Synergy between phytogenics and butyric acid in poultry production

Antibiotic-free (ABF) poultry production is becoming more and more the global standard, where the prophylactic use of in-feed antibiotics is banned either from a legal perspective or because of consumer demands. In ABF broiler production, antibiotics can only be used based on prescription by a veterinarian to cure bacterial diseases in birds.

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Although treated broilers cannot be delivered as 'raised without antibiotics', treatment of sick birds is essential from animal welfare perspectives and necessary from a viewpoint of good management practices. The main reasons for treatments are intestinal or respiratory diseases, first week mortality and bone disorders.

ABF broiler production has stressed the need to improve resilience of birds against bacterial, viral and parasitic infections. Resilience can be improved by nutrition, management and breeding.

During the last two decades, phytogenics (like plant extracts, herbs and spices) have received a lot of attention in feed additives for poultry, based on their multiple modes of action (see 'phytogenics and the intestinal barrier function').

Based on the desired effects and intended applications, different blends are available of pure phytogenic components or combinations with other non-phytogenic ingredients, like short and medium chain fatty acids.

Where high dietary inclusion levels of phytogenics are needed to control growth of potential pathogens in the intestinal tract, the addition of fatty acids can stimulate the antibacterial effects of phytogenic feed additives, based on synergistic modes of action, resulting in a more robust alternative for in-feed antibiotics in different phases of life, such as drinking water supplements during the first week of life or improving resilience against dysbacteriosis in the third or fourth week.

Phytogenics and the intestinal barrier function

Phytogenic products have been shown to affect intestinal health in multiple ways:

- They reduce bacterial pathogenicity via quorum sensing inhibition, resulting in less toxin production, less adhesion factors and/or biofilm formation reducing colonisation, or in synergy with organic acids promote direct antibacterial effects.

- They increase the production of antioxidant enzymes, or capture oxygen radicals in case of polyphenolic essential oils. These antioxidant effects will generally result in a lower turnover rate of enterocytes, stimulating cell differentiation, improve tight junction integrity and brush border enzyme activity

- They stimulate humoral immunity, phagocytic activity of macrophages and reduce local inflammations.

These different modes of action are partly supported by butyric acid, which is a main energy source for enterocytes, stimulating their differentiation and functionalities.

The value of fat coating of butyric acid and essential oils

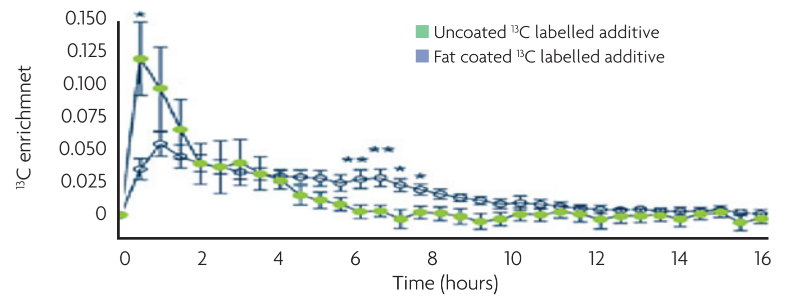
Van den Borne et al. (2015) demonstrated the efficacy of fat coating for targeted release of butyric acid in broilers. They compared the rate of oxidation of ^{13}C labelled butyric acid as such or after fat coating, based on ^{13}C enrichment or expiration air (Fig. 1).

Based on the assumption that butyric acid is efficiently oxidised after absorption, ^{13}C enrichment of expiration air is a good indicator for the rate of absorption of butyrate by the enterocytes.

Fat coating clearly delayed and flattened the $^{13}CO_2$ peak, demonstrating that the fat coated butyric acid was still available for absorption even 8-10 hours after feeding.

This clearly showed that fat coated butyric acid reached the hind gut and it is fair to assume that other fat soluble components, like essential oils, would also follow the same absorption pattern, when they are part of the same coated blend.

Fig. 1. The rate of oxidation of ^{13}C labelled butyric acid fat in the intestinal tract of broilers, when fed as such or after fat coating (reproduced from Van den Borne et al., 2015). The X-axes indicates time after feeding and the Y-axes ^{13}C enrichment of expiration air.



Synergy between essential oils and short chain fatty acids

The synergy between fatty acids and essential oils on their antibacterial activity is well-accepted. Based on their pKa value, short chain organic acids can pass the bacterial cell wall, acidifying the bacterial cytoplasm, resulting in bacterial ATP depletion as it has to maintain the optimum internal pH, eventually resulting in cell death. Essential oils increase the bacterial cell wall permeability for organic acids,

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enhancing the antibacterial effects of the latter.

ElanPlus C4

ElanPlus C4 is a blend of essential oils from oregano, cinnamon, garlic and star anise, combined with calcium butyrate, that fully utilises the synergy between essential oils and butyrate. Both essential oils and calcium butyrate are matrix encapsulated so the active components are released throughout passage through the small intestine.

Without such coating, these fat soluble bio-active components are absorbed very efficiently, and will not even reach the lower intestinal segments. Therefore, the coating technology is as important as the final blend of essential oils and organic acids to determine their in vivo efficacy.

The efficacy of ElanPlus C4 has been tested in broilers, housed in small floor pens, located in the middle of a commercial farm. This way, efficacy is tested under practical circumstances, without additional challenges that generally overestimate the efficacy of feed additives. The results are shown in Table 1.

Fig. 2 shows that the efficacy increases with age. During the starter phase body weight gain was enhanced by 2.6%, whereas the effect of ElanPlus C4 was increased to 5.9% in the finishing phase.

The latter might, at least partly, be related to the absence of ionophores in the finisher diet. This would probably stimulate the positive effects of feed additives that control the growth of the intestinal microbiota, compared to the negative control. ■

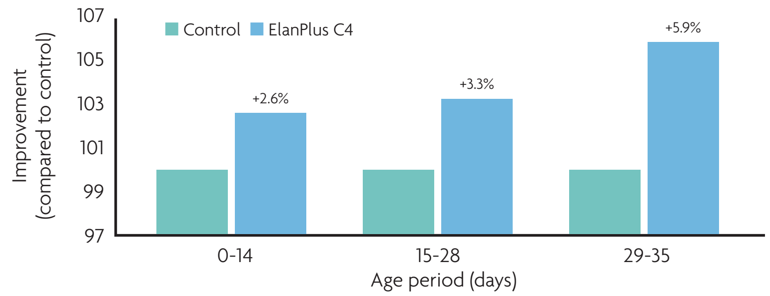

Fig. 2. Efficacy in each phase.

Table 1. The effect of ElanPlus C4 on production performance of broilers under commercial circumstances.

	Control	ElanPlus C4	Difference	P-Value
Final body weight (g)	2071	2149	+78g	‹0.05
FCR 0-35 days	1.427	1.417	-1.0 pt	0.10
FCRc*	1.433	1.407	-2.6 pt	‹0.05
Daily gain 0-35 days (g)	58.1	60.4	+4.0%	‹0.05

*FCRc, corrected to the average body weight of 2,100 g (correction 0.02 points FCR/100 g bodyweight)