When to use aerobic spoilage inhibitors?

Frank Mickan
Pasture and Fodder Conservation Specialist
DEDJTR, Ellinbank

Many silage additives have been used widely and confidently in Europe, UK and USA for many years now, backed up by thorough company and independent research. They are now recognised as another step towards ensuring satisfactory silage fermentation in a wide range of situations, although some are more suitable than others in specific circumstances. This statement is just one source of competition between companies selling products.

Although many Australian farmers and professional contractors have been reluctant to use these additives, and sceptics still abound, those using them have first-hand experience of some of their benefits. This is most notable when the additive runs out during the harvest of a paddock.

Silage fermentation is highly complex with many interactions between practical factors such as moisture content, length of wilt, chop length, degree of compaction, sealing effectiveness and the micro-organism involved in the ensiling process, plant enzyme activity and organic chemical changes. As a result, worldwide research is continuing to look for improvement of existing products as well as for new additives to ensure a successful fermentation.

There are three main groups of silage additives: *Fermentation enhancers, Anaerobic fermentation inhibitors* and *Aerobic spoilage inhibitors.*

- *Fermentation enhancers* or *stimulants* (inoculants, enzymes and sugars) result in a faster fermentation which creates a faster drop in pH (ie. becomes more acidic) which preserves the crop more rapidly, thereby reducing dry matter and quality losses.
- *Anaerobic fermentation inhibitors* (organic acids, buffered acids, specific sulphur bearing compounds + amylase) which mainly work via a direct chemical basis to reduce or prevent fermentation by all naturally-occurring bacterial groups (good and bad) in the forage. The latter product uses amylase enzymes and sulphur compounds to achieve the same outcomes.
- *Aerobic spoilage inhibitors* (organic acids, buffered acids, special purpose inoculants, non protein nitrogen, sulphur-bearing compounds + amylase) delay the onset of silage spoilage such as heating (Figure 1) and mould growth causing lost dry matter and quality and soften lowered palatability.

This article focuses on the aerobic spoilage inhibitors. Some crops and situations are particularly vulnerable to aerobic deterioration when the silage stack/pit/bunker is opened. Silage spoilage arises from air (actually oxygen) entering the silage and is due to the activity of aerobic bacteria, yeasts and moulds. This results in losses of silage dry matter and nutritive value, reduced intakes due to poorer palatability, and sometimes animal health issues. This all leads to lost animal production and increased costs.

Spoilage may not occur for two to three days in 'stable' silages but can be immediate and substantial in specific crops and also as a result of some management circumstances. This is where aerobic spoilage inhibitors are targeted.

In the past and particularly in Europe and the UK, organic acids (egs. Formic, Sulphuric, Propionic) were used to kill all microorganisms in the ensiled forage. These were very effective BUT dangerous to humans and corrosive on machinery and concrete. In recent years their buffered counterparts were developed to become much safer options for humans, equipment and concrete. All were usually very successful in reducing aerobic spoilage at feed out.

Continued research into this aspect of silage production has lead to the successful development of alternative additives, using different modes of action, to obtain the same outcome, delaying aerobic spoilage of silage after opening of the storage.

We do not need this group of additives if wilting and harvest occurred within one to two days, the stack or bales compacted very densely and sealed airtight soon after harvest. If only ONE of these ensiling management practices is less than ideal, such as large quantities of air being trapped in the stack due to poor compaction (Figure 2), the air-loving mongrel microorganisms will use this air to "live" and consume the sugars and causing protein breakdown, and populate rapidly before the air is totally used.

It is important to understand that these mongrels now become dormant until air enters again at opening but their activity has made conditions very unfavourable for the desirable lactic acid-producing bacteria to do their job of reducing the acidity of the forage.

In the good ensiling conditions mentioned above, a rapid feed out rate across the face at stack opening will result in negligible aerobic deterioration. However, if ensiling management slipped up there will have been a large numbers of aerobic bacteria, yeasts and mould spores in the storage, becoming dormant once the oxygen finally runs out. These large dormant populations "wake up" and start consuming any residual plant sugars and break down the lactic acid produced by favourable bacteria at ensiling into less acidic acids, opening the gate to more air-loving mongrels.

Where are aerobic spoilage inhibitors most useful? This group of additives, applied at ensiling, is very useful in the following scenarios:-

- Where the ideal ensiling process has not occurred, as is common on many farms.
- Specifically in many maize crops, Lucerne, and whole crop cereal silages cut at the soft dough stage, and even more so if these species are harvested at higher drier than ideal.
- Where the feeding face of pasture silage stacks is too wide for the feed out rate. Farmers will know this by the heat and mould presence in previous years.
- Where silage is left in a TMR wagon overnight.

Apart from the acids and buffered acid salts mentioned above there have been recent developments in other aerobic spoilage inhibitors. A major advance has been bacterial inoculants containing *Lactobacillus buchneri* 40788. The 40788 refers to a specific

strain of *L. buchneri*, which has been shown to be very effective in doing the job. Be aware that there are other bacteria such as *Lactobacillus brevis* currently being researched for the same purpose.

It is still unclear as to how *Lactobacillus buchneri* 40788 completely achieves the end result but it is known to break down some of the lactic acid to acetic acid which in turn, inhibits yeast growth, the main culprits in stack heating and subsequent mould growth.

L. buchneri bacteria on its own, and some products contain other bacteria as well, will usually delay the onset of aerobic spoilage for several days. It works best if well established good ensiling practices are followed but should not be used to cover up poor stack face management or loose silage left at the stack base. These additives will not prevent silage spoilage deterioration in stacks where the plastic has been holed for many weeks during storage.

Another product containing sulphur compounds plus amylase is a fermentation inhibitor but also has the effect of being an aerobic spoilage inhibitor at feed out. There are other products purporting to act as aerobic inhibitors which may/may not be effective. Ask the representative to provide independent research to back up the product claims, and if convinced to buy the product, test its effectiveness at feed out. There should be no heating or mould growth for at least two to three days after opening, if not longer.

Watch this space as research is continuing in this area of spoilage inhibitors and new inoculants in particular, such as *Lactobacillus hilgardii*, will be coming available in the near future.

Figure 1. Aerobic spoilage in pasture silage stack Figure 2. Poor compaction