

## Methods of Feed Processing For Improving Nutritive Values of Grains and Roughages

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**ARTICLE ID: 33**

### **Introduction**

In Animal production now attention is on maximizing nutrient utilization because feed costs 70-80% of total cost. For achieve the maximum potential nutritional value of feed stuff, feed processing is best way. Feed processing is technique in which application of physical, chemical, biochemical, biological and physiochemical methods to increase the nutrient utilization of feeds and fodders in animal production. Advanced feed processing technologies such as fine grinding, pelleting, baling, micronizing, roasting, high-shear conditioning, together with optimum uniformity can improve feed utilization and subsequently animal performance. The effect of feed conditioning and processing on nutrient availability needs to be determined to increase the precision of feeding programs to reduce costs optimally. Feed processing and costs of processing include wide range of operations including receiving, grinding, proportioning, mixing, pelleting, load out and delivery. Each operation has a positive or negative influence on subsequent animal performance and can certainly influence final profitability.

### **Objective of feed processing**

- To make the feed more palatable
- To detoxify or remove undesirable ingredients
- To make the storage easy and safe
- To increase nutrient content and nutrient availability
- To change the particle size or density of feed
- To make animal production more economical
- To improve keeping qualities
- To lesson moulds, salmonella and other harmful substances

## Roughage processing methods

Processing of roughage does not increase the nutritive value but palatability, digestibility and availability of nutrients increased. Processing methods such as baling, field chopped, cubing are to be done to make handling easy, to reduce the cost of transportation and space required for storage.

### Physical Methods

#### a. Dry processing method

In dry processing methods water content is reduced to a desired level.

- **Baling:** The forage is cut and dried in the field condition. Dried forage is then baled or bundled with Baler. By this method we make storage and handling of forage easy and convenient.
- **Chopping/Chaffing:** The forages are chopped into small pieces as fine or course particles. Chopping avoids the selective feeding thus wastage of plant material is reduced. Chopping facilitates easy handling due to increased bulk density. Also improves digestion due to exposure of relatively large surface area of roughages for microbial digesting.
- **Grind:** It is process of particle size reduction. Course grinding of roughages improves the feed consumption and growth rate whereas fine grinding of roughages of reduce the digestibility of crude fibre due to which faster rate of feed particles in GIT. Grinding of roughages is not economical.
- **Pelleting:** Pelleted feed has become extremely popular over the last decades in a number of species. The ground roughages are pelleted and fed to animals. Improves the consumption of poor-quality roughages. A complete feed: - Pelleting poor quality of roughages with 30% concentrate. The size of pellets is 12/64” to 48/64” and has density of 40 lb/ cft.
- **Dehydration:** It is the process of reduction of moisture content in a dehydrator using a temp. 600- 1500<sup>0</sup>F for a short time period of 3-5 minutes. Dehydrated forage retains high DM and CP.
- **Cubing:** -It increases the density of roughages upto 30lb/ cft. Good quality hay is sprayed with water to increase the moisture content upto 14%. Broken down rather than to ground the roughage, so that there is minimum of fine particles in the cube.



Baling



Chopping



Cubing

#### b. Wet processing method

- **Soaking:** Soaking is a process of mixing or spraying water on roughages so that stems become soft and mixing of concentrates with roughage is uniform which improves the feed intake and digestibility of roughages.
- **Chaffing:** When green roughages are chaffed, there is no need of soaking and fed as such or mixed with dry roughages or concentrate mixture.

#### ✚ Chemical Methods

- **Alkali method:** Mostly used in treating straw and other agro-industrial crop residues. It reduces the strength of the intermolecular hydrogen bonds which bind the cellulose fibre without affecting much of the cell wall. In this method straw is soaked in 10 times its weight of 1.5% sodium hydroxide for about 24 hrs. The liquid is then drained off and can be used for succeeding batches of straw.
- **Lime treatment:** Calcium hydroxide generated from lime may prove to be cheapest alkali available for effective treatment for coarse roughages. In this method 1.25% commercial lime is used and the straw/ agro industrial by products is soaked in the lime solution for several days and the digestibility have shown to increase by 25-30 %.
- **Urea treatment:** Animal can use urea as source of nitrogen which will generate ammonia for the ruminal microbes and microbial biomass used as nitrogen source for the host animal. Generally, 4 per cent of urea is sprayed over the chopped straw and keep for 25-30 days period for liberate ammonia to act upon ligo-cellulosic bond.
- **Urea mixed in silage:** Another way of urea feeding to livestock especially dairy cattle is through addition of urea to crops which are being ensiled. Maize plant in

50% flowering cut and chopped. This chopped material ensiled and urea is then added at 0.5 per cent on wet basis.

#### **Biological Methods**

- Use of selected bacterial and fungal culture in roughages has been considered in recent past to increase the nutritive value over chemical treatments. Plant residue composed of cellulose, hemicellulose and lignin. The biological treatment causes simplification of these compounds by releasing appropriate enzymes from microbes so that the materials ultimately become easily digestible upon intake by the ruminants.
- The fast growth rate of microbes results in enriching the roughages with protein values also.
- Enzyme treatment: Cellulase solution is sprayed on straw at 25mg/100kg straw.

#### **Processing of grains**

Grain processing methods are divided into wet and dry processing methods. The primary objectives of grain processing are to improve the availability and digestibility of starch.

#### **Dry processing method**

- **Grinding:** It is simplest process in which feed is reduced into particles by the application of pressure and shearing. This is least expensive method which is accomplished with the help of hand stone mill, hammer mill and roller mills. The size distribution of grains depends on the shape, size and hardness of kernel. Grinding is prerequisite for mixing, pelleting or extrusion. Fine grind increases surface area per unit volume for absorption more water which increases gelatization of starch and improve feed utilization. Coarsely ground grains are preferred for ruminants while finer grains are used for poultry and pig feeding.
- **Cracking or dry rolling:** It is the disintegration of kernels into particles with the application of pressure by moving rollers. It is done by combination of breaking and crushing of the grains. Cracking breaks the hull or seed coat and the results in an end product of coarsely grain sometimes referred to as flaking.

- **Crimping:** The process of rolling of feed ingredients with the use of corrugated rollers is called crimping. The process may include conditioning and cooling of the processed feed.
- **Crumbles:** The feed of granular particle size produced from the grinding of pelleted feeds is called crumbles.
- **Popping / puffing:** It is produced by the action of rapid application of dry heat for 15 - 30 seconds causing a sudden expansion of the grain which ruptures the endosperm. Rupture of the starch granules makes the starch more available to digestion. About 3% moisture of grain is lost during heat treatment. Popping reduces the density of grains hence require more space. Popped grains increases palatability and digestibility of starch improve. For increasing the digestibility of all grains may be processed by this method, but it appears that it is more effective in case of sorghum or other milo grains.
- **Micronizing:** Micronizing is especially the same process as popping, except that heat is provided in the form of infra-red energy. The popping of grains with the application of infrared heat energy having wavelength of  $3 \times 10^8$  to  $3 \times 10^8$  cycles/second is called micronizing.
- **Roasting:** The treatment of grains with direct flame is called roasting. It causes expansion in volume due to heating and generally increases digestibility. Roasting of whole soybeans inactivates enzymes or inhibitory factors which improves the nutritive value of poultry.
- **Dehulling:** Dehulling is the process of removing the outer coat of grains, nuts and some fruits as the hulls are high in fibres and low in digestibility in poultry and other mono-gastric animals. The best-known outer covering of cereals are barley hulls, oat hulls and rice hulls.

**Grinding****Crumbled Maize****Dehulling**



### ✚ Wet processing

- **Soaking:** Grains are soaked in water for 6 to 24 hours. Due to soaking grains swells and become softens which is more palatable. Soaked grains are easily mixed with roughages and wastage is reduced. Removes toxic factors present in feed.
- **Reconstitution:** It is similar to soaking water is added to mature dry grains (10%) to raise the moisture content 25 to 30%. Stored the wet grains in an oxygen limiting silo for 14 to 21 days prior to feeding. It also increases the solubility of the grain protein.
- **Steam rolling:** Grain steam for different periods of time depending upon the pressure used prior to rolling. Rolling refers to process by which grain is compressed into flat particles by passing between rollers. This only softens the grains without any significant change starch granules. The only advantage of steam rolling over dry rolling is the production of the large particles with little fines.
- **Steam flaking:** Grains are subjected to steam treatment for 15 to 30 minutes to raise moisture content in grains 18 to 20% and then rolling of such grains, flakes are produced. Process ruptures starch granules which improve physical texture, nutrient utilization and performance.
- **Pressure cooking and flaking** Grains are first cooked under steam pressure, cooled to room temperature and then rolled. The product is more or less similar to steam flaked grains but the processing is much expensive. Grains are subjected to steam at 50 psi for 1.5 min in air tight chambers, temperature of 300<sup>0</sup>F. When flakes are made, this temperature is reduced to 200<sup>0</sup>F and moisture content up to 20% by passing them through cooling and drying tower.
- **Extrusion:** -A process of cooking in which feed are also expanded by the application of adequate pressure is known as extrusion. Purpose of extrusion is gelatinization of starch of grain or complete feeds. It is also used for the corporation of urea in starchy feed. Control of pathogenic micro-organisms in feeds of animal source.

- **Exploding:** Exploding is the swelling of grain, produced by steaming under pressure followed by releasing the air. In this process of swelling of steam treated grains under high pressure and sudden expose to atmospheric pressure or Grains are treated with high pressure steam (250 psi) for 20 seconds followed by sudden decrease to atmospheric pressure is known as exploding. It is done in steel vessel fitted with valve for injecting steam to raise pressure inside the grain containing vessel to 250 psi for about 20 sec. After that outlet is opened through which treated grains escape in the shape of expanded grains with husk removed.
- **Pelleting:** The process of densification of ground grain or composite feed with or without the application of steam or moisture is known as pelting. The ground feed material is forced to pass through the holes of specific size by mechanical process. The purpose of pelleting is to change dusty and unpalatable feed material into more palatable easy to handle large particles of by application of optimum amount of heat, moisture and pressure. Normally pellets are cylindrical shaped 3.9mm to 19mm in size.
- **Gelatinization:** Complete disintegration of starch granules by the application of moisture, heat and pressure is known as gelatinization. It improves the digestion of feed by increasing water absorption ability and rate of action amylase on soluble carbohydrates (starches).

**Pelleting****Flaking****Extrusion**

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