TECHNICAL BULLETIN
Report 07-1

VIGORTONE®
A Leader In
Animal Nutrition Since 1912
1-800-553-1712 www.vigortone.com

DigestaMax4 For Enhancing Digestive Function In Cattle

Methods may vary but the message is clear. Columnist Baxter Black uses cowboy humor, advertisers play on words, and magazine editorials get right to the point. A recent issue of a beef industry periodical said, "One of the great hopes for beef is that producers have been slow to change… there is much unused technology around." Many improvements in feeding technology, in fact, have been slow to be implemented in the commercial feeding of cattle. An example is the use of fermentation products.

As a class, these products consist of one or more residues, known as biomass, resulting from an industrial fungal fermentation, most often that of *Aspergillus* or *Trichoderma* organisms, and are both catalytic and enzymatic in nature. Collectively, these characteristics result in stress alleviation in receiving cattle and digestive stimulation during growing and finishing. Vigortone's new **DigestaMax4** blend of yeast culture and live microbials contains these biomass type ingredients.

The Rationale For Fungal Feed Additives

Knowledge of the metabolites generated by fungi during rumen fermentation adds logic to the supplemental application of *Aspergillus* and *Trichoderma* biomass products to ruminant feeding. In the rumen, fungi produce some of the highest potency cellulase and xylanase enzymes known, giving them the ability to penetrate the cuticle barrier on the outside of the plant and partially degrade the most resistant cell walls (fiber) in forages. As a result, fungi are considerably more effective than rumen bacteria at physically weakening these components in low quality forages. This is done by disrupting the structural integrity of fiber for more efficient mastication (cud chewing) and digestion by the ruminant.

A specific segment of the rumen fungal population exhibits substantial cellulolytic activity, producing at least 12 different cellulase enzymes. These fungi utilize a number of soluble (such as glucose, fructose, maltose, sucrose, and lactose) and insoluble (starch and cellulose) sources of carbon for growth.

Considerable knowledge about the use of fungal organisms, specifically *Aspergillus*, in manipulating industrial fermentations has made this the preferred bioprocess in the synthesis of citric acid for industrial, food, and feed applications. Like the rumen, these industrial fermentations utilize both soluble and insoluble substrates, including sucrose, cane molasses, beet molasses, citrus molasses, pineapple molasses, potato starch, corn starch, apple pomace, grape pomace, whole sugarcane, and both chemically- and enzymatically-hydrolyzed sugarcane bagasse (stalk). By-products remaining in an industrial *Aspergillus* biomass after extraction of the citric acid include numerous alcohols, organic acids, B-complex vitamins, and betaine, steroid precursors, ergocalciferol (a source of vitamin D_2), and enzymes that aid in the digestion of fiber, starch, protein, fat, oxalic acid (organically bound calcium), and phytic acid (organically bound phosphorus).

It becomes apparent then that fungi participating in rumen fermentation and those used industrially hold significant similarities. Although it cannot be assumed that these industrial biomass materials are a source of viable fungi when used in cattle feeds, they can, nonetheless, contribute measurably to the catalytic and enzymatic complement necessary for active rumen fermentation.

Performance Data

DigestaMax4 contains *Aspergillus oryzae, Aspergillus niger,* and *Trichoderma viride* fermentation products, which collectively contribute cellulase, pectinase, amylase, protease, and lipase enzymes.

Aspergillus oryzae has been shown to increase dry matter intake and milk production, and lower

(continued)

body temperature during heat stress in dairy cattle. Tests in feedlot cattle have demonstrated faster rate of gain, improved feed efficiency, and reduced morbidity. *Aspergillus niger* in beef starting, growing, and finishing rations has increased rate of gain by 8 to 12% and improved feed conversion by 10 to 11%. Lambs appear to respond similarly. Comparable results have been recorded for various *Trichoderma* species.

Favorable responses to fungal biomass feeding appear to occur over a wide range of roughage intakes. The file data below were obtained from a contract study with crossbred beef steers finished on whole shelled corn and a pelleted supplement in the absence of an ionophore. No roughage was offered. Cattle fed the *Aspergillus* biomass gained 12.8% faster on 7.3% less feed per pound of gain.

	Control	**Aspergillus**
No. of pens	2	2
Total no. of steers	15	16
Initial weight, lb	870	869
Final weight, lb	1,125	1,156
Daily gain, lb	3.44	3.88
Dry matter intake, lb	22.2	23.2
Feed:gain	6.45	5.98

In a second contract study (file data), growing steers were fed 65% ground corn, 25% ground hay, and 10% of a protein supplement containing an *Aspergillus* biomass but no ionophore. Rate of gain was significantly (P<.01) faster, and both feed intake and feed conversion were numerically improved by the *Aspergillus* biomass.

	Control	**Aspergillus**
No. of pens	2	6
Total no. of steers	16	48
Initial weight, lb	511	511
Final weight, lb	807	850
Daily gain, lb	2.90	3.32
Dry mater intake, lb	21.0	21.9
Feed:gain	7.24	6.60

These performance data were further substantiated by accompanying reports of both *Aspergillus oryzae* and *Aspergillus niger* supplementation over a range of roughage:concentrate ratios resulting in an *in vitro* increase in volatile fatty acid (VFA) production. Logic would suggest, then, that a product like DigestaMax4 could be used in all-natural feeding programs, which prohibit the use of ionophores, with the expectation of recapturing at least part of the performance advantage lost by the absence of Rumensin® or Bovatec®. That appeared to be the case in a third contract study (file data) in which growing steers were fed 60% ground corn, 30% ground hay, and 10% of the same protein supplement containing: 1) the *Aspergillus* biomass, or 2) Bovatec at 315 mg/head/day. The cattle weighed 606 lb initially and were fed for 120 days. Resulting data suggested numerically comparable gain and feed conversion between the fungal biomass and the ionophore.

Fungal supplements for cattle appear to be an effective means of increasing the digestibility of structural carbohydrates. Fungal products obtained through industrial fermentations, like those used in DigestaMax4, can provide adjuvant enzymatic activity to the rumen, which when coupled with that of indigenous fungi, can offer a strategy for exploitation of starch and fiber utilization.

Diamond V XP Yeast Culture, the base ingredient for DigestaMax4, has been shown to improve diet palatability and intake, stimulate rumen microbial growth and fermentation, enhance trace mineral uptake, and reduce morbidity in stressed arrival cattle. In addition, DigestaMax4 provides guaranteed levels of live, ruminally-active and intestinally-specific bacteria. The *Propionibacterium* are strong rumen colonizers which convert lactate to propionate, increase rumen pH, and stimulate intake. In the intestines, the *Lactobacillus, Enterococcus, Pediococcus,* and *Bacillus* strains restore lower gut microbial balance, inhibit common bacterial pathogens, improve nutrient absorption across the intestinal lining, and protect cells from toxins. Refer to the DigestaMax4 label for feeding directions.

Key words: DigestaMax4, fiber digestion, receiving cattle