SDSU Extension

BEEF

Chapter 19

Taking Advantage of Alternative Feeds

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Introduction

Nearly all food consumed by cattle is subjected to some amount of fermentation in the rumen. Thus, cattle can utilize a wide variety of feedstuffs to support maintenance, growth, gestation and lactation. Increased demand for commonly used feedstuffs to produce non-feed resources (e.g., ethanol production from corn grain) without corresponding increases in production can increase cost and decrease availability of these feedstuffs for use as cattle feed. Therefore, producers and nutritionists attempting to optimize cattle performance and feed costs are often incentivized to use feedstuffs that have not been broadly used in cattle diets (i.e., alternative feeds). The purpose of this chapter is to introduce some basic concepts of utilizing less common feed ingredients in cattle diets, and to provide an introduction to some alternative feeds commonly available in South Dakota and the Northern Great Plains at the time of publication. This chapter is not a comprehensive review of all available alternative feeds. For additional information on this topic the reader is directed to the review of Lardy and Anderson (2009).

General Concepts

Feeds can contain carbohydrates, fiber, proteins, fat, minerals, vitamins and water, and typically an individual feedstuff consists of a mixture of all of these nutrients. Cattle require each of these nutrients in different amounts to support maintenance, growth, gestation and lactation. Additionally, cattle in different stages of production (e.g., growth, gestation, lactation) have different nutrient requirements. Generally, feedstuffs with nutrient profiles that closely match requirements of cattle are referred to as 'high-quality' because these feedstuffs can most appropriately meet nutritional requirements.

The terms 'traditional' and 'alternative' feeds are subjective because feeds commonly used can vary by location and availability. Additionally, cattle operations which focus on different aspects of production (i.e., cow-calf operations, stocker or feeder, feedlots)

Key Points

- Nutrient composition among alternative feedstuffs can vary tremendously, thus testing for nutrient composition is important for optimal use.
- An increased amount of grain processing in South Dakota and the Northern Great Plains has increased the relative availability of many alternative feeds.
- A variety of alternative feeds are available; however, individual feeds need to be evaluated for nutritional value and cost effectiveness before use in beef cow diets.

often have different feedstuffs which they consider 'common' or 'traditional'. However, during the past 60 years several crops (e.g., corn, sorghum, soybeans) and forages (e.g., alfalfa, brome, timothy, wheat grass) have been broadly available and are commonly referred to as 'traditional' feeds and feeds that have been relatively less available are more likely to be referred to as 'alternative' feeds.

Many alternative feeds are residues or fractions of feeds remaining after processing of traditional feed ingredients for manufacture of non-feed resources (e.g., production of ethanol from cereal grains). Because nearly all processing techniques in these industries utilize a component (typically the component in greatest concentration) of a traditional feed, the remaining residue is often nearly devoid of that nutrient. Thus, the nutrients not utilized during manufacture are concentrated in the residue. For example, ethanol is produced from cereal grains (e.g., corn, sorghum) by fermentation of starch to ethanol. After removal of ethanol the remaining residue is commonly referred to as distillers' grains plus solubles (DGS). Currently, the typical composition (dry matter-basis) of corn grain is 77% starch, 8% crude protein (CP) and 3.5% fat (USDA, 2013). If all the starch in corn grain is removed the resulting DGS would subsequently contain about 35% CP and 15% fat. However, manufacturing processes vary by type of non-feed resource produced, manufacturer, location and economic incentives. As a result, nutrient composition among alternative feedstuffs can have large variations.

Evaluating Alternative Feeds

All feeds should be tested for nutrient composition when fed to cattle. An understanding of each feed's nutrient profile can allow diets to be accurately formulated to meet the needs of cattle, prevent costly overfeeding and minimize environmentally harmful contributions. Determination of nutrient content through wet chemistry techniques is preferred to near infrared spectroscopy unless it has been verified that the laboratory calibrated their equipment for the specific type of sample being analyzed. The use of near infrared spectroscopy is common in many commercial laboratories; however, if this equipment is not properly calibrated to a specific feedstuff, then the results may not be accurate. All feeds should be valued based on the content of nutrients most limiting to cattle performance. This form of feed evaluation is different than cost per unit weight. Typically, cattle that are beyond the age of weaning are most often first-limited in performance by energy intake. In fact, the major benefit of protein supplementation in cows is to provide sufficient amounts of ruminally available nitrogen, which in turn allows more extensive fermentation of feed. In other words, supplementation of protein to cattle is most often done to improve energy status rather than to provide greater amounts of protein directly. Because cattle are most often first-limited by energy then most feeds will be valued on a cost per unit energy basis.

For example, let's assume that a producer is trying to decide what feed to purchase to supplement their cows during winter after all available pastures have been grazed or when climatic conditions (e.g., extensive snow and ice cover) prevent grazing. This producer may try to evaluate the relative costs of feeding harvested corn stalks, brome hay or corn grain with a current market value of \$48, \$140 and \$187 per ton (as-fed basis), respectively. The first step to evaluate costs on a nutrient basis is to transform prices to a dry-matter basis. A typical dry matter (DM) content for corn stalks (80%), brome hay (91%) and corn grain (89%) can be found in published feed composition tables (e.g., NRC, 1996, 2001; Waller, 2004; Lardy and Anderson, 2009; Preston, 2013) if the actual dry matter content is unknown. Next, the price per DM ton can be calculated for corn stalks (\$48/0.80 = \$60), brome hay (\$140/0.91= \$154) and corn grain (\$187/0.89 =\$210). Similarly, the net energy for maintenance content (DM basis) of each feed can be estimated from feed composition tables. If the net energy for maintenance content in corn stalks (1,080 Mcal/DM ton), brome hay (1,100 Mcal/DM ton) and corn grain (2,032 Mcal/DM ton) is considered then the price per Mcal can be calculated by dividing the price per DM ton by the Mcal per ton for each feed ingredient. This would result in a price per Mcal of \$0.06 for corn stalks, \$0.14 for brome hay and \$0.10 for corn grain. Thus, in this scenario corn stalks would be the most economical option when priced on an energy basis, followed by corn grain and brome hay would be the most costly. It is important to understand that additional factors should be considered before making feed purchasing decisions. Additional consideration must be given to costs and method of delivery, rate of spoilage, and methods of storage in order to determine a feed's true value in any cattle production system. Costs of labor and initial capital investments should be considered if modifications to feeding systems will be necessary.

Chapter 18, Supplementation of Beef Cows, provides additional examples of costs of both "traditional" and alternative feedstuffs, taking many of these factors into account. The above example is provided in part to stimulate thinking on options available to cow-calf producers and to broaden understanding of cattle nutrient requirements.

When evaluating specific alternative feeds for inclusion in any type of cattle feeding system, it is also helpful to have an understanding of specific nutrients or chemical additives that may be added as a result of the manufacture of the non-feed resource. Specific concerns related to some alternative feeds have been outlined in the 'Summary of Some Specific Alternative Feeds' section.

Procurement of Alternative Feeds

Availability of many alternative feeds is related to location; however, an increased amount of grain processing in South Dakota and the Northern Great Plains has increased the relative availability of many alternative feeds. Additionally, many alternative feeds can be shipped long distances, but additional mileage for shipping will add to costs. It is important to have a preliminary understanding of the current market values when procuring feeds. This knowledge will be helpful in making procurement decisions from specific distributors. Several resources are available online that may be helpful in discovery of current prices and distributor contact information. The University of Missouri (Horner and Sexton, 2014) and North Dakota State University (Schroeder, 2014) maintain current listings of co-product availability and pricing. Additionally, the United States Department of Agriculture's Agricultural Marketing Service publishes national and regional reports on commodity pricing (USDA-AMS, 2014).

Summary of Some Selected Alternative Feeds

The following list contains a summary description of some selected alternative feeds. The Association of American Feed Control Officials (AAFCO) publishes an Official Publication annually (e.g., AAFCO, 2014) that provides definitions of animal feeds which are generally recognized in law. If the reader is interested in a feed not included in this selected list, we recommend the AAFCO Official Publication (2014) for further information on feed definitions. Additionally, Lardy and Anderson (2009) have published a more comprehensive list of feed descriptions that can be found in the Northern Great Plains region. Also, for an on-line reference, the French National Institute for Agricultural Research (INRA) maintains an online animal feed resources information system (Feedipedia; INRA, 2014).

Beet Pulp

Beet pulp is a byproduct of the sugar industry and is an effective energy supplement for gestating or lactating cows. Beet pulp is relatively low in CP (8%) but relatively high in total digestible nutrients (TDN: 72%). Feeding dry shreds or pellets is typically the most economical option in South Dakota. Beet pulp is an excellent high fiber energy supplement that does not result in negative associative effects on rumen function (Chapter 18, Supplementation of Beef Cows).

Camelina Meal

Camelina is a member of the Brassica genus (e.g., mustards, turnips, cabbage) and is commonly classified as a non-food oilseed because it contains appreciable amounts of anti-nutritional factors such as glucosinolates and Smethylcysteine sulfoxide. Glucosinolates are commonly found in many mustards and contribute to their pungent flavor. Smethylcysteine sulfoxide is converted in the rumen of cattle to dimethyldisulfide, which is a hemolytic agent (i.e., a substance that interferes with functions of red blood cells). Currently, the United States Food and Drug Administration regulates inclusion of camelina meal to not greater than 10% of diet DM. Recently, Camelina and Ethiopian mustard have garnered significant interest as feed stocks for use in production of high octane biofuels. The resulting meal contains large amounts of CP and can be used in cattle diets. The fat content of Camelina meal is likely to be affected by processing techniques, which currently include mechanical extrusion or use of chemical solvents. Because Camelina meal contains a large amount of CP it can be used as a protein supplement to cattle.

Canola Meal

Canola meal is the byproduct after canola oil has been extracted from canola seed. This is a high protein supplement that contains 40 to 44% CP that is a good source of supplemental rumen-degradable protein for cattle fed low-protein forages or cows grazing dormant range. Depending on the process of extracting the oil, there could be 8 to 15% oil left in the product, resulting in great variability from different plants.

Condensed Distillers Solubles

Condensed distillers solubles are a liquid byproduct from the ethanol industry. Often times this is referred to as "syrup". Being a liquid product, condensed distillers solubles are high in moisture and require additional equipment for handling that other supplements do not require. This product is often times added back to the distillers' grains to achieve distillers' grains plus solubles (DGS). The solubles are high in protein and energy and contain a high percentage of fat on a DM basis. A challenge is the potential high level of sulfur that can be contained in the product due to the use of sulfuric acid in the production of ethanol. As with all byproducts, there is large variability in batches, therefore the product should be analyzed prior to implementation into a ration.

Corn Gluten Feed

As a byproduct of the corn sweetener industry, corn gluten feed consists primarily of the bran and germ from the corn. This product can be fed wet or in a dry pelleted form. This product is similar to DGS, in that the energy content is similar to that of corn. The product averages 22% CP (DM basis), and can provide challenges with minerals, as it is high in phosphorus and low in calcium. Storage challenges need to be assessed prior to utilizing this product.

Corn Stalks

Corn stalks are the plant residue remaining after corn harvest. Mature corn stalks can be extensively lignified; thus, total tract digestibility may be less compared to other forage resources. Perhaps the most efficient utilization of corn stalks in beef production is in grazing systems; however, corn stalks can be baled after harvesting the grain. Treatment of corn stalks with ammonia or strong alkalis (e.g., CaO, CaOH, NaOH) can increase nutrient digestibility and nutritional value to cattle. The process of chemical treatment of forages is sometimes referred to as 'upgrading'. It is important to understand that alkali treatment of lignified forages such as corn stalks can be a strongly exothermic (heat releasing) reaction. Caution should be used with chemical treatment of corn stalks to prevent excessive heat damage to corn stalk residues or in extreme cases to prevent potential fire hazards. Ammoniation of corn stalk residues will increase digestibility and nitrogen content; however, ammonia is caustic and can present human health risks. If ammoniated corn stalk residues are allowed insufficient time to 'air out' they can contribute to ammonia toxicity in cattle.

Corn Steep Liquor

Corn steep liquor (also referred to as corn refinery concentrate) is a condensed liquid byproduct of the corn wet milling industry (i.e., the process used in manufacture of high fructose corn syrup). Corn steep liquor often contains large amounts of CP (can range from 35 to 44%). In addition to use as a feed conditioning agent, corn steep liquor is also a good source of supplemental protein and energy. Corn steep liquor contains an appreciable amount of water (approximately 50%). Similar to molasses corn steep liquor can increase in viscosity or freeze in harsh winter conditions.

Distillers' Grains with Solubles

Distillers' grains are a co-product of the ethanol industry. The ethanol plants in South Dakota are corn-based plants. Various products come from these plants, depending on local facilities and equipment. These products include wet distillers grains (WDG) which are approximately 35% DM, modified distillers grains (MDG) at approximately 50% DM, and dry distiller's grains (DDG) which are approximately 90% DM. On a DM basis these products contain approximately 27 to 29% CP, with a large portion (approximately 60% of CP) being by-pass protein and 80% + TDN. The sulfur content of distillers' grains should be considered when feeding this product to cattle. Yeast used in manufacturing ethanol from corn grain produce greater amounts of alcohol in acidic conditions. Currently, sulfuric acid is commonly added to create acidic environments during ethanol manufacture and a portion of the added acid is contained in distillers' grains. Excessive sulfur intake can contribute to a neurologic disease in cattle known as polioencephalomalacia (swelling of the brain); this disorder is sometime referred to as 'brainers' because cattle suffering from polioencephalomalacia will apply pressure to their skull in effort to relieve pressure associated with swelling.

Fescue

Many fescues contain appreciable amounts of crude protein and truly fermentable organic matter compared to other grasses. Additionally, these plants are often less impacted by environmental and grazing pressures. Much of the resiliency attributes among fescue are associated with endophytic fungi that are in a symbiotic relationship with the plant. These endophytic fungi often produce ergot alkaloids that are toxic to mammals and cause constriction of peripheral blood vessels. This vasoconstriction can increase susceptibility to thermal stress in cattle. Varieties of fescue that lack endophytic fungi are much less resilient. Some varieties are available that contain endophytic fungi that do not produce significant quantities of ergot alkaloids toxic to cattle.

Field Peas

Field peas are an annual legume that provides a good combination of CP (20 to 27%) and energy (88 to 90% TDN) when fed as grain. Field peas are a good supplement for cows with the protein and energy combination they possess, but they should be dry rolled to maximize feeding efficiency.

Glycerol (Glycerin)

Glycerol is a byproduct of the biodiesel industry. Approximately 10% of the fat used in manufacture of biodiesel will result in crude glycerol. Thus, glycerol may be a readily available alternative feed for cattle. Biodiesel is commonly produced by reactions of vegetable fats with short-chain alcohols (most commonly methanol). Methanol can be toxic to cattle. The United States Food and Drug Administration limits methanol concentrations in feed-grade glycerol to 0.5%. Glycerol may be able to supply a large amount of energy to cattle. However, responses among cattle to glycerol are varied and different responses to glycerol inclusion may be related to methanol content.

Grain Screenings

Screenings are the light or broken grain seeds, weed seeds, hulls, chaff, joints, straw and elevator dust that are left after the grain cleaning process. The variability of these products is huge and therefore they should be analyzed prior to feeding to determine nutrient content. The screenings can be used as the only source of supplemental concentrate feed for dry cows and replacement heifers, but maximum limitations should be adhered to. For heifers, screenings should be limited to 6 lb per day; cows can be given up to 10 lb per day. If screenings could be or are contaminated with ergot, do not feed them to breeding livestock, as this can cause abortions.

Linseed Meal (Flaxseed Meal)

Flax is a small oilseed. Flax is able to be cultivated in northern climates and potential human health benefits of oil and fiber from flax have increased interest in its production. Linseed meal is the remaining product after extraction of oil from flax seed. Typically, it contains relatively large amounts of CP (36 to 40% on DM basis). Currently, linseed meal is produced from either solvent extraction or mechanical extrusion of oil from flax. These production methods vary in efficiency of oil extraction (i.e., greater amounts of oil are often found in linseed meal produced from mechanical extrusion). Thus, levels of fat in cattle diets may need to be considered prior to use of mechanically extruded linseed meal; however, greater amounts of dietary fat will likely increase energy density of the diet.

Soybean Hulls

Soybean hulls are removed during oil extraction from soybeans and can be marketed separately or included in soybean meal. Soybean hulls are a fiber source that contains large amounts of acid detergent fiber, but is readily fermented in the rumen because most of the fiber is cellulose. The CP content in soybean hulls varies and is related to efficiency of soybean extraction from the hulls. Typically, soybean hulls range in CP concentration from 12 to 14%. Soybean hulls are very palatable and can be easily pelleted.

Sunflower Hulls

Sunflower seeds typically contain 20 to 30% hulls that are often removed prior to oil extraction. Sunflower hulls are relatively poor forage, but can be used to provide some effective fiber to cattle rations. Amounts of protein and energy provided to cattle from sunflower hulls are small.

Sunflower Meal

Sunflower meal is the byproduct following oil extraction from oil sunflower seeds. The meal contains 32 to 35% CP and can be utilized as a protein supplement. The product can vary based on the amount of hulls that are added to the meal. The addition of the hulls decreases the overall energy level, so nutrient analysis is needed to determine how the sunflower meal can be incorporated into a ration.

Wheat

Wheat is a commonly produced cereal grain in the United States. Generally, a substantial portion of wheat produced contributes to human food and as a result the economic viability of using wheat in cattle diets can be limited. However, when prices of other cereal grains are large wheat may be an economically viable alternative. The rate and extent of ruminal starch fermentation from wheat is large and grain processing methods should be considered before including wheat in cattle diets. Grinding wheat often produces a very small particle size (i.e., flour) and this can greatly increase potential for ruminal acidosis in cattle. Alternatively, steam-flaking wheat will result in a larger particle size and limit potential for metabolic disorders relative to grinding.

Wheat Middlings (MIDDS)

These are a high fiber by-product of the flour milling industry. Wheat midds have a moderate level of CP (18%) and energy. Wheat midds are used in a variety of commercial supplements ranging from creep feed to range cubes. Storage of wheat midds can provide challenges and special consideration should be taken. Though wheat midds are fed commonly in the pelleted form, fines and waste can be an issue. Wheat midds can be utilized as a fiber-based energy source in cow rations.

Wheat Straw

Wheat straw is the plant residue remaining after harvest of wheat grain. Similar to corn stalks, wheat straw is often largely lignified, but can be improved by ammoniation or alkali treatment. Wheat straw can provide a good source of effective fiber in cattle diets.

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