

# Monitoring Total Mixed Rations and Feed Delivery Systems

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## KEYWORDS

- Total mixed ration (TMR) • TMR Audit • Mixing factors
- Penn State Particle Separator (PSPS) • Percent coefficient of variation • Sampling

## KEY POINTS

- Total mixed rations (TMRs) are formulated to contain a combination of feedstuffs that provide the right balance of nutrients in every bite consumed.
- Poorly mixed TMRs negatively impact animal performance and health.
- A system has been developed to monitor the feeding process and the consistency of the TMR (TMR Audit is a system developed by Diamond V dairy technical specialist to evaluate TMR consistency. 2008).
- There are 9 main factors in the TMR mixing process that can each create variation in the TMR.
- Facing silage from bunkers and piles and premixing the defaced silage with a loader bucket or mixer wagon makes the silage more consistent in moisture and nutrients and is a key to minimizing variation between formulated and prepared diets.
- Mixing feedstuffs into a uniform TMR requires a lifting and dropping action created by augers, reels, paddles, or a combination of these elements in mixers.
- The Penn State Particle Separator (PSPS) is a useful tool to evaluate particle size variation in a TMR and to evaluate TMR consistency.
- TMR consistency or mix quality can be determined by performing PSPS analysis on 10 equally spaced samples of freshly delivered TMR along the feed bunk.



**Videos of pushing, lifting, and mixing defaced haylage as it is made into a pile; mixing and unloading haylage that was stored in a bag; mixing action of a well-maintained vertical mixer and lack of proper mixing action of a vertical wagon with a wornout kicker plate; 2 fresh cows in the same pen eating hay or grain in a TMR that was poorly mixed with underprocessed alfalfa hay; the influence of unlevel mixer box (left) and level mixer box (right) on distribution and**

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consistency of the TMR; feeder loading corn silage in the front of a dual-auger vertical mixer wagon; overfilled and normal-filled reel-auger mixer; overfilled 4-auger mixer and overfilled dual-auger vertical mixer; an underfilled dual-auger mixer containing close-up dry cow TMR with mineral remaining on the auger; grain mix does not get mixed into the TMR; liquid dispensed through a single pipe in front of the mixer box accompany this article at <http://www.vetfood.theclinics.com/>

## THE TOTAL MIXED RATION AUDIT

The TMR Audit is an on-farm evaluation of the following:

- Silage management
- Distribution and levels of feed and sorting across feed bunks
- Feed center organization and feed mixing equipment flow
- Total mixed ration (TMR) loading and mixing process
- TMR delivery
- Evaluation of the TMR particle size consistency within and across loads of TMR

This article focuses on reducing variation in TMRs with silage face management and with TMR loading and mixing.

## REDUCING VARIATION IN CORN SILAGE AND HAYLAGE

A key part of the TMR Audit evaluates the feed out management of silages. Key practices that minimize dry matter (DM) and nutrient variation and silage spoilage are as follows:

- Vertical and smooth faces from where the silage is removed each day
- An adequate depth of silage is removed from the face each day to prevent heating and spoilage
- The leading edge of plastic covering the silage is cut back at least twice weekly to minimize spoilage and weighted with a continuous row of tires to prevent air from traveling across the silo beneath the plastic
- Spoiled silage is removed before facing
- Multiple layers of plastic, and the use of oxygen-limiting plastic, help to reduce spoilage
- The mechanically defaced silage is premixed with the loader bucket or mixer wagon before feeding
- Little to no loose silage should remain after feeding is complete

Significant variation in DM and nutrients often exists across the vertical face of haylage and corn silage stored in bunker silos.<sup>1</sup> Similar variation occurs in forages stored in bags and bales. A key management approach to minimizing this variation, and in making “the paper” ration more similar to the prepared TMR, is to premix forages before they are used to make a load of feed. For example, there was a stepwise reduction in the differences between the high and low content of crude protein (**Figs. 1–3**) in haylage sampled directly from the face (F) of a drive-over pile, from haylage mechanically faced into a windrow (WR) and from mechanically faced haylage after it was pushed and lifted into a conical shaped pile (P) as shown by the video (**Video 1**). **Fig. 4** shows average content and coefficients of variation of selected nutrients in alfalfa haylage sampled from the F, WR, and P. Pushing and lifting haylage into a pile with the pay loader created a mixing action that reduced the nutrient variation

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