and 85% in HIGH and LOW dietary balanced protein groups, respectively. Birds receiving additional protein at some point during the rearing phase ultimately produced 8 fewer chicks than hens on the standard diet Control treatment.

In a related trial, chicks were fed ad lib for either 1 or 3 weeks. Growth curves thereafter were designed to merge the 2 groups by 10 weeks of age. As expected, the 3WK group initially gained much more weight, but upon being feed restricted virtually matched the other group in all respects, including apparent reproductive development, by the end of the trial (16 weeks). Flock uniformity was better for the 1WK group, presumably due to the easier transition into feed restriction and less competition for feed from aggressive birds. The pullets were photostimulated at 17, 19, 21 or 23 weeks. As expected, stimulating birds later resulted in delayed onset of sexual maturity, but these birds matured more quickly than those photostimulated early. Flocks stimulated later came into lay most consistently and had larger early eggs. These results suggest that more mature birds can better respond to photostimulation cues.

Data were also collected on 2 commercial breeder flocks from hatch to end of lay. Chick size had little correlation to production traits while measurements at 9 weeks were more predictive. On average, lighter birds had fewer large yellow follicles (LYFs) in their ovary and a higher percentage of them were out of lay. Everting the cloaca, as is done during artificial insemination, was used to indicate if a hen was laying or not. Heavy birds, on the other hand, tended toward more LYFs (too many LYFs can result in double-yolked eggs and other reproductive problems).

Future work:
The results continue to be analyzed in the context of the overall breeder physiology program. As the broiler breeders of the future continue to improve their growth and breast muscle deposition potential, protein delivery may start to play a more important role and warrant rethinking how we grow our breeding stocks. This project has identified some of the issues we will face.

ENV006

Distribution uniformity and emission reduction potential of a precision applicator for surface and sub-surface land application of poultry manure

Principal Investigator: *Claude Laguë, P.Eng., Ph.D., Adjunct Professor, Department of Agricultural and Bioresource Engineering, College of Engineering, University of Saskatchewan (Dr. Laguë is currently Dean and Professor, Faculty of Engineering, University of Ottawa)*

Collaborators: *Joy Agnew, P.Eng., M.Sc., Ph.D. candidate, Department of Agricultural and Bioresource Engineering, College of Engineering, University of Saskatchewan*

Hubert Landry, P.Eng., Ph.D., Project Leader, Prairie Agricultural Machinery Institute

Funding: $504,743 (CPRC $12,935, NSERC/AAFC $25,866, Universities of Saskatchewan and Ottawa $55,500, NSERC (IRF) $60,000, PAMI (in kind) $21,800, SAFRR $103,318, ACAAF $225,324)
Start date: November 2005
Expected end: October 2007
Interim report received: September 14, 2006
Final report received: January 2008

Background:
The main objective of this project was to engineer a precision land applicator adapted to a variety of solid and semi-solid manures (including poultry manure) and other organic fertilizers. The performance goals of the applicator included application and subsurface incorporation in a single pass, uniform distribution, and low odour and greenhouse gas emissions.

Research Progress:
Several improvements were made to the original prototype applicator that had been previously developed by the University of Saskatchewan, especially the design of an innovative subsurface application system adapted to solid manure products. A flexible auger system was developed to feed manure into a tube that injects the material directly behind a disk opener. Another disk closes the trench, effectively incorporating the manure.

Results:
Not only does the new prototype incorporate manure, it distributes it very uniformly. Uniformity of distribution, measured using beef cattle manure compost (similar in physical characteristics to poultry manure), was demonstrated by a coefficient of variation (CoV) of approximately 7% (CoV gives an indication of how evenly manure is applied – the smaller the number, the more uniform the manure is spread. CoV's for commercial solid manure spreaders typically range from 30% to 110%. A spinner-type spreader broadcasting poultry manure over a 40 ft width has a CoV of about 50%).

The current prototype (with 6 injectors) requires an estimated 72 kW (~100 hp). By comparison, spreaders with vertical or horizontal beaters require about 40 kW (~55 hp), while spinning disc type spreaders require about 60kW (~80 hp). Although a larger tractor is required, manure is simultaneously spread and incorporated, which represents time and energy savings versus separate spreading and incorporating operations.

When the prototype is adjusted to achieve maximum coverage of material, subsurface application of solid manure will significantly reduce odour emissions. There is, however, a trade-off in that greenhouse gas (CO_2, CH_4, N_2O) emissions increase with injection - the increase is about 30% for solid manure injection compared to surface application and about 45% for liquid manure injection compared to surface application.

ENV007
Development of a Dynamic Model of Ca and P flows in Layers
James France, University of Guelph

Funding: $60,180 (CPRC $20,060, NSERC/AAFC $40,120)
Start date: November 2005
Expected end: October 2007
Interim report received: July 2006
Final report received: January 2008

Background:
The main objective of this project was to develop a mathematical model to describe and predict calcium (Ca) and phosphorus (P) flows in layer chickens. A functional model would help industry (producers, nutritionists etc.) make dietary and management decisions to optimize Ca intake and reduce P excretion in manure. This process has the potential economic impact of saving dietary input costs while maximizing layer productivity and will help mitigate the environmental impact of commercial layer production

Research progress:
The first step in this project was to perform a literature review to collect relevant data regarding the interactions of Ca and P in layers. Data collected were entered into a database that was used to develop a model of Ca and P flow in layers. Using data from the literature, the research team was able to enter variables into the model and accurately predict outcomes that matched those measured in real experiments. There were few data representative of Canadian field conditions in the literature, however, so the model was not tested as vigorously as the research team hoped. Based on tests that were performed, it is anticipated that the model will serve as a useful tool to help the industry adjust layer diets and make management decisions that will optimize Ca intake and minimize P excretion in layer manure.

ENV008
Activity-specific Workplace Exposures of Poultry Barn Workers
Principal investigator: A. (Sentil) Senthilselvan, University of Alberta
Co-investigators: Irene Wenger, Nicola Cherry, John Feddes, Jerry Beach, University of Alberta

Funding: $33,726 (CPRC $11,242, NSERC/AAFC $22,484)
Start date: February 2006
Expected end: March 2008
Interim report received: n/a
Final report received: July 2008

Background:
There are relatively few data available on the exposure of poultry workers to environmental contaminants. The purpose of this study was to log the amount of time poultry workers spend on various activities on farm and to measure their exposure to environmental contaminants (respirable dust, ammonia, CO2). Exposures were compared between layer and broiler operations throughout production cycles at different times of the year

Research Progress:
During a previous study, poultry workers completed questionnaires designed to determine the amount of time they spent on various farm activities. Workers were also fitted with Personal Environmental Sampling Backpacks to measure contaminant (dust, ammonia, relative humidity, carbon dioxide) exposure during these activities. In all, there were 17 layer operations and 16 broiler operations visited. Broiler farm visits occurred at different times of the year and layer visits occurred at various stages of the flocks' production cycles. Data from point exposures were linked to activity diaries to estimate total exposures for the workers.

Dust (<10μm) levels overall were higher in broiler barns than in layer barns. There was no season difference in dust levels in the broiler barns, but they were higher in the layer barns during the winter than the summer.

Relative humidity (RH) was generally higher in broiler barns than layer. There was no season difference in RH in the broiler barns, but it was higher in the layer barns in the summer than in the winter.

Carbon dioxide levels were higher in the broiler barns vs. layers, and were higher in the winter vs. summer for both types of operations.

There was no season difference in temperature in the layer barns while the broiler barns were warmer in summer than in the winter.

As the broilers aged, dust levels increased, but there were no changes in ammonia, CO2 or RH. There were no layer flock age effects on any of the contaminants measured.

All stated objectives were met. In addition to the measurements outlined above, the project was intended to suggest measures to protect poultry workers from potential environmental health hazards. Surprisingly, the study suggests that ammonia exposures did not exceed the 25ppm Time Weighted Average Threshold Limit Value (the TLV of a chemical substance is a level to which it is believed a worker can be exposed day after day for a working lifetime without adverse health effects, according to the American Conference of Governmental Industrial Hygienists (ACGIH)). The authors did point out, however, that the sampling equipment used has a time lag and may have underestimated ammonia levels since the workers were in the barns for relatively short periods of time. Similar to ammonia, measured CO2 levels did not exceed the 5,000ppm TWA TLV. The authors do recommend that poultry workers use N95 or comparable respirators while working in their barns to mitigate adverse effects of respirable dust.

ENV009
Reducing pollution from veterinary pharmaceuticals in agricultural runoff from poultry manure
Principal investigator: Shiv Prasher, McGill University
Co-investigators: Xin Zhao, McGill University, Ciro Ruiz-Feria, Texas A&M University

Funding: $114,000 (CPRC $38,000, NSERC/AAFC $76,000)
Start date: January 2006
Expected end: December 2007
Interim report received:
Final report received: April 2008

Background:
This project was aimed at investigations into the fate and transport of veterinary pharmaceuticals (VPs) in soil and water. There has been relatively little work done in this area, especially specific to Canadian conditions. More information is required to determine the extent to which VPs persist in agricultural soil and runoff, and what risks are posed by their presence.

Research progress:
Manure from Quebec poultry farms feeding one of 3 coccidiostats (monensin, narasin and salinomycin) was applied to soil at 10 Mg/ha (~4.5 ton per acre). The soil was previously free of poultry manure for 10 years. Specially designed devices, known as lysimeteres, were used to track the movement of these VPs through the soil and into ground water. Rainfall was simulated to represent the 50-year maximum in the area over 3 months (July to September). Soil samples were collected from the surface and at three depths (0.1, 0.3, 0.5m), and leachate (water runoff) was collected 0.9m below the surface throughout the experiment.

Monensin persisted at various soil depths for over 60 days. At the surface, it decreased from 16.1 mg/kg on day 0 to 1.54 mg/kg on day 60. At other depths, monensin levels initially increased, and then decreased. The pharmaceutical was detected at all four soil sampling depths from day 7 through day 60. A small amount of monensin was also observed in drainage waters from day 3 to day 15. At the soil surface, narasin levels declined from 11.08 mg/kg on day 0 to 0.036 mg/kg on day 30, while below the soil surface and in drainage water, it only persisted until day 15. Salinomycin at the soil surface, initially at 8.5 mg/kg dropped to 0.72 mg/kg by day 3, and was undetectable thereafter. While below the soil surface, salinomycin only remained detectable until day 7 it remained detectable in drainage water until day 60, where its concentration (1.56 mg/L) was greater than that of either monensin (0.34 mg/L) or narasin (0.32 mg/L). It appears that whereas monensin could persist in soil over a longer period, salinomycin is more mobile and may present a greater threat to water resources. Studies are also underway to investigate the effect of VP-manure on the half-life of commonly used herbicides. Initial results indicate that half-lives of three herbicides (atrazine, metolachlor, and metribuzin) increased with the presence of VPs in soil. One of the primary mechanisms of pesticide degradation in soil is microbial degradation and the presence of VPs in soil may be affecting microbial survival in soil. However, more work needs to be done in this area before any concrete conclusions can be drawn.

Future work:
It took longer than expected to develop and refine techniques for VP extraction. The objective of testing the project's data against a mathematical model was therefore not achieved in the expected timeframe. This work is, however, currently underway. It is hoped that information gathered during ongoing work will lead to Best Management Practices designed to mitigate any negative effects of VPs in the environment.

AGA010
Cryopreservation of Canada's Remaining Avian Germplasm
Fred Silversides, Agriculture and Agri-Food Canada

Funding: $69,000 (CPRC $34,500, AAFC $34,500)
Start date: September 28, 2006
Interim report received:
Final report received: July 27, 2007

Background:
In 1946 there were 300 breeders of poultry in Canada. Today, 90% of the broiler chickens in North America and 90% of layers worldwide come from 2 breeder companies each; none of these companies is Canadian owned. Many genetic lines at institutions and research facilities across the country have also been dropped. According to a 2005 survey of institutions at Agriculture and Agri-Food Canada (AAFC) and the Faculties of Agriculture and Veterinary Medicine, only 5 institutions still carry genetic stocks, representing 33 lines of chickens in 23 different populations. These stocks of live birds are at continual risk from disease and budget cuts. There needs to be an economical way to address this drastic reduction in the genetic diversity of poultry stocks in Canada.

Freezing and storing semen, as has been used to preserve genetic stocks in other agricultural species, does not work well with poultry. Furthermore, the large size and fragility of the avian egg prevents any attempts to freeze its genetic material. Although freezing and storing cells from undifferentiated embryos has met with some success, the procedure to reconstitute flocks is technically difficult. Dr. Silversides and his team suggest an alternative procedure. They have demonstrated that ovarian tissue can be collected from day-old chicks and transferred to recipient chicks. They have also shown that testicular tissue can be transplanted from one chick to another resulting in live offspring once the recipient reaches sexual maturity. The implication of these results is that these tissues can be collected from chicks of genetic interest and frozen for long-term storage. When there is a need to regenerate flocks, the tissues can then be thawed and transplanted to recipient chicks that, upon reaching sexual maturity, can be bred to produce offspring with the genetic makeup of the transplanted tissue.

Research progress:
The aim of this project was to freeze the gonads of 120 individuals from each population of chickens currently kept at AAFC and university facilities across Canada, with the eventual goal of recuperating offspring from each flock. Thus far, tissues from 1558 individuals representing 18 populations from 3 institutions were frozen. Unfortunately, due to hatching problems, enough material was collected from only 3 populations (there needs to be a certain number of individuals recuperated per line to produce enough birds in a flock to avoid inbreeding problems). Attempts have not been made to regenerate flocks from any of these frozen tissues.

Future work:
Dr. Silversides and his team will continue to freeze gonadal tissue from lines of birds across the country. Although the proof of concept of recuperating flocks from frozen gonads has been established, Dr. Silversides notes that long-term institutional commitment is required to form a fully functional gene bank.

Related publications:
Silversides, F. G., Shaver, D. McQ. and Song, Y. 2007. Pure line laying chickens at the Agassiz Research Centre. Animal Genetic Resources Information 40: 79-85.

Song, Y. and Silversides, F. G. 2006. The technique of orthotopic ovarian transplantation in the chicken. Poult. Sci. 85: 1104-1106.

Song, Y. and Silversides, F. G. 2007. Offspring derived from orthotopic ovarian transplants in chickens. Poult. Sci. 86: 107-111.

Song, Y. and Silversides, F. G. 2007. Heterotopic transplantation of testes in newly hatched chickens and subsequent production of offspring via intramagnal insemination. Biol. Reprod. 76: 598-603.

Song, Y. and Silversides, F. G. 2007. Production of offspring from cryopreserved chicken testicular tissue. Poult. Sci. 86: 1390-1396.

FSQ011
Immunization of broiler chickens against necrotic enteritis
John Prescott, University of Guelph

Funding: $96,813 ($33,981 CPRC, $62,832 NSERC/AAFC)
Start date: September 2006
Expected completion date: August 31, 2009
Interim report received: July, 2007
Final report received:

Background:
The long-term goal of this project is to develop a means of protection against Necrotic Enteritis (NE) in broiler chickens alternative to the antimicrobials currently used in the industry. The issue of increasing bacterial resistance to antimicrobials is of major concern to the Canadian poultry industry; alternative means to control important disease such as NE would have significant impact.

Research progress:
The project is progressing well. Several proteins, produced uniquely by virulent strains of Clostridium perfringens (the causative organism of NE) have demonstrated varying ability to protect chickens against disease challenge. It was previously thought that alpha-toxin produced by C. perfringens was a significant factor in development of clinical NE. However, there is growing evidence from Dr. Prescott's lab and elsewhere that production of this toxin is not a prerequisite of the disease. This project will shed more light on the role of alpha-toxin in immunity to NE.

Future work:
Dr. Prescott and his team are now building expression plasmids for the proteins of interest (as well as alpha-toxin) that will eventually be delivered through an attenuated Salmonella vaccine vector.

This project has direct industry implications and could well lead to an effective means of controlling NE in chickens without the need for prophylactic doses of antimicrobials.

FSQ012
Immunology of T cell-mediated immune response to avian influenza virus in the chicken
Shayan Sharif, University of Guelph

Funding: $359,400 (CPRC $59,800, PIC $60,000, NSERC/AAFC $239,600)
Start date: March 2007
Expected end: February 2009
Interim report received: December 2007
Final report received:

Background:
The long-term objective of this project is to develop effective, broad-spectrum vaccines against avian influenza (AI) virus. There is relatively little known about the chicken's immune response to AI virus infection. The immediate objectives of this project, therefore, are to identify the molecular determinants that confer immunity to the virus and identify the immune system cells that see these determinants. The project is also aimed at determining the dynamics of immune system cells in response to AI virus infection and to elucidate the genetic pathways that control that response. A better understanding of the immunology of AI is required before rational control strategies can be developed.

Research progress:
Much of the effort for this project thus far has been towards development of assays and other analytical tools. Dr. Sharif's team previously developed an immune system-specific array that can be used to measure the differential expression of various immune system genes. They have also developed assays that can measure the expression of a number of cytokines and other immune enhancing molecules, as well as for measuring cell proliferation in vitro. They are working towards development of a stable line of chicken T-cells that can be grown and manipulated in culture (T cells are thymus-derived lymphocytes which either kill the pathogen, destroy host cells that harbour the pathogen, or help other immune system cells, including B lymphocytes (derived from the bursa of Fabricius) to undertake killing or inactivating the pathogen). These tools will be used in lab studies to tease out the molecular intricacies of the chicken's immune response to antigens such as AI virus. Dr. Sharif's team is uniquely qualified to carry out these experiments. With these tools in hand, they will begin to establish which cytokines etc. might be used to enhance the effectiveness of AI vaccines. These molecules may be expressed in recombinant vaccines that carry the genes that code for them, or they may be administered in purified form as an adjuvant to the vaccine. Work is ongoing to develop a system that will use bacteria to produce the appropriate proteins in culture.

Future work:
This is a large, complex project that integrates with Dr. Sharif's overall program of investigating the molecular control of immune function in birds. Much of the groundwork has been laid in terms of development of analytical tools which has set the stage for an array of experiments.

FSQ014
Development of second generation RNA interference constructs against avian influenza virus
Serguei Golovan, University of Guelph

Funding: $76,500 (CPRC $25,200, NSERC/AAFC $50,400)
Start date: November 2006
Expected end: October 2008
Interim report received:
Final report received:

Background:
Poultry is in continuous contact with a great variety of viruses, and while they are resistant to the majority, they are harmed by a few, resulting in significant economic losses. Recent events have demonstrated that avian influenza is a constant threat to poultry industry worldwide. Avian influenza not only results in significant monetary loss for the poultry industry, but also represents a serious risk to human health. The possibility of another worldwide influenza pandemic is now taken very seriously. At the first sign of avian influenza outbreak, millions of birds have to be destroyed and an embargo on import of poultry products from the affected country is implemented. It is almost impossible to eliminate natural reservoirs of avian influenza virus in wild migratory birds that show no visible symptoms yet can easily spread the pathogenic virus strains across the borders. Vaccination is only partially effective due to rapid antigenic drift of targeted epitopes of influenza virus. Conventional breeding has not produced highly resistant and commercially acceptable varieties. As the virus depends on the host cellular machinery for its propagation, preventing access to this machinery in the cells might block viral replication and interrupt the infection cycle. This project aims to develop RNAi molecules highly efficient against avian influenza virus. The development of this technology might lead to treatments that prevent avian influenza infection, and production of influenza-resistant poultry. The proposed research will also improve the understanding the role natural RNAi plays in protecting poultry from viral infection.

FSQ015
Novel multivalent vaccines for avian health
Eva Nagy, University of Guelph

Funding: $276,750 (CPRC $96,750, NSERC/AAFC $180,000)
Start date: December 2006
Expected end: November 2009
Interim report received: September 2007
Final report received:

Background:
Infectious diseases caused by a host of pathogens constantly threaten the poultry industry. As part of the arsenal of prevention and control measures, there is a need for more effective vaccines. The goal of this research to create a biological platform for the production of effective vaccines that protect flocks from more than one pathogen at a time and, when used to infect birds, can be distinguished from that of naturally occurring viral infection in the field. This is an ambitious project that endeavours to use molecular biology to create a vaccine vector based on the fowl adenovirus (FadV-9) that can deliver genes of interest (such as those coding for pathogenic virus antigens) to the bird thereby eliciting an immune response against those antigens

Research Progress:
Results have not yet been approved for public release due to intellectual property issues.

PWB017
Engineering, animal welfare and meat quality considerations of broiler transportation in a heated and ventilated vehicle
Trever Crowe, University of Saskatchewan

Funding: $1,229,757 (CPRC $90,000, NSERC/AAFC $800,000, PIC $23,300, CFOS $80,000, ACP $30,000, AFAC $10,000, SCIDF $55,425, Lilydale (in kind) $141,032)
Start date: January 2007
Expected end: December 2010
Interim report received: October 2007
Final report received:

Background:
Transport of broiler chickens represents a major welfare challenge to the poultry industry. Temperature and humidity levels in commercial transport vehicles are highly variable, which can expose some or all of the birds to undue stress. Previous research at the University of Saskatchewan demonstrating this variability has led to the development of a prototype broiler transport trailer with active heating and ventilation capable of much better environmental control than commercial trailers currently used. The purpose of this project is to measure and compare differences in temperature and humidity between the prototype and commercial trailers in a range of environmental conditions typical of Canadian winters. The effects of temperature and humidity extremes on the welfare of the bird will also be examined.

Research progress:
Activities thus far include recruitment of personnel, development of protocols, completion of funding applications and equipment acquisition. Fifteen field trials have been performed under ambient conditions ranging from –27^{o}C to 13^{o}C. Many data have been collected covering such parameters as trailer temperature, trailer humidity, body core temperatures, and shrinkage during transport. Dr. Crowe's team is also looking at and adjusting air flow patterns through the prototype trailer to optimize humidity control; there is a possibility that controlling humidity will allow the birds to better tolerate low temperatures with less need for auxiliary heat. Data have also been collected on over 750 carcasses, which will be used to establish the effects of environmental effects on meat quality.

Future work:
There have already been many data collected with several more field trials planned. Future studies using environmental chambers will help determine the low ambient temperature threshold at which broilers can safely be transported.

PWB018
Improving welfare for beak trimmed hens through reducing variability and technology transfer
Hank Classen, University of Saskatchewan

Funding: $162,375 (CPRC $60,253, NSERC $102,122)
Start date: April 2007
Expected end: March 2010
Interim report received: January 2008
Final report received:

Background:
Beak trimming is commonly performed on layers, breeders and turkeys to minimize feather pecking and cannibalism in commercial flocks. The practice has come under scrutiny, however, because of associated pain, both immediate and chronic. While there remains some question as to the amount, or even presence of, chronic pain resulting from beak trimming, it is clear that acute pain can be minimized by trimming beaks less aggressively and doing so when the chicks are young. Achieving this end in the commercial setting, however, is difficult as chicks vary in size for which semi- or fully automatic equipment cannot properly adjust. The objectives of this project are:

1. To establish the degree of variability in beak trimming in commercial flocks
2. To determine the causes of this variability and develop methods to minimize it (perhaps by sorting eggs, and therefore chicks, by size and calibrating trimming equipment according to a specified size range)
3. To develop Standard Operating Procedures and training programs to be used by personnel performing beak trimming

Several strains of layer chicks will be monitored immediately after various trimming techniques to assess acute pain, as well as long-term (to approximately 40 weeks of age) to determine if any experience chronic pain or inferior performance occurs due to beak trimming. The economic impact of any long-term effects will also be considered.

Research progress:
Visits to commercial farms are planned for February and March 2008. Chicks from commercial hatcheries trimmed using infrared light or a hot blade are being raised at the University of Saskatchewan and observations are being collected (expected completion in July). Laser-trimmed chicks are no longer available Western Canada so provisions have been made to obtain some from the U.S. Results are expected from these chicks in June 2009.

PWB019
Effect of lighting programs on leg weakness and bird welfare in modern commercial broilers
Hank Classen, University of Saskatchewan

Funding: *$241,037(CPRC $52,214, NSERC/AAFC $158,223, Lilydale (in-kind) $30,600)*
Start date: March 2007
Expected end: February 2010
Interim report received: January 2008
Final report received:

Background:
Previous research suggests that lighting programs that include a period(s) of darkness are a simple way to improve broiler welfare. This research project aims to provide information on the impact of various darkness patterns, initiated at various ages, on leg weakness in broilers. Another objective of this project is to develop a simple method of assessing leg weakness on farm. Specifically, the objectives of this project are:
1. To define the importance of length of continuous darkness on leg weakness and production traits in broilers
2. To establish the effects of age of initiating extended darkness on leg weakness and broiler productivity
3. To determine if gait scoring represents an accurate measure of leg pain
4. To evaluate the use of force plate technology in assessing leg weakness
5. To establish the relationship of behaviour to leg weakness
6. To model the economic effects of implementing lighting programs with extended darkness

Research Progress:
The first experiment towards achieving objective 1 is complete with a second underway. Ross x Ross 308 broilers were subjected to various lighting programs. Data were collected on body weight, feed consumption, mortality (frequency and cause), and behaviour (at 32-24 days of age), gait score, footpad condition and meat yield. Many data have been tabulated and analyzed. Video (behaviour) records have not been observed yet. Towards objective 4, a force plate system has been designed with testing and calibration work planned for January or February 2008. Work towards achieving objectives 2, 3 and 6 are planned for subsequent phases of the project.

PWB020
Evaluation of alternative methods of euthanasia for cull turkeys
Tina Widowski, University of Guelph

Funding: $75,579 (CPRC $25,193, NSERC/AAFC $50,386)
Start date: April 2007
Expected end: October 2009
Interim report received:
Final report received:

Background:
The goal of any euthanasia method must be the humane death of an animal with the minimum of pain, fear or distress. Euthanasia procedures should also be safe and aesthetically acceptable to those staff members that have the responsibility of performing them. There are several methods currently available to the turkey producer but there is little information as to the most appropriate methods to use for birds of different weight classes. The Canadian Codes of Practice recommend cervical dislocation for euthanizing young turkeys and a "quick firm blow to the head" following restraint for larger birds. Neither of these methods are aesthetically pleasing to the operator, and depending on the size of bird and skill of the stockperson, they may not be the most humane. Penetrating and non-penetrating captive bolt devices have been effective for stunning animals in abattoirs. These devices stun through disruption of brain function via the transfer of energy from the device to the brain tissue. One disadvantage of penetrating captive bolt devices for use on-farm is the potential of contamination of premises from diseased animals. Non-penetrating captive bolts reduce this risk. There is currently no published research on the use of a non-penetrating captive bolt device for euthanizing turkeys. Recently, a non-penetrating captive bolt device for stunning rabbits was developed using a commercially available pneumatic nailing device. It is powered by a commercially available, portable air compressor. The objectives of this study are:

- To evaluate the use of non-penetrating captive bolt for different weight ranges of turkeys
- To make recommendations concerning use of this device in practical settings
- To compare the use of this device to traditional methods
- To make recommendations concerning best practices for cull turkey euthanasia.

PWB021
Impact of ammonia on welfare of laying hens, and implications for the environment
Steve Leeson and Tina Widowski, University of Guelph

Funding: $458,499 (CPRC $51,118, NSERC/AAFC $305,666, Novus $60,000, Ajinimoto $41,715)
Start date: January 2008
Expected end: December 2010
Interim report received:
Final report received:

Background:
Atmospheric ammonia is known to impact bird health and that of poultry workers. Ammonia is a breakdown product of uric acid, which is the main nitrogenous component of avian urine. Consequently, the more uric acid excreted, the greater the potential for ammonia release. To date, the main mechanism to control environmental ammonia levels in layer barns has been by adjustment to the ventilation air flow. There is now concern about the contribution of animal agriculture to ammonia release into the atmosphere, and so this option is likely going to be curtailed and/or regulated in the near future. The goal of this research program is to quantitate ammonia release from caged layers relative to various nutritional and intervention strategies and assess layer welfare in terms of any physiological changes to the bird, as well as test the layers voluntary aversion to, or acceptance of, graded levels of atmospheric ammonia.

CTM022
Use of dietary thyroxin as an alternative moulting procedure in turkey breeder hens
Gregoy Bédécarrats, University of Guelph

Funding: $61,650 ($27,125 Canadian Turkey Marketing Agency, $3,700 Hybrid Turkeys (in kind), $30,825 NSERC (not yet confirmed))
Start date: June 2007
Interim report received: August 2007
Final report received:

Background:

Although genetic selection has dramatically increased egg production of the modern breeder chicken hen, similar strides have not been made for turkey breeders. As a result, turkeys breeder stocks are replaced as their egg production declines. This approach works within the industry only when replacements are in sufficient supply. In times when supply is cut off, such as when bird movement restrictions are imposed during a disease break, alternative means to maintain fertile egg production in the industry may be needed. Moulting is a procedure that could be used to 'reset' a flock and gain a second production cycle after the first has stopped. Traditional methods of severe light, water and feed restriction are effective in inducing a moult, but have serious welfare concerns. As an alternative, dietary supplementation with thyroxin has been used successfully in chickens. This aim of this project is to determine if this method could be adapted to turkeys.

The objectives of this project are:

1. To determine if a relatively high does (40 ppm) of thyroxin will induce moulting in turkey hens with minimal impacts on the birds' health and welfare.

2. To determine if turkey hens treated with thyroxin can enter a second reproduction cycle.

The long-term objective of this research program is to develop moulting protocols that would be applicable on a large scale and would be ethically acceptable to both the industry and the public

Research progress:

A preliminary trial shows that dietary supplementation with 40 ppm thyroxin for 10 days will induce moulting in end-of-cycle turkey hens. Thyroxin treatment results in lower feed intake and reduction in body weight coupled with egg production that decreases to zero within 25 days of treatment. Following treatment, hens resumed or exceeded pre-treatment feed consumption levels and returned to their initial body weights. By the time the trial was terminated at day 37 (27 days after thyroxin treatment stopped), most treated hens had replaced feathers lost during the moult cycle and several treated hens began to lay eggs again. Reducing photoperiod to 6 hours of light per day (vs. 14 hours) appeared to induce moult more rapidly. No adverse effects of the treatment were noted during the trial.

Future work:

A dose response trial is planned to determine the minimum dose of thyroxin that will induce moulting and to determine if treated hens can return to a reproductive cycle. The trial will also test the effect of "holding" the treated flocks with 6 hours of light for 6 or 12 weeks on subsequent egg production. Levels of thyroxin and corticosterone in plasma samples collected during this and the previous trial will be measured.

AMN023
The use of cyclic-di-GMP, a novel immunotherapeutic and antibacterial molecule in chickens
Principal investigators: Moussa Diarra, Agriculture and Agri-Food Canada and François Malouin, Université de Sherbrooke
Collaborator: Brian Talbot, Université de Sherbrooke

Funding: $223,954 ($60,002 CPRC, $163,952 AAFC)
Start date: August 2008
Expected end: March 2012
Interim report received:
Final report received:

Background:

The objective of this project is to demonstrate the usefulness of cyclic-di-GMP, a novel immunotherapeutic molecule, for the prevention of infections by microbial pathogens in chickens. These molecules have been shown to protect mice from bacterial challenge (S. aureus) and elicit varied immune system responses. Human immature dendritic cells in culture also show responses to the presence of c-di-GMP. The responses demonstrated in these and other studies suggest that c-di-GMP is a novel immunostimulant that could be used to protect poultry from bacterial infections and as a new adjuvant for vaccines against poultry pathogens.

Specific objectives are to demonstrate the ability of c-di-GMP to enhance host immunity and to provide proof of concept for their use in chicken production to replace antibiotherapies and antibiotic-based growth promoters. The project will look at the effect of c-di-GMP on the immune response to IBDV vaccination in broiler chickens, on gut microflora and emergence of resistant bacteria, and on the control of Clostridium perfringens in broiler chickens.

AMN024
Investigation into cell-cell signalling in Clostridium perfringens infection for developing a novel disease-control strategy
Principal investigator: Joshua Gong, Agriculture and Agri-Food Canada
Collaborators: Mansel Griffiths and John Prescott, University of Guelph

Funding: $180,500 ($60,000 CPRC, $63,000 AAFC, $57,500 SCIDF (not yet confirmed))
Start date: October 2008
Expected end: November 2010
Interim report received:
Final report received:

Background:
Clostridium perfringens causes necrotic enteritis (NE), a common enteric disease of birds. NE occurs when C. perfringens overgrows and dominates the flora in the intestine and produces a high level of α-toxin. This toxin was considered to be a major virulence determinant associated with the disease, however this theory was recently called into question. NE in poultry is currently controlled by prophylactic use of antibiotics in feed. The continued emergence of antibiotic-resistant bacterial pathogens in both humans and food animals, however, represents a potentially severe negative impact of this common practice. The increasing public anxiety has spurred research into non-antibiotic alternatives for controlling the disease. One of the recent significant discoveries in microbiology is bacterial communication and its mechanism through cell-cell signalling (quorum sensing). Quorum sensing has a role in the regulation of a wide variety of physiological processes, especially the production of virulence factors which are important during pathogen bacterium-host interactions. In C. perfringens, for example, quorum sensing is involved in regulating production of several toxins, including α-toxin. This information came from studies on a human isolate of C. perfringens. Dr. Gong and his team will be looking at C. perfringens in the chicken in an attempt to answer the following questions: 1) Does the quorum sensing occur in the chicken intestine? 2) How much is it involved in the toxin production by C. perfringens and NE development in the intestine? 3) Can an effective strategy be developed to control NE by blocking the signalling (so-called quorum quenching)?

AMN025
Engineered antibodies and phage products for food safety applications
Principal investigators: Christine Szymanski, University of Alberta
Roger MacKenzie, National Research Council
Jamshid Tanha, National Research Council
J. Christopher Hall, University of Guelph

Funding: $1,324,000 ($54,000 CPRC, $1,000,000 Alberta Ingenuity Fund, $270,000 NRC)
Start date: June 2009
Expected end: May 2012
Interim report received:
Final report received:

Background:
In the past decade, the protein therapeutics market, led by monoclonal antibodies, has rapidly expanded to annual sales of approximately US$20 billion. Most protein therapeutics currently on the market are for the treatment of cancer, but there is huge potential for protein therapeutics to expand into other areas such as infectious diseases. Most approved protein drugs are extremely costly full-length antibodies so there is a pressing need to develop less expensive alternatives. This proposal follows a growing trend in the protein therapeutics industry away from whole antibodies and mammalian expression systems. In applications in which only the antigen binding function is required, single-domain antibodies (sdAbs) and surrogate antibodies such as the receptor binding domains of bacteriophages (PRBDs) are attractive alternatives. Plant expression of such molecules has the potential to greatly reduce cost and give high value agricultural products. The proposed work builds on preliminary data that have established proof-of-principle for the concept that oral administration of Campylobacter jejuni-specific pentameric sdAbs (pentabodies) and Salmonella enterica serovar Typhimurium-specific PRBDs, can reduce the levels of chicken colonization by these organisms. This represents a reduction-at-source approach to decreasing the incidence of food-borne illness. For C. jejuni, the specific pentabodies will be engineered for improved protease resistance and thereby lowering the dose levels required. Dr. Szymanski and colleagues have also recently obtained the first genome sequence for a C. jejuni bacteriophage. The PRBD of the phage has been identified and will be cloned, engineered and over-expressed for chicken studies to evaluate its efficacy in terms of reducing C. jejuni colonization levels.

Table 2 - Abbreviations used in research project summary

Agriculture and Agri-Food Canada	AAFC
Alberta Agricultural Research Institute	AARI
Advancing Canadian Agriculture and Agri-Food Program	ACAAF
Alberta Chicken Producers	ACP
Alberta Farm Animal Council	AFAC
Agri-Food Research & Development Initiative (Manitoba)	ARDI
Canadian Bio-Systems Inc.	CBS
Chicken Farmers of Saskatchewan	CFOS
Canadian Poultry Research Council	CPRC
Matching Investment Initiative	MII
Natural Sciences and Engineering Research Council	NSERC
National Research Council	NRC
NSERC/AAFC Research Partnership Program	NSERC/AAFC
Industrial Research Fellowship	NSERC-IRF
Prairie Agricultural Machinery Institute	PAMI
Poultry Industry Council	PIC
Saskatchewan Agriculture, Food and Rural Revitalization	SAFRR
Saskatchewan Chicken Industry Development Fund	SCIDF