Chicken Meat
RIRDC Completed Projects in 2013-14 and Research in Progress at June 2014

November 2014
RIRDC Publication No.14/097
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Foreword

The intention of this summary of completed and continuing projects for the 2013-14 financial year is to:

- provide stakeholders with early access to the results of ongoing and completed work to inform their decisions, and
- inform researchers of results to shape research directions.

The RIRDC Chicken Meat Program aims to stimulate and promote R&D that will deliver a productive and sustainable Australian chicken meat industry that provides quality wholesome food to the nation. *Completed Projects in 2013–14 and Research in Progress at June 2014* contains short summaries of projects funded by the Program.

The Chicken Meat RD&E objectives for 2014–19 are to:

1. Increase the productivity and efficiency of chicken meat production
2. Deliver safe food and good animal welfare outcomes
3. Manage the environment for sustainable development
4. Create foundations for the future, including capacity and market insight
5. Ensure research adoption via extension and communication.

This report is an addition to RIRDC’s diverse range of over 2000 research publications most of which are available for viewing, free downloading or purchasing online at [www.rirdc.gov.au](http://www.rirdc.gov.au). Purchases can also be made by phoning 1300 634 313.

**Craig Burns**
Managing Director
Rural Industries Research and Development Corporation
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Completed Projects

Objective 1. Production efficiency for profit, climate change response and food security outcomes

PRJ-005121 Evaluation of NIR-based diet formulations for broiler chickens

| Start Date: | 25/06/2010 |
| Finish Date: | 31/01/2014 |
| Researcher: | Bob Hughes |
| Organisation: | The Minister for Agriculture, Food and Fisheries, acting through South Australian Research and Development Institute |
| Email: | Bob.Hughes@sa.gov.au |

Objectives
- To fill gaps in the current NIR database and improve the NIR calibrations by evaluating and adding data for 25 new sorghum grain samples
- To validate improvements in accuracy of the NIR prediction of AME and compare NIR-based diet formulation in a standardised large-scale broiler growth study
- To compare the predictive power of single grain NIR calibrations for AME of grain and grain AME intake with the global calibrations involving all grain types in the current AusScan data base

Background
Feed is the greatest individual cost in producing chicken meat. Observed large variations in the efficiency of feed use, growth rate of birds and days to market have a major impact on profitability. Research that results in either a reduction in variability through real-time quantification of essential nutrients within ingredients, or a reduction in ingredient cost through a more reliable and diverse supply would greatly benefit the poultry industry.

Through previous research, an NIR-based tool for predicting the energy available from feed grains has been developed and is commercially available through a company called AusScan. However, the current NIR data base, upon which the NIR predictions are based, is sparsely populated with data on sorghum and triticale samples, compared with wheat and barley. This places a limitation on the usefulness of the NIR technology for those nutritionists. The current project will add data for additional grain samples to the database and allow the NIR calibrations to be upgraded and hopefully improved.

Research
This project evaluated and further refined near infrared reflectance (NIR) tests for available energy in cereal grains. A large-scale metabolism experiment evaluated the apparent metabolisable energy (AME) values for 25 sorghum grains fed with and without a mixture of xylanase and phytase enzyme products to meat chickens. The experiment included ‘connectivity’ grains used in previous industry funded work that contributed to the AusScan NIR calibration database, enabling data to be analysed statistically for valid comparison across many experiments conducted in the period 1998 to 2013.

Outcomes
Including results from additional grains in the AusScan NIR calibrations for predicting the AME content and AME Intake Index of cereal grains improved the accuracy and robustness of the calibrations.

Results from the large scale chicken growth study demonstrated that by using NIR-predicted values for grain showed a significant improvement of 3.5 points of feed conversion (amounting to a 2% reduction) in feed conversion ratio at 42 days of age, and trends towards increased growth rate, reduced time to achieve market weight, and reduced feed intake. Based on current grain and feed costs, this improvement equates to a potential saving of about $15M annually across
the Australian chicken meat industry.

At this point, single grain NIR calibrations for grain AME content and grain AME intake are generally not as accurate compared with the global calibrations which included all grain types.

**Implications**

Improved accuracy and robustness of the AusScan NIR calibrations for predicting the AME content and AME Intake Index of cereal grains provide value to industry nutritionists who utilise this technology, and encourage wider usage of the technology for more efficient formulation of commercial diets for meat chickens.

**Publications**


Completed Projects

**Objective 1. Production efficiency for profit, climate change response and food security outcomes**

**PRJ-000251  Avian influenza: improved diagnostics for detecting antibodies to H5N1**

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<tr>
<td>Finish Date:</td>
<td>30/09/2013</td>
</tr>
<tr>
<td>Researcher:</td>
<td>Sandra Sapats</td>
</tr>
<tr>
<td>Organisation:</td>
<td>CSIRO</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:sandra.sapats@csiro.au">sandra.sapats@csiro.au</a></td>
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</table>

**Objectives**

- To develop a competition ELISA aimed at detecting antibodies specifically against H5N1

**Background**

An incursion of H5N1 into Australia may ultimately necessitate the vaccination of broiler breeder and layer flocks if the virus was to rapidly spread through the wild bird and/or commercial poultry populations. The DIVA approach, which differentiates infected from vaccinated animals, appears to be the most effective way of eradicating the virus in such circumstances. Although there are serological tests available capable of detecting field exposure to H5N1, many have limitations or are not suited for high throughput. Hence, there is a need to develop a simple cost effective diagnostic test which can be used on a mass scale for surveillance purposes should H5N1 enter Australia and spread significantly.

**Research**

Using recombinant DNA techniques an attempt was made to develop chicken monoclonal antibodies specific for H5N1. Chickens were immunised against H5N1 and the generated antibody libraries were screened against a panel of human and avian influenza viruses in an enzyme linked immunosorbent assay (ELISA). The research also sought to express recombinant flu proteins for incorporation into the competition ELISA to eliminate the necessity of working with infectious avian influenza and to produce antigens of consistent quality. Hence, an attempt was made to express the haemagglutinin (HA) and neuraminidase (NA) proteins of a H5N1 strain in the yeast *Pichia pastoris*.

**Outcomes**

Thirty one unique chicken recombinant antibodies (CRAbs) were identified showing different patterns of reactivity in ELISA. Unfortunately, no CRAbs specific for H5N1 were identified. Most CRAbs showed a moderate level of cross reactivity with other ‘non H5N1’ strains, preventing their use in a competition ELISA. Although the research team was able to detect low expression levels of the NA protein in the yeast *Pichia pastoris*, the HA protein appeared to be unstable, with evidence of proteolytic degradation. An attempt to express the HA protein in *E. coli* proved more successful.

**Implications**

Further research is required to identify CRAbs specific for H5N1 and to fully optimise expression of influenza antigens in both yeast and *E. coli*. The development of a competition based ELISA for H5N1 using recombinantly derived reagents could greatly assist in minimising the spread of disease by providing cost effective large scale surveillance.

**Publications**

RIRDC Publication No 14/068
## Completed Projects

**Objective 1. Production efficiency for profit, climate change response and food security outcomes**

<table>
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<th>PRJ-005199</th>
<th>Characterisation of avian nephritis virus (ANV) in commercial poultry</th>
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<tr>
<td><strong>Start Date:</strong></td>
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<tr>
<td><strong>Finish Date:</strong></td>
<td>30/08/2013</td>
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<tr>
<td><strong>Researcher:</strong></td>
<td>Jagoda Ignjatovic</td>
</tr>
<tr>
<td><strong>Organisation:</strong></td>
<td>The University of Melbourne</td>
</tr>
<tr>
<td><strong>Email:</strong></td>
<td><a href="mailto:jagodai@unimelb.edu.au">jagodai@unimelb.edu.au</a></td>
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</table>

**Objectives**

- To develop diagnostic methods for serological characterisation of avian nephritis virus (ANV)
- To develop molecular methods for identification and differentiation of ANV and chicken astrovisruses (CAstVs)
- To sequence the complete genome of isolated ANV and compare with ANV strains from other countries
- To characterise biological properties of isolated ANV in chicks and eggs
- To determine prevalence of ANV in meat chicken flocks at suspected of being infected and from locations already identified to be uninfected

**Background**

ANV has been reported in poultry flocks worldwide, whereas little is known about the status of ANV in Australia. ANV is suspected to be shed vertically and thus accidentally contaminating poultry vaccines produced in chicken eggs. Diagnostic tools to detect and characterise ANV have been developed overseas, however preliminary research indicated that they could not be applied in Australia, likely due to differences between international and local ANV strains.

The project therefore sought to develop diagnostic tests and determine the spread of ANV throughout Australia in order to achieve a better understanding of the impact of ANV in Australian chicken flocks.

**Research**

Multiple molecular and serological methodologies, including PCR and high resolution melt (HRM) curve analysis, were used in this project for the detection, differential diagnosis and characterisation of ANV strains in diagnostic specimens. Various sequencing techniques were applied to obtain the entire ANV genome sequence, to identify contaminating viruses and identify multiple strains in a single specimen. ELISA was used for detection of ANV antigens or antibodies.

Five ANV strains were isolated from broiler flocks in Australia and partially characterised at the genetic and antigenic levels. 75% of the whole genome of one Australian ANV strain was sequenced which enabled positive identification of isolated strains as ANV. The sequencing of the capsid gene that codes for the major antigen of ANV showed that all Australian ANVs identified to date are genetically different from each other and also differ from ANV described in other countries such as the US, Japan and the UK. Antisera to Australian ANVs were produced and compared to antisera to ANV1 strain (imported from overseas) in serological assays where antigenic differences were detected.

Molecular diagnostic tests were developed for the detection of Australian ANV. An ELISA based on an Australian ANV was developed for the detection of ANV antibodies. Evaluation showed the test was specific, sensitive and detected antibodies to all Australian ANV strains and also antibodies to reference strain ANV1.
<table>
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<th>Implications</th>
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<tr>
<td>An ELISA test for detection of antibodies to Australian and overseas ANV strains was developed and used to estimate ANV prevalence in meat chicken flocks. A molecular method for fast diagnosis of ANV virus was developed and implemented in the University of Melbourne’s avian diagnostic laboratory. The types of ANVs occurring in Australia were determined and it was established that they differ from ANV strains occurring in other countries.</td>
<td>ANV is prevalent in Australian meat chickens, with at least 50% of flocks infected. The strains of ANV identified in Australia differ from strains of ANV isolated in other countries and diagnostic methods developed overseas are not suitable for use in Australia. Serological and molecular methods developed for diagnosis and characterisation of Australian ANV are now available and could be used to obtain useful data on the economic significance and health impact of ANV infections in commercial poultry.</td>
</tr>
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Completed Projects

Objective 1. Production efficiency for profit, climate change response and food security outcomes

PRJ-006015 Dislocated calcium alimentation for broilers

Start Date: 01/07/2011
Finish Date: 01/08/2013
Researcher: Aaron Cowieson/Peter Groves
Organisation: The University of Sydney
Email: Peter.Groves@sydney.edu.au

Objectives

- To use choice feeding of calcium to establish the calcium requirement of meat chickens under different digestible phosphorus (P) and phytase regimes
- To assess the usefulness of choice-feeding calcium per se to improve performance, digestibility of P and amino acids and to enhance the value of microbial phytase

Background

Calcium is an essential macro-mineral for meat chickens and is particularly important for adequate bone development. However, consumption of calcium as part of a mixed ration can reduce the digestibility of phosphorus and other important nutrients such as amino acids, through various co-precipitation and acid-binding effects. Thus, it may be of value to provide calcium to chickens separately from the rest of the diet in order to achieve delivery of key nutrients without compromising digestibility or performance.

Research

A total of four chicken experiments were conducted, including three of moderate size and scope and one large experiment that incorporated three separate objectives. These experiments followed a logical progression, starting with confirmation of a calcium appetite in contemporary meat chickens, exploration of the interaction between calcium and phosphorus using a novel geometric approach, assessment of the effect of phosphorus on calcium appetite and, finally, an application study to investigate if post-pellet addition of limestone would be a practical way to exploit these effects. In all studies, performance metrics, skeletal integrity and digestibility effects were explored.

Outcomes

Major outcomes from this research included:

- Modern meat chickens retain a calcium-specific appetite.
- The calcium appetite of meat chickens is not expressed equally in all birds.
- Separate provision of calcium improves performance, phosphorus and amino acid digestibility.
- Post-pellet addition of limestone does not significantly improve performance.
- Where calcium and phosphorus are marginal, chickens prioritise calcium over phosphorus.
- The calcium appetite of meat chickens is regulated crudely, with an insufficiency in the diet leading to an increase in appetite slowly over several days/weeks.

The major conclusion is that though meat chickens have a calcium-specific appetite, the regulation of this is not sensitive, rapid or ubiquitous enough to allow commercial exploitation at this stage. However, the regulatory priorities for calcium and phosphorus are of interest as calcium appears to be prioritised
over phosphorus despite a phosphorus insufficiency having more significant consequence for the animal.

**Implications**

Addition of calcium to a mixed ration (in the form of limestone) reduces the nutritional value of the diet significantly. Provision of calcium separately can enhance phosphorus and amino acid digestibility and improve performance, but this strategy relies on each bird within the flock having adequate regulation of calcium appetite to maintain net calcium intake. Unfortunately, this research suggests that around 10-15% of the flock are unable to regulate calcium intake within the sensitivities required to maintain optimal skeletal health and/or FCR. These effects are assumed to be associated with genetic differences in calcium appetite and nutrient receptor expression. However, this research has also shown that calcium appetite is dependent on digestible phosphorus and that when presented with a diet insufficient in calcium most birds can increase their consumption of a separate calcium source to compensate. Furthermore, the research has shown that calcium intake is defended at the expense of phosphorus and not vice versa i.e. birds are prepared to overconsume phosphorus to defend a calcium intake target but not vice versa. These effects suggest that calcium is the more closely regulated macromineral and so attention must be paid to dietary calcium concentration, even when present in excess. Exploitation of the calcium appetite through separate feeding or post-pellet addition may be viable but more work must be done to optimise this system.

**Publications**


Plus a total of 17 conference papers, abstracts and plenary papers.
Completed Projects

**Objective** 1. Production efficiency for profit, climate change response and food security outcomes

**PRJ-006478** Parallel development of novel vaccine vectors (pilot study)

<table>
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<td>Finish Date:</td>
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<tr>
<td>Researcher:</td>
<td>Joanne Devlin</td>
</tr>
<tr>
<td>Organisation:</td>
<td>The University of Melbourne</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:devlinj@unimelb.edu.au">devlinj@unimelb.edu.au</a></td>
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**Objectives**
- To demonstrate that attenuated strains of ILTV and APEC are suitable vector delivery systems for poultry vaccines
- To assess and compare the vaccine efficacy of IBV antigen expressed by ILTV and APEC vaccine vector delivery systems
- To generate research findings to support future project proposals that would examine expression of protective antigens from other pathogens

**Background**
Vectored vaccines that can induce immunity against a number of different pathogens simultaneously have a number of potential advantages for poultry producers, including advantages arising from the administration of fewer vaccines to poultry flocks. Vectored vaccines are increasingly being used in poultry industries in other countries and could be used in the Australian poultry industry in the future.

**Research**
This research project investigated the use of an attenuated strain of the poultry pathogen, infectious laryngotracheitis virus ($\Delta gG$ ILTV) as a vector to express antigen from infectious bronchitis virus (IBV). This research was undertaken as a pilot (proof-of-concept) study to examine the potential to use $\Delta gG$ ILTV as a vaccine vector. (NB. This project originally included a study into the use of APEC as a vector delivery system but a project variation was approved by the RIRDC to focus on the ILTV vector delivery system.)

**Outcomes**
The results from this research project showed that $\Delta gG$ ILTV could be used as a vector to express IBV proteins. The recombinant virus grew well in cell culture and embryonated hen eggs but did not induce immunity to IBV when it was used to vaccinate SPF chickens under the conditions tested in this study. Future studies investigating the expression of different IBV antigens, different routes of administration, and different doses of the vaccine could be useful for further exploring the use of $\Delta gG$ ILTV as a vaccine vector.

**Implications**
The results from this pilot study demonstrate that $\Delta gG$ ILTV can be used as a vector to express antigens from another poultry pathogen. Although the recombinant ILTV-IBV generated and tested in this study did not induce immunity in vaccinated birds, the successful completion of this project demonstrates that there is the capacity within Australia (and specifically within the Asia Pacific Centre for Animal Health, APCAH) to use ILTV as a vaccine vector. This could be useful for the future development of vectorized vaccines for the Australian poultry industry. Previously, only one other research group in the world (in Germany) had successfully used ILTV to express antigens from other pathogens. The ability to generate Australian ILTV-vectored vaccines could be useful in the future, particularly for pathogens that are of local importance, or exist in unique forms (unique serotypes or genotypes) in Australia.

**Publications**
RIRDC Publication No 14/079
Completed Projects

Objective 1. Production efficiency for profit, climate change response and food security outcomes

PRJ-006708  Available phosphorus requirement of meat chickens

Start Date: 01/07/2011
Finish Date: 15/07/2013
Researcher: Xiuhua Li
Organisation: The University of Queensland
Email: x.li1@uq.edu.au

Objectives
- To re-evaluate the available phosphorus (AP) requirement of meat chickens fed typical Australian diets
- To determine the effect of phytase on AP requirement
- To examine the optimal dietary Ca:AP ratio
- To provide safe guidelines as to how to meet AP requirements for maximum production while minimising phosphorus (P) excretion

Background
Research on the phosphorus (P) requirement of meat chickens has been the subject of numerous investigations over many decades; however, the requirement for this nutrient is still unclear. It is common practice to add considerable amounts of inorganic P to poultry diets with much of the P excreted in manure. Moreover, much of the past research has been conducted with birds fed corn/soybean diets which are of little relevance to Australian conditions.

Research
A series of experiments were conducted to determine the available phosphorus (AP) requirements and effects of calcium (Ca) and phytase on the AP requirement of meat chickens, from 1 to 49 days of age, fed sorghum based diets. Growth performance and tibia bone and toe ash contents were measured. Calcium and P retention of the experimental diets were determined.

Outcomes
The report provided updated information on broiler AP requirement with optimal dietary Ca and AP combinations with or without phytase supplementation. These results will give nutritionists the confidence to reduce dietary AP levels. This will reduce the cost of poultry production and decrease P excretion.

Implications
Decreasing AP levels in chicken diets by reducing dietary inorganic P supplementation will reduce the cost of poultry production, the magnitude of P excretion and environmental pollution attributed to excess P excretion.

Publications
Li, X, Zhang, D, Huang, KH and Bryden, WL (2013) Available phosphorus requirement of broilers fed sorghum based diet from day 22 to 49. Accepted by 19th European Symposium on Poultry Nutrition, in press.
Completed Projects

Objective 2. Animal welfare – a proactive response that includes objective standards and training

PRJ-006653 Vitamin K and broiler bone development

Start Date: 01/09/2011
Finish Date: 20/09/2013
Researcher: Wayne Bryden
Organisation: The University of Queensland
Email: w.bryden@uq.edu.au

Objectives
- To determine the relative efficacy with which the different forms of vitamin K are transferred from the maternal diet to the egg and the chick
- To determine the maternal dietary level of vitamin K required to maximise transfer into the egg without inducing embryo toxicity

Background
The requirements of chickens for vitamin K are supposedly met from the diet and from microbial synthesis in the gut. However, there is human and rodent evidence that these sources of the vitamin are not always bioavailable. The major forms of Vitamin K are: phylloquinone (K1), which is synthesised in fresh green plants but destroyed by drying; menaquinone (K2), which is synthesised by bacteria in the hindgut and may not be absorbed by the bird; menadione (K3), the synthetic form of the vitamin added to poultry diets and which may have very limited activity in bone metabolism. Vitamin K is a cofactor for carboxylation of glutamate in proteins in different tissues of the body. This role of the vitamin defines its significance for two important physiological processes - blood coagulation and bone metabolism - and other important metabolic functions, including energy metabolism and immunity. Significantly, the latter roles are usually overlooked as the role of many of the vitamin K dependent proteins has not been elucidated.

Research
The studies were conducted with broiler breeders using a recently developed form of stabilised soluble vitamin K. Egg and tissue analyses for vitamin K were undertaken by HPLC.

Outcomes
Vitamin K concentration in eggs can be manipulated in response to both the dietary concentration of the vitamin in the donor hen’s diet and the form of the vitamin fed. The hepatic concentration of vitamin K in day-old chicks reflects egg concentrations.

Implications
Most of the research on vitamin K metabolism and requirements in poultry occurred some two decades ago, but in the intervening period much progress has been made in our understanding of the pivotal role that vitamin K dependent proteins play in different aspects of human metabolism and health. There is increasing awareness of the role of vitamin K in bone health, energy metabolism and immunity but little research has been conducted with young rapidly growing animals. How do these findings in humans and rodents relate to vitamin K status and the health and welfare of birds? It would appear from the studies in this project and the current state of knowledge in other species that there is a need to undertake studies in poultry to address these aspects of avian vitamin K metabolism.
Completed Projects

**Objective 3. Food safety – for enhanced consumer confidence and industry returns**

**PRJ-003555  Development of a vaccine to control *Campylobacter* in chickens**

| Start Date: | 01/03/2010 |
| Finish Date: | 28/02/2014 |
| Researcher: | Mary Barton |
| Organisation: | University of South Australia |
| Email: | mary.barton@unisa.edu.au |

**Objectives**
- To construct an adenovirus based vaccine for *Campylobacter jejuni* in chickens
- To evaluate the effectiveness of the vaccine in preventing colonisation of chickens with *C. jejuni*

**Background**

*Campylobacter jejuni* is a serious human pathogen and poultry meat has been identified as a major source of human infections. The industry has invested significantly in a variety of control measures, some of which are able to reduce *Campylobacter* contamination of chicken carcasses. There have been many attempts to develop vaccines but to date the results have been disappointing. Adenoviral vector vaccines are increasingly being investigated as potential vaccine vehicles for human and veterinary vaccines. The vector lacks some of the genes essential for viral replication but carries the specific immunogens of the organism to which you wish to induce immunity. They are safe (unable to replicate) and also more effective in the face of maternal antibody than many other vaccines.

**Research**

Vaccines were constructed using a commercially available human adenovirus vector (AdX3) into which was inserted, firstly, Omp18 (a *C. jejuni* surface protein) and FlaA (a flagella antigen). Chickens were vaccinated with AdX3-Omp18 at one week of age; others with AdX3-OmpA and AdX-FlaA. The chickens were challenged with wild-type *C. jejuni* at 21 days of age. IgG was monitored fortnightly and faeces were collected at weekly intervals to culture for *C. jejuni*. At 42 days, chickens were killed humanely and caecum, intestine and bile were collected to check mucosal IgA levels and for *C. jejuni* isolation. Levels of the cytokines IL-4 and IFNgamma were also measured.

**Outcomes**

AdX3-Omp18: IgG levels increased significantly at 28 days post-vaccination (14 days post-challenge) and high IgG levels were maintained until the end of the experiment. High serum IgA levels were also found and IgA was high in intestinal contents and bile at slaughter. There was high rate of clearance of *C. jejuni* in faeces from 7 to 28 days post-challenge. There was a 1.4 log reduction in caecal *C. jejuni*.

AdX3-Omp18 plus AdX3-FlaA: IgG levels were increased at 28 days but the increase was not significant when compared with the empty vector control. Other antibody findings were similar to those with AdX3-OmpA18 alone. There was also a significant increase in faecal clearance of *C. jejuni* and a reduction in caecal counts at slaughter.

**Implications**

The vaccine has the potential to provide a successful strategy to significantly reduce *Campylobacter* contamination of chicken carcasses. In so doing, it has potential to reduce the incidence of *Campylobacter* infections in the community and increase consumer confidence in the wholesomeness and safety of chicken meat.
Completed Projects

Objective 3. Food safety – for enhanced consumer confidence and industry returns

PRJ-008926  2013 Microorganism survey to support ongoing pathogen reduction programs

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<tr>
<td>Finish Date:</td>
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<tr>
<td>Researcher:</td>
<td>Lesley Duffy</td>
</tr>
<tr>
<td>Organisation:</td>
<td>CSIRO</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:Lesley.Duffy@csiro.au">Lesley.Duffy@csiro.au</a></td>
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Objectives
- To test the incidence and levels of *Salmonella* (plus types) and *Campylobacter* on whole chicken carcasses submitted by chicken processing plants across Australia
- To provide participating plants with the current status (with respect to key pathogens) of their finished product
- To make direct comparisons with results obtained in 2008 and 2009, overall, and for individual participating plants

Background
RIRDC has supported two previous surveys of this nature, in 2008 and 2009. The current survey provides a measure of the effect of any intervention strategies that have been implemented since the previous survey(s).

Research
A total of 24 plants participated in the 2013 survey and a total of 28 plants have participated in at least one of the surveys. Each plant was informed of their individual results and provided with a graphical comparison between plants for both 2013 and for previous surveys.

Outcomes
The overall prevalence and level of *Salmonella* has not significantly changed since 2008. The overall prevalence of *Campylobacter* in 2013 was significantly lower than in 2008. The overall mean of *Campylobacter* counts is significantly lower in 2013 compared to either 2008 or 2009. The number of samples with *Campylobacter* counts above the agreed industry acceptable standard fell significantly from 2008 to 2009 and remained at a similar level in 2013.

Implications
The prevalence and level of *Salmonella* contamination on finished whole chickens has not significantly changed in the three years since the previous survey. However if S. Sofia (generally considered not to be significant in a human health context) is removed from the overall calculation, *Salmonella* prevalence can still be considered to be low.

Significant improvements have been made by the industry as a whole in the overall prevalence and level of *Campylobacter* contamination. This supports the ongoing work of RIRDC to continue to assist the industry in achieving the agreed industry acceptable limits.
Completed Projects

**Objective 4. Addressing climate change, delivering resource use efficiency and environmental outcomes**

**PRJ-009278  Solar guidelines for the Australian on-farm chicken industry**

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<th>Start Date:</th>
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<tbody>
<tr>
<td>Finish Date:</td>
<td>16/05/2014</td>
</tr>
<tr>
<td>Researcher:</td>
<td>Chris Davies</td>
</tr>
<tr>
<td>Organisation:</td>
<td>GHD Pty Ltd</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:Christopher.Davies@ghd.com">Christopher.Davies@ghd.com</a></td>
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</tbody>
</table>

**Objectives**

- To develop reference materials to assist farmers in the chicken meat industry make informed decisions on the installation of solar PV systems to reduce grid electricity consumption and reduce operations costs. Specifically the project sought:
  - To develop and present two business cases of very different installations
  - To provide a user friendly tool to assist farmers quickly establish suitability of solar installations
  - To provide information for farmers on key factors to take into account when considering solar installations on their farms

**Background**

The Australian chicken meat industry has continually reviewed opportunities to improve production efficiency and reduce production costs. Energy consumption comprises a significant percentage of on-farm costs and these costs have increased substantially over the past seven years due to a number of factors, primarily in the electricity sector. As a primary cost of production this has a significant impact on the profitability of farms.

The electricity load profile for chicken meat chicken farms appears to correlate well with electricity generation from solar photovoltaic (PV) systems (i.e. electricity loads during daylight hours are higher than night time loads). Solar PV generation may therefore be suitable for chicken meat chicken farms to reduce electricity consumption from the grid, reduce exposure to increasing electricity tariffs, and improve profitability.

**Research**

A business case assessment for the installation of rooftop solar PV was undertaken for two meat chicken farms, and two industry-specific resources were developed to assist farmers assess the feasibility of solar PV energy projects on their own farms.

**Outcomes**

Assessment of the practicality and viability of solar installations on two meat chicken farms concluded that solar PV systems do not presently represent a viable investment for either farm based on the stated assumptions. The primary limitations included:

- relatively low electricity prices for both farms;
- electricity demand profiles for both farms that include significant periods of low consumption;
- solar PV system costs are currently too high when combined with other project factors for these two farms; and
- a solar resource for the Victorian farm that resulted in nearly 20% less electricity production from solar PV compared to equivalent sized systems in Queensland.
Solar Guidelines for the Australian Chicken Meat Industry were developed to provide an introduction to rooftop solar photovoltaic (PV) electricity generation as it applies to the meat chicken.

The Guide provides an initial reference point for chicken growers, including:

- an overview of solar PV and how it relates to chicken growers;
- key issues to consider when investigating solar PV;
- an introduction to electricity contracts and tariffs;
- questions to ask suppliers; and
- useful reference resources.

The Guide is accompanied by a simple self-assessment tool for Australian chicken growers to assist them in making a preliminary assessment of the feasibility of solar PV for their farms.

### Implications

Solar PV electricity systems may or may not represent a viable investment for meat chicken farms. In fact, in the two case studies examined as part of this project they did not. There are a number of farm and location specific factors that will affect viability of solar PV. This project developed tools to assist growers in making an assessment of whether solar PV will be a practical and viable option in their particular circumstances.

### Publications

RIRDC Publication Nos 14-105 and 14-106
Completed Projects

**Objective 4. Addressing climate change, delivering resource use efficiency and environmental outcomes**

<table>
<thead>
<tr>
<th>PRJ-002342</th>
<th>Artificial olfaction system for on-site odour measurement</th>
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<tr>
<td><strong>Finish Date:</strong></td>
<td>07/04/2014</td>
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<tr>
<td><strong>Researcher:</strong></td>
<td>Michael Atzeni</td>
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<tr>
<td><strong>Organisation:</strong></td>
<td>The State of Queensland acting through the Department of Agriculture, Fisheries and Forestry</td>
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<tr>
<td><strong>Email:</strong></td>
<td><a href="mailto:michael.atzeni@daff.qld.gov.au">michael.atzeni@daff.qld.gov.au</a></td>
</tr>
</tbody>
</table>
| **Objectives** | • To identify and incorporate design features from potential key market segments identified during market needs research  
• To develop a prototype AOS to meet the needs of identified key market segments  
• To evaluate and demonstrate the sensitivity and discrimination capability of the AOS through intensive laboratory testing and field trials at meat chicken operations |
| **Background** | An earlier proof-of-concept project demonstrated the potential of an artificial olfaction system (AOS), based on electronic nose principles, to quantify odour concentrations in meat chicken sheds over time. The prospect of using AOS more widely in the poultry industry, and beyond, resulted in this current project, developing a commercialisable AOS prototype for measuring broiler shed emissions on-site, both in-shed and beyond the sheds. |
| **Research** | Market research was conducted on requirements and expectations leading to development of an AOS with a hybrid array of non-specific and specific gas sensors. The AOS odour prediction model was developed from a dataset of in-shed, near-shed and downwind odour measurements. The AOS was subsequently validated. Prototype VOC pre-concentrator and field olfactometer units were also developed to complement and facilitate odour measurements in future. |
| **Outcomes** | Market research confirmed demand for odour assessment instruments that are convenient, cost-effective and objective. The AOS that was developed predicted ‘ball park’ odour concentration in and around sheds, but due to sensor insensitivity and the confounding influence of non-odorants, AOS odour predictions were found to be subjective and unreliable. AOS is not commercially viable for chicken farm odour applications unless sensors that are more specific and sensitive to the key odorants become available. The developed field olfactometer has potential for calibrating odour measurement tools more cost-effectively. The pre-concentrator is potentially useful in combination with mass spectrometry instruments (e.g. SIFT-MS, PTR-MS) to identify and quantify odorants. |
| **Implications** | The current methods of poultry odour assessment will remain the norm in the short to medium term. Researchers should focus on identifying and measuring the key volatiles contributing to odour nuisance and developing sensors that can detect them at the low levels they occur. |
Completed Projects

**Objective 4. Addressing climate change, delivering resource use efficiency and environmental outcomes**

**PRJ-003669  Poultry litter: alternative fertiliser and ways to increase soil organic carbon**

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<tr>
<th>Objectives</th>
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<td>To evaluate and demonstrate the use of chicken litter as an alternative</td>
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<td>source of nutrients (phosphorus in particular) for pastures</td>
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<td>To promote and support adoption of the use of alternative fertilisers and</td>
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<td>practices that are cost effective and can improve soil organic carbon</td>
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<td>can increase the rates at which total soil organic carbon and more stable</td>
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<td>forms of carbon (humus) are built up, in comparison to use of inorganic</td>
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**Background**

Rising costs of conventional fertilisers have led broad- acre livestock producers (wool, lamb, beef) to seek alternative nutrient sources to fertilise pastures and crops. Spent litter from meat chicken sheds is a viable alternative, particularly when key inputs like phosphorus fertiliser prices are very high, or where a range of macro nutrients and trace elements are required. There is the additional benefit of adding organic matter, although this benefit has not been quantified for pasture soils. The wider implication of increasing organic matter in soil is the potential for carbon sequestration and carbon trading.

Market research undertaken by RIRDC highlighted a range of barriers to greater adoption of chicken litter on broad- acre farms. Key barriers were: the need to demonstrate the value of litter to potential end users, difficulties associated with storing, handling and applying litter, and a perceived lack of information about what is in litter and its performance benefits.

**Research**

Replicated field experiments were established at two sites, with different soil types and limitations, in central Victoria to evaluate and demonstrate the use of chicken litter as an alternative fertiliser for pastures compared with conventional, inorganic fertilisers. Fresh (non-composted) litter, sourced from a meat chicken grow-out farm, was used at three different rates. Each batch of litter was analysed for composition to allow an appropriate application rate to be determined. Litter and fertiliser products were applied each year from 2009-2012.

Data was collected on the following parameters:

- pasture production (kg DM/ha)
- species composition
- pasture feed quality
- top-soil macro nutrient (N,P,K,S) levels, trace elements/heavy metals, pH, salt, cations
- top-soil and sub-soil carbon content and carbon fractions
- leaf tissue macro nutrient and trace elements levels
- soil microbial activity and microbial biomass organic carbon.

An extension program was conducted to extend research results to sheep and...
Outcomes

Broadcasting poultry litter onto pastures can give similar pasture growth responses to conventional fertilisers.

In soils with adequate phosphorus levels, pasture responses were mainly due to nitrogen. In the short-term, it is more-cost effective to apply nitrogen (urea) alone rather than litter.

Litter was as effective as conventional fertiliser at increasing soil fertility, when applied at similar rates of nutrients. Soil phosphorus and plant potassium levels increased with increasing rates of either litter or fertiliser. Plant tissue levels of copper and molybdenum also increased with increased rates of litter. Trace elements/heavy metals were still at acceptable levels in soils and plant tissue where very high rates of litter were applied.

Soil organic carbon increased by 0.4-0.5% in the top-soil where high rates of litter were applied relative to the Control (nil fertiliser) treatment. Increases in soil organic carbon did not increase pasture production during the trial period. However, increases in soil organic carbon could be worth an additional $2.00 - 4.80/m3 ($5 - 12/t) on the price of litter.

Capital rates of litter and conventional fertiliser (NPKS blend) both increased pasture quality by 1-2 MJ ME/kg DM and protein by 3-8% in the winter following autumn application.

Litter had a positive effect on pasture composition, promoting both clover and improved perennial grass content.

This project will impact on the way that chicken litter is used by livestock producers on pastures by ensuring that it is used effectively for optimum pasture and soil responses while minimising potential risks. Usage from year to year will always be influenced by the relative price of inorganic fertilisers, so this will set a limit to what price can be put on litter. The cost of litter varies from $16 - 28/m3 spread, from district to district, with the lower price representing good value for a single nutrient like phosphorus ($/kg basis) compared to conventional fertilisers.

Implications

Grazing industries (wool, lamb and beef)

Chicken litter contains a range of valuable nutrients for pasture production and can be a cheaper alternative than conventional fertiliser. In the short-term, increases in soil carbon and cations, from applying high rates of litter, did not translate into additional yield but may do so in the long term. Hence the cost-effectiveness will depend on the composition of the litter, what nutrients the soils require, and the price of litter relative to inorganic fertilisers. There is an opportunity for many producers located close to chicken farms to access litter as an alternative fertiliser.

Chicken meat industry

The grazing industries are an important outlet for used litter from chicken sheds. There may be opportunities to increase returns from litter, but the litter will still need to be competitively priced relative to conventional fertilisers. In addition to the nutrient value in litter, the value of carbon sequestration, from application of high rates of litter, could be worth a further $2.00 - 4.80/m3 on the price of litter, based on a carbon price of $10 - 24/t.

Increased demand for litter will mean litter may be transported direct from chicken farms to broad-acre farm. This will reduce the need for double handling/carting litter to and from stockpiles and could reduce costs for contractors who supply litter.
Forecast growth of the chicken meat industry will result in increased volumes of used litter which has waste management and environmental ramifications. Increasing the demand of used litter by the grazing industries is a positive solution to achieve effective utilisation of the increasing volumes of litter.

RIRDC publication number 14/067
Completed Projects

Objective 4. Addressing climate change, delivering resource use efficiency and environmental outcomes

PRJ-008688  Reducing costs and energy by replacing inefficient ventilation fans

| Start Date:        | 01/07/2013 |
| Finish Date:       | 30/04/2014 |
| Researcher:        | Grant Brown |
| Organisation:      | The State of Queensland acting through the Department of Agriculture, Fisheries and Forestry |
| Email:             | grant.brown@daff.qld.gov.au |
| Objectives         | ● To quantify the energy and cost savings of replacing some or all of the inefficient ventilation fans on a meat chicken shed with higher efficiency models |

Background
Mechanically ventilated meat chicken sheds rely on exhaust fans to control the in-shed environment. These fans operate year-round and are the main consumer of electricity on a chicken farm. With electricity prices likely to increase over the coming years, chicken farms will need to be more resilient to increasing production costs. One way to reduce costs and energy is to replace any poor performing ventilation fans with high efficiency models.

Research
Updated fan performance and efficiency data for ventilation fans available to Australian meat chicken growers were compiled from a number of sources. This data was used to form the basis of an interactive spreadsheet that could be used to calculate the economics associated with running fans of different efficiencies in a number of scenarios. Outputs from this spreadsheet were used to determine the feasibility of replacing some or all of the fans on a meat chicken shed.

Outcomes
Full shed replacement resulted in greatest savings in electrical power but requires a large initial investment. The savings will depend on the efficiency of the currently installed fans; if they are very inefficient to begin with and need upgrading, a full shed replacement might be a good option.

Replacing the most used fans with high efficiency models also proved to be a profitable solution but requires less initial investment for the purchase price of the fans. The greatest benefits were seen when poor efficiency fans were already installed on the shed. Benefits are further increased where fans do more operating hours per year.

Individual fan hours were shown to vary considerably, with some fans doing four to five times more work than other fans on the same shed.

Implications
Inefficiently operating ventilation fans will cost many thousands of dollars in extra electrical power over their life. A more energy efficient fan may cost more to purchase; however, it is likely that savings in electrical power will more than pay back the original investment. Therefore, it is advisable to replace inefficient ventilation fans with high efficiency models as soon as it becomes a practical option.

An interactive spreadsheet for growers to enter their own shed information to calculate approximate savings from replacing fans will accompany the final report.
Completed Projects

**Objective 4. Addressing climate change, delivering resource use efficiency and environmental outcomes**

**PRJ-008767  Rapid continuous chemical analysis of broiler shed emissions by SIFT-MS**

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<tbody>
<tr>
<td>Finish Date:</td>
<td>12/06/2014</td>
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<tr>
<td>Researcher:</td>
<td>Michael Atzeni</td>
</tr>
<tr>
<td>Organisation:</td>
<td>The State of Queensland acting through the Department of Agriculture, Fisheries and Forestry</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:michael.atzeni@daff.qld.gov.au">michael.atzeni@daff.qld.gov.au</a></td>
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</table>
| Objectives:          | - To determine the suitability of SIFT-MS for poultry emissions monitoring and odour characterisation  
- To assemble a comprehensive VOC database from SIFT-MS sampling at various chicken farms in SE Queensland  
- To compare chemical composition (odorants) of in-shed and downwind VOC data  
- To critically compare in-shed SIFT-MS data and non-selective sensor array data from the current Artificial Olfaction System (AOS)  
- To provide direction for future poultry emissions measurement and modelling based on improved knowledge of key odorants and their temporal variability |
| Background:          | SIFT–MS allows rapid, real time measurement of volatile organic compounds and certain inorganic gases, including ammonia and hydrogen sulphide, to sub-part per billion levels. SIFT–MS requires no sample preparation and can provide near-real time, on-site analysis. By eliminating sample storage, transport and analysis delays, VOCs could be more accurately quantified and monitored over time. But these instruments are expensive and unproven for poultry odour assessment. Therefore, a leasing arrangement was proposed to gather a number of relevant datasets for critical evaluation and comparison to other measurements including GC–MS, olfactometry and artificial olfaction system (electronic nose) data. |
| Research:            | A state-of-the-art SIFT–MS was evaluated across four meat chicken farms (one in NZ and three in SE Queensland). The SIFT–MS was used on-site to analyse in-shed, near-shed and downwind odour samples, covering a range of bird ages, and significant odour events (litter harvesting; bird pick-up). SIFT–MS mass spectra and odorant concentration data for 18 key odorants were examined critically. GC–MS, artificial olfaction system and olfactometry data were also collected for comparison with the SIFT–MS data. |
| Outcomes:            | SIFT–MS shows considerable potential for poultry odour applications, particularly for applications measuring targeted odorants for odour assessment/abatement purposes. The complexity of poultry odour results in some overlapping odorant spectra (masking). Masked VOCs needs to be confirmed independently before SIFT–MS could be used to track them. SIFT–MS’s strength is in quantifying specific odorants in real time using selected ion mode (SIM). It affords the opportunity to verify the effectiveness of odour reduction strategies designed to reduce those odorants. |
SIFT–MS technology will allow industry to obtain and evaluate comprehensive data for specific odorants of interest. If such data can then be correlated to odour concentrations, then evaluation of odour abatement strategies will be easier and strategies can be implemented with greater confidence.

Having the right tools for assessing odour is important for future odour research. Such decisions should be based on comparative evaluations of SIFT–MS with similar technologies to determine their ability to quantify and monitor the odorants causing odour nuisance.
Objective 4. Addressing climate change, delivering resource use efficiency and environmental outcomes

PRJ-008924  FAO Poultry Technical Working Group

Start Date: 01/06/2013  Finish Date: 30/03/2014
Researcher: Stephen Wiedemann  Organisation: FSA Consulting
Email: stephen.wiedemann@fsaconsulting.net

Objectives

- To provide expert technical assistance and region specific data to the FAO for developing an international poultry life cycle assessment (LCA) methodology

Background

The Food and Agriculture Organisation (FAO) developed an initiative referred to as the ‘Livestock Environmental Assessment and Performance’ (LEAP) Partnership in 2012 with stakeholders across the livestock industries. The primary objective is to develop comprehensive guidance and methodology for understanding the environmental performance of livestock supply chains. The overarching goal of this initiative is to “contribute to improved environmental performance of the livestock sector while considering social and economic viability”.

The Partnership will contribute towards the achievement of this goal through support to decision-making by providing guidance on environmental assessments and their subsequent application.

The Partnership promotes an exchange of data and information, technical expertise and research geared towards improving and harmonising the way in which livestock food chains are assessed and monitored.

The LEAP Partnership has recognised the effectiveness of Life Cycle Assessment (LCA) as a research method for guiding environmental improvement. The Partnership has identified a need for standardisation to improve research standards, by supporting the development of guidelines, metrics, methods, and indicators for livestock LCA research. The LEAP Partnership has developed a three year program to advance this work.

To achieve this, the FAO convened a number of Technical Advisory Groups (TAGs) to provide technical input into the development of methodologies for measuring environmental performance.

Technical advice relevant to the Australian situation was provided to the poultry TAG by Wiedemann, whose participation on the TAG was partly supported by RIRDC. A summary of the outcomes of the initiative are provided in the final report on this project.

Research

The TAG held two face to face meetings at FAO headquarters in Rome - in February 2013 and again in September 2013. Frequent phone and internet meetings were held, particularly in the later part of the year after the September meeting. Face to face meetings were used to address difficult issues such as the boundaries, functional units, impact categories to be assessed, allocation rules and inventory methods. Phone meetings were held to agree on the wording of the document and review items.

A rigorous review process was conducted late 2013 and early 2014, with input received from researchers and industry.
### Outcomes
The project delivered a draft poultry LCA guideline, with significant input provided to improve the relevance of this document to the Australian context and to utilise previous RIRDC funded research.

### Implications
The process will deliver clear value to the poultry sector. Firstly, the guideline will underpin future research and allow harmonisation within the poultry sector. This will avoid confusion about the environmental impact of poultry products in general. Secondly, with global trade blocs such as the EU developing guidelines for Product Environmental Footprints (PEF) to underpin future regulation of the environmental impact of all food products, this process will certainly provide a valuable and understandable framework for such developments. If these programs gain traction, it is quite possible that environmental footprinting will become much more prevalent and important in the future of food production and trade.

### Publications
Completed Projects

Objective 4. Addressing climate change, delivering resource use efficiency and environmental outcomes

PRJ-009544  Broiler farm odour dispersion modelling from AERMOD, AUSPLUME and CALPUFF

Start Date: 31/01/2014  
Finish Date: 30/04/2014  
Researcher: David Featherston  
Organisation: GHD Pty Ltd  
Email: david.featherston@ghd.com

Objectives

- To compare modelling methodologies and predicted outcomes from three odour dispersion modelling packages: AERMOD, AUSPLUME and CALPUFF
- To present results in a format useful from the view point of an intending chicken farm operator of the likely implications for: (i) required separation from sensitive land uses as predicted by the three models, and (ii) the time and cost of complying to the Victorian Broiler Code (2009)

Background

Many meat chicken farms require an air quality assessment to be undertaken prior to their approval for construction or expansion by regulating authorities such as local council, planning authorities and the relevant Environmental Protection Authorities (EPAs). Specifically under Victorian regulations, the Victorian Broiler Code (Code 2009), henceforth referred to as the Code (2009), requires that an odour environmental risk assessment (ERA) be undertaken for broiler farms that fall into the “special class” or “farm cluster” categories. The ERA is to be undertaken to show that compliance with State environment protection policy air quality management (SEPP(AQM)) can be achieved. Until recently, the regulatory approved model under SEPP(AQM) was AUSPLUME Version 6. This air dispersion model has also been adopted as the default regulatory model for all Australian jurisdictions.

As of 1 January 2014, EPA Victoria replaced the air dispersion model AUSPLUME with the more advanced and current US EPA approved air dispersion model, AERMOD Version 12345 or later. Replacement of an older regulatory model with a more advanced model will generally result in improved prediction of air quality impacts. However, initial performance testing by EPA Victoria has found that use of AERMOD can result in predicted odour levels significantly different from those predicted by AUSPLUME. These results are consistent with the outcomes of various studies undertaken by the US EPA when it introduced AERMOD to replace ISC3.

There are also other proposed changes to Victoria’s air quality framework, one of which is the requirement for assessment against five (rather than one) years of meteorological data, with compliance to be shown for all five years. Furthermore, the EPA Victoria AERMOD modelling (draft) guidelines propose a method for the synthesis of meteorological data for any site which is located at a distance greater than 5km from an observational station.

Research

Two fictitious meat chicken farm configurations were constructed from industry standard and publically available information. Each farm consisted of an array of eight sheds each with a capacity of 50,000 birds for a total farm size of 400,000 birds. It was assumed that the sheds were tunnel ventilated, with mini vents on solid sides and evaporative cooling opposite the fan end.

Farm 1 was located in central Victoria as there have been a significant number
of recent proposed developments in the area. Farm 2 was located in the rolling hills to the south east of Melbourne, just north of Western Port Bay.

Odour dispersion was modelled for both sites for five years of meteorology using AUSPLUME and AERMOD, as required by the (draft) modelling guidelines for AERMOD. The years 2008, 2009, 2010, 2011 and 2012 were selected. A single year, 2008, was modelled using CALPUFF for each of the farms.

Meteorological data was synthesised using TAPM, as allowed for in the modelling guidance in the absence of on-site observational or nearby representative data. Derived meteorological parameters were generated using the provided Victorian (draft) guidance documentation. Other parameters such as surface roughness were interpreted from the the guidance documentation.

The shed odour emission rates were derived for each farm for each year using the K factor approach developed by PAEHolmes. Ventilation rates for every hour were determined using the regression models of Dunlop and Duperouzel (2014) (see https://rirdc.infoservices.com.au/items/13-024).

The release of the ventilated odorous air from each shed was characterised conservatively as near-ground volume sources.

The assessment of odour impact was undertaken consistent with the requirements of the Victorian SEPP(AQM) and the Code (2009).

The environmental risk assessments were undertaken using the methodology determined by the Victorian Civil and Administrative Tribunal, VCAT.

Outcomes

The effect of changing the regulatory model from AUSPLUME to AERMOD is to significantly increase the area and distances required to meet the Code criterion at and beyond the site boundary, and to meet the level of acceptable risk of odour impact at nearby residences.

A requirement for assessment against five years of meteorology with each year assessed independently has the effect of:

- increasing the effective compliance threshold above the current 99.9th percentile predicted odour level;
- an expected increase in the associated costs of undertaking an odour assessment;
- requiring a higher level of skill and knowledge by consultants to undertake odour assessments, and also by regulators who will have to assess the merits and validity of the odour impact assessment; and
- not efficiently accounting for inter-annual variability, which can be better assessed using five years as a whole.

Of the three models examined, only CALPUFF allowed for the temporal change in odour dispersion direction due to the local terrain features. It was evident that assessing local wind divergence and channelling can be more critical for odour dispersion than a better representation of turbulence.

Implications

The information provided in this report will enable members of the poultry industry, not just those associated with chicken farms, to understand some of the implications of changing the default regulatory model from AUSPLUME to AERMOD. Additional work is required to understand the source of discrepancy in model predictions, including on-site monitoring to determine which characterisation of Monin-Obukhov length is closest to the measured values, for Victorian and/or Australian climates (if adopted beyond Victoria).

Specifically, the findings and conclusions of this research are of relevance to the following identified groups:

- chicken farm owners, operators and developers;
• other poultry industries such as egg farms;
• other type of odorous industry such as waste treatment facilities or piggeries where odour emanates from low level or ground based sources;
• regulatory agencies throughout Australia who are considering the adoption of AERMOD as a regulatory model; and
• professionals or other consultants who undertake air quality assessments.

Publications

RIRDC publication number 14/102
Research in Progress

**Objective 1. Production efficiency for profit, climate change response and food security outcomes**

PRJ-009194  Deterrence of waterfowl from waterbodies: a critical review

| Start Date: | 30/05/2014 |
| Finish Date: | 31/01/2015 |
| Researcher: | Darren Fielder |
| Organisation: | Red Leaf Projects Pty Ltd |
| Email: | darren@redleafprojects.com.au |

**Objectives**

- To review the literature on deterrents and management of birds from water bodies and the range areas surrounding chicken farms, focussing on the more practical and cost-effective methods.
- To assess which birds pose the most risk with consideration given to (a) the particular behaviours of each species (e.g. habitat preferences such as open water, grazing pasture, deep divers, fly at night and land on open water), (b) their geographic distributions and (c) and which are most likely to carry AI viruses.
- To gather anecdotal and unpublished information on the above subjects, as well as published literature, with an emphasis on Australian information.
- To provide direction for future trials into practical, cost-effective controls suited to Australian conditions.

**Current Progress**

The project began 30 May 2014 and the following progress has been made:

- On-line literature search has commenced on deterring and controlling waterfowl.
- Publications about deterring birds from airports and other areas where they represent a hazard have been collected to assess potential techniques in range areas.
- Details of project shared with relevant people involved with wild bird avian influenza research and met with key researchers in the field who have expertise in the field of interest.
- Compiled contact details for manufacturers/suppliers of bird deterrents.
- Made initial inquiries to obtain bird control information from Australian airports.
- Commenced a review of the biology and behaviour of those Australian species considered a high AI-risk.
Research in Progress

Objective 1. Production efficiency for profit, climate change response and food security outcomes

PRJ-007583 Available and retainable phosphorus of feedstuffs for broilers

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<tr>
<td>Finish Date:</td>
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</tr>
<tr>
<td>Researcher:</td>
<td>Xiuhua Li</td>
</tr>
<tr>
<td>Organisation:</td>
<td>The University of Queensland</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:x.li1@uq.edu.au">x.li1@uq.edu.au</a></td>
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Objectives

- To determine available/retainable calcium (Ca) and phosphorus (P) of respective feedstuffs in meat chickens at 42 days of age
- To provide updated and essential information on biologically determined available/retainable Ca and P of feedstuffs to allow nutritionists to formulate diets to meet the exact Ca and P requirements of birds, and to reduce the safety margin in P inclusion levels and cost of P for poultry production
- To reduce P excretion to the environment

Current Progress

The available/retainable Ca and P contents of more than 35 feed ingredients have been determined in Ross male broilers at 42 days of age. All bird experiments have been completed. Laboratory analysis of the samples collected in the final experiment is under way.
Research in Progress

Objective 1. Production efficiency for profit, climate change response and food security outcomes

PRJ-007650 Optimization of Australian protein meals

Start Date: 15/06/2012
Finish Date: 15/05/2015
Researcher: Robert Swick
Organisation: University of New England
Email: rswick@une.edu.au

Objectives

- To benchmark current variation and feeding value of commercial canola meal and cottonseed meal for meat chickens
- To determine the relative importance of amino acids, energy and anti-nutritional factors on feeding value of canola meal and cottonseed meal in meat chickens
- To generate new data on the net energy content and amino acid digestibility of Australian canola and cottonseed meals
- To evaluate the use of exogenous enzymes and supplemental amino acids on feeding value of high and low quality canola meals
- To examine and recommend adjustments to the crushing process with intent to enhance the nutritive value of canola and cottonseed meals
- To produce laboratory quantity amounts of protein concentrate meals (canola and cottonseed) using secondary ethanol extraction and evaluate in the laboratory and if positive in a feeding evaluation
- To foster strong linkages with the crushing industry and commercial chicken meat sector and communicate progress and results

Current Progress

The project has made good progress against goals. As energy and protein in canola meal are lower than soybean meal, it is difficult to formulate meat chicken diets with canola as the sole oilseed meal.

Canola meal samples have been obtained from various crushing plants and a crushing plant operating under experimental parameters. A chemical assay procedure to estimate the energy value of canola meal has been developed. A manuscript on this is undergoing its second review for publication in Poultry Science Journal.

A second manuscript on amino acid digestibility is being written. In kind contributions have been received from Evonik for amino acid analysis and from MSM for donation of test material. A feeding study has been completed on canola meals from various Australian crushing plants. This has shown large variation in bird performance.

Chemical and NIRS analysis of samples was found to be closely correlated to bird performance. An enzyme experiment has been designed with the goal of formulating high performance canola meal diets with no soybean meal for chickens. The cottonseed meal aspect of the project has been partially developed and will be implemented in the near future.
Research in Progress

**Objective 1. Production efficiency for profit, climate change response and food security outcomes**

PRJ-008695  The factors influencing sorghum starch digestibility in broiler chickens

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<tr>
<td>Finish Date:</td>
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<tr>
<td>Researcher:</td>
<td>Peter Selle</td>
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<tr>
<td>Organisation:</td>
<td>The University of Sydney</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:p.selle@usyd.edu.au">p.selle@usyd.edu.au</a></td>
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**Objectives**
- To assess the relative importance of five factors (phenolic compounds, phytate, kafirin, glutelin, sorghum particle size) on sorghum starch utilisation in meat chickens so that more appropriate counteractive strategies can be adopted.

**Current Progress**

The first feeding study of this project was completed on March 20, 2014. In this study, sodium metabisulphite (SMBS) and phytase, individually and in combination, were added to sorghum- and wheat-based diets. In sorghum-based diets, SMBS alone significantly increased jejunal nitrogen digestibility by 14.9% (0.634 vs. 0.552) and ileal nitrogen digestibility by 4.92% (0.786 versus 0.732). Also, SMBS tended to increase starch digestibility by 12.0% (0.691 vs. 0.617; P = 0.064) in the proximal jejunum and significantly increased rapidly digestible starch by 17.2% (116 versus 99 g/bird/day; P < 0.02). However, SMBS numerically depressed AME by 0.33 MJ (P < 0.10). This outcome in energy utilisation was not anticipated and appears to be associated with the increase in rapidly digestible starch. In a previous experiment, SMBS decreased rapidly and increased slowly digestible starch and unequivocally improved energy utilisation (AME, AMEn) but did not enhance protein (N) digestibility. The reasons for these unanticipated outcomes are under investigation.

The second feeding study of this project was completed on May 8, 2014. The primary aim of this study is to investigate the effects of sorghum grain particle size (different hammer-mill screen sizes) on starch digestibility coefficients in four small intestinal segments. The relevant starch analyses are currently being completed.

A real breakthrough has been achieved in that the research team is now in a position to determine kafirin concentrations in sorghum. The kafirin quantification method follows an established method and this is almost certainly the first time kafirin in sorghum has been quantified in Australia. Given the capacity to quantify kafirin the research team is now very well situated to assess the impact of this sorghum protein fraction on starch digestibility. The consensus is that kafirin has a tangible negative impact on starch utilisation.
Research in Progress

**Objective 1. Production efficiency for profit, climate change response and food security outcomes**

**PRJ-008714 Loop-mediated isothermal amplification tests to detect poultry pathogens**

| Start Date: | 01/07/2013 |
| Finish Date: | 01/07/2016 |
| Researcher: | Katrin Renz |
| Organisation: | University of New England |
| Email: | krenz@une.edu.au |

**Objectives**

- To implement and optimise the loop-mediated isothermal amplification (LAMP) method for rapid and low cost detection of Marek’s disease virus Type 1 (MDV)
- To develop and optimise new LAMP tests for fowl adenovirus Types 8 and 11 (FAdV-8 and -11), following the principles from the MDV1 LAMP test
- To determine the sensitivity, specificity and robustness of LAMP tests for MDV1 and FAdV-8 and -11, Compare LAMP test results with real-time PCR assays, and validate the tests using field samples from a variety of tissues
- To implement and optimise LAMP tests for chicken anaemia virus (CAV), infectious bronchitis virus (IBV) and infectious laryngotracheitis virus (ILT) from pre-existing published tests
- To develop and optimise new LAMP tests for *Mycoplasma gallisepticum* and *Mycoplasma synoviae* To determine the sensitivity, specificity and robustness of LAMP tests for CAV, IBV and ILT, *Mycoplasma gallisepticum* and *Mycoplasma synoviae*
- To compare LAMP test results with real-time PCR assays, and validate the tests using field samples from a variety of tissues To assess the feasibility of performing pathogen testing on field samples using LAMP assays

**Current Progress**

Primer sets for FadV-8 and -11 were designed successfully. PCR products amplified using the FadV-8 and -11 primer sets were sequenced. A BLAST search revealed 100% specificity for FadV-8. The BLAST search showed a small likelihood that the FadV-11 LAMP test will amplify FadV-2 and -9 serotypes. Work is ongoing to improve the specificity of the test.

Positive standards were obtained from known FadV-8 and FadV-11 samples. Assays of serial dilutions of the standards were performed, achieving a sensitivity that is similar to that of the generic FadV real-time PCR assay (230 copies per reaction). To date, neither the FadV-8 nor -11 LAMP test have shown any cross-reactivity between the two serotypes. The FadV-8 LAMP test has shown no cross-reactivity with imported DNA from FadV-2 or -9. The FadV-11 test unfortunately has been shown to cross-react with the imported FadV-2 and -9 DNA.

A total of 41 samples originating from liver, faeces, litter and dust from known FadV-8 infection were analysed using the FadV-8 and -11 tests. The FadV-8 LAMP results matched 100% with results obtained from the generic FadV qPCR assay. None of the 41 FadV-8 samples amplified in the FadV-11 LAMP test, as expected.
Research in Progress

Objective 1. Production efficiency for profit, climate change response and food security outcomes

PRJ-008722 Dietary manipulation of nutrient-specific appetite in broiler chickens

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<td>Finish Date:</td>
<td>31/05/2017</td>
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<tr>
<td>Researcher:</td>
<td>Eugeni Roura</td>
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<tr>
<td>Organisation:</td>
<td>The University of Queensland</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:e.roura@uq.edu.au">e.roura@uq.edu.au</a></td>
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Objectives

- To identify three subpopulations of phenotypic growth variation in chickens: these being high, medium and low performers
- To determine behavioural differences regarding nutrient specific appetites (mainly Ca, fatty acids and amino acids) between the three phenotypic groups
- To identify the main nutrient sensors involved in the specific appetite and to quantify their level of expression in oral tissues of the three subpopulations
- To study the allelic variations of the main nutrient sensors involved according to the behavioural tests
- To correlate phenotypic changes in nutrient specific appetites with differences in gene expression or in allelic variation
- To identify the main nutrient appetite correlating phenotypic and genomic data
- To target the main nutrient specific appetite to identify excess and shortage of specific nutrients in commercial formulations
- To collate all the information in formulation guidelines to assist in decreasing the marginal costs of feeds and increase dietary efficiencies in broiler production

Current Progress

This project proposes to study the nutrient specific appetite of three phenotypic subpopulations of meat chickens: high, medium and low performers (based on growth rate). During the first phase of the project, a PhD student has been recruited. The recruitment process resulted in a small delay in the commencement of the project. Since joining the project team, the student has been learning the principles of the experimental paradigm that needs to be addressed, working on a detailed experimental design for the future trials and finalising the animal ethics application for all trials. The chicken trials will start once the animal ethics approval has been cleared.
Research in Progress

**Objective 2. Animal welfare – a proactive response that includes objective standards and training**

PRJ-008616  Opportunities to improve broiler locomotory ability

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<tr>
<td>Finish Date:</td>
<td>01/08/2015</td>
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<tr>
<td>Researcher:</td>
<td>Peter Groves</td>
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<tr>
<td>Organisation:</td>
<td>The University of Sydney</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:zootechny@bigpond.com">zootechny@bigpond.com</a></td>
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**Objectives**

- To establish the effects of different egg shell temperatures (ESTs) during incubation of both Cobb 500 and Ross 308 chicks, on their hatching times, bone mineralisation and subsequent locomotion as late stage meat chickens, as determined by the latency-to-lie test.
- To determine optimal EST targets for Cobb 500 and Ross 308 chicken eggs, and matching hatch window to take-off, to achieve best early chick bone mineralisation and subsequent locomotory ability, without deleteriously affecting hatchability and chicken performance.

**Current Progress**

The project began in January 2014. One incubation experiment has been completed and a second is currently underway.

The first experiment used fertile Cobb 500 meat chicken eggs and these were incubated at the recognised ‘ideal’ egg shell temperature of 37.8°C (the control group) throughout the first 18 days of incubation. Three other incubation profiles were compared: these started at 36.9°C (two incubators) or 37.3°C (one incubator) and EST was gradually raised at different rates to reach 37.8°C by 7 days or 13 days of incubation. All three varied profiles resulted in a ten hour delay in the hatching time of embryos compared to controls (499 hours compared to 489 hours) and hatch of fertile eggs from the three varied profiles exceeded that of the control group; in one case, significantly. Chicks which hatched early grew faster over the first week but not thereafter. There was a higher incidence of severity of tibial dyschondroplasia (TD) at 35 days of age in earlier hatched chicks and birds with higher TD scores failed to stand for as long in the latency-to-lie test.

The second experiment repeats the slower incubation profile comparison with Ross 308 eggs.
**Research in Progress**

**Objective 2. Animal welfare – a proactive response that includes objective standards and training**

**PRJ-008899  Assessment of factors influencing behaviour and welfare of birds in FR systems**

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<tr>
<td>Finish Date:</td>
<td>16/12/2015</td>
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<tr>
<td>Researcher:</td>
<td>Jean-Loup Rault</td>
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<tr>
<td>Organisation:</td>
<td>The University of Melbourne</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:raultj@unimelb.edu.au">raultj@unimelb.edu.au</a></td>
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**Objectives**

- To elucidate the relative use of the outdoor range by the flock over time
- To assess the impact of outdoor range use on the behaviour and welfare of individual birds
- To identify the influence of outdoor range characteristics, weather, and management practices on the use of the outdoor range

**Current Progress**

Three different camera systems were purchased and tested for their suitability for recording the behaviour of birds in the outdoor range continuously over three to four week periods. Those cameras are to be used to determine use of the range, in conjunction with a tracking system on individual birds.

Several Victorian free range farms were identified as suitable for the study, based on age and range design and ethics approval obtained for the study.

Unfortunately, the first experiment was delayed due to technical difficulties with the cameras purchased, which proved to be unreliable (changing the set recording time unexpectedly, or stopping recording altogether at random times). While the cost of these cameras was subsequently refunded, these technical issues resulted in a four month delay in commencement of the experiment. An alternative camera system is being purchased and the first trial on the free-range farm is scheduled to commence in June 16th.
Research in Progress

Objective 3. Food safety – for enhanced consumer confidence and industry returns

PRJ-006238 Campylobacter dynamics in free-range & conventional farming systems

Start Date: 28/07/2011
Finish Date: 30/11/2014
Researcher: Nalini Chinivasagam
Organisation: The State of Queensland acting through the Department of Agriculture, Fisheries and Forestry
Email: nalini.chinivasagam@daff.qld.gov.au

Objectives

- To compare the levels of Campylobacter in the litter, caeca and carcasses of chickens from conventional (litter cleaned out after every batch), partial reuse (Australian practice, whereby reused litter is used only in the grow-out end, whereas new bedding is used in the brood end) and free range farms (both with or without reuse of litter)
- To isolate (and identify) various Campylobacter phages that may prevail within the different farming systems with special emphasis on both free range and reuse environments ie litter, soil and caeca
- To study the above at farms supplying to two major companies
- To evaluate (within different ecological settings) the C. jejuni and C. coli dynamics attributed to the different farming systems
- To provide the industry with the knowledge (and options) to manage C. jejuni by exploiting the merits attributed to already adopted farming practices
- To provide background knowledge (and data) to explore the future potential for ‘phage therapy’ to be adopted at farm level

Current Progress

On farm studies continued to be carried out in 2013, completing the required number of 24 farms sampled across two companies. Following the completion of the farm samplings, work commenced in 2014 to develop a preliminary understanding of the nature of the bacteriophages isolated across the various farms. A sub-set of bacteriophages collected across the farms were selected as representative of the full set and the majority were against C. jejuni. Further work is being carried out on this set of phages to develop a better understanding of their diversity and their lytic profile, which can potentially be exploited in future work on on-farm Campylobacter bio-control. Techniques were initially developed to purify and prepare high titres of the individual bacteriophages and (a) electron microscopy for assessing their morphology, (b) using pulsed-field gel electrophoresis on the phage DNA for determining their genome size, and (c) using restriction endonuclease analyses of phage genomic DNA for their further characterisation. The methodologies for these techniques have been optimised and they are currently being analysed to enable the categorisation of the Campylobacter bacteriophage into different groupings. Work is also in progress to evaluate the interaction of these bacteriophages on a select few Campylobacter isolates sourced across these farms to gain a broad overview of their lytic profiles. This research is generating methodologies and an understanding of on-farm Campylobacter dynamics which will be required in future work to investigate opportunities for the biocontrol of this organism.
Research in Progress

**Objective 4. Addressing climate change, delivering resource use efficiency and environmental outcomes**

**PRJ-009570**  Increasing renewable energy generation through embedded hybrid energy precincts

**Start Date:** 01/03/2014  
**Finish Date:** 28/02/2017  
**Researcher:** James Hamilton  
**Organisation:** University of Tasmania  
**Email:** james.hamilton@utas.edu.au  

**Objectives**
- To undertake a renewable energy pilot demonstrating increased opportunity for renewable energy technologies within rural industries and communities

**Current Progress**

Code has been written to model the thermodynamic exchange between a single storey tunnel ventilated chicken shed and the external environment. Output from this model (heat and relative humidity) has been validated with manual calculations and is awaiting an on-site measurement campaign, for validation against measured data. Modification to the source code to allow modelling of a naturally ventilated single storey chicken shed is also planned. Once both models are successfully validated against measured data, they will allow for an optimised heating and ventilation program to be developed. Such a program is a key facilitator to determining the optimal heating system design, a process allowing consideration for substitution of fossil fuel heating sources for renewable heat sources.
Research in Progress

**Objective 4. Addressing climate change, delivering resource use efficiency and environmental outcomes**

**PRJ-008485 National Agricultural Manure Management Program (NAMMP)**

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<tr>
<td>Researcher:</td>
<td>Various</td>
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<tr>
<td>Organisation:</td>
<td>Australian Pork Limited</td>
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<tr>
<td>Email:</td>
<td><a href="mailto:Janine.Price@australianpork.com.au">Janine.Price@australianpork.com.au</a></td>
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**Objectives**

- To develop and support a nationally coordinated program of research and development focussed on the estimation of the agricultural greenhouse gas (GHG) emissions abatement potential for various manure management systems, to underpin the development of new Carbon Farming Initiative (CFI) methodologies for Australian agricultural industries.
- To provide information to research bodies, industry and government that will assist in the development of cost-effective mitigation strategies that decrease national agriculture emissions with minimal impact on productivity and profitability.

**Progress**

RIRDC contributes to a number of projects within this collaborative Program.

One of these projects is gathering data to understand the emissions resulting from the land application of different manures from piggeries, feedlot cattle and poultry compared to the baseline emissions from conventional fertilisers. The aim will ultimately be to develop practical field strategies to mitigate emissions when applying these manures to different soil types and cropping systems.

Research undertaken to date has shown that GHG emissions from manured soils were highest after manure application and rainfall events; therefore, application methods that incorporate manures in the soils should be considered. Findings also indicated that low manure application rates promote methane uptake by the soils. However, GHG emissions from manured soils were dependent upon the type of manure and soil type, therefore knowledge on one soil or manure cannot be used to describe another. Composting and pelletising during manure storage were found to be the best abatement methods for reducing GHG from soils amended with manures. Another good option for mitigating GHG is incorporation during land application. Nitrifying bacteria were highly correlated with nitrous oxide emissions in WA soils and are most abundant in surface soil. Incorporation of manure to a depth of at least 5 cm or placement of pelletised manure at depths below 5 cm is recommended.

Another project is seeking to identify strategies to realise improved fertiliser efficiency and reduced greenhouse gas (GHG) emissions from land-applied livestock manures, in order to decrease nutrient losses to the environment via greenhouse gas emissions and soil runoff and leaching, through the adoption of improved manure management strategies and novel fertiliser formulations.

Results from work undertaken to date have shown that fresh intensive livestock manures have generally exhibited greater gas emission potentials than composted manures. Estimates of greenhouse gas emissions from intensive livestock manures suggest that the best opportunity to reduce GHG emissions from manures may be through targeting emissions from beef feedlot manure, poultry shed litter and pig manure. Research into sorber materials has demonstrated a range of clays which have strong capacity to reduce ammonia, and therefore secondary N₂O, emissions from manures. In this respect, vermiculite seems to have the greatest potential at this stage. Key environmental
factors such as temperature and moisture are critical for driving N$_2$O emissions from manures applied to soils.

A third project has been measuring baseline emissions from the meat chicken and egg layer industries and aiming to identify practical ways to reduce emissions. Measurements of GHG emissions from chicken sheds showed that GHG gas emissions were considerably lower than assumed in Australia’s National Greenhouse Gas Inventory (NGGI) but were higher than international defaults. Controlled studies conducted in chicken sheds showed that decreasing litter depth (from 60 to 40mm) resulted in a 46% decrease in nitrous oxide emissions but corresponded to slightly higher ammonia and methane emissions. When the change in all GHG sources was taken into account, the net mitigation was 38% for the reduced litter trial. A second trial demonstrated that lower dietary crude protein was effective in reducing emissions of nitrous oxide, ammonia and methane, while improving bird performance. The net mitigation was a reduction in total emissions of 23% relative to bird production, when dietary crude production was reduced by 10%.
Research in Progress

Objective 6. Collaboration to deliver human capital formation and extension outcomes

PRJ-007382 Robert A Swick, UNE Poultry Research Hub

| Start Date: | 25/06/2011 |
| Finish Date: | 01/01/2016 |
| Researcher: | Robert Swick |
| Organisation: | University of New England |
| Email: | rswick@une.edu.au |

Objectives

- To develop a significant research program at the University of New England that focuses on poultry nutrition and/or digestive physiology
- To provide leadership for and oversee the poultry nutrition research program at the University of New England
- To identify and facilitate collaborations between scientists within the University community
- To foster strong linkages with the commercial chicken meat sector and communicate
- To foster strong linkages between the undergraduate program in relevant faculties at the University of New England and the poultry program
- To foster the development of a strong honours and post-graduate program in poultry nutrition at the University of New England, thereby fostering next generation poultry researchers and industry personnel
- To co-ordinate the University of New England's involvement in implementation of the National Poultry RDE strategy, in particular by fulfilling its role as the national 'hub' of poultry nutrition R&D

Current Progress

A range of teaching and supervisory roles in poultry feed and nutrition at UNE were fulfilled by Prof Swick over the course of the year, including the supervision of nine higher degree research students and one post-doctoral position. Additionally, a highly successful poultry formulation workshop was organised and hosted in June 2013.

In the research sphere, Prof Swick supervised RIRDC’s net energy project; over the course of the year this entailed the development of regression equations and the planning and initiation of a major validation feeding study as well as the organisation of a project Steering Committee meeting which included industry (Baiada and Inghams), the Poultry CRC, RIRDC, Feedworks and Dr Jean Noblet from the French institute, INRA. Prof Swick also supervised and managed RIRDC’s Australian oilseed meals project, under which canola meal energy, amino acid digestibility and feeding evaluations were completed over the course of the year.

Eleven conference publications were prepared with seven of these presented this year. Three peer reviewed publications have also been accepted, with a further two submitted and under review.

Over the course of the year, prof Swick also took on the role of coordinating chair for Recent Advances in Animal Nutrition conference, which will be held in October 2015. He has also had a significant role to play in finalising the design of new animal science facilities and a feedmill at UNE. A University grant has also been awarded for the renovation of the UNE’s chicken feeding shed at Kirbyfarm, with plans drawn up and construction to begin in the second quarter of 2014.
Research in Progress

*Objective 6. Collaboration to deliver human capital formation and extension outcomes*

**PRJ-008152**  Co funding contribution National Welfare RD&E Capacity Building Project

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<td>Finish Date:</td>
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<tr>
<td>Researcher:</td>
<td>Dr Jean-Loup Rault</td>
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<td>Organisation:</td>
<td>c/- Australian Pork Limited</td>
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<tr>
<td>Email:</td>
<td>c/- <a href="mailto:vivien.kite@chicken.org.au">vivien.kite@chicken.org.au</a></td>
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<tr>
<td>Objectives</td>
<td>To build capacity in the field of animal welfare RD&amp;E for the pig and poultry industries by creating an industry supported position, focusing on pig and poultry welfare, within the AWSC/University of Melbourne for three years.</td>
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<td>To develop and foster an animal welfare research program relevant to and beneficial for the Australian egg, poultry and pork industries.</td>
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<td>To provide research and development leadership the benefit of the aforementioned Australian industries and provide beneficial research outcomes.</td>
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<td>Current Progress</td>
<td>Since last year, Dr Jean-Loup Rault has been successful in obtaining funding from four projects, including two funded by the RIRDC Chicken Meat Program (“A review of science-based evidence for the welfare of Australian meat chickens”, and “The effects of light intensity on broiler behaviour and welfare”), one from APL and one from the US National Pork Board. Over the course of the last two years in his position, Dr Rault has secured research funding of $1,168,159 across 12 projects as the lead researcher, and collaborated on six other projects.</td>
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<td>Dr Rault continues giving presentations at a range of industry and scientific events, including at PIX 2014, Pork CRC 2014 Sow housing workshop, APVA 2013, APSS 2013 and the South Australian Poultry Industry Day 2013, among others. He acts as a member of University of Melbourne Animal Ethics Committee and as a member of the Victoria Animal Welfare Advisory Committee Working Group for Wildlife. He was also appointed as international secretary of the International Society of Applied Ethology. Since last year, he has published five papers, with another two in press and several others soon to be submitted relating to pig and poultry welfare. Since the start of his appointment two years ago, he has published eight papers and 12 conference abstracts.</td>
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<td>Dr Rault is currently supervising two PhD students, three Masters students, and is co-supervising two other PhD students. These students, working on poultry and pig welfare projects, have been highly successful – for instance, one of these PhD students received the best student award at APSS 2014.</td>
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<td>The position is meeting the intended objectives of stimulating research and scientific and industry communication in the area of pig and poultry welfare.</td>
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Research in Progress

Objective 6. Collaboration to deliver human capital formation and extension outcomes

PRJ-005621 Poultry CRC

Start Date: 01/01/2010
Finish Date: 30/06/2017
Researcher: Mingan Choct
Organisation: Poultry CRC
Email: mchoct@poultrycrc.com.au

Objectives

- To help Australia achieve sustainable, ethical poultry production in the face of population growth and climate change
- To conduct research and drive education and training to help Australia’s poultry industries produce more from less, sustainably
- More specifically, to pursue innovative approaches to (i) maintaining poultry health and welfare, (ii) improving resource utilization and reducing environmental impacts of poultry production, and (iii) controlling poultry product-associated food safety issues and enhancing egg quality for consumers

Current Progress

During the year, the Poultry CRC has focussed on transferring its research and education outcomes to end users, as many of its projects are now completed and some students graduated.

Some highlights of the research, utilisation, education and communication activities from the reporting period include those described below.

One of the objectives of the Poultry CRC is to produce evidence-based tests for the welfare status of birds. Our researchers have found that the expression of some micro RNAs differs between eggs from relaxed and stressed hens. This is a world first discovery that could revolutionise the way bird welfare is assessed.

Another exciting development has been the use of a fluorescent protein to differentiate male and female embryos, a technology which has the potential for practical application in both the egg and chicken meat industries.

Wastes from hatcheries, processing plants, and production (daily mortalities, litter and spent hens) present challenges in terms of disposal as well as presenting opportunities in terms of value adding and by product development. These issues have been tackled from a number of angles. This has included trialling value-adding to wastes using both anaerobic and aerobic digestion technologies to address hatchery and processing wastes as well as daily mortalities. Momentum has now gathered for the use of these technologies in the poultry industry, solving a costly problem in dealing with a low-volume, continuous waste stream on site. Environmental concerns associated with composting, and the safe use of poultry compost, were carefully investigated by studying odour emissions from compost heaps and viral survival in poultry compost. In addition, the Poultry CRC is working closely with local and state governments to incorporate poultry compost into the national Fertcare® Program.

Another important area that affects sustainability of the chicken meat industry is feed utilisation, because feed accounts for 65-70% of the cost of producing the live bird. Therefore a small improvement in feed efficiency means millions of dollars of savings for the industry. A project was completed on the inclusion of whole seed canola into poultry feed in close collaboration with industry. Canola
is now the primary vegetable protein source produced in Australia and the proper use of whole seed canola in poultry feed is of immense economic importance.

In the flock health area, sales of the CRC-supported fowl cholera vaccine (Vaxsafe® PM) have continued to grow and the range of diagnostic tests available to the industry has expanded.

In the education sphere, almost all of the CRC’s postgraduates who have completed their theses have found employment in research organisations or in industry. The CRC’s industry internship program has proven highly successful - to date, six of its seven interns have been employed by the poultry industry. The CRC has also launched the X Program (Early Career Support) where young researchers are encouraged to spend up to six months with industry to understand the key issues affecting productivity.

A 3-D animation of chicken embryo development was developed and released over the year. This was partly funded by the World’s Poultry Science Association as an outreach educational project. This animation has won the American Association of Medical Illustrator’s ‘Member’s Choice Award’ and the ‘Award of Excellence for a Didactic/Instructional’ in the Non-Commercial Animation category.

Communication has gone hand in hand with utilisation and education activities. The CRC has organised teams of key scientists and managers to visit its industry and research partners to understand their needs. Additionally, the annual Ideas Exchange conference enhances the links that exist between end users, scientists and students, resulting in the submission of innovative new projects targeting important industry issues. The CRC’s monthly ‘eChook’ newsletter; Facebook avatar, Isa Brown; and Twitter account @PoultryCRC have also been active together with Poultry Hub, which is the one of the world’s leading poultry information websites.
Other supported activities

**Scholarships**

PRJ-008778  Nuffield Australia Farming Scholarships – Guy Hebblewhite (2013)
PRJ-008422  RIRDC Horizon Scholarship – Emma Ludington (2012-15)
PRJ-008931  RIRDC Horizon Scholarship – Mikaela Baker (2013-16)
PRJ-009570  University of Tasmania, PhD candidate – James Hamilton (2014-17)

**Collaborative Programs**

PRJ-007370  Animal Welfare RD&E Strategy Committee Membership
PRJ-005882  Feed Grains R&D Partnership
PRJ-008152  Co funding contribution - national welfare RD&E capacity building project
PRJ-008476  Co-funding for executive function for the Strategy Committee for the National Animal Welfare RD&E Strategy
PRJ-008485  National Agricultural Manure Management Program (NAMMP)
PRJ-009570  Poultry CRC

**Travel Grants / Conference Sponsorships**

PRJ-009523  Travel Sponsorship: Attendance at Australian Poultry Science Symposium (APSS) 2014
PRJ-009545  Travel Sponsorship: Speaker support for Australian Poultry Science Symposium (APSS) 2014
PRJ-009565  Conference Sponsorship: Poultry Information Exchange (PIX) 2014
PRJ-009671  Travel Sponsorship: 10th International Symposium on Marek’s Disease and Avian Herpesviruses – Carol Handley

**Other**

PRJ-008870  National Tunnel Ventilation workshops
PRJ-008928  Chicken Meat R&D Program Evaluation and Five Year R&D Plan 2014/15-2018/19
PRJ-008929  Communication Plan for the Chicken Meat Program
PRJ-008937  Poultry CRC WPSA Schools Poultry Education competition
Chicken Meat
RIRDC Completed Projects in 2013-14 and Research in Progress at June 2014

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RURAL INDUSTRIES
Research & Development Corporation

Phone: 02 6271 4100
Fax: 02 6271 4199
Bookshop: 1300 634 313
Email: rirdc@rirdc.gov.au
Postal Address: PO Box 4776,
Kingston ACT 2604
Street Address: Level 2, 15 National Circuit,
Barton ACT 2600

www.rirdc.gov.au