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Butyrate in poultry

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Diamond V Original XPC™ provides prebiotic-like activity, as demonstrated in a laboratory model of poultry digestion (Intestinal Activity Modifier Model, IAMM). Interestingly, the XPC-induced changes in bacterial populations not only reduced pathogen growth(1), but resulted in a significant increase in butyrate production (2). This result led Diamond V to look more closely at the published benefits of short-chain fatty acids (SCFAs), particularly the role of butyrate.

Short-chain or volatile fatty acids function as a major energy source for cells in the lower gut of animals, including poultry. Butyrate provides the following benefits:

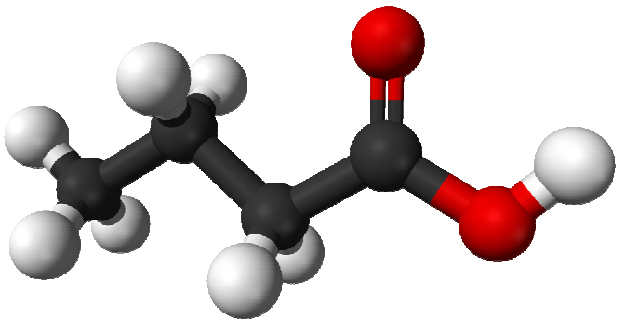
- **Homeostasis and immune function**
  - Butyric acid in the form of butyrate is the most important energy source for colonic epithelial cells (colonocytes).
  - Butyrate aids gut homeostasis – the healthy interaction between the gut, resident bacteria, and immune system.
- **Antimicrobial activity**
  - Butyrate in the poultry gut may also enhance resistance to pathogenic *Salmonella* and *Clostridium* bacteria.
- **Support for a healthy gut wall**
  - Butyrate production in the poultry gut supports a healthy gut wall, including the function of tight junctions.

Based on these benefits, poultry producers are interested in butyrate. However, in order to deliver malodorous and rapidly absorbed butyric acid directly to the poultry gut, the product must be coated or protected.

Another approach is to feed a product like Diamond V Original XPC that supports butyrate production in the gut, naturally.

Short Chain Fatty Acids and butyrate

Animals do not produce short chain fatty acids (SCFA) directly. These SCFA are the major end products of carbohydrate (dietary fiber) fermentation in the colon by commensal bacteria. Diet and resident bacteria affect the amount and ratios of SCFAs, but generally acetate is most prevalent, followed by propionate and butyrate.



Butyrate is a simple 4-carbon fatty acid (shown above), produced in the colon by a phylogenetically diverse group of Gram-positive anaerobic bacteria belonging to the *Firmicutes* phylum. The main route for synthesis of butyrate is the break down of glucose.

Homeostasis and immune function

Although butyrate is the least abundant of the three major SCFA, it is the most important for colonocyte metabolism – as much as 90% of butyrate is metabolized by colonocytes. Colonocytes are instrumental in water, sodium, and chloride re-absorption from the intestinal lumen, resulting in feces having a more solid consistency.

Butyrate also plays an extensive role in gut homeostasis, including support for the gut barrier function. Butyrate facilitates the creation and maintenance of cellular tight junctions or *zonula occludens* (3) which are the closely associated areas between two cells whose membranes join together. These junctions form a mucosal barrier that is more efficient in nutrient absorption and more resistant to attack by invading pathogens.

There also have been reports of more direct effects of butyrate on the immune system of mammals, suggesting that butyrate interacts with the cytokines (the messaging system of immunity). For example, butyrate may increase levels of the anti-inflammatory cytokine Interleukin-10 in humans and reduce inflammation. Butyrate also may regulate or modulate immunity in broiler chickens(5).

Antimicrobial activity

In addition to the cellular barrier function, butyrate acts through other mechanisms to help reduce infection. For example, antimicrobial peptides, also known as host defense peptides (HDPs), are a critical part of innate immunity(6). Research also shows that butyrate can enhance disease resistance to *Salmonella* Enteritidis in chickens by inducing synthesis of various HDPs(7).

Other research has demonstrated the antimicrobial activity of butyrate towards poultry pathogens (*Salmonella* Typhimurium and *Clostridium perfringens*) in both *in vitro* (8) and *in vivo* trials(9, 10).

Another mechanism for the effect of butyrate is down-regulation of expression of invasion genes in *Salmonella*, which reduces the ability of the bacteria to attach to host cells of the intestinal epithelium, thereby becoming less invasive and virulent(11)

Supporting a healthy gut wall

Butyrate production in the poultry gut supports a healthy gut wall, including the function of tight junctions. Butyrate also helps support the poultry immune system and demonstrates activity against certain gut pathogenic bacteria. With coating or encapsulation technology, it is possible to deliver butyric acid directly to the poultry gut. However, there is another approach – feeding an all-natural supplement that increases gut exposure to butyrate produced by commensal gut bacteria.

Research has shown that Original XPC significantly increases butyrate production *in vitro*. Butyrate's effects on the immune system and gut health, as described above, may help explain why poultry in commercial production that are supplemented with Original XPC have a more balanced immune system and are better able to maintain productivity, even when facing many challenges from their environment.

A more detailed white paper on butyrate in poultry is available from your Diamond V representative.

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