PATHKINEX UPDATE

How can *Bacillus* DFMs Influence Intestinal Butyrate?

Butyrate is a key driver of gut health and development for all livestock and poultry. Produced by fiber-degrading anaerobic bacteria from dietary fiber, butyrate serves as the primary energy source for enterocytes lining the GI tract. Intestinal butyrate can enhance gut development and structure in growing animals, reduce inflammation, and can help control enteric pathogens, resulting in improved energy availability, fatty acid metabolism, and immune status in livestock. Shifts in butyrate-producing bacterial populations caused by feed additives including *Bacillus* DFMs may help explain their effects on health, growth performance, or milk production.

In a recent trial conducted with Iowa State University in dairy cows, we investigated the effects of a *Bacillus* DFM (Strateris® ECL) on several microbial populations, including pathogenic species and beneficial butyrate-producers, while tracking milk production and immune and metabolic markers related to cow health and performance. Microbial findings were presented at the annual meeting of the American Dairy Science Association in June 2023 in four posters and talks presented by MDG, UAH, and ISU lab members.

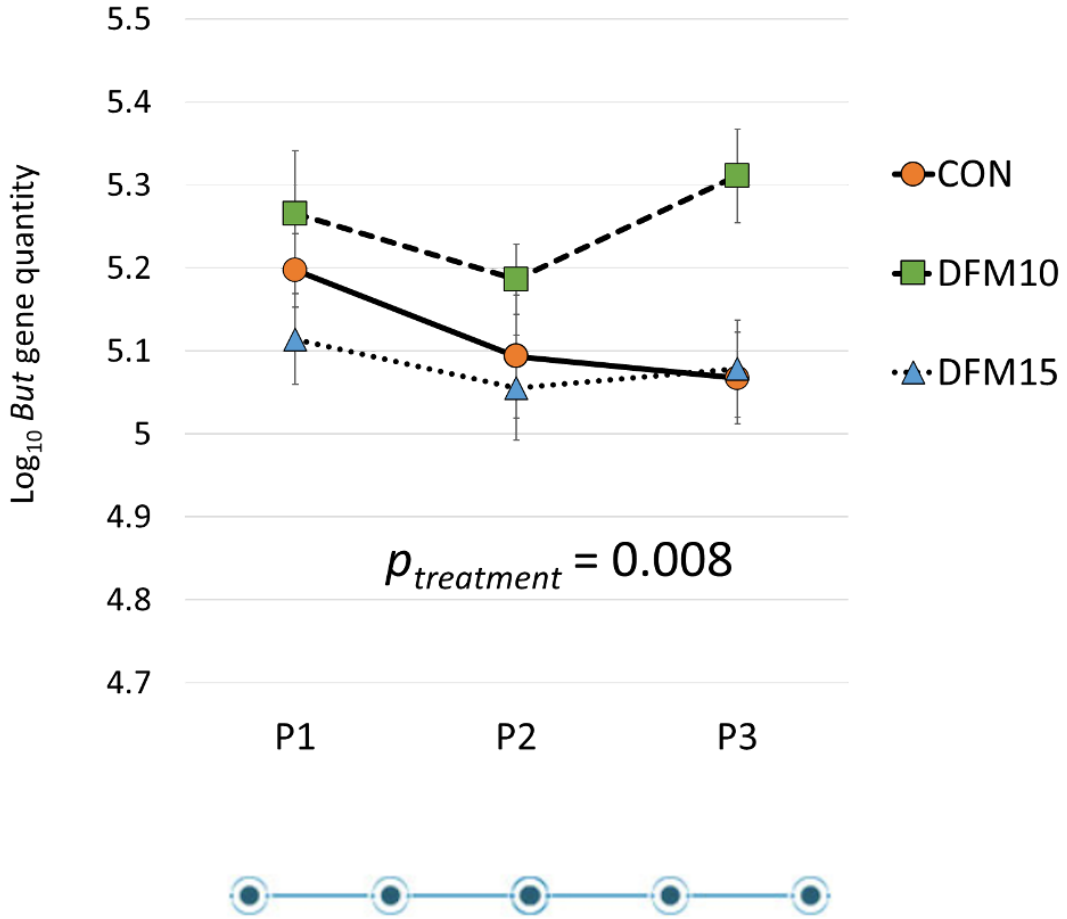
Trial Design
This trial followed 36 lactating dairy cows receiving no treatment (CON), 10g/day Strateris® ECL (DFM10), or 15g/day Strateris® ECL (DFM15) in a feeding trial designed to determine if the product was protective against inflammation, intestinal permeability, or other adverse effects induced by a feed restriction period. Feed restriction is frequently used as a model stressor in ruminant gut health research. It can occur in commercial farm settings due to management problems or animal transport or as a result of feed refusal due to digestive issues, feed quality, or other health conditions.

Cows received dietary treatments for a total of 35 days before the intensive experimental phase with daily data collection: a 5-day baseline (P1) with *ad libitum* feed intake, a 5-day feed restriction period at 40% of baseline feed intake (P2), and a 5-day recovery period (P3). Rectal swabs were taken during P1, P2, and P3, and DNA extracted from these swabs was used for dairy PathKinex. In addition to the standard PathKinex panel, we looked for the Butyryl-CoA CoA transferase gene (*But*) found in beneficial butyrate-producing anaerobic bacteria.

Trial Results:
***But* Gene Increased in Cows on Strateris® 10g**

The *But* gene was elevated in cows receiving the DFM10 treatment during pre-feeding and intensive experimental phases and rebounded in the recovery period (P3) after feed restriction (P2)

DFM10 also increased key production metrics including dry matter intake, milk yield, and lactose yield compared to the control and DFM15 and decreased inflammatory biomarkers compared to high-dose DFM15. *Bacillus* DFMs and butyrate-producing bacteria may both contribute to decreases in inflammatory biomarkers observed in DFM10 (Goetz et al., 2023, #1513T).



When Pathogens Are Low, Higher Immune Stimulation Isn't Always Better

Our standard PathKinex panel showed that cows in this healthy research herd harbored virulence gene quantities from *E. coli, Clostridium perfringens,* and other pathogenic species at low quantities, similar or below levels observed in healthy commercial dairy cows.

Though much of the previous mode-of-action research with *Bacillus* DFMs has focused on control of pathogenic species, this cannot always explain benefits observed on healthy farms where rates of bacterial disease are already low. In high-health commercial dairies, our research has shown that the 10g Strateris® program has the greatest performance benefit whereas the 15g dose provides most benefit in health-challenged situations. Though necessary to fight microbial challenges, too much immune stimulation may constrain beneficial butyrate populations which may help explain the dose effect observed in this trial and in other animal species.

What Are the Advantages of a DFM Over Supplemental Butyrate?

Supplemental butyrate is sometimes added to animal diets to provide these benefits, but as a feed additive it is difficult to handle, has an offensive odor, and some forms may be absorbed in the upper gut preventing it from reaching the intestine. Enhancing microbial butyrate production naturally via DFM use is a practical alternative with multiple benefits from live *Bacillus.*

Key Takeaway: Feeding a Low-dose Direct-fed Microbial Impacts the Microbial Community Favoring Butyrate-producing Anaerobes

Supplementation with a *Bacillus* direct-fed microbial at a low dose enabled shifts in the microbial community of the hindgut favoring butyrate-producing anaerobes which promote animal health by directly fueling enterocytes, modulating inflammatory immune pathways, and increasing energy availability in the GI tract.

Discussion Question

What types of benefits are you encountering when using DFMs in high-health farms?

Respond to MDG

Is there a topic you'd like to learn more about in a future newsletter? We enjoy hearing from you! We welcome your questions, comments and suggestions on PathKinex updates. Please contact us at AnimalAg@mdgbio.com

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