Reducing emissions from poultry production whilst improving profitability

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Recent years have seen an increasing interest from consumers regarding how food is produced, which is influencing how the animal production and feed industry is having to behave. Whilst originally this pressure was basically a request for improvement of animal welfare, more recently the environmental impact of food production has become more of a focus. The animal industry as a whole and nutritionists specifically should then look into how to improve broiler production not only from a performance perspective but also taking into account these new and less familiar parameters.

Specifically, regarding environmental impact, the metric most traditionally used is to calculate the emissions back to CO2 equivalent (CO_2e) using an accredited model based on IPCC standards. This is a clearly defined way where different emissions are corrected based on their pollutant factors to produce one single value. When assessing the emission of broiler production using an IPCC standard, we have observed that feed formulation represents around 75% of these emissions, reinforcing the key role that nutritionists can play in reducing emission from feed and consequently from the broiler production. As improvement of performance has always been part of the responsibility of nutritionists when formulating diets, this statement can be oversimplified as animals with better performance would logically obtain the target weight consuming less feed and consequently have lower environmental impact. But the fact is that animals with similar performance and costing can have wide differences in CO_2e/kg of meat and so such environmental impact need to be seen beyond simply performance and cost benefits but rather how to improve the usage of the nutrients presents in the diet. When you use the model to compare different feed treatments any effect on CO_2e is calculated from the combination of changes in feed composition and animal performance. As an example, a lower protein diet with less soybean meal inclusion most likely has a lower amount of CO_2e per tonne of feed, but if the animal performance is not as good then the CO_2e per kg of broiler produced may not be reduced. However, if equivalent performance can be achieved then the CO_2e per kg of broiler produced will be lower. At the same time it is also likely that the diet cost has reduced, giving a win-win situation.

One specific example of this is through the use of enzymes in feed formulation. Enzymes have long been recognised as ways to reduce environmental impact, improve animal performance and reduce feed cost, but most of this was through an on over the top use or minimal use of matrix values.

When utilising the full matrix for enzymes it typically results in lower levels of soybean meal in the diet and thus the environmental footprint of broiler production can be substantially reduced, provided animal performance is equivalent. However, most nutritionists are reluctant to use the full matrix values supplied by additive suppliers, often applying substantial 'safety' margins. Additionally it is clear that whilst a matrix value for one additive may be 100% correct, it doesn't mean that one could apply such a matrix in diets where more than one additive is in use: The additive matrix values are not additive! This is because the first additive in use improves nutrient utilisation, which then leaves less room for improvement for the second additive and so on. A typical approach to this dilemma is to use 80% of the combined matrix values of a combination of additives, for instance when calculating with both phytase and xylanase in a diet. Today, phytases and carbohydrases are widely accepted in poultry nutrition but, despite this, the way in which feed enzymes are applied to diets remains conservative. Historically, this has been based on a limited understanding of the level and nutritional influences of enzyme substrates and of the changes enzymes can bring about to animal metabolism and physiology. In recent times our understanding in each of these areas has progressed, opening up new opportunities to exploit the full potential of feed enzyme application. The concept of using the full recommended nutrient release values like this has been called Maximum Matrix Nutrition or MMN.

This strategy capitalises on the properties of Quantum Blue, an enhanced *E. coli* phytase with a high affinity for phytate resulting in maximum reduction of the negative effects of phytate. Combining this with a stimbiotic product containing a thermostable and inhibitor-resistant xylanase as well as fermentable xylo-oligosaccharides (Signis) enables customers to take higher dietary nutrient contributions whilst maintaining animal performance, enabling considerable cost savings and a reduction in the excretion of nutrients.

Extensive research has been conducted to determine the effect of targeted enzyme application to degrade both phytate and NSP, reducing the antinutritive effects of both substrates. These risks can be mitigated in a precision enzyme combination strategy which delivers complete phytate breakdown whilst reducing viscosity and increasing fibre fermentability. Lee et al. (2018) and Aftab & Bedford (2018) published two studies demonstrating that there are important systemic effects when using higher doses of phytase and xylanase, aiming a strong action on both substrates (phytate and NSP), reducing the deleterious effects of these antinutritional factors, resulting in a great cost saving opportunity of formulation with maintenance of zootechnical performance

At the European Symposium on Poultry Nutrition in Gdansk in 2019 a trial was presented to test whether this approach is valid. In this broiler trial a control diet (PC) was formulated to normal nutrient levels utilising the expected nutrient release of a standard 500 FTU/kg dose

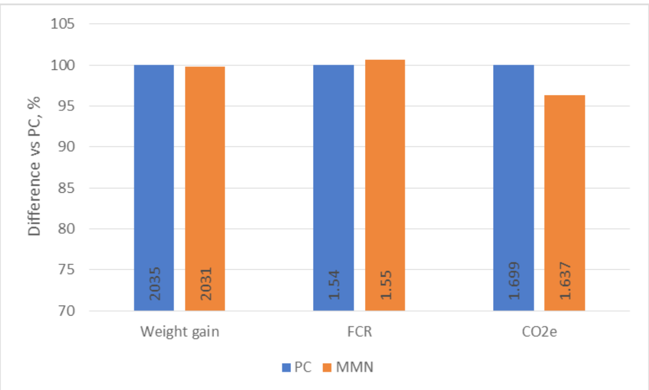
Table 1: Diet Formulations

	Starter (1-13d)		Grower (14-24d)		Finisher (25-42d)	
	PC	MMN	PC	MMN	PC	MMN
Wheat	498.72	540.93	608.04	652.43	684.45	733.05
Maize (corn)	100.00	100.00	50.00	50.00		
Rapeseed (Canola), cold pressed	40.00	40.00	40.00	40.00	50.00	50.00
Soybean Meal 48.5%CP	299.85	281.80	243.21	224.69	201.12	181.67
Soya oil	23.78	3.48	26.36	4.37	26.75	1.40
Fat Lard	5.00	5.00	5.00	5.00	15.00	15.00
Limestone	10.61	10.11	9.32	8.83	7.85	7.29
Monocal phosphate; HCL	6.97	3.85	5.02	1.90	2.98	
Salt	1.90	1.46	1.33	0.89	0.95	0.50
Sodium bicarbonate	1.00	1.00	1.00	1.00	1.00	1.00
Lysine HCl	2.06	2.03	2.33	2.31	2.59	2.58
DL Methionine	1.90	1.79	1.66	1.55	1.46	1.34
L Threonine					0.05	0.05
Coccidiostat						
Quantum Blue 5G	0.10	0.30	0.10	0.30	0.10	0.30
Signis		0.06		0.06		0.06
Premix (including coccidiostat)	8.13	8.19	6.63	6.69	5.70	5.76
Diet cost (€/ton)	264.88	253.24	252.66	240.04	248.24	233.74
Diet cost saving		11.64		12.62		14.50

of phytase (Quantum Blue). A second diet was formulated to contain 1500 FTU/kg of phytase as well as a stimbiotic product (xylanase (9600 BXU/kg) combined with fermentable xylo-oligosaccharides (Signis)). For this diet (MMN) the calculated nutrient release of the combined package was slightly higher than the normally recommended levels to ensure the outcome would be valid even considering safety margins. As can be seen in Table 1 the MMN diet was substantially lower in monocalcium phosphate, soybean meal and fat (soy oil) due to the implementation of the combined matrix values. There was also a substantial cost reduction, although of course the actual cost reduction will very much depend on market conditions.

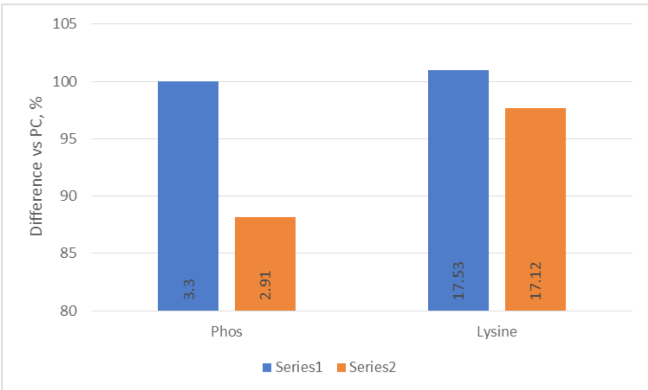
The results, shown in Figure 1, show that performance for the two groups was very similar, with no differences in weight gain, feed intake or feed conversion. But calculation of the CO_2e showed a clear difference in favour of the MMN group. There was a 3.6% reduction in CO_2e which was statistically significant.

Figure 1. Effect of using Maximum matrix nutrition strategy in broilers performance and CO2e up to 34 days of age



Another way to look at efficiency is to calculate the amount of phosphorus (P) or protein (as indicated by lysine) is needed to produce each broiler. This data (shown in Figure 2) clearly shows a substantial reduction (12% less P and 3 % less lysine) in the resources needed to produce broiler chicken.

Figure 2. Effect of using Maximum matrix nutrition strategy in P and Lysine utilisation on broilers up to 34 days of age



The data shows that if feed additives such as enzymes are used whilst taking nutrient release values into account it is possible to achieve significant reductions in CO_2e figures at the same time as lower feed cost and maintaining animal performance.