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Alternative Feeds for Ruminants

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General Concepts and Recommendations for Using Alternative Feeds

Many feedstuffs are available to producers in North Dakota and the surrounding region, including crop residues, processing coproducts and new or alternative grains and forages, as well as more traditional grains and forages.

This publication is intended to familiarize livestock producers with the variety of feeds available and to provide feeding guidelines for various alternative feeds.

Feeds are listed alphabetically under the broad categories of:

- Forages
- Residues and fibrous coproducts
- Weeds
- Roots, tubers and associated coproducts
- Grains, screenings and grain processing coproducts
- Oilseeds and protein meals
- Liquid coproducts

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General Concepts and Recommendations for Using Alternative Feeds

Many of the alternative feeds vary widely in nutrient content, making an analysis or some assessment of the feed value necessary. Producers must know the energy, protein and major mineral levels of these feeds to develop balanced, least-cost diets for livestock. With alternative feeds, we recommend wet chemistry analysis to determine nutrient content. If near infrared spectroscopy (NIRS) is used, ensure that the laboratory has calibrated its equipment for your specific feed; otherwise, the analysis will not provide accurate data. Whatever feed products are used, the ration must be balanced to meet livestock needs and producer goals on a least-cost basis.

Harvesting and Use of Residues

Grazing is the easiest way to harvest crop aftermath. Grazing crop residues allows animals to select a higher-quality diet than would otherwise be obtained by harvesting and mechanically feeding. In grazing scenarios, ruminants preferentially will consume grain and leaves before consuming lower-quality stalk material. This is an important consideration when developing diets based on crop residues.

Stocker cattle may have acceptable gains if allowed to selectively graze residues. Younger cattle should be removed from the field or supplemented with protein and energy feeds once high-quality residue components are consumed. Depending on the number of animals and the acreage, stocker cattle can graze on residues until cattle performance declines or feed quantity or quality becomes limiting. Mud and snow can reduce access to forage, limiting intake and selectivity, and ultimately reducing diet quality.

Water supply and fencing must be addressed prior to grazing crop residues. Portable waterers and electric fences can provide low-cost, temporary methods of fencing large areas of crop aftermath. We recommend cross-fencing and strip grazing for longer periods of grazing or for grazing large acreages. In some cases, wind protection also may be necessary for grazing into the winter months.

Mechanically harvesting crop residue (baling, stack wagon) often leaves the higher-quality components (cob, grain, etc.) in the field. Chopping residue adds more expense and is recommended only when crop residues will be included in a total mixed ration (TMR) or as a method to reduce feed waste.

When stacking or baling dry corn residue, wait until the moisture content has dropped below 20 to 25 percent or the temperature has fallen late in the fall to avoid mold in the stored material. Corn stover can be packaged in large, round or square bales. A flail harvester or rotary mower may be used to cut stalks prior to baling. Wait until stalks are dry after combining to minimize spoilage in mechanically harvested residue.

Low-quality feeds (straw, corn stover, beet tops, etc.) can be fed when cow nutrient requirements are low, such as during the second trimester of gestation following weaning. Alternatively, they can be blended with higher-quality forages for stages of production with greater nutrient demands. Supplemental macro and micro minerals and vitamin A usually are needed when rations include large proportions of crop aftermath.

A number of low-quality forages can be fed to dry cows and replacement heifers, including small-grain straw, corn stover, sunflower stover, slough grass and others.

Feedlot diets can use low levels of crop residue in growing rations (maximum of 20 to 30 percent of diet, depending on desired performance levels) and finishing rations (maximum of 6 to 8 percent of the diet).

Procuring Alternative Feeds

Increased grain processing in the northern Great Plains and Upper Midwest has made large quantities of several different coproducts available for livestock producers. Economics dictate if, when and how much coproduct could be included in the ration with some other limitations. Shipping, storage, seasonal price variation, amount available, processing and nutrient suitability need to be considered for each coproduct. Contracts or volume purchases may be negotiated at less than spot market prices.

For information regarding current prices and contact information for specific suppliers, refer to this website: www.ag.ndsu.nodak.edu/aginfo/dairy/dairyext/CoProduct.pdf.

Forages and Fibrous Coproducts

Alfalfa Pellets
Alfalfa Regrowth
Bulrush
Canola Forage, Grazed
Canola Forage, Hayed
Canola Forage, Silage
Canola Straw
Cattails
Cover Crops
Hollowstem
Lakereed
Millet Hay
Mint Hay or Silage
Mustard Hay and Silage
Safflower Hay
Slough Hay
Small-grain Hay
Small grain, standing
Sorghum (Forage)
Sorghum-Sudan, Sudangrass
Soybean Hay
Sunflower Silage

ALFALFA PELLETS

Pelleted or finely ground forages can provide approximately one-half of forage needs for all dairy cattle. Since pelleted forage material is quite fine, another forage source will be needed to maintain required "effective" fiber in rations. Dehydrated pellets are usually higher in quality than sun-cured pellets.

ALFALFA PASTURE – LATE SEASON

Alfalfa regrowth can be grazed without injury to the plant after a killing frost has occurred. Be sure cattle are full and are not hungry before allowing them access to alfalfa pasture. Observing cattle frequently for the first few days after giving them access to alfalfa is advisable. Alfalfa regrowth can be grazed in conjunction with low-quality aftermath to balance a growing diet. Grazing alfalfa regrowth immediately after a frost increases the likelihood of bloating problems. To reduce the risk of bloat, make sure the entire plant is dead (no green plant material remaining), wilted and dried before grazing, which may take up to 10 days after a killing frost. Heavy grazing of alfalfa regrowth late in the season also can increase the risk of winterkill in some fields.

BULRUSH

Bulrush has little value for forage purposes but may be useful as bedding.

CANOLA FORAGE, GRAZED

Little information is available regarding canola as a forage crop. Anecdotal evidence indicates that canola regrowth can be grazed following harvest and cattle prefer it to other forage sources in some cases. Animals should be introduced to canola or rapeseed forage gradually. Canadian reports indicate that forage rapeseed is similar to alfalfa in nutrient content. In cases where producers wish to graze poor stands of canola, consider turning cattle out before plants reach physiological maturity for greatest plant utilization.

CANOLA FORAGE, HAYED

Winter canola's abundant fall and early spring growth makes it an excellent early season forage crop. Livestock should be adjusted to canola forage by mixing the feed rations during a seven- to 10-day period by blending with other forages to help prevent bloating.

In the spring, haying of winter canola should occur before it flowers (similar to alfalfa). Canola hay is difficult to cure due to the high moisture content of the forage. Experiments in Idaho and Montana have reported yields ranging from 2 to 13 tons per acre. This wide variation in yield may be due to differences in varieties, soil types, growing conditions and rainfall.

CANOLA FORAGE, SILAGE

Canola also can be harvested as a silage crop because the crop is difficult to dry for hay, with moisture levels commonly averaging 75 to 80 percent during active growth. Consequently, seepage and effluent losses from the silage can be large. Allowing the crop to dry in the swath is usually necessary prior to ensiling. Other options can include adding dry feeds (hay, grain or straws) to the silage pile to reduce effluent (seepage) losses. Chop and pack in bunker or pile as other silage crops.

CANOLA STRAW

Canola straw is of little or no feeding value. It contains 3.5 percent crude protein and only 20 percent total digestible nutrients (TDN).

CATTAILS

Cattails have little feed value but can be fed in an emergency. Cattails cut at a relatively young age may be equivalent to straw in feeding value. Mature cattails are a poor feedstuff, having energy values similar to or lower than straw and may best be used as bedding.

COVER CROPS

Cover crops are generally mixtures of cool-season forages typically planted shortly after the cereal grain harvest or intercropped with longer-season crops in an effort to extend the grazing season or provide soil health benefits. The "cocktail" seed mixtures typically contain two to 10 different varieties of annual legumes (peas), brassicas (rape, kale, turnip) and cereal grains (triticale, oats). With adequate moisture for germination and growth, this technique can provide high-quality vegetative forage for grazing animals late into the fall and early winter. The variability of plant species, growing conditions, yield, harvest methods and other factors preclude stating any definitive nutritional value but vegetative forages are highly digestible and typically contain more protein than animal requirements, especially with legumes in the mixtures.

For more information about cover crops, see publication R1759, "Annual Cover Crop Options for Grazing and Haying in the Northern Plains," available at www.ag.ndsu.edu/pubs/ansci/range/r1759.pdf.

HOLLOWSTEM

Hollowstem is used quite regularly and extensively as a coarse hay but it is of less value than upland hay. Cut at flowering time or as soon as the area is dry enough.

LAKEREED

Lakereed can be used to supplement other hay or forage. It is rather unpalatable for livestock and can be somewhat of a laxative. Sometimes two cuttings are possible if the first crop is cut early. Cut before heading, if possible, to increase nutrient content.

MILLET HAY

Foxtail and proso millets are annual forages that produce respectable hay yields (2 to 4 tons per acre at various research centers in North Dakota), even when planted relatively late in the season. Nutritional quality is related to maturity, as with most other forages. Optimum harvest time is when seeds are in the milk to soft dough stage. Millet hay sometimes may cause scouring. Avoid feeding it to horses because it can cause lameness and affect kidney function. Hairy and waxy varieties of millet can be difficult to cure as hay.

MINT HAY or SILAGE

Hay or silage can be made from peppermint or spearmint following oil extraction. The nutritive content is similar to good-quality grass hay. Be sure to review chemical label guidelines related to haying and grazing restrictions for pesticides in mint production before grazing or harvesting this crop for forage.

MUSTARD HAY and SILAGE

Mustard (brown, yellow and Oriental) can be used as a hay crop. Mustard hay typically averages 50 to 55 percent TDN and 10 to 12 percent crude protein (CP). However, nutrient content can vary, so we recommend a nutrient analysis. The crop should be cut from the early podding stage just after the flowers have dropped to the point where the lower leaves are starting to drop. Mustard does not dry down rapidly and can be difficult to bale at proper moisture levels. High moisture levels (75 to 80 percent) and difficulty drying mustard have been reported.

Crimping will ensure more uniform drying. Mustard also can be harvested as silage. Some producers have blended small grain and mustard together in the silage pile with good results. A silage inoculant also may be beneficial since mustard is low in soluble carbohydrate. Mustard hay or silage should be limited to 60 percent or less of the diet dry matter. Scouring and hemolytic anemia have been reported when higher levels have been fed. In addition, producers should provide a trace mineral high in copper and selenium because long-term feeding of mustard hay has been associated with inhibited absorption of these minerals. Mustard also can accumulate nitrate, so nitrate poisoning may be a potential problem.

SAFFLOWER HAY

Research conducted in Montana and Alberta indicates that safflower crops damaged by frost may be cut for hay. Naturally, the thorny nature of the plant causes concern, but in feeding trials conducted with ewes in Alberta, no aversions to the forage were noted and intakes were similar to a conventional alfalfa hay-based diet.

SLOUGH HAY

Slough hay is usually higher in nutritive value than cereal straw and may approach brome hay in quality. However, slough hay is more variable in quality. Slough hay harvested after a killing frost will have a nutritive value similar to straw.

SMALL-GRAIN HAY

Wheat, oats, barley, triticale and rye hay can be used in beef, sheep and dairy rations. Harvesting should occur between heading and soft dough stages. Rye hay loses palatability and protein content rapidly after flowering. The nutritive value of these hays should be similar to brome hay when cut at the heading to soft dough stage. Energy per acre is maximized by delaying harvest until the soft dough stage. However, protein content is maximized by harvest at late boot to early heading. All these feeds should be checked for nitrate content if drought stressed and/or fertilized heavily with nitrogen.

For more information on nitrate poisoning, see NDSU Extension publication V-839, "Nitrate Poisoning of Livestock," at www.ag.ndsu.edu/pubs/ansci/livestoc/v839.pdf.

SMALL GRAIN, STANDING

Standing small grains (immature or mature) can be used in grazing situations for beef, sheep and dairy. In years where the harvest occurs early, some small-grain fields will have substantial regrowth, with young plants having nutrient content similar to alfalfa (may be greater than 30 percent crude protein). Plant residue with the feeding equivalent of baled straw also may be available for animals to consume. As with any other postharvest grazing, producers should be aware of any grain spills that happened during harvest and attempt to remove or redistribute the grain from a single pile before animals are allowed to graze. Some fall planting scenarios of winter wheat, winter barley or winter rye may allow for grazing after plants tiller, but try to remove the cattle two weeks in advance of the final frost to allow plants to put reserves back into their crowns. In cases of crop failure or wind/hail damage, small-grain fields also can be grazed in the spring/summer. Caution is needed in many cases when planning to graze grain that is maturing: High nitrate concentrations can be present if growing conditions have been excessively dry, ergot can proliferate if growing conditions have been wet, and digestive upsets can occur if grain is approaching maturity.

SORGHUM (FORAGE), SORGHUM-SUDAN and SUDANGRASS

Several commercial seed companies market these warm-season annual forages. Forage sorghum and sorghum-sudan yield well and usually are ensiled because stems cure slowly when windrowed. Nutritional value varies greatly with maturity. Late-harvested sorghum and sorghum-sudan are similar in composition to corn stover.

Vegetative sorghum-sudan and sudangrass are good protein and energy sources. Sudangrass hay cut in the vegetative state has nutritional values similar to good-quality grass hay. Prussic acid and nitrate poisoning are potential problems. Select varieties with lower propensity for prussic acid to reduce the risk. Haying the crop will reduce prussic acid problems compared with the same forage in a grazing situation, and ensiling the crop will reduce prussic acid and nitrate risks.

Generally, when the green plant is hit with a killing frost, removing grazing cattle until the plant has dried is advisable because the prussic acid in the plant volatilizes as the plant dries. Dried plants normally contain very little prussic acid, but monitor cattle closely the first few days after turning them back into the field. The problem develops when the plant is not completely killed by the frost. If the weather turns warm and the plants start to regrow, pull the cattle out until another killing frost dries the plants. The new growth is generally quite high in prussic acid. The onset of prussic acid (cyanide) poisoning is very rapid and clinical signs last only minutes before the animal dies. Signs of poisoning are nervousness, abnormal breathing, generalized muscle tremors, gasping for breath and convulsions. Distinguishing characteristics are bright cherry red blood. No known treatment is available.

See NDSU Extension Service publication V1150, "Cyanide Poisoning," at www.ag.ndsu.edu/pubs/ansci/livestoc/v1150.pdf for more information.

For more information on nitrate poisoning in livestock, see NDSU Extension Service publication V839 at www.ag.ndsu.edu/pubs/ansci/livestoc/v839.pdf.

SOYBEAN HAY

Soybeans can be harvested as a hay crop. Crude protein content can be similar to alfalfa or clover, with moderate TDN. In some areas of the U.S., soybean hay is used as a substitute for alfalfa or sweet clover. When allowed free access to soybean hay, cattle generally will not eat the stems because they are quite coarse. Chopping or tub grinding and blending with other forages or feedstuffs can be used to improve consumption. Soybean hay stems are quite low in energy and protein. When stored in round bales, water penetration and spoilage is more of a problem than with grass hay because of the coarse stems. Hay quality does not change drastically with increasing maturity because more mature soybean hays have a higher proportion of the bale weight as whole soybeans.

Soybeans can accumulate nitrate. Specific varieties of soybeans also are available to plant specifically for forage production.

SUNFLOWER SILAGE

Sunflower silage is 80 to 85 percent as nutritious as corn silage under normal conditions. Intake may be a problem, especially with high-oil varieties. The inclusion of another forage with sunflower silage is advisable for lactating cow rations. Dry cows and heifers may be fed sunflower silage as their only source of forage. Damaged sunflowers can be ensiled most easily by chopping and incorporating them into other forage(s) being ensiled at the same time, such as corn, small grains or sorghum-sudan grass. Moisture levels are generally too high when sunflowers are ensiled alone, so we recommend ensiling with dry forages or other feeds to prevent excessive nutrient loss. Waiting until after one or two killing frosts or incorporating ground dry roughage are methods to reduce the average ensiling moisture to 70 percent or less.

Straws, Residues and Fibrous Coproducts

- Ammoniated Straw
- Buckwheat Hay
- Buckwheat Hulls
- Buckwheat Straw
- Cereal Straw
- Chaff, Small Grain
- Chaff, Ammoniated
- Chickpea Residue
- Corn Stover, Harvested
- Dry Edible Bean Residue
- Corn Cobs
- Corn Residue, Grazed
- Field Pea Residue
- Field Pea Regrowth
- Flax Straw
- Grain Sorghum (Milo) Stover
- Lentil Straw
- Millet Straw
- Oat Hulls
- Soybean Residue
- Sunflower Residue
- Sunflower Hulls

AMMONIATED STRAW

Straw sometimes is ammoniated to improve the feeding value by increasing nitrogen (protein) content and fiber digestibility. When limited amounts of hay or other roughages are available, ammoniation may be a cost-effective way to increase the value of straw. Ammonia adheres to moisture in the straw, so very dry straw may not "absorb" as much ammonia as straw harvested in the dew or after a shower, but ensure straw is dry enough to not mold. Ammoniated feeds should be analyzed prior to feeding to determine the actual nutrient content. Energy supplementation still may be necessary after ammoniation, depending on the nutrient requirements of each particular set of livestock. Ammoniated straw has a feeding value similar to average-quality grass hay. Anhydrous ammonia is a dangerous chemical, and proper safety precautions should be taken during the ammoniation process to reduce the risk of injury or death.

Refer to this website – www.ag.ndsu.edu/drought/feeds-and-feeding/ammoniation-of-low-quality-roughages – for more information regarding ammoniation.

BUCKWHEAT HAY

In emergency situations, buckwheat can be used as a forage crop. For optimum forage quality, buckwheat should be harvested prior to maturity. Mature buckwheat is relatively low in crude protein and digestibility. Anecdotal reports indicate that buckwheat hay is palatable.

BUCKWHEAT HULLS

Buckwheat hulls have very little feeding value. They are high in fiber, low in protein and essentially indigestible.

BUCKWHEAT STRAW

Buckwheat straw can be used as part of the diet. Reports indicate that buckwheat straw is quite palatable. If the straw is used as a bedding source, cattle tend to consume buckwheat straw due to its palatability. Some reports indicate that buckwheat straw can cause digestive upsets if fed in large quantities. Buckwheat straw should be limited to 25 percent or less of the diet.

CEREAL GRAIN STRAW

Straw, the most common crop residue in North Dakota, is useful in maintenance or wintering rations for cows and sheep if properly supplemented with energy, protein, minerals and vitamins Satisfactory supplements include cereal grains such as barley, crop processing coproducts such as wheat midds or oilseed meals, or high-quality hays. Oat straw is the most palatable and nutritious (especially from hull-less oats), followed by barley straw and wheat straw. Rye straw has little feed value. Straw also can be used successfully as a fiber fraction in dairy and feedlot diets.

Straw can constitute up to about 60 percent of the brood cow ration but has only about half the value of hay in growing rations. Straw can be used in combination with other feeds as the major roughage for beef cows. Rations based on wheat straw and wheat midds have

given similar performance to rations based on corn silage and alfalfa hay when fed to lactating first-calf heifers at the Carrington Research Extension Center. Grinding straw can increase intake 10 to 15 percent, according to research done at the Dickinson Research Extension Center; however, compaction can be a problem in diets with high levels of chopped straw. Mixing with silage or equal parts of long-stemmed forage will reduce potential for compaction. Straw that is a year or more old is usually more palatable than fresh straw.

Late-planted oats often are susceptible to rust. The resulting straw will be dusty and act as a respiratory irritant but is not toxic.

CHAFF, SMALL GRAIN

Chaff collected in bunch wagons behind combines can be used as a component of many ruminant livestock rations. It contains grain that passes through the combine, weed seeds and hulls, as well as some leaves. Bunch wagons, however, can be an inconvenience when harvesting grain. Other attachments that connect directly to the combine and leave small piles in the field for later collection or for fall-grazing cows to consume are available.

Some producers use silage dump wagons to collect chaff. Chaff can be deposited directly into trucks for transport to storage areas at the farm or ranch. This system requires additional trucks and drivers. Chaff also can be collected with stack wagons and transported to the feeding facility. Chaff can be collected from a number of different crops, including wheat, barley, oats, peas, lentils and flax. Approximately 300 to 500 pounds of chaff can be collected per acre. The feeding recommendations for chaff are similar to those for good-quality straw. Chaff from some of the very rough-awned, bearded wheat and barley varieties may cause irritation and affect palatability.

CHAFF, AMMONIATED

Chaff may be ammoniated to improve its feeding value. Ammoniation improves the energy availability and protein content. Procedures to produce ammoniated chaff are the same as those used to ammoniate straw or other low-quality forages. Dry cows can be wintered successfully on ammoniated chaff. Lactating cows may require a source of supplemental energy (grains or grain coproducts) for optimum performance on ammoniated chaff rations.

See the comments related to Ammoniated Straw for more information.

CHICKPEA RESIDUE

Little useful stubble material remains after the harvest of chickpeas. Chickpea straw is slightly higher in nutritive value than wheat straw (44 to 46 percent TDN; 4.5 to 6.5 percent CP). Chickpea straw can be more palatable than wheat straw but livestock should be allowed to acclimate to the taste before offering large quantities.

CORN COBS

Corn cobs can be used as a ration ingredient in gestating cow diets or as a portion of the roughage for growing and finishing cattle. Corn cobs are low in protein (2.8 percent) but higher in TDN (48 percent) than other crop residues such as wheat straw.

CORN RESIDUE, GRAZED

Grazed corn residue (cornstalk fields following harvest) can winter beef cows or "rough winter" beef calves effectively. The amount of downed ears in a particular field will vary with the weather conditions prior to harvest, variety, degree of insect infestation and other factors. Producers need to be very cautious of piles of grain that spilled into fields during harvest and high amounts of downed ears that can result in increased incidence of digestive disturbances (acidosis, founder).

Corn residue is made up of grain, husk, leaf, stalk and cob. Grain and husk are usually highest in protein and energy, while the stalk is the lowest. Cobs are low in protein but higher in digestibility than stalks. Depending on the desired level of performance, protein supplements should be provided once the grain and better-quality forage material has been consumed. Supplemental phosphorus and vitamin A should be provided for cattle grazing corn stalks.

Do not force cattle to eat stalks and cobs. These products are of low quality. As one might expect, irrigated corn has more residue per acre than dryland corn. However, dryland corn residue is typically higher in energy and protein content than is irrigated corn residue. Grazing is typically the most cost-effective harvest method. However, many producers will bale or mechanically harvest corn residue due to the possibility of snow cover limiting grazing *(see Corn Stover)*.

For more information, see publication AS1548 at www.ag.ndsu.edu/pubs/ansci/beef/as1548.pdf.

CORN STOVER, HARVESTED

Corn stover is corn residue that has been harvested mechanically. Typical harvest methods include baling directly behind the combine or raking and baling. Nutrient content is similar to other crop residues such as straw. As with other residues, corn stover can be used as a portion of the diet for gestating beef cows. Nutrient content is low, so energy and protein supplementation is necessary. Phosphorus and vitamin A supplementation also is needed. Depending on the harvest method and field conditions, corn stover can have a high amount of soil contamination. High amounts of soil lowers the energy content of the material further. Calcium oxide and calcium hydroxide have been used to reduce the cell wall content of stover, making it more digestible. Rewetting ground stover with water before a period of storage in a silo bag also can increase intake and gain of backgrounding calves, compared with untreated stover.

DRY EDIBLE BEAN RESIDUE

Dry bean residue may be baled or stacked, but yield is modest and often includes substantial dirt. Grazing is the least expensive and most efficient method of utilizing this coproduct. As a legume, bean residue generally contains more protein than cereal grain residue and is quite palatable, although cattle will not consume the coarser stems.

FIELD PEA RESIDUE

The residual vines, leaves and stems from field peas are a palatable and nutritious residue often resembling medium-quality grass hay in nutritional content. However, field pea straw appears to be quite variable (4 to 12 percent CP; 40 to 60 percent TDN). Consequently, we recommend a nutrient analysis prior to feeding. Peas are harvested in the early fall, so grazing or baling are options for utilizing pea straw. Windrows may blow around or the straw may wrap on rotating equipment such as stack wagons or balers. Field pea residue decomposes more rapidly than cereal crop residues. Therefore, it should be harvested or grazed shortly after combining to minimize loss of leaves and retain nutrient quality.

FIELD PEA REGROWTH

Pea fields lightly tilled shortly after harvest can produce excellent forage growth before freeze-up. This regrowth is excellent quality forage and, depending on forage quantity, can be grazed, ensiled or harvested for hay if weather is favorable.

FLAX STRAW

This is a tough and fibrous coproduct historically harvested for linen or cigarette paper. It contains little energy or protein, is not very digestible, and can cause impaction and death. Flax straw often is baled (or burned) to remove it from the field because it does not deteriorate as rapidly as other residues. Flax straw bales can be used for bedding or windbreaks.

GRAIN SORGHUM (MILO) RESIDUE

Residue from this crop remains upright in the field and retains nutritional value similar to grass hay late into the fall and winter. Because leaves and stems are left largely intact during harvest, cattle can graze sorghum stover through deeper snow, compared with the aftermath of other crops.

LENTIL STRAW

Lentil straw is higher in digestibility, protein, calcium and phosphorus compared with wheat straw. In addition, lentil straw tends to be more palatable than cereal straws. However, lentil crops tend to have little residue following harvest, so grazing animals may be the best method of salvaging any feed.

MILLET STRAW

Millet straw is more palatable and higher in energy and protein than small-grain straws. Several millet varieties are available and residue may vary in nutrient content, so we recommend nutrient analysis prior to feeding.

OAT HULLS

Oat hulls are a coproduct resulting from oat processing. They are high in fiber and low in protein and have low digestibility. Research conducted at South Dakota State University indicates that oat hulls are similar in energy to alfalfa hay when used in diets for growing calves. However, Canadian research indicates that oat hulls are inferior to barley silage as a source of roughage. Ammoniating oat hulls can increase digestibility, increase protein levels and improve animal performance.

Oat hulls are difficult to ship due to their low density. Oat hulls generally are ground prior to shipment to increase bulk density and lower the transportation costs. This may make the product dusty and relatively unpalatable, so we recommend mixing it in a ration with moist feed.

Due to low nutrient content, oat hulls may be used best to stretch tight forage supplies by blending with higher-quality feeds or ammoniating it prior to feeding to increase nutrient content. In most cases, oat hulls should be limited to 25 percent or less of the diet.

SOYBEAN RESIDUE

Soybean stubble is best used by grazing animals following harvest rather than trying to harvest the residue mechanically. Stems, leaves and pods vary in nutrient content, with leaves and pods being more nutritious. The greatest value in grazing soybean residue is in the missed or shattered beans. Nonlactating cows early in gestation may subsist on soybean stubble but monitor them closely for condition and supplemental feed when residue quality deteriorates. Lactating cows, growing calves and other livestock with higher nutrient requirements will not perform adequately if given only soybean stubble.

Compared with corn and sorghum stover, snow cover will limit forage availability more rapidly when grazing soybean residue. Soybean stover can be collected following harvest with either a baler or stack wagon. However, soybean stover is generally low in protein and energy and should be used only as a feedstuff in maintenance diets or for modest-gaining animals. Generally, limit soybean stover to 20 percent or less of the diet (dry-matter basis), provided the diet includes other feedstuffs that are higher in protein and energy. Soybean stover is very useful as bedding and appears to keep cattle very clean in confinement buildings and outside pens.

SUNFLOWER RESIDUE

The head contains the most feed value, followed by the top, middle and bottom thirds of the stalk. If residue cannot be collected behind the combine, grazing will afford good use, although the traditional late-fall sunflower harvest window usually limits the time before snow cover prevents grazing. Sunflower seeds are high in energy (due to the high oil content) and a good source of protein. Consequently, downed heads in the field result in a residue that can be highly nutritious. Sclerotinia is not a problem based on research conducted at the Carrington Research Extension Center in which sunflower screenings containing 52 percent sclerotia bodies by weight were fed to beef cows.

SUNFLOWER HULLS

Sunflower hulls are a very poor-quality roughage. They may be used to increase the total fiber level of dairy heifer growing rations or to provide roughage in high-grain growing or finishing rations at not more than 20 percent of the ration. Hulls are low in protein and digestibility.

Weeds

Awned Grasses and Weeds
Kochia
Leafy Spurge
Pigeon Grass
Pigeon Grass Hay
Pigeon Grass Straw
Quackgrass
Russian Thistle

AWNED GRASSES and WEEDS

Little wild barley and cheat grass awns stick to clothing, hair or wool. Awns may work into nostrils, mouths and eyes of livestock, causing soreness and irritation. This can result in the development of abscesses. Use forages containing these weeds cautiously. Viable weed seeds may be passed through the digestive system. Composting manure will help control weed infestations.

> *For more information about composting, see NDSU Extension publication NM1478, "Composting Animal Manure," at www.ag.ndsu.edu/manure/documents/nm1478.pdf.*

KOCHIA

Kochia can be used as an alternative feed source for cattle. Harvesting kochia at 20 to 26 inches in height, before flowering, will ensure a palatable and nutritious feed. Kochia cut at later stages is less desirable but still can be used if no other alternative is available. Kochia can yield approximately 1.8 tons per acre. A second cutting may be obtained if the first cutting leaves live branches on the stubble. Hairy leaves give the hay a gray appearance. The nutrient analysis of kochia may be similar to alfalfa hay, although second-cutting kochia alone may not be adequate for growing heifers.

Reports indicate kochia hays vary from 6 to 22 percent protein, suggesting a wide variation in quality, which may be due to variation in plant maturity at harvest. Palatability seems very good. Unfortunately, the laxative nature of kochia means much of its potential nutrient value likely will be lost in feces due to a rapid rate of passage.

Cattle have been reported to develop photosensitivity (sensitivity to light) from eating kochia. Some cattle that have been fed kochia for 45 days or more may develop impaired liver and kidney function. Kochia is high in oxalates, which may be the cause of the problem. Do not graze kochia heavily, and only maintain cattle on kochia for about 60 days. Provide calcium supplementation to help counteract the effect of the oxalates. Provide clean, fresh water when feeding kochia.

LEAFY SPURGE

Leafy spurge can be very palatable and nutritious for sheep and goats. However, cattle appear to develop an aversion to the milky latex found in the plant. Leafy spurge can be hayed or grazed as a feed for sheep and goats. Grazing leafy spurge with sheep or goats can be an effective part of a biological control program. Leafy spurge hay cannot be hauled to other farms due to noxious weed laws. Seeds are not digested well, so manure from animals fed or grazing leafy spurge may contain viable seeds, resulting in the further spread of this weed. Composting manure should destroy the viability of the seed. Ensiling does not improve palatability of leafy spurge for cattle.

PIGEON GRASS

This grass is often present in small-grain straws. It is similar to a medium-quality grass hay if harvested in the vegetative state, but as maturity approaches, the plant lignifies and decreases in value. The presence of pigeon grass in small-grain straw increases the nutrient content of the straw. Pigeon grass can be grazed following the small-grain harvest.

PIGEON GRASS HAY

Pigeon grass can be used as an alternative forage in drought and other emergency situations. It has a forage value similar to millet when harvested before maturity. When mature, it is relatively low in energy and protein. Pigeon grass can be difficult to windrow and harvest due to its relatively short growing height. Grazing may be a more viable option.

PIGEON GRASS STRAW

Pigeon grass straw has relatively little feeding value. Pigeon grass growing in small-grain fields often ends up mixed with the cereal grain straw, which can be used as feed or bedding. We recommend composting manure to minimize weed seed viability.

QUACKGRASS

Quackgrass can be harvested and fed to beef cattle and sheep. Quackgrass hay is of moderate quality (8 percent CP; 52 percent TDN).

RUSSIAN THISTLE HAY

The crude protein of young Russian thistle is similar to alfalfa and the TDN or energy is about 10 to 15 percent less. Russian thistle should be hayed at the blossom stage before spines form. Russian thistle makes good silage when mixed with other crops. It is somewhat of a laxative and should not make up more than half of the ration.

Roots, Tubers and Associated Coproducts

Beets, Sugar	Carrots
Beet Pulp	Potatoes
Beet Tops	Potato Waste
Beet Top Silage	Onions
Beet Tailings	Turnips

BEETS, SUGAR

Occasionally, regional sugar processors must dispose of whole sugar beets due to spoilage or in cases where production exceeds plant processing capacity. In addition, sugar beets are a crop that can be grown successfully in high-alkaline soils. Whole beets can be fed successfully to cattle. Whole beets are low in crude protein (6.8 percent) but high in energy (75 percent TDN). If possible, whole beets should be broken up prior to feeding. Producers can utilize extended mixing times with a conventional mixer wagon to break up whole beets if they are not frozen. In addition, some producers have reported success using manure spreaders to spread whole beets on stubble or stalk fields and allowing cows to have access to the beets on the field. Choking may be a potential problem when feeding or grazing whole beets. Beets also can be chopped

with a modified forage chopper or a freshly cleaned "slinger" style manure spreader prior to feeding. Beets are being planted that are referred to as "energy" or "fodder" beets, but the nutrient content of both products falls within the normal range of variation for sugar beets.

BEET PULP

Beet pulp has a nutrient profile similar to corn silage and can be used effectively as an energy supplement for gestating or lactating cows, as an ingredient in backgrounding diets or as a roughage source in finishing diets. Beet pulp is relatively low in protein (8 percent) but relatively high in TDN (72 percent). Research conducted at NDSU indicates that beet pulp has an energy value slightly less than corn in backgrounding diets. In finishing diets, it can be used as the roughage source, having an energy value greater than corn silage.

Beet pulp is available in wet (pressed shreds) or dry (shreds or pellets) forms. Wet pulp contains approximately 75 percent moisture, which limits the distance it can be transported economically. Wet pulp can be stored effectively in silage bags or in trench or bunker silos. Dry pelleted pulp can be stored in bins or flat storage. Wet pulp also can be ensiled with other dry feeds to extend its shelf life and improve storage characteristics. Knowing the moisture content of beet pulp is critical to ensuring appropriate nutrient delivery and developing properly balanced rations.

BEET TOPS

Historically, beet tops were grazed directly or windrowed and grazed. Recent advancements in defoliator technology have limited the usefulness of beet tops because they essentially are mulched as they are removed. This makes gathering the remaining residue into a windrow or grazing the material difficult.

If beet tops are used as a feedstuff, the tops will weigh about half as much per acre as the marketed beets. Beet tops contain oxalates, which have a laxative effect. Consequently, tops should be fed in moderation. Feeding a high-calcium mineral with them will reduce scouring. Cattle should be watched closely when grazing beet tops because the smaller beets left behind by the harvesting equipment can cause choking problems. No more than 20 to 30 percent (dry basis) of a growing ration should be beet tops. Limit beet tops to 10 percent of the ration (dry basis) for finishing cattle. Beet tops should not be the only source of roughage in finishing rations.

BEET TOP SILAGE

Sugar beet tops should be ensiled at approximately 60 percent moisture, so allow the tops to dry partially in the field. Mixing with other feeds or forages at ensiling will reduce the sticky, gummy consistency of this coproduct. Field harvesting may be a problem and considerable soil contamination usually results. Beet tops are accumulators of nitrate, but the ensiling process should reduce this problem. The silage is less of a laxative than the fresh tops, but feeding no more than 30 pounds per head daily to cattle and 3 pounds to sheep (as-fed basis) is best.

BEET TAILINGS

Beet tailings consist of small beets, broken or damaged beets, soil and other foreign material not suitable for sugar production. Tailings are high in moisture (approximately 80 percent) and can be quite variable. Depending on soil contamination, beet tailings have a feeding value similar to or higher than corn silage on a dry-matter (DM) basis. Choking may be a problem with beet tailings. Due to the high moisture content, transportation is a major expense with beet tailings. In addition, the tailings can contain rocks, field debris and, on rare occasions, metal objects. As a result, occasional cases of hardware disease have been reported anecdotally with feeding beet tailings.

CARROTS

Cull carrots from the vegetable industry are sometimes available as a livestock feed. Carrots are high in moisture (85 to 90 percent) and about 10 percent crude protein on a dry-matter basis. Carrots are highly digestible. High levels of carrots in the diet can result in off-colored fat in finishing lambs and cattle. Therefore, levels should be limited to 20 percent or less of the diet (DM basis). The leaf material of the carrot plant can accumulate nitrate. Consequently, take care when grazing residues resulting from carrot production.

POTATOES

Potatoes have a feeding value equal to cereal grain (barley) on a dry-matter basis. Potatoes are high in energy and low in protein and vitamin A. Chopping potatoes will prevent choking in cattle (see sugar beet section for processing ideas), but they can be fed whole if necessary. The choking risk is minimized if they are fed from low troughs. Acclimate cattle to potatoes gradually or they may cause digestive disturbances. Sprouted potatoes

contain toxic alkaloids. The long sprouts should be removed before feeding. Frozen potatoes never should be fed because of the danger of choking. Satisfactory results can be obtained in finishing rations by feeding potatoes free choice with a protein supplement and low-quality dry roughage. Fifty percent of the ration (as-fed basis) as potatoes is probably the maximum for finishing cattle.

Ensiling can be used as a method of preserving potatoes. Potatoes should not be ensiled alone because of their high (80 percent) water content because effluent losses will be excessive. Adding 20 to 25 pounds of dry forage or 400 pounds of corn or sorghum-sudan silage per 100 pounds of potatoes will reduce moisture to an acceptable level. Other products such as wheat midds, sugar beet pulp, or cereal grains can be added to potatoes to reduce the moisture content. Moisture levels for optimum ensiling should be 60 to 65 percent (35 to 40 percent dry matter). Ensiling also will reduce the turgidity of the tubers and the risk of choking.

Potatoes also can be spread on fields or pastures and freeze-dried during the winter. The following spring, cattle are allowed to graze the pasture or field and consume the potatoes. The danger of choking is reduced or eliminated with freeze-dried potatoes.

POTATO WASTE

Potato waste is the product remaining after potatoes have been processed to produce frozen potato products for human consumption. The product can include peelings, cull potatoes, rejected french fries and other potato products. Due to differences in processing plants, moisture levels can vary considerably from plant to plant (75 to 85 percent moisture). The high water content limits transportation distances to local areas surrounding the processing plants. Potato waste is very palatable as the pH drops to about 3 to 4 after two to three days of open storage and it has a distinct odor.

Potato waste is equal in energy to cereal grains such as barley on a dry-matter basis but the starch ferments slower in the rumen. It is lower in protein and vitamin A with more variation in nutritional components than cereal grains such as barley. Research conducted at NDSU indicates optimal levels in finishing diets are less than 20 percent of the diet on a dry-matter basis. Due to the wet nature of the product, spoilage can be a concern, especially during the summer.

Potato waste plus small-grain chaff (1-to-1 mix) and potato waste plus chopped alfalfa are viable alternatives. One ton of potatoes and hay mixed in a silage was found to be equal in nutrient content to 1 ton of corn silage on an equal dry-matter basis.

ONIONS

Cull onions can be used as a feed for ruminant livestock. Onions are high in moisture (approximately 90 percent). On a dry-matter basis, onions are 9 to 13 percent crude protein, 83 to 90 percent TDN, 0.35 percent calcium and 0.40 percent phosphorus. When fed at high levels, onions can cause anemia due to the presence of sulfur compounds that cause hemolysis of red blood cells, and off-flavors in milk. To maintain acceptable performance in cattle fed onions, the level of onions in the diet should be limited to 25 percent or less (DM basis). The ruminal microorganisms in sheep appear to adapt to higher levels of onions readily. Consequently, higher levels of onions have been fed to sheep and sheep tend to be less prone to anemia when fed onions.

TURNIPS

Turnips can be planted to use in grazing programs and often are included in cover-crop seed mixtures. Turnips can also be harvested and fed using recommendations similar to sugar beets and potatoes. Grazed turnips are highly digestible and a good source of protein. Grazed turnips can be used as high-quality forage for yearling cattle or grazing lambs, a means to improve cow nutrition or to flush ewes prior to breeding.

Turnips can be grazed as early as 70 days following planting. Livestock should be introduced to lush turnip pasture gradually during three to five days. Be sure the animals are full when turned into the turnip field. Allow animals to have access to dry hay, straw or other roughage while grazing turnips and other Brassica species. After the tops are consumed, animals will consume the tubers. In loose soils, tubers are pulled easily from the ground by grazing animals. However, in heavy soils or soils that are compacted, some light tillage or spiking may be used to loosen the tubers. Some producers have reported choking by cattle eating tubers, so be sure to observe cattle regularly.

Grains, Grain Coproducts and Screenings

Barley Malting Coproducts
Bread and Bakery Coproducts
Buckwheat
Buckwheat Middlings
Chickpeas (garbonzo beans)
Corn Gluten Feed
Corn Gluten Meal
Corn, Old
Corn, Light test weight
Dry Edible Beans (culls and splits)
Distillers Grains Plus Solubles
Ergot-contaminated Feeds
Earlage
Emmer and Spelt
Faba Beans (chickpeas)
Field Peas
Grain Millet
Grain Sorghum (milo)
Hull-less Oats
Lentils
Lupines
Rye
Screenings, Corn
Screenings, Field Pea
Screenings, Grain
Screenings, Sunflower
Screenings, Wheat
Smut-contaminated Feeds
Spelt
Triticale
Wheat
Wheat Middlings (midds)
Wild Oats

BARLEY MALTING COPRODUCTS

Barley malting coproducts consist primarily of dried malt sprouts, but may also include thins, light test weight barley and screenings. Barley malt sprouts often are marketed as pellets. The malty aroma makes this feed especially palatable and can be used effectively in creep feed or backgrounding rations. Barley malt sprout pellets contain moderate levels of crude protein (16 percent) and are moderate in energy (74 percent TDN).

BREAD and BAKERY COPRODUCTS

Stale and discarded bread and bakery products can be used in cattle and sheep rations as a source of energy and protein. These products vary greatly in nutrient content, depending on the particular product that was discarded. They are generally high in energy and may contain relatively high levels of fat. These products also tend to ferment rapidly in the rumen. Therefore, levels should be limited to 20 percent or less of the diet to prevent digestive disturbances.

BUCKWHEAT

Buckwheat is not a cereal but has the same general nutritive characteristics as cereal grains. It contains energy and protein levels slightly less than oats. Buckwheat typically is used in livestock rations when it is low in price compared with other feeds. Normally a bushel of buckwheat weighs 45 to 48 pounds. Buckwheat should be ground for all classes of livestock. Buckwheat grain contains a compound called fagopyrin, which can cause photosensitivity, eruptions on the skin and itching behavior. Only white or light-colored areas of the hide are affected. The animals apparently become photosensitive after consuming large amounts of buckwheat for an extended period of time. Buckwheat should be limited to 20 to 25 percent of the concentrate mixture.

BUCKWHEAT MIDDLINGS

Buckwheat middlings are high in protein and energy. They should not be used as the sole source of concentrate or fed at more than 25 percent of the diet because a skin rash can develop if it is fed at high levels.

CHICKPEAS (Garbonzo beans)

Chickpeas are an annual legume and are high in energy and protein. Chickpeas can be fed at less than 30 percent of the concentrate in calf diets. Rolling or coarse grinding may improve digestion and will allow for better mixing in total mixed rations. The benefits of processing have not been evaluated. Calves fed chickpeas performed equally to calves fed field peas when both were fed at 17 percent of the ration.

CORN GLUTEN FEED

Corn gluten feed is a coproduct of the corn sweetener industry. It consists of various combinations of corn bran, corn germ and corn steep liquor, depending on the plant that manufactures it. Corn gluten feed is sold either as a wet product (typically 40 percent dry matter) or as a dry pellet (88 percent dry matter). Wet corn gluten feed is equal in energy to corn (DM basis), with dry corn gluten feed being slightly lower in energy due to heat altering the volatile fatty acid content and causing slight reductions in fiber digestibility. Corn gluten feed contains 22 percent CP.

Corn gluten feed is low in calcium and high in phosphorus. Corn gluten feed is useful in many different types of rations. The wet coproduct has a short shelf life during warm weather. Signs of spoilage include off colors, odors and mold development. However, it may be stored in bunker or trench silos as well as plastic silage bags for extended periods.

See NDSU Extension publication AS1127, "Corn Gluten Feed: Composition, Storage, Handling, Feeding and Value," at www.ag.ndsu.edu/pubs/ansci/dairy/as1127.pdf.

CORN GLUTEN MEAL

Corn gluten meal is a very high-protein product also produced by the corn sweetener industry. Corn gluten meal is not used widely in livestock rations because of the high cost resulting from demand in the pet food market. If priced competitively, it can be used as a protein supplement. It is high in escape protein.

CORN, OLD

Shelled corn or ear corn stored for more than a year will be similar in value to newer corn. Switch from new corn to old corn or old corn to new corn gradually (during the course of several days). The reason for the gradual change is that old grains are somewhat less palatable and new grains may be higher in moisture and more rapidly digested. Old grains are practically devoid of vitamin A. Old grains should be inspected for evidence of mold and insect damage prior to feeding.

CORN, LIGHT TEST WEIGHT

Immature corn can be harvested as high-moisture corn or earlage, processed to reduce particle size and packed into a bunker or pile or bagged, provided the moisture content is acceptable (for example, 24 to 35 percent moisture). Energy content of light test-weight corn is generally lower than normal test-weight corn (54-pound test weight) but growing and finishing cattle gained equally when fed light test-weight corn in NDSU research because they consumed more of the light test-weight corn. Light test-weight corn contains higher levels of fiber and less starch and is generally higher in protein compared with normal test-weight corn.

Cattle fed light test-weight corn stored as high-moisture corn in a bunker silo had similar gains and feed efficiencies, compared with cattle fed dry-rolled corn in research conducted at the Carrington Research Extension Center. However, in research conducted in Fargo with light test-weight corn that was dried for storage, cattle fed 54-pound corn had slightly better feed conversion than cattle fed 39- or 47-pound corn. Calves fed 39-, 43- and 47-pound test-weight corn gained the same and had equal feed efficiency to mature dry corn grain.

For more information on harvesting high-moisture corn, see www.ag.ndsu.edu/pubs/ansci/livestoc/as1484.pdf.

For more information on harvesting, storing and feeding corn as earlage, see www.ag.ndsu.edu/pubs/ansci/livestoc/as1490.pdf.

DRY EDIBLE BEANS (culls and splits)

Cull beans contain moderate levels of energy (68 to 78 percent TDN) and protein (22 percent). Raw cull beans should be used as only a small portion of cattle diets (less than 10 percent of the diet) with reports of severe diarrhea resulting from higher intakes. Roasting increases usefulness to more than 25 percent of the diet because the enzyme inhibitors are rendered ineffective with heating. Colorado and Nebraska research indicated depressed performance in growing steers at levels greater than 10 percent of the ration. Exercise care in adapting the cattle to rations containing cull beans. Cull beans should be ground or rolled to improve utilization.

DISTILLERS GRAINS AND SOLUBLES

Distillers grains are a coproduct of producing ethanol from corn grain using the dry-milling process. In most cases, ethanol production is corn-based, but other grains (barley, wheat or milo) can be used. The product can be sold as a wet cake (60 to 65 percent water), modified wet cake (approximately 50 percent water) or dried meal (8 to 10 percent water). Distillers grains products continue to evolve as the ethanol industry modifies processing technology to capture additional value from different components of the corn kernel and coproduct stream. For example, many plants are extracting a greater proportion of corn oil than in the past, resulting in “low-oil” distillers grains.

The shelf life of the wet material is limited to less than seven days in warm weather and two to three weeks in colder weather. Distillers grains that have some spoilage also can be fed to growing and finishing cattle without reduction in performance. However, producers must take steps to minimize shrinkage and nutrient loss. Bunker or trench silos as well as plastic silage bags can be used to store the wet material alone or mixed with other dry forages for longer periods of time.

Distillers grains are very palatable and mix well with other ration ingredients. The product can be used to condition or add moisture to dry rations to improve acceptability. Distillers grains contain approximately 28 to 30 percent crude protein, with a relatively high proportion being bypass (escape) protein.

For more information, see this publication: www.ag.ndsu.edu/pubs/ansci/beef/as1242.pdf.

EARLAGE

Earlage is produced by harvesting the grain, cob, husk and sometimes the upper portion of the stalk of the corn plant and then subsequently ensiling the material. Earlage can be harvested with a combine or with a snapper head on a silage chopper. Harvesting with a snapper head will produce a lower-fiber, higher-energy earlage than harvesting with an all-crop header. Nutrient content varies with the harvest method and is intermediate in corn silage and high-moisture corn grain.

For more information, see this publication: www.ag.ndsu.edu/pubs/ansci/livestoc/as1490.pdf.

ERGOT-CONTAMINATED FEEDS

Ergot bodies have the potential for constricting circulation to body extremities, causing lameness, abortion and gangrene. Due to the possibility of abortion, no ergot-contaminated feed should be offered to breeding animals. Ergot is more prevalent in grains and hays grown in wet years. Grain screenings also may contain ergot. Carryover hays and grains may contain ergot. If the ergot content of contaminated feeds exceeds 0.1 percent, the contaminated feeds should be blended with other grain or forage to reduce the ergot concentration.

EMMER and SPELT

Emmer (Triticum sativum, dicoccum) and spelt (Triticum sativum, spelta) are close relatives of wheat, but the grain resembles barley in appearance. The hulls are not usually removed from the kernels in threshing. Emmer often is incorrectly called "speltz" or "spelt." Emmer and spelt resemble oats in nutritive value. They may be used in the same manner as oats in feeding the various classes of stock. When a large proportion of the hulls are removed during threshing, emmer will resemble barley more than oats in composition and feeding value. Emmer and spelt should be rolled or cracked prior to feeding.

FABA BEANS

Faba beans can be fed whole or processed. They do not need to be heated. Faba beans should be no more than 30 percent of the grain mixture.

FIELD PEAS

An annual legume, field peas are grown in combination with small grains as a high-protein forage or in a pure stand and harvested for grain. Field pea grain is high in protein (20 to 27 percent) and energy (88 to 90 percent TDN) and is very palatable. Optimum use may be in diets where nutrient density is important, such as creep rations, receiving diets or cow supplements. Trials feeding increasing levels of peas in creep rations resulted in a linear increase in intake. Gain data suggests the most economical use of peas may be at 30 to 50 percent of creep diets. Data from lambs and feedlot cattle fed field peas in finishing diets indicate that the TDN of field peas is similar to or slightly higher than corn. As a general recommendation, field peas should be rolled for beef cattle.

For more information, see this publication: www.ag.ndsu.edu/pubs/ansci/beef/as1301.pdf.

GRAIN MILLET

Millet (proso and pearl) ranks intermediately as an energy source among cereal grains. It has many of the nutritional characteristics, including deficiencies, common to other grains. Seed density and fiber content are issues to consider. Grind or dry-roll millet to break all the kernels. Breaking all the small kernels by rolling is more difficult. Do not powder proso during grinding because powdering will not improve intake or utilization versus rolling or moderate grinding.

Hammer milling with a one-fourth-inch screen makes a very acceptable product. Because of its higher fat content, millet tends to have more "body" when ground than most other grains and does not powder so badly when hammer milled. Millet can be the sole grain source if maximum gains of 2 pounds a day are desired. Limit millet to approximately 50 percent of the ration if gains of 2.7 to 3 pounds are desired. Millet may be a laxative when starting cattle on feed. Using oats to start cattle on proso may be of benefit. Proso likely will work best in grain rations when combined with other grains such as corn or barley.

GRAIN SORGHUM (Milo)

This warm-season plant is very drought tolerant and provides grain nearly equal to corn in nutritional value. Short-season milo varieties have been grown successfully in the southern half of North Dakota in all but the coolest summers. Milo grain ferments slowly in the rumen because of its dense, starchy component. Processing milo via dry rolling or steam flaking is recommended because of its dense seed coat. The nutrient profile of whole-plant sorghum silage is equal to corn silage.

HULL-LESS OATS

This is a very nutrient-dense grain, high in protein (18 percent) and energy (10 percent fat, 93 to 95 percent TDN). Finely processing hull-less oats will result in digestive upsets and acidosis. Consequently, the ability to control particle size through proper rolling is important in beef feedlot rations with this grain. Feeding hull-less oats whole is recommended if particle size cannot be controlled in the mill or if the milling operation produces fine particles. We recommend mixing it with corn or barley at less than half the grain component. Hull-less oats are useful in supplementing cows at only a few pounds per day.

LENTILS

This pulse grain crop is grown for human food. Excess or off-quality grain or unharvestable fields can be used as grain or forage for cattle. Lentils contain energy similar to field peas and corn, with protein content of approximately 26 percent, so this is a nutrient-dense and versatile feed. Lentils should be ground coarsely or rolled for optimum utilization. NDSU feeding trials suggest it is very palatable and calves performed equally to calves fed field peas and chick peas. Lentil screenings or hulls may vary significantly in energy and protein but can be very useful feeds when procured at competitive prices.

LUPINES

Lupine is an annual legume that can be fed as an ensiled forage or as a seed meal. Lupine meal is made by grinding or flaking lupine seeds and is an excellent protein source (32 to 42 percent crude protein, 72 percent TDN, 5 percent fat) for ruminants. It is used around the world as a protein feed. Sweet white lupines are the preferred variety because others contain bitter alkaloids and are unpalatable. Lupine silage contains 13 to 18 percent crude protein and 52 to 61 percent TDN, depending on maturity at harvest.

RYE

Rye is a minor feed grain in North Dakota. However, it might be available for feeding at times. Rye can be relatively unpalatable and also can have problems associated with ergot contamination. Therefore, rye should be limited to no more than 40 percent of the concentrate mixture. When limited to this amount and when ergot is not a problem, the feeding value is similar to barley. Rye should not be used as an ingredient in calf creep feeds or calf starters due to its low palatability. Rye should be rolled or cracked prior to feeding.

SCREENINGS, CORN

Corn screenings contain cracked kernels, portions of corn cob and other trash. Energy content varies greatly depending on the amount of cob and other foreign matter. The lower the test weight, the lower the energy content. Processing is usually not required.

SCREENINGS, FIELD PEA

Field pea screenings can include off-color, shrunken or broken kernels, hulls, chaff, weed seeds and other residue. The protein content is typically greater for field pea than other grain screenings; however, nutrient content is variable. Field pea screenings generally are palatable and accepted well by livestock.

SCREENINGS, GRAIN

Screenings are a combination of materials obtained in the grain cleaning process. Screenings may include light or broken grain seeds, weed seeds, hulls, chaff, joints, straw, elevator dust and floor sweepings. Understandably, the nutritive value of screenings varies substantially. The best grades of screenings resemble oats in composition and may nearly equal oats or barley in feeding value. However, some of the poor-quality screenings more nearly resemble straw in composition. A large proportion of dark seeds (usually mustard or pigweed) can reduce the palatability of screenings. When feeds contain large numbers of viable seed, the resulting manure is a possible weed menace. The manure from livestock fed grain screenings should be composted to reduce weed seed germination. Grinding the seeds will reduce germination, but with small weed seeds (for example, pigeon grass), grinding is difficult. One might expect less viable seeds being voided from sheep than cattle since sheep chew their food more extensively. Screenings may be used as the only concentrate for dry cows and replacement heifers. Ergot also may be a concern when feeding screenings.

SCREENINGS, SUNFLOWER

Sunflower screenings consist of a mixture of groat pieces, light weight seeds, pieces of the heads, sclerotinia bodies and hulls in variable proportions. Protein and fiber levels may be equivalent to good-quality hays or higher, depending on the amount of whole seeds and groats in the screenings. Oil found in broken and/or lightweight seeds increases the energy and protein content. Nutritive value can be extremely low also,

with the presence of substantial stalk material and hulls. High levels of sclerotia bodies in sunflower screenings do not appear to affect intake and performance of gestating beef cows, according to NDSU experiments.

SCREENINGS, WHEAT

The most common ingredients in wheat screenings are broken wheat kernels and pigeon grass (green and yellow foxtail) seed. Nutrient content and feeding recommendations are dependent on the proportions of each. Wheat is high in energy (equal to corn) and contains more protein (13 to 15 percent) than pigeon grass seed. Wheat ferments rapidly in the rumen, especially if ground, but makes a good rumen-degradable protein for supplementing low-quality forages when fed at modest levels (less than 6 pounds/head/day). A general rule in ruminant rations is to use less wheat screenings as the proportion of grain in the ration increases. In growing or backgrounding rations that are less than 60 percent concentrate, up to half of the grain mixture may be wheat screenings.

Wheat screenings often contain large amounts of pigeon grass seed. Pigeon grass seed is high in CP (14 percent) and low in energy (62 to 65 percent TDN) compared with grains such as corn, but the protein may not be as digestible because it is bound in the fibrous matrix. Dry screenings should be ground prior to feeding because the pigeon grass seed coat is relatively difficult to digest. Intact pigeon grass seed found in the manure can germinate, resulting in the spread of this weed. Composting manure can reduce or eliminate this problem.

Screenings accumulated just after harvest may contain immature pigeon grass seed with high moisture levels that will not store well. Adding screenings to corn silage at ensiling time will increase protein content of silage but may not alter energy. The ensiling process will prevent the seed from germinating and will soften the hull.

Sheep require less processing of grains and can use pigeon grass whole rather efficiently. NDSU trials have shown fattening lambs can be fed up to 40 percent pigeon grass seed in their ration with no reduction in gain.

SMUT-CONTAMINATED FEEDS

Smut-contaminated feeds such as corn, corn silage and oats appear to be harmless to livestock. Corn smut is consumed by humans in other cultures after sauteing. Removing smut from grain or silage corn prior to feeding is not necessary.

SPELT

See Emmer.

TRITICALE

Triticale is a hybrid of wheat and rye. At times, triticale is available for feeding. Triticale is higher in protein than other cereal grains and similar in TDN to barley. For best results, triticale should be rolled or cracked prior to feeding. Triticale grain ferments rapidly like wheat or barley, so feed limited amounts or use it in a mixed ration. Ergot can develop in triticale, so producers should evaluate triticale for ergot content prior to feeding.

WHEAT

Wheat (hard red spring, winter or durum) levels should not exceed 30 percent of the ration for beef or dairy cattle unless producers take extreme care in balancing the diet and mixing the ration. Wheat should be limited to 30 to 40 percent of the grain mix for dairy cows. Popping does not appear to improve utilization. Steam rolling can produce a ration that contains less fines, resulting in fewer incidences of digestive disturbances when high levels are fed. However, steam rolling is a relatively expensive method of processing. For cattle, wheat should be coarse rolled and fines should be kept to a minimum. Sheep, however, can utilize whole wheat. Less protein supplement is required where wheat is included in the ration, compared with feeding corn or other lower-protein cereal grains. This is a particular advantage for wheat when protein is expensive.

Wheat is an excellent livestock feed but is not conducive to self-feeding programs because of its rapid fermentation rate. If self-feeding is the only option, then mixing salt (necessary salt level will vary depending on conditions) with wheat may be a viable option. We recommend ionophores in feedlot diets containing more than 20 percent wheat.

WHEAT MIDDS

This coproduct has moderate levels of protein (18 percent) and energy (80 percent TDN) and is a versatile and palatable feedstuff for a variety of livestock diets. Wheat midds are very useful in growing calf diets and as a supplement for gestating and lactating beef cows. Wheat midds are used as an ingredient in many different commercial supplements, creep feeds and cakes. Storage of wheat midds can be a problem. Storage in a bin with an aeration system or in flat storage (Quonset) is recommended, especially during summer.

Pellet quality also can deteriorate as wheat midds are handled multiple times. The price of wheat midds varies seasonally with demand for feed products. Wheat coproducts are lower in calcium and higher in phosphorus than most other grains and grain coproducts. Wheat midds can be fed as the only concentrate source to growing calves (up to 10 to 12 pounds per head per day) but should be limited to less than 40 percent of the concentrate in finishing diets.

WILD OATS

Wild oats have little value as a feed for livestock. They are often part of grain screenings. We recommend hammer milling to break the germ and maximize nutrient availability. Fed whole, few nutrients are extracted and the physical form may irritate the mouth. Whole wild oat seed is viable in manure, but hammer milling before feeding and/or composting manure will reduce weed seed viability significantly.

Oilseeds and Oilseed Coproducts

Camelina	Mustard Bran
Camelina Meal	Safflower
Canola	Safflower Meal
Canola Meal	Soybeans
Crambe Meal	Soybean Hulls
Flax	Sunflower Meal
Linseed Meal	Sunflower Seeds

CAMELINA

Camelina is a cold- and drought-tolerant oilseed plant that may have value for biodiesel production. The crop sometimes is referred to as "false flax" or "gold-of-pleasure" because, like flax, the oil contains relatively high proportions of C18:3 (omega 3) fatty acid. Camelina seed contains approximately 38 percent oil and 27 percent crude protein on a dry-matter basis. Very little research has been conducted to evaluate the energy value and other feeding characteristics of camelina seed. Camelina contains glucosinolates; however, the levels of these compounds in camelina varieties tested in Europe are relatively low compared with other crops such as crambe or mustard. Camelina also contains relatively low amounts of other anti-nutritional factors such as sinapine and condensed tannins.

CAMELINA MEAL

Little data has been collected to determine its feeding value. At this writing, the Food and Drug Administration has limited the inclusion of camelina meal to 10 percent of ruminant diets.

The mechanically extracted meal contains approximately 13 percent fat and about 41 percent crude protein. Since the quantities of glucosinolates and other anti-nutritional factors are relatively low in camelina seed, one would expect the levels to be relatively low in the resulting meal as well. Camelina meal has been fed to backgrounding and newly received feedlot calves successfully, resulting in slightly reduced intake and a tendency for reduced daily gain. Replacement heifers fed camelina meal as a supplement at 0.33 percent of body weight had similar intake and gain, compared with heifers fed a conventional supplement.

CANOLA

Whole canola seed can be used as a protein and energy supplement. It is a good source of energy because of its high oil content (40 percent fat). Canola seed is very small and should be ground, rolled or cracked prior to feeding. Due to the high oil levels in canola, it should be limited to approximately 10 percent of the ration (dry-matter basis).

CANOLA MEAL

Canola meal contains 40 to 44 percent CP and makes a good source of supplemental rumen-degradable protein for cattle fed low-protein forages or cows grazing dormant range and feedlot cattle on growing and finishing corn-based diets. Expeller processing may leave 8 to 15 percent residual oil in the meal compared with solvent processing, which is by far the most common and removes all but 0.5 percent of the oil. However, protein content of expeller-produced meals is typically lower than solvent-extracted meal due to the presence of the oil.

CRAMBE MEAL

Crambe meal has been proven to be useful as a protein source for feedlot cattle and beef cows. Presently, FDA regulations limit the inclusion level to 4.2 percent of the diet for feedlot cattle. No other classes of beef or dairy cattle are covered under this clearance. The meal contains approximately 30 percent CP and 65 to 70 percent TDN. Residual oil levels may be as high as 8 percent in expeller crambe meal. Crambe meal is best used in totally mixed rations or at low to moderate levels in protein supplements.

FLAX

Flax can be used as a livestock feed but is often more expensive than other feeds on a per unit of nutrient basis. It can be used as a protein supplement and for energy from its oil content. The seed should be ground before feeding to livestock. In rare cases, flax may contain prussic acid. Flax should be limited to 10 percent of the grain in livestock diets.

For more information on feeding flax to livestock, see this publication: www.ag.ndsu.edu/pubs/ansci/beef/as1283.pdf.

LINSEED MEAL

The residual meal from flax processing, linseed meal, is in demand as high-quality protein for dairy cows, poultry and swine. Expeller processing leaves up to 8 percent residual oil in the meal compared with solvent processing, which removes all but 0.5 percent. Linseed meal is very palatable, but demand from the dairy industry often limits economical inclusion levels in beef cattle diets.

MUSTARD BRAN

Mustard bran is the outer coat of a mustard seed that is removed during processing. Bran typically comes in a ground powder form because of its low bulk density after removal from the seed. Crude protein content varies from 15 to 22 percent, crude fat from 15 to 20 percent and NDF from 38 to 55 percent. Mustard bran is a palatable feedstuff that was fed to dairy cattle up to 8 percent of diet DM. However, a compound called S-methyl cysteine dimethyl disulfide can lead to hemolysis and bloody urine after a period of accumulation in the rumen. In addition, when mustard bran is mixed with silage, aromatic compounds are released. These compounds can be slightly irritating to the eyes if personnel are close to feed in confined areas.

SAFFLOWER

Safflower seed can be used as a protein and energy supplement for beef cattle and sheep. Safflower seed is high in oil and therefore high in energy. Research conducted in Montana indicates that feeding high-linoleic whole safflower seed may improve survival of calves subjected to cold stress. In North Dakota research, feeding ewes supplemental safflower prior to lambing improved lamb survival.

SAFFLOWER MEAL

Safflower meal can be used as a protein supplement for low-protein forages or in backgrounding diets where a source of natural protein is needed. Safflower meal is relatively low in energy (57 percent TDN) due to the inclusion of the hulls with the meal.

SOYBEANS

Soybeans can provide the total protein supplement for beef cattle and sheep, but growing and finishing cattle and lambs should not be fed more than necessary to balance the ration. Research is limited, but in two trials, steers supplemented with 2 pounds of soybean meal gained slightly faster and consumed more feed than calves supplemented with soybean seeds.

Processing the beans by rolling or coarse grinding for cattle may improve performance. Processed raw soybeans should not be stored longer than one week before feeding since they may become rancid, especially in warmer weather. High levels of fat (greater than 8 percent of total diet) can reduce ruminal fiber digestion, so soybeans should be limited based on fat content.

Heating or roasting soybeans is not essential, but it does provide benefits by decreasing the amount of protein degraded in the rumen and increasing the escape or bypass protein available for the animal. Raw beans degrade more rapidly in the rumen, which may or may not be of benefit, depending on other ration ingredients and the need for ruminally degradable protein. Heating also makes the beans more palatable and easier to store.

Green, immature or frost-damaged soybeans can be fed to ruminants without problems. Research conducted at South Dakota State University indicates the raw, frost-damaged soybeans should be limited to less than

14 percent of the diet dry matter to avoid any negative effects due to the amount of oil or enzyme inhibitors present in the raw soybeans. Lambs fed higher levels of soybeans (in corn silage-based diets) had lower fiber digestibility due to the high oil levels, which interfere with fiber digestion in the rumen.

SOYBEAN HULLS

Soybean hulls are relatively low in protein but high in energy. Even though the laboratory analysis of soyhulls shows this feed is high in fiber, it may contain energy (TDN) similar to corn grain when fed as an energy supplement at less than 25 percent of forage-based diets for cattle. The energy from soybean hulls is provided largely by digestible fiber (hemicellulose) rather than starch. Soybean hulls are very palatable. They also pellet well and are used in many commercial feeds.

SUNFLOWER MEAL

Sunflower meal is the coproduct that remains following oil extraction from oil sunflower seeds. The meal contains 32 to 35 percent CP and can be used effectively as a protein supplement in beef cattle rations. Lower (28 percent CP) or higher (40 percent or more CP) protein levels are the result of adding or removing sunflower hulls from the meal product. The addition of hulls to the meal lowers the energy content of the meal as well, so a nutrient analysis of the meal is appropriate.

SUNFLOWER SEEDS

Whole sunflower seeds may be included as a protein and energy supplement. Whole seeds should be limited to 10 to 15 percent of the ration. Whole sunflower seeds do not need to be processed before feeding. Oil-type sunflowers are higher in oil (ether extract) and consequently are higher in energy than confectionary-type sunflowers.

Liquid Coproducts

- Condensed Distillers Solubles
- Corn Steep Liquor
- Desugared Molasses (Concentrated Separator Byproduct)
- Glycerol or Glycerin
- Molasses
- Thin Stillage
- Whey

CONDENSED DISTILLERS SOLUBLES

Condensed distillers solubles are a liquid coproduct of the ethanol industry. This byproduct sometimes is referred to "syrup" or "corn syrup." Condensed distillers solubles are high in moisture and must be handled with pumps and tanks. Condensed distillers solubles are high in protein and energy and contain 6 to 20 percent fat on a dry-matter basis. Condensed distillers solubles are a good source of supplemental protein, phosphorus and trace minerals. It often is used as a ration conditioner and is very palatable.

Condensed distillers solubles contain high levels of sulfur and the amount fed may need to be limited depending on total sulfur levels in the diet. In addition, nutrient variability is high and a laboratory analysis should be conducted to determine proper feeding levels. Because of the risk of overconsumption, this product should not be self-fed.

The product works well in many different types of rations, but the high moisture level limits the distance it can be transported economically. Since it is a liquid, it also requires an investment in liquid-handling equipment.

For more information, see this publication: www.ag.ndsu.edu/pubs/ansci/beef/as1242.pdf.

CORN STEEP LIQUOR

Corn steep liquor (also referred to as "steep" or "steep liquor") is a liquid coproduct of the corn sweetener industry. Corn steep liquor contains 30 to 35 percent CP (on a dry-matter basis) and is high in energy (88 percent TDN) as well. Nebraska research indicates corn steep liquor is an effective ingredient in growing and finishing rations for beef cattle. It also can be used as a protein supplement for cows grazing dormant winter range. The level of use will be dictated by economics, which include transportation costs because this product contains a high proportion of water.

DESUGARED MOLASSES (CONCENTRATED SEPARATOR BYPRODUCT or CSB)

This product is derived during sugar processing from molasses that has gone through further refinement to remove remaining sugar. It is slightly lower in energy (67 percent TDN) compared with molasses but is higher in protein (20 percent CP) and potassium. Research conducted at NDSU indicates that it increases intake in a wide variety of diets when fed at 5 to 15 percent of the diet. This liquid feed product works well as a ration conditioner in addition to the nutrients it adds.

GLYCEROL OR GLYCERIN

Glycerol is a coproduct of biodiesel production from animal or vegetable fat. Glycerol, also known as glycerin or glycerine, is a colorless, odorless, sweet-tasting liquid. Approximately 10 percent of the weight of the oil or fat entering the biodiesel production process will end up as crude glycerol. Feed usage will be the salvage market for this coproduct. Industry is the primary market for crude glycerol, with refined glycerol used in cosmetics and even human food. Feed-grade glycerol is refined partially to remove residual methanol. Methanol can be toxic to cattle, so the FDA requires a maximum level of 0.5 percent in feed-grade glycerol. Glycerol is 85 percent dry matter but handled as a liquid.

NDSU feedlot research indicates feed-grade glycerol can be used at up to 18 percent in receiving and finishing diets without negatively affecting intake, gain or carcass quality. Other research indicates that feeding glycerol up to 8 percent of diet DM resulted in improved gain and feed efficiency in finishing cattle. Adding glycerol to corn silage-based diets improved intake and daily gain of growing calves. Glycerol has an energy value similar to corn on a pound-for-pound basis in dairy and feedlot cattle.

Glycerol contains very small amounts of crude protein and crude fat. Sodium and chloride are the two minerals that make up the majority of the ash content.

MOLASSES

Beet or cane molasses is used primarily as a source of energy (75 percent TDN) in animal feed, but it also is included as a palatability enhancing agent, an agent for reducing dust, a binder for pellets and a carrier for urea, a nonprotein nitrogen (NPN) source, vitamins and minerals. When molasses is used in dry feeds, it should not be incorporated in an amount exceeding 15 percent for adult cattle, 8 percent for calves and 8 percent for sheep. Beet molasses may have a greater laxative effect than cane molasses, so we strongly recommend lower inclusion. It is handled primarily as a liquid but is available as a dry product that can be added to improve palatability.

THIN STILLAGE

Thin stillage is a liquid coproduct from ethanol production. In some cases it may be marketed as a separate coproduct but generally is condensed (heated) to remove moisture and then becomes condensed distillers solubles (CDS). Thin stillage contains 90 to 95 percent water and sometimes is offered to livestock as a replacement for water. In addition to water, it contains protein, fat, minerals and fermentation byproducts, as well as spent yeast cells.

WHEY

Whey is the coproduct of cheese manufacturing. Whey may be available in liquid, condensed or dried forms, depending on the equipment at a particular plant. Dried and condensed whey can be transported economically for longer distances than can liquid whey, but it is more expensive. Liquid whey contains about 93 percent water, condensed whey contains approximately 36 percent water and dried whey contains 7 to 10 percent water.

On a dry-matter basis, whey is approximately equal to corn in energy and to barley in protein. Liquid whey can supply 20 to 30 percent of the ration dry matter in cattle diets. One hundred pounds (12 gallons) of liquid whey can replace up to 7.5 pounds of grain in cattle diets. Cattle should be adapted to whey gradually by blending with water. Liquid whey should be delivered on a daily basis and a continuous supply should be provided to prevent digestive upsets. Whey that is not fresh is lower in palatability, so try to use fresh whey within 36 hours. Cows need time to become accustomed to liquid whey. Producers may need to limit water during this period to force them to consume the liquid whey. Cows will consume about two-thirds of their liquid intake as whey and one third as water.

The nutrient values in this table are from multiple sources and represent the best estimates available at the time of publication. Nutrients in feeds will vary so a laboratory analysis is recommended for accurate values.

Nutrient Content of Conventional and Alternative Feeds

Feedstuff	DM	CP	UIP	TDN	NE_m	NE_g	ADF	Ca	P
	%	% DM	% CP	%	Mcal/lb	Mcal/lb	%	%	% DM
Alfalfa Hay, Immature	90.0	21.5	10.0	63.0	0.63	0.36	NG	1.72	0.30
Alfalfa Hay, Early Bloom	90.0	18.4	15.0	60.0	0.60	0.34	NG	1.40	0.23
Alfalfa Hay, Midbloom	90.0	15.9	20.0	57.0	0.56	0.30	NG	1.35	0.22
Alfalfa Hay, Mature	90.0	13.5	30.0	51.0	0.50	0.24	NG	1.26	0.17
Alfalfa Haylage, Immature	50.0	21.5	10.0	63.0	0.63	0.36	NG	1.72	0.30
Alfalfa Haylage, Early Bloom	50.0	18.4	15.0	60.0	0.60	0.34	NG	1.40	0.23
Alfalfa Pellets, Dehydrated	90.0	19.7	55.0	61.0	0.61	0.35	35.0	1.43	0.26
Alfalfa Pellets, Sun-cured	90.0	16.3	30.0	59.0	0.58	0.32	41.0	1.32	0.24
Alfalfa Silage, Immature	35.0	21.5	10.0	63.0	0.63	0.36	NG	1.72	0.30
Alfalfa Silage, Early Bloom	35.0	18.4	15.0	60.0	0.60	0.34	NG	1.40	0.22
Alfalfa Silage, Midbloom	35.0	15.9	20.0	56.0	0.56	0.30	NG	1.35	0.20
Alfalfa Silage, Mature	35.0	13.5	30.0	50.0	0.50	0.24	NG	1.26	0.17
Alfalfa Stubble (Regrowth)	27.2	19.3	NG	57.0	0.58	0.29	43.0	1.72	0.31
Alfalfa-Brome Hay, Early Bloom	90.0	16.2	15.0	56.0	0.52	0.27	NG	1.03	0.30
Alfalfa-Brome Hay, Midbloom	90.0	14.0	20.0	53.0	0.50	0.24	NG	1.14	0.15
Alfalfa-Brome Silage	35.0	16.2	20.0	56.0	0.52	0.27	NG	1.03	0.30
Barley Grain	88.0	13.5	27.0	84.0	0.94	0.64	7.0	0.05	0.47
Barley Grain, Lightweight	89.1	15.0	20.0	77.4	0.81	0.56	16.0	0.07	0.37
Barley Grain, Thick	89.0	11.0	20.0	86.0	0.96	0.66	NG	0.07	0.39
Barley Hulls	93.3	13.0	NG	73.0	0.78	0.51	18.7	0.20	0.56
Barley Hay, Forage Type, Boot	90.0	14.7	NG	61.0	0.61	0.35	NG	NG	NG
Barley Hay, Forage Type, Milk	90.0	11.7	NG	62.9	0.64	0.38	NG	NG	NG
Barley Hay, Forage Type, Soft Dough	90.0	9.9	NG	63.8	0.65	0.39	NG	NG	NG
Barley Hay, Forage Type, Firm Dough	90.0	9.8	NG	62.6	0.64	0.37	NG	NG	NG
Barley Malt Sprout Pellets	89.0	14.0	NG	74.0	0.77	0.52	15.0	0.14	0.56
Barley Screenings	89.0	11.6	NG	77.0	0.79	0.53	11.0	0.35	0.32
Barley Straw	90.0	4.1	25.0	43.0	0.38	0.00	52.0	0.37	0.11
Beans, Dry Edible	90.0	25.4	20.0	87.0	0.91	0.64	6.0	0.17	0.63
Beans, Dry Edible, Culls and Splits	90.0	24.4	20.0	78.0	0.81	0.56	16.0	0.15	0.59
Bean Straw, Dry Edible	90.0	6.8	NG	51.0	0.51	0.12	56.0	1.85	0.14
Beans, Garbanzo (Chickpeas)	89.0	21.9	NG	89.0	0.93	0.65	10.0	0.17	0.37
Beet Tops, Sugar	17.0	15.1	NG	58.0	0.59	0.27	14.0	1.01	0.22
Beet Top Silage, Sugar	21.0	12.7	NG	53.0	0.55	0.20	18.0	1.56	0.20
Beet Tailings, Sugar	18.4	8.9	NG	65.0	0.67	0.40	34.0	2.35	0.27
Beet Tailings Silage, Sugar	20.0	10.0	20.0	65.0	0.66	0.40	NG	2.50	0.20
Beet Top Silage, Sugar	32.0	11.9	20.0	51.0	0.45	0.20	NG	1.56	0.22

Feedstuff	DM	CP	UIP	TDN	NE_m	NE_g	ADF	Ca	P
	%	% DM	% CP	%	Mcal/lb	Mcal/lb	%	%	% DM
Beet Pulp, Dried Sugar	90.0	9.1	30.0	72.0	0.77	0.49	31.0	0.72	0.20
Beet Pulp, Wet Sugar	25.1	9.1	30.0	72.0	0.77	0.49	31.0	0.72	0.20
Beets, Whole Sugar	20.1	6.8	NG	81.0	0.90	0.60	NG	0.24	0.24
Bread Coproduct	70.2	15.9	NG	90.0	1.00	0.70	NG	NG	NG
Brome Hay, Immature	90.0	15.0	10.0	63.0	0.58	0.32	NG	0.59	0.32
Brome Hay, Early Bloom	90.0	10.5	15.0	55.0	0.52	0.26	NG	0.43	0.25
Brome Hay, Midbloom	90.0	8.0	20.0	53.0	0.50	0.25	NG	0.29	0.28
Brome Hay, Mature	90.0	6.0	30.0	50.0	0.46	0.21	NG	0.26	0.15
Buckwheat Grain	86.6	12.5	NG	77.0	0.79	0.53	17.0	0.11	0.36
Buckwheat Hulls	87.8	3.5	NG	16.6	0.00	0.00	NG	0.29	0.02
Buckwheat Middlings	88.7	33.5	NG	83.7	0.88	0.60	10.0	NG	1.15
Buckwheat Straw	88.0	4.9	NG	42.0	0.42	0.00	NG	1.41	0.12
Bulrush Hay	90.0	8.8	NG	NG	NG	NG	42.0	0.76	0.16
Camelina	88.7	27.0	NG	110.2	1.27	0.91	15.1	NG	NG
Camelina Meal, Expeller	91.5	36.5	NG	88.6	0.97	0.64	19.2	0.38	0.77
Canola Hay	88.0	16.3	NG	65.0	0.67	0.40	41.0	1.30	0.27
Canola Meal, Expeller	90.0	41.0	35.0	76.0	0.80	0.52	16.0	0.60	0.94
Canola Meal, Solvent	90.0	43.6	28.0	69.0	0.73	0.45	18.0	0.67	1.00
Canola Seed	92.0	21.0	20.0	115.0	1.34	0.97	12.0	0.35	0.68
Canola Seed, Frozen	85.0	21.1	NG	101.0	1.16	0.82	NG	0.39	0.69
Canola Silage	25.0	12.5	NG	55.0	0.52	0.27	40.0	1.03	0.30
Carrots	13.0	10.3	NG	82.0	0.86	0.59	11.0	0.37	0.32
Cattail, Narrowleaf	91.0	6.4	NG	45.0	0.45	0.11	50.0	NG	NG
Chaff, Small Grain	93.0	6.2	NG	37.0	0.39	0.00	45.0	0.21	0.07
Chaff, Small Grain, Ammoniated	85.0	10.0	NG	50.0	0.51	0.12	NG	0.21	0.07
Chickpeas (Garbanzo Beans)	89.9	21.7	NG	89.0	0.93	0.65	8.0	0.17	0.37
Chickpea Straw	89.0	5.5	NG	45.0	0.36	0.12	53.6	NG	NG
Concentrated Separator By-product (CSB)	66.0	20.0	20.0	67.0	0.75	0.42	0.0	0.05	0.03
Condensed Distillers Solubles	30.0	25.0	20.0	97.5	1.08	0.87	NG	0.10	1.38
Corn Cobs, Ground	90.0	2.8	30.0	48.0	0.47	0.07	44.0	0.12	0.04
Corn Gluten Feed, Wet	43.0	21.5	20.0	88.0	0.99	0.68	14.0	0.10	1.20
Corn Gluten Feed, Dry	90.0	21.5	20.0	83.0	0.92	0.62	14.0	0.10	1.20
Corn Gluten Meal	91.0	65.9	60.0	89.0	1.00	0.69	5.0	0.08	0.51
Corn Grain, Dry Rolled	88.0	10.0	60.0	90.0	1.02	0.70	3.0	0.02	0.31
Corn Grain, Ear	87.0	9.0	60.0	83.0	0.92	0.62	NG	0.05	0.28
Corn Grain, High Moisture	75.0	10.0	40.0	90.0	1.02	0.70	NG	0.02	0.31
Corn Grain, High Moisture Ear	75.0	8.7	40.0	83.0	0.92	0.62	NG	0.05	0.28
Corn Grain, High Moisture snapped (Earlage)	74.0	8.8	40.0	81.0	0.90	0.59	NG	0.06	0.27
Corn Grain, Steam Flaked	82.0	10.0	45.0	94.0	1.06	0.73	NG	0.02	0.31

Feedstuff	DM	CP	UIP	TDN	NE_m	NE_g	ADF	Ca	P
	%	% DM	% CP	%	Mcal/lb	Mcal/lb	%	%	% DM
Corn Silage	35.0	8.0	25.0	70.0	0.74	0.47	NG	0.27	0.20
Corn Silage, Drought Damaged	35.0	11.1	25.0	61.0	0.67	0.40	NG	0.34	0.20
Corn Steep Liquor	54.0	35.0	0.0	90.0	1.02	0.70	0.0	0.06	1.10
Corn Stover	90.0	4.8	30.0	45.0	0.44	0.19	46.0	0.49	0.09
Cottonseed Meal, Solvent	91.0	45.8	30.0	76.0	0.83	0.54	NG	0.17	1.21
Crambe Meal	91.0	29.8	20.0	70.0	0.77	0.50	30.0	1.10	0.90
Crested Wheat Hay, Midbloom	90.0	9.7	20.0	53.0	0.49	0.24	NG	0.33	0.21
Crested Wheat Hay, Full Bloom	90.0	8.7	25.0	50.0	0.46	0.21	NG	0.28	0.16
Crested Wheat Hay, Mature	90.0	6.0	30.0	44.0	0.33	0.09	NG	0.26	0.12
Distillers Dried Grains, Barley	92.0	30.1	NG	69.1	0.70	0.43	14.0	NG	NG
Distillers Dried Grains, Corn	92.0	29.5	60.0	86.0	0.96	0.66	17.0	0.10	0.40
Distillers Dried Grains, Milo	93.0	33.2	60.0	83.0	0.92	0.62	16.0	0.16	0.74
Distillers Dried Grains, Wheat	93.0	33.5	NG	78.9	0.85	0.56	NG	0.08	0.56
Distillers Wet Grains, Corn	30.0	29.5	60.0	126.0	1.43	0.98	NG	0.10	0.40
Emmer, Grain	91.0	13.5	NG	80.0	0.85	0.56	NG	0.06	0.40
Faba Beans	85.0	30.6	NG	88.2	0.93	0.68	10.0	0.12	0.59
Faba Bean Silage	33.0	20.0	NG	53.9	0.54	0.25	39.0	0.91	0.24
Field Peas, Grain	88.0	23.6	30.0	90.0	1.02	0.70	8.0	0.15	0.44
Field Pea Hay	88.0	13.6	NG	58.0	0.56	0.27	38.0	1.39	0.28
Field Pea Hulls	92.1	9.0	NG	60.0	0.59	0.33	40.0	0.48	0.09
Field Pea Screenings	90.0	23.6	NG	80.0	0.88	0.59	8.0	0.14	0.48
Field Pea Silage	35.0	15.4	NG	58.0	0.57	0.31	37.0	1.32	0.22
Field Pea Straw	89.0	8.5	NG	46.0	0.38	0.13	38.0	1.62	0.11
Flax	94.0	22.8	NG	110.0	1.28	0.89	8.0	0.26	0.56
Flax Straw	95.0	3.7	NG	37.6	NG	NG	46.0	0.72	0.11
Glycerol	84.3	2.0	NG	89.0	NG	NG	0.0	0.08	0.0
Hollowstem Hay, Mature	90.0	5.3	NG	27.0	0.04	0.00	NG	NG	NG
Kochia Hay, Early	87.0	17.0	NG	57.0	0.58	0.29	43.0	NG	NG
Kochia Hay, Late	89.0	12.6	NG	NG	NG	NG	45.0	NG	NG
Lentil Grain	91.0	27.7	NG	85.0	0.92	0.62	7.0	0.08	0.61
Lentil Hay	89.0	14.1	NG	56.0	0.54	0.28	39.0	1.22	0.22
Lentil Silage	35.0	14.5	NG	56.0	0.54	0.28	38.0	1.22	0.22
Lentil Straw	90.0	6.9	NG	45.0	0.36	0.12	46.0	0.65	0.20
Linseed Meal, Solvent	90.0	38.3	48.0	78.0	0.85	0.56	19.0	0.43	0.89
Lupines	89.7	36.2	NG	82	0.87	0.59	14.0	NG	NG
Lupine Silage	37.0	15.4	NG	66	0.68	0.41	34.0	NG	NG
Millet Grain, Proso	90.0	12.9	30.0	84.0	0.93	0.64	17.0	0.15	0.42
Millet Hay, Foxtail	89.0	14.7	30.0	57.0	0.58	0.29	36.0	0.31	0.23
Millet Hay, Pearl	87.0	13.2	30.0	57.0	0.58	0.29	37.0	NG	NG
Millet Hay, Proso	90.0	10.4	30.0	56.0	0.55	0.23	NG	0.33	0.19

Feedstuff	DM	CP	UIP	TDN	NE_m	NE_g	ADF	Ca	P
	%	% DM	% CP	%	Mcal/lb	Mcal/lb	%	%	% DM
Millet Hulls	93.4	5.7	NG	65.0	0.67	0.41	32.0	0.06	0.24
Millet Straw	86.0	6.4	NG	51.0	0.47	0.15	45.0	0.44	0.12
Milo (Grain Sorghum)	88.0	10.0	60.0	84.0	0.93	0.64	5.0	0.03	0.33
Milo (Grain Sorghum) Stover	80.0	5.3	30.0	47.0	0.50	0.23	NG	0.48	0.11
Mint Hay	87.5	14.6	NG	57.4	0.56	0.30	NG	1.71	0.22
Molasses, Beet	77.0	10.0	20.0	75.0	0.77	0.50	0.0	0.12	0.03
Mustard Seed, Tame	94.2	35.1	NG	69.0	0.69	0.42	27.0	0.33	1.04
Mustard Seed, Wild	95.9	24.0	NG	93.7	1.07	0.75	NG	NG	NG
Mustard Bran	94.5	17.5	NG	74.1	0.84	0.56	31.1	1.19	0.34
Mustard Hay, Tame	90.0	10.0	NG	52.5	0.48	0.23	NG	NG	NG
Oats, Grain	89.0	13.6	30.0	77.0	0.84	0.55	NG	0.07	0.36
Oats, Grain, Light	89.0	13.2	30.0	74.0	0.81	0.53	NG	0.10	0.41
Oats, Grain, Heavy	89.0	12.8	30.0	80.0	0.86	0.57	NG	0.06	0.41
Oats, Grain, Hull-less	89.3	17.8	30.0	93.0	0.97	0.67	4.0	0.11	0.44
Oats, Hay, Flower	90.0	9.2	30.0	59.0	0.58	0.31	NG	0.26	0.24
Oat Hay, Boot	90.0	14.7	NG	61.1	0.61	0.35	NG	NG	NG
Oat Hay, Milk	90.0	11.7	NG	59.8	0.59	0.33	NG	NG	NG
Oat Hay, Soft Dough	90.0	9.9	NG	61.9	0.63	0.36	NG	NG	NG
Oat Hay, Firm Dough	90.0	9.8	NG	61.8	0.66	0.39	NG	NG	NG
Oat Hulls	91.6	5.9	NG	55.0	0.57	0.30	36.0	0.15	0.18
Oat Straw	90.0	4.5	30.0	47.0	0.45	0.09	50.0	0.27	0.10
Oat-Field Pea Hay, Boot	90.0	14.8	NG	61.1	0.61	0.35	NG	NG	NG
Oat-Field Pea Hay, Milk	90.0	13.0	NG	62.9	0.64	0.38	NG	NG	NG
Oat-Field Pea Hay, Soft Dough	90.0	11.9	NG	64.1	0.66	0.39	NG	NG	NG
Oat-Field Pea Hay, Firm Dough	90.0	10.6	NG	62.8	0.64	0.37	NG	NG	NG
Onions	10.0	10.2	NG	86.0	0.97	0.66	NG	0.35	0.40
Pasta Waste	89.7	16.4	NG	91	1.02	0.71	1.0	0.06	0.02
Pigeon Grass Hay, Immature	85.7	9.4	NG	57.7	0.56	0.30	40.0	NG	NG
Pigeon Grass Hay, Mature	88.1	7.6	NG	50.0	0.44	0.19	44.0	NG	NG
Pigeon Grass Seed, Green and Yellow Foxtail	84.0	14.0	NG	62.0	0.63	0.36	32.0	0.20	0.38
Pigweed, Seed	90.0	18.7	NG	65.7	0.65	0.39	NG	NG	NG
Potatoes	23.0	9.6	20.0	80.0	0.83	0.57	3.0	0.05	0.24
Potato Silage (Cull Potatoes)	25.0	8.2	20.0	79.0	0.82	0.55	5.0	0.04	0.23
Potato Processing Waste	13.0	9.9	20.0	82.0	0.91	0.61	9.0	0.11	0.26
Prairie Hay, Early Bloom	90.0	8.7	15.0	53.0	0.52	0.27	NG	0.49	0.19
Prairie Hay, Full Bloom	90.0	6.2	25.0	50.0	0.45	0.20	NG	0.38	0.14
Prairie Hay, Mature	90.0	4.9	30.0	46.0	0.38	0.13	NG	0.38	0.09
Quackgrass Hay	87.0	8.0	NG	52.0	0.48	0.20	48.0	0.34	0.28
Rapeseed, Forage (Pasture)	20.0	17.0	NG	65.0	0.67	0.40	30.0	NG	NG
Rapeseed Straw	80.0	3.5	NG	19.0	0.00	0.00	59.0	NG	NG

Feedstuff	DM	CP	UIP	TDN	NE_m	NE_g	ADF	Ca	P
	%	% DM	% CP	%	Mcal/lb	Mcal/lb	%	%	% DM
Russian Thistle Hay	90.0	7.2	NG	44.0	0.33	0.00	45.0	NG	NG
Rye Grain	88.0	13.8	30.0	84.0	0.94	0.64	4.0	0.07	0.37
Rye Straw	88.0	3.6	NG	41.0	0.40	0.05	51.0	0.22	0.08
Safflower, Seeds	93.0	17.5	20.0	91.2	1.00	0.65	40.0	0.26	0.67
Safflower Hay, Immature	90.1	9.7	NG	58.0	0.56	0.31	23.0	NG	NG
Safflower Hay, Mature	90.9	13.1	NG	55.0	0.52	0.26	39.0	NG	NG
Safflower Meal, Solvent	92.0	25.4	20.0	57.0	0.55	0.29	41.0	0.37	0.81
Sagebrush, Fresh	50.5	12.9	NG	49.9	0.50	0.18	28.0	1.01	0.25
Screenings, Barley	93.0	12.6	NG	62.0	0.63	0.36	26.3	NG	NG
Screenings, Canola	89.8	15.4	NG	90.0	1.00	0.70	10.0	1.04	0.47
Screenings, Corn	90.0	9.0	60.0	83.0	0.90	0.62	7.0	0.04	0.41
Screenings, Field Pea	90.0	20.0	NG	75.5	0.82	0.54	NG	0.11	0.44
Screenings, Flax	94.0	23.1	NG	96.0	1.09	0.80	17.0	0.33	0.64
Screenings, Grain	90.0	14.2	NG	70.0	0.72	0.44	16.0	0.48	0.43
Screenings, Millet	89.3	13.1	NG	NG	NG	NG	13.1	0.08	0.28
Screenings, Pigeon Grass	89.0	15.8	NG	NG	NG	NG	25.0	0.08	0.44
Screenings, Refuse	90.0	11.5	NG	56.0	0.57	0.29	40.0	0.46	0.32
Screenings, Sunflower	87.0	11.1	NG	64.0	0.66	0.39	29.0	0.72	0.42
Screenings, Wheat	86.0	16.0	20.0	72.0	0.75	0.49	16.0	0.17	0.40
Slough Hay	94.6	5.0	NG	45.0	0.54	0.19	47.0	0.42	0.14
Sorghum Grain (milo), Dry Rolled	88.0	10.0	60.0	84.0	0.93	0.64	NG	0.03	0.33
Sorghum Grain, High Moisture	75.0	10.0	40.0	90.0	1.02	0.70	NG	0.03	0.33
Sorghum-Sudan Hay	91.0	6.0	30.0	56.0	0.57	0.27	42.0	0.55	0.30
Sorghum-Sudan Silage	28.0	8.0	20.0	55.0	0.56	0.26	42.0	0.46	0.44
Soybeans, Whole	91.0	41.7	20.0	91.0	0.96	0.67	10.0	0.27	0.63
Soybean Hay	88.0	16.6	20.0	55.0	0.53	0.22	40.0	1.25	0.25
Soybean Hulls	92.0	12.4	30.0	80.0	0.83	0.57	45.0	0.59	0.17
Soybean Meal, Solvent	89.0	49.0	30.0	84.0	0.94	0.64	NG	0.33	0.71
Soybean Residue	88.0	5.2	20.0	40.0	0.31	0.06	55.0	1.59	0.06
Spelt, Grain	90.0	13.3	30.0	75.0	0.78	0.53	17.0	0.13	0.42
Sudan Grass Hay, Early Bloom	89.0	11.0	15.0	56.0	0.54	0.29	NG	0.56	0.19
Sudan Grass Hay, Mature	90.0	6.6	30.0	48.0	0.41	0.16	NG	0.26	0.14
Sudan Grass Silage, Immature	25.0	16.8	10.0	59.0	0.58	0.32	NG	0.43	0.19
Sudan Grass Silage, Early Bloom	28.0	11.3	15.0	55.0	0.55	0.28	NG	0.46	0.19
Sudan Grass Silage, Mature	30.0	6.0	20.0	48.0	0.52	0.24	NG	0.26	0.14
Sunflower Hulls	90.0	5.0	NG	40.0	0.41	0.00	63.0	0.00	0.11
Sunflower Meal, Solvent	90.0	38.9	20.0	64.0	0.65	0.35	28.0	0.39	1.06
Sunflower Seed, Confectionary	94.9	17.9	20.0	83.0	0.93	0.63	39.0	0.18	0.56
Sunflower Seed, Oil Type	94.9	17.9	20.0	121.0	1.42	1.03	39.0	0.18	0.56
Sunflower Silage	25.0	12.2	NG	55.0	0.56	0.26	33.0	1.32	0.38

Feedstuff	DM	CP	UIP	TDN	NE_m	NE_g	ADF	Ca	P
	%	% DM	% CP	%	Mcal/lb	Mcal/lb	%	%	% DM
Sweetclover Hay, Early Bloom	90.0	17.8	15.0	60.0	0.60	0.34	NG	1.45	0.24
Sweetclover Hay, Midbloom	86.0	16.0	20.0	55.0	0.56	0.28	NG	1.40	0.21
Sweetclover Hay, Full Bloom	86.0	13.0	25.0	52.0	0.50	0.25	NG	1.35	0.18
Sweetclover Hay, Mature	88.0	11.0	30.0	47.0	0.42	0.17	NG	1.30	0.18
Sweetclover Silage, Early Bloom	27.0	17.8	15.0	60.0	0.60	0.34	NG	1.45	0.24
Sweetclover Silage, Midbloom	30.0	16.0	20.0	55.0	0.56	0.28	NG	1.40	0.21
Triticale, Grain	89.0	16.5	20.0	84.0	0.93	0.64	6.0	0.05	0.33
Triticale Hay, Boot	90.0	15.6	NG	60.9	0.61	0.35	NG	NG	NG
Triticale Hay, Milk	90.0	10.5	NG	59.5	0.59	0.33	NG	NG	NG
Triticale Hay, Soft Dough	90.0	9.4	NG	63.2	0.64	0.38	NG	NG	NG
Triticale Hay, Firm Dough	90.0	9.2	NG	62.7	0.64	0.37	NG	NG	NG
Turnip Roots	9.0	14.0	20.0	84.0	0.88	0.61	15.0	0.64	0.21
Turnip Tops	10.0	16.0	20.0	58.0	0.57	0.31	NG	2.90	0.58
Wheat Bran	89.0	18.0	20.0	70.0	0.72	0.44	14.0	0.12	1.32
Wheat Chaff	92.6	5.5	NG	39.8	0.39	0.00	40.0	0.20	0.15
Wheat, Hard Red Spring	89.0	15.1	20.0	88.0	0.99	0.68	4.0	0.04	0.44
Wheat, Durum	88.0	15.7	30.0	85.0	0.95	0.65	4.0	0.11	0.41
Wheat Middlings	90.0	19.1	20.0	83.0	0.87	0.59	11.0	0.16	1.01
Wheat Straw	90.0	3.6	30.0	43.0	0.40	0.02	52.0	0.19	0.09
Wheat Straw, Ammoniated	90.0	9.7	NG	48.0	0.47	0.07	NG	0.19	0.09
Whey, Condensed	63.6	13.7	0.0	82.3	0.87	0.59	0.0	0.60	0.91
Whey, Dried	90.0	14.2	0.0	84.0	0.88	0.61	0.0	0.95	0.80
Whey, Liquid	7.0	14.0	0.0	78.0	0.81	0.54	0.0	0.98	0.81
Wild Oats, Grain	89.0	9.1	NG	74.0	0.80	0.52	22.0	0.25	0.27

Abbreviations

DM = Dry Matter
CP = Crude Protein
UIP = Undegradable Intake Protein (Escape Protein)
TDN = Total Digestible Nutrients
NE m = Net Energy for Maintenance
NE g = Net Energy for Gain
ADF = Acid Detergent Fiber
Ca = Calcium
P = Phosphorus
NG = Not Given

Table adapted from:

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