

Final Project Summary

Project title	Development of an accurate means to predict the nutritive value of wheat for broilers and an investigation of the novel wheat factors on broiler performance		
Project number	RD-2012-3805	Final Project Report	PR563
Start date	April 2013	End date	April 2015
AHDB Cereals & Oilseeds funding	£123,000	Total cost	£323,000

What was the challenge/demand for the work?

Wheat is the major component of broiler diets but it is highly variable in terms of nutritive value, leading to variable performance and reduced profitability. To date, there is no rapid and accurate means to predict wheat quality for broilers. Specific weight continues to be used as an indicator of quality despite some evidence to the contrary. New research was required to develop a rapid and accurate means of predicting wheat quality for broilers. In addition, there was a need to investigate the effect of wheat moisture content at harvest and wheat microdochium content on broiler performance.

How did the project address this?

The aims of this project were to validate existing NIRS equations developed using laboratory trials with commercially relevant feeding trials to provide a tool to predict the nutritive value of wheat for broilers and to investigate novel wheat factors (moisture content at harvest and microdochium content) which may influence broiler performance. Twenty six wheat samples were sourced from across Northern Ireland, Great Britain, Europe and North America and were formulated into broiler diets. The wheat samples were analysed for specific weight and *in vitro* viscosity and for a number of chemical constituents (gross energy, crude protein, total starch, microdochium, DON, ZON, ochratoxin A and B and amino acid contents). The ranges for the measured parameters were within reported limits. The majority of the relationships between the wheat chemical and physical parameters were weak and non-significant. However, there were significant relationships ($P < 0.01$) between specific weight and microdochium content ($R^2 = 0.29$) indicating that specific weight may be affected by wheat microdochium content. Separate broiler trials were conducted at AFBI, Harper Adams University and Moy Park Ltd. to determine intake, live weight gain (LWG) and feed conversion ratio (FCR). Results show differences in performance due to wheat sample. There was no relationship between wheat specific weight and broiler performance ($R^2 = 0.01$ for feed intake, $R^2 = 0.03$ for LWG and $R^2 = 0.02$ for FCR, respectively). However, wheat moisture content at harvest was shown to be positively related to LWG ($R^2 = 0.40$, $P = 0.005$) which may be attributed to the positive effects of the drying process or the benefits of early-stage sprouting. A positive relationship was observed between wheat microdochium content and feed efficiency ($R^2 = 0.19$, $P < 0.05$). The effect of the mycotoxins DON and ZON were variable and difficult to explain.

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NIRS equations were developed to predict wheat microdochium content and boiler performance. Wheat samples were scanned on a Foss NIRSystems 6500 spectrophotometer and the scans subjected to analysis using Foss Chemometrics software Win ISI4. The strength of the relationship between actual and predicted microdochium content was reasonably robust ($R^2=0.70$ for the entire dataset). However, the errors associated with the prediction and the ratio of prediction to deviation (RPD) were unacceptable. Although the errors and RPD values improved when the dataset was split into low, medium and high microdochium contents, they still did not reach an acceptable threshold. Nonetheless, this initial works shows that NIRS may have potential in predicting the microdochium content but the dataset needs to be increased to improve accuracy.

Strong NIRS prediction equations were developed to predict broiler performance ($R^2=0.92$, 0.83 and 0.85 for feed intake, LWG and feed efficiency, respectively). The error associated with predictions were low (SEP= 2.955 , 2.787 and 2.023) and the RPD values indicated that the predictions were excellent, quantitative and good for feed intake, LWG and feed efficiency, respectively. Using the equations to predict the performance of broilers within the Moy Park trial resulted in somewhat weaker relationships between actual and predicted performance ($R^2=0.37$, 0.46 and 0.46 for feed intake, LWG and feed efficiency, respectively). It is, therefore, concluded that while strong prediction equations have been developed using birds housed under commercial conditions, these equations could be further strengthened using additional samples.

What outputs has the project delivered?

Overall conclusions:

1. Specific weight is not a good predictor of wheat chemical composition.
2. There was no relationship between specific weight and broiler performance.
3. Formulating diets from different wheat samples resulted in variable performance across all trials. This highlights the need for an accurate predictor of wheat quality.
4. Supplementary enzyme improved the feeding quality of diets based on wheat samples with lower specific weight and soft endosperms.
5. Wheat with a higher moisture content at harvest resulted on better bird performance – perhaps due to the beneficial effects of limited sprouting or the subsequent drying process. More research is required in this area.
6. NIRS has the potential to predict wheat microdochium content but the errors associated with the prediction are high. A larger dataset is needed to develop the equations. Given the relationship between microdochium content and broiler performance, this is an area which should be further explored.

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7. Strong NIRS prediction equations were developed using data from birds kept at AFBI under commercial conditions. These equations can accurately predict how birds will perform when offered a diet-based on a particular wheat.
8. Using the prediction equations to compare actual and predicted performance under different commercial conditions within Moy Park resulted in a somewhat weaker but still acceptable relationship. The prediction equations should be further strengthened using additional samples and could then be made commercially available.

Who will benefit from this project and why?

1. **The broiler industry.** It has been estimated that the lack of knowledge on wheat nutritive value represents a cost to the Northern Ireland industry of two million pound per annum. The development of a tool to predict broiler performance when offered a specific wheat-based diet will reduce this loss and improve profitability. If the use of this tool reduces the cost associated with wheat variability by one million per annum the return on investment will be 2:1 per annum for the broiler industry.
2. **The environment.** Incorrect assumptions relating to the nutritive value (i.e. specifically energy and protein content) of wheat leads to incorrect ration formulation which may adversely affect the environment. If a ration contains excess energy, fat is deposited and carcass and meat quality deteriorate. However, if a ration contains excess protein then energy must be expended to deaminate and excrete the excess nitrogen – this represents a cost both in terms of diet production and environmental emissions. The findings from this project will improve the accuracy of ration formulation.

If the challenge has not been specifically met, state why and how this could be overcome

The NIRS relationship between actual and predicted broiler performance on the commercial trial conducted at Moy Park was weaker than when all three trials were included in the equations. This is reflective of the fact that the birds were housed under completely commercial conditions and that data from additional wheat samples is required to strengthen the equations prior to being made commercially available.

Lead partner	Elizabeth Ball, Agri-Food and Biosciences Institute
Scientific partners	Harper Adams University
Industry partners	Aunir and Moy Park Ltd.
Government sponsor	Department of Agriculture and Rural Development for Northern Ireland

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