Silage Inoculants Role In Aerobic Stability

As silage production practices have improved there has been an unanticipated side effect which created a fairly new problem. As producers improved initial fermentations by using additives and practices which maximize both the speed and levels of lactic acid production, silages became less stable during storage if exposed to air. Similarly, these silages which contained both more lactic acid and a higher percentage lactic acid had more problems with yeast and mold growth during storage were less stable at feedout as were the TMR’s which contained them.

It was and is ironic that producers were still being sold silage inoculant products which contained only lactic acid producing bacteria (lab’s) and being told that these products improved aerobic stability and or helped silages retain their freshness. The truth was finally revealed in a study compiled by Dr.s Muck and Kung. In only 1/3 of the trials where lab’s were added to silage was the aerobic stability improved. In another 1/3 of the trials where only homolactic lab’s were used as an additive the aerobic stability of the silage was unaffected.   But, in the remaining 1/3 of the studies where only homolactic bacteria were used as a treatment these products actually reduced aerobic stability making the problems with yeast and mold growth worse.

The reason is fairly obvious in hindsight. By improving the fermentation and increasing the lactic acid proportionally all of the other fermentation acids which had been being produced were reduced. Ironically, of the typical fermentation acids in silages, lactic, acetic, propionic, butyric and iso-butyric, only lactic acid does not inhibit yeast and mold growth. Once fermentations were improved to be 100% lactic there were none of the other fermentation acids present to limit growth of the yeasts and molds.   There are yeasts in silage which when exposed to air can actually utilize lactic acid as an energy source. By consuming the lactic acid these yeasts cause the pH of the silage to rise. Once the pH rises, others yeasts and bacteria can grow as can eventually molds. Producers see molds growing but before the mold grew, yeasts consumed the lactic acid and the pH rose.

The answer to this problem came from a discovery made in Denmark by Dr Muck of the USDA Forage Research Center. When looking at silages that were very aerobically stable he discovered a novel bacteria, Lactobacillus buchneri. Upon much further study it was determined that this bacteria was unique in that after initial fermentation lowers the pH of silage to 5 or less, Lactobacillus buchneri converts lactic acid to both acetic acid and propylene glycol, a pre-cursor for propionic acid. Both of these acids have strong anti-mycotic properties and reduce the populations of yeast and molds. In all likelihood, the Lactobacillus buchneri in fact produce other compounds which inhibit yeast and mold growth since the levels of the acetic acid and propionic acids alone do not explain the exceptionally strong, beneficial aerobic stability the lactobacillus buchneri provides.

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The first observed drawback however was that for at least some strains of Lactobacillus buchneri to provide the desired aerobic stability they needed to be applied at 400,000 cfu's per gram of treated forage. The second drawback was that although the Lactobacillus buchneri improved aeroic stability, it also resulted in slightly more dry matter loss occurring in the initial fermentation (1-2% maximum increased dry matter loss).

Subsequently much more was learned about Lactobacillus buchneri and how it could be used most effectively. In summary, research has showed the following:

1) The Lallemand strain needs be applied at 400,000 cfu's per gram to consistently improve aerobic stability

2) Several other strains, notably Pioneer's has been shown to be effective at improving aerobic stability even at much lower levels than 400,000 cfu's per gram, having improved aerobic stability as much as the Lallemand product (used at 400,000 cfu's) when the Pioneer was used at only 100,000 cfu's per gram of treated forage.

3) The problem of increased dry matter loss associated with using Lactobacillus buchneri, although minor, was eliminated by combining Lactobacillus buchneri with 100,000 cfu's per gram of treated forage of either Lactobacillus plantarum or Lactobacillus acidilacti but NOT when combining Lactobacillus buchneri with only Pediococcus pentosaceus. (Some products are combinations of only Lactobacillus buchneri with a Pediococcus pentosaceus which may be undesirable or explain the higher addition rates bring required.)

4) The addition of Pediococcus pentosaceus alone with buchneri has been repeatedly found to reduce or eliminate the benefit of buchneri to improve aerobic stability. These combinations also require the highest levels of L. buchneri be supplied.

5) Some manufacturers claim improved fiber digestibility as a result of treating with Lactobacillus buchneri but independent documentation is scarce.

Based upon all these facts, that some buchneri strains improve aerobic stability when added at rates as low as 100,000 cfu per gram of treated forage, all strains of buchneri have been found to improve aerobic stability when used at 400,000 cfu's per gram of treated forage. The drawbacks of using the buchneri are eliminated by adding lab's other than Pediococcus pentosaceus alone. Improvements in fiber digestibility from it's use is uncertain. We recommend using a combination product supplying at least 400,000 cfu's per gram of treated forage in combination with any lab's to supply 100,000 cfu's per gram (other than straight Pediococcus pentosaceus).

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