R1769

Processing Forages for Livestock Feed

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Forage is the foundation feedstuff for ruminant livestock production.
Forage choices are diverse, depending on the region and climate, and include annual and perennial cool- and warm-season grasses, cereal grains and legumes. Forage quality can be highly variable, depending on forage species, stage of harvest, curing methods and storage.

Diet consistency, palatability, nutrient content and cost effectiveness for livestock diets are critical. Feed costs for beef cattle in the northern Great Plains can be well in excess of half of the production costs.

Processing forages provides some advantages. Processing can maximize the use of forages to be included in a total mixed ration for livestock diets. This process also can decrease waste from animal selection and allow more precise ration formulation.

Processing forages will decrease particle size, reduce opportunity for sorting of forages by animals, and allow for uniform blending of one or more roughage sources in a total mixed ration (TMR). Additionally, using processed forages in a TMR allows managers to control the amount of roughage consumed more precisely, compared with relying on self-fed forages.

Current methods of processing dry forages include chopping, grinding and shredding.

This publication will address:

- **Equipment used for processing**
- **Benefits that may be gained through processing forages**
- **Other considerations for processing forages for livestock diets**

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Equipment Used for Processing Dry Forages

Three basic types of equipment are available to alter the particle size of dry forage for livestock diets: bale processors, tub grinders and vertical mixers.

A **bale processor** has a flail system that penetrates a rotating round bale or a large square bale on a moving platform. The bale leans on a set of slug bars, with the internal chamber turning at approximately 1,300 revolutions per minute (rpm). Forage particle size is influenced by adjustable bale distance from the slug bars, chamber speed and texture of the forage.

A finer forage such as cool-season grass hay will produce shorter particles than a coarser warm-season grass hay or a cereal-grain hay. Particle size will vary from 4 to 8 inches, depending on the variables mentioned previously.

The processed forage can be discharged in a windrow for feeding on the ground or in a fence-line bunk with the use of a shroud.

The bale processor also can be used to spread bedding material over a wide area for animal comfort or possibly as mulch in establishing vegetation on specific areas by opening the discharge chute. A tractor size of 80 to 150 horsepower (HP) is required, depending on the size of processor.

A **tub grinder** is constructed with a large rotating tub in which bales are deposited. The grinder is equipped with a hammermill that breaks the forage up through screens of various opening sizes. The screen opening size will determine the size of the forage particle.

Screen sizes range from ⅛ inch for grains to a large 8-inch round opening for simply conditioning forages. Forage particle size will be very consistent with the tub grinder. Particle size in beef diets will depend on the objective of the operation and type of cattle that are being fed. In general, the larger the screen size, the quicker the forage will be ground.

On the other hand, if sorting of coarse or other feeds is a concern, a smaller screen size can reduce particle size, which is most desirable for even forage distribution and less sorting in feedlot diets.

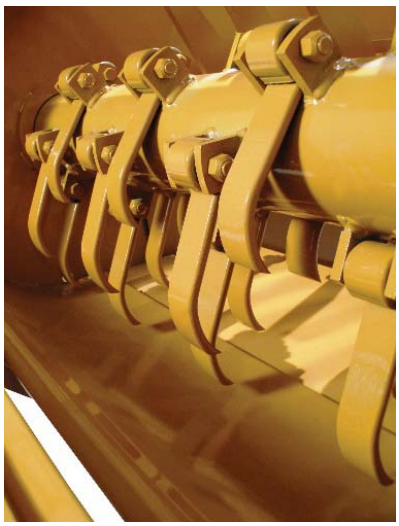
Larger screen sizes may be chosen with coarse forages such as corn stover if chopping speed is an objective. In the case of high-moisture forages, grinding time can be compromised with a small screen, so the choice of a larger screen size will reduce grinding time and clumping within the forage.

If leaf loss is a concern, as in alfalfa, a larger screen size or removal of the screen can minimize leaf loss, compared with a small screen.

The tub grinder discharges ground/chopped forage onto a moving belt that elevates and piles the forage for later handling by a front-end loader. The stockpiled forage typically is added as needed to a mixer wagon or vertical mixer as part of a TMR.

A bale processor is used for shredding long-stemmed hay, most commonly in a large round bale. Bales up to 5½ feet long by 6½ feet diameter and 2,000 pounds can be processed. This unit also is useful for spreading bedding material such as small-grain straw or corn stover.

(Photo courtesy of DuraTech Industries/Haybuster, Jamestown, N.D.)



This is a close-up view of the flail system inside a bale processor.

(Photo courtesy of DuraTech Industries, Jamestown, N.D.)

A tub grinder can grind forages to a precise size. Most tub grinders can process round and large square bales.

(Photo by Fara Brummer, NDSU Extension)

These are screens for tub grinder. From left to right, they are 5-inch, 2-inch and 7-inch screens.

(Photo courtesy of DuraTech Industries/Haybuster, Jamestown, N.D.)

This is an inside look at a vertical mixer with vertical augers and knives that will shred forages in a general range of sizes. Most vertical mixers will have a weight limit for hay addition, depending on their capacity.

(Photo courtesy of DuraTech Industries/Haybuster, Jamestown, N.D.)

A **vertical mixer** also can be used to reduce the particle size of baled forages. It operates like a large blender, similar to a feeder wagon but with vertical instead of horizontal augers. A series of knives are attached to the augers, which allows the shredding of forages. An entire bale can be placed into the vertical mixer, along with other ration ingredients, for a TMR. The aggressiveness of the knives can be adjusted by an outside mounted restrictor plate that is controlled by a lever.

The vertical mixer allows for convenience and speed in mixing a ration. However, forage particle size will not be as precise or consistent as with a tub grinder. A tractor size of 150 to 250 HP is required for the vertical mixer, depending on its size.

Benefits of Processing Forages in Livestock Diets

Baled forages are subject to waste when fed directly to livestock. Waste occurs because of livestock discriminately selecting specific components of forage (leaves, smaller stems), animal trampling, spoiling (urine and manure deposition) or bedding on excess forage.

Rolling out large round bales on the ground, while an easy form of delivering hay, can result in substantial waste. Bale feeders of various types can reduce waste; however, animal crowding can be an issue with some bale feeders, and changing placement or location of feeders requires additional labor and machinery.

Differences in social status within a herd also can influence the amount of forage individual cows consume. Dominant "boss" cows often will push more timid cattle away from the feeder, especially if access area is limited.

Bale processers can provide an even row of chopped forages that will allow evenly spaced cow access to the forage. Providing only the amount of forage required per day reduces the likelihood of trampling or contamination losses and the chances of cattle using the feed as bedding.

For feedlot applications, ground hay from a tub grinder works very well with a feed mixer wagon for a total mixed ration. Research has shown that weaned calves in the feedlot gained 0.25 pound more per day and were 10 percent more efficient when fed a TMR, compared with the same hay and grain components fed separately.

Other Considerations for Processing Forages for Livestock Diets

Particle Size and Effect on Rumen

Cattle require dietary fiber with a minimum particle size for proper rumen function and diet digestibility. Forages encourage chewing by the animal, which is directly related to saliva production. Saliva contains bicarbonate, which buffers the rumen pH and reduces ruminal upsets such as acidosis.

Cattle spend less time chewing and ruminating when fed processed forage, compared with long-stem hay. Therefore, a balance between proper rumination and forage intake should be reached in the ruminant diet to maximize the feed value of forages.

Forage particle size has been shown to influence the dry-matter intake (DMI) and dry-matter (DM) digestibility of forage in the cattle diet. Research has shown that larger particle size can decrease DMI due to more rapid gut fill, but forage maturity and preservation may have more influence on intake than does particle size. Other researchers report that changing the particle size of alfalfa hay did not increase feed value in the diet.

Further research in processed forages in the beef cattle diet is warranted to determine specific recommendations for particle size.

In beef cattle diets, common practices include a particle size of 4 to 5 inches for finishing diets to encourage rumination and prevent acidosis on a finishing ration. A smaller particle size often is used in backgrounding diets, especially with low-quality roughage.

Forage processing will not improve low-quality forage, such as late-cut, mature or moldy forage. It also will not improve the feed value, although it will allow the feed to be mixed, diluted and blended into a TMR.

Grinding high-quality hay such as alfalfa could result in poorer-quality feed in the pile than the original bales if large amounts of leaves blow away during grinding or spoilage occurs because of exposure to precipitation.

Inclusion in Specialized Livestock Diets

Chopping or processing hay can break up coarse forages, which can result in more complete digestion. This potentially can provide a more palatable and digestible diet for older or broken-mouth cows, or young stock on a wintering program. Cull cows on a finishing diet may be better able to utilize ground forages than long-stemmed hay.

Summary

Processing forage by chopping or grinding is useful for ensuring livestock diet consistency. The primary benefits include reduced feed waste and the ability to mix diets more precisely with a wider variety of feedstuffs.

Processing will not improve hay quality; however, it potentially can increase DMI within a blended TMR due to a smaller particle size. Processing also can help producers develop more precise and cost-effective rations.

These benefits need to be weighed against the processing cost to determine if forage processing is warranted.

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