NOTES FROM SUSAN GARLINGHOUSE EQUINE NUTRITION & RESEARCH

AVS 303: Feed Preparation and Processing

Feed processing methods may be chemical, thermal, mechanical (or combination)
Processing may also include microbial fermentation ,ie ensiling

Processing does one or more of the following:
alters physical form of particle size
prevents spoilage
isolate specific parts of a seed or plant (separate corn grain fromplant, but also corn starch from grain)
improves palatability
inactivate toxins or antinutritional factors
improve handling (chopped hay can be fed more easily by mechanicalfeeders than can baled hay)

Processing becomes more important as level of production increases (whenmax production is desired)
Not so important in band of sheep on rangeland that don't need to growat any specific rate
Very important in intensive production such as poultry, swine confinement operation, dairy

Why, because heavily fed animals more likely to sort through feed andpick out only the feed they like, or to refuse/waste feed if they don'tlike it.

Also, in ruminants, efficiency of digestion decreases as level of consumption increases. This because food moves too rapidly throughrumen for maximum fermentation and extraction of nutrients. Processing counteracts part of this decline in digestion

Processing of grain can be divided into wet/dry methods, hot/cold methods

Cold-processing:
Hammer mill grinding - most common processing method. Used forboth grains and roughages. Hammer mill is rotating metal bars that blowsground feed through a screen, the finer the screen used, the smaller the particlesize.
Can produce anything from a cracked grain to a fine dust. Particlesize is important because the smaller the particle size, the more SA you'reexposing to digestive enzymes and microbes, but—ruminants and horses don't like eating very small particles, okay for poultry and swine.

Roller mill cracking and grinding - used only for grains, not roughages.
Grain goes between two metal rolls, particle size controlled by howfar apart the rollers are. Particle size range from cracked grainto fine

powder (fines). Does produce as much dust as hammer mill processing,but doesn't grind hulls as well as hammer mill.

Soaking and reconstitution - two similar processes, where grain is soaked prior to feeding. In soaking, feed is soaked in water, sometimeswith heat for 12-24 hours. Increases palatability, but not marked increasesin digestibility. In reconstitution, enough water is added to wholegrains to increase moisture content to 25-30% and kept in oxygen-limited silofor 14-21 days. Some fermentation takes place. Increases palatabilityand feed efficiency, but not enough to warrant the amount of work and storagespace required.

High Moisture Grain - Grain harvested at high moisture content (20 -35%), sometimes ground or rolled, treated with 1 - 1 ½ % acid andstored in a silo or under plastic. Acids used to preserve are primarily propionic,or mixture of propionic with acetic or formic acid. Feed efficiencyis higher than for dried grains (no matter how dried grains are processed), butharder to store and transport. Mostly used when weather conditions don'tallow for complete drying of grains in the field prior to harvesting. Candry grains artificially, but may be more expensive than storing as high-moisturegrain.

Hot processing methods:

Includes steam rolling/flaking, extruding, pelleting.

Steam rolling/flaking - in rolling, grain is exposed to hot steam for5 minutes before rolling to soften grain. In steam flaking, steamedfor 15-30 minutes. Steam rolling has increased feed efficiency over drygrains, steam flaking higher feed efficiency over steam rolling (exception barley-steam rolling just as good as flaking). Both, better physical texturesas fewer fines, so ruminants like them better.

Pelleting - feed is ground, usually steamed (not always), then forced through dies to produce pellets. Good use for fines that otherwisemay not be eaten. Animals like texture pellets more than they do a meal,less waste in windy areas because fines blow away. Improvement in feed efficiencyis due to grinding, not due to pelleting—the pelleting just makes thetexture more appealing to the animal.

Extruding - process where feed is ground, heated and forced througha head to form a long ribbon which is then chopped into desired particle sizeis. Used commonly in pet and human foods. Used with soybean products,because heat is enough to destroy antinutritional factors in raw soybeans. Soybeans contain several different compounds that inhibit amino acid utilization, decrease protein digestibility or are goitrogenic factors, but allcan be destroyed by heat. So soybeans are always heat-processed beforebeing fed to livestock (or pets or humans), extruding is one method.

Effect of processing on nutritive value:

Heating - excess heat causes Maillard reaction, reaction between proteins and carbohydrates in feeds, lysine becomes partially unavailable. Primarily a concern in plant protein sources (SBM, CSM< alfalfa, etc) or milk products, as other animal source feeds don't have enough carbohydrates present to cause reaction to any significant extent.

Excessive heating of animal or fish proteins decreases feeding value
Heating of cereal grains gelatinizes starch content and increases feeding value in dogs, cats, pigs, poultry, but not for ruminants or horses

Any processing method which increases surface area exposure to light, oxygen, heat, etc is going to decrease vitamin content. Vitaminsmost susceptible to heat are fat soluble vitamins (, thiamin, pantothenicacid, folic acid and biotin.

Excessive heating of fats releases acreolins and increases oxidation=> rancidity

Processing for specific species:

Swine: grinding and pelleting most common processing methods. Increases digestibility, decrease in sorting. Max feed conversion (numberof pounds of feed required per pound of gain) produced with fine grinding (.16cm screen), also develop stomach and esophageal ulcers, so medium grind(1.27 cm) better.

Screen size	0.16	1.27	2.54
ADG, kg	.65	.63	.63
Feed conversion	3.19	3.56	3.67

Pelleting - 9-10% improvement in feed conversion, gain weight at samerate, but eat slightly less and waste less. Pigs like physical textureof pellets, eliminates sorting. Alfalfa is primary roughage fed,but because of limited ability to digest roughages, relatively small portion ofration. If fed as hay or meal, pigs tend to waste a lot, so usually incorporated into pellet.

Horses - Pelleting, cubing feeds has very little or no effect on rateof digestibility in horses. In horses with good teeth, no increasein digestibility by flaking, cracking, etc. The advantages in processing/pelleting feeds is to decrease waste, eliminate sorting,allow use of fine particles (horses don't like fines), and easier handling, transport and storage:

Ton of hay cubes occupies 60-70 cubic feet storage
baled hay 200-330 cubic feet
loose hay 450-600 cubic feet

Horses eating pelleted hay also produce less feces, less labor costsin cleanup. Less feces is not due to increased digestibility ornutrient retention, is due to decreased (6% less) water content (theory of increased chance of feed impactions)

Increased feed intake because of less gut fill, useful if you need additional feed intake or don't want "hay belly" look in show horses. Horses can be fed 100% of their ration as pellets or cubes without physiological harm. However, feeding pellets = decreased feedingtime (25% less time to eat pellets than same amount of loose hay). Mayincrease incidence of choke, although uncommon problem.

In cattle, feeding all pellets or cubes may produce progressive enteritis, not investigated in horses, but indications that may be true for horsesas well. Prevented by 25% of forage ration as hay.

Feeding pellets doesn't satisfy grazing instinct, so increase in wood chewing four times over that in horses fed loose hay or cubes. Recommend at least 25% of ration in the form of long-stem hay to satisfy grazing instinct and provide entertainment.