Direct Fed Microbial Products (DFM)

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This Feed Management Education Project was funded by the USDA NRCS CIG program. Additional information can be found at http://www.puyallup.wsu.edu/dairy/joeharrison/publications.asp

This project is affiliated with the LPELC http://lpe.unl.edu

Introduction

This fact sheet has been developed to support the implementation of the Natural Resources Conservation Service Feed Management 592 Practice Standard. The Feed Management 592 Practice Standard was adopted by NRCS in 2003 as another tool to assist with addressing resource concerns on livestock and poultry operations. Feed management can assist with reducing the import of nutrients to the farm and reduce the excretion of nutrients in manure.

The concept of Direct Fed Microbial (DFM) involves the feeding of beneficial microbes to dairy cattle when they are under periods of stress (disease, ration changes, environmental, or production challenges). Probiotics is another term for this category of feed additives. Probiotics or DFM have been shown to improve animal performance in controlled studies. In this section, we will evaluate bacterial additives (not fungal or yeast-based products).

Role of DFM

The proposed mechanisms for improvement in dairy cattle performance when feeding DFM are outlined below.

- Produce of anti-bacterial compounds (acids, bacteriocins, or antibiotics)
- Compete against undesirable (pathogenic) organisms for nutrients and/or colonization of the digestive tract (competitive exclusion)
- Produce nutrients or other growth factors
- Stimulate production of enzymes and/or stimulate growth of natural bacteria

- Metabolize or detoxify undesirable compounds (such lactic acid, mycotoxins, etc.)
- Stimulate the immune system

Several studies the have reported positive animal performance when using a combination of several microbial species listed in Table 1.

The mode action and dosages of many bacterial species are given in Table 2. For example, *Lactobacillus acidophilis* produces lactic acid that may lower the pH in the small intestine thereby inhibiting the growth of undesirable microbes (pathogens). Calves that have been stressed (i.e. weaning, scouring, and shipping challenges) have responded quite favorability to large doses of *Bifidobacterium, Enterococcus, Bacillus,* and *Lactobacillus*. *Megasphaera elsdenii* is a major lactate utilizing organism found in the rumen of cattle fed high grain diets. Feedlot producers have used DFM when adapting cattle to high energy diets thereby reducing lactic acidosis. Applications in high producing cows are being explored in the field. *Propionibacteria* have the ability to convert lactic acid and glucose to acetic and propionic acid thereby potentially improving the energy status of early lactation cows. Similar results have been demonstrated in beef cattle through improved feed efficiency. Certain species of bacteria can reduce/detoxify nitrates in the ration.

Practical Considerations

The bacteria in DFM products must be alive to impact ruminal fermentation or lower gut responses. Thus, the viability and number of organisms fed must be ensured at the time of feeding to ensure performance responses. The use of DNA figure printing offers an approach to select the optimal strain(s) of bacteria to ensure optimal animal performance. Some products have guaranteed levels (i.e. 1 x 10^{6-10} CFU/g) of micro-organisms in the product to achieve animal performance.

The method of delivery of these products can vary from powders, pastes, boluses, to capsules using feed or water as carriers. If water is used, chlorination, temperature, minerals, flow rates, ionophores, and antibiotics must be considered to avoid killing or reducing the effectiveness of the DFM product. For example, the approval of monensin, which targets gram positive bacteria in the rumen, may result in certain DFM products being less effective due to the microbials being affected by monensin. Producers and nutritionists need to ask for controlled studies demonstrating the use of a particular DFM product in combination with monensin. Some DFM products may require a higher feeding rate or dosage to “seed down” the digestive tract for several days to out compete pathogenic bacteria followed by reducing the feeding rate to achieve a maintenance rate.

The ability of DFM to survive feed processing, especially pelleting, should be requested for each product. In addition, viability data during prolonged feed storage and stability when mixed with low pH silages in the bunk for several hours should be requested. The viability of DFM products in the market place has improved over the years, but follow manufacturers directions concerning heat, oxygen exposure, and moisture to ensure product performance and ultimately animal performance.

Summary

At this time, most nutritionists are "cautious" when adding DFM. However, the success in controlled and field studies has demonstrated improvements in animal performance. The use of DFM's in milk fed calves seems to warrant the inclusion of a DFM product until dry matter intake of starter is over two pounds per calf per day. The inclusion of DFM products in drench products administered to off-feed cows, cows treated with high levels of antibiotics for various diseases, and those cows under stress would appear to be warranted. At this point, ask for data on animal performance responses to DFM products, evaluate the type and number of microbes added, and follow handling guidelines to ensure product performance and ultimately animal performance.

Table 1. Effects of bacterial DFM on dry matter intake, milk yield, and milk composition in lactating dairy cows in five studies (Krehbiel et al).

Treatment	number	Milk (lb/day)	Fat (%)	Protein (%)	DMI (lb)
Control	16	64.0 a	3.81	3.34	na
L. acidophilis (BT1386)	16	68.0 b	3.75	3.36	na
Control	550	70.0 a	3.64	na	46.6
L. acidophilis (BT1386)	550	73.9 b	3.63	na	47.1
Control**	6	18.0 a	3.30 a	3.09	na
Yeast culture	6	20.5 b	3.96 b	3.15	na
L. acidophilis + yeast culture	6	20.4 b	3.57 b	3.13	na
Control	32	106.0	na	3.01 a	54.1
Yeast + L *plantarum and E. faecium*	32	108.0	na	3.27 b	55.2
Control	100	85.4	4.24	3.02	55.0
L acidophilis, L casei, E. faeium + Mannanoligosaccharide	100	87.1	4.34	3.04	54.1

ab means in columns differ (P, 0.05)

** Tropical feeding conditions

Table 2. Bacteria with potential use as DFM (Kung, 2001).

Source	Strain	Dose	Effect
Megashrera elsdenii	B1459 407A	8.7 x 10 6	Prevent lactic acidosis when diets change to higher fermented CHO
Lactobacillus acidophillis	na	1 x 10 9	Increase milk yield when feed intake depressed and under stress
Propionibacteria and L *acidophillis*	P-63 5345	1 x 10 9 1 x 10 8	Improve feed efficiency during adaption to higher CHO diet
Propionibacterium Freudenrechii and L Acidophilus (B2FFO4)	na	1 x 10 9 1 x 10.8	Improve feed efficiency
Propionibacterium acidipropionic	DH42	1 x 10.9	Increased propionic acid
Propionibacterium Freudenrechii plus lactobacilli	na	na	Improve weight gain in calves

Selected References:

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Project Information

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