

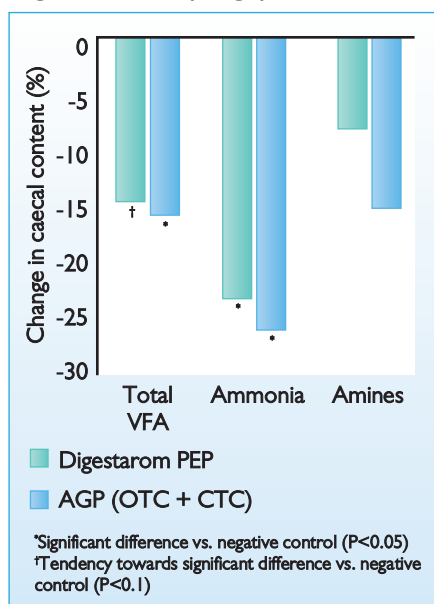
A holistic view on the use of phytogenic feed additives

by Inês Rodrigues, technical manager, Biomin Singapore Pte Ltd, Singapore.

Around the globe, the use of plant and plant derived substances is highly generalised and well accepted, being in aromatherapy massages or in the very popular Traditional Chinese Medicine (TCM). Although some people still find themselves sceptical about the beneficial effects of the usage of these ingredients in animal feeds, first written records of the use of plants for medicinal purposes can be traced back to the year 2,600 BC in Mesopotamia.

However, a change in attitude is yet to be achieved as the focus of the use of phyto-based products should emphasise, as does TCM, on a holistic approach, thus focusing on the analysis of the entire body functions, performance and health rather than on focusing on disease treatment.

Fig. 1. Results of a scientific trial conducted at the National Chiayi University in Taiwan. 80 birds/treatment (20 birds/replicate; four replications/treatment). Three treatment groups as follows: Negative control; Positive control (OTC 50ppm and CTC 50ppm); Digestarom PEP (125g/t).



Treatment	NE challenge	Lesion score	Mortality (%)	Log ₁₀ CP/g
Experiment 1				
Negative control	-	0.29 ^c	8	1.00 ^b
Positive control	+	1.33 ^a	26	3.42 ^a
Digestarom PEP	+	0.58 ^c	8	2.16 ^{ab}
Experiment 2				
Negative control	-	0.32 ^c	8	1.57 ^c
Positive control	+	1.28 ^a	27	4.79 ^a
Digestarom PEP	+	0.96 ^a	20	3.69 ^b
Experiment 3				
Negative control	-	0.30 ^c	6	0.63 ^c
Positive control	+	2.15 ^a	22	4.96 ^a
Digestarom PEP	+	1.20 ^b	17	2.87 ^b

^{ab} P<0.05

Table 1. Results of three trials conducted at USDA, Food and Feed Safety Research Unit, USA. 50 birds/treatment in a total of three treatments, as follows: Negative control; Positive Control (*C. perfringens* at 1.5ml of 10⁷ CFU/mL); Trial Group (*C. perfringens* at 1.5ml of 10⁷ CFU/mL + Digestarom PEP (125g/t)).

When one tries to read and analyse the multitude of scientific reports written about the topic, the major challenge is to understand which of the phytogenics' properties – flavouring, antioxidant, antifungal, antiviral, antibacterial, antidepressant, immune modulating and physiological, amongst others, is responsible for their performance-enhancing effect in animals.

Moreover, the fact that most of these reports are written with basis on data generated by the use of specific commercially available blends of ingredients rather than on single active substances makes it difficult to ascertain which exact component is responsible for which effect.

Gut microflora modulation

Comparisons and conclusions are only possible if trials are performed with the same blend of ingredients, thus, this article summarises information gathered by different trials performed in poultry which show the effects of Biomin's specific product line of phytogenics – Digestarom PEP – at different levels.

The well known antimicrobial mode of action of botanicals is considered to arise

mainly from the potential of the hydrophobic essential oils to intrude into the bacterial cell membrane, to disintegrate membrane structures and cause ion leakage.

Modulation of microbial activity is of great relevance. It reduces pathogenic microbial pressure in the gastro-intestinal tract thus limiting the competition between the animal and the microbes for nutrients. In turn, production of digestion by-products, such as ammonia, is reduced.

Besides its great negative impact on the environment, ammonia is considered the most harmful gas in broiler chicken housing as it irritates respiratory airways and predisposes chickens to respiratory infections, causes keratoconjunctivitis and reduces bacterial clearance from lungs.

Likewise, endogenous biogenic amines, known to decarboxylate limiting essential amino acids thus rendering them unavailable for growth and performance, are not desirable digestion by-products. Similarly to the results obtained in piglets the use of Digestarom PEP in poultry reduced total VFA, amines and ammonia were reduced in relation to an antibiotic growth promoter (AGP)-supplemented group (Fig. 1). Such results were accompanied by a statistically

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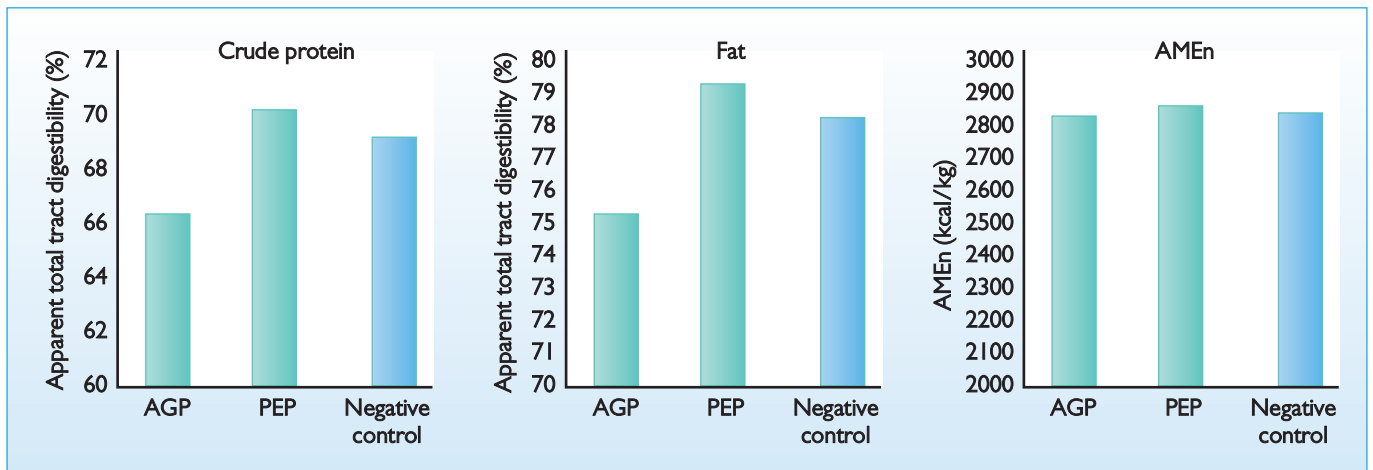


Fig. 2. Results of a trial conducted at UNIOESTE University in Brazil. 384 birds/treatment (24 broilers/replicate; 16 replicates/ treatment) three treatment groups as follows: AGP (Enramycin 10ppm + Salinomycin 125ppm); Digestarom PEP (125g/t); Negative control.

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 significant ($P < 0.05$) reduction of the FCR in comparison with both the negative control (-11 points) and the group (-9 points) (data not shown). Other tests further confirm the anti-microbial effect of the product against specific bacterial oral challenges. Besides greatly reducing the mortality of birds, intestinal clostridia levels and intestinal lesion scores were significantly lowered by the supplementation of the phytogenic product in *Clostridium perfringens* challenged broilers (Table 1).

Specific impact of phytogenics

There is evidence that phytogenic feed additives may favourably affect gut functions (optimise passage rate of ingesta, activity of digestive enzymes and nutrient absorption).

Preliminary results generated from a research project with an acknowledgeable European research institute show that Biomin's phytogenic product line improved maltase, sucrase and amino peptidase activity by 27, 26 and 27%, respectively, in comparison with the non-supplemented group (scientific report to be released soon).

These enzymes have important roles both in carbohydrate and protein digestion.

Growth promoting efficacy

Following the ban of antimicrobials as growth promoters in animal diets Kroismayr et al. tested Digestarom PEP in piglet diets as a potential antibiotic growth promoters (AGP) replacement. His findings on improvement in apparent digestibility of organic matter and crude protein were later confirmed in poultry diets (Fig. 2).

Phytogenics performed better than the

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mixture of the two synthetic antimicrobials improving final body weight and FCR of birds (data not shown).

Effects on gut morphology

Changes in gut morphology may be especially important when animals are challenged with very costly diseases such as coccidiosis and/or necrotic enteritis. Typically, infected enterocytes turn over more quickly and therefore are not able to fully differentiate, a fact that severely impairs digestive enzyme secretion thus reducing digestibility of nutrients and rendering animals more susceptible to osmotic and secretory diarrhoea.

Biomin's phytogetic product line increased villus length: crypt depth ratio in broilers challenged with Paracox-5 vaccine (Fig. 3).

Concomitantly, the number of goblet cells was significantly increased ($P < 0.05$) (data not shown). These factors are proof of the increased absorptive surface and of the improved protection of the gut provided by Digestarom PEP both reflected on the higher final body weight and on the improved FCR of supplemented animals.

There is a lack of knowledge on the exact mechanism of AGP. Most arguments point toward an anti-inflammatory role of AGP, which reduces energy waste and spares energy for production. Based on this, effective alternatives for AGP should share simi-

Fig. 3. Results of a trial conducted at Biomin's R&D station in Austria. 165 birds/treatment (32 broilers/replicate; 8 replicates/treatment). Birds orally challenged with Paracos-5 vaccine. 2 treatment groups, as follows; Challenged group; Challenge + Digestarom PEP supplementation.

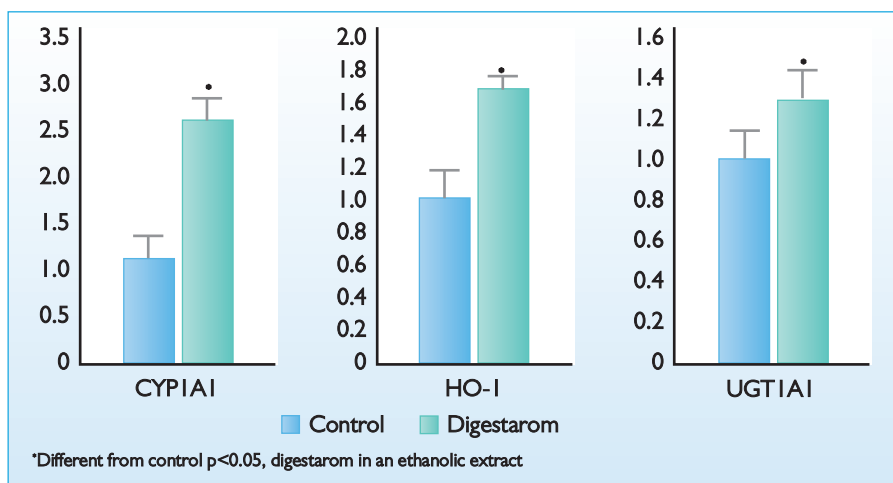
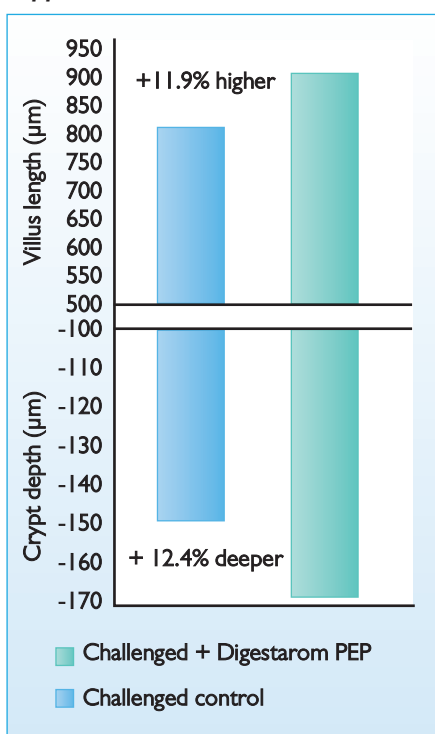


Fig. 5. Results of in vitro scientific studies at Giessen University, Germany. The Nrf2-Keap system, one of the major cellular defence mechanisms against oxidative and xenobiotic stresses, was studied.

lar properties. The impact of Digestarom Product Line components on intestinal epithelial cells was investigated by challenging them in vitro with TNF (Tumor necrosis factor), a cytokine involved in systemic inflammation.

Results showed a down regulation of intercellular adhesion molecule-1 (ICAM-1), interleukin-8 (IL-8), and monocyte chemoattractant protein-1 (MCP-1), all circulating inflammatory mediators (Fig. 4).

Conversely, Digestarom up-regulated anti-inflammatory Cytochrome P450 1A1 (CYP1A1), Heme oxygenase 1 (HO-1), uridine diphosphate glucuronosyltransferase (UGT1A1), all target genes in intestinal cells involved in cell protection (Fig. 5).

Further considerations for the use of phyto-genics include nutrient sparing effects, increase of total antioxidant capacity of meat and increase juiciness of meat as per sensory quality panel evaluation (data available but not shown).

The first is an interesting possibility either for feed mills wanting to manage their costs by down-specifying their diets or for producers who would like to increase the animal's final weight while maintaining the formulation. The latter ones will reflect on a longer shelf life of meat originating from supplemented birds and on better acceptance of the final product by customers.

Conclusions

Giving a definite answer on the exact mode of action of phyto-genics in animals is probably as difficult as replying to the famous, still unanswered question, "which came first, the chicken or the egg?"

Nonetheless, one cannot dismiss the variety of data available showing very positive impacts of carefully selected and blended phyto-genic components on animal performance and health.

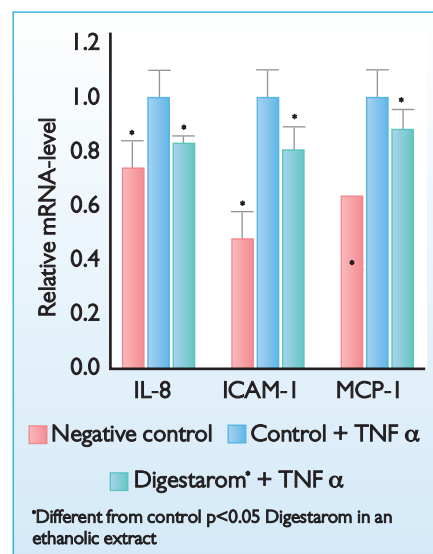
As basic needs of the world population are met, consumers will become more focused on the quality of products they ingest.

Products providing similar results to antibiotic growth promoters in terms of performance – without their acknowledged negative impacts on bacterial resistance – will be imperative for a sustainable production.

Digestarom Product Line has proven to achieve and even to exceed AGP results with regard to animal performance.

Complementary to that, the combination of plant-derived substances brings extra beneficial parameters which certainly cannot be obtained with the use of synthetic substances. Finally, if you dare to think holistically, make sure you choose a product which is fully backed up with sound technical information and which obeys proper quality control standards. ■

Fig. 4. Results of in vitro scientific studies at Giessen University, Germany. Caco-2 intestinal epithelial cells were challenged with TNF α and the expression of the different pro-inflammatory mediators was studied.



Full data regarding individual trials mentioned through the article are available upon request.