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'Stimbiotics' may be new approach to beneficial fiber fermentation

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ANTIBIOTIC growth promoters have been utilized successfully in the past to control gut dysbiosis (Dibner and Richards, 2005). However, reliance on their use in livestock production globally is being reduced dramatically.

This shift in production practice is increasing the incidence of health-related challenges in animal production, as highlighted in a recent survey by Roembke (2019).

In a commercial situation, there is always a low level of inflammation in the gut (Ducatelle et al., 2019), and that's even more true without the use of antimicrobials. Today, nutritionists are evaluating all possible avenues to maintain a good gut environment and microbiota.

One important dietary component that requires particular consideration is dietary fiber, since it is the main substrate available for bacteria in the hindgut to ferment and thrive upon, so in effect, it is the banquet for beneficial bacteria. Recent findings in relation to how nutritionists can steer the microbiome to better utilize fiber will be summarized throughout this article.

Carbohydrases as tools

Carbohydrase enzymes are often used in pig and poultry diets, but until recently, they were just considered digestion aids, and the associated health-related benefits were overlooked. Most likely, the confusion was due to the belief that carbohydrases directly disrupt the cage effect of the cell wall, which is now believed to not be the case (*Feedstuffs*, Sept. 2).

It would take several enzymes to disrupt the cell wall, which was shown to be lacking in scientific support, as highlighted by Bedford (2018a) and also discussed in a recent article (*Feedstuffs*, Sept. 30). These concepts led us to believe that carbohydrases were only responsible for releasing entrapped nutrients, but more recently, it has been shown that one of the main mechanisms by which xylanases work is through the modulation of the microbiome toward improved fermentative capacity of the fibrous fraction of the feed (Bedford, 2018a,b).

This leads to another misconception whereby nutritionists often believe the fiber content of monogastric diets is low and, therefore, of little or no importance. As Choct (2015) highlighted, this is due to the use of obsolete methods for determining fiber.

The use of more appropriate methodologies — e.g., determining non-starch polysaccharides (NSPs) and lignin — would enable us to better understand fiber and then exploit the beneficial effects of fiber hydrolysis.

There still is a misconception in some parts of the industry that swine and poultry hardly utilize fiber; however, the effect of fiber is more related to the commensal microbiota than digestibility. The microbiota is responsible for fiber utilization and fermentation, ultimately producing beneficial metabolites, e.g., volatile fatty acids (VFAs), vitamins, etc.

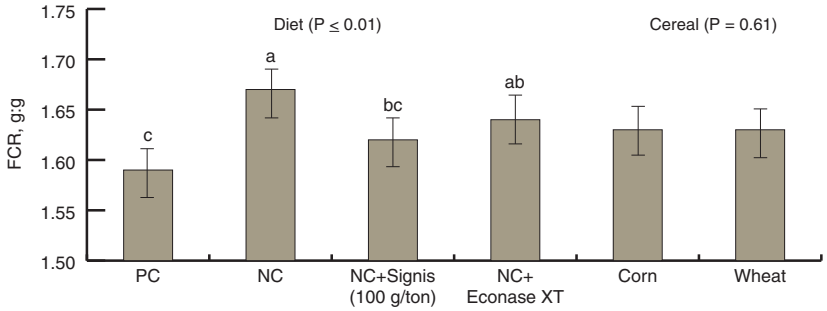
Fiber-fermenting microbiome

Animals and microbes evolved over several million years to benefit from one another. Most bacteria present in the gut are considered harmless, but some are pathogenic (Ducatelle et al., 2019). The intestinal environment provides the ideal habitat for these bacteria to produce several metabolites that can affect gut function, productive performance and even host behavior (Selosse, 2019).

Beneficial bacteria in the caeca of chickens thrive on NSP-rich substrate (Ducatelle et al., 2019). The products of fermentation — VFAs — play an important role in gut health and the overall metabolism of the host (Jozefiak et al., 2004; den Besten et al., 2013; Hervik and Svihus, 2019).

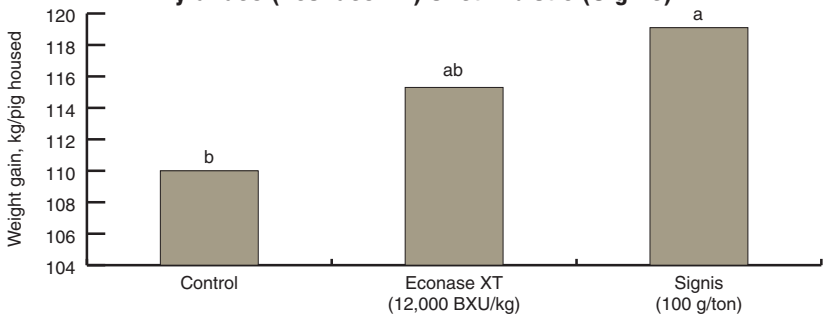
With increased age, the chicken gut microbiota improves its ability to degrade fiber (Bautil, 2019) and ferment it (Lee et al., 2017). Recent research has even

1. Bodyweight-corrected feed conversion ratio (FCR) of broilers fed diets reduced in nutrients (energy and amino acids), based on different cereal types and supplemented with stimbiotic (Signis) or xylanase (Econase XT)



Note: Bodyweight-corrected FCR: target bodyweight gain of 2.83 kg, and 33 g = 1 point of FCR.
[a,b,c]Means followed by different superscripts are statistically different (P ≤ 0.05).

2. Weight of pigs fed control diet alone or supplemented with xylanase (Econase XT) or stimbiotic (Signis)



[a,b]Means followed by different superscripts within columns are statistically different (P ≤ 0.05).

shown that some factors accelerate establishment of this specific microbiome when the diet is supplemented with xylanase (Bedford and Apajalahti, 2018) and xylo-oligosaccharide (XOS; Bautil, 2019).

Broekaert et al. (2011) demonstrated that the provision of oligosaccharides favorably stimulates the microbiota's fermentative capacity, and it is enhanced by supplementing XOS or arabinoxylan-oligosaccharides. These oligosaccharides are usually able to exert a beneficial effect at very low dosages and, therefore, are not considered a "prebiotic," by definition.

This is supported by Ribeiro et al. (2018), who postulated that the addition of 100 g per ton would equate to less than 0.3 kcal/kg of fermentation products, which does not equate to the performance benefits usually seen when these are supplemented. Bacteria can sense the environment, checking for the "worthiness" of producing costly molecules such as enzymes (Grandclement et al., 2016).

IN fact, Marinho et al. (2007) demonstrated that XOS supplementation in piglet diets increased the endogenous xylanolytic and cellulolytic activities in the animals' intestine. Gonzalez-Ortiz et al. (2019) postulated that any additive that has the ability to stimulate a fiber-degrading microbiome to increase fiber fermentability without becoming the substrate for this microbiome growth should be defined as "stimbiotic."

Stimbiotic benefits

Stimbiotic supplementation is providing additional gains beyond the use of xylanase alone for both broilers and pigs (Figures 1 and 2). Cho et al. (2019) demonstrated that stimbiotic supplementation was more efficient than prebiotics at increasing VFA content in the feces and plasma cytokines in piglets, especially when exposed to poor sanitary conditions.

Little or no attention has been paid to further understanding the fiber composition and content of monogastric diets. This can be partially attributed to outdated analytical methods but also because fiber is perceived to have a negative impact on animal performance and nutrient digestibility.

Dietary fiber clearly has more value than what was once thought. Taking into consideration that fiber represents a high proportion of the diet content, it seems unreasonable not to harvest the benefits fiber fermentation can exert.

There are no silver bullets that will solve the challenge associated with removing antibiotic growth promoters, yet stimulating fiber-fermenting bacteria to accelerate the development of a fiber-degrading microbiome can play an important role in working toward antibiotic-free production.

The list of references may be obtained from nam@abvista.com.■