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Questions and Answers on Beef Cattle Nutrition

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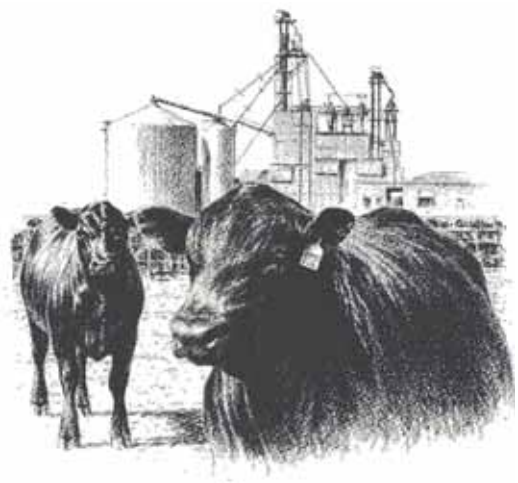

Kansas State University
Agricultural Experiment Station and
Cooperative Extension Service

Questions and Answers on Beef Cattle Nutrition

Maintaining a profitable cattle operation is increasingly difficult. And providing a well balanced ration at a reasonable cost is increasingly complex. This publication provides concise answers to specific questions. Questions are divided into six categories, making information easy to find:

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The list of questions addressed in the roughages section tells you what kinds of information you will find: What is forage quality? How important is it? What are the key factors influencing forage quality; what lab analyses should one get on forages? How do you use a forage crude protein analysis? How do you determine the energy level of forages; Should you make hay or silage out of forage crops? How can corn and milo crop residue be used most economically? Can corn or milo stover be made into silage? Can wheat straw be used in beef cattle rations? Should one consider ammoniating wheat straw? Can the producer make wheat and other small grain forages into silage? What is the status of harvesting high-moisture hay? Are silage additives necessary to make quality silage? When a roughage "heats," is there a loss of protein?

Questions About Roughages

1. What is forage quality?

Forage quality is a combination of the protein level as well as the digestibility (energy) of a forage. A high-quality forage allows increased cattle intake and digestibility, and enhanced feed conversion. The best means of evaluating the cattle performance potential of a forage is the product of its digestibility and intake (i.e., digestible dry matter intake).

2. How important is forage quality?

Forages can constitute 5 to 100 percent of beef cattle rations. Depending on the class of livestock, forage quality can be very important. In general, as the percentage of roughage in the diet increases, the impact of forage quality also increases. Successfully harvesting top quality forage can reduce the amount of protein supplement and grain fed and reduce the amount of forage needed to get the same animal performance.

3. What are the key factors influencing forage quality?

Stage of growth at cutting time and proper moisture level at harvest are key factors that influence forage quality. Some forages such as alfalfa need to be cut when immature (early bloom). Forages such as corn and forage sorghum silages have more feed value when cut at the dough stage of grain maturity. It is critical to harvest alfalfa hay at the proper moisture level depending on the bale package used. Failure to bale at the proper moisture can result in leaf loss if too dry or mold growth in storage if too wet.

4. What lab analyses should one get on forages?

In most cases, an analysis for 1) moisture, 2) crude protein, and 3) acid detergent fiber (ADF for estimation of energy value) is sufficient to balance diets properly. If alfalfa or any forage shows substantial heat damage, browning or mold, it is recommended to have an acid detergent fiber nitrogen analysis conducted as well. In addition, if the forage is to be fed to cattle that are physiologically challenged (late gestation, early lactation, receiving diets), it maybe well to have the forage analyzed for calcium and phosphorus.

5. How do I use a forage crude protein analysis?

By estimating the pounds of forage an animal is consuming each day, you can use the crude protein analysis to determine if you are meeting the animal's protein requirements.
Example: Requirement is 1.4 pounds crude protein (CP)/day We estimate an animal consumes 15 pounds of 6 percent CP hay per day:
15 x 6% = 0.9 lbs. of CP/day
1.4 lbs. CP required – 0.9 pounds. CP from forage = 0.5 lbs./CP deficient from animal's protein requirement.

6. How do I determine the energy level of forages?

A commercial laboratory can estimate the TDN or energy content (NEm, NEg) from the forage analysis by using the ADF level as an indicator.

7. Should I make hay or silage out of my forage crops?

The decision to make hay or silage is an economic and management question. As a general rule, crops harvested as silage will have 10 to 25 percent greater feed value than the same crops cut as hay. Forage field and feeding losses are higher with hay, while storage losses often are greater with silage. Silage making generally is more expensive, and the crop has much less marketability than hay, however, harvesting as silage reduces weather risks. The class of livestock being fed is also important. Growing calves can utilize the extra feed value in silage for growth compared to mature animals such as beef cows fed maintenance.

8. How can corn and milo crop residue be most economically utilized?

Effective use of crop residues offers cattle producers a means of reducing their feed costs, especially with the beef cows. The most economical way to use crop aftermath is to graze it the first 50 to 60 days after grain harvest and then have adequate roughage stored to feed the cows during the

mid-winter months of January and February. Research shows that, in most cases, during the initial six to eight week fall grazing period, gestating beef cows can be grazed on corn and milo stalks without the need of supplemental protein, except that salt, phosphorus and vitamin A should be fed.

When harvested crop residues are fed in winter months to pregnant cows that are within one to two months of calving, additional protein and energy should be fed. Crop residues for lactating beef cows do not supply sufficient energy and should only serve as a small portion of the cow's diet.

Another possible use of harvested corn and milo stover is in growing rations, especially when other forages are scarce. Kansas State research shows that either dry, chopped stover or stover silage can be fed as one-third of the roughage along with other higher quality forage with acceptable calf performance. But when corn or milo stover constituted all of the roughage portion (75 percent of the total ration), daily gains were only 0.75 to 1 pound, which would be unsatisfactory to many producers. Crop residues may also be used in feedlot rations provided they do not exceed 5 percent of the diet.

9. Can corn or milo stover be made into silage?

Grain sorghum stover is easily made into silage, particularly if it is chopped shortly after grain harvest. Adequate moisture content in the stover is very important for efficient ensiling. Shortly after grain harvest, milo stover will have 60 to 70 percent moisture, so it can be direct chopped and ensiled without the need to add water. When corn stover is chopped immediately after grain harvest, it will usually contain 50 to 60 percent moisture, but that drops rapidly within a few days after grain harvest. In most cases, water will need to be added to chopped corn stover to ensure effective packing and fermentation. As with all forages, successful stover silage management consists of adequate moisture content, fine chopping, firm packing and covering the silage to exclude air and minimize top spoilage. Corn and milo stover silages typically contain 5 to 7 percent crude protein and 45 to 55 percent TDN on a dry matter basis. The feeding value of stover produced under dryland conditions is generally higher than that from irrigated grain production.

10. Can wheat straw be used in beef cattle rations?

Yes. Wheat straw is greatly underutilized as a feedstuff, particularly in beef cow rations. It can be used as the primary forage in dry cow rations and at low levels in lactating rations. For example, wheat straw can make up two-thirds of the ration when combined with a high-quality forage such as alfalfa hay for dry cows. It can constitute as much as one-third of the ration with quality hay for lactating cows. It has great potential for reducing feed costs and stretching feed supplies in dry years.

Experience by Kansas producers indicates that the palatability of wheat straw is adversely affected by weathering. Thus, it should be baled as soon after wheat harvest as possible. Wheat straw may also be used as a partial roughage source in growing and finishing diets. Straw needs to be chopped prior to inclusion in mixed rations, with an average particle length of not more than 1 inch.

Optimum utilization of wheat straw results when used in combination with high-quality forage such as alfalfa hay. Substitution of straw for alfalfa hay should be done on a forage neutral detergent fiber (NDF) basis, rather than on a weight or percentage basis. In Arizona research with growing and finishing steers, daily gain and feed gain were optimized when wheat straw and alfalfa hay each contributed 50 percent of the forage NDF. Another consideration when using wheat straw is protein supplementation. Straw is very low in protein so as the level of straw in the diet increases, protein supplementation also must increase.

11. Should I consider ammoniating wheat straw?

Research at Kansas State and other universities clearly shows that ammoniation increases straw intake and digestibility 15 to 25 percent, and doubles the protein content of wheat straw. These nutritional changes make ammoniated wheat straw comparable to prairie hay as a feedstuff. Furthermore, KSU research indicates that it can be used as the sole forage with mineral and vitamin supplementation for beef cows before calving. Your county Extension agent can assist you with the ammoniation procedure.

12. Can I make wheat and other small grain forages into silage?

Extensive research at Kansas State University has demonstrated that small grain silages are excellent roughages in growing and finishing rations. Maximum yield and total feed value for beef cattle are obtained when these forages are harvested in the soft dough stage. At this stage of maturity, the crops usually can be direct cut or swathed and chopped within one to three hours at an optimum moisture content of 60 to 70 percent. Because of the hollow stems and bulky nature of these chopped forages, the moisture level should be at least 60 percent for adequate packing and preservation. In some cases, it may be necessary to add water, especially to the surface layer, to ensure a denser pack before to covering the silage.

The energy content of cereal crops cut in the soft dough stage is directly related to the proportion of grain to forage in the silage. Typically, wheat silage contains about 35 percent grain in the silage dry matter and has a feed value of about 80 percent of corn silage. In contrast, barley silage contains up to 45 percent grain and has 95 to 100 percent the energy content of corn silage in growing rations.

Silages made from oats, rye and triticale are lower in grain content and have an energy content only about 70 percent that of corn silage. When using these three crops in growing

rations, it is often advisable to harvest them in the late boot stage when the forage is higher in nutritional value, although yield will be reduced about 40 percent and the forage needs to be wilted prior to chopping. Small grain silages are higher in crude protein than corn or forage sorghum silages and usually contain 9 to 11 percent at the dough stage and 14 to 16 percent when cut in the boot stage.

13. What is the status of harvesting high-moisture hay?

Harvesting hay at moisture levels exceeding 20 percent, compared to normal field-cured forage containing 14 to 18 percent water, has several advantages, especially with alfalfa hay. First, leaf loss is greatly reduced, resulting in a higher quality, more nutritious feedstuff. Second, baling at higher moisture allows producers to harvest earlier, with less chance of rain damage during unpredictable weather. These advantages must be weighed against the extra time, labor and expense of hay preservative application, equipment and product to help prevent excessive molding and potential fire in the hay crop.

14. Are silage additives necessary to make quality silage?

The basic principles for making quality silage are harvesting the crop at the proper stage of maturity and moisture content (60 to 70 percent), chopping it finely, filling the silo rapidly, packing it tightly, and covering the silage with black plastic. These keys to success optimize silage yield and nutritional value while minimizing harvesting and storage losses. For example, covering bunker silos will dramatically reduce top spoilage by 65 to 85 percent.

There are a wide variety of silage additives and preservatives, ranging from organic acids and nutritive products to bacterial and enzyme inoculants sold as aids to fermentation. The two most popular types are microbial and Non Protein Nitrogen additives. Effective bacterial inoculants should stimulate lactic acid production and rapidly lower silage pH in order to preserve the forage dry matter and minimize fermentation losses. The most promising silage inoculants provide at least 100,000 live lactic acid producing bacteria per gram of ensiled forage, and consist of *Lactobacillus* and *Pediococcus* species, and/or *Streptococcus faecium*. These products produce small, but significant, reductions in silage dry matter losses and enhanced silage stability at feed-out. Silage crops that are difficult to ferment, such as alfalfa, show the greatest response to inoculants, while corn and high grain-containing sorghum silages show the least. Their economic benefit depends on the level of response, feed value of the silage, and cost of product and application.

The ammonia-containing additives—Cold-Flo NPN (anhydrous ammonia) and Pro-Sil (an ammonia, molasses and mineral suspension)—are the only two corn silage additives currently approved by FDA for both safety and effectiveness. Thus, extensive university research has been conducted with these products, and both are economically beneficial when properly used. These additives increase the crude protein of silage 3 to 5 percentage units, reduce mold and fungus growth, decrease protein degradation in the forage, and substantially increase the lactic acid content and silage stability in the silo and feed bunk. However, apparent dry matter recovery may be reduced somewhat, especially with overly wet silages.

15. When a roughage "heats," is there a loss of protein?

Failure to adequately exclude air during the ensiling process, or baling hay that is too wet, will cause heat-damaged forage—created by fixation of the protein to fiber when temperatures exceed 140 F. This heat-damaged protein is not digested by animals. Unfortunately a standard crude protein analysis will not show the degree of heat-damaged protein present. However, forages can be analyzed for acid detergent insoluble nitrogen (ADIN) to evaluate the amount of unavailable, heat-damaged protein.

Questions About Crude Protein and Urea

1. What does the term "crude protein" mean?

The term crude protein includes all nitrogenous compounds in a feed. The crude protein content or equivalent of a feed is calculated by first determining its nitrogen content and then multiplying the result by 6.25. On average, the nitrogen content of natural protein is approximately 16 percent (100 ÷ 16 = 6.25).

2. What does the term "digestible protein" mean?

Digestible protein indicates that portion of crude protein that is digested and absorbed into the body.

3. How does the protein digestibility of various feedstuffs compare?

The digestibility of protein in low quality roughages such as straw, corn stover, cottonseed hulls and corn cobs is quite low. In contrast, the protein digestibility of high quality forages, grains and oil seed meals is relatively high. The digestible protein content of some common feedstuffs is shown in the following table.

4. Do I need to feed a mixture of protein sources to ensure that my cattle are obtaining the proper balance of amino acids for maximum performance?

For most pasture and range situations, the answer is no, given the limited production potential of grazing cattle and the ability of rumen bacteria to provide a quality protein source in sufficient supplies to meet cattle needs. With growing diets where calves are challenged for performance, research shows significant increases in efficiency of protein utilization early in the feeding period by mixing two or more escape protein sources and urea together. This has been attributed to the high level of some essential amino acids in rendered animal protein by-products, particularly blood meal and feather meal.

5. Can I feed raw, unprocessed soybeans to my cattle?

Yes. Cooking or roasting whole soybeans is not necessary when fed to ruminants. The age of the cattle will influence how well the unprocessed soybeans are utilized. Older cattle tend to better utilize unprocessed soybeans than do calves under six months of age. Remember that raw, unprocessed soybeans contain approximately 37 percent protein. Soybean meal products contain 44 and 49 percent. *(Table 1)*

6. Can I self-feed protein to my beef cattle?

Yes, protein supplements can be self-fed; however, most oil seed meals are highly palatable and cattle will overconsume them if given the opportunity. To control intake, a limiting agent of some type is necessary. One that has received extensive use is salt. Two or three parts of protein supplement to one part of salt has successfully worked. The key to this method of feeding is that an animal will consume approximately 0.1 pound of salt per 100 pounds of body weight per day. A ration of 1 pound salt and 2 pounds oil seed meal supplement will provide a daily consumption of about 2 pounds of supplement for 1,000-pound cows.

The ratio of salt to meal can be varied to provide the desired level of protein supplement intake. In the beginning, use a mixture containing one part salt to four parts of meal, with the percentage of salt increased as the animals become accustomed to it. **Be sure to provide plenty of fresh, clean water at all times.** Also, when starting cattle on a salt/protein mix, it is advised to hand feed the first few days to avoid over consumption. The addition of Rumensin to stocker supplements will reduce the salt required by approximately 25 to 35 percent.

7. How is urea converted to protein?

Provided that a sufficient amount of readily digestible carbohydrate grain is present in the ration, ruminal microorganisms will manufacture microbial protein from the ammonia that is released from urea. If the carbohydrates are not available at the time of ruminal ammonia release, the ammonia cannot be incorporated into microbial protein and is absorbed from the rumen into the blood and excreted in the urine.

8. Why do we see so much use of urea?

Urea is included in most commercially available protein supplements to reduce cost of supplemental protein.

Table 1: Percent Crude and Digestible Protein in Feedstuffs

Feedstuff	% Crude Protein	% Digestible Protein
Wheat	12.5	9.8
Corn	9.0	7.0
Oats	12.0	9.4
Sorghum	9.0	7.0
Barley	12.0	9.5
Soybean meal	44.0	39.6
Cottonseed meal	41.0	33.2
Linseed meal	32.0	26.8
Alfalfa hay	15.0	10.6
Brome grass hay	10.6	6.4
Sorghum stover	6.8	3.4
Corn Stalks	5.0	2.0
Ground cobs	2.0	0.0
Cottonseed hulls	3.9	0.0

9. What is the protein equivalent of urea?

The feed-grade urea most commonly available today contains 45 percent nitrogen. Therefore, 100 pounds of 45 percent urea contains 45 pounds of nitrogen. Because natural protein is about 16 percent nitrogen, there is 1 pound of nitrogen in each 6.25 pounds of protein (100 lbs ÷ 16% = 6.25 lbs). Thus, the "equivalent" protein in 100 pounds of 45 percent nitrogen urea is 281 pounds of protein equivalent.

10. Is one pound of urea equal to seven pounds of soybean meal?

No. Urea furnishes only nitrogen and contains no energy, vitamins or minerals. On the other hand, natural proteins such as soybean meal furnish other nutrients, especially energy, that are of value to cattle. To make 1 pound of urea equal to 7 pounds of soybean meal, some readily available source of energy such as grain must be added. Therefore, 1 pound of urea plus 6 pounds of grain supply about the same amount of energy and nitrogen as 7 pounds of soybean meal.

11. Are protein supplements containing urea well utilized in low quality roughage rations?

No. Low-quality forages do not contain sufficient amounts of readily available energy to efficiently "capture" and convert the nitrogen from urea into microbial protein. In contrast, trials at Kansas State University showed that calves backgrounded on higher quality roughages, such as sorghum silage, plus 3 to 4 pounds of grain daily, effectively utilized urea as a protein source. Similarly, urea is effectively utilized as the only supplemental protein source in highgrain finishing rations.

12. How should high urea supplements be used in beef cattle rations?

They should be thoroughly blended with the grain mix, and preferably with the complete ration. Because

urea is extremely soluble, its nitrogen is quickly released in the rumen in the form of ammonia. If a ration mixture including urea is always available in the feed bunk, frequent eating by the cattle on high-quality growing and finishing rations will result in the urea supplement being used about as efficiently as soybean meal.

13. How do liquid supplements compare with dry protein supplements?

In finishing studies at several universities, cattle performance was similar whether liquid or dry supplements of equal composition were fed.

Liquid supplements are popular in some feedlots because they are easy to blend in a complete ration and assist in bunk management. The addition of a liquid supplement or molasses to a ration reduces dust and fines improving the texture and condition of the ration. Molasses can also mask the flavor of urea and add energy to the ration.

There can be differences in the amount of water in liquid supplements (typically 25 to 35 percent) in which the same levels of protein equivalents, minerals and additives are guaranteed. If water is added to liquid supplement, it will have a lower energy value. Molasses alone will not supply sufficient energy at the level and time needed to get maximum utilization of urea. Therefore, other sources of energy such as grain are required to best utilize supplements with a high urea content. Research shows that beef cows and stockers grazing low-quality forages usually make poor use of urea in liquid or dry supplements.

14. How much non-protein nitrogen can be used safely and efficiently in beef cattle rations?

A. Receiving Rations.

Newly arrived cattle recovering from the stresses of weaning and shipment have poor appetites. Under these conditions, highly palatable, largely all-natural protein supplements are preferred to stimulate intake and improve health and gain. Small amounts of urea (less than 0.05 pound/head daily) may be fed in starter diets to adapt rumen microbes to NPN, if urea-based supplements are going to be used later in the feeding period.

B. Finishing Rations.

Numerous university studies have shown that virtually all of the supplemental protein in high concentrate diets can be furnished by NPN sources such as urea. Most feedlot nutritionists suggest that urea be limited to about 1 percent of the total ration dry matter, or about 0.2 pound of urea per head daily (0.55 pound of crude protein equivalent) for finishing cattle.

C. Growing Rations.

Once calves have been properly started on feed, urea or other NPN sources such as ammoniated silage can make up most of the supplemental protein in high quality backgrounding rations. In general, urea can furnish 35 to 50 percent or more of the supplemental protein in silage or hay-based rations containing 4 to 6 pounds of grain per head daily. Generally, supplementing rations with more natural protein ensures optimal performance during relatively short growing programs (less than 100 days), whereas higher levels of urea can be used in longer backgrounding programs. While urea may not be as efficiently utilized as natural protein, the cost differential is enough to justify its use. Research has shown better utilization of NPN when combined with high ruminal escape protein sources such as blood meal, corn gluten meal and dehydrated alfalfa.

D. Maintenance Rations.

NPN sources are poorly used with low energy forages like dormant range, crop residues or hay, because they do not contain sufficient readily available energy. Under these conditions it is generally advisable to use an all-natural protein supplement containing little or no urea.

15. What is meant by DIP and UIP?

DIP is the abbreviation for degradable intake protein", which is the proportion of the total crude protein in a feedstuff that is degraded in the rumen. This fraction is typically used by rumen microbes to build their own protein, which is a high quality protein and is later digested by the animal in the small intestine. This is the primary source of protein for most ruminants. UIP is the abbreviation for "undegradable intake protein, which is the fraction of protein in a feedstuff that is not degraded in the rumen, but remains intact to be digested by the animal in the small intestine.

16. What is more important to supplement on low quality pasture, protein or energy?

Protein. If crude protein content of the consumed forage is less than 7 percent (dormant pasture and crop residue will often be 3-6 percent crude protein), the rumen bacteria are being "starved" for nitrogen, and will not break down the forage as efficiently as possible. By supplementing with a highly degradable (or DIP) source of protein, such as soybean meal or cottonseed meal, the bacteria will do a more effective job of breaking down the consumed forage and the animal will get more out of the forage. The secondary benefit of this improvement in digestion is that the animal is able to consume more forage, so the benefit of supplementing protein is that the cow gets more energy from her diet. For example, a 1000 pound cow grazing unsupplemented dormant Flint hills pasture may consume about 15 pounds of dry matter forage, and only digest about 50 percent of it, for a net intake of 7.5 pounds of TDN. By supplementing 2 pounds of soybean meal, we can increase consumption to 18 pounds and increase digestion to 55 percent, for a net intake of (18* 0.55 = 9.9 lbs TDN) + (2 lbs SBM * 0.90 = 1.8 lbs TDN) for a total of 11.7 lbs of TDN, or a 56 percent increase in energy intake.

Conversely, supplementing low quality forage diets with grain can have a negative impact on total energy intake because digestion of grain produces acids, which causes a reduction in forage digestion and intake.

This could result in less total energy being consumed, even though you are supplementing with energy.

Questions About Concentrates and Grain Processing

1. What is the value of wheat in beef cattle rations?

Wheat is an excellent feed grain when priced competitively with corn and milo. Typically, Kansas red wheats are 3 to 4 percentage units higher in protein and similar in energy to corn. In addition, mill run wheat is usually drier and cleaner than other feed grains. Wheat is very useful in growing rations because of its higher protein content. Pound for pound, wheat is generally worth 103 to 108 percent of the value of corn in beef cattle rations. Blending wheat with other grains in growing and finishing diets also shows excellent benefits.

2. How much wheat can be fed in the ration?

Because wheat is very rapidly digested and tends to produce excessive fines when dry processed, it is usually blended with other feedstuffs to prevent the possibility of digestive upsets. Conservatively, beef cow supplements and creep feeds can contain 30 to
50 percent wheat. In growing programs, wheat can be the sole source of grain in silage-based diets, and it can constitute up to 50 percent of the grain in dry, hay-based rations. In finishing rations dry rolled wheat can account for 50 to 60 percent of the grain fed. However, steamrolled wheat can be used as the only grain in well managed feedlot diets.

3. How should wheat be processed?

Wheat must be processed to improve digestibility by cattle. Steam rolling (not flaking) wheat to a 36 to 39 pound/bushel density is optimal for feedlots. The resulting product is thick and durable and has a crimped appearance. In addition to minimizing ration fines, K-State research shows that steam rolling reduces the rate of wheat starch digestion in the rumen compared to dry rolling. This results in higher intakes, more rapid and efficient gains, and less likelihood of digestive upsets. For farmer–feeders without steam rolling capabilities, *coarse* dry rolling or grinding of wheat results in a very acceptable product. When rolling or grinding, process as coarsely as possible. Moisture tempering of the dry grain prior to rolling, or adding water or molasses on the feed truck or mixer wagon, particularly when dry roughages are used, may help bind fines to roughage particles and aid in ration conditioning. Whatever processing method is used, the goal is to maximize particle size and minimize fines.

4. Does it pay to pellet beef cattle rations?

Pelleting high concentrate rations usually reduces cattle gain as well as feed intake. Feed efficiency may be improved slightly, but not enough to cover the cost of pelleting. In contrast, pelleting hay or high roughage rations improves both gain and feed conversion of cattle. However, pelleting enhances the feed value of poor quality forages to a greater degree than that of high quality ones. Pelleting also facilitates mechanical forage handling and shipping, while reducing feed wastage and wind loss.

5. What is the nutritional value of high moisture ensiled corn and milo?

High moisture or early harvested grain is obtained prior to grain maturity. Reconstitution is the process by which water is added to mature harvested grain. The optimal moisture level for high-moisture or reconstituted grain is between 28 and 30 percent. High-moisture grain is typically rolled or ground prior to ensiling in bunker or trench silos. Reconstituted grain is usually ground also before feeding to cattle. Proper processing (ensiled whole, rolled at feedout) of high-moisture harvested or reconstituted corn or grain sorghum results in feeding values comparable to those when each grain is steam flaked. Feed efficiency of feedlot cattle is improved by 10 to 15 percent in reconstituted milo diets compared to dry rolled milo rations. High moisture corn ensiled whole results in feed efficiency improvements of 5 to 7 percent when compared to cattle fed dry rolled corn. Most feeders limit the level of high-moisture grain to 50 percent of the concentrate portion of finishing rations.

6. What are the various methods of processing grain?

A. Dry rolled.

Dry rolling or coarse grinding of grains is the cheapest form of mechanical processing. Rolling involves passing the grain through corrugated rollers which fracture the kernel. Typically, moisture is not added to the grain prior to processing. However, cold tempering by adding water or commercial grain conditioners can be used for treating grain prior to rolling. Reduction of grain kernel particle size improves digestibility and utilization of the grain. Mixing efficiency is also improved with ground grain compared to whole grain. Corn, wheat, barley, rye and oats require only coarse processing, while grain sorghum must be very finely cracked or rolled for maximum feed value.

B. Steam flaked.

This method employs heat, moisture and mechanical pressure during the steam flaking process. Whole grain is exposed to steam in a closed chamber before passing through rollers that flatten the grain kernel into a flake. Flatness of flake can be controlled by moisture content and tension settings between the two rollers. Corn, and especially grain sorghum, are commonly steam flaked for use in feedlot diets. Feed efficiency is improved 10 to 12 percent when grain sorghum is steam flaked compared to dry rolled. Corn also responds to steam flaking, but the improvement is only about one-half that for grain sorghum. Bulk density or bushel weight for both flaked grain sorghum and corn should

be less than 28 pounds, but not less than 24 pounds per bushel. Other grain-processing methods, including popping, micronizing, roasting, extruding and exploding, improve feeding value similar to steam flaking. However, these methods are not routinely used in the cattle feeding industry.

7. What is the feed value of light-weight sorghum grain?

The feeding value of clean grain sorghum weighing 35 to 40 pounds or more per bushel is virtually equal to standard test weight milo on a pound-for-pound basis. Nutritionally, light-weight milo is higher in crude protein, fiber and minerals, but somewhat lower in starch than normal grain. However, their digestible energy values are similar when properly processed. Light milo is more difficult to process because of greater variation in seed size, smaller berries and more foreign material. Because of its lower bulk density, light test weight milo also requires more transportation and storage space per ton and takes longer to process than normal grain.

8. How important is grain grade to feeding value?

Grading factors and impaired kernel appearance often reduce market value for grain without influencing its feed value. The major problem with off-quality grain is generally one of storage and handling rather than nutrition, as this type of grain is more susceptible to mold and insect infestation.

9. What are the relative feed values of different grains? *(Table 2)*

Table 2

Grain	Relative Feed Value %*	Maximum Replacement for Corn
Shelled Corn	100	100
Ground ear corn	90	100
Grain sorghum	92-96	100
Barley	100-105	100
Wheat	103-108	50
Tritacale	100-105	50
Rye	100-103	50
Oats	90-92	30

* Considers both protein and energy contents of dry rolled grains for growing and finishing cattle.

10. How do feed grains vary in rate of starch digestion?

Relative Rate of Ruminal Starch Digestion:

FASTEST

Wheat—flaked = high moisture < dry rolled
Barley—flaked = high moisture < dry rolled
Corn—high moisture and processed (bunker)
Corn—flaked = high moisture, fed whole
Milo—flaked = high moisture
Corn—dry rolled or cracked
Corn—dry, fed whole
Milo-dry rolled or cracked

SLOWEST

Questions About Vitamins, Minerals and Water

1. What are the water requirements of cattle?

The water needs of cattle are influenced by a number of factors such as: rate and composition of gain, pregnancy, lactation, physical activity, type of ration, diet salt content, dry matter intake and environmental temperature. An estimate of the daily water intake of various classes of cattle at various times of the year is shown in *table 3*. However, during summer months most of the water consumption occurs during midday when heat stress is greatest. Water supply capacity during peak demand needs to be considered in addition to total daily requirements.

2. What vitamins need to be added to cattle rations?

Although many vitamins are known to be important to cattle, the one that is routinely added to most cow-calf/stocker/feedlot diets is vitamin A (20,000 to 40,000 I.U. daily). In recent years, vitamin E has taken on new significance in cattle diets. For example, supplementing highly stressed calves with 150 to 300 I.U. of vitamin E daily during the receiving period has been beneficial. Vitamin E has also shown a substantial increased shelf life of fresh beef when fed at 500 I.U. per day for the last 100 days before slaughter.

3. What does International Units or I.U. mean?

Commonly vitamin A requirements are expressed as I.U. (International Units) or sometimes referred to as USP units. These are the standard units of potency of a biologic, such as a vitamin, as defined by the International Conference for Unification of Formulae.

4. How can I supply vitamin A to cattle?

The most common methods of supplying vitamin A include:

a. Use of forages known to be high in vitamin A activity (carotene), such as green grass or alfalfa and other legume hays.

b. Inclusion of vitamin A in mineral mixes or protein supplements fed daily.
c. Through injectable vitamin A.

5. Is vitamin A stored?

Cattle are able to store considerable amounts of vitamin A in their livers and, to some extent, other tissues when they receive a liberal supply. Typically, animals with adequate liver stores need to be on a vitamin A deficient diet for several weeks or months before deficiency symptoms are observed.

6. Is the vitamin A content of stored forages stable?

No. In properly preserved forage, the vitamin A content is fairly stable for four to six weeks after which there is a gradual decline. By six months, up to half of the vitamin A may be depleted, and after 1 year, most of the vitamin A is gone in hay or silage.

7. What minerals normally have to be added to range cattle rations?

Typically, minerals for grazing cattle are broken down into two broad classifications: macro minerals and micro minerals. Macro minerals that are needed for grazing cattle are:

- Sodium (salt)
- Magnesium
- Phosphorus

8. What are the salt requirements of cattle?

Typically, cattle need a diet that contains 0.25 to 0.3 percent salt (sodium chloride). Grazing cattle will typically consume sufficient salt if offered free choice in loose or block form.

9. What trace minerals are needed for range cattle?

Typical micro minerals that need to be considered with grazing cattle are:

- Copper
- Iodine
- Zinc
- Selenium
- Cobalt
- Manganese

Table 3: Estimate of the daily water intake of various classes of cattle at various times of the year

Month	Mean Temp (˚F)	600 lb Stocker or Growing Cattle (Gal)	1,000 lb Feedlot Cattle (Gal)
January	36	5.0	8.5
March	50	6.0	9.5
May	73	8.0	13.0
July	90	13.0	20.5
September	78	8.5	14.0
November	52	6.0	10.0

Table 4: Phosphorus requirements of 1,000-pound cows as influenced by a number of factors

Stage of Production	Minimum Daily Phosphorous Requirements, Grams
Pregnant:	
Mid Stage	17 grams
Late stage	20 grams
Lactating:	
10 lbs./day	22 grams
20 lbs./day	27 grams

Table 5: Varying mineral mix prices with the cost/lb of phosphorus

Mineral Mix	Cost/Ton	Phos. Content	Cost/lb Phos.
A	$400	12%	$1.67
B	$300	8%	$1.87
C	$250	8%	$1.56

10. What are the calcium and phosphorus requirements of grazing cattle?

Typically in situations where cows or stocker cattle are grazing or being fed harvested forages, the calcium requirements (0.2 to 0.4 percent) are met. An exception to this would be cows placed on a high grain diet during periods of drought. In these instances, calcium should be supplemented. In contrast, phosphorus (0.2 to 0.3 percent required) is often deficient in grazing situations. Table 4 lists the phosphorus requirements of 1,000-pound cows as influenced by a number of factors. To adjust these daily requirements, the following guidelines should be used:

1. Adjust the phosphorus requirement by 2 grams per 100 pounds change in cow body weight.

2. Adjust these requirements by 0.5 grams per pound of milk change. *(Table 4)*

Examples are based on varying mineral mix prices, the following is the cost/pound of actual phosphorus. *(Table 5)*

11. The requirements are listed in grams. How do I calculate whether the requirements are met?

The first step is to determine the requirements of the cattle. The second step is to determine the mineral content in the forage being fed. Transfer this from a percentage, which appears on most forage analysis sheets, to grams as follows: i.e., 20 pounds dry matter intake x 0.2% phosphorus x 454 grams = 18.2 grams. Then compare the daily dietary intake to the requirement. (Note: 454 grams = 1lb.)

12. How do I calculate the best buy in a mineral supplement?

First, you need to determine what the key nutrient is in the mineral mix. For example, if your main interest is supplying phosphorus, then the easiest calculation is to determine the cost per unit of phosphorus (typically per pound of phosphorus). This is calculated by taking the cost of the mineral mix per ton times the phosphorus content giving the pounds of phosphorus that a mineral mix supplies. Then divide the cost per ton by the pounds of phosphorus in the mineral mix. Table 5 gives an illustration of how three minerals might be compared.

13. Can I make my own home mixed mineral supplements?

In some cases it may be economically advantageous to do your own formulating. There are some excellent commercial mineral mixes on the market, and many companies can help you in formulating a proper mineral mix for your cattle. Simple mixes such as 50 percent trace mineralized salt and 50 percent dicalcium phosphate make a very good mineral for cows. This mix containing 9.5 percent phosphorus, is easy to mix and is very functional for beef cows under many grazing systems. For stockers on native range, a mixture of two-thirds trace mineralized salt and one-third dicalcium phosphate is adequate. *In doing your own self-mixing it is important that you understand what you are trying to accomplish and that you get a good mix on the mineral prior to feeding. Add 3 to 5 percent dry molasses to prevent caking and increase palatability.* Be sure to monitor consumption closely to ensure adequate intake of trace minerals and to avoid over consumption.

14. Are there any minerals available to help prevent grass tetany?

Lush, immature pastures, especially cool-season grasses and wheat pasture, are magnesium deficient or have forage conditions that cause a magnesium "tie-up," resulting in a health condition referred to as grass tetany. If this is a problem in your area, you should use extra magnesium in the form of magnesium oxide and add this to the mineral mix at the rate of 15 to 20 percent of the total mineral formulation. To prevent grass tetany, cows typically need from 50 to 60 grams of magnesium oxide per day. When magnesium is added to a typical mix, it may be less palatable and it may be necessary to add 6 to 10 percent of a flavoring agent such as molasses or soybean meal to ensure desired animal intake.

Commercial mineral supplements are also available that contain 8 to 10 percent magnesium for cows and 4 to 6 percent for stockers.

15. Do cattle have the nutritional wisdom to consume mineral as needed to meet their requirements?

Unfortunately, research has consistently shown that the only mineral that cows have the nutritional wisdom to consume at a level that meets their dietary requirements is salt.

Questions About Feed Additives and Implants

1. What growth promoting implants are available?

(Refer to Table 6)

2. Should I implant my suckling calves?

Absolutely. Implanting probably returns more per dollar invested than any other management practice. Field

Table 6 **Recommended Implants and their Approved Uses ***

BRAND	SEX	GROWTH PHASE
Ralgro®	both	suckling, growing, finishing
Synovex® -C	both	suckling
Compoonent™ E-C	both	suckling
Compudose®	both	suckling, growing, finishing steers and finishing heifers
Synovex® - S	steers	over 400 lbs., growing and finishing
Component™ E-S	steers	over 400 lbs., growing and finishing
Synovex® - H	heifers	over 400 lbs., growing and finishing
Component™ E-H	heifers	over 400 lbs., growing and finishing
Revalor® - IS	steers	over 400 lbs., growing and finishing
Revalor® - IH	heifers	over 400 lbs., growing and finishing
Synovex® - Choice	steers/heifers	over 400 lbs., growing and finishing
Synovex® - Plus	steers/heifers	finishing
Finaplix® - H	heifers	finishing
Revalor® - 200	steers/heifers	finishing
Revalor® - S	steers	finishing

**For cattle intended for slaughter*

research has routinely shown a 15 to 25-pound increase in weaning weight from implanting. With any of the currently cleared implants, potential replacement heifers should not be implanted until they are 30 to 45 days old to minimize reproductive effects.

3. Could I use two implants during the suckling period?

Perhaps. Field research in Kansas has shown that re-implanting midway through the suckling period will increase weaning weight by 10 to 15 pounds. The additional time and labor required to re-implant calves must be considered in evaluating this practice. One practice that many cattlemen have found useful is to re-implant spring-born calves in mid-August and give the calves their pre-weaning vaccinations at the same time. Heifers intended for breeding should not be implanted twice before weaning.

4. What is the withdrawal time for implants prior to slaughter?

Currently all implants used in suckling, growing and finishing cattle have a 0-day withdrawal period. This is not a consideration in the use of implants.

5. Where should implants be located in the ear?

The current recommendation for all implants is that they be placed in the middle one-third of the ear as shown in Figure 1. It is crucial that implants be placed in the middle-third of the ear as recommended by manufacturers.

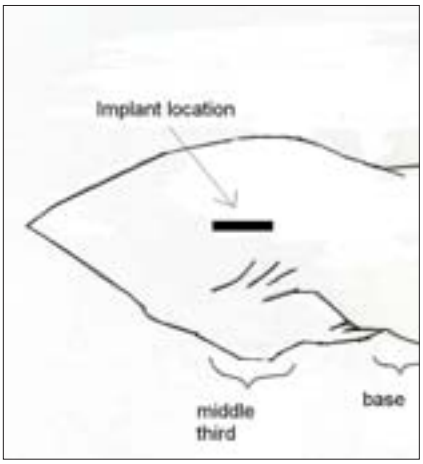

Figure 1

6. Should feedlot heifers be fed MGA?

Melengestrol Acetate (MGA) is a synthetic, orally active hormone similar in structure and activity to progesterone. As a feed additive it is beneficial in suppressing estrus in feedlot heifers. The suppression of estrus reduces injuries due to riding and chasing and helps maintain feed intake. Performance response to MGA is variable and may depend upon: 1) age of heifers being fed; 2) number of sources of heifers fed together; 3) amount of feeding space per heifer; and/or 4) implant effects.

MGA is approved for use in liquid supplements and can be fed Rumensin and Bovatec. MGA fed with Rumensin or Bovatec and a growth-promoting implant results in only a small additive effect. The approved level of MGA intake is 0.25 to 0.50 mg/head/day, with 0.40 mg the most common dose.

7. What are antibiotics? How practical are they in cattle finishing rations?

Antibiotics are chemicals which inhibit the growth of bacteria deleterious to animal health. They are classified as drugs, not nutrients. In general, animals respond most to antibiotic feeding when stressors such as disease, crowding, inclement weather, muddy lots or shipping exist.

Producers must evaluate, on a pen-by-pen basis, whether antibiotics such as chlortetracycline or oxytetracycline will benefit the transition of newly received feeder cattle to the intended feeding program and improve performance. Antibiotic usage for control of liver abscesses caused by prolonged, high concentrate feeding is common in most finishing diets and include oxytetracycline or tylosin, approved for use in combination with ionophores.

8. Are ionophores beneficial in beef cattle rations?

Yes, ionophores consistently improve feed conversion 5 to 10 percent by enhancing the efficiency of rumen fermentation and reducing protein degradation in the rumen. Moreover, Rumensin is somewhat effective for reducing bloat and acidosis by encouraging more uniform consumption patterns. Rumensin and Bovatec are also effective coccidiostats.

9. Do ionophores work with grazing cattle, and how do I feed them?

Yes, research has shown that grazing stocker cattle gain 0.15 to 0.20 pounds faster per day when receiving 125 to 200 mg of an ionophore daily.

The economics of feeding an ionophore depends on the cost of the carrier supplement. The carrier may be a mineral mixture, protein supplement or grain mix. The most common carriers are loose mineral mixes or blocks. If an ionophore is fed in a loose mineral, dry molasses or a similar product must be added to achieve 3 to 4 ounce intake per day to obtain the desired level of ionophore consumption. Alternative supplements containing ionophores can be hand-fed daily, every other day or three times a week with similar performance benefits, as long as average daily intake is the same.

10. Do ionophores and implants both work when used together?

Yes, ionophores and implants have different modes of action. Ionophores exert their influence via the rumen and implants via the endocrine system.

11. How important is it to follow withdrawal regulations on the label of drugs and implants?

It is extremely important to follow the withdrawal times and other instructions on any drug or implant used with livestock for production of wholesome food. These guidelines help ensure the safe and effective use of a product while preventing any drug residue in the beef supply.

12. What is Optaflexx?

Optaflexx (the chemical name is ractopamine) is a type of compound

called a beta agonist, which increases the amount and rate of protein deposition in finishing beef cattle. Optaflexx increases carcass weight by 10 to 20 pounds in steers, and slightly less in heifers. There is also a measurable increase in ribeye size, as beta agonists act primarily by increasing protein deposition in muscle. Available data suggests Optaflexx has no negative impact on carcass quality, although the carcasses may be slightly leaner.

13. Can antibiotics be used in free-choice mineral mixtures for grazing cattle?

Yes, antibiotics can be fed in mineral mixtures for grazing cattle to improve performance and reduce health problems. Stockers fed antibiotics typically gain 0.15 pounds/day faster, with a marked reduction in foot rot and pinkeye problems.

Research also shows that antibiotics in mineral mixtures for cows are effective in preventing certain diseases, such as anaplasmosis, and improving weaning weights by 15 to 20 pounds. The commonly recommended antibiotic level for grazing cattle is 350 mg/head/day. For anaplasmosis control, the recommended antibiotic level is 350 mg/head daily for cattle up to 700 pounds, and 0.5 mg/pound for cattle over 700 pounds.

Before formulating a medicated mineral mixture, read the antibiotic label and add the proper dosage in accordance with intended use. *(Figure 2)*

Figure 2

FEEDLOT 30-20
CONCENTRATE R-300
MEDICATED
For Beef Cattle Only.
For Improved Feed Efficeincy.
DO NOT FEED UNDILUTED
ACTIVE DRUG INGREDIENT

Monensin (As Monensin Sodium).....300 g/ton

Crude Protein, not less than	30.0%
This includes not more than	20.0%
equivalent protein from non-protein nitrogen	
Crude Fat, not less than	1.0%
Crude Fiber, not more than	12.0%
Calcium (Ca) not more than	7.0%
Calcium (Ca) not less than	6.0%
Phosphorus (P), not less than	1.0%
Salt (NaCl), not more than	5.0%
Salt (NaCl), not less than	4.0%
Iodine (I), not less than	0.0008%
Vitamin A, USP Units Per Pound, not less than	30,000

INGREDIENTS

Plant Protein Products, Processed Grain By-Products, Animal Protein Products, Urea, Ground Limestone, Dicalcium Phosphate, Salt, Vitamin A Supplement (Stability Improved), D-Activated Animal Sterol (Source of Vitamin D3), Vitamin E Supplement, Magnesium Oxide, Potassium Chloride, Calcium Sulfate, Manganous Oxide, Iron Carbonate, Zinc Oxide, CobaltCarbonate and Potassium Iodide.

MIXING DIRECTIONS

Feed at the rate of 1.0 lb. to 1.5 lbs. per head per day to provide 150 mg. to 225 mg. of monensin sodium. Feed countinuously. Must be mixed thoroughly with grain and roughage before feeding.

FEEDING DIRECTIONS

Feed Continuously So that Each Animal Consumes Not Less Than 360 Mg. Per Head Per Day.

CAUTION

1. MONENSIN MEDICATED CATTLE FEED IS SAFE FOR USE IN CATTLE ONLY. CONSUMPTION BY UNAPPROVED SPECIES MAY RESULT IN TOXIC REACTIONS.
2. Do no allow horses or other equines access to formulations containing Monensin. Ingestion of Monensin by equines has been fatal.
3. Feeding this supplement undiluted or mixing errors resulting in high concentrations of Monensin could be fatal to cattle.
4. Do not exceed the levels of Monensin recommended in the feeding directions as reduced average daily gains may result.

Questions About Commercial Supplements

1. What information is a feed manufacturer mandated by law to provide on a feed tag?

With the exception of custom formulated feeds, all commercially available feeds shall contain a label or tag bearing the following information:

1. The net weight.
2. The product and/or brand name.
3. A guaranteed analysis stating the level of those nutrients guaranteed by the company.
4. The common name of each ingredient. Some states may permit the use of collective terms for ingredients of similar type.
5. The name and principal mailing address of the manufacturer/seller.
6. Adequate directions for use of all commercial feeds containing drugs.
7. Precautionary statements for safe and effective use.

2. Do medicated feeds require additional labeling?

Yes, in addition to the information required for non-medicated products, medicated feeds require the following information:

1. The purpose of the medication.
2. Directions for use of the feed product.
3. The names of all active drug ingredients.
4. The concentration of all active drug ingredients in the feed.
5. A warning or precautionary statement for withdrawal period when required by law.
6. Warnings against misuse.

3. What are collective feed terms and why are they used?

Collective terms refer to a general classification of ingredients of common origin, and that have a similar function, but does not imply equivalent nutritional values. Collective terms provide flexibility in feed formulation by allowing feed manufacturers in different geographical areas to use the same feed labels and take advantage of ingredient price fluctuations. This ultimately assures the producer of feed products at least cost. Some examples (below) of collective terms and a partial listing of ingredients contained within each include:

4. How do you determine the amount of natural protein in a supplement?

This can be determined by subtracting the percentage of protein equivalent from nonprotein nitrogen (NPN) sources from the total percentage of crude protein listed on the feed tag. The difference will give you the amount of natural protein.

Example (from feed tag)

Crude Protein (not less than)	30%
Protein Equivalent from NPN (not more than)	- 20%
Amount of Natural Protein	10%

5. How do I determine what proportion of the protein in a feed is supplied by urea or other NPN sources?

The illustrated feed tag (Figure 2) shows that not more than 20 percent equivalent protein is from non-protein nitrogen. This means that of the 30 total units of protein supplied in this example supplement, 20 units or two-thirds are from non-protein nitrogen sources such as urea.

6. How much urea is in a supplement?

To calculate the amount of urea in any supplement, divide the percentage of protein equivalent from non-protein nitrogen by 2.81. *(Table 7)*

Example from illustrated feed tag: 20% NPN ÷ 2.81 = 7.12% of the total supplement by weight is urea.

Table 7: Non-protein nitrogen

Animal Protein Products	Grain Products	Plant Protein Products
Animal blood, dried	Corn	Cottonseed meal
Fish meal	Wheat	Soybean meal
Whey, dried	Sorghum	Corn gluten meal

7. How do I determine how much urea I am feeding?

Determine the level of non-protein nitrogen (NPN) in the supplement, as illustrated in Question 6. Multiply this percentage by the pounds of supplement fed per head daily.

Example: Feeding 1 pound of illustrated supplement 1 pound/day x 7.12% urea =.0712 pound urea/ head daily.

8. What does crude fiber tell me about a feed?

The crude fiber analysis on a feed tag is a rough indicator of energy level. Low crude fiber at 8 percent or less indicates that substantial grain is included, and 12 percent or more crude fiber may indicate that considerable plant or milling byproducts are used. Cottonseed and sunflower meals are exceptions, as they are high in fiber with 13 percent; thus, if large amounts are used in the supplement, the total fiber would be over 10 percent.

9. How do I determine the energy level of cattle supplements?

Examining the crude fiber content of a supplement is normally the first place to estimate energy content. For example, a typical 20 percent range feed without any non-protein nitrogen contains approximately the energy (TDN) levels (below) where fiber levels are varied. Many supplements contain processed plant byproducts such as wheat middlings, soy hulls, dehy alfalfa and corn gluten feed, that contain substantial levels of crude fiber. However, these crude fiber sources are highly digestible by ruminant animals. Thus, these supplements are higher in energy than indicated by their fiber levels. Protein can also be used as a source of energy for cattle, but it is an expensive proposition. Use of high energy byproducts or grains is more economical if energy is lacking in the diet.

Table 8: TDN levels

Fiber %	5	10	15	20	25
TDN %	72	68	62	55	46

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service

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