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## THE DETERMINATION OF A NUTRITIONAL MATRIX BY MODELLING

“Including a phytogetic feed additive (PFA) in feed has shown effects on enhancing the performance of broilers and swine at all stages of the production cycle (Amad et al., 2013). A PFA can be formulated into the diet with nutritional matrix values, playing an essential role in the least cost formulation and sustainability of feed. The key is to make a trustable estimation of the nutritional matrix values of a PFA.”

### INTRODUCTION

One of the objectives of any poultry or swine producer is to feed the animals with balanced diets at the least cost. Feed constitutes the highest variable cost in poultry and swine production, accounting for at least 60% of such costs, especially in an intensive rearing system. The nutritionist's role is to work with the different tools available to deliver the best possible diet solution balancing cost and animal performance. Nutritional values have been established for some feed additives, allowing for cost savings when the additive is added to the diet, and its nutritional matrix is included in the feed optimization. However, the related research and data that supported the development of the matrix values are of utmost

importance to the nutritionist. The nutritional matrix values can be generated/validated in different ways. One is the traditional way, *in vivo* digestibility trials, an established and standard method for many years (Zhang and Adeola, 2017). Another option is the 'new' way, via mathematical modelling, providing matrix values based on previous performance trial results. Can mathematical modelling be as reliable as digestibility studies to generate and/or validate a feed additive nutritional matrix?

### THE FUNCTION OF A PHYTOGENIC FEED ADDITIVE

Including a phytogetic feed additive (PFA) in feed has shown effects on enhancing the performance of

broilers and swine at all stages of the production cycle (Amad *et al.*, 2013). There are several categories of PFAs, and all of them have a different effect on the animal, including essential oils, spices, bitter substances, and saponins. Essential oils can positively affect the secretion of digestive juices and nutrient absorption (Amad *et al.*, 2013). Spices and bitter substances have been shown to have an additional effect on an increased bile flow in the gut which is vital for fat digestion (Platel and Srinivasan, 2000; Srinivasan, 2005). Lastly, saponins may improve the gut wall's permeability, which will likely positively impact the absorption of nutrients and minerals (Reyer *et al.* 2017). Due to this, therefore, phytogenic will not likely improve the digestible fraction of the feed but may have the potential to target a better utilization of the non-digestible fraction. Thus, with these benefits, a PFA can be formulated into the diet with nutritional matrix values, playing an essential role in the least cost formulation and sustainability of feed. The key is to make a trustable estimation of the nutritional matrix values of a PFA.

### THE CLASSIC WAY, WITH DIGESTIBILITY TRIALS

For many years, feed additives, such as enzymes, have assigned nutritional matrix values. This nutritional value is then part of the entire diet's nutritional value, allowing for the reduction of the incorporation of some ingredients, such as those needed for energy (oil/ fat) and protein (soybean), and minerals (Bedford and Cowieson, 2020). In theory, as a result, this leads to a feed cost reduction while the animal maintains the same performance. This improves the poultry or swine producer's economy and returns on investment.

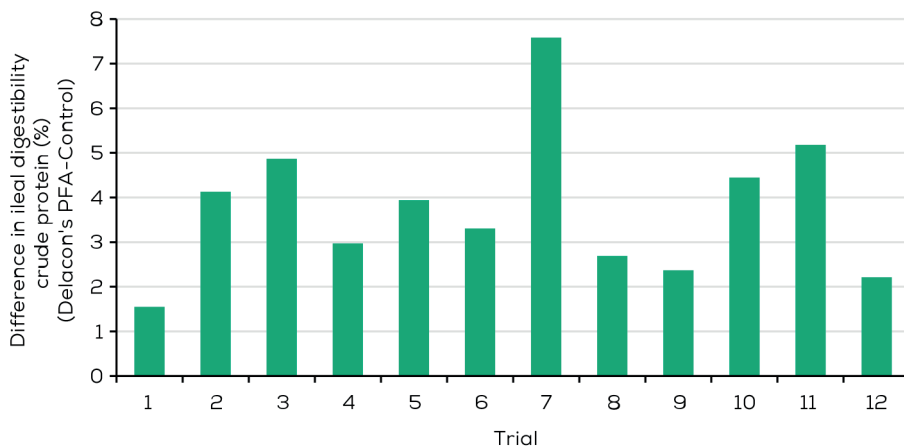
Before a nutritional matrix value can be reached for the additive, several methods are employed to confirm the matrix values (Bedford and Cowieson, 2020). One method is by using an *in vivo* digestibility study or several studies. Digestibility is currently the most widely used method for evaluating feedstuffs and diet formulation for different stages of poultry and the pigs' life (Zhang and Adeola 2017). Efforts have been made to improve these methods and

make them more applicable in practice and more accurate in assessments (Zhang and Adeola, 2017). The sampling time, site, and possible intake effects may all affect the outcomes/results of this type of trial (Bedford and Cowieson, 2020). Typically, these kinds of studies are conducted in research institutes. If an ileal collection is required, as in the instance of amino acid digestibility in poultry, this requires animal sacrifice or surgical Ileal cannulation, as for swine. This can lead to a considerable cost and low data replication to ensure the digestibility of the animal/ feed is correct.

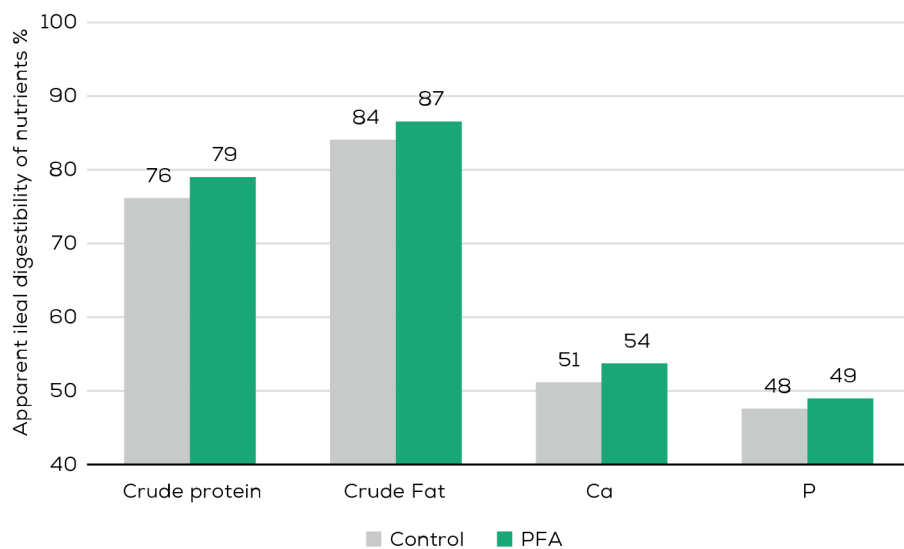
The analysis of 16 ileal nutrient digestibility studies in both broilers and layers fed corn/soy diets supplemented with Biostrong 510 demonstrated increased ileal digestibility of crude protein (CP), amino acids, fat, calcium, and phosphorus. The increase in CP digestibility from these trials is shown in Figure 1 (as the difference between CP digestibility of Delacon's PFA – CP digestibility Control). Delacon's Performizer solution is based on the results of these ileal nutrient digestibility studies, where the nutrient digestibility of the diet is measured and compared, allowing for a quantification of the feed efficiency generated when the phytogenic solution is added to a diet. Those nutrient digestibility enhancements from PFA are transposed to nutrient matrix values and then applied to the least-cost feed formulation.



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**Figure 1.** Differences in ileal digestibility crude protein PFA and Control in poultry (internal data)



**Figure 2:** PFA effect on the apparent ileal digestibility of nutrients, measured in pigs of 50 kg (internal data)

The same is also true for Delacon's Swine PFA – Aromex Pro. Several scientific and field trials have shown that adding Delacon's PFA into a growing and finishing diet improves performance, such as feed efficiency. Figure 2 shows how the ileal digestibility of nutrients can improve when the Delacon PFA is fed to pigs.

**THE NEW WAY, MATHEMATICAL MODELLING**

Based on previous performance trial results and diet formulations, mathematical modelling can be

used to validate the digestibility effects of a given feed additive used. A non-invasive method, like mathematical modelling, can be used to calculate digestibility (Moore-Colyer *et al.*, 2003). Furthermore, when considering all aspects of this method, a large amount of data from multiple performance trials can be used within the model - as you can use historical data to the present day. The model can account for diet nutritional content/values, age, breed, and trial length. Therefore, establishing a correlation between nutrient intake and the animal's performance and then applying that regression to the improved performance of the animals fed the PFA will provide a theoretical value for intake required for the improved performance result. This is the basis of the nutritional matrix value calculation.

Delacon undertook the 'mathematical modelling' technique to validate the digestibility and performance results observed from previous studies. The analysis included an impressive 81 broiler trials (from 2002 to 2022). Diet formulation, performance results, age, and breed were some of the critical inputs required for the model. The initial results seem to validate the already existing Performizer solution values obtained from the classic digestibility trials. The next step is to do the same validation in swine, and if similar results are achieved, this may be a promising approach to use in the future.

## CONCLUSION

Creating a dataset to support a phytogetic nutritional matrix is not without challenges. It is crucial to have a margin of safety and limit the risk of a performance decrease. Consequently, the larger the dataset, the greater the confidence in the conclusions generated. Digestibility trials were used to develop Delacon's Poultry and Swine Performizer solution. The Performizer solution was proven in a final experiment on the animals. There was no significant reduction in performance when matrix values were applied to the diet in combination with PFA, while feed cost was substantially lower.

This promising new tool – mathematical modelling - to validate and generate new nutritional matrix values for phytogetic feed additives has shown results as reliable as the classic digestibility trials. The advantages of this method are clear: a faster, non-invasive, and cheaper methodology.

**Note:** Matrix values of Delacon's PFA can be requested from Delacon technical team.

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### About Caroline Donaldson

Caroline graduated in Veterinary Science in 2008 and completed her Ph.D. in Laying hen behaviour and Welfare in 2012. Caroline has over 10 years of experience in the poultry industry, working as the Poultry Product Development Manager for a premix company. She gained valuable experience and knowledge in fundamental and applied research. She joined Delacon in 2021 as Global Solution Researcher and is responsible for the research application of internal and external trials.

### About Manu De Laet

Manu De Laet graduated in 2009 as a bio-engineer at the University of Leuven, Belgium. He has a master's degree in animal production. After earning valuable experience with phytoGENICS, Manu started working for Delacon as Global Technical Manager Poultry in September 2018. He is now specialized in nutrition and the effect of phytoGENICS on digestibility.

### About Sandra Chamusco

Sandra Chamusco has a degree in Animal Science from the University of Évora, Portugal. She has worked in the swine nutrition field for over 20 years, where she has held various positions as a feed formulator, customer advisor, technical manager, and operations manager. She joined Delacon as Species Leader Swine.