



THE UNIVERSITY OF
SYDNEY

2015 Annual Report

Poultry Research Foundation

Faculty of Veterinary Science

Governance Statement

The Poultry Research Foundation recognises the importance and benefit of reviewing its adoption and alignment with governance principles and provides the following report.

Principle 1 – Lay solid foundations for management and oversight

Nature of the entity:

The Poultry Research Foundation is a part of the University of Sydney (ABN 15 211 513 464) and not separately incorporated under a State or Commonwealth Act. The Foundation is required to gain prior approval for its fundraising activities from the appropriate University delegate. The Foundation's activities are not-for-profit and covered by the DGR status of the University of Sydney. The University is exempted from the requirement to hold an Authority to Fundraise and obligations upon holders of such an authority but is still required to comply with the balance of provisions of the Charitable Fundraising Act.

Roles of board / council and management:

The Foundation operates under the authority of the Senate of the University of Sydney, as approved in June 2011, and has no powers of delegation. The Foundation conducts its affairs pursuant to the Foundation Rules and the relevant policies of the University.

Principle 2 – Structure of the council to add value

The Council of the Foundation in 2015 consisted 14 members. (Refer to page 7)

Council members were elected at the Foundation's AGM on 9th April, 2014. There is not a separate nomination committee of Council. The full Council resolves on nominations for co-opting of members to fill vacancies outside of the process of election at the AGM There was not a performance evaluation of the Council undertaken in the reporting period.

Principle 3 – Promote ethical and responsible decision-making

Council members have been provided with the University of Sydney Foundation Governance Guide, Foundation Rules, Code of Conduct, Work Health & Safety policy and the External Interests policy. All these policies are available on the University's Policy Register, as are other relevant University policies regarding harassment, grievance procedures and the Delegations of Authority.

Principle 4 – Safeguard integrity in financial reporting

The annual accounts of the Foundation are prepared by the financial staff of the University, signed off by the Director of the Foundation and included in this Annual Report to the Senate. The Foundation is part of the University and therefore does not have its own audit sub-committee. While the Annual Financial Report of the University is audited by the Audit Office of NSW, the Annual Accounts of the Foundation have not been audited.

Principle 5 – Make timely and balanced disclosure

The Foundation complied with the reporting and disclosure requirements of the Senate. These include an annual budget and this Annual Report

Members and Council have been made aware of the processes for disclosure pursuant to the Code of Conduct, External Interests policy, which include protected disclosure to the ICAC, to the Ombudsman or to the Auditor General.

Principle 6 - Respect the rights of shareholders, members, staff, volunteers, clients & other stakeholders

The Foundation Council and/or membership consists of invited industry professionals, industry bodies and University representatives, whose input is invited via the Annual General Meeting and Council meetings of the Foundation. Each year the Foundation conducts a General Meeting in Oct/Nov and the AGM in March/April.

Principle 7 - Recognise and manage risk

The Foundation recognises its activities within University premises or other premises require risks such as health and safety, environmental protection, privacy, trade practices, and compliance with the Charitable Fundraising Act to be considered and managed. The Foundation has managed these risks during the year by complying with risk management procedures as outlined by the University.

Principle 8 – Remunerate fairly and responsibly

No member of a Council is entitled to receive any remuneration for acting in that capacity except reasonable remuneration on a basis which has first been approved in writing by the University Officer (Foundations). Members of the Foundation Council may be reimbursed for reasonable expenses after written approval of the University Officer (Foundations). Any such instances are recorded in the minutes of the Council.

Foundation Objectives

OBJECTIVES OF THE FOUNDATION

The objectives of the Poultry Research Foundation are to advise the Senate of the University of Sydney and the Vice-Chancellor on matters associated with poultry research, education and scholarship within the University of Sydney and to provide an interface between the Australian poultry and allied industries and the University.

In doing so, the Foundation shall increase the resources of the University by way of membership to the Foundation and utilising benefits given by members in provision of services and other non-financial contributions.

AIMS OF THE FOUNDATION

1. To provide an interface between the poultry and allied industries in Australia and the University of Sydney.
2. To undertake research of relevance to these industries.
3. To assist in the training of scientific and technical personnel to service the private and public sectors of these industries.
4. To act in an industrial liaison capacity.

PRIORITIES 2015

1. Develop links between the University of Sydney and the Poultry CRC
 - a. Research projects
 - b. Educational programs
 - c. Postgraduate scholarships
2. Develop research projects lead by the Director of Poultry Science
3. Complete infrastructure maintenance of the Poultry Unit
4. Promote postgraduate opportunities within the Poultry Research Foundation
5. Organise the 2016 Australian Poultry Science Symposium
6. Management of the Foundation is vested in a Council which comprises the President, Deputy President, Director, Faculty of Veterinary Science Dean and Provost Nominee along with elected Industry Members from the categories of Governors and Executive Members, Honorary Governors and Ex Officio Members.
7. The administrative office and Research Unit are based at Camden.

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President's Report

2015 has been another year of vital contribution to the Australian Poultry Industry by the Poultry Research Foundation. Once again, a diverse and valuable range of work has been conducted reflecting the needs of the industry. The PRF continues to enjoy healthy participation by industry with two Governors, nine Executive Members and ten Associate Members amongst its ranks. This interface breathes relevance into the Foundation's lines of enquiry.

The PRF's joint bid with SARDI to assume management of the heritage of the Poultry CRC beyond its completion on the 30th of June 2017 was unsuccessful. However, the University of New England, the successful applicant, will work closely with the PRF, SARDI and others as partners. This new effort is now known as the Poultry Hub Australia. Our goal will be to work in concert with but not limited to the Poultry Hub Australia.

There is still an intention to transition from being a Foundation to being a Research Centre, however this will be examined in more detail by late 2016. This will coincide with application for co-funding from the ARC's Industrial Transformational Research Hub. This will also involve collaboration with other Universities - several are currently interested.

We were very pleased to announce the appointment of two Poultry Nutrition Lecturers during 2015: Dr. Sonia Liu and Dr. Cormac O'Shea. Sonia has been promoted from within, and Cormac joins us from Dublin Ireland. We congratulate them on their appointments and wish them every success in their new roles.

The 26th Australian Poultry Science Symposium was held in February 2015 and was attended by 200 delegates including many internationals. The Symposium examined opportunities for improvement from the formation of the egg, right through efficient production and delivery of safe, high quality poultry products with welfare of the bird in mind. Once again, the social programme was very enjoyable including the Welcome Drinks, the Barbeque and the Harbour Cruise. We thank our Sponsors for their ongoing support to make it all possible.

As the challenges presented to the industry change, it is important that we identify and respond to those changes. The unique qualities of the PRF provide us with the means to do so. By harnessing the meeting of minds of this Foundation, we strive to innovate our way to the future - with confidence.

Judy O'Keefe
President

Director's Report

2015 was a challenging year for the PRF and change was a major factor before us.

Changes in University attention to Foundations will require us to change the structure of the PRF to that of a Research Centre. The PRF and SARDI made a combined submission to the Poultry CRC Board to take on the transition of the CRC's activities after its completion in 2017. Unfortunately this was unsuccessful, even though we fully met all the criteria requested, including full coverage of administration costs so that industry contributions would not be drained away from research funding and the establishment of a semi-autonomous entity which had branding and contractual authority. The CRC transition will pass to UNE and they will develop a Centre to facilitate "Poultry Hub Australia". Sydney University will still be a significant partner in this process and will benefit from funding opportunities as the transition takes effect. There have been no details from UNE of how this transition will work as yet and they have not identified a Director at present. Had the PRF obtained the transition, our Centre would have been operating from November, 2015.

We continue with progression towards transformation of the PRF into a Research Centre. We have looked strongly at application for funding under the ARC's Industrial Transformational Research Hub program. This involves generous funding (\$500,000 to \$1,000,000 per year for up to five years) but requires at least 75% of the government funding to be matched from commercial partner cash contributions. The basics of the research proposal were circulated to PRF members. We have a strong start and will work towards an application for the 2016 round. Further to this goal, we have strong agreement now from researchers at Sydney University, UNE, University of Melbourne (AWSC), RMIT University and the University of Central Queensland. We also have a memo of understanding with the Agricultural Research Organization, Israel. Each institute would form a hub of the Centre and take on specified sections of the research goals. I expect that most of the institutes will contribute cash to the proposal, progressing us by about \$150-200,000 towards the cash goal. The Director continues to liaise with industry partners where the level of interest is high and hopefully cash commitments will follow. Visits and presentations have already been made to two major broiler companies, APIA, Woolworths and Coles. This work will be followed up throughout early 2016.

We obtained a contract template that clearly simplifies the IP issues that may complicate contracted research which was tabled at our November 2015 meeting. I believe this will overcome concerns and issues previously encountered in this complicated field.

We have continued substantial research on poultry nutrition and welfare. A brief report from each researcher will be available for the meeting and many of the researchers and students will be available for questions and comment as desired. Our facilities have been extensively utilized this year and the support from the technical staff has been up to its usual high standard. We offer our continued thanks for their support and efforts.

A detailed report on the 2015 APSS is included in this report

Peter Groves
Director

Poultry Research Foundation Members

GOVERNORS	EXECUTIVE MEMBERS	ASSOCIATE MEMBERS
Baiada	ADM Australia	Alltech Biotechnology
Inghams	Feedworks	BEC Feed Solutions
	DSM Nutritional Products	Biomin Australia
	Elanco Animal Health	Bio Processing Australia
	Evonik Degussa Australia	Cordina Chicken Farms
	Novus Nutrition	International Animal Health
	Ridley Agriproducts	Kemin (Aust)
	Weston Animal Nutrition	Phibro Animal Health
	Zoetis	Ruth Consolidated Industries
		The Egg Basket (Sales)

HONORARY GOVERNORS
Emeritus Professor E. Frank Annison
Dr. Balkar S. Bains
Dr. Derick Balnave
Prof. Wayne Bryden
Mr. John Darling
Mr. Ern Newton
Dr. Ron MacAlpine

INVITEES
The Deans of Agriculture and Natural Resources
The President, World's Poultry Science Association (Australian Branch)
The Program Manager, RIRDC Chicken Meat Program
The Program Manager, Australian Egg Corporation Ltd
A Representative, Poultry CRC

Poultry Research Foundation Council

PRESIDENT	Ms. Judith O’Keeffe
DEPUTY PRESIDENT	Dr. David Cadogan
DIRECTOR	Associate Professor Peter Groves
GENERAL MEMBERS	UNIVERSITY COUNCIL MEMBERS
ADM Australia Pty Ltd Mr. John McLeish	Executive Dean - Faculty of Veterinarian Science Prof. Rosanne Taylor
Baiada Poultry Pty. Limited Mr. Greg Hargreave	Division of Alumni & Development – University Foundations Ms. Melissa Bonevska
Biomin Mr. Neil Gannon	The Pro-Dean - Faculty of Veterinary Science Assoc. Prof. Paul Sheehy
Elanco Animal Health Dr. Avril Grieve	Associate Dean for Research - Faculty of Veterinary Science Prof. Katherine Belov
Inghams Enterprises Pty Ltd Mr. Greg McDonald	
Novus Nutrition Mr. Nick Nettle	
Phibro Animal Health Mr. Thomas Wakeford	
Weston Animal Nutrition Ms. Christine Sydenham	
Zoetis Mr. John Reeves	

Poultry Research Foundation Staff and Students

Director

Associate Professor Peter Groves *BVSc, MANZCVS(Epidemiology), PhD (Sydney)*

Academic Staff

Dr. Wendy Muir *BScAgr, PhD (Sydney), GradDipEd (UNE), GradCertEducStud(Higher Education)*

Dr. Jeff Downing *WDA (Wagga Agr. Col.), BSc, PhD (Macquarie), GradCertEducStud(Higher Education)*

Dr. Greg Cronin *BAgrSc, MAgrSc (Melbourne), PhD (Wageningen NL), GradCertEducStud(Higher Education)*

Dr. Sonia Yun Liu *BEng, MFoodSc (Queensland), PhD (Sydney)*

Dr. Cormac O'Shea *BAgrSc, PhD (Ireland)*

Dr. Mini Singh *BScGen (India), MScVetSc, PhD (Sydney)*

Honorary Research Fellows

Adjunct Associate Professor Peter Selle *BVSc, PhD (Sydney)*

Administration Staff

Mrs. Jo-Ann Geist

Mr. Benjamin Geist

Project Management Staff

Mrs. Joy Gill

Mrs. Melinda Hayter

Project Support Staff

Ms. Kate Dehon

Mr. Don Nicholson

Mr. Duwei (Wade) Chen

Mrs. Kylie Warr

Postgraduate & Masters Students

Ms. Emma Bradbury - *Ca, P and phytase and the effects on broiler welfare.*

Ms. Linda Browning - *Vitamin D, Ca, P and phytase in poultry.*

Mr. Tugrul Durali - *Comparative digestive physiology and health of conventional and free range broilers.*

Ms. Kate Hartcher - *The underlying motivation behind injurious feather-pecking in free-range laying hens.*

Mr. Dean Powell - *Investigating the effect of nutritional status on chicken satellite call fate, proliferation and differentiation and their implications on muscle development.*

Ms. Ha Hong Truong - *Starch utilisation and glucose absorption in broiler chickens with emphases on grain sorghum, phytase enzyme and whole grain feeding.*

Ms. Angela Scott - *Avian Influenza Risk Mitigation for the Free-Range sector of the Australian Poultry Industry.*

Mr. Ryan Hopcroft - *Developing a Ca and P balanced pre-starter ration.*

Mr. Kevin Prescilla - *Evaluating the nutritional motivation for feather eating as a cause for feather pecking.*

Honours Students (conducting thesis projects under Poultry Research Foundation supervision)

Ms Danielle Azevedo (BAVBS) (Supervisors: Wendy Muir & Peter Groves)

'Identifying incubation conditions to optimise hatch time and leg strength in broiler chickens'

Ms Mihaela Jovanovski (BAVBS) (Supervisors: Wendy Muir & Peter Groves)

'Early post-hatch nutrition to improve leg strength in broiler chickens'

Mr Jacob Freilikh (BAVBS) (Supervisors: Wendy Muir & Peter Groves)

'Improving leg strength in broiler chickens through early nutrition'

Ms Stephanie Alfred (BAVBS) (Supervisors: Robyn Alders & Mini Singh)

'A review of the regulatory framework relating to backyard poultry raising in Sydney'

Scarlette Li: (BAVBS) (Supervisors: Imke Tammen & Mini Singh)

'Animal Models for NCL (batten disease)'

Mr. Christian Colosi (BAVBS) (Supervisor: Jeff Downing)

'The behaviour of hens housed in modified conventional cages to include a perch and nest box'

Staff Memberships and Affiliations

Dr. Peter Groves:

Member: Australian Veterinary Poultry Association

Member: Commercial Poultry Veterinarians (an SIG of AVA)

Adjunct Senior Lecturer: Charles Sturt University - Department Agriculture & Veterinary Sciences

Member: National Newcastle Disease Technical Working Group

Dr. Wendy Muir:

Member: Australian Poultry Science Symposium Organising Committee

Member: Worlds Poultry Science Association

Associate Editor: Animal Production Science

Dr. Peter Selle:

Member: Australian Poultry Science Symposium Organising Committee

Associate Editor: Poultry Science

Dr. Greg Cronin

Member: Editorial Advisory Board, Applied Animal Behaviour Science

Member: Australian Society for Animal Production

Associate of the Animal Welfare Science Centre

Dr. Jeff Downing:

Member: Worlds Poultry Science Association

Member: Pork CRC Research and Development Committee

Member: Pork CRC Education Committee

Member: Australasian Pig Science Association

Dr. Mini Singh

Member: Worlds Poultry Science Association

Member: Australian Society for Animal Production

Dr. Sonia Yun Liu

Member: Worlds Poultry Science Association

Member: Global Food and Nutrition Security Research Node, Charles Perkins Centre

Dr. Cormac O'Shea

Member: Australasian Pig Science Association

Member: Global Food and Nutrition Security Research Node, Charles Perkins Centre

Conference Attendance, Presentations, Acknowledgements and Awards

Conference Attendance and Presentations by PRF Staff and Students

26th Annual Australian Poultry Science Symposium, Sydney NSW, February 2015

Presentations by Wendy Muir, Greg Cronin, Ha Truong, Peter Selle and Dean Powell

Attended by Peter Groves, Mini Singh, Jeff Downing, Kevin Prescilla and Ryan Hopcroft

Australian Veterinary Poultry Association Scientific Meeting, Sydney NSW, February, 2015

Presentation by Peter Groves

Consultative Committee on Emergency Animal Diseases (CCEAD) Training, Griffith ACT, March 2015

Attended by Peter Groves

20th European Symposium on Poultry Nutrition, Prague, Czech Republic, August 2015

Presentations by Wendy Muir, Ha Truong

Attended by Mini Singh

Sydney University Veterinary Science Post Grad Conference, Sydney NSW, September 2015

Presentation by Kevin Prescilla, Ryan Hopcroft

Poultry CRC Innovation and Ideas Exchange, Gold Coast QLD, September 2015

Attended by Jeff Downing, Kevin Prescilla,

Australian Veterinary Poultry Association Scientific Meeting, Queenstown, New Zealand, October 2015

Presentation by Peter Groves

RSPCA World Farm Animal Day Symposium - Welfare in Animal Production, Wacol, QLD, October 2015

Invited Presentation by Greg Cronin

Australasian Pig Science Association Conference, Melbourne, VIC, November 2015

Presentation by Greg Cronin, Jeff Downing

Attended by Cormac O'Shea

14th International Symposium of Veterinary Epidemiology and Economics, Merida, Yucatan, Mexico, November 2015

Presentation by Mini Singh

Awards

RIRDC Science and Innovation Award for Young People in Agriculture, Fisheries and Forestry

Dr. Sonia Yun Liu

Best Masters Presentation Award at Sydney University Veterinary Science Post Grad Conference

Kevin Prescilla

Acknowledgments

Thank you to all of our research partners who funded research projects, student scholarships and post-doctoral fellowships throughout 2015:

RIRDC
Poultry CRC
AECL
Feedworks
Danisco
DSM
AB Vista
Baia da

Australian Poultry Science Symposium 2015

The 26th Annual Australian Poultry Science Symposium was held 9th-11th February, 2015. The Poultry Research Foundation in conjunction with the World's Poultry Science Association (Australian Branch) organised this combined meeting which presented subjects of "Quality of the Egg", "Energy Vs Protein And Amino Acids" and "Poultry Welfare" along with the hot topic of "Emerging Technologies in Poultry Research". This year we return to our usual venue at the Veterinary Science Conference Centre, with the Welcome BBQ held on the lawns surrounding the Roundhouse on Monday evening. We had 6 international speakers, hailing from the US, UK and Germany, as well as 3 local researchers who were invited to present some of their recent work for a crowd of approximately 200 attendees. In total, there were 73 contributing papers presented in a very busy program which saw the need to break up into concurrent sessions on the second day.

As always, the conference symposium dinner was very well received by around 180 people. It was again held on board the Starship Sydney, cruising around Darling Harbour offering amazing views of the Sydney Harbour Bridge and Opera House.

INVITED SPEAKERS:

Dr. Aiden Leek - Hyline International, UK
 Assoc. Prof. Juliet Roberts - University of New England, Australia
 Prof. Maureen Bain - University of Glasgow, UK
 Prof. Michael Kidd - University of Arkansas, USA
 Dr. Peter Selle - University of Sydney,
 Prof. Werner Bessei - Hohenheim Universität, Germany
 Prof. Marian Dawkins - University of Oxford, UK
 Prof. David Raubenheimer - University of Sydney, Australia
 Dr. Kristen Brennan - Alltech, USA

Sponsorship of the APSS 2015 was kindly supported by:	
Invited Speaker Sponsors	Poultry Research Foundation RIRDC Chicken Meat Program Australian Egg Corporation Ltd Hy-Line Alltech
Gold Sponsors	Poultry CRC
Silver Sponsors	Feedworks DSM Nutritional Products Ltd. BEC Feed Solutions / Adisseo ADM Elanco Animal Health Zoetis
Bronze Sponsors	Biomin Australia Phibro Animal Health Corporation Baiada Poultry / Steggles Kemin Novus Nutrition Ruth Consolidated Industries
Item Sponsors	Evonik Industries Zoetis Kemin BASF Feedworks Novus Nutrition

Foundation Research in Review

The Poultry Research Unit has been very active in both the broiler and layer research fields for more than 50 years here at Camden. Some major contributions to research and industry during this time have been in the areas of:

- Amino Acid Digestibility Studies (RIRDC)
- Modulation of lean tissue deposition by dietary fatty acids (RIRDC, ARC)
- Development of a non-invasive test for stress in laying hens (RIRDC)
- Mucosal immunity in chickens (RIRDC)
- Nutritional and toxicological evaluation of transgenic plants (CSIRO)
- Application of feed enzymes (Industry)
- Mycotoxins in poultry feeds (ADAB)
- Egg Shell Quality (RIRDC)
- Amino acid balance for heat stressed broilers (Industry)
- Nutritional requirements of recently imported layer stock (RIRDC)

We will continue to serve the needs of research, industry and teaching over years to come.

Current Research Projects

Associate Professor Peter Groves:

RIRDC Chicken Meat project 9075: "Post-hatch management for improved broiler locomotion." This project follows on from previous studies which evaluated the effects of incubation conditions on subsequent broiler leg strength. There were strong indications that some leg weakness issues in modern broilers may be due to limitations in phosphorus supply remaining in the remnant yolk sac when chicks hatch and a delay in access to feed may lead to poor bone mineralization in the chick's early life. The current project explores whether alterations to early dietary phosphorus and calcium levels can affect this and subsequent leg strength.

Co-supervisor for the POULTRY CRC "Avian Influenza Risk Mitigation for the free-range sector of the Australian Poultry Industry". This project will survey a cross section of the NSW poultry industry attempting to identify risk factors for exposure to Avian Influenza virus. The aim of the project is to determine strategies that will minimize the exposure risks, especially for free range farming operations.

Dr. Wendy Muir:

RIRDC Chicken Meat Project No: PRJ-8616 "Opportunities to improve broiler locomotory ability"; with senior investigator Dr Peter Groves.

RIRDC Chicken Meat Project No: PRJ-9075 "Post hatch management for improved broiler locomotion" with senior investigator Dr Peter Groves, and Australian Poultry CRC funded Masters student Ryan Hopcroft. Dr Groves has provided an outline of this project above.

Australian Poultry CRC Project – in association with Professor Sandra Velleman at Ohio State University and PhD student Dean Powell, "Investigating the effect of nutritional status on chicken satellite cell determination, proliferation and differentiation". During 2015 three manuscripts from the in-vivo studies undertaken at the PRF, University of Sydney were submitted for publication. One manuscript has been accepted for publication in Animal Production Science and two manuscripts submitted to Poultry Science are approved for publication pending some minor changes. Dean has also been finalizing his PhD thesis for submission.

Dr. Jeff Downing:

Poultry CRC Project: "Proteomic measures of albumen degradation as indicators of egg freshness". The objective of the project is to find specific proteomic makers of albumen degradation which can be used to assess egg freshness. We continue to develop the 2D-PAGE methodology and identify a candidate protein marker. We have investigated the effect of hen age, ambient temperature and acute stress have on egg quality overtime when stored at different temperatures.

RIRDC Chicken Meat project: "Electrolyte supplementation of broilers prior to transport". In this project three studies investigated the electrolyte supplementation of broilers for 2 days prior to transport and the effect this had on carcass yield and meat quality after transport and processing. The data is being analysed and a report prepared for the RIRDC.

Dr. Greg Cronin:

During 2015 Greg Cronin completed and submitted the final report for his AECL-funded project (1US111) “investigating the effects of factors in the rearing environment on the development of feather pecking and cannibalism in free range hens”. Two peer-reviewed papers were published by Kate Hartcher in 2015 from her PhD research, while another three papers were accepted for publication in international peer-reviewed journals. Kate submitted her PhD thesis for examination in early October 2015.

Greg completed a collaborative project at Camden, with Dr Jean-Loup Rault from the Animal Welfare Science Centre, University of Melbourne, on “the impact of two light intensities from LED lights on broiler chicken welfare and growth”. The project was funded by RIRDC Chicken Meat.

A paper by Greg Cronin on the behaviour of Australian Merino lambs with a genetic mutation that results in Batten’s disease in humans (neuronal ceroid lipofuscinosis), and which is used as a model for disease research in children, was accepted for publication in Applied Animal Behaviour Science.

Dr. Sonia Liu:

In 2015, Sonia completed three feeding studies looking at “the influence of digestive dynamics, Ca-butyrate and exogenous enzymes, respectively, in broiler chickens”. Box-Behnken design was applied to understand the influence of protein and starch digestive dynamics in broiler chickens from 14-28 days post-hatch. Response surfaces were generated and confirmed that FCR may be improved by rapidly digestible protein and starch digestion rate had little impact on feed efficiency.

The lab analyses of two geometric framework studies have been completed and Generalised Additive Models were applied to describe response surface. Protein had more impact on FCR, N retention and carcass compositions. In 2016, another three geometric framework studies will be completed and the relative importance of starch and fat as energy sources will be discussed. Also, the influence of anti-nutritive factors on energy utilisation will be considered.

Dr. Mini Singh:

Poultry CRC Project 1.5.7: Co-investigator for the project “Avian Influenza Risk Mitigation for the Free-Range sector of the Australian Poultry Industry”. Co-ordinated on-farm surveys and expert opinion workshop and maintained close collaboration with industry bodies, poultry integrators, and growers to maintain poultry health and improve bird welfare by directly addressing a critical infectious disease threat for the industry.

Poultry CRC Project 2.1.7: Co-investigator for the Poultry CRC funded project “Improving the performance of free range poultry production”. Coordinated research trials, submitted the Project Final Report and collaborated closely with poultry integrators, farmers and other stakeholders to mitigate the production gap between free range and conventional poultry production in Australia.

Usyd-Base Titanium Project: Worked in an international development project in collaboration with Robyn Alders at USyd and B4MD (an Australian based NGO) to develop a commercially sustainable, community based and owned poultry out-grower industry within Kwale County, Kenya. Terms of reference included research inception, planning, developing training program and manuals, pilot research delivery, monitoring and evaluation and deriving research conclusions.

Associate Supervisor to two AVBS Honours students and three PhD students and Principal Supervisor to one PhD student.

Secured Poultry CRC funding and scholarship for a MSc project: “Evaluating the nutritional motivation for feather eating as a cause for feather pecking” starting in March 2015.

Adjunct Associate Professor Peter Selle:

In September 2015, Peter Selle was invited to speak at the Arkansas Nutrition Conference which was held in Rogers, AK. Peter's lecture was entitled "Dietary phytate and exogenous phytase: an expanding comprehension".

Two RIRDC Chicken-meat funded projects were successfully completed in 2015. One was focused on the factors influencing sorghum starch utilisation in chicken-meat production. The second was focused on the problem of "wet-litter" in chicken-meat production with considerable input from Mark Dunlop. A third RIRDC Chicken-meat project investigating "whole grain feeding" is ongoing.

Several R&D projects were completed for private companies and another project was funded by the Poultry CRC.

We would like to acknowledge the extraordinary analytical support of Mr Ali Khoddami in determining concentrations of polyphenols and phenolic acids in grain sorghums and their RVA starch pasting profiles.

We would also like to acknowledge the collaboration with Dr Karlie Neilsen, Dr Leon McQuade and Mr Bernie McInerney of the Australia Proteome Analytical Facility, or APAF, (Macquarie University). This included quantification of kafirin in Australian sorghums and the identification of the amino acid profile of kafirin. Also in collaboration with APAF we are now determining concentrations of glucose and 27 free amino acids in the portal (anterior mesenteric vein) and systemic (brachial vein) blood-streams. This is an endeavour to determine the extent to which glucose versus amino acids are catabolised in the gut mucosa for energy provision.

In 2015, a series of ten "Sorghum TechNotes" were completed in association with Mr Denis McGrath of the Feed Grain Partnership.

As a result of negotiations completed in 2015 with Danisco/DuPont and Evonik two new PhD candidates, Ms Amy Moss and Ms Christine Sydenham, have enrolled. In this connection the generosity of the Poultry CRC and Feedworks should be noted.

Dr. Cormac O'Shea

A new twist from an old tale; can "selenium restrain the infectivity of Salmonella in broilers through modifying oxidation / reduction balance"? During infective stage, Salmonella use an inflamed gut to good advantage, switching from slow fermentation to anaerobic respiration by utilizing metabolites of oxidative stress. Thus Salmonella can outcompete obligate fermentative microbes, amplifying cellular invasion. Selenium may have a role to play in attenuating oxidative stress and therefore starving Salmonella of the nutrients required for metabolic switching. Marie Bashir Institute Funded Project "Investigation into the effect of light intensity in mediating gastrointestinal mucosal integrity and inflammatory cytokine gene expression in broiler chickens". Birds reared in low lux may be heavier than birds kept at higher lux. This study aims to expand on the role of melatonin which acts as a signaling hormone and antioxidant. Studies in rats show that light can affect the level of melatonin at mucosal interfaces. Increased levels of melatonin in the gastrointestinal mucosa may contribute toward improved gut integrity and absorption.

"Effect of incremental levels of a novel selenoprotein on growth performance, meat quality, antioxidant and selenium status in heat-stressed broilers". During heat stress, broilers may undergo higher levels of cellular oxidation due to the production of free radicals. Therefore, higher levels of selenoprotein may be merited to mitigate oxidative stress. This study sought to establish a heat stress model in broilers and investigate the merit of incremental levels of a selenoprotein in alleviating oxidative stress.

"Investigations into calcium and phosphorus on feed efficiency and egg production in laying hen". Dietary calcium and phosphorus levels appropriate for multiple production traits are still being elucidated due to complex interactions between the two minerals and with other nutrients. This study is a continuation of a body of work funded by the AECL looking at how to optimise dietary calcium and non phytate phosphorus in layers.

Research Collaboration and Industry Services

The PRF continues to collaborate with the Charles Perkins Centre and a three-year joint post-doctoral fellowship began in February, 2014, to extend the Geometric Framework to broiler nutrition. The project aims to extend the Geometric Framework (GF) for nutrition to commercial poultry nutrition and diet optimization. The primary objective is to use the Geometric Framework for the first time to understand regulation of protein and carbohydrate intake in broiler chickens. This will enable diets to be formulated to optimise multiple output criteria including meat yield and flesh quality, feed efficiency, animal health and welfare, and environmental waste.

Dr. Wendy Muir is collaborating with Prof. Sandra Velleman (Ohio State University) on muscle development in broiler chickens.

Dr. Greg Cronin is collaborating with Prof. Paul Hemsworth and Dr. Jean Loup Rault (both from the University of Melbourne) on free-range laying hen behaviour and welfare, and broiler welfare.

Dr. Peter Groves is continuing collaborations with Dr Jean-Loup Rault from the University of Melbourne in a project examining broiler behavior and welfare under free range conditions. Several collaborative projects with UNSW and Birling Avian Laboratories are continuing, looking at Salmonella antigens and the production of egg yolk antibody (IgY) to a number of human cancer antigens. Dr Groves is co-supervising three postgraduate students, including one at University of Melbourne and two at UNSW.

Dr Mini Singh was involved in a number of collaborative research activities in 2015. Within the poultry CRC project 1.5.7 project 'Avian Influenza Risk Mitigation for the Free-Range sector of the Australian Poultry Industry'. Mini collaborated with scientists from NSW DPI, CSU, and ANU. Her work on developing a poultry out grower program in Kwale county of Kenya was in collaboration with Assoc. Prof. Robyn Alders at USyd and B4MD (an Australian based NGO). The reporting for Poultry CRC funded "Free Range Poultry Survey 2014" continued collaboration with researchers from PIRSA-SARDI, DAFF QLD, CSIRO AND UNE, Armidale and various independent consultants.

Cormac O'Shea is collaborating with Marinova and participating in contract research with several companies. He is also collaborating with research partners at the University of Western Sydney Meat Science. Dr. Christine Hutchison at the UWS is a collaborator looking at meat quality in broilers.

Dr. Jeff Downing is collaborating with Dr. Anthony Keyburn (CSIRO) on a Poultry CRC grant on a new test for poultry welfare also with Dr Dana Cambell (CSIRO) investigating the free range space allowance for laying hens on their production and welfare.

Communications

Publications from PRF Staff & Students for 2015:

- Bradbury EJ**, Wilkinson SJ, **Cronin GM**, Walk CL & Cowieson AJ (2015) Interaction between phytase and calcium source, concentration and particle size on broiler performance and skeletal integrity. *Proceedings of the Australian Poultry Science Symposium* **26**: 133-136.
- Cronin GM & Hopcroft RL** (2015) Nest-box use by young free range hens may be influenced by perching location resulting from social avoidance. *Proceedings of the Australian Poultry Science Symposium* **26**: 223-226.
- Cronin GM**, Macnamara GF, Macnamara BLF, Cronin MA, Bøe KE & Andersen IL (2015) Pre-partum straw-directed behaviour by sows in farrowing pens is positively associated with piglet survival. *Animal Production Science* **55**: 1514 (Abstract).
- Hemsworth PH, Mellor DJ, **Cronin GM** & Tilbrook AJ (2015) Scientific assessment of animal welfare. *New Zealand Veterinary Journal* **63**: 24-30.
- Bøe KE & **Cronin GM** (2015) Individual variation in eating speed of dry sows. *Journal of Animal Science* **93(4)**: 1881-1886.
- Fogarty ES, Manning JK, Trotter MG, Schneider DA, Thomson PC, Bush RD & **Cronin GM** (2015) GNSS technology and its application for improved reproductive management in extensive sheep systems. *Animal Production Science* **55**: 1272-1280.
- Larsen H, Hemsworth PH, **Cronin GM**, Smith K-L & Rault J-L (2015) Determining behaviour of free-range laying hens in the outdoor environment. *Proceedings Australian Veterinarian Poultry Association Scientific Meeting, 11-12 Feb 2015, Sydney NSW*, pp. 5-6.
- Monk J, Belson S, Doyle R, Small A, **Cronin GM** & Lee C (2015) Development of an attention bias test to measure anxious states in Merino sheep. *Behaviour 2015 Conference, 9-14 Aug, 2015, Cairns, QLD*. Poster 677.
- Larsen H, **Cronin GM**, Hemsworth PH, Smith KL & Rault J-L (2015) What are hens looking for? Preference testing for structural elements in free-range chickens. *Behaviour 2015 Conference, 9-14 August, 2015, Cairns, QLD*. Poster 559.
- Wilson RL, Doyle RE, **Cronin GM** & Holyoake PK (2015) A comparison of inflammation models in weaner pigs. *Animal Production Science* **55**: 1449 (Abstract).
- Wilson RL, Doyle RE, **Cronin GM** & Holyoake PK (2015) A comparison of three anti-inflammatory drugs in weaner pigs using Improvac as an inflammation model. *Animal Production Science* **55**: 1529 (Abstract).
- Downing JA** (2015) An opportunity to revolutionise sow management. *Animal Production Science* **55**: 1411-1423.
- Sayed MAM & **Downing JA** (2015) Effects of dietary electrolyte balance and addition of electrolyte-betaine supplements in feed or water on performance, acid-base balance and water retention in heat-stressed broilers. *British Poultry Science* **56**: 195-209.
- Groves PJ**, Sharpe SM & Cox JM (2015) Response of layer and broiler strain chickens to parenteral administration of a live *Salmonella* vaccine. *Poultry Science* **94**: 1512-1520.
- Banowary B, Dang VT, Sarker S, Connolly JH, Chenu J, **Groves PJ**, Ayton M, Raida S, Devi A, Vanniasinkam T & Ghorashi SA (2015) Differentiation of *Campylobacter jejuni* and *Campylobacter coli* using Multiplex-PCR and high resolution melt curve analysis. *PLoS ONE* **10(9)**: e0138808.
- Hartcher KM**, Tran KTN, Wilkinson SJ, Hemsworth PH, Thomson PC & **Cronin GM** (2015) The effects of environmental enrichment and beak-trimming during the rearing period on subsequent feather damage due to feather-pecking in laying hens. *Poultry Science* **94**: 852-859.
- Hartcher KM**, Tran KTN, Wilkinson SJ, Hemsworth PH, Thomson PC & **Cronin GM** (2015) The effects of rearing treatments, beak-trimming and environmental enrichment, on the reaction to novelty during rearing and feather damage in adulthood in free range laying hens. *Applied Animal Behaviour Science* **164**: 64-72.
- Liu SY**, **Selle PH**, Simpson SJ, Cowieson AJ & Raubenheimer D (2015) The euclidian pathway to more instructive broiler bioassays: nutritional geometry. *Proceedings of Australian Poultry Science Symposium* **26**: 52-60.
- Liu SY**, **Truong HH**, Cadogan DJ & **Selle PH** (2015) 'Contour plot' biometrics enhance interpretation of broiler bioassays. *Proceedings of Australian Poultry Science Symposium* **26**: 68-71.

- Liu SY**, Cadogan DJ, Péron A, **Truong HH** & **Selle PH** (2015) A combination of xylanase, amylase and protease influences growth performance, nutrient utilization, starch and protein digestive dynamics in broiler chickens offered maize-, sorghum-, and wheat-based diets. *Animal Production Science*, **55**: 1255-1263.
- Liu SY** & **Selle PH** (2015) A consideration of starch and protein digestive dynamics in chicken-meat production. *Worlds Poultry Science Journal* **71**: 297-310.
- Liu SY**, Bold RM, Plumstead PW & **Selle PH** (2015) Effects of 500 and 1000 FTU/kg phytase supplementation of maize-based diets with two tiers of nutrient specifications on performance of broiler chickens. *Animal Feed Science and Technology* **207**: 159-167.
- Liu SY**, Fox G, Khoddami A, Neilson KA, **Truong HH**, **Moss AF** & **Selle PH** (2015) Grain Sorghum: A Conundrum for Chicken-Meat Production. *Agriculture* **5**: 1224-1251.
- Liu SY**, **Truong HH** & **Selle PH** (2015) Whole-grain feeding for chicken-meat production: possible mechanisms driving enhanced energy utilisation and feed conversion. *Animal Production Science* **55**: 559-572.
- Muir WI**, Cowieson AJ, **Hopcroft R**, **Freilikh J**, **Jovanovski M** & **Groves PJ** (2015) Altering the Ca to P ratio in a pre-starter diet: Its impact on early chick performance and bone ash in relation to chick hatch time. *Proceedings of the European Symposium on Poultry Nutrition. Prague, Czech Republic* **20**: 130.
- Muir WI** & **Groves PJ** (2015) Incubation temperature: Influence on chick hatch time and bone ash. *Proceedings of the Australian Poultry Science Symposium* **26**: 241.
- Heim G, O'Doherty JV, **O'Shea CJ**, Doyle DN, Egan AM, Thornton K & Sweeney T (2015) Maternal supplementation of seaweed-derived polysaccharides improves intestinal health and immune status of suckling piglet *Journal of Nutritional Sciences* doi: 10.1017/jns.2015.16.)
- Heim, G., **C.J. O'Shea**, D.N. Doyle, T. Sweeney, and J.V. O'Doherty (2015) Effect of maternal dietary supplementation of laminarin and fucoidan, independently or in combination, on pig growth performance and aspects of intestinal health. *Animal Feed Science and Technology* **204**: 28-41.
- Powell D**, **Muir WI**, Cowieson AJ & Velleman SG (2015) Immediate posthatch nutrient restrictions: The effect on broiler muscle development and occurrence of intramuscular fat. *Proceedings of the Australian Poultry Science Symposium* **26**: 107.
- Selle PH**, **Truong HH** & **Liu SY** (2015) On free amino acids: Their role in starch and protein digestive dynamics. *Proceedings of the Australian Poultry Science Symposium* **26**: 97-105.
- Singh M**, Ruhnke I, De Koning C, Drake K, Hinch G, Skerman A, **Scott A**, Hernandez-Jover M, **Groves PJ** & Toribio J-A (2015) Avian influenza risk to Australian poultry industry from free range farm practices. *The 14th International Symposium of Veterinary Epidemiology and Economics, Merida, Yucatan, Mexico, 3-7 November 2015*.
- Singh M**, **Durali T** & Cowieson AJ (2015) Use of n-alkanes for determination of Kikuyu grass (*Pennisetum clandestinum*) intake in free-range broilers. *Animal Production Science* <http://dx.doi.org/10.1071/AN14778>.
- Ruhnke I, Dekoning C, Drake K, Choct M & **Singh M** (2015) Feed practices in Australian free-range egg production. *Proceedings of the European Symposium on Poultry Nutrition* **20**: 250.
- Ruhnke I, Dekoning C, Drake K, Glatz P, Skerman A, Hinch G, Sommerlad M & **Singh M** (2015) Free range farm demographics and practices in Australia – preliminary data. *Proceedings of the Australian Poultry Science Symposium* **26**: 260.
- Truong HH**, **Liu SY** & **Selle PH** (2015) Phytase influences the inherently different starch digestive dynamics of wheat- and maize- based broiler diets. *Proceedings of the Australian Poultry Science Symposium* **26**: 126-129.
- Truong HH**, Bold RM, **Liu SY** & **Selle PH** (2015) Starch and protein intestinal uptakes in tandem influence weight gain of broiler chickens. *Proceedings of the European Symposium on Poultry Nutrition* **20**: 253.
- Truong HH**, Bold RM, **Liu SY** & **PH Selle** (2015) Standard phytase inclusion in maize-based broiler diets enhances digestibility coefficients of starch, amino acids and sodium in four small intestinal segments and digestive dynamics of starch and protein. *Animal Feed Science and Technology* **209**: 240-248.
- Truong HH**, Neilsen K, McInerney B, Khoddami A, Roberts PH, **Liu SY** & **Selle PH** (2015) Performance of broiler chickens offered nutritionally-equivalent diets based on two red grain sorghums with quantified kafirin concentrations as intact pellets or re-ground mash following steam-pelleting at 65 or 97°C conditioning temperatures. *Animal Nutrition* **1**: 220-228.

- Truong HH, Cadogan DJ, Liu SY & Selle PH** (2015) Addition of sodium metabisulphite and microbial phytase, individually and in combination, to a sorghum-based diet for broiler chickens from 7 to 28 days post-hatch. *Animal Production Science* <http://dx.doi.org/10.1071/AN14841>.
- Truong HH, Liu SY & Selle PH** (2015) Starch utilisation in chicken-meat production: the foremost influential factors. *Animal Production Science* <http://dx.doi.org/10.1071/AN15056>.
- Khoddami A, **Truong HH, Liu SY, Roberts TH & Selle PH** (2015) Concentrations of specific phenolic compounds in six red sorghums influence nutrient utilisation in broiler chickens. *Animal Feed Science and Technology* **210**: 190-199.

Invited Presentations from PRF Staff & Students for 2015:

- Cronin GM** (2015) Can low-confinement housing for the farrowing sow and her litter be successfully achieved in intensive pig production in Australia? *Proceedings of the RSPCA Queensland, World Farm Animal Day Symposium: "Back to the Future - Welfare in Animal Production", Friday 9th October 2015, Wacol, QLD* pp. 6.
- Selle PH, Truong HH & Liu SY** (2015) On free amino acids: Their role in starch and protein digestive dynamics. *Proceedings of the Australian Poultry Science Symposium* **26**: 97-105.
- Selle PH, Moss AF, Truong HH & Liu SY** (2015) Dietary phytate and exogenous phytase: an expanding comprehension. *Proceedings of the Arkansas Nutrition Conference, September 10, 2015, Rogers, AK*.
- Truong HH, Liu SY & Selle PH** (2015) Choosing the right phytase to improve sodium pump function, reduce the catabolism of amino acids and increase protein and glucose uptake. *Du Pont Phytase 101 Workshop, 24 August 2015, Prague, Czech Republic*.

Financial Report and Statements

Another extremely busy year for staff of the Poultry Unit - 2015 has been constantly flowing from one trial to another.

Memberships have dropped off a little due to some amalgamation of some companies and ones that unfortunately have not been in a financial position to continue at higher levels, but we would like to thank all foundation members for their continued support and trust that we can continue to support their needs.

The finance reports show that the \$ 145K overspend last year shows as an adjustment this year, so hopefully gives a more true reading of the actual operating costs for 2015.

There were no major equipment purchases this year through the Foundation, it was basically just maintenance on of our equipment and an upgrade to some of our holding pens and forklift bucket. We did however, provide assistance with some funding for a new grinder for the DRF which we will be able to utilise as well for \$ 8K. Sonia, Cormac and Wendy were all successful in receiving some small grant funding monies from the Faculty that required to be applied prior to the end of the year so we were able to purchase a new Freeze Dryer Unit for the Poultry Lab along with a Texture Analyser and joint ownership of a qPCR machine.

Overall the accounts are in good order for whatever will come our way in 2016 as decisions are made on how we progress from a Foundation to a Centre.

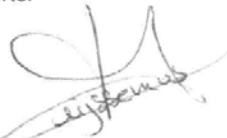
Jo-Ann Geist
March 2016

The University of Sydney
The Poultry Research Foundation

Income Statement
for the year ended 31st December 2015

	Notes	2015	2014
		\$	\$
INCOME			
Business and Investment Income	2	189,090	239,742
Memberships and Subscriptions		64,500	82,000
Symposium Income	3	178,659	125,594
Other Income		-	267
Total Income		432,249	447,603
EXPENDITURE			
Salaries	4	131,658	241,694
Consumables		12,868	27,626
Equipment and Repairs & Maintenance		8,556	35,303
Services and Utilities		33,818	57,735
Travel, Conferences and Entertainment	5	33,020	118,580
Contributions to University areas		12,433	4,330
Commercial Business Expense		49,431	104,452
Other Expenses		16,643	2,726
Total Expenditure		298,426	592,447
SURPLUS / (DEFICIT)		133,823	(144,845)
Accumulated Funds brought forward 1st January		240,127	379,384
Prior Year Adjustment	6	134,215	5,588
Accumulated Funds as at 1st January		374,343	384,972
ACCUMULATED FUNDS AS AT 31ST DECEMBER		508,165	240,127

I certify that the Income Statement and Balance Sheet of the Foundation have been prepared in accordance with the University's accounting practices and procedures. These Foundation accounts form part of the University of Sydney's financial reports.



Anne-Laure Rijssenius
Finance Director
Divisions of Natural Sciences, Engineering & Information Technologies and Business
24th February 2016

The University of Sydney
The Poultry Research Foundation

Balance Sheet
as at 31st December 2015

	Notes	2015 \$	2014 \$
ASSETS			
CURRENT ASSETS			
Short Term Investments		508,165	240,127
Total Current Assets		<u>508,165</u>	<u>240,127</u>
TOTAL ASSETS		<u>508,165</u>	<u>240,127</u>
LIABILITIES			
CURRENT LIABILITIES			
Total Current Liabilities		-	-
TOTAL LIABILITIES		<u>-</u>	<u>-</u>
NET ASSETS		<u>508,165</u>	<u>240,127</u>
EQUITY			
Accumulated Funds		508,165	240,127
TOTAL EQUITY		<u>508,165</u>	<u>240,127</u>

Notes to the Financial Statements

1. Accounting Policies
 - The financial statements have been prepared on a modified accrual accounting basis.
 - All fixed assets are expensed in the year of purchase.
 - Employee entitlements for Long Service Leave are held centrally in the University's accounts.
 - The University (including the Foundations) is exempt from income tax.
2. \$62,500 in outside trial work for Poultry Research Foundation and Industry members taken up in 2014.
3. Increase realised due to strong sponsorship and attendance at the Australian Poultry Science Symposium (APSS) in 2015.
4. Decrease in Salary Costs over the prior year due to the discontinuation of two Post-Doc positions.
5. Decrease in costs over the prior year due to one-off student travel and staff conference attendance in 2014, as well as significantly reduced APSS travel costs for speakers.
6. Reimbursement from Research Grant projects for non salary expenditure realised in prior years re Rural Industries Research & Development Corp (RIRDC) and Australian Egg Corp Ltd (AECL) trials.