

FEED ADDITIVES



BASICS

OVERVIEW

Feed Additives are non-nutritive compounds added to diets to improve nutrient utilization, enhance performance, minimize risk of diseases, and limit negative impacts on the environment. Feed additives can be used to manipulate rumen fermentation and/or improve efficiency of animal performance through changes in animal physiology.

Feed additives are supplemented to complement good nutritional management and not to ameliorate a nutritional deficiency.

Feed additives have different modes of action and effects. They can either have only one mode of action or several actions at the same time. They can (i) modulate rumen pH and lactate buildup, (ii) reduce the risk of diseases like calf diarrhea, ruminal acidosis or bloat, (iii) enhance rumen development in neonatal ruminants, (iv) improve the efficiency of energy utilization by reducing ruminal methanogenesis and decreasing the acetate to propionate ratio without affecting milk fat synthesis, (v) improve the efficiency of ruminal nitrogen utilization by reducing proteolysis, and amino acid deamination, consequently minimizing production and losses of NH_3 to the environment; inhibiting the activity of ruminal protozoa that phagocytize desirable bacteria, contribute to proteolysis and deamination, and serve as hosts for methanogens; enhancing the synthesis of microbial protein by facilitating synchrony of ruminal energy and protein supply, or (vi) increase ruminal organic matter and fiber digestibility. Governmental regulation varies depending on the type of additive.

GEOGRAPHIC DISTRIBUTION

Worldwide, depending on production management.

SYSTEMS AFFECTED

Gastrointestinal, renal, immune system



MEDICATIONS

TYPE OF ADDITIVES AND MODE OF ACTION

Buffers

Compounds that modulate changes in proton concentrations or pH. They are supplemented to cows to complement the buffering effect of saliva to control acid overload in rumen. They

stabilize rumen pH preventing acidosis and related disorders (rumenitis, liver abscesses, and laminitis). They also improve water consumption, fiber digestion and milk fat synthesis. Within these compounds are: sodium bicarbonate (100 to 300 g daily), limestone (150 to 350 g daily), and magnesium oxide (50 to 100 g daily).

Gluconeogenic precursors

Compounds that improve hepatic gluconeogenesis with end results of increasing glucose levels to support lactose synthesis and milk production and decrease ketogenesis and excessive fat mobilization. These products are recommended to be used during the entire transition period (prepartum and postpartum). Within these additives are:

- Calcium propionate at a rate of 200 to 400 g per day: provide calcium and propionate for hepatic gluconeogenesis
- Sodium monensin at a rate of 250-350 mg per day. Ionophore that modifies rumen fermentation patterns in favor of propionate synthesis.
- Propylene glycol at a rate of 250 to 450 g per day. A 3 carbon compound that is converted to glucose in the liver. Stimulates insulin responses, reducing fat mobilization.
- Glycerol at a rate of 200 g per day. Another 3 carbon compound that is converted to glucose in the liver. Stimulates insulin responses, reducing fat mobilization.

Specific vitamins and precursors

Vitamins A and beta carotenes improve reproductive performance and immune response. Lactating dairy cows have a requirement for vitamin A of 70,000-100,000 IU a day. Vitamin D improves calcium and phosphorus metabolism. Cows need certain exposure to sunlight to stimulate activity of vitamin D. Recommendations of 20,000 to 28,000 IU a day have been established. Vitamin E is a potent antioxidant. It is high in fresh pastures consequently in grazing cattle supplementation is not necessary. Cows need 500 IU per day, increasing up to 2000 IU per day during the transition period, especially during the prepartum period.

Although B complex vitamins are synthesized by rumen microorganisms, under certain production conditions the supplementation of some of these vitamins has demonstrated to be beneficial for animal health and performance. Biotin at a rate of 10 to 20 mg per day 6 to 12 months a year has improved hoof quality, reducing the presentation of heel warts and claw lesions, decreasing the incidence of lameness and improving milk yield and fertility. Rumen protected choline, a methyl donor stabilizing cell membranes, at a rate of 15 g per day, has reduced hepatic lipidosis development. It is recommended during the entire transition period. Niacin, which is a coenzyme in several cell biochemical reactions, at a rate of 6 to 12 g a day during the transition period has shown to decrease ketogenesis and improve energy balance.

Yeast and Fungus

Yeast are single-celled carbohydrate-fermenting fungi that reproduce by budding. They are based on varying proportions of live and dead organisms of the species *Saccharomyces cerevisiae*. Yeasts stimulate fiber-digesting bacteria, stabilizes rumen environment and utilizes lactic acid, reducing the risk of acidosis, increasing microbial protein synthesis and improving animal performance. Yeasts are recommended at a dose of 10 to 120 g a day, depending on yeast culture concentration, during prepartum and up to 10 weeks postpartum.

Aspergillus oryzae is a fungus subjected to a thermal extraction of fungal spores and mycelium. These extracts are rich in cellulase, xylanase and esterase enzymes that may improve fiber hydrolysis. These extracts also increase total and cellulolytic ruminal bacteria populations.

Sometimes they improve DMI, milk production, and stabilize rumen pH. The dose recommended is 3 g per day.

Probiotics (bacterial direct-fed microbes)

Probiotics are defined as “live microorganisms that beneficially affect the host upon ingestion by improving the balance of the intestinal microflora”. Probiotic bacteria belong mostly to *Lactobacillus* spp., *Bifidobacterium* species, *Enterococcus* species and others of secondary importance. Most of the probiotic bacteria are lactic acid producing bacteria. Lactic acid might inhibit the growth of pathogenic coliforms in the intestinal tract of animals; consequently, expected responses are reduction of the incidence of diarrhea in calves, and maintenance of intestinal health. They have been recommended to dairy calves on liquid diet, transition cows and during stress conditions.

Anionic salts

These compounds are based on chloride and sulfur inducing a mild metabolic acidosis to improve the activity of parathyroid hormone (PTH) and vitamin D to increase calcium intestinal absorption and calcium bone resorption. Consequently, anionic salts are recommended during the prepartum period to prevent hypocalcemia around parturition. The dose recommended is to reach a dietary cationic (Na and K) anionic (Cl and S) difference of -25 to - 75 milliequivalents per kg of DM. The target of feeding anionic diets is to obtain a urine pH of prepartum cows between 6.0 and 6.8.



MISCELLANEOUS

SYNONYMS

- Supplements
- Growth promoters
- Feed efficiency stimulants

SEE ALSO

- Dairy Heifer Nutrition: Basics (www.fiveminutevet.com/ruminant)
- Nutrition and Metabolic Diseases: Dairy
- Transition Cow Management (www.fiveminutevet.com/ruminant)

ABBREVIATIONS

- DMI = dry matter intake
- g = grams
- mg = milligrams
- PTH = parathormone
- IU = international units

Suggested Reading

Adesogan, A. T. 2009. Using dietary additives to manipulate rumen fermentation and improve nutrient utilization and animal performance. <http://dairy.ifas.ufl.edu/rns/2009/Adesogan.pdf>

Goff JP. Major advances in our understanding of nutritional influences on bovine health. *J Dairy Sci.* 2006; 89:1292–1301.

Hutjens, M. Feed additives for dairy cattle. Cooperative Extension System. <http://articles.extension.org/pages/11774/feed-additives-for-dairy-cattle#.VkIB9yv0-k4>

LeBlanc SJ, Lissemore KD, Kelton DF, Duffield TF, Leslie KE. Major advances in disease prevention in dairy cattle. *J Dairy Sci.* 2006; 89:1267–79.

Risco, C.; Melendez, P. 2011. Editors of book: Dairy Production Medicine. 800 pp. Wiley-Blackwell. First edition, October, 2011.

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