Silage additives: Effects on silage fermentation and animal production. L. Kung Jr.*, University of Delaware, Newark, DE.

Silage fermentation is an uncontrolled process affected by a multitude of forage factors and management practices. In general, undesirable fermentations result in excessive losses of DM and energy, and can result in an accumulation of unwanted end products that can negatively affect animal performance. Various types of additives including enzymes, organic acids, and microbial inoculants have been used to maintain and improve forage quality and improve aerobic stability during ensiling. For example, plant cell wall degrading enzymes have been added to silage to improve digestibility. However, true pre-digestion of nutrients in the silo is a questionable goal. Instead, the goal should be to improve the digestibility of silage when it reaches the rumen and or intestine of the cow. Short chain organic acids such as propionic acid, potassium sorbate, and sodium benzoate have good antifungal properties that can suppress yeasts that are responsible for initiating aerobic spoilage. Various microbial organisms have also been added to silages to improve fermentation. Originally classified as homolactic acid bacteria, such organisms were used to hasten silage fermentation and result in fermentations that recovered more DM and energy. Ironically, extremely efficient fermentations can lead to poor aerobic stability of silages. Over a decade ago, the introduction of L. buchneri, a heterolactic acid bacteria, resulted in a paradigm shift because it was able to anaerobically convert moderate amounts of lactic acid to acetic acid, which is highly antifungal in nature and thus improved aerobic stability. Changes in silage fermentation and aerobic stability from the use of additives can have direct and indirect effects on animal performance. This review will give a history of various silage additives, their modes of action and effects on animal production.

Key Words: silage, additive, inoculant

Quantification of the emission reduction benefits of mitigation strategies for dairy silage. F. M. Mitloehner*, Department of Animal Science, University of California, Davis, Davis, CA.

Dairy silages can be a major air emission source of volatile organic compounds (VOCs). In general, emission of VOCs from silage can be mitigated by either 1) reducing VOC production in the liquid/solid phase of the silage pile, or 2) reducing relative emission from the face of the silage pile or the feedlane. The focus of the present research was on monitoring and modeling of VOC production, as well as emissions mitigation via various silage storage methods, de-facing practices, and feed management approaches. For the field monitoring of emissions from different silage storage and defacing methods, we used flux chambers and wind tunnels that were attached vertically on the silage face, immediately after de-facing. Different storage methods (i.e., conventional standard pile vs silage bag), and defacing methods (e.g., perpendicular, lateral, and rake extraction) were compared aiming at reducing emissions. The monitoring data was used to inform and validate a new VOC process-based model that was developed to predict VOC emissions from silage sources on farms using theoretical relationships of mass transfer and parameters determined through our earlier laboratory experiments and numerical modeling. The results for silage storage indicated that silage bags vs. conventional silage piles emit considerably fewer VOC emissions. Furthermore, lateral defacing versus perpendicular- and rake defacing reduced emissions of most VOCs. Simulations of all relevant silage mitigation options that were studied on the commercial dairies were conducted using the VOC modeling tool. These simulations clearly showed that most of the reactive VOC emissions on a California dairy occur from feed lying in feed lanes during feeding as opposed to the silage storage pile or bag. However, one shall not view those monitoring results in isolation, because only the integration of other parts of the feed’s life cycle, using whole farm modeling, explains not just the relative but also the absolute effectiveness of mitigation techniques in reducing VOCs on the entire dairy. The whole farm modeling clearly showed that mitigation efforts should be applied to reducing VOC emissions from feeding rather than focusing solely on those from the exposed face of silage piles.

Utilization of silages in the diets of high-producing dairy cows: Effects on milk production and feed efficiency. K. F. Kalscheur*, USDA-ARS, US Dairy Forage Research Center, Madison, WI.

Silage is an integral ingredient in the diets of high-producing dairy cows throughout the world. In North America, silages formulated into the diets of high-producing dairy cows are predominantly corn silage and alfalfa silage along with smaller usage of other forages such as small grain silage and grass silage. Silages can be one of the least expensive feedstuffs to include in dairy cow diets, therefore it can be advantageous to include as much forage into the lactating dairy cow diet if it does not limit intake and does not result in decreased milk production. Typically, diets with increasing forage NDF concentration decrease DMI attributed to greater forage NDF concentration and bulk density of the diet. While increased forage NDF concentration may decrease milk production, with proper diet formulation and the inclusion of high quality silages, milk production may be maintained and feed efficiency may be improved. Implementation of harvesting techniques such as increased cutting length can improve nutrient digestibility of the resulting silage. In addition, selection of forage varieties containing the brown midrib (BMR) gene results in silage with lower lignin, higher fiber digestibility, greater intake, and potentially higher milk production. Lower lignin alfalfa varieties are now available that may result in greater fiber digestibility and potentially improved production. Utilizing both BMR silages and lower-lignin alfalfa varieties into one diet may help push the upper limit of how much forage can be included while maintaining high milk production and improving feed efficiency.

Key Words: dairy cow, silage, feed efficiency


The production of baled silages is increasingly popular, particularly with small and mid-sized dairy and beef producers. There are several reasons this silage preservation technique is attractive to producers, but the primary advantage is a reduced risk of weather damage to valuable forage crops compared with preservation as dry hay. Most core principles...
for making high-quality baled silages are similar to those for precision-chopped silages; among these, maintaining anaerobiosis is a priority. However, there are some notable differences between silage types. Principal among these is the restriction of rate and extent of fermentation within baled silages, which often results in less production of desirable fermentation acids and a greater (less-acidic) final pH. For baled silages, fermentation restrictions occur in part because recommended moisture concentrations (45 to 55%) are drier, and particle-length is much longer. Preservation of baled silages is optimized by applying polyethylene (PE) film wraps promptly, using an appropriate number of film layers (6 to 8), selecting an appropriate storage site, and by close monitoring for evidence of puncture, particularly by birds or vermin. The heterogeneous nature of baled silages, coupled with a restricted rate and extent of fermentation, may increase clostridial activity relative to precision-chopped forages ensiled at comparable moisture concentrations. To date, research evaluating inoculants or other additives designed to improve the fermentation has been limited in scope. Embedding PE films with an oxygen-limiting barrier has been beneficial in some trials, but most differences between these novel plastic formulations and commercial PE films have been limited to decreased yeast and mold counts at the surface layer; whole-bale assessments of fermentation or nutritive value have been less conclusive. Recent evaluations of bale-cutting mechanisms have demonstrated modest improvements in fermentation, but bale-cutting is difficult to justify solely on that basis. Baled silages can be produced successfully by adhering to straightforward management principles, and is likely to remain popular in the well into the future.

**Key Words:** baled silage, fermentation, pH