Final Report

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Prepared by: Natalie Morgan

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Dissemination and enhancement of an NSP database for feed formulation

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In submitting this report, the researcher has agreed to Poultry Hub Australia publishing this material in an edited form.

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Project Summary

Project Title	Dissemination and enhancement of an NSP database for feed formulation
Project No.	17 - 002
Date	Start: 13th July 2017 End: 13th July 2018
Project Leader(s)	Natalie Morgan
Organisation	University of New England
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Project Aim	The aim of this project was to convert an Excel file database containing soluble, insoluble and free oligosaccharide values for feed ingredients fed to poultry into an interactive only database at UNE.
Background	A non-starch polysaccharide (NSP) database was previously developed at the University of New England. This database contained soluble, insoluble and oligosaccharide contents of approximately 1000 feed ingredient samples from Australia. This database was on Excel, which meant it was not accessible for poultry nutritionists.
Research Outcome	Non-starch polysaccharides (NSP) are present in all feed ingredient fed to poultry. These NSP have a negative impact on bird nutrient utilisation by reducing ability of nutrients to be absorbed through the gastrointestinal tract wall, through increasing digesta viscosity and acting as a physical barrier. It is therefore important for poultry nutritionists to be aware of the quantity and structure of the NSP in poultry diets, and include ingredient NSP values during feed formulation. To aid with this, an online non-starch polysaccharide (NSP) database was developed for nutritionists. This database can be accessed on https://my.une.edu.au/nspdb. Users set up an account on this platform; account access is verified by Poultry Hub and Australian Pork. Within the database there is the option to a) select an ingredient and obtain the average soluble and insoluble NSP composition b) compare the soluble and insoluble NSP values between two feed ingredients, and c) enter ingredient level values within a diet and obtain the average soluble and insoluble NSP composition for the diet. This enables users to predict NSP composition of diets during feed formulation.
Impacts and Outcomes	The NSP database is used by commercial poultry nutritionists, including those at Inghams, Baiada and Turosi, when formulating poultry diets. This tool allows users to predict the NSP composition of diets during feed formulation, and make informed decisions about the potential effects of these NSP on bird performance and litter quality. This could result in implementation of different enzyme strategies or modifications to formulations.
Publications	The online database is available at https://my.une.edu.au/nspdb. Oral presentations at Poultry Hub Ideas Exchange 2017, Australian Poultry Science Symposium 2018 and RCI Monogastric Nutrition Information Exchange 2016. Poster presentation at Poultry Information Exchange

	2018. Articles in PoultryHub Australia Echook News, Poultry Digest and Pork Digest.

Executive Summary

Non-starch polysaccharides (NSP) refers to a wide variety of polysaccharide molecules of feed ingredient cell walls with varying degrees of water solubility, size and structure. Their functions and chemical structure are defined by whether they are water soluble or insoluble. The amount of soluble and insoluble NSP varies greatly between different ingredients; for example, corn and sorghum contain very low levels of NSP but wheat, rye and triticale contain high amounts of both soluble and insoluble NSP. The structure and physiochemical characteristics of the NSP also differ widely between ingredients, and there is a great deal of variation within the same ingredient due to variety and geographical location; for example the NSP content of soyabeans varies from 20-30% (Jankowski *et al*., 2009). Knowledge of the soluble and insoluble NSP of feed ingredients is required to predict the effects of dietary fibre on nutrient and energy digestibility. Commercial poultry nutritionists have largely either not considered dietary fibre during feed formulation, or have been relying on inaccurate crude fibre, neutral detergent fibre and acid detergent fibre values. The issue with these values is that the methods used are unable to extrude all the carbohydrate fractions in a feedstuff, so do not represent all the fibre available to the bird.

To combat this issue, an NSP database was produced at the University of New England (UNE) by Dr Morgan. The soluble, insoluble and oligosaccharide contents of approximately 1000 feed ingredient samples, both conventional and unconventional, from Australia were collated into this database, based on values measured at UNE or presented in literature. The database presents the average, range and sugar composition of the soluble, insoluble and total NSP and oligosaccharide contents of the ingredients. This database was produced on Excel. In this project, this Excel database was transformed into an interactive online database. The link to access the online database is https://my.une.edu.au/nspdb. Users are required to register an account, specifying if they work in poultry, pigs or both. The database can be accessed worldwide, and Poultry Hub and Australian Pork grant approval of users. Additional samples were also analysed and added to the database.

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Introduction

Fibre is a highly variable and complex component of plant-based feed ingredients and is perhaps the most poorly understood constituent of monogastric diets. Despite increased understanding and developments in carbohydrate research, commercial nutritionists still use inaccurate crude fibre, and occasionally neutral detergent fibre and acid detergent fibre values, as a measure of fibre composition of a diet. The analytical methods used to characterise these fibre values do not adequately relate to fibre utilisation in the animal, as they are unable to extrude all the carbohydrate fractions in a feedstuff (Kim *et al*., 2005). It is imperative for future efficiency gain, and hence viability of productive farms, that a more accurate system of estimating true fibre levels is used. This is possible by using soluble and insoluble NSP values during feed formulation, as measurements of NSP represent the total fibre fraction of feedstuffs (excluding lignin).

It is essential that cost-effective ways to meet poultry dietary needs is established, given high worldwide feed prices and increasing demand for food with increasing human population. In order to accomplish this, technologies, such as enzymes and processing techniques, need to be developed and evaluated that accurately determine and potentially improve the nutritional value of fibre and high fibre co-products. The success of this is dependent on ability to accurately predict true fibre levels in diets, and thus bird response to this fibre. Thus it is necessary to provide poultry nutritionists with accurate estimations of true fibre levels for formulations, by providing the soluble and insoluble NSP levels. It is important to include both, as soluble and insoluble NSP have differing properties. Insoluble NSP act as nutrient diluents and a physical barrier to enzymes, thereby reducing efficient digestion of nutrients within the cell wall matrix of grains. Soluble NSP increase digesta viscosity, thereby affecting nutrient digestion and absorption and reducing digesta transit time, and display anti-nutritive properties resulting in reduced ileal digestibility of nutrients. The online database produced in this project provides values for both the soluble and insoluble NSP concentration of feed ingredients. This will allow nutritionists to include ingredient NSP values during feed formulation. It also has a function to predict the total, soluble and insoluble NSP concentration of diets, based on the levels of the different feed ingredients.

Objectives

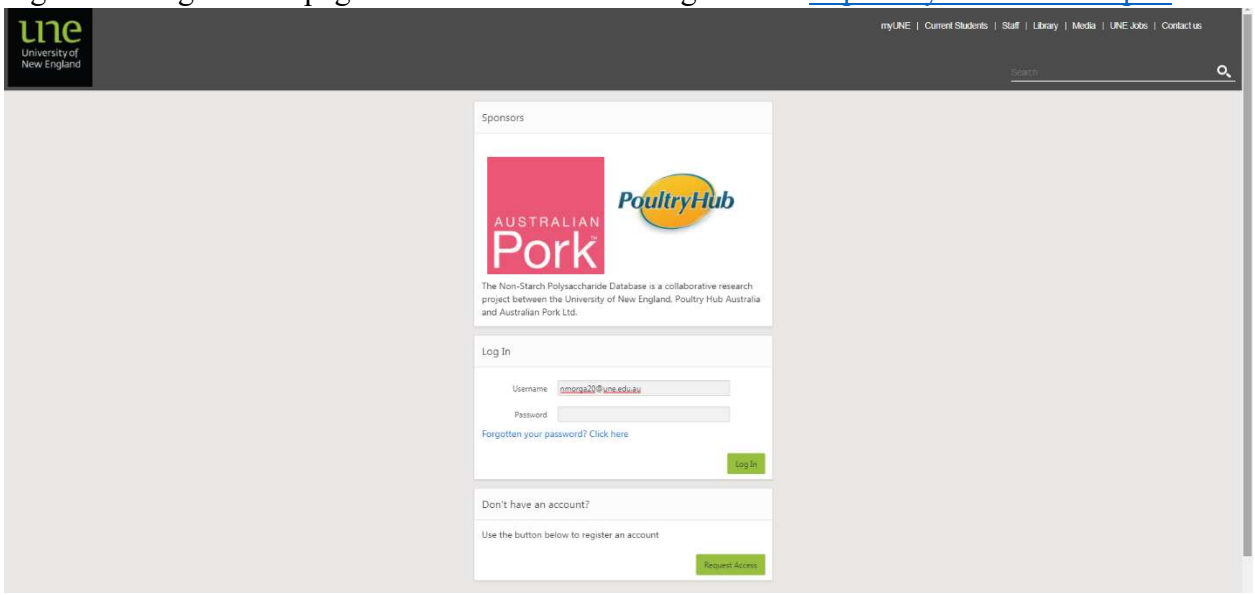
The aim of this project was to convert an Excel database containing soluble and insoluble NSP and free oligosaccharide values of feed ingredients into an online database, so that this information is accessible to registered users, such as poultry nutritionists. The objective was to provide functions in this database for both viewing the NSP composition of an ingredient, and for predicting NSP concentration in a complete diet.

Methodology

The non-starch polysaccharide data values from the Excel file were transformed into an interactive online database at UNE. The link to access the online database is https://my.une.edu.au/nspdb

Users are required to register an account, specifying if they work in poultry, pigs or both. Poultry Hub and Australian Pork to approve and manage these accounts. There is a counter in place that will allow Poultry Hub and Australian Pork to identify how many users there are accessing the database. Data on user email address, organisation and role can be accessed by the administrators.

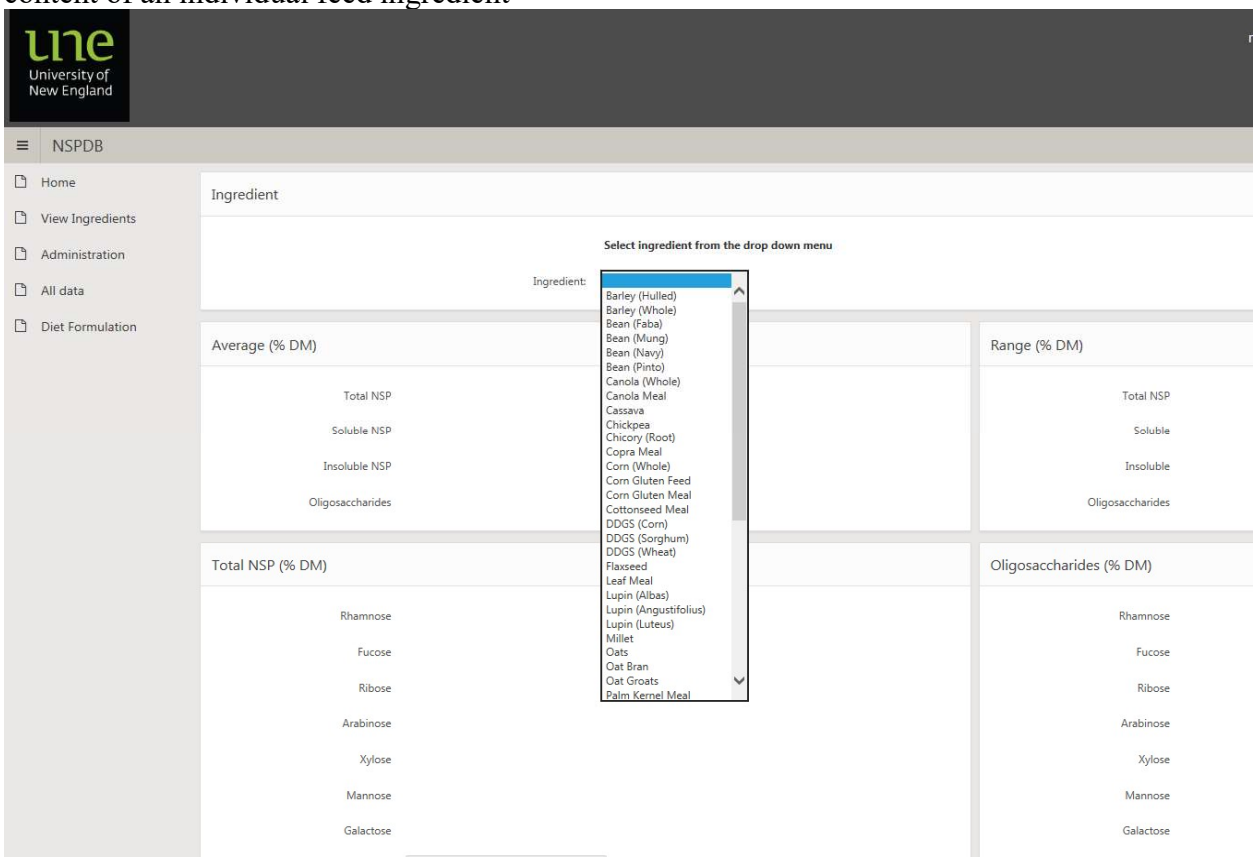
Figure 1: Image of webpage observed when accessing the link https://my.une.edu.au/nspdb



There are two key co components to the application; 'View Ingredients' and 'Diet Formulation'.

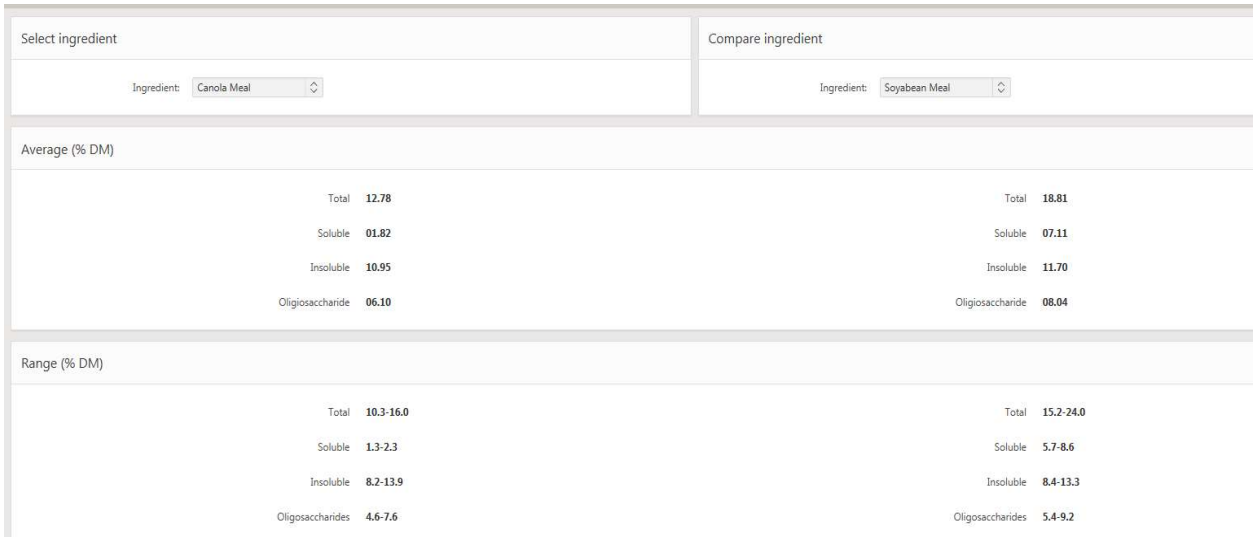
Firstly, users can select an ingredient and obtain information about the average and range of NSP content, along with the total NSP, soluble NSP, insoluble NSP and free oligosaccharide content and the sugars that make up these NSPs.

Figure 2: Image of webpage view when selecting to examine the non-starch polysaccharide content of an individual feed ingredient



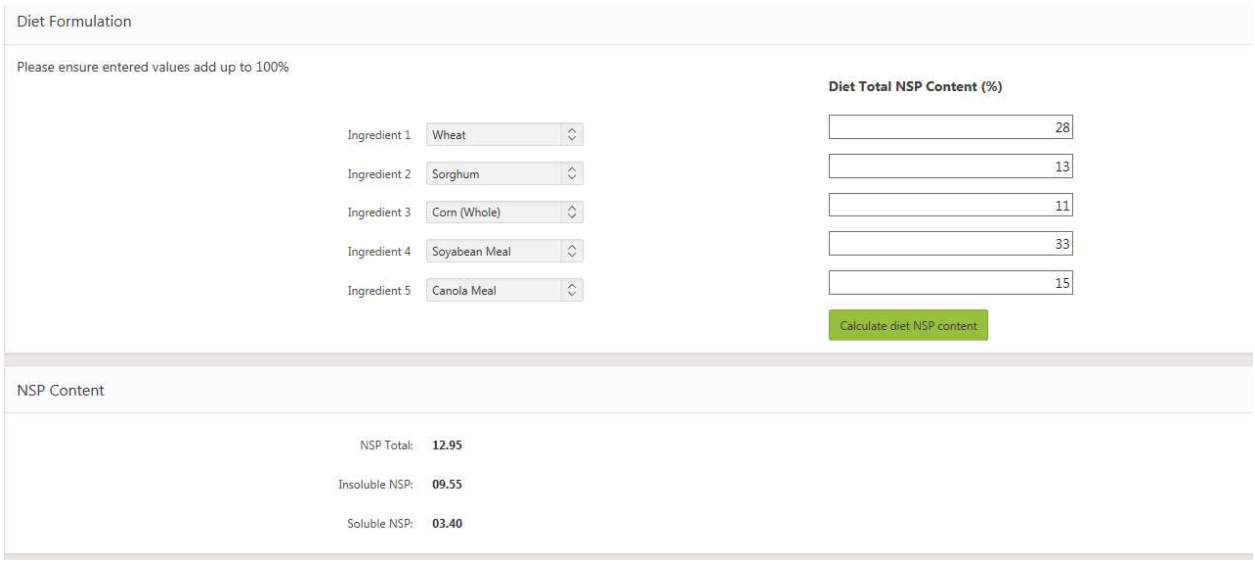
Users can also directly compare the NSP content of two ingredients, including the total, soluble and insoluble NSP and free oligosaccharide content.

Figure 3: Image of webpage view when selecting to compare the non-starch polysaccharide content between two individual feed ingredients



Secondly, users can evaluate the NSP content of their diets by selecting the ingredients and % level of these ingredients featuring in their diets, and the application calculates the predicted total, insoluble and soluble NSP content of the diet.

Figure 4: Image of webpage view when selecting to examine the non-starch polysaccharide content in a diet



Additional samples (n=90) were also collected from mills across Australia, and the soluble and insoluble NSP and free oligosaccharides were analysed and put into the database. This has been in conjunction with poultry feed producers in Australia, namely Ridley and Inghams.

Discussion of Results

The NSP database is being used by the industry; there is over 100 members, with new members joining constantly. Promotion of the importance of considering NSP in feed formulation and presence of the database is ongoing. Samples are continuing to be analysed and added to the database; this will be ongoing, to continually strengthen the database. Numerous researchers at UNE have been trained in the methodology and in adding values to the database. The same control sample is used in every batch of samples analysed, ensuring accuracy. The original database was produced in 2017, funded by Australian Pork Limited, containing 835 feed ingredient samples. The database contains only values from samples that have been analysed at UNE, or using the same method as that used at UNE, to ensure the values are comparable to each other.

Implications

The availability of this database will potentially have a positive economic impact, namely because increased knowledge on NSP will enable increased accuracy and flexibility in least-cost feed formulations and development of enzymes that can target specific polymers. It also increases the possibility of using unconventional ingredients, as provides their NSP values, enabling enzyme strategies to be applied.

Prior to this project there was no online database of NSP values; the NSP database was produced on Excel, and this project converted the Excel file into an online database that could be accessed externally. Making NSP values for these ingredients readily available may encourage increased use during feed formulation, which could result in more tailored use of NSP-degrading enzymes, thus increasing bird performance and reducing incidences of poor litter quality. This may be coupled with increased use of cheaper, more readily available feed ingredients, and increased accuracy when predicting nutrient and energy digestibility, having beneficial effects on feed efficiency.

Recommendations

Commercial nutritionist should use the NSP database values when formulating diets. This will allow for more accurate determination of nutrient contents of the diets and predictions of any issues that may occur due to the fibre content of the diet (i.e. excessively high soluble NSP inducing litter quality issues). The database is continually being updated when NSP values of feed ingredients are analysed at University of New England or become available online. Research in NSP utilisation by poultry is ongoing, drawing attention to the need to have a better understanding of dietary NSP contents, and the benefits of this database. Additional research is required, and promotion of the importance of NSP in poultry feed.

Media and Publications

- Poster about NSP database at Poultry Information Exchange 2018 ‘How much fibre is REALLY in your chickens’ diet?’
- Articles in PoultryHub Australia Echook News, Poultry Digest and Pork Digest: ‘Online nutrition database to reduce feed costs’
- Invited Speaker Poultry Hub Ideas Exchange 2017, Australia ‘Online Nutrition Tool: Non-Starch Polysaccharide Database’
- Oral Presentation at Australian Poultry Science Symposium 2018, Australia ‘Effects of dietary insoluble and soluble non-starch polysaccharides on performance and ileal and excreta moisture contents in broilers’, using the NSP database values
- Invited Speaker at RCI Monogastric Nutrition Information Exchange 2016, Australia. ‘Understanding NSPs in Australian grains’

References

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Kim, J.C., Simmins, P.H., Mullan, B.P. and Pluske, J.R. (2005). The effect of wheat phosphorus content and supplemental enzymes on digestibility and growth performance of weaner pigs. *Animal Feed Science and Technology* 118, p. 139-152.