



Dept. of Animal & Food Sciences

531 South College Avenue
Newark, DE 19717-1303

Phone: 302-831-2522

FAX: 302-831-2822

Email: LKSILAGE@UDELEDU

July 2011

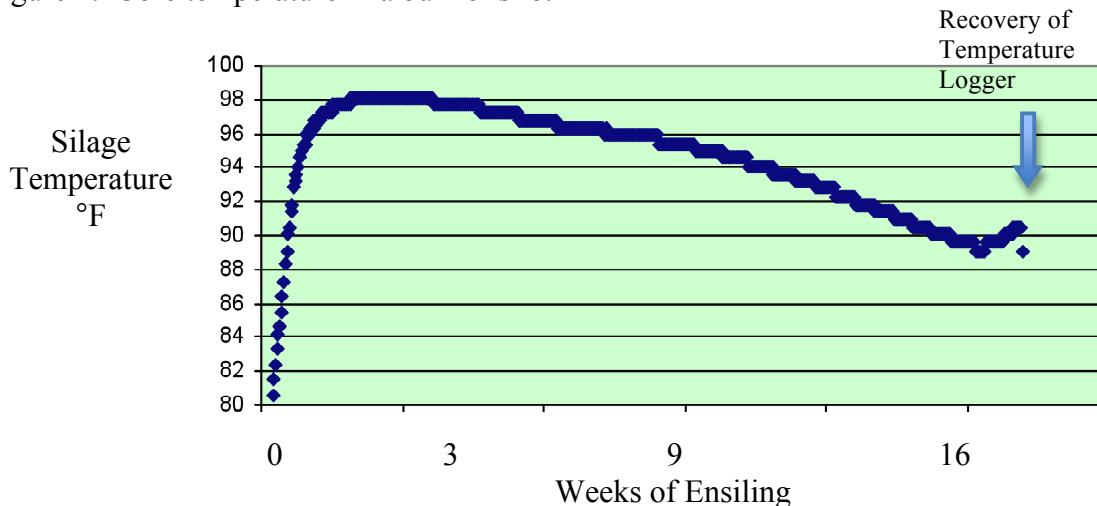
Silage Temperatures: How Hot is Too Hot?

Limin Kung, Jr., Ph.D.

The production of heat is a normal occurrence during silage fermentation. If silage is well packed and sealed immediately, the average temperature of the main forage mass should not rise to more than 10 to 20°F above the ambient temperature at filling. However, temperatures in the upper most layers (top 6 to 12 inches) of a forage mass may reach as high as 110-130°F especially after sitting overnight or for several days because of equipment breakdowns or packing delays because of bad weather. These high temperatures are often a result of excessive amounts of air trapped in the forage mass leading to oxidation from aerobic microorganisms. The key is that these temperatures should decrease quickly as further packing removes air from the mass and fermentation takes place. Prolonged high temperatures above 115-120°F can lead to heat damaged protein. Temperatures in this range may also be detrimental to many lactic acid bacteria that are needed to achieve a successful fermentation. Thus, forage should be chopped adequately, packed quickly and tightly sealed as soon as possible to remove and keep the air out of the forage mass.

When the active phase of fermentation is complete, temperatures in the core of the silo often fall slowly to 70 to 85°F. Small silos (including bag silos and large bales) should cool more quickly than larger silos. Retained heat should seldom register above 95°F especially after 2 to three months of storage. Core silage temperatures often remain high for prolonged periods of time in large silos because the large forage mass acts as insulation, resulting in a very slow dissipation of heat. Figure 1 shows the core temperature of a large bunker silo of corn silage in Wisconsin measured from a temperature logger that was buried at the time of ensiling. The silo was filled on Aug 18 and the data logger was retrieved on Dec 23. The temperature rose to a high of 98°F and slowly declined thereafter but remained above 90°F for more than 3 months although ambient temperatures were in the 40-50°F in December.

Figure 1. Core temperature in a bunker silo.



In some instances, silages can be found to be relatively hot (> 100°F) even after 4 to 6 weeks (or more) in the silo. This finding may be more common in silages that have been harvested dry (>40% DM) and poorly packed. In these instances, prolonged heat may be the result of a slow fermentation and/or aerobic oxidation. Dry silages tend to be more porous when packed and the slow fermentation prolongs total microbial activity and is unable to suppress the metabolism of yeasts and molds because there are low amounts of antifungal acids produced and a rather high pH. If the silo in question is also being fed out of, this may exacerbate the problem because the silo face is being constantly disturbed, allowing air to continually penetrate into the mass. Decreasing the length of chop for high DM forages (and mechanical processing of corn silage) may be warranted as these practices help to increase packing density.

High temperatures in a silo can be due to aerobic deterioration. Penetration of air into the silage mass results in growth of lactate-assimilating yeasts, an increase in silage temperature, and an increase in silage pH. The latter ultimately results in the growth of opportunistic bacteria and molds that thrive in oxygen cause more heating and spoilage. In some cases temperatures in silage faces may reach in excess of 145°F. During cool weather, steam is often released during feedout from the face of large silos because of the difference between retained heat and the ambient temperature. The presence of steam does not always mean that silage is spoiling. Signs that silage is aerobically spoiling include measuring temperatures in excess of 100°F four to eight inches in back of the silo face at feed out, reheating in the bunk, visible mold, lack of a sharp or sweet smell to the silage and/or a flat or moldy/musty smell. If a pH meter is available, a moldy smell coupled with a high pH may also be a good indicator that a feed has undergone aerobic deterioration. Aerobic deterioration of silages is of course more common during warmer weather.

Relatively inexpensive probes can be used to monitor temperatures in silage piles. Purchase one that is at least a 2-3 ft long.

Table 1. Average normal temperatures of silage.

Stage	Normal Temperature Range
Early ensiling - core samples	85 to 105°F
Early ensiling - shallow surfaces, loosely packed forage	85 to 130°F
During storage – core samples, small silos	Similar to ambient or just a few degrees warmer
During storage - large silos, core samples	75 to 90°F
Active, aerobically spoiling silages	>105 to 120°F