

Final Report

GRDC Project No: PCL00002

1. Project Information

Line of Business Practices Program Validation and Integration

Project title

Enhancement of NIR calibrations for predicting the energy value of weather damaged grains for pigs

Commencement date 01/09/2006 Completion date 31/05/2011 Number of years

2. Contact Information

Project Supervisor Contact

Title	Initials	First name	Family name (Surname)
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Position

Research Management Consultant

Name of organisation

John L Black Consulting

Australian Business Number (ABN) *if applicable*

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Administration Contact

Title	Initials	First name	Family name (Surname)
Mr	G	Geoff	Crook

Position

Business Manager

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3. Budget Summary

Financial Year	2006 2007 \$	2007 2008 \$	2008 2009 \$	2009 2010 \$	2010 2011 \$	\$	Total \$
Total GRDC \$ Agreed (excl GST)	100,032	99,988	99,994				300,014

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4. Project Summary

The NIR calibrations for predicting whole tract digestible energy content (faecal DE, MJ/kg) and digestible energy content to the end of the small intestines (ileal DE, MJ/kg) in pigs has been substantially improved over the Premium Grains for Livestock Program (PGLP) calibrations by inclusion of 220 new weather damages and specially selected grains in this project. The accuracy with which faecal DE could be predicted with 95% confidence improved ± 0.38 MJ/kg for the PGLP calibration to ± 0.27 MJ/kg for the final calibration. The accuracy of prediction of ileal DE improved from ± 0.68 to ± 0.52 MJ/kg.

5. Outcome Benefits

Although more samples need to be included in the calibrations for them to become fully robust for predicting values for unknown grains, the current calibrations provide far greater accuracy in estimation of the available energy content of cereal grains for pigs than any other existing system.

When the price of wheat is at \$250/t, estimates of the money value of a 1 MJ/kg difference in the available energy content of grain range from up to \$18/t for pigs. The actual value depends on the base cost of the grain relative to other high and low energy ingredients. Similarly, an increase in AME intake (MJ/d) that simulates growth rate and results in chickens reaching sale weight one day earlier has been estimated to be worth \$2m/year for a 1 million bird per week broiler operation. Thus, there is a substantial economic advantage for livestock producers to know the available energy content and the relative available energy intake of individual batches of grain.

The calibrations are now being used widely in the pig and poultry industries for feed formulation and are expected to become the preferred method for valuing and purchasing grains for livestock.

6. Pesticide and Herbicide Research

Did this project conduct research on pesticide and herbicide products?

No

Yes List the active ingredients, rate and timing

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7. Outputs

Reproduce any outputs not previously reported against

Output 1	Planned delivery date	Achieved
	31/12/2007	Yes

Description

NIR calibrations for the rapid and cheap measurement of the energy value of weather damaged cereal grains for pigs and tools for grain growers and pig producers to predict the relative monetary value of any batch of weather damaged grain. Recommendations on future research for improving the energy value of weather damaged grains through processing techniques.

Achievement prior to this report

Results from two experiments containing 72 cereal grains (wheat 23, barley 16, triticale 9, sorghum 24) with 30% being weather damaged have been used to enhance the PGLP NIR calibrations.

Achievement for this reporting period

Results from four experiments containing 105 new cereal grains (wheat 35, barley 29, triticale 13, sorghum 26, pearl miller 2) with 41% being weather damaged have been used to enhance the PGLP NIR calibrations.

Achievement of commercialisation details

The calibrations have been made commercially available to the grains, pig, broiler and ruminant industries through the Pork CRC, AusScan project, with licenses to laboratories, livestock integrators, feed manufacturers and grain handling companies. A set of guidelines for interpreting the calibrations has also been produced and distributed to licensees.

Non-achievement details

Nil

Output 2	Planned delivery date	Achieved
	31/12/2007	Yes

Description

A tool (Table/graph or spreadsheet) based on AUSPIG simulations or other algorithms that allows grain growers, pig producers and other sectors of the feed grain value chain to assess the relative monetary value of any batch of weather damaged or normal grain based on NIR predicted values of energy availability.

Achievement prior to this report

A large number of AUSPIG simulations have been conducted to determine the monetary value of changes in digestible energy (DE) content of cereal grains and DE intake. An 'interpretative guide' has been produced.

Achievement for this reporting period

Output has been achieved.

Achievement of commercialisation details

The interpretative guide and other documents are distributed with the NIR calibrations through the AusScan project.

Non-achievement details

Nil

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Output 3	Planned delivery date	Achieved
	30/06/2010	Yes

Description

A report describing the chemical, physical and structural characteristics of weather damaged grains that determine variation in their energy value for pigs and recommendations on processing or other techniques to be further investigated for improving the nutritional quality of these grains.

Achievement prior to this report

Chemical analyses have been completed for the 72 grains used in experiments 1 & 2. Analyses for the final 50 grains in experiment 3 are still to be complete.

Achievement for this reporting period

Chemical analysis of all grains used in the project have been completed and covariate statistical processes used to determine the grain characteristics most closely related to the DE content of the grains for pigs. Faecal DE was significantly positively related to the total starch, fat and beta-glucan content of the grain, whereas it was negatively related to grain amylose, lignin and NDF content.

Achievement of commercialisation details

The chemical analysis results have been included with PGLP results to upgrade the NIR calibrations for many of the chemical and physical characteristics of cereal grains that are related to DE values for pigs. Elimination of large particles through regrinding grains was one processing method to improve the efficiency of grain use by pigs.

Non-achievement details

Nil

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8. Milestones

Milestone number:	Planned achievement date	Achieved
1	30/04/2009	Yes

Description

Opportunistic collection and/or special production in Central Queensland each year of at least 10 weather damaged cereal grains (wheat, barley, triticale and/or sorghum) varying in stage of maturity when the damage occurred and in the degree of damage (water stress, germination, screenings percentage, frosting).

Achievement prior to this report

A total of 134 grains have been collected and used in experiments.

Achievement for this report

A total of 134 grains have been collected and used in experiments. 105 of these were new grains, whereas others were used across experiments for statistical connectivity.

Milestone number:	Planned achievement date	Achieved
2	30/04/2009	Yes

Description

Complete NIR scans of at least 10 weather damaged whole grains obtained each year and of formulated pellets from diets made from these grains.

Achievement prior to this report

Complete NIR scans of at least 10 weather damaged whole grains obtained each year and of formulated pellets from diets made from these grains.

Achievement for this report

Completed NIR scans on 43 weather damaged and all other grains used in the four experiments. All grains were formulated into pellets and fed to pigs in digestibility experiments.

Milestone number:	Planned achievement date	Achieved
3	30/04/2010	Yes

Description

Complete digestibility trials with pigs offered at least 10 weather damaged grains each year, where ileal and faecal digestibility of energy and selected chemical components (including starch, amino acids and fatty acids) and rate of passage of digesta are measured. Complete intake, growth rate and efficiency of feed use trials using weaner pigs offered the same grains.

Achievement prior to this report

Experiments have been completed for 84 grains in experiments 1 and 2. The third experiment is in progress and will be completed in early April 2010.

Achievement for this report

Four experiments measuring the faecal and ileal DE content of 105 new cereal grains and 30 connectivity grains have been completed.

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Milestone number: 4	Planned achievement date	Achieved
	30/04/2010	Yes

Description

Analyse the results from Milestone 3 to obtain statistically corrected values for ileal DE, faecal DE, ileal:faecal DE ratio and DE intake index. Update the PGLP NIR calibrations for these characteristics by including the new information. Make the new NIR calibrations available annually to current users of the PGLP NIR calibrations through the feed grains value chain.

Achievement prior to this report

Results from experiments 1 and 2 have been analysed to produce statistically corrected results and added in two stages to results from PGLP to improve the NIR prediction calibrations for pigs. Addition of the new results to those collected in PGLP has substantially improved the ability of the calibrations to predict values for unknown, new samples of cereal grains and to enhance the precision of predictions.

Achievement for this report

Results from all grains examined have been included in the NIR calibration. The second and third generation calibrations have been supplied to the grains and animal industries through the AusScan project. The fourth generation calibrations are expected to be provided to licensees shortly.

Milestone number: 5	Planned achievement date	Achieved
	28/01/2010	Yes

Description

Complete analysis of selected chemical, physical and structural characteristics of at least 10 weather damaged grain samples collected each year and of the ileal digesta following feeding of these grains to pigs.

Achievement prior to this report

Analysis of the grains used in experiments 1 & 2 have been completed. Results for the final grains has been delayed because of relocation of the DEEDI analytical laboratory in Queensland. The laboratory expects to be reopened in June 2010. Results from all samples are expected to be available for writing the Final Report.

Achievement for this report

All grains used in the four experiments have been analysed for chemical and physical characteristics.

Milestone number: 6	Planned achievement date	Achieved
	31/12/2008	Yes

Description

Develop a tool(s) (table, graph and/or spreadsheet) from simulations of the AUSPIG model or simpler algorithms to predict, from NIR measured values of grain quality characteristics determined in Milestone 4, the relative monetary value of any batch of weather damaged or normal grain.

Achievement prior to this report

The AUSPIG simulation model has been used to predict the effects of changes in the DE content of grains (MJ/kg) and DE intake on the profitability of a standard piggery. Results from the simulations show that 1 MJ/kg is worth between \$7.50 and \$21.00 per tonne if grain depending on the base cost of the grain, the relative costs of other grains and the relative cost of high and low energy nutrients.

Achievement for this report

Milestone previously achieved.

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Milestone number: 7	Planned achievement date	Achieved
	31/12/2009	Yes

Description

The tool(s) developed in Milestone 6 will be delivered to the grains and pig industries, and relevant sectors of the feed grain value chain through GRDC, the Pork CRC and members of the Feed Partnership group.

Achievement prior to this report

The 'interpretative guide' outlining the relative value of difference in the energy value of grains has been made available to NIR calibration licensees and the industries through the Pork CRC project, AusScan.

Achievement for this report

The interpretative guide has been delivered with NIR calibration licenses to all licensees.

Milestone number: 8	Planned achievement date	Achieved
	30/04/2009	Yes

Description

Complete statistical analysis of results from Milestone 5 to produce "statistically corrected values" and identify the grain characteristics responsible for variation in the energy value of weather damaged grains for pigs.

Achievement prior to this report

Statistically corrected values have been produced for grains used in experiments 1 & 2, but not those used in experiment 3.

Achievement for this report

Statistically corrected values have been produced for grains used in all four experiments. These values were used to upgrade the NIR calibrations.

Milestone number: 9	Planned achievement date	Achieved
	30/06/2010	Yes

Description

Complete a written report on the reasons for variations in the energy value of weather damaged cereal grains for pigs and including recommendations for future research into processing or other methods that may improve the energy value of specific batches of damaged grain. Hold appropriate meetings with industry groups, scientists and funding organisations.

Achievement prior to this report

Completion of this Milestone depends on completion of Milestone 8.

Achievement for this report

The milestone has been completed and the report is attached to this document. Some meetings have been held with scientific groups, pig and grains industry producers, the Pork CRC, but not yet GRDC.

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Milestone number: 10	Planned achievement date	Achieved
	30/06/2010	Yes

Description

Deliver to GRDC and the Pork CRC annual Progress Reports and the Final Report.

Achievement prior to this report

Annual Progress Reports have been delivered on time.

Achievement for this report

The final report will be delivered to GRDC prior to 31 May 2011 as agreed.

Milestone number: 11	Planned achievement date	Achieved

Description

Achievement prior to this report

Achievement for this report

Milestone number: 12	Planned achievement date	Achieved

Description

Achievement prior to this report

Achievement for this report

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9. Delivery Activity— Products

What were the proposed target audiences and/or organisations for the activities/outputs? (e.g. Grain growers, agribusiness, researchers, breeders)

NIR calibrations for predicting the energy value of cereal grains for pigs: grain growers, feed test laboratories, bulk handlers, plant breeders

Was this activity/output delivered as part of the project?

No

Yes

Date of delivery (dd/mm/yyyy)

01/12/2008

Was there recurring years for this activity/output?

No

Yes

Month and year of activities/outputs

Approximately yearly Oct. 2009, July 2010, June 2011

Did this activity/output include third parties?

No

Yes

Name of principal contractor

Pork CRC

Was this activity/output funded within the project budget?

No

Details of external funding

A separate project (AusScan) established by the Pork CRC

Yes

Was this activity/output national/regional/local?

National

Regional

Specify region if possible

Local

Specify locality if possible

Final summary of the outcome for this activity/output

Updated NIR calibrations for predicting the energy value of cereal grains for pigs. See attached document for full details. These calibrations are being used widely within some sections of the pig industry and have been used by grain growers and grain handlers/distributors.

Delivery Activity— Products

What were the proposed target audiences and/or organisations for the activities/outputs? (e.g. Grain growers, agribusiness, researchers, breeders)

'Interpretive Guide' for the NIR calibrations: grain growers, feed test laboratories, bulk handlers, plant breeders.

Was this activity/output delivered as part of the project?

No

Yes

Date of delivery (dd/mm/yyyy)

10/10/2009

Was there recurring years for this activity/output?

No

Yes

Month and year of activities/outputs

Did this activity/output include third parties?

No

Yes

Name of principal contractor

Pork CRC

Was this activity/output funded within the project budget?

No

Details of external funding

A separate project (AusScan) established by the Pork CRC

Yes

Was this activity/output national/regional/local?

National

Regional

Specify region if possible

Local

Specify locality if possible

Final summary of the outcome for this activity/output

An interpretive guide for NIR results developed and distributed by the Pork CRC AusScan project. Details are given in a separate document.

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Delivery Activity—

What were the proposed target audiences and/or organisations for the activities/outputs? (e.g. Grain growers, agribusiness, researchers, breeders)

Was this activity/output delivered as part of the project?

No

Yes

Date of delivery (dd/mm/yyyy)

Was there recurring years for this activity/output?

No

Yes Month and year of activities/outputs

Did this activity/output include third parties?

No

Yes Name of principal contractor

Was this activity/output funded within the project budget?

No Details of external funding

Yes

Was this activity/output national/regional/local?

National

Regional Specify region if possible

Local Specify locality if possible

Final summary of the outcome for this activity/output

Delivery Activity—

What were the proposed target audiences and/or organisations for the activities/outputs? (e.g. Grain growers, agribusiness, researchers, breeders)

Was this activity/output delivered as part of the project?

No

Yes

Date of delivery (dd/mm/yyyy)

Was there recurring years for this activity/output?

No

Yes Month and year of activities/outputs

Did this activity/output include third parties?

No

Yes Name of principal contractor

Was this activity/output funded within the project budget?

No Details of external funding

Yes

Was this activity/output national/regional/local?

National

Regional Specify region if possible

Local Specify locality if possible

Final summary of the outcome for this activity/output

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[Additional Extension Activities/Referred Publications \(in bibliographical format\)](#)

Black, J.L., Nielsen, S.G. and Tredrea, A.M. (2008). Grains for animal feed. In: Proceedings of the 58th Cereal Chemistry Conference, – 31st August – 4th September, 2008. Surfers Paradise, Queensland". pp. 68-71. Eds. J.F. Panozzo and C.K. Black. AACCI International, Downunder section, North Ryde, Australia.

Black, J., Nielsen, S., Tredrea, A. and Flinn, P. (2009). Barley as a feed for animals: measuring its quality. 14th Australian Barley Technical Symposium, Maroochydore, Queensland, September 2009.

Black, J.L., Flinn, P.C., Nielsen, S.G. and Tredrea, A.M. (2010). The value of NIR to the Australian feed grains industry. Proceedings of the Australian Near Infrared Spectroscopy Group. Adelaide, pp 74.

Black, J.L. and Spragg, J.C. (2010). NIR of feedstuffs and enhancement of NIR predictions of nutrient availability. In Proceedings of the Midwest Swine Nutrition Conference, Indianapolis, September 2010. Pp. 24-30.

[Delivery/Path to Market](#)

The updated NIR calibrations for the DE content of grains for pigs and for the chemical and physical characteristics of cereal grains have been made available to the pig and grains industries and cereal plant breeders through the Pork CRC AusScan project.

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10. Environment/Economic/Social Analysis

Outline the benefits/risks associated with this proposed investment.

Benefits

Include an estimate of the benefit and the scale to which the impact will apply (i.e. ha, tonnes).

Also include likelihood of benefit and proposed extent of the adoption by industry in the project timeframes and beyond.

Risks

Include likelihood of risk and management options.

Environmental Benefits

Environmental benefits accrue from the project through accurate knowledge of the energy value of cereal grains leading to improved formulation of diets and improved efficiency of feed use on piggeries. This results in an overall reduction in feed being used by the pig industry.

Environmental Risks

There are no environmental risks from the project.

Economic Benefits

The faecal DE value of pigs has been shown to vary by up to 4 MJ/kg within any grain species depending on the cultivar and environment in which it has been grown. AUSPIG and other economic analyses show that this can be worth up to \$18/t when cereal prices are \$250/t. Two economic assessments undertaken in PGLP showed that such benefits are normally shared on a 70:30 basis, animal:grain industry

Economic Risks

The NIR calibrations are expected to become the National basis for trading grains for livestock. The risk is that there is insufficient education and promotion across the animal and grains industries.

Social Benefits

Social Risks

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11. Overview of Project Achievements

Approximately 220 cereal grains have now been included in NIR calibrations for predicting faecal and ileal DE content of grains for pigs. The original calibrations developed in the Premium Grains for Livestock Program (PGLP) contained just over 90 grains, including wheat, barley, triticale, sorghum and rice. Research in the Pork CRC projects, co-funded by GRDC, has more than doubled the number of grains in the calibrations. An emphasis was placed in the Pork CRC experiments to select grains that would increase the reliability of the calibrations for predicting accurately values for unknown samples.

Two samples of pearl millet were added to the existing cereal grain types. Approximately 25 new grains were selected because they were either grown under dry conditions and were drought affected or were sprayed with desiccant herbicides at intervals after flowering to simulate rapid, early finish to the growing season. Approximately 20 other grains were selected because they were either naturally or artificially germinated. Several grains were frost affected. Other grains were selected because they were found to be spectral 'outliers' in the WINISI software used for calibration development. Other grains were selected because they had unusual characteristics, such as different coloured seed coats, large or small seeds, waxy or non-waxy endosperms.

Four experiments were conducted to determine faecal and ileal DE content of grains. The results from each experiment were used first to determine the accuracy with which the results could be predicted using the existing NIR calibrations. The results from each experiment were then added to all existing results to develop the next generation calibrations. The ability of the new calibrations to predict the results from previous experiments and the statistics for these calibrations were determined.

Inclusion of results from these experiments substantially improved the regression coefficient relating predicted to measured values (R^2), the accuracy expected for a predicted value (SECV) and the robustness or reliability of the calibration for predicting values for unknown samples (RPD). The R^2 values for predicting unknown samples increased from 0.79 to 0.91 for faecal DE and from 0.69 to 0.85 for ileal DE. With the fourth generation calibrations, there was little bias in the predictions with the slope of the relationship being near 1.0 and the intercept near 0.0.

The accuracy with which faecal DE could be predicted with 95% confidence improved ± 0.38 MJ/kg for the PGLP calibration to ± 0.27 MJ/kg for the fourth generation calibration. The accuracy of prediction of ileal DE improved from ± 0.68 to ± 0.52 MJ/kg as fed. Similarly, the robustness of the calibrations improved with RPD increasing from 2.08 for the PGLP calibration to 2.73 for the fourth generation faecal DE calibration. The RPD values increased from 1.96 to 2.18 for ileal DE. These results suggest the calibrations have good predictive ability for faecal DE and are generally quantitative for ileal DE. However, RPD values above 3.0 are needed for the calibrations to be regarded as excellent.

Inclusion of a large number of extremely unusual grains for the last experiment provided important information about the calibrations. Values for several of these grains were not well predicted. However, the addition of these grains improved the robustness of the calibrations (faecal DE) or ability to predict unknowns (ileal DE). The experiment also demonstrated that many more grains need to be added to the calibrations to improve their reliability and make them more suitable for use as the basis for trading grains for pigs. The results suggest that at least 100 more grains with differing characteristic need to be added to the calibrations. Some of these grains should be selected for unusual characteristics and as spectral 'outliers' while others should be regarded as more normal grains. The latter group of grains are needed to demonstrate the reliability and precision of the NIR calibrations for more normal grain samples.

When the price of wheat is at \$250/t, estimates of the money value of a 1 MJ/kg difference in the available energy content of grain range from up to \$18/t for pigs. The actual value depends on the base cost of the grain relative to other high and low energy ingredients. Similarly, an increase in AME intake (MJ/d) that simulates growth rate and results in chickens reaching sale weight one day earlier has been estimated to be worth \$2m/year for a 1 million bird per week broiler operation. Thus, there is a substantial economic advantage for livestock producers to know the available energy content and the relative available energy intake of individual batches of grain. The only way these values can be realistically obtained is by use of the NIR calibrations. Guidelines have been prepared on assessing and interpreting the NIR calibrations for each industry.

The NIR calibrations are now part of a suite of calibrations commercialised by the Pork CRC, AusScan project. The calibrations have been licensed to feed testing laboratories, livestock integrators, grain traders and distributors and plant breeders. The calibrations are being widely used by industries and are expected soon to become the future basis for trading grains for livestock in Australia and other places.

12. Conclusions

The NIR calibrations for predicting the available energy content of cereal grains for pigs have been greatly improved from the Premium Grains for Livestock Program by the research carried out in this project. These upgraded calibrations have been made available to the pig and grains industry chains and plant breeders through the Pork CRC, AusScan project. Interpretative guides have been prepared and distributed with the calibrations.

The available energy contents of cereal grains for pigs have been found to vary by up to 4 MJ/kg for any grain species. Economic analyses suggest that when the price of grain is \$250/t, the value of 1 MJ/kg is up to \$18/t for a pig producer. The NIR calibrations provide the only currently available realistic way for estimating the energy value of grains for pigs.

It is anticipated that the upgraded calibrations for pigs, broilers, ruminants and chemical/physical characteristics of cereal grains will become the future method for trading grains for livestock in Australia and other countries.

13. Recommendations

There are still opportunities to improve the robustness of the NIR calibrations for pigs and have fewer grains where NIR scans are seen as 'outliers' and values cannot be predicted with confidence. Consequently, it is recommended that at least 100 more cereal grains selected on the basis of NIR scans are included in the calibrations. Thus, digestibility experiments are recommended for the next 3-4 years, with results from the experiments being included in continually updated calibrations.

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14. Other Research and Development Opportunities

15. Attachments

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16. Management of Intellectual Property/Commercialisation

Provide a summary of any strategies undertaken or planned to facilitate the protection and / or commercialisation of the project's realised outputs

All of the IP relating to this project is being managed by the commercialisation section of the Pork CRC.

Provide a list of all scientific or technical papers published, and any patents filed

See earlier.

Provide a list of any confidential information, if relevant and attach details to this report

Nil

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17. Details of International Collaboration

Did this project have international collaboration?

No

Yes Provide details of the international collaborating organisations/people below

Provide details of the international collaborating organisations/people below

Detail the nature of the international collaboration

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- 18.** Please use this area to include any additional text to support your report. Please do not include images. You may also attach a document (e.g. Word, Excel, PDF) limited to a maximum of 5 x A4 pages to this Report. Any additional information will be viewed as supplementary data. The report will only be evaluated on the previous sections of this document.

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19. Plain English Summary for Public Release

<p>Project Title:</p> <p>GRDC Project No:</p> <p>Primary Contact:</p> <p>Organisation:</p> <p>Phone:</p> <p>Fax:</p> <p>Email:</p>	<p>Enhancement of NIR calibrations for predicting the energy value of weather damaged grains for pigs</p> <p>PCL00002</p> <p>Dr John Black</p> <p>John L Black Consulting PO Box 4021 Warrimoo NSW 2774 Australia</p> <p>+ 61 247536231</p> <p>+61 247536295</p> <p>jblack@pnc.com.au</p>
<p>Objectives</p>	<ol style="list-style-type: none"> 1. Enhance the Premium Grains for Livestock (PGLP) NIR calibrations for predicting ileal DE and faecal DE in pigs for weather damaged grains. 2. Provide through NIR calibrations a rapid method for identifying the energy value for pigs of weather damaged grains and thus provide a basis for establishing their monetary value.
<p>Background</p>	<p>Preliminary Near Infrared (NIR) calibrations were developed in a previous GRDC project – The Premium Grains for Livestock Program. Results from pig digestibility studies with approximately 90 cereal grains, including wheat, barley, triticale, sorghum and rice were used to develop NIR calibrations for the whole tract digestible energy content (faecal DE, MJ/kg) and digestible energy content to the end of the small intestines (ileal DE, MJ/kg). These calibrations showed promise, but needed further development with the inclusion of more grains, and particularly weather damaged grains. Four pig digestibility experiments were conducted in this project to increase the number of cereal grain samples included in upgraded NIR calibrations.</p>

19. Plain English Summary for Public Release

Project Title:	Enhancement of NIR calibrations for predicting the energy value of weather damaged grains for pigs
GRDC Project No:	PCL00002
Primary Contact:	Dr John Black
Organisation:	John L Black Consulting PO Box 4021 Warrimoo NSW 2774 Australia
Phone:	+ 61 247536231
Fax:	+61 247536295
Email:	jblack@pnc.com.au
Research	Four experiments were conducted to determine faecal and ileal DE content of grains in pigs. Two samples of pearl millet were added to the existing cereal grain types. Approximately 25 new grains were selected because they were either grown under dry conditions and were drought affected or were sprayed with desiccant herbicides at intervals after flowering to simulate rapid, early finish to the growing season. Approximately 20 other grains were selected because they were either naturally or artificially germinated. Several grains were frost affected. Other grains were selected because they were found to be spectral 'outliers' in the WINISI software used for calibration development. Other grains were selected because they had unusual characteristics, such as different coloured seed coats, large or small seeds, waxy or non-waxy endosperms. The results from each experiment were used first to determine the accuracy with which the results could be predicted using the existing NIR calibrations. The results from each experiment were then added to all existing results to develop the next generation calibrations. The ability of the new calibrations to predict the results from previous experiments and the statistics for these calibrations were determined.

19. Plain English Summary for Public Release

<p>Project Title:</p> <p>GRDC Project No:</p> <p>Primary Contact:</p> <p>Organisation:</p> <p>Phone:</p> <p>Fax:</p> <p>Email:</p>	<p>Enhancement of NIR calibrations for predicting the energy value of weather damaged grains for pigs</p> <p>PCL00002</p> <p>Dr John Black</p> <p>John L Black Consulting PO Box 4021 Warrimoo NSW 2774 Australia</p> <p>+ 61 247536231</p> <p>+61 247536295</p> <p>jblack@pnc.com.au</p>
<p>Outcomes</p>	<p>Inclusion of results from these experiments substantially improved the regression coefficient relating predicted to measured values (R²), the accuracy expected for a predicted value (SECV) and the robustness or reliability of the calibration for predicting values for unknown samples (RPD). The R² values for predicting unknown samples increased from 0.79 to 0.91 for faecal DE and from 0.69 to 0.85 for ileal DE. With the fourth generation calibrations, there was little bias in the predictions with the slope of the relationship being near 1.0 and the intercept near 0.0.</p> <p>The accuracy with which faecal DE could be predicted with 95% confidence improved ± 0.38 MJ/kg for the PGLP calibration to ± 0.27 MJ/kg for the fourth generation calibration. The accuracy of prediction of ileal DE improved from ± 0.68 to ± 0.52 MJ/kg as fed. Similarly, the robustness of the calibrations improved with RPD increasing from 2.08 for the PGLP calibration to 2.73 for the fourth generation faecal DE calibration. The RPD values increased from 1.96 to 2.18 for ileal DE. These results suggest the calibrations have good predictive ability for faecal DE and are generally quantitative for ileal DE. However, RPD values above 3.0 are needed for the calibrations to be regarded as excellent.</p>
<p>Implications</p>	<p>When the price of wheat is at \$250/t, estimates of the money value of a 1 MJ/kg difference in the available energy content of grain range from up to \$18/t for pigs. The actual value depends on the base cost of the grain relative to other high and low energy ingredients. Similarly, an increase in AME intake (MJ/d) that simulates growth rate and results in chickens reaching sale weight one day earlier has been estimated to be worth \$2m/year for a 1 million bird per week broiler operation. Thus, there is a substantial economic advantage for livestock producers to know the available energy content and the relative available energy intake of individual batches of grain. The only way these values can be realistically obtained is by use of the NIR calibrations. Guidelines have been prepared on assessing and interpreting the NIR calibrations for each industry.</p>



Final Report

19. Plain English Summary for Public Release

<p>Project Title:</p> <p>GRDC Project No:</p> <p>Primary Contact:</p> <p>Organisation:</p> <p>Phone:</p> <p>Fax:</p> <p>Email:</p>	<p>Enhancement of NIR calibrations for predicting the energy value of weather damaged grains for pigs</p> <p>PCL00002</p> <p>Dr John Black</p> <p>John L Black Consulting PO Box 4021 Warrimoo NSW 2774 Australia</p> <p>+ 61 247536231</p> <p>+61 247536295</p> <p>jblack@pnc.com.au</p>
<p>Publications</p>	<p>Black, J.L., Nielsen, S.G. and Tredrea, A.M. (2008). Grains for animal feed. In: Proceedings of the 58th Cereal Chemistry Conference, – 31st August – 4th September, 2008. Surfers Paradise, Queensland”. pp. 68-71. Eds. J.F. Panozzo and C.K. Black. AACC International, Downunder section, North Ryde, Australia.</p> <p>Black, J., Nielsen, S., Tredrea, A. and Flinn, P. (2009). Barley as a feed for animals: measuring its quality. 14th Australian Barley Technical Symposium, Maroochydore, Queensland, September 2009.</p> <p>Black, J.L., Flinn, P.C., Nielsen, S.G. and Tredrea, A.M. (2010). The value of NIR to the Australian feed grains industry. Proceedings of the Australian Near Infrared Spectroscopy Group. Adelaide, pp 74.</p> <p>Black, J.L. and Spragg, J.C. (2010). NIR of feedstuffs and enhancement of NIR predictions of nutrient availability. In Proceedings of the Midwest Swine Nutrition Conference, Indianapolis, September 2010. Pp. 24-30.</p>

Final Report

20. Scientific Report for Public Release

Are you required to submit the Scientific Report for Public Release for GRDC Progress and Final Reports?

No

Yes

Use the section headings shown below:

Abstract:

Introduction:

Materials and Methods:

Results:

Discussion:

Conclusion:

Appendices:

Acknowledgements:

References.

Step 1: Click to go the template on our website

Step 2: Attach this Scientific Report to the Progress Report

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No

22. Certification

Reports to the GRDC should be made by the organisation conducting the research and coordinated through their central administrative area. For example, tertiary education institution reports should be processed through the Registrar or Bursar's office. Ensure the Certification details are complete before the form is submitted electronically. The electronic copy received by GRDC will be the copy that is evaluated.

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Project Supervisor's signature

Name

Date

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Research organisation signature

Name and title of authorised signatory

Date

Dr. ROGER CAMPBELL	30/5/11
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