Mississippi Master Cattle Producer Program

Beef Cattle Nutrition

Welcome to the Mississippi Master Cattle Producer Program Self-Study Program Beef Cattle Nutrition training module. This program is administered by the Mississippi State University Extension Service. For answers to questions about this training program, contact Dr. Brandi Karisch, MSU-ES Extension Beef Cattle Specialist.

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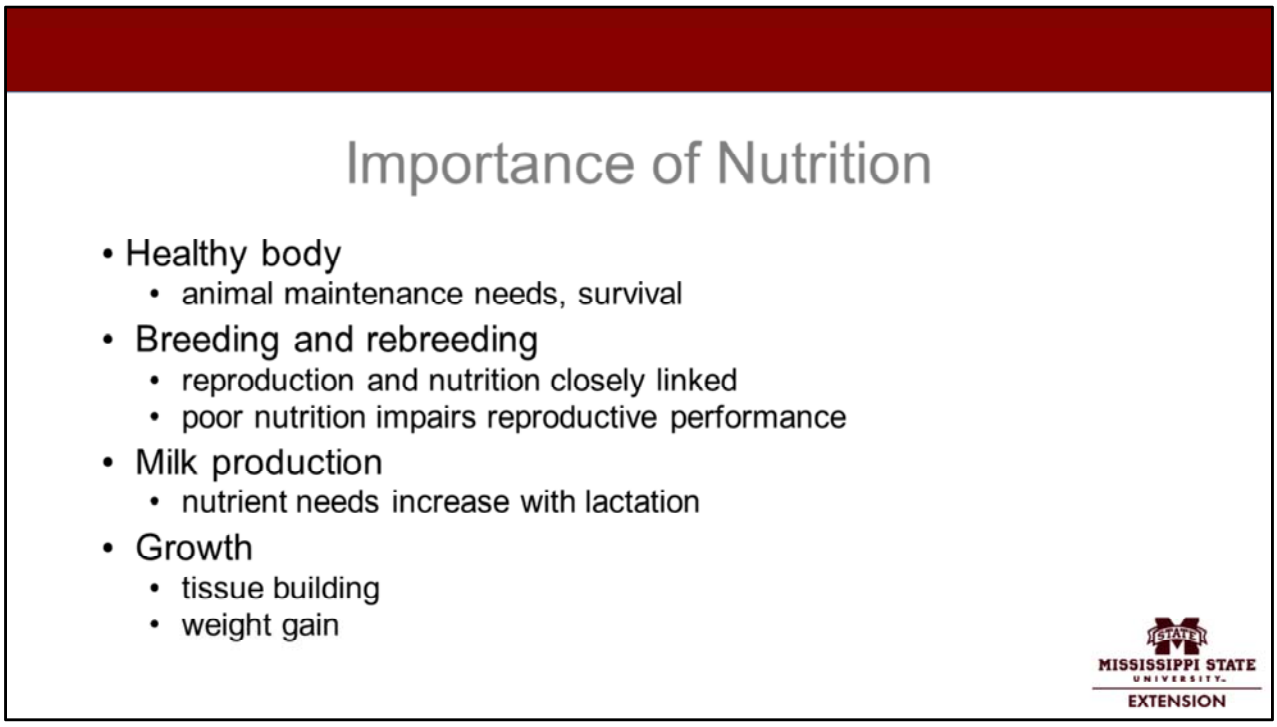
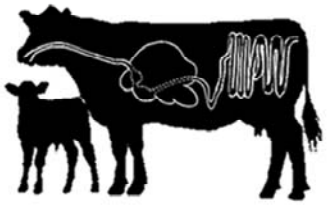


Beef cattle require nutrients to support body maintenance, reproduction, lactation, and growth. Proper nutrition is critical for animal productivity. Calving rates, weaning weights, and stocker average daily gains are all affected by the nutritional program of the operation. The market values of cows and bulls are also influenced by previous nutrition.

Ruminant Digestive System



- Mouth, tongue, salivary glands
- Esophagus
- 4 compartment stomach
  - rumen – largest, microbial fermentation
  - reticulum – "honeycomb", traps heavy/dense objects, small fold of tissue separates from rumen
  - omasum – "many plies", water absorption
  - abomasum – "true stomach", HCl, digestive enzymes from abomasum and pancreas
- Small intestine
- Large intestine

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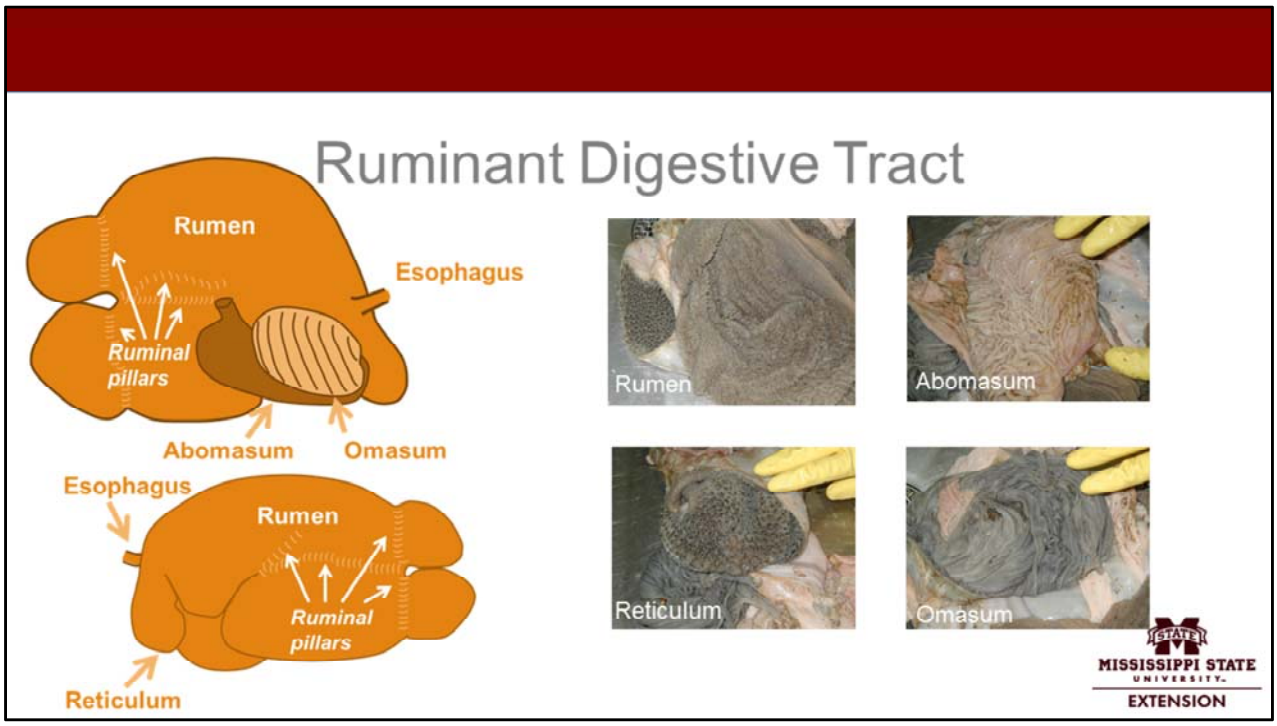
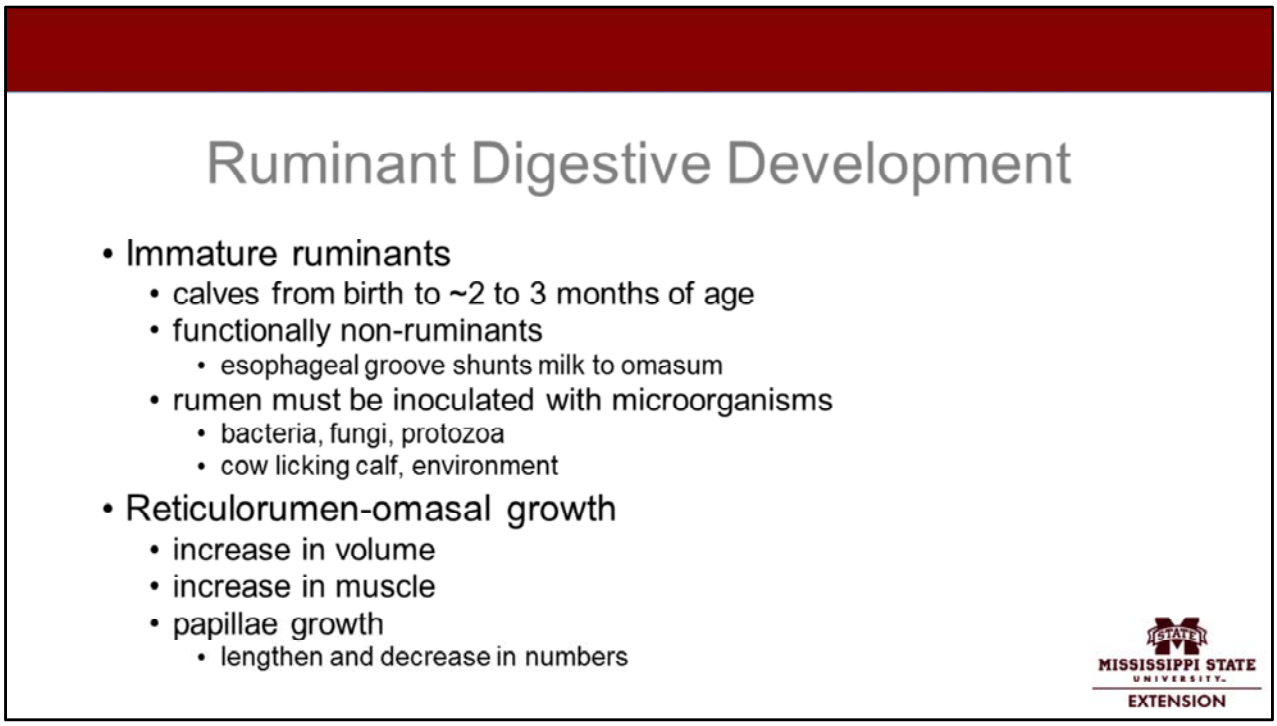
Ruminant livestock include cattle, sheep, and goats. Ruminants are hoofed mammals that have a unique digestive system that allows them to better utilize energy from fibrous plant material than other herbivores. Unlike monogastrics such as swine and poultry, ruminants have a digestive system designed to ferment feedstuffs and provide precursors for energy for the animal to utilize. By better understanding how the digestive system of the ruminant works, livestock producers can better understand how to care for and feed the ruminant animal.

The ruminant digestive system uniquely qualifies ruminant animals such as cattle to make efficient use of high roughage feedstuffs such as forages. The ruminant digestive system includes the mouth, tongue, salivary glands (producing saliva for buffering rumen pH), esophagus, 4-compartment stomach (rumen, reticulum, omasum, and abomasum), small intestine (duodenum, jejunum, and ileum), and large intestine. The rumen is the largest stomach compartment, hosting microbial fermentation. The reticulum is separated from the rumen by only a small fold of tissue. It has a honeycomb appearance and traps heavy/dense objects consumed by the animal. The rumen and reticulum are collectively referred to as the reticulorumen. Water absorption occurs in the omasum, which is referred to as "many plies" due to its many tissue folds. The abomasum is the "true stomach" of a ruminant. It produces hydrochloric acid and digestive enzymes and receives digestive enzymes secreted from the pancreas. The small and large intestines follow as

further sites of nutrient absorption.
Mississippi State University Extension Service Publication 2503, “Understanding the Ruminant Animal Digestive System” discusses ruminant digestive processes in detail.

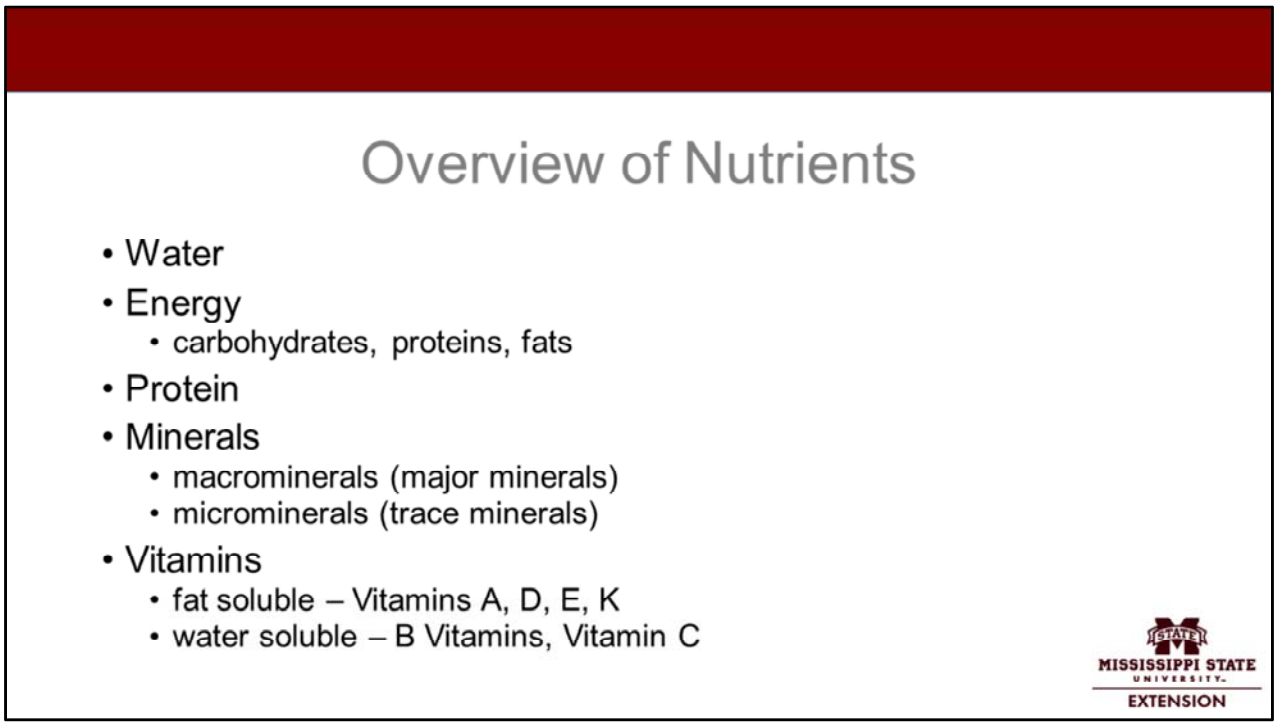


True ruminants such as cattle, sheep, goats, deer, and antelope have one stomach with four compartments: the rumen, reticulum, omasum, and abomasum. The ruminant stomach occupies almost 75 percent of the abdominal cavity, filling nearly all of the left side and extending significantly into the right side. The relative size of the four compartments is as follows: the rumen and reticulum comprise 84 percent of the volume of the total stomach, the omasum 12 percent, and the abomasum 4 percent. The rumen is the largest stomach compartment, holding up to 40 gallons in a mature cow. The reticulum holds approximately 5 gallons in the mature cow. Typically, the rumen and reticulum are considered one organ because they have similar functions and are only separated by a small muscular fold of tissue. They are collectively referred to as the reticulorumen. The omasum and abomasum hold up to 15 and 7 gallons, respectively, in the mature cow.



Immature ruminants (young, growing calves from birth to about 2 to 3 months of age) are functionally non-ruminants. The esophageal groove present in these young animals is formed by muscular folds of the reticulum. It shunts milk directly to the omasum and then abomasum, bypassing the reticulorumen. The rumen in these animals must be inoculated with rumen microorganisms including bacteria, fungi, and protozoa. This is thought to be accomplished through mature ruminants licking calves and environmental contact with these microorganisms. Immature ruminants must undergo reticulorumen-omasal growth including increases in volume and muscle. Rumen papillae, where nutrient absorption occurs, must lengthen and decrease in numbers as part of rumen development.
In a calf at birth, the abomasum is the largest compartment of the stomach, making up over 50 percent of the total stomach area. The reticulorumen and omasum account for 35 percent and 14 percent, respectively, of the total stomach area in the newborn calf. As ruminants develop, the reticulorumen and omasum grow rapidly and account for increasing proportions of the total stomach area. In mature cattle, the abomasum encompasses only 21 percent of the total stomach capacity, whereas the reticulorumen and omasum make up 62 and 24 percent, respectively, of the total stomach area.
Because immature ruminants do not have a functional rumen, feeding recommendations differ for developing ruminants compared with adult ruminants. For instance, it is recommended immature ruminants are not allowed access to feeds containing non-protein nitrogen such as urea. Developing ruminants are also more sensitive to gossypol and

dietary fat levels than mature ruminants. Design nutritional programs for ruminants considering animal age.



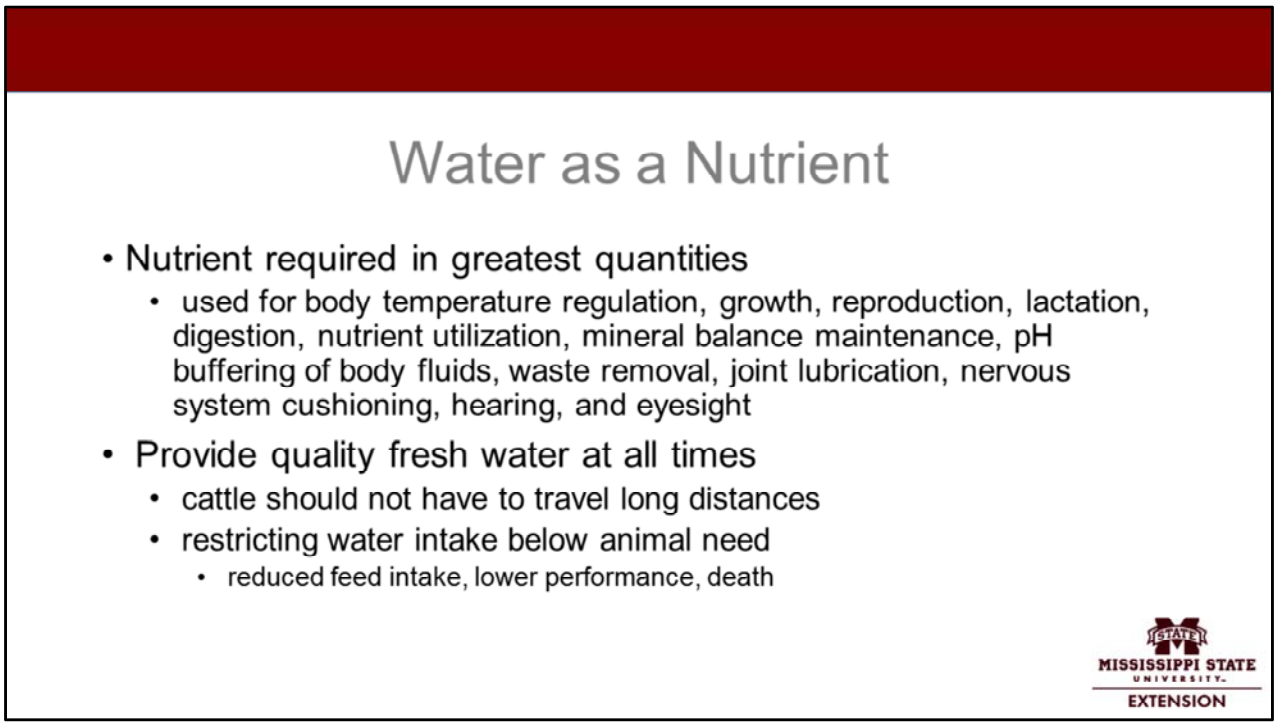
Nutrients required by beef cattle include water, protein, carbohydrates, fats, minerals, and vitamins. Of these nutrients, water is required by beef cattle in the greatest amounts daily. Beef cattle water requirements appear in Mississippi State University Extension Service Publication 2490, “Beef Cattle Water Requirements and Source Management”.

The second greatest daily intake need is energy, which is supplied by carbohydrates, fats, and protein. Energy values include total digestible nutrients, net energy for maintenance, and net energy for gain. Mississippi State University Extension Service Publication 2504, “Energy in Beef Cattle Diets” discusses energy needs of beef cattle.

Protein is a key nutrient in beef cattle diet formulations. The role of protein in beef cattle diets is presented in Mississippi State University Extension Service Publication 2499, “Protein in Beef Cattle Diets”.

Minerals and vitamins are required by beef cattle in the smallest quantities of the nutrients listed above but are essential to animal health and productivity. Mineral requirement values for calcium and phosphorus appear in Mississippi State University Extension Service Publication 2528 “Beef Cattle Nutrient Requirements”. Mississippi State University Extension Service Publication 2484, “Mineral and Vitamin Nutrition for Beef Cattle” outlines in detail calcium and phosphorus as well as other mineral and vitamin nutritional

requirements of beef cattle.



Water is the most abundant nutrient in the body and a critical nutrient for all classes of beef cattle. Cattle need access to adequate supplies of clean water at all times and should not have to travel long distances for water. Water is a critical nutrient required for a wide variety of body functions in cattle. It is needed for body temperature regulation, growth, reproduction, lactation, digestion, nutrient utilization, mineral balance maintenance, pH buffering of body fluids, waste removal, joint lubrication, nervous system cushioning, hearing, and eyesight.

Cattle cannot adapt to water restriction very well. Restricting water intake to less than is required by the animal will result in decreased feed intake and reduced performance. Water deprivation for extended periods can ultimately result in death. Thirst is a result of water need, and cattle drink to fill this need. Thirsty cattle may indicate that water needs are not being met. Cattle should be supplied with all the water they can drink to avoid stress, production losses, and possible dehydration.

Water Requirements

Beef Animal	Daily water needs, gallons/head	
	50°F	90°F
400-lb calf	4	10
800-lb feeder	7	15
1,000-lb feeder	8	17
Cows and bulls	8	20

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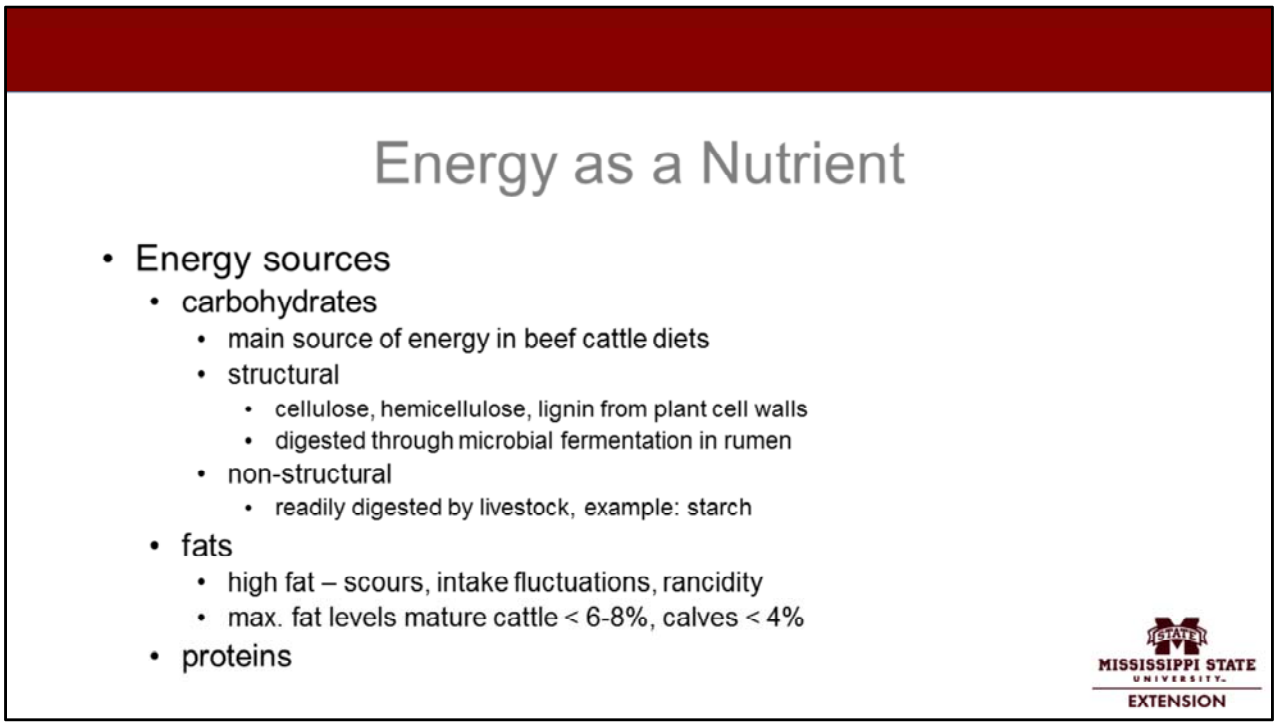
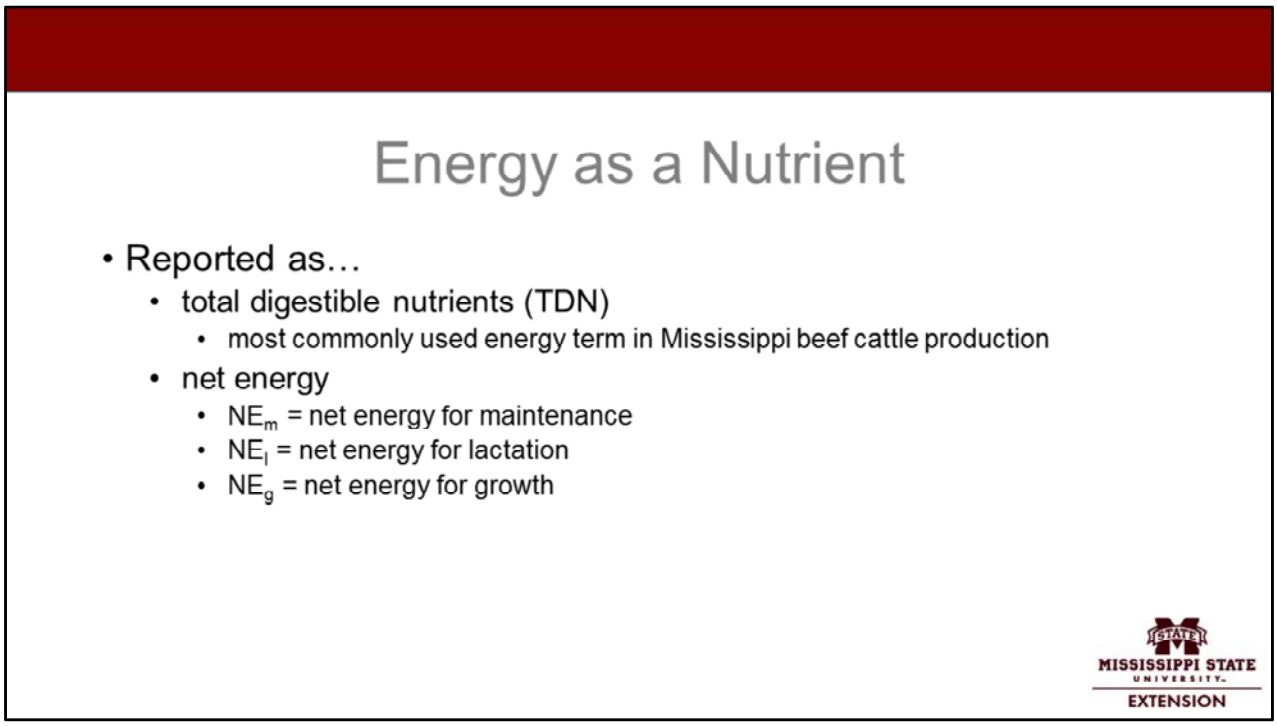
Cattle water requirements and consumption depend on a number of factors including air temperature, humidity level, water temperature, milk production, pregnancy status, physical activity, growth rate, animal size, breed, diet type, moisture level in the diet, salt intake, and dry matter intake. Lower evaporative losses of water from cattle in high humidity conditions can slightly lower water intake requirements. Diets high in protein, salt, minerals, or diuretic substances that increase urination can raise water requirements of cattle. Brahman-influence cattle have an enhanced ability to adapt to hot, dry conditions and may withstand short-term water deprivation better than other breeds. Water intake studies of Brahmans comparing with Herefords revealed lower water intake by Brahmans.

Seasonal differences in water intake occur. Water intake is greatest in summer, intermediate in spring and autumn, and least in winter. Providing shade in summer can reduce water intake. Temperature increases from 50 degrees Fahrenheit to 90 degrees Fahrenheit can increase daily water requirements by 2.5 times. According to the most recent edition of the Nutrient Requirements of Beef Cattle, a 400-pound growing calf requires approximately 5.8 gallons of water per day when the temperature is 70 degrees Fahrenheit. This increases to 9.5 gallons per day when the temperature reaches 90 degrees Fahrenheit. As the size of the calf increases, water requirements also rise. For a 600-pound calf, daily water intake needs are 7.8 gallons at 70 degrees Fahrenheit and 12.7 gallons at 90 degrees Fahrenheit.

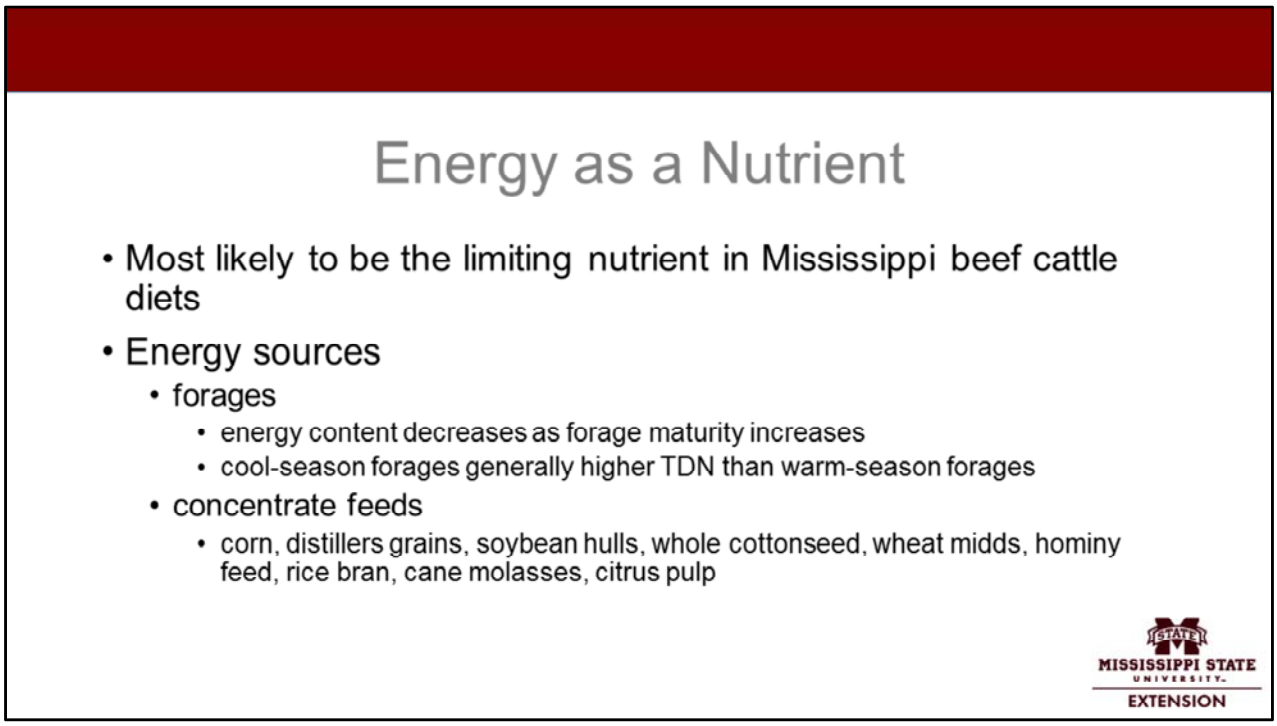


Protein, carbohydrates, and fats provide energy in beef cattle diets. Carbohydrates are the main source of energy in beef cattle diets. Carbohydrates are either non-structural (readily digested by all livestock) or structural (some are digested through fermentation that occurs in the rumen). Ruminant animals including beef cattle have the unique ability to digest some structural carbohydrates in plant cell walls as a source of energy through microbial activity in the rumen. Structural carbohydrates include cellulose, hemicelluloses, and lignin. Beef cattle can digest cellulose and hemicelluloses through rumen microbial action but cannot digest lignin.

Fat levels can limit practical feeding levels of feedstuffs. High fat intake leads to scours (diarrhea) and feed intake fluctuations. Fat can contribute to feeds becoming rancid and unpalatable. Maximum recommended fat levels in beef cattle diets are less than 6 to 8% fat for mature beef cattle and less than 4% fat for growing calves.



Energy is often referred to as digestible energy, net energy for maintenance (NE_m), net energy for gain (NE_g), net energy for lactation (NE_l), and total digestible nutrients (TDN). On forage and feed quality analysis test results digestible energy in Mississippi beef cattle diets is most commonly expressed as TDN. For practical purposes of ration balancing and determining energy supplementation needs on forage-based diets, TDN is a key value to consider.



Energy is more likely than protein to be deficient in forage-based beef cattle diets in Mississippi. Recent five-year forage test data from the Mississippi State Chemical Laboratory and the Louisiana State University AgCenter Forage Quality Laboratory support this claim.

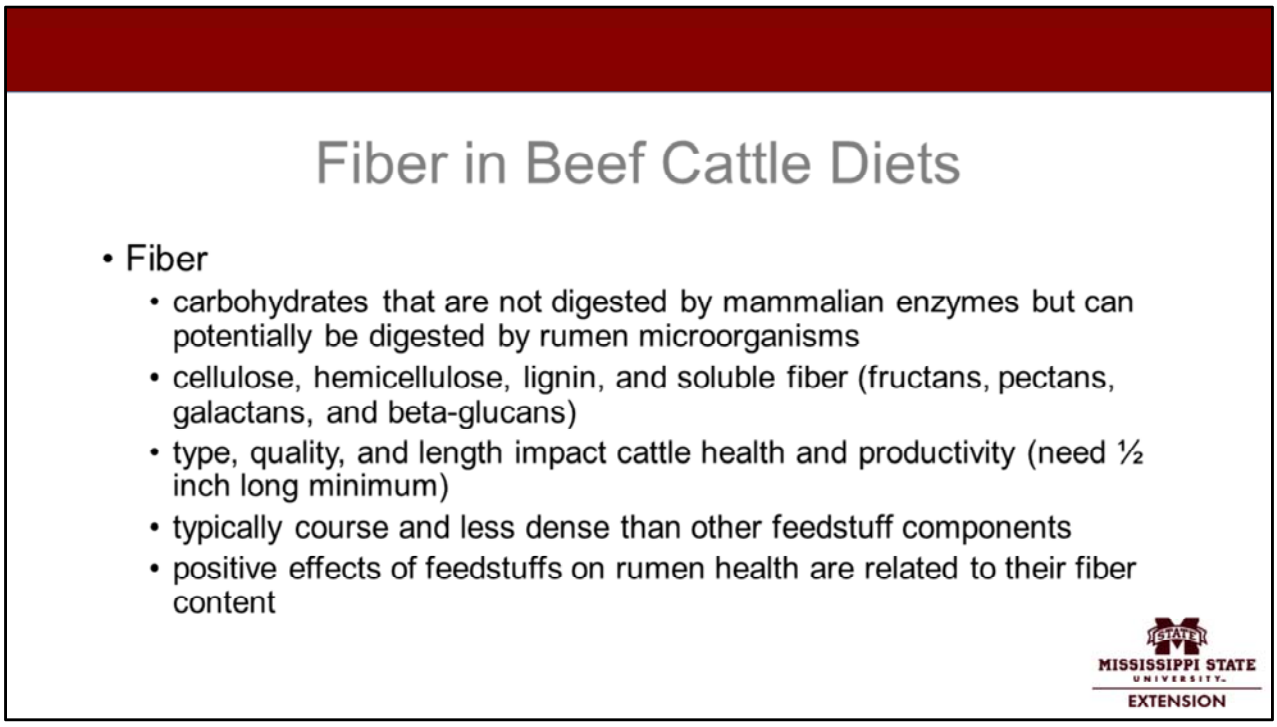
As plants mature, cell walls become more lignified and less digestible. Forage digestibility declines tremendously when forages are allowed to become over mature before cutting or grazing. High ambient temperatures tend to increase plant lignification (production of the indigestible compound lignin), thus lowering digestibility in forages.

It is important to provide cattle with adequate amounts of digestible energy for optimal animal performance. Highly lignified forages are slower to digest than less lignified forages and feeds. Increasing lignin levels in forages consumed by cattle increases time the forage spends in the rumen, decreases dry matter intake, and reduces animal performance. While many factors affect forage digestibility and ultimately TDN, the primary factor that producers can control is forage maturity.

Beef cattle diets in Mississippi are primarily forage based. Many factors affect digestible energy levels in forage including forage maturity and species. Cool-season grasses, such as tall fescue and annual ryegrass, generally are more digestible than warm-season grasses,

such as bermudagrass and dallisgrass. Cool-season annuals (annual ryegrass, wheat, rye) typically are more digestible than cool-season perennials (tall fescue, orchardgrass). Legumes like clovers and alfalfa generally are higher in digestibility than grasses.

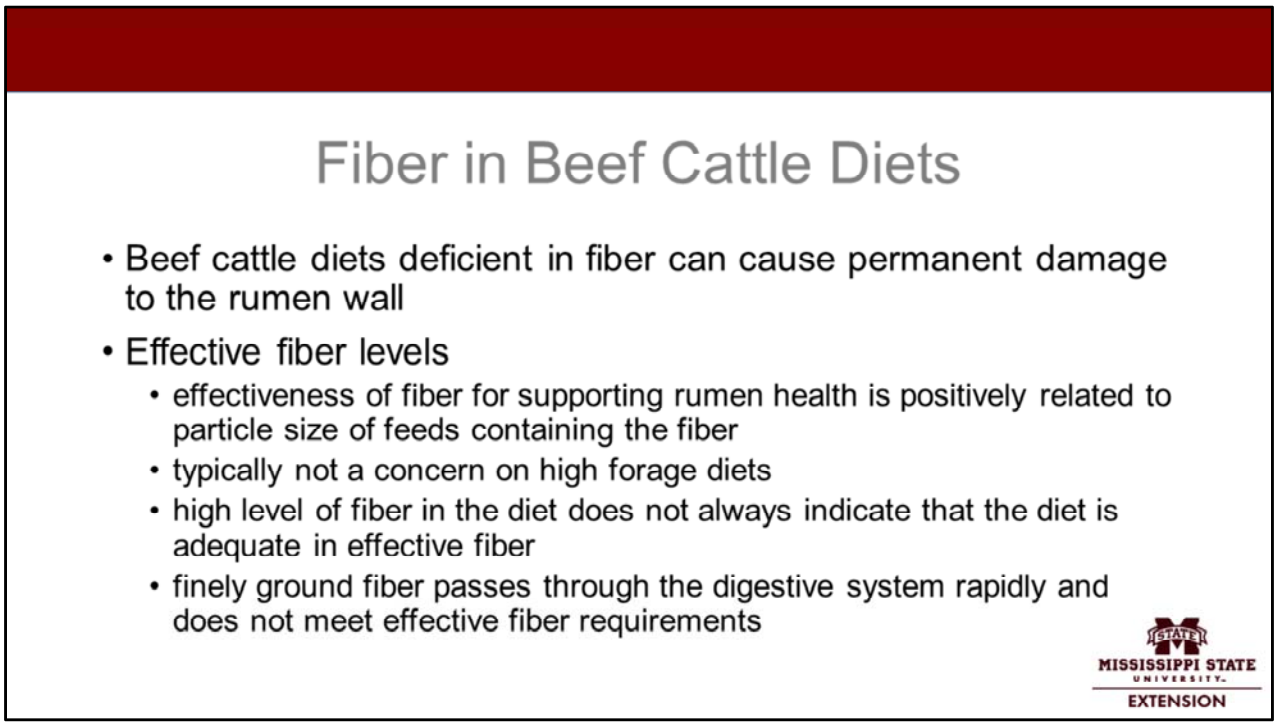
Concentrate feeds that serve as good energy sources in beef cattle diets include corn, distillers grains, soybean hulls, whole cottonseed, wheat middlings, hominy feed, rice bran, cane molasses, and citrus pulp.



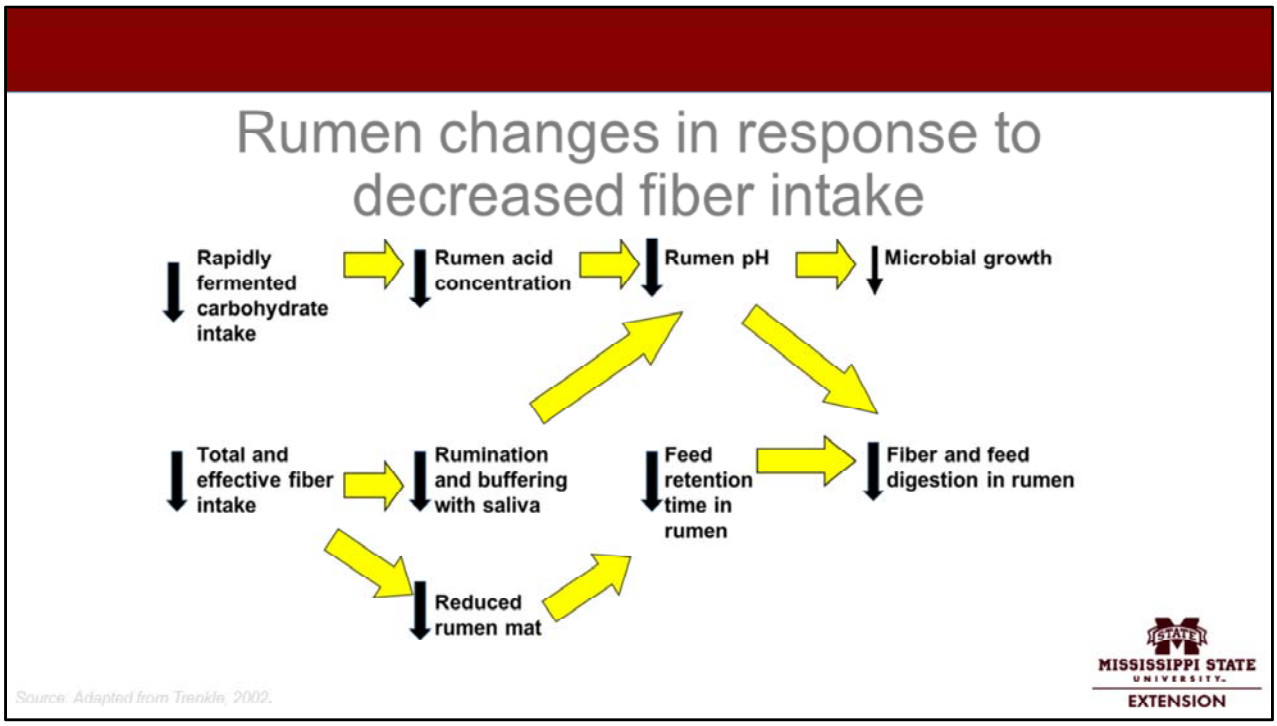
Fiber is an essential diet component. Fiber type, quality, and length impact cattle health and productivity. Fiber is typically course and less dense than other feedstuff components, and the positive effects of feedstuffs on rumen health are related to their fiber content. When hay shortages are commonplace on Mississippi beef cattle operations, producers must consider alternative roughage sources for cattle nutritional programs. Effective fiber levels are typically not a concern in beef cattle on high forage diets, such as when grazing with sufficient available forage or with free-choice hay supplementation. However, in periods of hay and grazing shortages, effective use of fiber substitutes in beef cattle diets becomes critical.

Fiber can be defined as carbohydrates that are not digested by mammalian enzymes but can potentially be digested by rumen microorganisms. Fiber includes cellulose, hemicellulose, lignin, and soluble fiber (fructans, pectans, galactans, and beta-glucans). Fiber in plant material is in the structural components of cell walls.

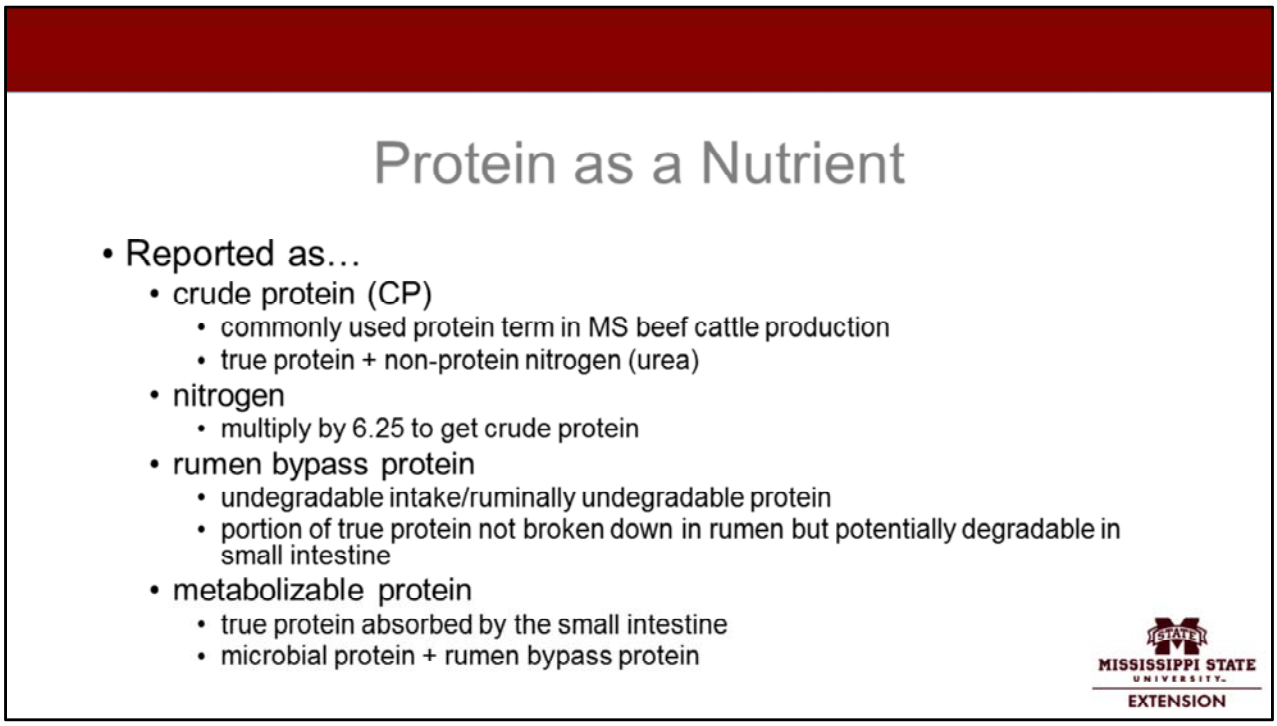
Mississippi State University Extension Service Publication 2489, “Fiber in Beef Cattle Diets” discusses fiber needs of beef cattle.



Beef cattle diets deficient in fiber can cause permanent damage to the rumen wall. The effectiveness of fiber for supporting rumen health is positively related to particle size of feeds containing the fiber and is referred to as effective fiber. Effective fiber is generally not a concern on high-forage diets. A high level of fiber in the diet does not always indicate that the diet is adequate in effective fiber. If the fiber is chopped or ground too short or fine it may not be effective in promoting rumen health. A good example of this is soybean hull pellets. Soybean hulls are high in digestible fiber levels and yet have a small particle size and are relatively low in effective fiber levels. Studies show that effective fiber supplementation improves the performance of cattle fed soybean hull pellets. Therefore, soybean hull pellets should not be used as an exclusive fiber source to replace hay. Finely ground fiber will pass through the digestive system rapidly and will not meet the effective fiber requirements of cattle.



Rumen responses to decreased fiber intake are illustrated in this figure.



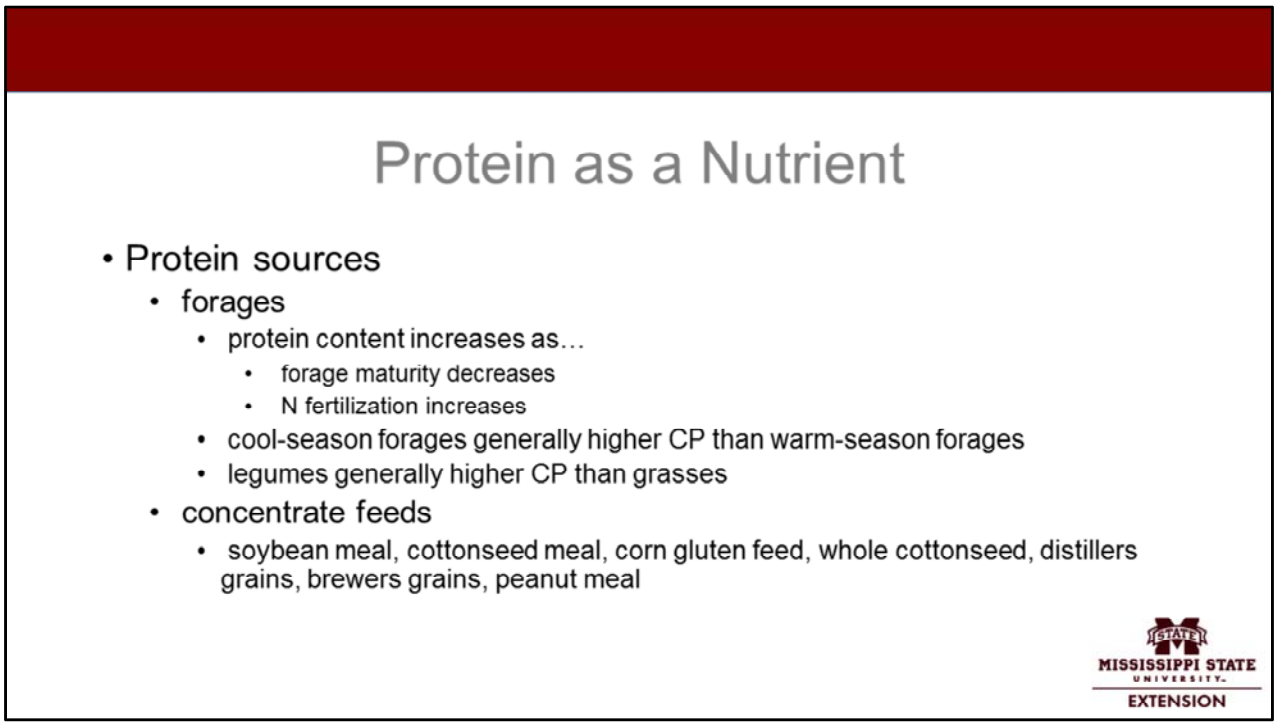
Protein in beef cattle diets is commonly expressed as crude protein. To determine the crude protein content of a forage or feedstuff, first measure the nitrogen content of the feed. Then multiply the nitrogen value by 6.25, because proteins typically contain 16 percent nitrogen (1 / 0.16 = 6.25).

Crude protein is comprised of both true protein and non-protein nitrogen. Not all nitrogen-containing compounds are true proteins. Urea is an example of a non-protein nitrogen (NPN) source. Many NPN compounds can supply nitrogen to the rumen microbes that then build microbial protein in the rumen using this nitrogen.

True protein is sometimes called “natural protein”. It is either degradable (can be broken down) or undegradable (cannot be broken down) in the rumen. Ruminally degradable protein (RDP) is broken down in the rumen and is also referred to as degradable intake protein (DIP). Ruminally undegradable protein (RUP) is protein that is not broken down in the rumen but is potentially degradable in the small intestine. It is sometimes called undegradable intake protein (UIP) or rumen bypass protein. A minimum amount of DIP is needed in the diet to support microbial growth. Otherwise the intake and digestibility of the diet will be limited. Crude protein is the sum of UIP and DIP.

Metabolizable protein accounts for rumen degradation of protein. It separates protein

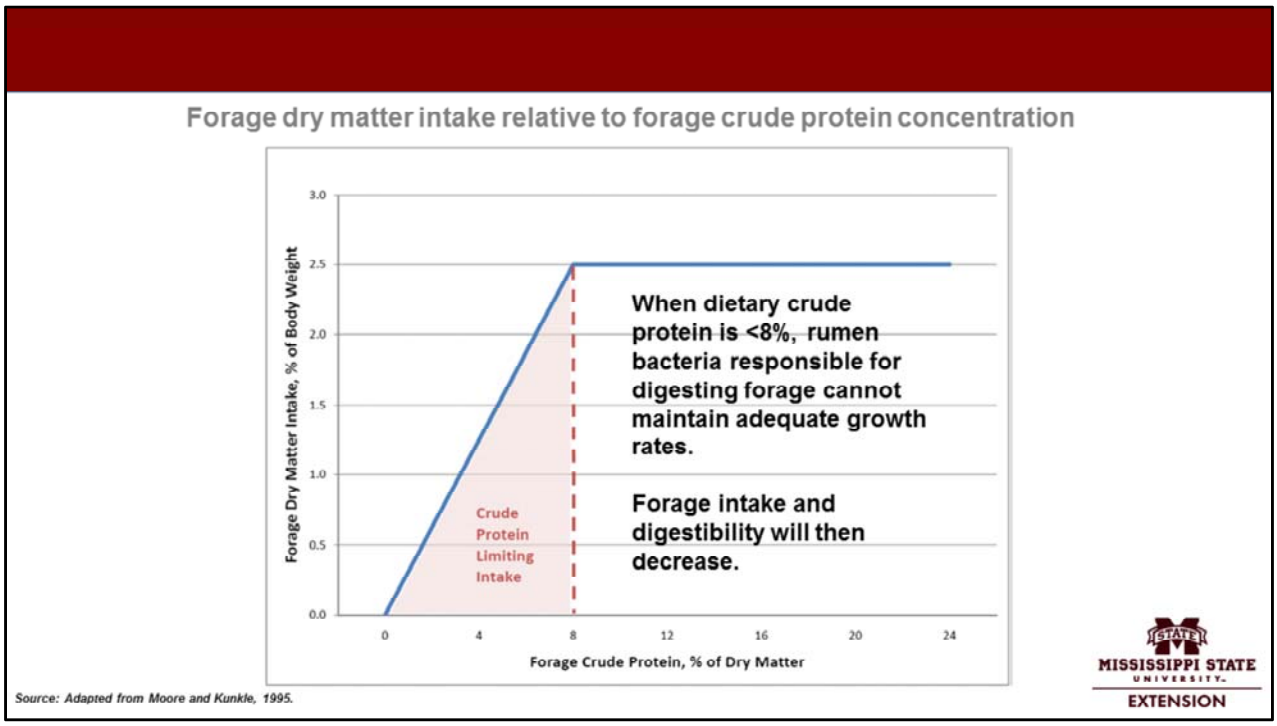
requirements into the needs of rumen microorganisms and the needs of the animal. Metabolizable protein is true protein absorbed by the intestine. It is made up of microbial protein and UIP.



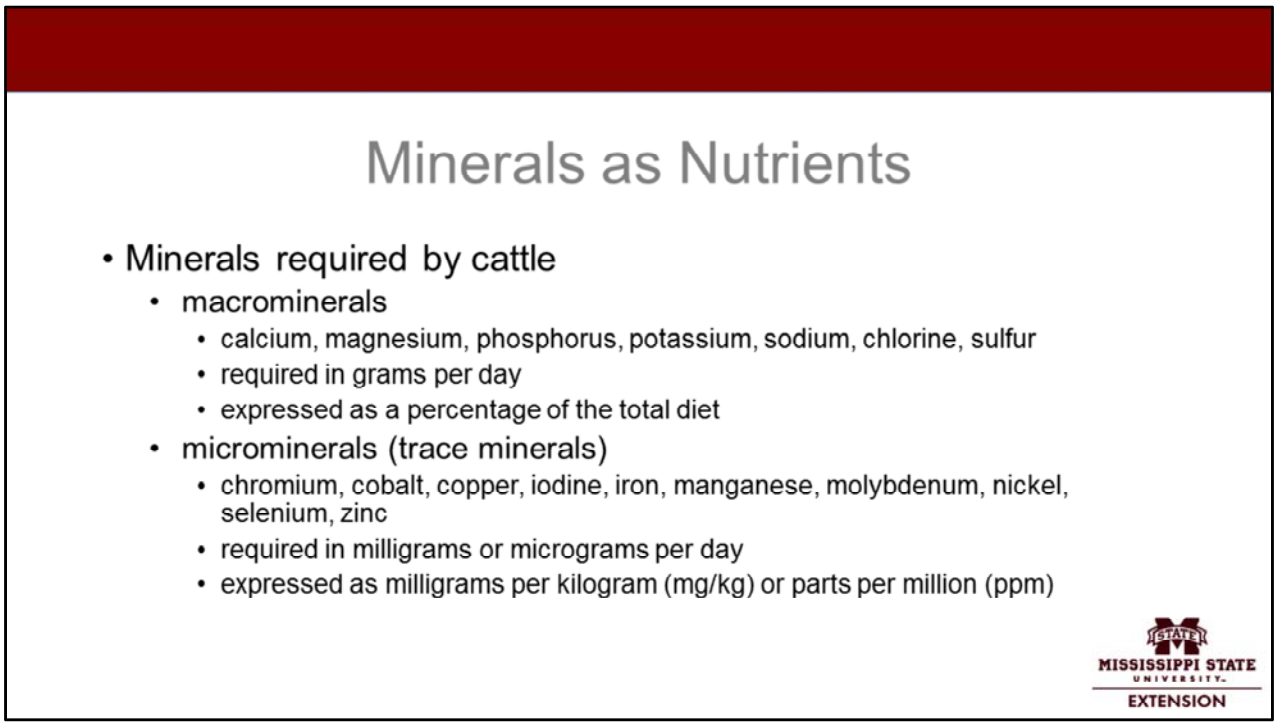
Beef cattle diets in Mississippi are primarily forage based. The protein composition of forages typically varies by forage species, soil nutrients, and forage maturity. Cool-season forages tend to contain greater crude protein concentrations than warm-season forages, and legumes generally contain greater crude protein concentrations than grasses. Crude protein concentration also generally decreases with increasing forage maturity and decreasing nitrogen fertilizer rates.

Insufficient protein can be a problem on warm-season grasses receiving inadequate nitrogen fertilization, particularly when forage is allowed to become mature before harvest or when frosted pasture is grazed during winter. Excessive rainfall can also leach nitrogen from the soil and reduce nitrogen levels available for plant protein production and animal consumption.

Concentrate feeds serving as good protein sources for beef cattle include soybean meal, cottonseed meal, corn gluten feed, whole cottonseed, distillers grains, brewers grains, and peanut meal.



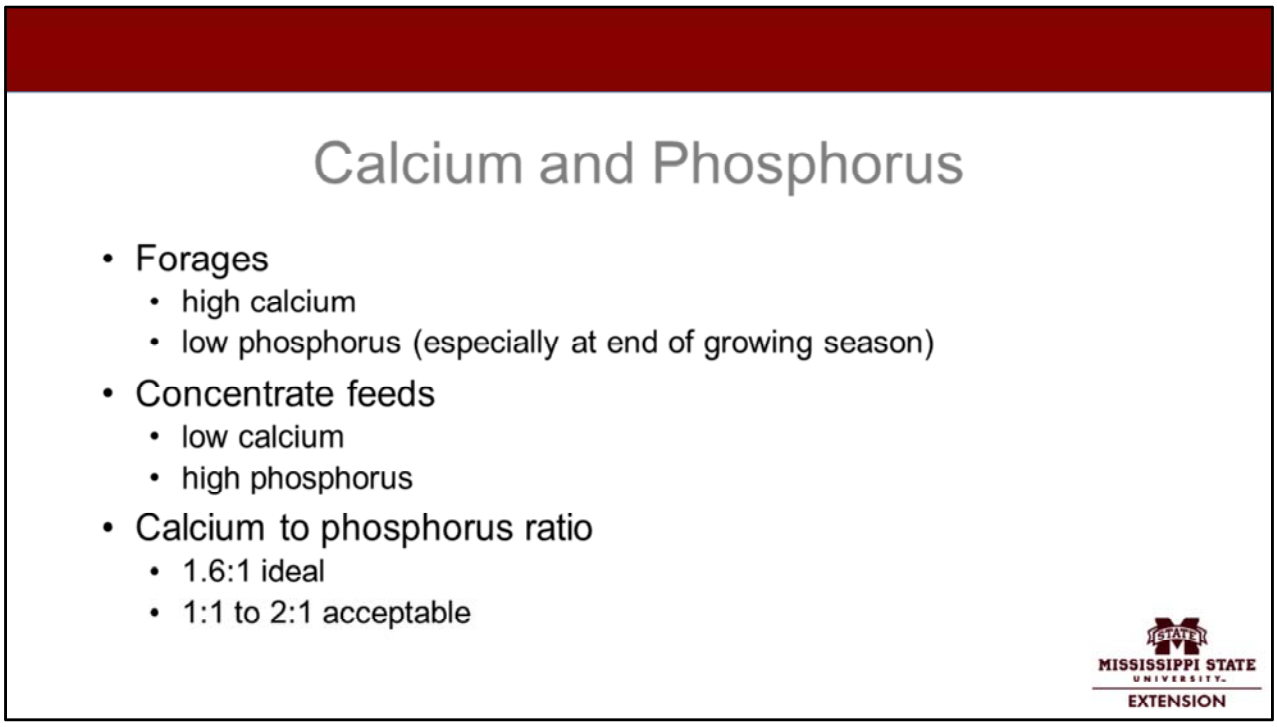
When dietary crude protein is less than eight percent, rumen bacteria responsible for digesting forage cannot maintain adequate growth rates. Forage intake and digestibility will then decrease. Crude protein supplements are appropriate under these conditions to stimulate forage intake. Forages with adequate levels of crude protein will not require protein supplementation to improve intake but may need crude protein supplementation if cattle nutrient requirements for crude protein are not being met by the forage alone. If the forage supplies at least eight percent crude protein, then forage intake will likely decrease with the addition of protein supplements fed at a rate of 0.3 percent of body weight or more as a substitution effect takes place. Forage quality testing is an invaluable tool for determining stored forage crude protein concentrations in advance of feeding.



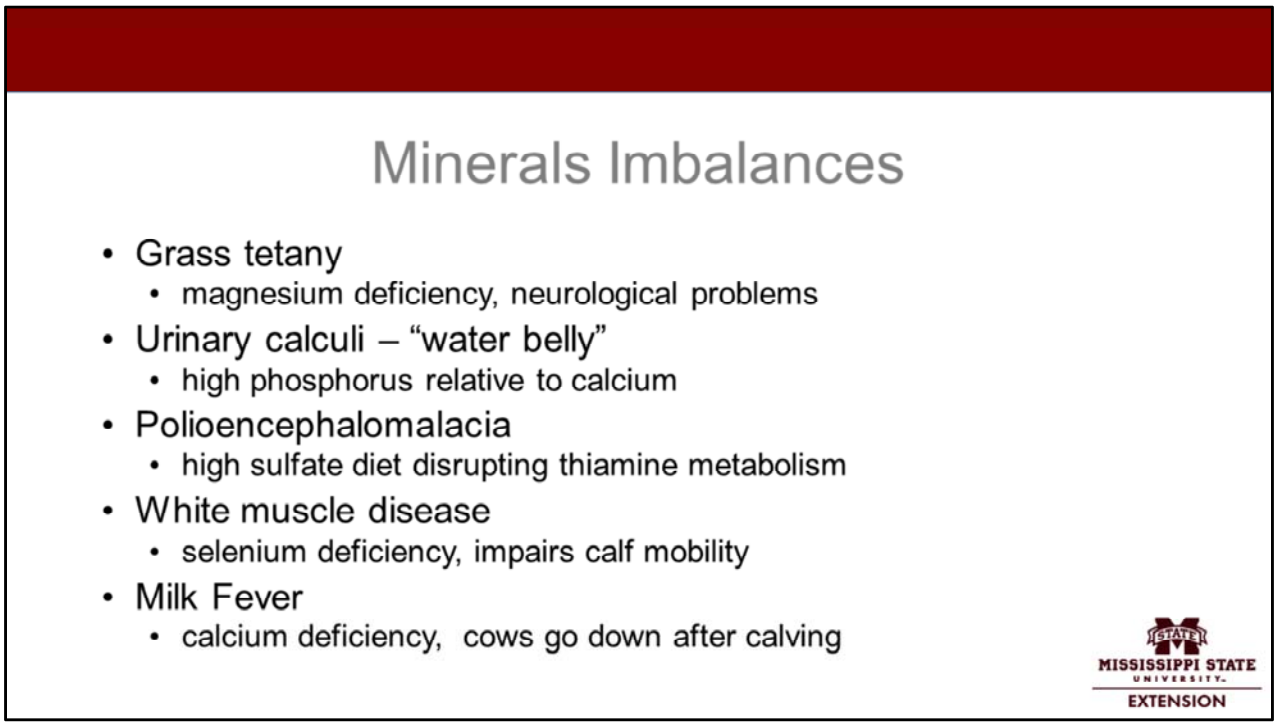
Minerals and vitamins account for a very small proportion of daily dry matter intake in beef cattle diets and as such can sometimes be overlooked in a herd nutritional program. Although minerals and vitamins are needed as a very small percentage of dietary nutrients, they are very important in beef cattle nutritional programs. Of particular production importance, cattle growth and reproductive performance can be compromised if a good mineral program is not in place. Appropriate mineral intake is also essential for proper bone development, immune function, muscle contractions, and nervous system function.

Beef cattle require at least 17 different mineral elements in their diets. Required minerals are classified as either macrominerals (major minerals) or microminerals (trace minerals) based on the quantities required in beef cattle diets. Macrominerals are required in larger quantities (grams per day) than microminerals (milligrams or micrograms per day). Macromineral requirements are typically expressed as a percentage of the total diet, while micromineral requirements are generally expressed as milligrams per kilogram (mg/kg), which is the equivalent of parts per million (ppm). To convert percent to ppm, move the decimal four places to the right (e.g., 0.2500% = 2500 ppm).

Macrominerals required by beef cattle include: calcium, magnesium, phosphorus, potassium, sodium, chlorine, and sulfur. Required microminerals include chromium, cobalt, copper, iodine, iron, manganese, molybdenum, nickel, selenium, and zinc.



Forages are typically high in calcium and low in phosphorus concentrations with phosphorus levels declining further late in the growing season. Concentrate (grain-based) feedstuffs are generally low in calcium and high in phosphorus concentrations. Dicalcium phosphate is 22% calcium and 19.3% phosphorus and is added to beef cattle diets to balance the calcium to phosphorus ratio. It adds both calcium and phosphorus to the diet. Limestone is 34% calcium and is added to beef cattle diets to increase the calcium levels of the diet. The calcium to phosphorus ratio should ideally be within the range of 1:1 to 2:1. Complete mineral supplements including needed trace minerals and vitamins should be available to cattle at all times.



Mineral imbalances (toxicities or deficiencies) can trigger nutritional disorders in cattle. While these disorders can produce dramatic signs in affected cattle, mineral imbalances are often overlooked because only subclinical signs are present.

Grass tetany is associated with low levels of magnesium or calcium in cattle grazing annual ryegrass, small grains (e.g., oats, rye, wheat), and cool-season perennial grasses (e.g., tall fescue) in late winter and early spring. Grass tetany most commonly affects lactating cattle, particularly the highest-milking animals in the herd. Grass tetany results when magnesium and calcium levels in forages are too low to meet the requirements of cattle and cattle do not receive adequate magnesium and calcium supplementation.

Urinary calculi (kidney stones) are hard mineral deposits in the urinary tracts of cattle. Affected cattle may experience chronic bladder infection from tissue damage produced by the calculi. In more serious cases, calculi may block the flow of urine, particularly in male animals.

Polioencephalomalacia is caused by a disturbance in thiamine metabolism. Thiamine is required for a number of important nervous system functions. This

disease most commonly affects young, fast growing cattle on a high concentrate ration and may result from a thiamine-deficient diet, an increase in thiaminase (an enzyme that breaks down thiamine) in the rumen, or an increase in dietary sulfates from high grain diets.

“White muscle disease” (enzootic nutritional muscular dystrophy) most commonly affects cardiac or skeletal muscle of rapidly growing calves. This disease results from vitamin E and/or selenium deficiency and results in muscle breakdown. This metabolic imbalance can be due to dietary deficiency or to calves being born to dams that consumed selenium deficient diets during gestation.

Milk fever (parturient paresis or hypocalcemia) is generally associated with older, high-producing dairy cattle. However, incidences of milk fever may also occur with beef cattle. Milk fever occurs shortly after calving and the onset of milk production. Milk fever occurs when the lactating cow is not capable of absorbing enough calcium from the diet or has not started mobilizing bone calcium to meet the increased calcium demand of lactation. Calcium losses from lactation coupled with inadequate supply results in a drop in blood calcium level. Because calcium is needed for muscle contraction, cows suffering from milk fever often lose their ability to stand.

Mineral Feeding

- Provide year-round
- Excessive intake
  - do not let mineral run out
  - add salt
  - move away from water and shade
- Inadequate intake
  - add protein meal or dry molasses
  - make sure salt is not offered separately
  - move closer to water or shade
  - change mineral mix

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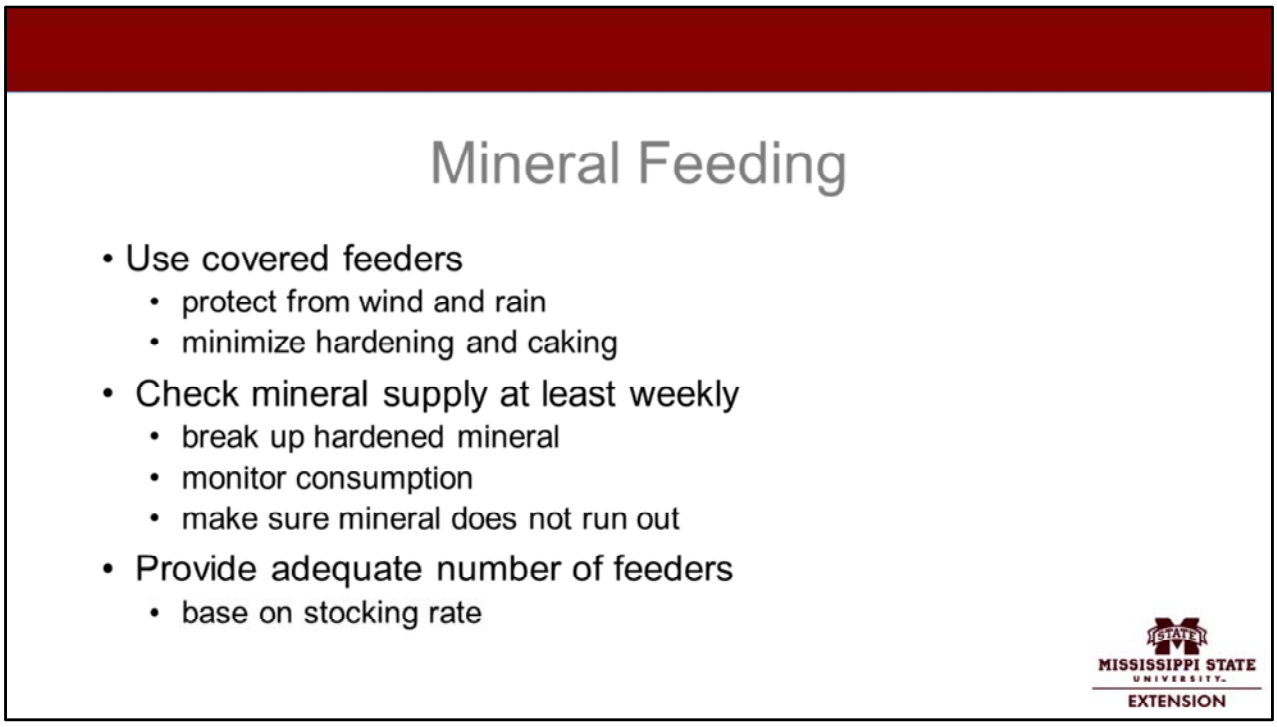
A single mineral and vitamin supplement formulation may not be ideal year-round. Mineral and vitamin supplements can be used to deliver beneficial drugs, antibiotics, and parasite control ingredients to cattle diets. These products may only need to be supplied to cattle for defined periods of time or during certain times of year. Reformulate the mineral and vitamin supplement to remove these products when they are not needed. Also adjust mineral and vitamin composition of supplements for forage conditions. For example, increased magnesium supplementation is justified during grass tetany season but should be reduced during other periods to better match cattle nutrient needs and avoid unnecessary reductions in supplement palatability often associated with high levels of magnesium.

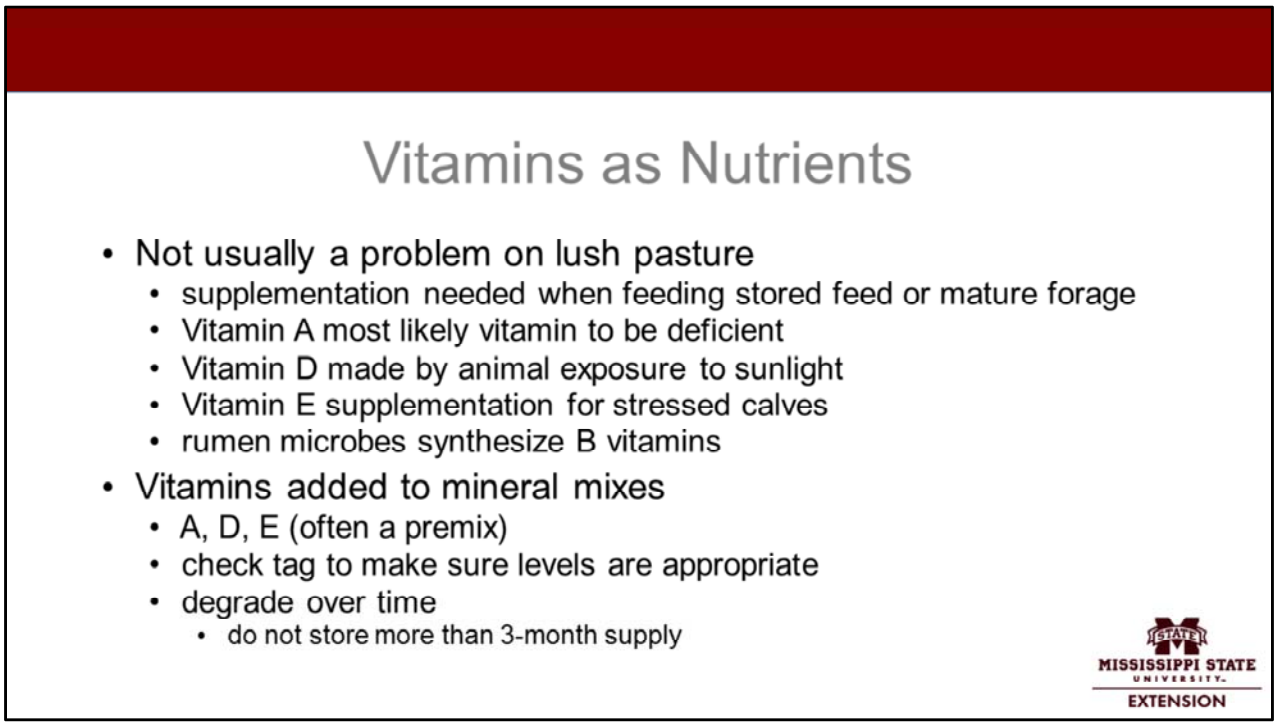
Excessive intake is a potential problem with mineral and vitamin supplements and can result in unnecessary expense. Cattle will sometimes over consume a mineral and vitamin mix when they are first exposed to it but then drop supplement intake to appropriate levels after an adjustment period. Also, if cattle are allowed to run out of mineral and vitamin supplement, they may over compensate by increasing consumption when it is put out again. If intake does not drop to recommended levels after a month of feeding a continuous supply of mineral and vitamin supplement, try adding salt to the mineral and vitamin mix or moving the supplement feeder farther away from water sources.

Inadequate mineral and vitamin intake, on the other hand, can be addressed by adding dry

molasses to the mineral and vitamin mix or by moving the supplement feeder closer to a water source or area where cattle congregate. Make sure that salt is not provided separately from a free-choice mineral supplement, because cattle may consume the salt supplement and avoid the complete mineral and vitamin mix. Changing mineral mixes is another option that can sometimes correct excessive or inadequate mineral consumption.

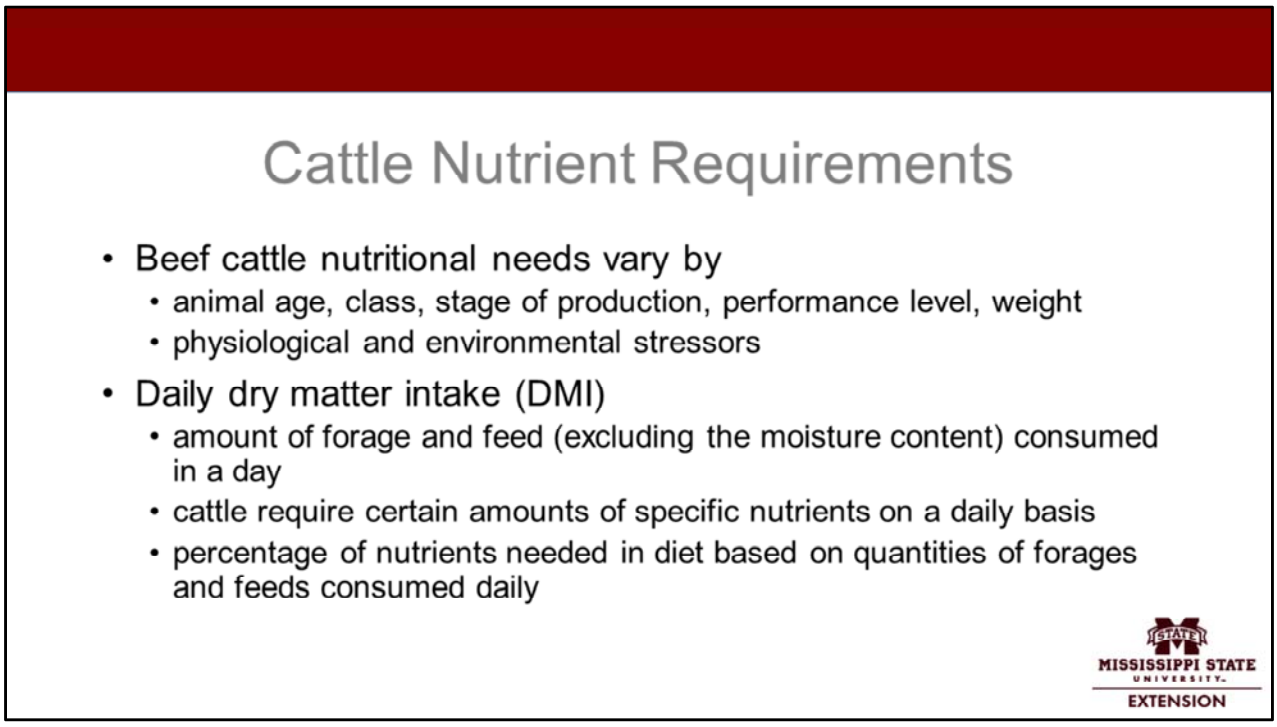


Many mineral supplements will cake and harden when allowed to get wet, causing mineral intake to drop. Magnesium supplements are particularly prone to this problem. Using covered feeders that protect from rain can help minimize mineral hardening. There are also some commercial mineral supplements available that are designed to better withstand rain damage and wind losses. Mineral and vitamin supplement selection should consider mineral and vitamin composition and price of the supplement as first priorities over weather protection. It is a good idea to check the mineral and vitamin supplement supply at least weekly. Hardened mineral should be broken up as much as possible. Checking the mineral supply on a regular basis is also important in monitoring consumption and making sure that cattle do not run out. Provide an adequate number of mineral feeders based on cattle stocking rate to ensure all cattle access to mineral supplements.



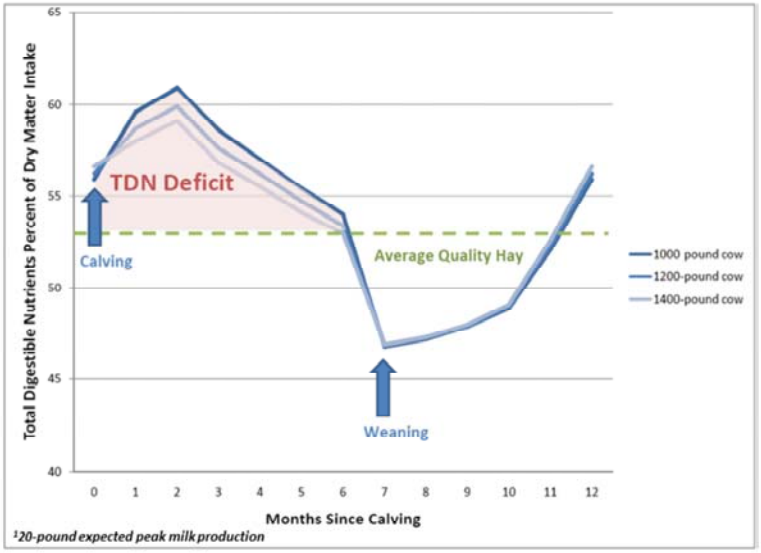
Vitamins are classified are either water soluble or fat soluble vitamins. Water soluble vitamins include the B complex vitamins and vitamin C. Fat soluble vitamins include vitamins A, D, E, and K. Rumen bacteria can produce the B complex vitamins and vitamin K in cattle. Vitamin supplementation is generally not as critical as mineral supplementation for beef cattle grazing actively growing forages. However, increased rates of vitamin A and E supplementation may be necessary when feeding dormant pastures or stored forages. For practical purposes, vitamins A and E should receive the most attention when planning cattle nutritional programs. Vitamin A is the vitamin most likely to be deficient in beef cattle diets. Stressed calves, in particular, can benefit from Vitamin E supplementation.

Vitamins A, D, and E are often added to mineral mixes or feed supplements as an A-D-E premix package. Many commercial mineral mixes have vitamins A, D, and E added at sufficient levels. However, it is important to review the mineral tag to be sure. Vitamin quantities are expressed as International Units (IU), which are set amounts defined for each specific vitamin form. Vitamins can degrade over time, so supplements purchased and stored for several months before being used may not supply adequate vitamin levels.



The nutritional needs of beef cattle vary by age, class, stage of production, performance level, and weight. Physiological and environmental stressors such as animal health and weather can also impact nutritional requirements. Whereas specific requirements for forage or feed intake do not exist, estimates of how much forage or feed animals will consume is needed for diet formulation and prediction of animal performance. Dry matter intake and average daily gain values are reported in nutrient requirement tables. Daily dry matter intake of forage and feed is the amount of forage and feed (excluding the moisture content) consumed in a day. Cattle require certain amounts of specific nutrients such as protein, calcium, and vitamin A on a daily basis. To meet specific nutrient requirements, the percentage of nutrients in the diet for cattle is based on the quantities of forages and feeds consumed daily.

Beef cow crude total digestible nutrient (TDN) requirements by stage of production[1]



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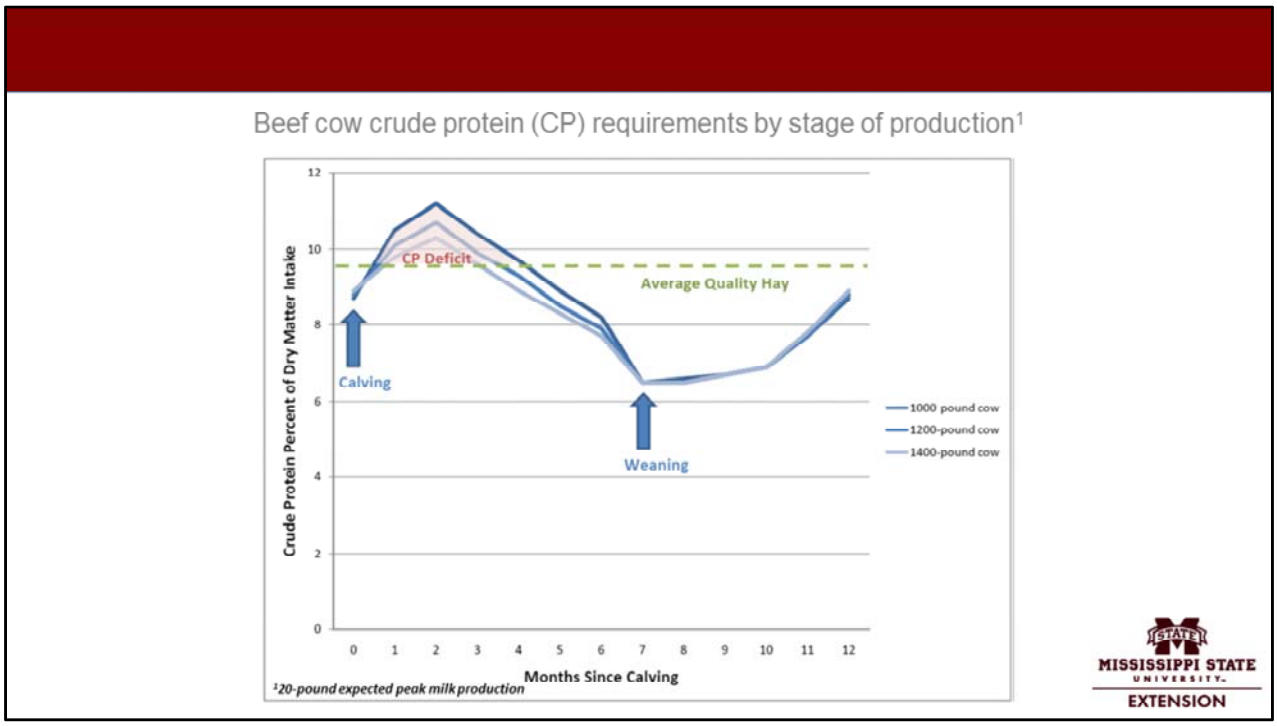
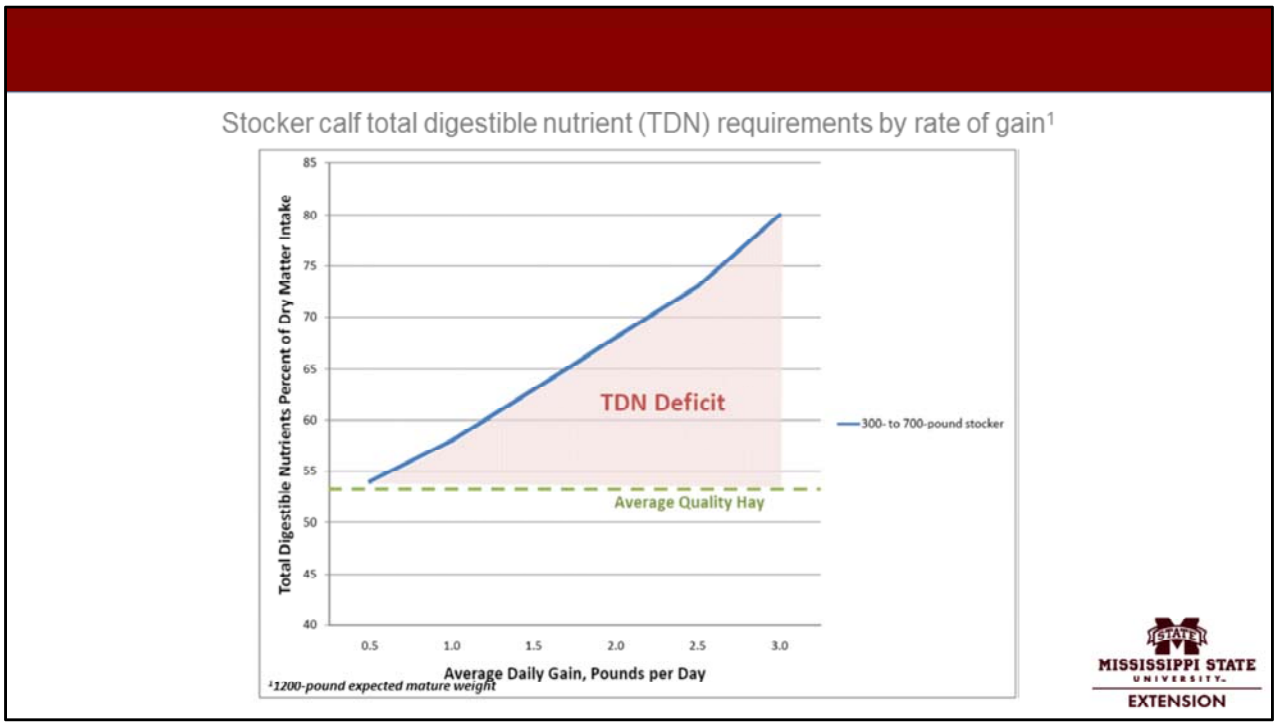
Cattle energy requirements vary with stage of production, size of the animal, and expected performance. Energy as TDN is required for milk production and body maintenance after calving. During lactation, larger cattle typically require more pounds of TDN per day than smaller cattle but as a lesser percentage of their total dry matter intake. Lighter cattle require higher quality feeds and forages at lesser quantities compared with heavier cattle.

Cattle requirements for total digestible nutrients increase with increasing lactation and rate of gain. Although there is often a nutrient deficiency after calving of both TDN and crude protein when feeding average quality hay, postpartum cows on forage-based diets are more likely to require longer periods of energy supplementation than protein supplementation.

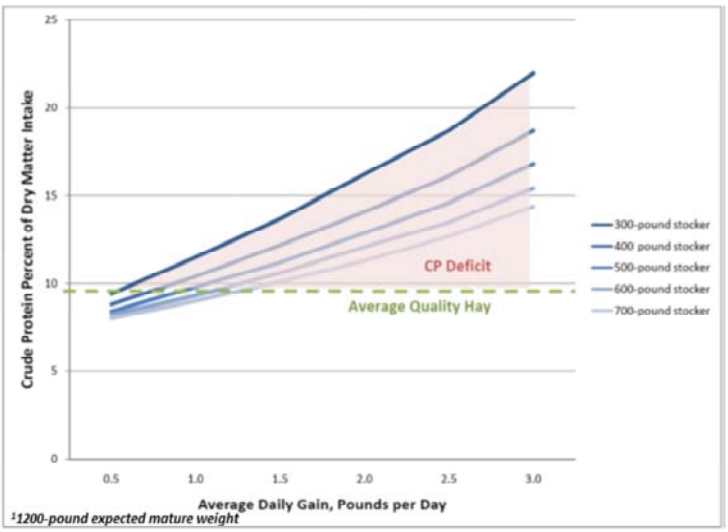


Cattle protein requirements vary with stage of production, size of the animal, and expected performance. During lactation, larger cattle typically require more pounds of crude protein per day than smaller cattle but as a lesser percentage of their total dry matter intake. In other words, lighter cattle require higher quality feeds and forages at lesser quantities compared with heavier cattle. Cattle requirements for crude protein increase with increasing lactation and rate of gain. Protein is required for milk production and reproductive tract reconditioning after calving.



Young, growing cattle, in particular, need relatively high levels of TDN in their diets to support growth. Additional energy and protein are often required to properly balance diets for growing cattle and lactating beef cows on forage-based diets. This is especially true when low quality stored forages are the majority of the diet, as is often the case during the winter hay-feeding period after a poor hay production season or with hay produced under low levels of management. Forage quality testing well before feeding is an invaluable tool for determining stored forage TDN concentrations.

Stocker calf crude protein (CP) requirements by rate of gain[1]



[1]1200-pound expected mature weight

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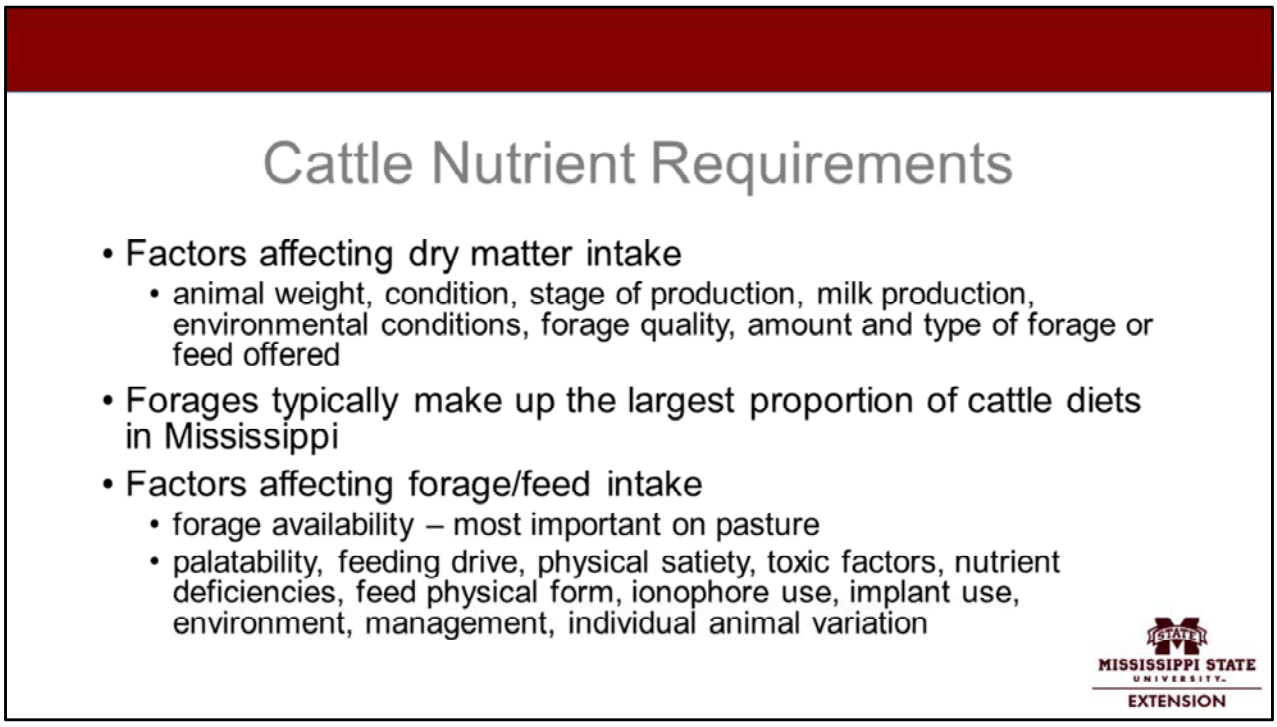
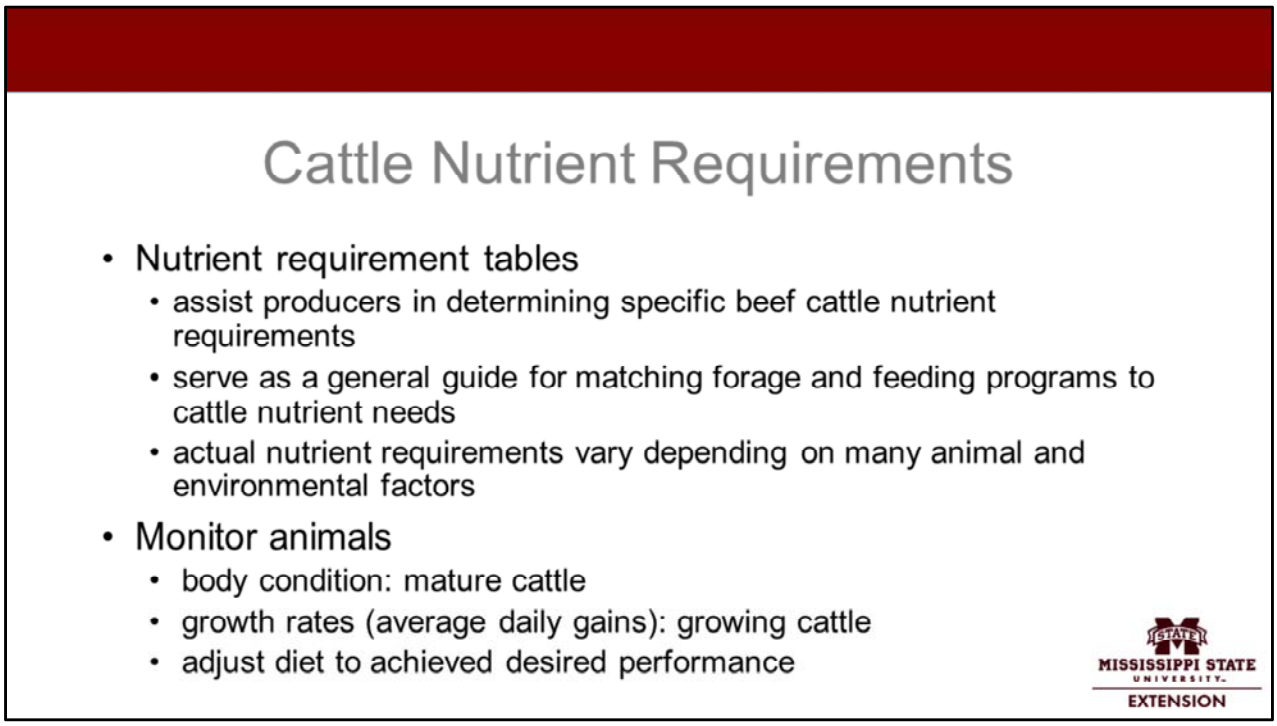
Young, growing cattle, in particular, need relatively high levels of crude protein in their diets to support muscle growth. Creep feeds or forages for nursing calves should contain at least 15 percent crude protein. High-protein creep feeds are best used when forage availability is abundant. Average daily gains in nursing calves tend to increase with increasing crude protein content of creep diets, but expense of the diet will likely also increase with increasing protein levels.



Many factors affect dry matter intake including animal weight, condition, stage of production, milk production level, environmental conditions, forage quality, and amount and type of forage or feed offered. Forages typically make up the largest proportion of cattle diets on both cow-calf and stocker cattle operations in Mississippi. Forage intake capacity is affected by stage of production and forage type and maturity. Factors affecting forage/feed intake include forage availability (most important factor on pasture), palatability, feeding drive, physical satiety, toxic factors, nutrient deficiencies, feed physical form, ionophore use, implant use, environment, management, and individual animal variation.

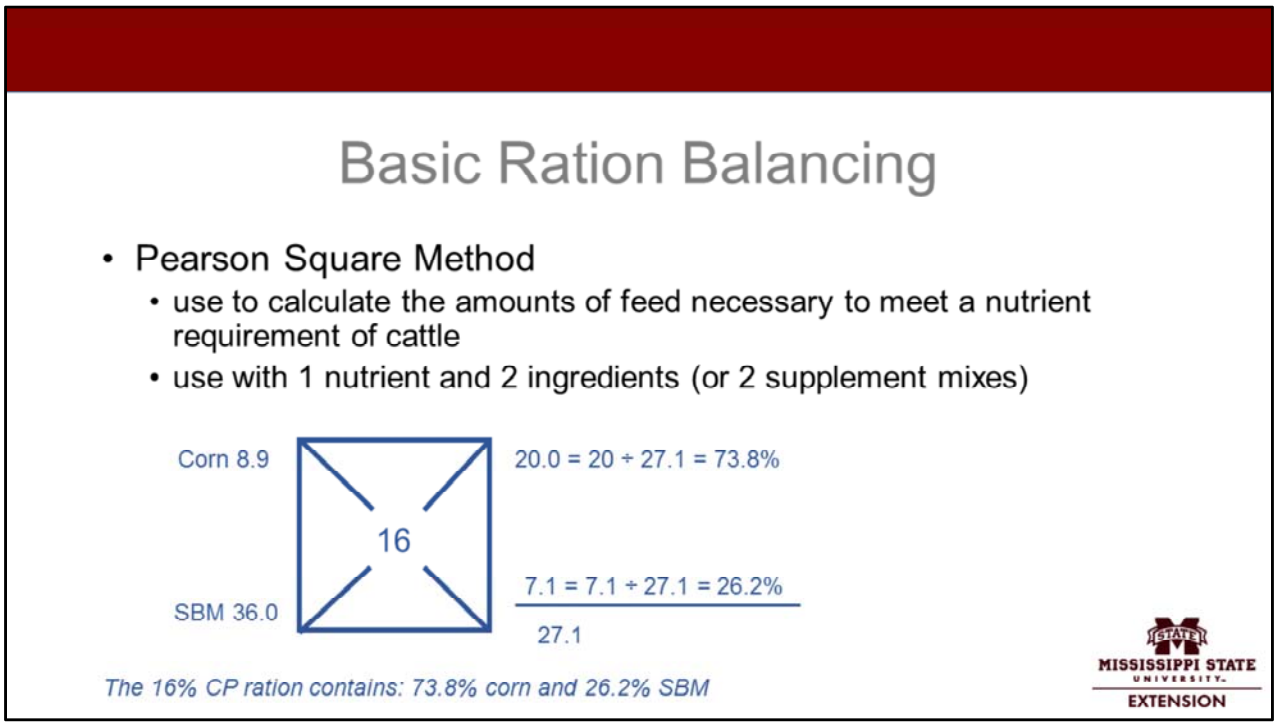


Nutrient requirement tables can assist producers in determining specific beef cattle nutrient requirements. The values listed in these tables serve as a general guide for matching forage and feeding programs to cattle nutrient needs. Actual nutrient requirements vary depending on many animal and environmental factors. Monitor body condition and weight in mature cattle and growth rates of growing cattle to make adjustments to cattle diets to achieve desired performance results.

Dry matter intake values are estimates determined using published prediction equations. These predictions assume that adequate protein is supplied in the diet for maximum rumen fermentation. If the diet is deficient in protein, then dry matter intake values will overestimate actual cattle consumption.

Tabular values are intended for healthy, unstressed cattle in good body condition. Thin cattle need additional nutrients to improve body condition. Higher maintenance energy requirements are also applicable to cattle subjected to stresses such as weather extremes or added physical exertion.

Beef cattle nutrient requirement tables appear in Mississippi State University Extension Service Publication 2528, “Beef Cattle Nutrient Requirements”.



Pearson's Square is a simple, quick way to calculate the amounts of feed necessary to meet a nutrient requirement of livestock and other animals. This method is most effective when only two feeds are being used. For example, when two grains are mixed for part of a total mixed ration (TMR) or as a supplement to pasture feeding, Pearson's Square can be used to determine what quantity of each grain would be needed to achieve a specific nutrient level in the mixture.

The basic structure of a Pearson's Square can be seen above. In this example, soybean meal (SBM) and corn are being used to meet the crude protein (CP) requirement of an animal. The nutrient requirement, in this case CP, could also be energy, total digestible nutrients (TDN), fat, and so on, depending on the information needed by the user.

1. Place the nutrient concentration of the final ration in the middle of the square
2. List the feed ingredients and their nutrient concentrations on the right side of the square
3. Subtract diagonally across the square for each feed ingredient, and place values on the right side of the square
4. Divide each number on the right hand side by the sum of the two right hand values and multiply by 100 to convert it to a percentage

Detailed information on Pearson's Square use is found in Mississippi State University

Extension Service Publication 2632, “Simple Ration Formulation: Pearson’s Square”.

Basic Ration Balancing

- Modified Algebra Method
  - use to calculate the amounts of feed necessary to meet a nutrient requirement of cattle
  - use when a known amount of feed will be fed

Ingredient:	Corn	Soybean meal	Hay	Diet
% CP	10	49	9	12
Amount	x	90 – x	10	100
Equation	10x	4410 – 49x	90	1200

Solution: **x = 80**
The 12% CP ration contains:
80% corn, 10% soybean meal, and 10% hay

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When a known amount of feed will be fed, the modified algebra method can be used for basic ration balancing.

1. Determine animal requirements
2. Determine amount of known feed(s)
3. Determine nutrient content of feeds included in the ration
4. Determine amount of total ration
5. Make a table and set up equation
6. Solve equation for x to determine amounts of unknown feeds

Example:

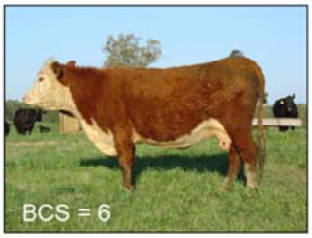
For 100 lb of a 12% CP ration, using the table shown above;
Solve the equation for x:
10x + 4410 – 49x + 90 = 1200
4320 – 39x = 1200
-39x = -3120
x = 80

The 12% CP ration contains:

80% corn, 10% soybean meal, and 10% hay.

Body Condition Score

- 1 to 9 scale
- 1 = emaciated, 9 = obese
- Recommended BCS at calving
  - Heifers = 6
  - Mature cows = 5
- Can be easily evaluated from truck driving through pasture



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Body condition scores in beef cattle range from 1 (extremely emaciated) to 9 (very obese). Body condition can be easily evaluated by visual appraisal while driving or walking through a herd. It can be assessed when cattle handling may be impractical. Body condition is a more reliable indication of nutritional status than live weight. Changes in shrink, gut fill, and the weight of fetus and fluids associated with pregnancy limit live weight from being an accurate indicator of nutritional status.

Recommended body condition score at calving is 5 for mature cows. Because heifers are still growing, their nutritional requirements in terms of nutrient percentages are greater than later in life. Therefore, manage heifers to calve in a body condition score of 6. Body condition scores of females in the breeding herd should fall within a range of 5 to 7 from the beginning of the calving season throughout the breeding season. Condition score cows and heifers in the herd to properly plan and adjust forage and feeding programs. This helps ensure adequate body condition for optimum reproductive performance. Ideal times to body condition score beef cattle are:

- When calves are weaned
- 60 days prior to calving
- At calving
- At the beginning of the breeding season

Proper body condition is also important for bulls to be fertile and active breeders. Target a body condition score of 6 for bulls at the beginning of the breeding season. Monitor bull body condition during the breeding season to identify bulls that become too thin. Hand feeding or bull rotation may be necessary to maintain adequate body condition for active breeding.

Body Condition Scores and Reproductive Rates

Body Condition Score	Reproductive Rates	# of Calves for a 40-Cow Herd
4 or Lower	64%	25.6
5	81%	32.4
Difference	17%	6.8

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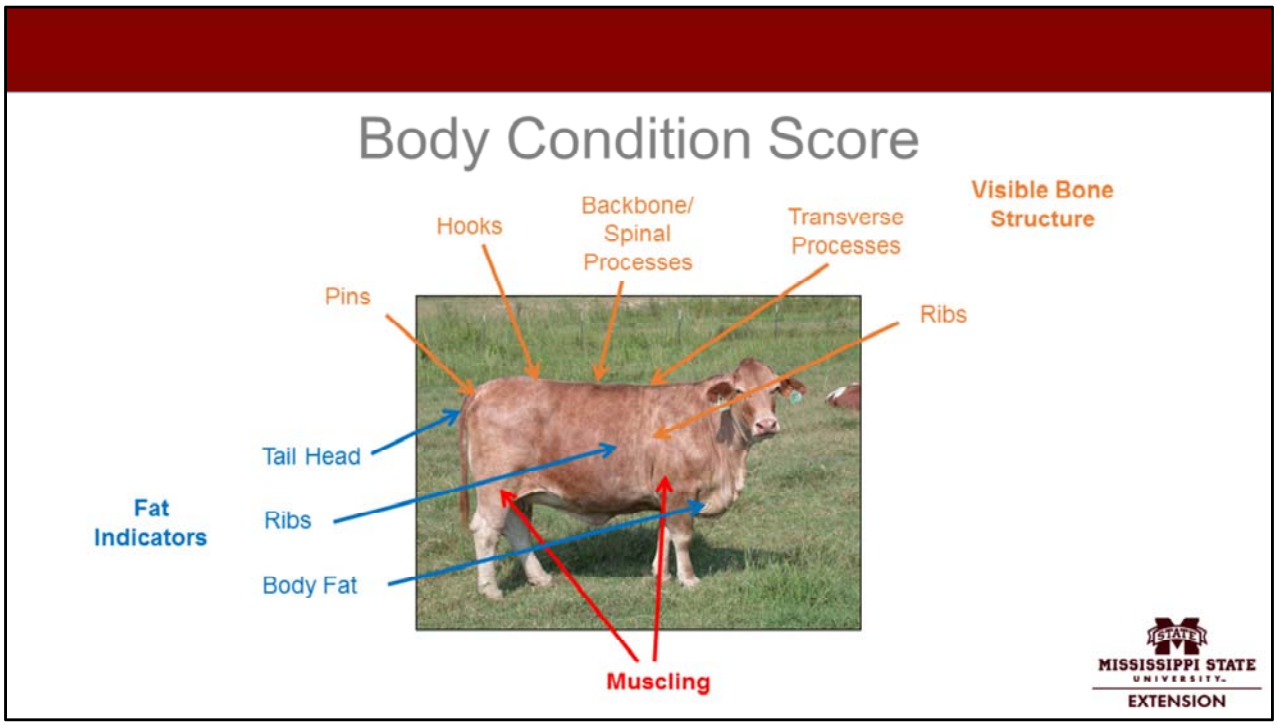
These data show the importance of body condition on reproductive rates. It is desirable for cows to be in body condition score 5 or 6 when they calve. A body condition score of 4 means reduced net calf crop and future income.

Beef cattle body condition scoring is discussed in detail in Mississippi State University Extension Service Publication 2508, “Body Condition Scoring Beef Cattle”.



There are several key places to assess body condition in beef cattle. Overall body fat should be evaluated along with fat cover over the tail head, ribs, and shoulder, and in the brisket. Muscling should be evaluated to determine if it has been broken down for energy. This occurs when cattle reach the low end of the body condition scoring scale. Visible and palpable bone structure is another essential part of body condition scoring and includes the ribs, backbone, spinous process, transverse processes, hooks (hips), and pins.

Palpate the animal's condition over the ribs, along the backbone, and over the tailhead to assist in assigning body condition scores. Fat (condition) will be spongy to the touch. Bone structure with little or no fat cover will feel sharp to the touch. Palpation of body condition is particularly beneficial when loose hide or thick hair coat makes visual appraisal of body condition more difficult.

BCS 1 – Emaciated

- Visible bone structure
  - shoulder, ribs, backbone
  - hooks and pins (sharp to touch)
- Muscling
  - very little
- Fat deposits
  - very little

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BCS 1 = Emaciated
No palpable fat is detectable over the spinous processes, transverse processes, ribs, or hooks. The tailhead and ribs appear very prominent.

BCS 2 – Very Thin

- Visible bone structure
  - spinous process easily seen, sharp to touch
- Muscling
  - some in hindquarters
- Fat deposits
  - very little

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BCS 2 = Poor

Animal is still somewhat emaciated but the tailhead and ribs are less prominent. Individual spinous processes are still sharp to the touch. Some tissue cover is present over the ribs towards the top of the back.

BCS 3 – Thin

- Visible bone structure
  - foreribs noticeable, backbone visible
  - spinous process
    - palpate with little pressure
    - less pronounced intervening space
- Muscling
  - apparent
- Fat deposits
  - beginning cover
    - loin
    - back
    - foreribs

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BCS 3 = Thin

Individual ribs including foreribs are easily identified but are not quite as sharp to the touch. Some fat can be felt along the spine and over the tailhead. Some tissue cover is present over the ribs towards the top of the back.

BCS 4 – Borderline

- Visible bone structure
  - Foreribs not noticeable
  - 12th and 13th ribs noticeable
  - Transverse processes
    - Felt with slight pressure
- Muscling
  - Full but straight
  - Not rounded
- Fat deposits
  - Ribs beginning

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BCS 4 = Borderline

Individual ribs may not be visually obvious. Individual spinous processes can be felt when palpated but feel rounded rather than sharp. Some fat cover is present over the ribs, transverse processes, and hooks.

BCS 5 – Moderate

- Visible bone structure
  - 12th and 13th ribs not visible except shrunk cattle
  - Transverse processes felt with firm pressure
- Muscling
  - Full
- Fat deposits
  - Area around tailhead filled out but not mounded

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BCS 5 = Moderate
Overall appearance is generally good. Fat cover over ribs feels spongy. Palpable fat cover is present on either side of the tailhead.

BCS 6 – Good

- Visible bone structure
  - No distinct structure
  - Transverse processes felt with firm pressure
- Muscling
  - Hindquarters plump and full
- Fat deposits
  - Sponginess
    - Over foreribs
    - Around tailhead

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BCS 6 = High moderate

A high degree of palpable fat exists over the ribs and around the tailhead. Firm pressure is needed to feel the spinous processes.

BCS 7 – Very Good

- Visible bone structure
  - No distinct structure
  - Ends of spinous processes felt with very firm pressure
- Muscling
  - Hindquarters plump and full
- Fat deposits
  - Abundant fat around tailhead with some patchiness

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BCS 7 = Good

Considerable fat cover is present with a fleshy overall appearance. Fat cover over the ribs and around the tailhead is very spongy. Fat “pones” or “rounds” may be starting to form along the tailhead.

BCS 8 – Fat

- Visible bone structure
  - No distinct structure to none
- Muscling
  - Hindquarters plump and full
- Fat deposits
  - Thick and spongy
  - Animal appears to be smooth and blocky

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BCS 8 = Fat

The animal is very fleshy and appears over-conditioned. Palpation of the spinous processes is near impossible. Large fat deposits are present over the ribs and around the tailhead. Fat pones around the tailhead are obvious.

BCS 9 – Very Fat

- Visible bone structure
  - None
- Muscling
  - Hindquarters plump and full
- Fat deposits
  - Tailhead buried in fat

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BCS 9 = Extremely fat

The overall appearance is blocky with patchy fat cover. The animal is clearly obese. The tailhead and hooks are buried in fatty tissue with fat pones protruding. Bone structure is no longer visible and barely palpable. Large fatty deposits may even impair animal mobility.

Beef cattle body condition score and associated body fat percent and shrunk body weight

Body Condition Score (BCS)	Animal Weight, pounds	Weight Change Needed to Increase One BCS, pounds
3	870	60
	1044	72
	1218	84
4	930	70
	1116	84
	1302	98
5	1000	80
	1200	96
	1400	112

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised ed.

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This table gives an example of weight differences between condition scores for different body weights.

Nutrient requirements to increase body condition score of mature beef cows from 4 to 5 during the last 90 days of pregnancy[1]

Animal Description	Dry Matter Intake (DMI)		Diet Nutrient Density			Daily Nutrients per Animal		
Mature body weight at body condition score 5, lb	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	CP, % DM	TDN, lb	NE_m, Mcal	CP, lb
1,000	20.5	2.1	60	.59	7.7	12.3	12.1	1.57
1,100	22.0	2.0	60	.58	7.5	13.2	12.8	1.65
1,200	23.5	2.0	59	.58	7.4	13.9	13.6	1.74

[1] BW = total body weight = shrunk body weight or 96% full body weight, TDN = total digestible nutrients, NEm = net energy for maintenance, CP = crude protein, Ca = calcium, P = phosphorus
Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

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Cattle require increased percentages of total digestible nutrients, in particular, in their diets above requirements for maintenance and performance to increase body condition score. Nutrient requirements to increase body condition score of mature cows from 4 to 5 during the last trimester of pregnancy are listed in this table.

Nutrient requirements to increase body condition score of non-pregnant mature beef cows [1]

Animal Description	Body Condition Score (BCS)		Dry Matter Intake (DMI)		Diet Nutrient Density			Daily Nutrients per Animal		
Mature body weight at body condition score 5, lb	Current BCS	Days to gain 1 BCS	DMI, lb/day	DMI, % of BW	TDN, % DM	NE_m, Mcal/lb	CP, % DM	TDN, lb	NE_m, Mcal	CP, lb
1,000	3	30	18.8	1.9	64	.65	6.1	12.0	12.2	1.14
		60	17.7	1.8	57	.55	6.4	10.1	9.8	1.14
	4	30	20.5	2.1	66	.67	5.9	13.5	13.8	1.21
		60	19.0	1.9	58	.56	6.4	11.0	10.7	1.21
1,100	3	30	20.3	1.8	65	.66	6.0	13.2	13.4	1.22
		60	19.0	1.7	58	.56	6.4	11.0	10.6	1.22
	4	30	22.2	2.0	67	.69	5.9	14.9	15.3	1.30
		60	20.4	1.9	58	.57	6.4	11.8	11.6	1.30
1,200	3	30	21.0	1.8	65	.69	6.2	13.7	14.5	1.30
		60	20.3	1.7	58	.56	6.4	11.8	11.3	1.30
	4	30	23.5	2.0	67	.68	5.9	15.7	16.0	1.38
		60	21.8	1.8	58	.56	6.3	12.6	12.3	1.38

[1] BW = total body weight = shrunk body weight or 96% full body weight, TDN = total digestible nutrients, NEm = net energy for maintenance, CP = crude protein, Ca = calcium, P = phosphorus

Source: NRC, 2000. Adapted from NRC Nutrient Requirements of Beef Cattle, 7th revised edition.

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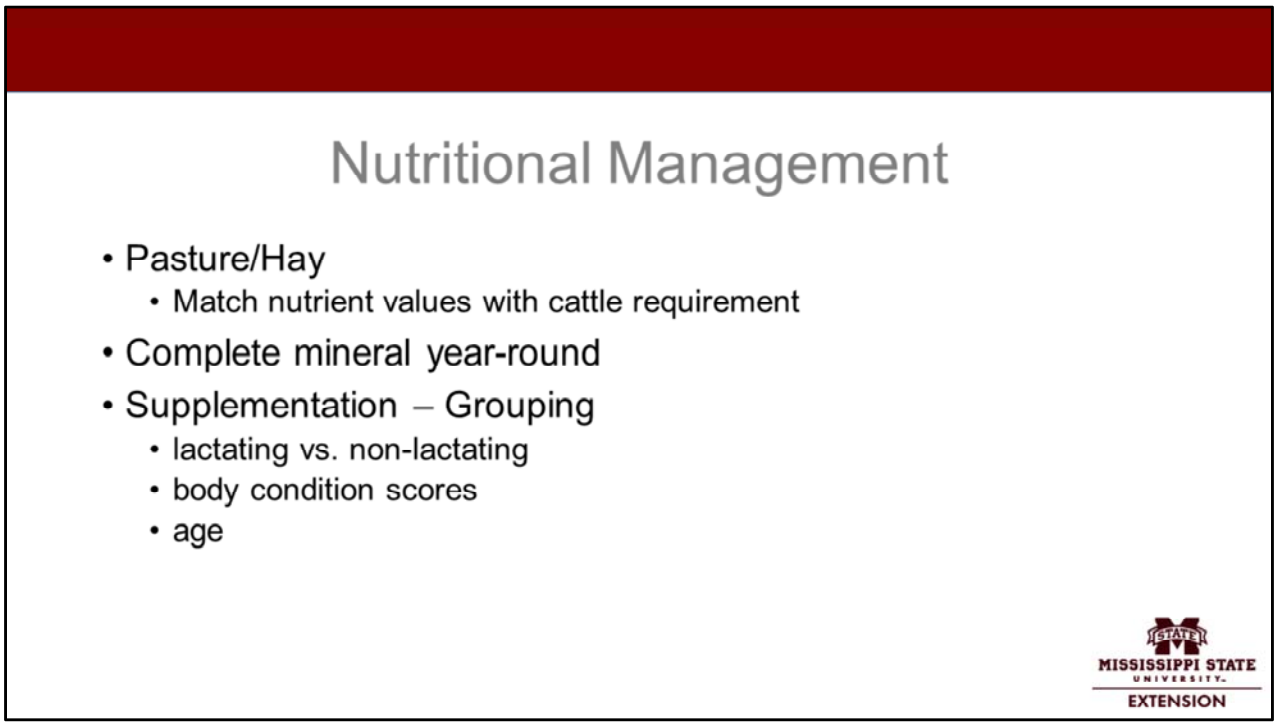
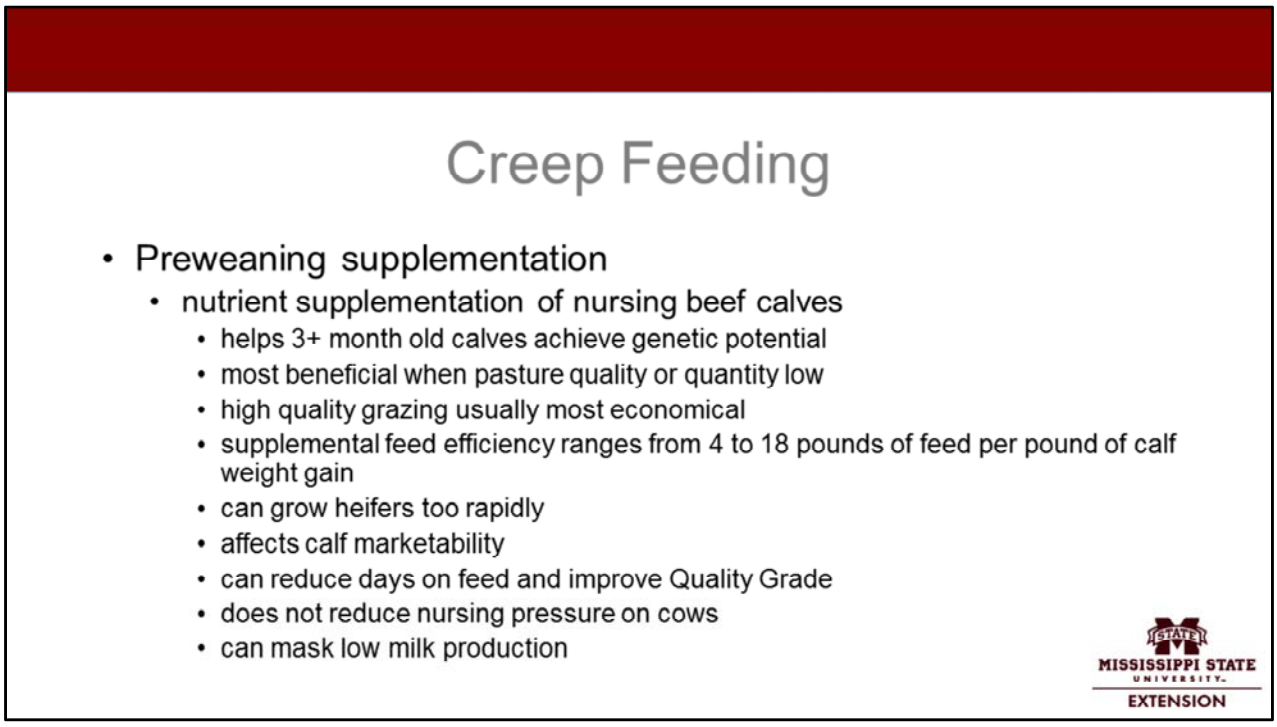
Nutrient requirements to increase body condition score of non-pregnant mature cows from 3 to 4 and 4 to 5 are listed in this table.



Mineral, fat, and effective fiber contents of forages and feeds are also important in balancing the overall diet. For more efficient use of nutritional resources, cattle can be divided into feeding groups based on nutrient needs. As a general rule, lactating cows have greater nutrient requirements than dry cows of the same size, and first-calf heifers have greater nutrient percentage requirements in their diets than mature cows. Young growing cattle tend to require greater percentages of dietary nutrients but less total dietary pounds of nutrients per day. Heifers can be separated by weight after weaning into feeding groups for more efficient feeding. The better quality forages and feeds should go to the feeding groups with greater nutrient needs. Another approach is to allocate higher quality grazing paddocks to the feeding groups with greater nutrient demands.



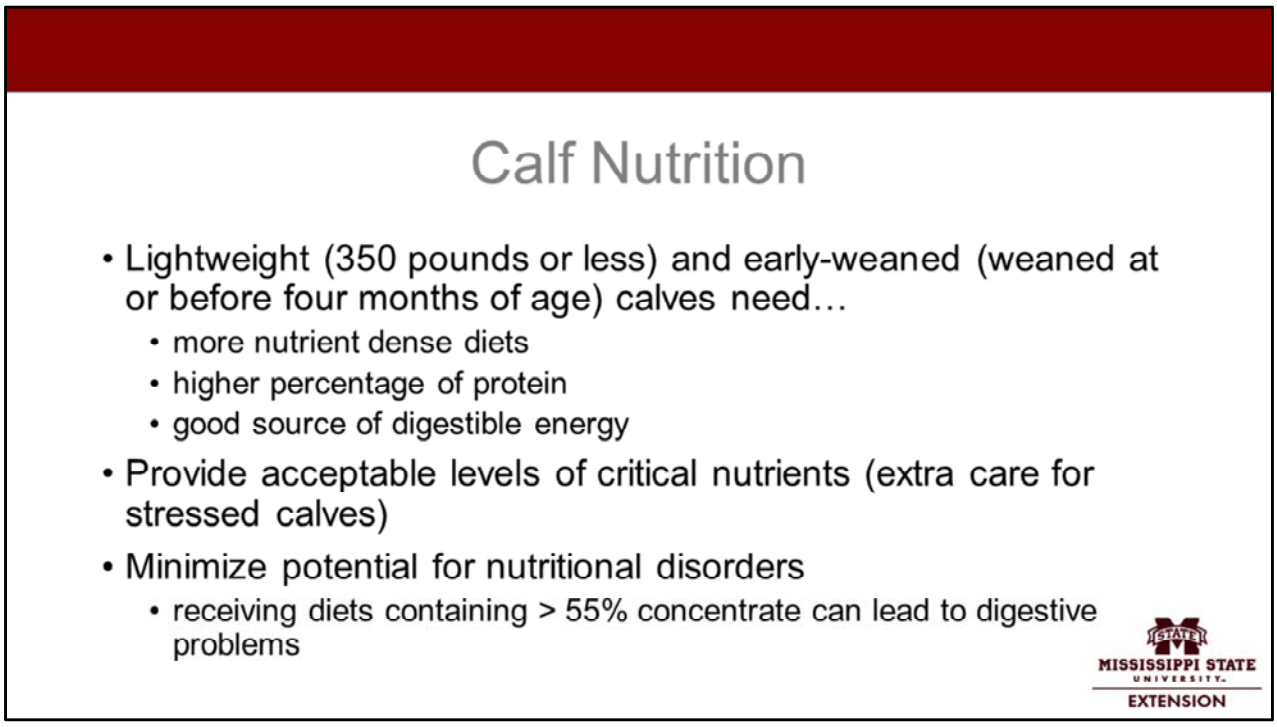
Preweaning supplementation, or "creep feeding," is the nutrient supplementation of nursing beef calves. Supplements can include creep feeding with concentrated feeds or creep grazing with high quality forage. Milk production in beef females typically peaks about 2 months after calving. Milk from a lactating beef cow offers only about half the nutrients that a 3- to 4- month-old calf needs for maximum growth. Calves need extra nutrients to perform to their genetic potential.

Typically, creep access to supplemental feed or forage uses creep feeders or gates that restrict access to the supplement by larger or more mature cattle while allowing calves to feed on or graze supplementation at will. When selecting feedstuffs for creep diets, consider forage conditions and milking levels of herd females to determine which feedstuffs may provide the most benefit to calves. Some producers creep feed calves for a short period before weaning to familiarize them with supplemental feed and ease their transition to the postweaning diet. Creep feeding affects preweaning and postweaning calf performance.

When making a decision about preweaning supplementation, consider several factors, including forage conditions, milk production levels, calf growth potentials, post-weaning marketing plans, feed costs, forage costs, pasture carrying capacity, calf prices, and price differentials for calves of varying body condition. There are both advantages and

disadvantages to creep feeding beef calves. Creep supplementation is a management decision that should be reevaluated with each calf crop.

Creep feeding is discussed in detail in Mississippi State University Extension Service Publication 2524, “Creep Feeding Beef Calves”.

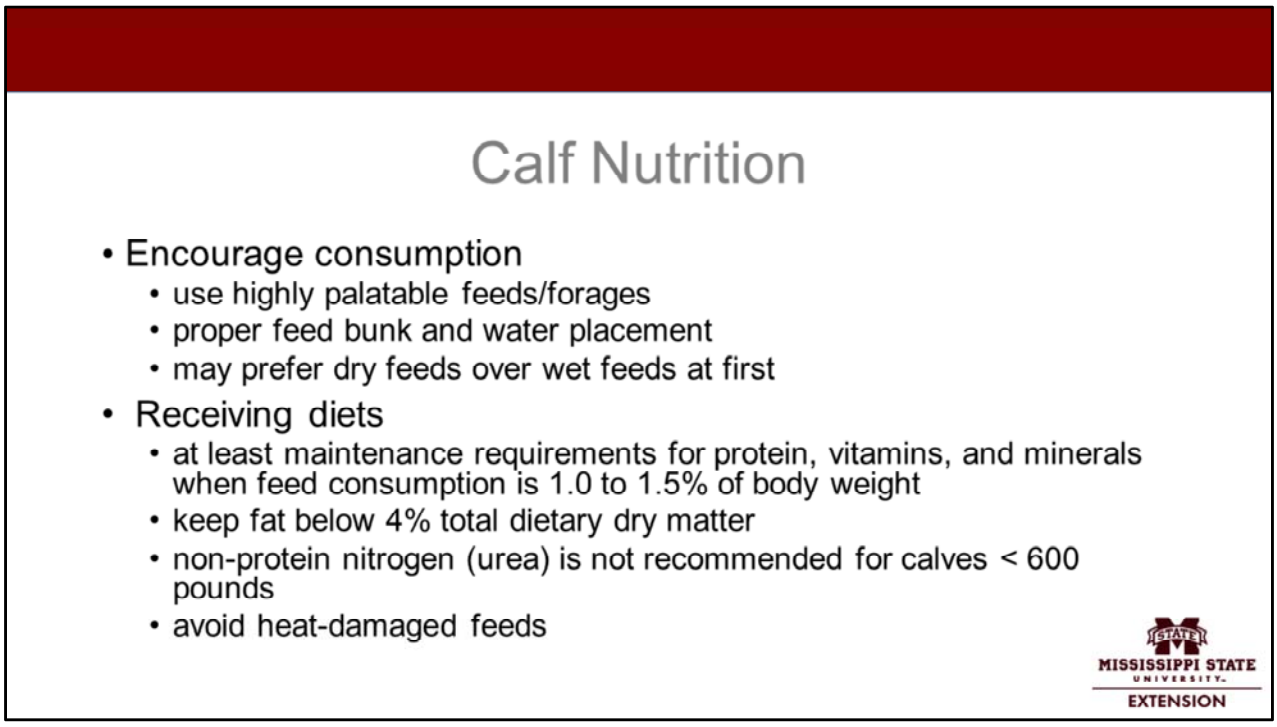


Lightweight (350 pounds or less) and early-weaned (weaned at or before four months of age) calves may need more nutrient dense diets than larger, later-weaned calves. These lighter calves require a greater percentage of protein and a good source of digestible energy in their diets than do larger calves.

Stressed calves have special nutritional concerns. One of the most challenging management problems resulting from stress on calves is lowered feed intake. Consider practices to minimize stresses as well as methods of coping with the effects of stress on calves.

Receiving diets must provide acceptable levels of critical nutrients and minimize the potential for nutritional disorders. Generally, receiving diets containing more than 55 percent concentrate can lead to digestive problems, resulting in greater medication costs and performance losses.

Calf nutrition is discussed in detail in Mississippi State University Extension Service Publication 2506, “Stocker Cattle Receiving Management”.



Good management can help newly arrived calves get on feed as quickly as possible. Calves initially walk the boundaries of their new pens searching for a way to escape. Placing feed bunks and water troughs along the fence lines of receiving pens, as opposed to in the center of the pens, increases the frequency of calves walking past the bunks and troughs. Therefore, calves find water and hay easier if they are placed around the fences. Using trainer or lead cattle to show newly arrived calves the locations of feed and water can also be effective. Receiving diets must be highly palatable to stimulate intake. Newly-arrived calves often prefer dry feeds over wet feeds, such as silages. However, calves will adapt to high levels of high moisture feeds such as corn silage in one to two weeks.

Diet formulation should take the age and size of the calf into consideration. As a general rule of thumb, receiving diets should be formulated so the calf receives at least maintenance requirements for protein, vitamins, and minerals when feed consumption is 1.0 to 1.5 percent of body weight. Stressed calves have a very low tolerance for fat in the diet. Receiving diet fat content should not go over 4 percent of the dietary dry matter. Commonly used feedstuffs containing relatively high fat levels include whole cottonseed, dried distillers grains, and rice bran (unless it has been defatted). Reduced feed intake and scours can be expected with excessive fat supplementation. The source of protein is also critical in receiving diets. Non-protein nitrogen (urea) is not recommended in receiving diets for calves less than 600 pounds and should be avoided altogether for feeding

lightweight calves. Avoid heat-damaged feeds for young calves, because they may have reduced levels of protein available for the animals to use.

Heifer Development

- Planning a heifer feeding program
  - Determine weight gain needed to reach target breeding weight (65% of mature weight)
  - Determine heifer nutrient requirements
  - Evaluate pasture and hay quality/supply
  - Determine supplementation feed requirements
- Monitor weight gains

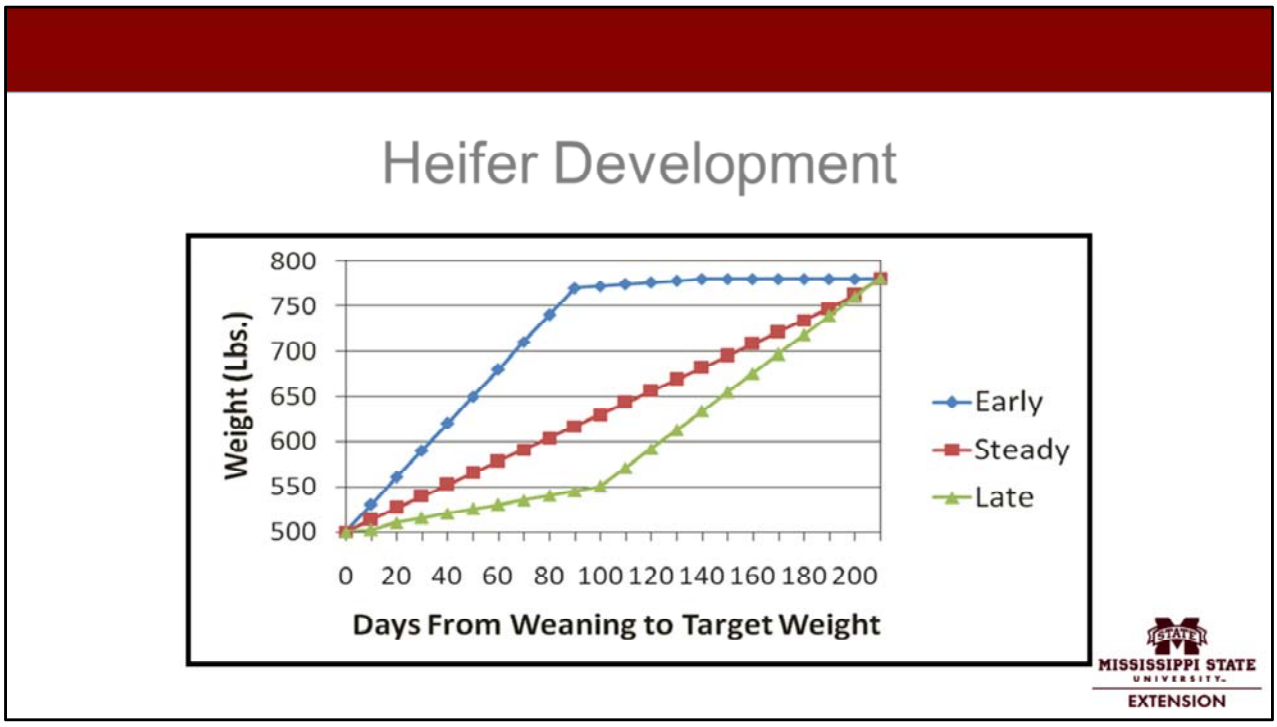
MISSISSIPPI STATE UNIVERSITY EXTENSION

The most important consideration in developing weaned heifers is nutritional management. The traditional approach to developing heifers has been the “target weight” method. For heifers to breed at 13 to 15 months of age and calve as two-year-olds, they must achieve approximately 60 to 70 percent of their mature weight by the start of the breeding season. For British breeds this usually means heifers need to weigh approximately 650 to 700 pounds at 14 to 15 months of age and heavier weights for cattle with larger expected mature weights. For Continental breeds this typically means heifers should weigh approximately 750 to 800 pounds at 14 to 15 months of age. Brahman influence cattle may be slower maturing. For example, if a heifer is expected to weigh 1,200 pounds as a mature cow, she should weigh 780 to 840 pounds before the beginning of the breeding season. This is referred to as target weight. After the target weight is determined, the time from weaning to breeding should be calculated. If the heifers are weaned on October 1 and will be bred on April 25, that leaves 177 days to reach the target weight. Then determine the average daily gain (ADG) required over the 177-day period to reach target weight. For this example, if the heifers are weaned at 600 pounds and the target weight is set at 800 pounds (1,200 x 67 percent = 800), they will need to gain a total of 200 pounds in 177 days. That results in a required ADG of 1.13 pounds (200 ÷ 177 = 1.13). Monitor weight gains every 30 to 60 days to make sure the heifers are gaining on schedule, and adjust the feeding program if appropriate.

To calculate target weights:

1. Determine the desired breeding date based on desired calving date.
2. Determine heifer age at start of breeding.
3. Determine expected mature weight.
4. Determine required average daily gain.

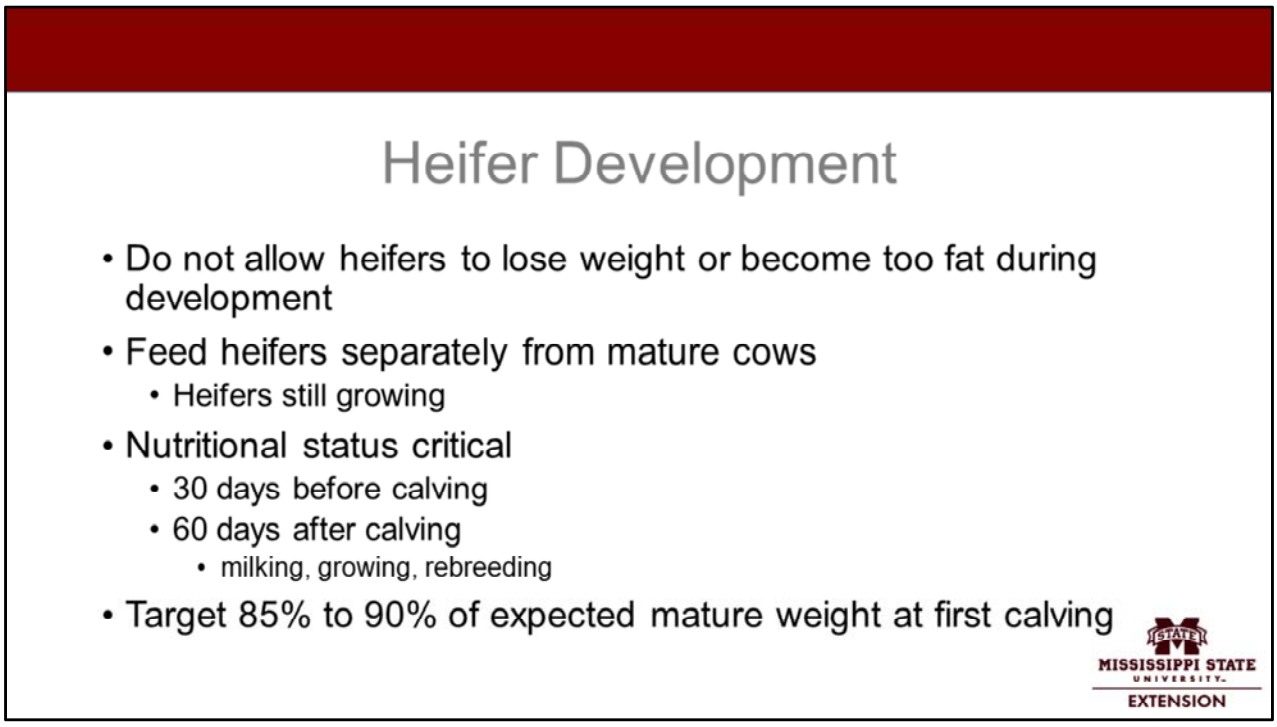
Evaluate pasture, hay quality, and supplies ahead of time. Determine supplemental feed requirements by examining weight gains needed to reach target breeding weights, animal nutrient requirements, and forage program deficiencies.



The plane of nutrition for reaching the target weight can be altered to match forage availability or feed cost. For instance, if forage is abundant or supplemental feed is relatively inexpensive early in the development period, heifers can be fed to maintain a high ADG early and reach the target weight faster. Then, when forage or supplemental feed availability declines, they can be maintained on a maintenance (or slightly above maintenance) diet until breeding. On the other hand, if forage is limited and supplemental feed cost is high during early development, heifers can be maintained on a low ADG and then pushed to reach the target weight as forage becomes available or supplemental feed cost decreases. If supplemental feed and forage availability are not a concern, a steady ADG can be maintained. At this point in developing replacement heifers, experience in feeding cattle is critical. Take weights frequently to ensure the heifers reach their targets.

More recent reports have suggested the “target weight” system for developing heifers is outdated and costly. As beef cattle producers switched from calving heifers as 3-year-olds to calving as 2-year-olds, more emphasis has been placed on selecting heifers that reach puberty at an earlier age and lighter weight in relation to their expected weights as mature cows. In support of this idea, field trials have demonstrated that heifers developed to only 53 percent of their mature weights achieved similar pregnancy rates and longevity in the herd over four years compared to traditionally fed heifers (67 percent of mature weight). When cost of production outpaces revenue, developing heifers to a lighter target weight

may be more appropriate. However, management practices should not be changed suddenly. Implement this practice carefully and only when genetic potential of the specific group of heifers is known.



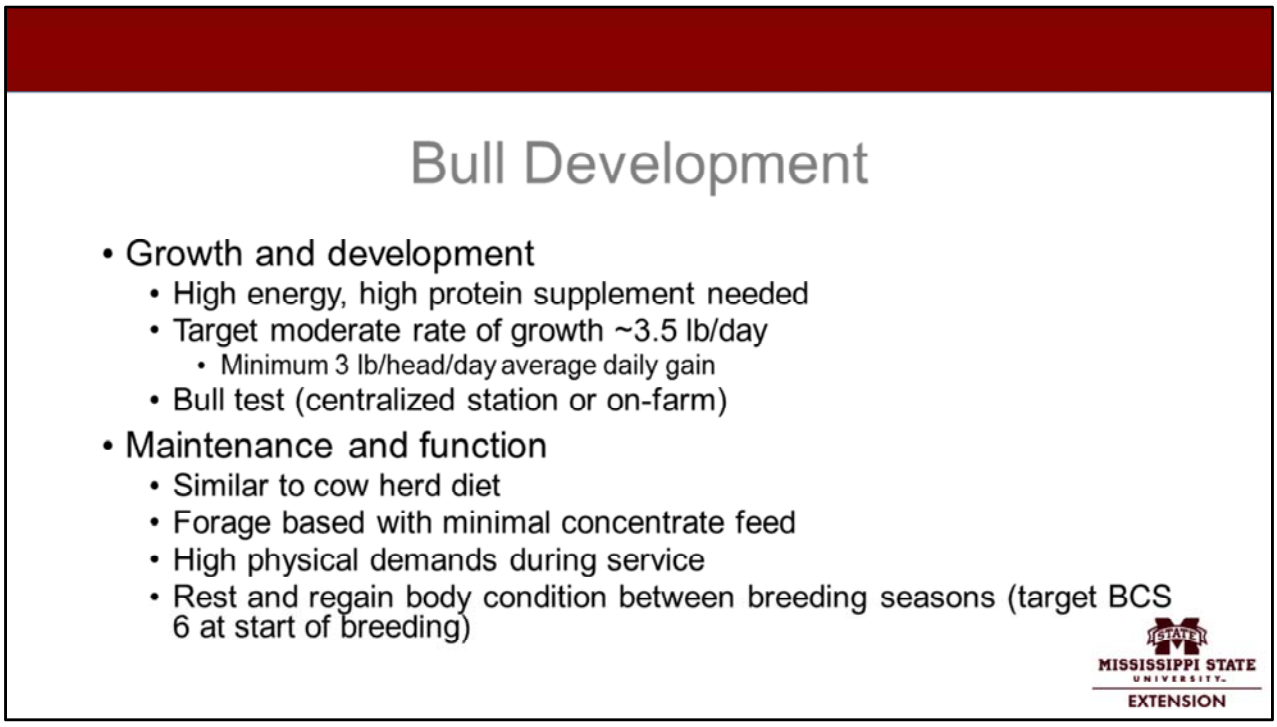
Regardless of the nutritional program used, it is important to remember that the heifers should not be allowed to lose weight ("back up") or become too fat during the developmental period. Losing weight can alter the age at puberty even if the target weight is reached at the desired time. If heifers are overfed, fat accumulation in the udder may inhibit milk production as a first-calf-heifer and mature cow. Furthermore, multiple feeding groups should be used because individual heifers will require different nutritional inputs.

A beef heifer's energy needs for maintenance, growth, and lactation must be met before energy is used for reproduction. Adequate nutrition is critical during the last two months of gestation, because much of the fetal growth occurs then.

Separating heifers from the mature cow herd limits competition for bunk space and allows them to be placed on separate nutritional programs that better meet their requirements. Depending on breeding weight, bred heifers usually need to gain about 1 pound per day until calving. The weight at first calving should be 85 to 90 percent of the expected mature weight. This translates to a target weight at calving of approximately 850 to 950 pounds for British breeds and approximately 950 to 1050 pounds for Continental breeds. They should have a body condition score of 6 and be on a positive plane of nutrition before calving. Underfeeding heifers just before calving does not significantly reduce calf weight and does increase calving difficulty and decrease calf immunity. Thin heifers may lack the stamina to

deliver a calf without distress.

Heifer development is discussed in detail in Mississippi State University Extension Service Publication 2488, “Replacement Beef Heifer Development”.



Young growing bulls require high energy, high protein supplements for proper development. Reasonable bull growth rate targets are around 3.5 pounds per head per day with a minimum average daily gain of 3 pounds per head. Bulls should be gain tested at centralized bull test stations (for example, Hinds Community College Bull Test Station) or on farm to monitor genetic differences for post-weaning growth while adequately developing young bulls.

Mature bulls can be nutritionally managed similarly to the cow herd. Base mature bull diets around forage programs with concentrate feed supplementation as needed. Increased physical activity of bulls during the breeding season can result in body condition loss. Adequate bull body condition is important for effective breeding performance. Because it can often be difficult to supplement bulls separately from the remainder of the breeding herd, bulls should be fed to go into the breeding season in at least good body condition without being excessively fat. A body condition score of 6 is a good goal for bulls at the start of breeding.

Bulls can lose significant amounts of weight during the breeding season. They must gain this weight back and yearling must continue to grow before the next breeding season to remain effective herd sires. It is important to observe growing bulls closely for changes in body condition. Adjustments to bull feeding programs can then be made in a timely

manner.

Bull Development

- Manage by age group
  - weanling bull calves
  - yearling bulls
  - gain-test bulls
  - 2-year old bulls
    - target 75% of expected mature weight
  - mature bulls
- Younger bulls require
  - lower forage/feed quantities
  - higher forage/feed qualities
  - higher protein % for rapid muscle growth

MISSISSIPPI STATE UNIVERSITY EXTENSION

Proper post-weaning development of beef bulls is important for future effectiveness as herd sires. Bulls should be separated and managed according to age groups (weanling bull calves, yearling bulls, highly-fitted or gain-tested bulls, 2-year old bulls, mature bulls). Separating younger and older bulls can be particularly important in preventing injuries. Dividing bulls into management groups also allows the different nutritional needs of the different groups to be better met. Yearling bulls still have lots of growth and development ahead of them and should be managed differently than older bulls.

As bulls mature, their nutritional requirements change. Younger bulls require less quantity but higher quality diets. For example, daily nutrient requirements for a 700 lbs. bull gaining 2 lbs. per day are approximately 16 lbs. of dry matter intake with 11.4% crude protein and 65% total digestible nutrients (TDN) on a dry matter basis, while a 1,500 lbs. bull gaining 2 lbs. per day needs approximately 34.5 lbs. of dry matter intake with 6.1% crude protein and 63% TDN on a dry matter basis. Whereas daily dry matter intake generally increases with increasing body weight, a bull's crude protein requirement decreases as a percentage of dry matter intake with advancing age and body size. Younger bulls require greater protein percentages for the rapid lean muscle growth that is occurring during early development.

A good target is for a 2-year old bull to weigh approximately 75% of his expected mature weight. For example, if a bull's expected mature weight is 2,000 lbs., then he should weigh

approximately 1,500 lbs. (2000 x .75 = 1,500) at two years of age.

Several feeding considerations must be taken into account when planning a feeding program including storage, ease of handling and flow through equipment, convenience, and feeding method. Some producers will not opt to hand feeding because of the labor requirements despite its advantages. Mississippi State University Extension Service Publication 2570, "Feedstuff Handling, Storage, and Feeding Systems for Livestock" discusses feeding considerations in detail.

Nutrient Content of Selected Beef Cattle Feeds[1,2]

Energy Feeds

Feed	Dry Matter %	Total Digestible Nutrients %	Crude Protein %	Crude Fiber %	Crude Fat %	Calcium %	Phosphorus %
Whole shelled corn	90	90	9	2	4	0.03	0.32
Hominy feed	90	91	11	7	8	0.06	0.58
Soybean hulls	90	80	12	39	2	0.60	0.17
Wheat middlings	89	77	18	9	5	0.15	1.00
Rice bran	90	70	16	12	15	0.10	1.73
Cane molasses	74	72	6	1	0	0.01	0.10
Citrus pulp	90	80	6.5	13	4	1.90	0.13

[1] Dry matter basis.
[2] The nutrient values presented are intended as a general guide to nutrient qualities of feedstuffs. Significant variation in nutrient values exists among different feed sources

MISSISSIPPI STATE UNIVERSITY EXTENSION

Just because certain feedstuffs are cheap in terms of dollars does not mean that they are necessarily a good value. The nutritional makeup of feeds and what they contribute to beef cattle performance determine their true value. The nutrient content of selected beef cattle feeds often used primarily as energy sources in beef cattle diets are listed in this table.

Nutrient Content of Selected Beef Cattle Feeds[1,2]

Protein Feeds

Feed	Dry Matter %	Total Digestible Nutrients %	Crude Protein %	Crude Fiber %	Crude Fat %	Calcium %	Phosphorus %
Corn gluten feed	90	83	24	10	4	0.07	0.95
Whole cottonseed	93	90	24	22	18	0.20	0.73
Cottonseed meal	92	76	41	13	3	0.18	1.21
Soybean meal	90	84	48	7	2	0.34	0.70
Peanut meal	88	77	53	2	2	0.32	0.66
Dried distillers grains	92	86	27	12	10	0.26	0.83
Brewers grains	24	69	26	15	11	0.30	0.57

[1] Dry matter basis.
[2] The nutrient values presented are intended as a general guide to nutrient qualities of feedstuffs. Significant variation in nutrient values exists among different feed sources

MISSISSIPPI STATE UNIVERSITY EXTENSION

The nutrient content of selected beef cattle feeds often used primarily as protein sources in beef cattle diets are listed in this table.

Nutrient Content of Selected Beef Cattle Feeds[1,2]

Roughages

Feed	Dry Matter %	Total Digestible Nutrients %	Crude Protein %	Crude Fiber %	Crude Fat %	Calcium %	Phosphorus %
Cottonseed hulls	91	42	4	48	2	0.10	0.07
Cotton gin trash	92	46	8	38		0.60	0.20
Peanut hulls	91	22	9	63		0.20	0.07
Corn stalks	85	50	6.6	34	2	0.50	0.10
Soybean stubble	88	40	5	44		1.00	0.06
Wheat straw	92	40	4	42	2	0.17	0.04

[1] Dry matter basis.
[2] The nutrient values presented are intended as a general guide to nutrient qualities of feedstuffs. Significant variation in nutrient values exists among different feed sources

MISSISSIPPI STATE UNIVERSITY EXTENSION

The nutrient content of selected beef cattle feeds often used primarily as fiber sources in beef cattle diets are listed in this table. Long-stem grazed forages and stored forages (such as hay) are also excellent effective fiber sources.

Corn

- 90% TDN
- 9% CP
- 4% Fat
- Low in calcium

MISSISSIPPI STATE UNIVERSITY EXTENSION

Corn is typically considered the gold standard energy feed for beef cattle and is heavily used in beef cattle diets including finishing diets. Corn is an extremely high energy feed. It is also quite palatable to cattle. Corn contains low calcium and high phosphorus levels like most feed grains.

Corn Gluten Feed

- 83% TDN
- 24% CP
- 4% Fat
- Low in calcium
- Feed at up to 50% of diet
- Sulfur, caking

MISSISSIPPI STATE UNIVERSITY EXTENSION

Corn gluten feed is a by-product of the corn milling process which produces high-fructose corn syrup used as a sweetener. It consists primarily of the bran and meal remains from the grain after starch removal. It has good protein content, but its protein quality is generally considered too low for poultry and swine diets. Corn gluten feed works as a protein and energy supplement in beef cattle diets. At feeding levels of 0.5% of body weight or less on high-forage diets, the TDN value is about equal to corn. It often prices in as a cost-effective feed ingredient, but should not make up more than 50% of daily dry matter intake. Corn gluten feed can be fed in self-feeders along with hay or pasture, however, caking is possible in humid conditions. Excessive processing or heating lowers corn gluten's feed value and palatability and darkens its color. Use of the wet form is only practical in areas relatively close to corn mills. Corn gluten feed is low in calcium and can contain high sulfur levels that necessitate mixing it with other feeds in the diet.

Dried Distillers Grains

- 86% TDN
- 27% CP
- 10% Fat
- Good fiber levels but not effective fiber
- Low starch
- High bypass protein

MISSISSIPPI STATE UNIVERSITY EXTENSION

Distillers grain is a co-product from the fermentation of grain to produce alcohol (e.g., ethanol). Availability of distillers grains is generally limited to areas near distilleries and ethanol plants. They are an excellent source of bypass protein and energy for beef cattle and can be fed as a majority of the total diet for mature beef cattle. Stocker diets benefit from inclusion levels of up to 15 to 25% of the total diet. Drying facilitates storage, transportation, and handling of distillers grains. The wet form is roughly ¾ water and has a limited storage life in Mississippi, particularly during hot conditions.

Soybean Meal

- 84% TDN
- 48% CP
- 2% Fat
- Excellent protein source
- Works well in hot mix

MISSISSIPPI STATE UNIVERSITY EXTENSION

Soybean meal is a co-product of the soybean oil milling process. It serves as an excellent protein source for beef cattle diets. It can be mixed with salt in a “hot mix” or “range meal” for limit feeding.

Soybean Hull Pellets

- 80% TDN (variable)
- 12% CP
- 2% Fat
- 39% Fiber
- Not an effective fiber source
- Good calcium source

MISSISSIPPI STATE UNIVERSITY EXTENSION

Soybean hulls are a co-product of the soybean oil milling process. They are a very palatable and digestible feed. Soybean hulls are also a good energy source, particularly on forage-based diets. Soybean hulls are roughly equal to corn as a supplement at feeding levels of 0.5% of body weight or less on high-forage diets. They are a decent protein source but can vary widely from load to load. The high fiber content in soybean hulls is not effective fiber, so an adequate roughage source is also needed when feeding soybean hulls. They can be fed in self-feeders along with hay or pasture, but are conducive to bloat when fed at high levels (over 7 pounds per head per day). Soybean hulls are bulky and dusty, so they are best when pelleted or mixed with silage or molasses to reduce dust. They are a good source of calcium while low in phosphorus. Soybean hull pellets are a widely used ingredient in Mississippi beef cattle diets.

Whole Cottonseed

- 90% TDN
- 24% CP
- 18% Fat
- 22% Fiber
- Feed at up to 20-25% of diet
  - 5-6 lbs (cows), 2-3 lbs (stockers)

MISSISSIPPI STATE UNIVERSITY EXTENSION

Whole cottonseed is a major co-product of the cotton ginning process. It is an excellent beef cattle feed, with good energy and protein levels. Two pounds of cottonseed roughly equals one pound each of corn and cottonseed meal for nutritional value. It is readily available in cotton-producing areas such as the Mississippi Delta. Its high fat content limits use levels to 25% or less of total dry matter intake. Feed no more than 5 to 6 pounds per head per day to mature cattle, and no more than 2 to 3 pounds per head per day to weaned calves. Do not feed at more than 20% of the diet for cattle in stocker or finishing programs. Whole cottonseed must be hand fed and not used in self feeders. Whole, fuzzy cottonseed has flow limitations in feeding bins and equipment and is difficult to auger or gravity flow unless coated with corn starch.

Cottonseed Meal

- 76% TDN
- 41% CP
- 3% Fat
- Excellent local protein source
- Works well in hot mix

MISSISSIPPI STATE UNIVERSITY EXTENSION

Cottonseed meal is a co-product of the cottonseed oil milling process. It is an excellent locally available protein source that works well in a hot-mix (mixed with salt and offered free-choice).

Cottonseed Hulls

- 42% TDN
- 4% CP
- 2% Fat
- 48% Fiber
- Stockers up to 10-25% of diet
- Very palatable, good fiber source

MISSISSIPPI STATE UNIVERSITY EXTENSION

Cottonseed hulls are a co-product of the cotton industry. They are extremely palatable to cattle. Cottonseed hulls are high in crude fiber and have low digestibility. Therefore, they can be used as the sole roughage source in cattle diets. Cottonseed hulls make a good hay-replacer diet ingredient or alternative to chopped hay in mixed feeds. They are bulky with excellent mixing qualities at low levels in concentrate diets. Cottonseed hull feeding levels should not exceed 10 to 25% of diet for growing or finishing cattle. They are often an expensive ingredient for cattle diets.

Gin Trash and Mote

- 46% TDN
- 8-12+% CP
- 38% Fiber
- Use to stretch hay
- Dusty

MISSISSIPPI STATE UNIVERSITY EXTENSION

Cotton gin trash is a co-product of the cotton ginning process. Gin trash contains boll residues, leaves, stems, and lint. It is bulky, dusty, and a lowly palatable, high fiber, and low energy feed. It is typically an inexpensive feed with limited uses. The most practical use is in hay-replacer diets when mixed with other feeds.

Cotton gin mote is the cotton extracted by a gin's lint cleaner during the cotton ginning process. It is also a high fiber, low energy feed. Yet palatability is usually not a problem. It is offered baled into 4' x 4' x 5' bales or loose. The baled form can be handled and fed with same equipment used for large round hay bales. Practical use of cotton gin mote is in hay-replacer diets with other supplemental feeds. Although it can be used to stretch hay supplies, cotton gin mote should not be used as the sole roughage source in cattle diets.

Rice Mill Feed

- 76% TDN
- 41% CP
- 3% Fat
- Combo of rice bran and hulls
- Finely ground, highly variable
- Bin use difficult unless in blend
- Founder at high dietary levels

MISSISSIPPI STATE UNIVERSITY EXTENSION

Rice mill feed is a co-product of the rice milling process. It consists of a finely ground material that is a combination of rice hulls and rice bran. Rice mill feed is often highly variable in composition. Founder is possible when feeding rice mill feed at high levels. Rice mill feed has handling characteristics similar to rice bran, but is typically less expensive and has a longer storage life than rice bran.

Rice Bran

- 70% TDN, 16% CP
- 15% Fat
- High fat unless defatted
- Limit to no more than 1/3 of diet
- Finely ground, best blended
- Palatability & rancidity concerns

MISSISSIPPI STATE UNIVERSITY EXTENSION

Rice bran is a co-product of the rice milling process. It is a finely ground material, making handling and storage in bins difficult. Blending rice bran with other feed ingredients improves flow through machinery and augers. Rice bran has moderate protein levels. It is high in fat content unless defatted, so limit rice bran to no more than one-third of total diet for beef cattle. Rice bran has substantially less energy than soybean hulls even with its high fat levels. Full fat rice bran is more susceptible to rancidity in warm weather and less palatable than defatted rice bran. Rice bran has a relatively high phosphorus concentration as seen with most other feed grain products.

Rice Hulls

- 12% TDN, 3% CP
- 1% Fat
- Low feed nutrient values
- High silica content
- Can cause bloody feces
- Not a recommended feed

MISSISSIPPI STATE UNIVERSITY EXTENSION

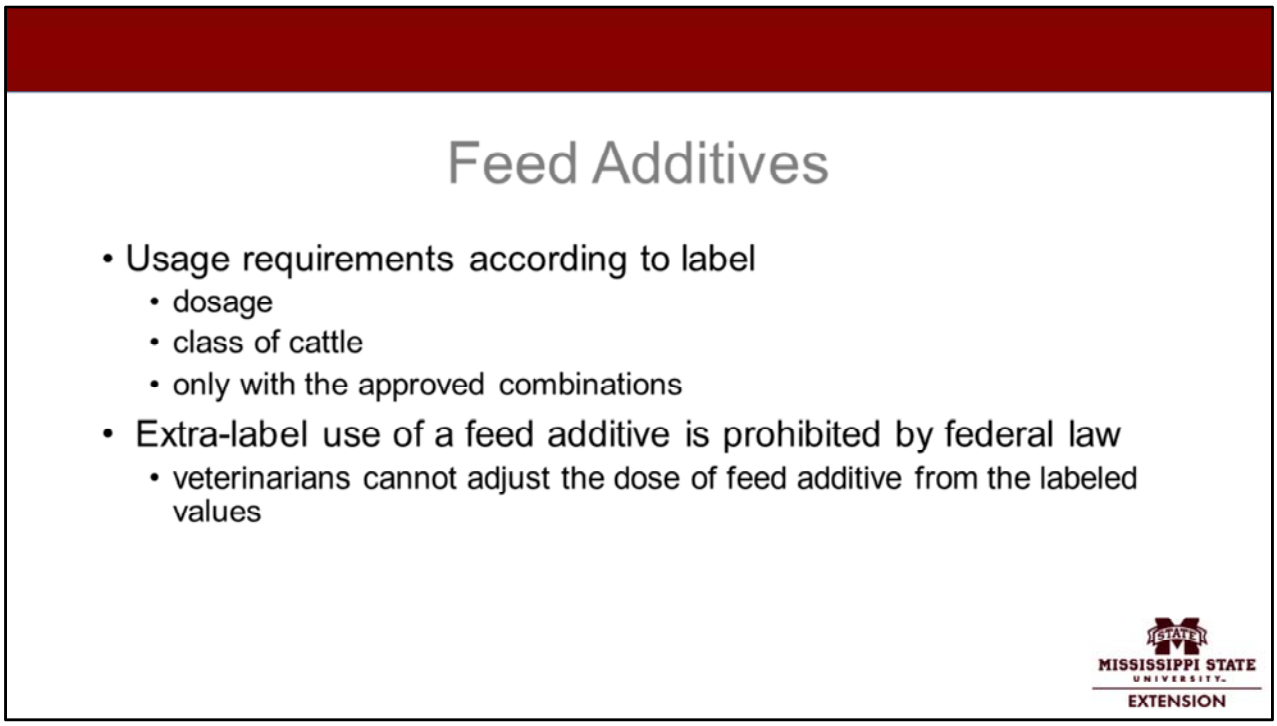
Rice hulls are a co-product of the rice milling process and may contain floor sweepings. They are extremely low in nutritional value for beef cattle diets. The high silica content in rice hulls can lead to bloody stools in cattle, particularly calves. Rice hulls are not a recommended feedstuff for beef cattle in large quantities.

Cereal Co-Product

- Available out of Memphis
- Can be blended with other feeds
- Variable product
- High in starch (acidosis, founder)

MISSISSIPPI STATE UNIVERSITY EXTENSION

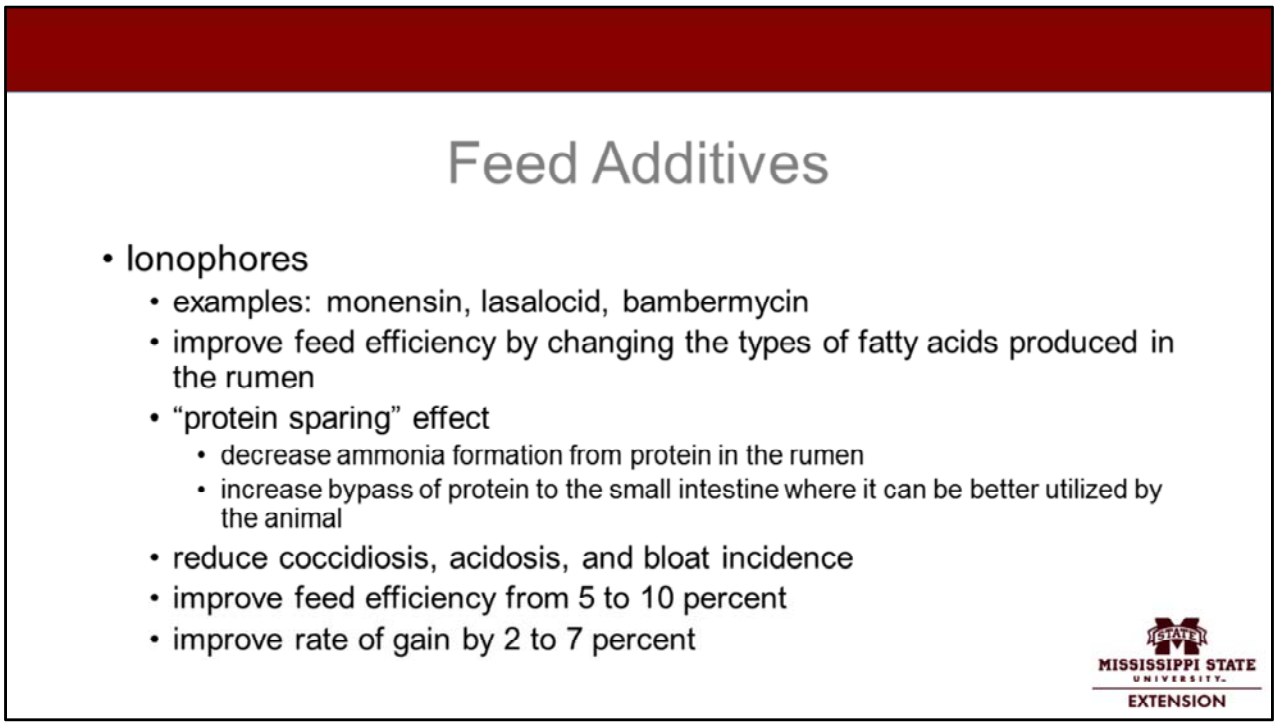
Cereal co-product is an example of one of the many industry co-products that are potential feedstuffs for beef cattle. Cereal co-products are generally available out of locations with food manufacturing such as Memphis, Tennessee. They are a highly variable product with a high starch content that may promote acidosis or founder in cattle. This product should, therefore, be blended with other feeds and fed at low inclusion levels in cattle diets. Other potential feedstuffs for beef cattle from human food supplies include bakery waste products, candies, etc.



Responsible feed additive use is important. Store medicated feeds properly. Observe product expiration dates. Use feed additives only for their intended purposes. Follow label directions and pay attention to label warnings. Only mix combinations of feed additives that are approved on the labels. This applies to both individual feeds and to different feeds offered in the same pen or paddock. Also avoid using different drugs in morning and afternoon feedings. To prevent an illegal drug combination, properly clean feed mixing equipment, feed delivery equipment, and feed bunks after medicated feed use and before switching to new medicated feeds. Feed additive residues can result in illegal drug combinations or feed additives offered to livestock for which they are not intended. Train ranch personnel on the principles of proper feed additive use.

Feed additives must be used at the dosage, for the class of cattle, and only with the approved combinations according to the label. Some feed additives that are approved for use in confined cattle intended for slaughter are not approved for use in grazing cattle. In addition, many feed additives that may be used in stocker cattle are not approved for use in breeding cattle, so reading and following feed additive labels is critical. Time of administration and withdrawal periods, if required, must be followed as well. No one has the authority to use a feed additive in any manner inconsistent with label specifications. Extra-label use of a feed additive is prohibited by federal law. A veterinarian cannot adjust the dose of feed additive from the labeled values.

Feed additives are discussed in detail in Mississippi State University Extension Service Publication 2518, “Feed Additives for Beef Cattle”.



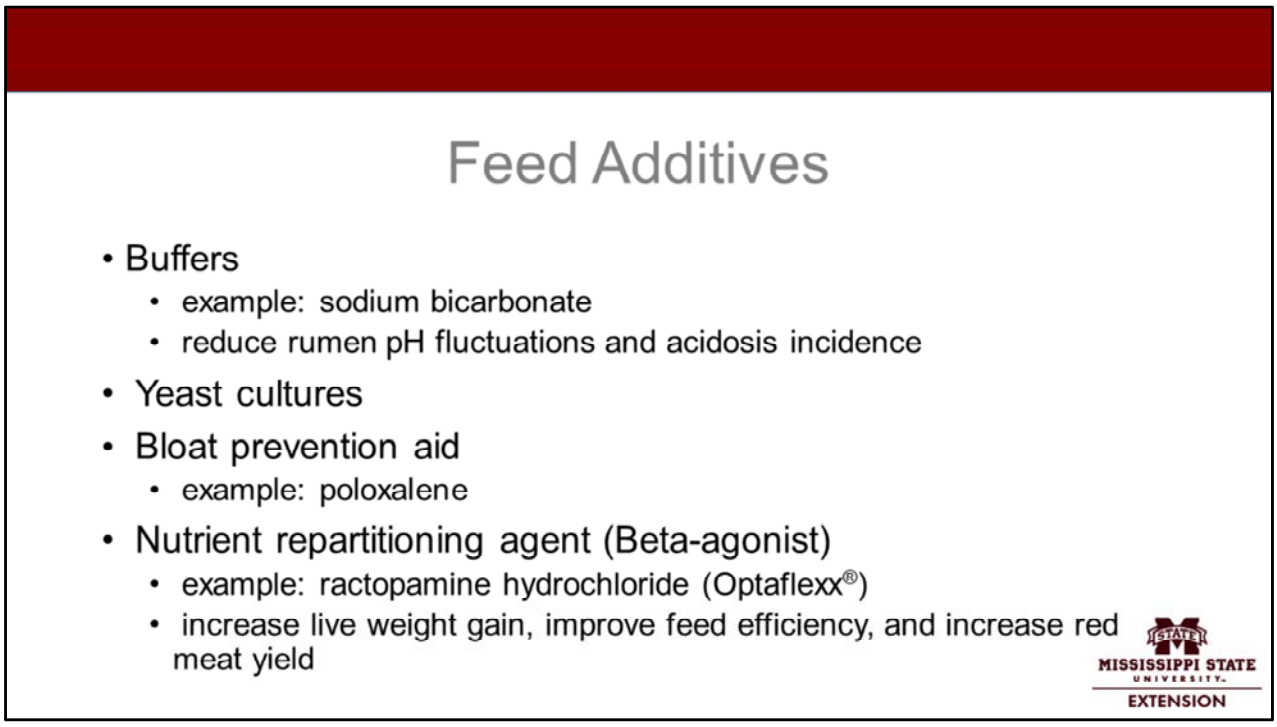
Ionophores are antimicrobial compounds that modify microbial fermentation in the rumen allowing cattle to obtain more energy from the feed consumed. Ionophores work by inhibiting or depressing the growth of certain rumen microorganisms. Inhibiting these organisms alters the rumen fermentation process in several ways.

1) Ionophores improve feed efficiency by changing the types of fatty acids produced in the rumen. They increase the capture of feed energy during rumen fermentation with less methane produced. Animal performance improves due to increased energy retention during rumen fermentation.
2) Ionophores decrease the breakdown of protein in the rumen. Monensin, for example, has been shown to have a "protein sparing" effect by decreasing ammonia formation from protein. The decreased breakdown of protein in the rumen increases the bypass of protein to the small intestine where it can be better utilized by the animal. This has little effect on performance of feedlot cattle on high grain diets, but it is important in growing cattle on high roughage diets.
3) Ionophores reduce the incidence of coccidiosis, acidosis, and bloat. Animal performance improves by reducing these stressors.
4) In addition to positive production impacts on cattle on high grain diets, ionophores significantly improve daily gain and feed efficiency when fed to cattle on high roughage diets. Feeding excessive levels of ionophores can reduce fiber digestion on high forage

diets. It is particularly important to use proper feeding levels of ionophores on forage-based diets common in Mississippi beef cattle operations.
5) In general, ionophores enhance the absorption of nitrogen, magnesium, phosphorus, zinc, and selenium.

Ionophores generally improve feed efficiency from 5 to 10 percent and improve rate of gain by 2 to 7 percent. Yet ionophores do not appear to impact carcass characteristics.

Monensin (Rumensin®) and lasalocid (Bovatec®) were two of the first commercially available ionophores. Laidlomycin propionate (Cattlyst®), bambermycin (Gainpro®), and virginiamycin (V-max®) are more recently approved performance enhancing antibiotics for cattle.

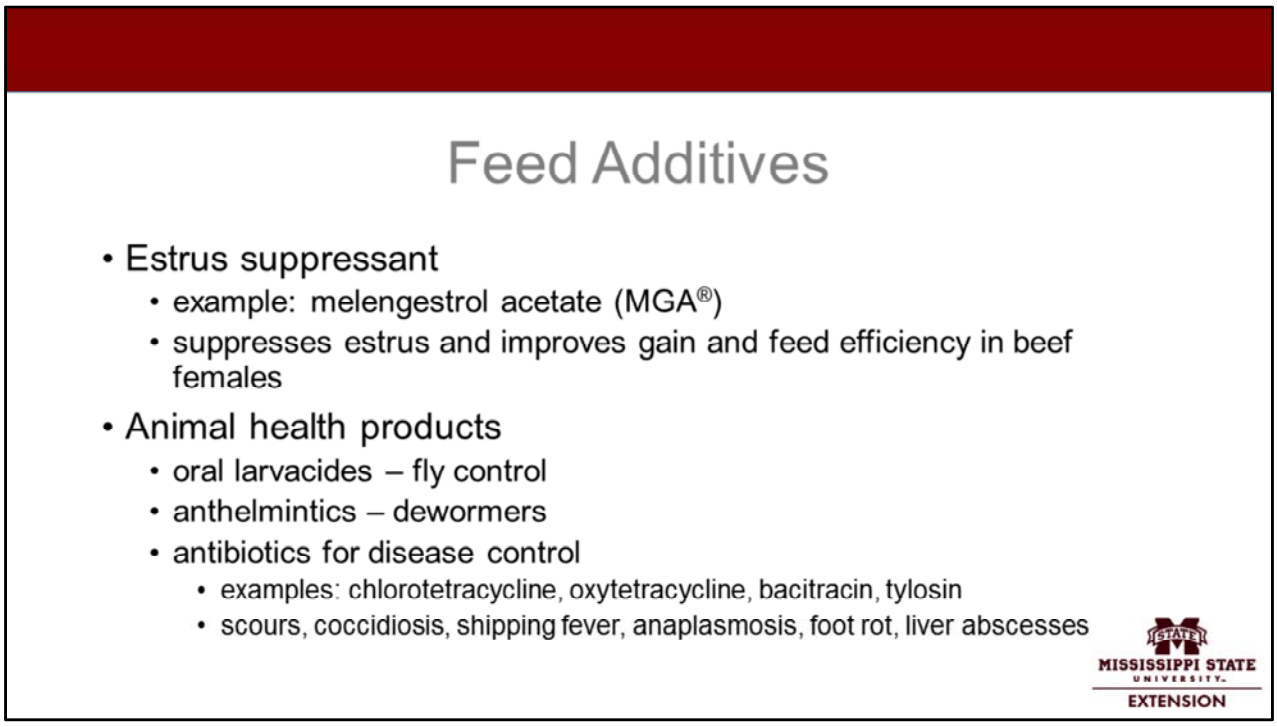


Buffers can be added to beef cattle diets to reduce fluctuations in rumen pH. Sodium bicarbonate is an example of a feed additive that buffers rumen pH. This helps reduce the incidence of acidosis when adapting cattle to high grain diets or when feeding cattle concentrate feedstuffs such as wheat at high levels.

Yeast (e.g., Saccharomyces cerevisiae) cultures may improve feed efficiency, gain, and health in cattle. Yeast-based products have been shown to affect dry matter intake, rumen pH, and nutrient digestibility. However, some studies show no benefits from addition of yeast cultures to beef cattle diets.

Poloxalene can be fed to beef cattle to aid in the prevention of bloat on legume and other lush pasture. Poloxalene can be mixed with feed or offered in block form. For product effectiveness, cattle must consume adequate quantities of poloxalene.

Ractopamine hydrochloride (Optaflexx) is an example of a beta-agonist that redirects nutrients that would have become fat and synthesizes them into protein. This increases muscle fiber size and lean meat yield. Ractopamine hydrochloride is fed to cattle during the final 28 to 42 days of the finishing period to increase live weight gain, improve feed efficiency, and increase red meat yield.



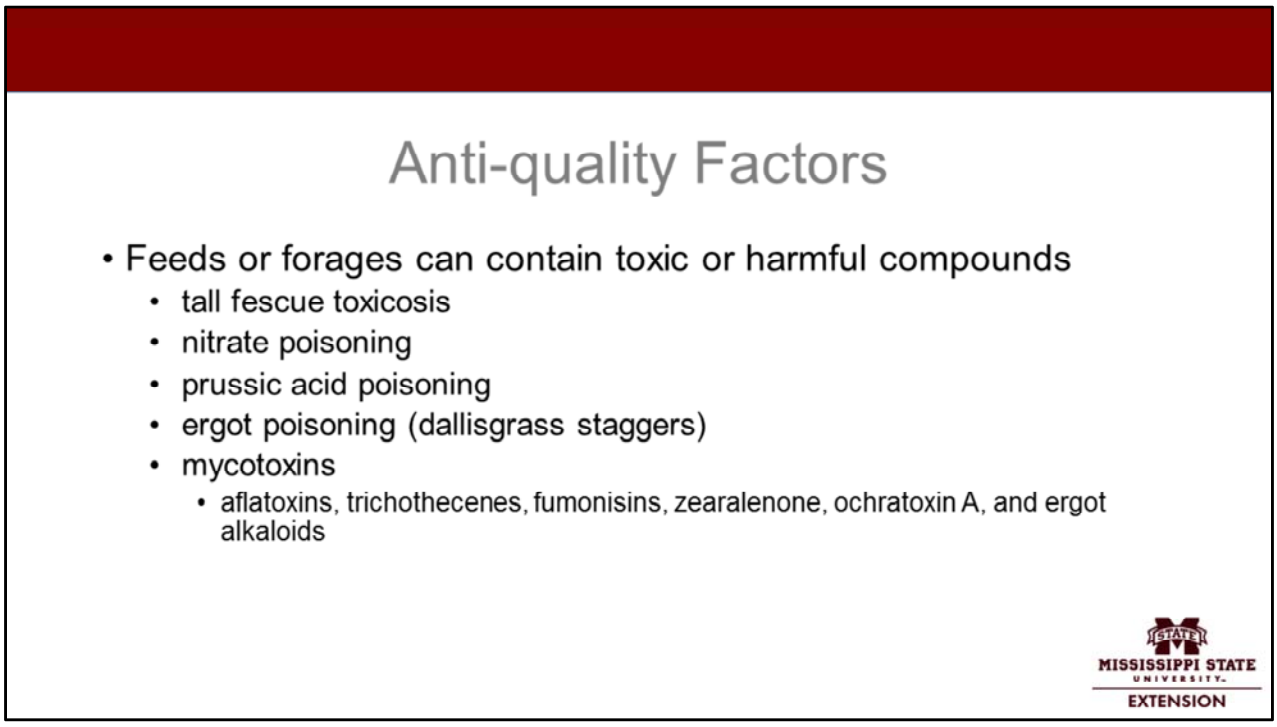
Melengestrol acetate (MGA®) is a feed additive that suppresses estrus (heat or cyclic sexual activity) and improves gain and feed efficiency in beef females. Practical application of MGA® is in heifer estrus synchronization programs. Feedlots also use MGA in finishing diets to reduce heifer riding behavior and associated production losses. Melengestrol acetate is a synthetic progestin that elevates progesterone levels and inhibits heat and ovulation, similar to EAZI-BREED™ CIDR®s. These progestins have been shown to jump start estrus in some non-cycling cattle as well. While CIDR®s are vaginal inserts, MGA® is administered through feed. Making sure that heifers consume adequate quantities of MGA® and that the length of the feeding period and timing of breeding are appropriate is crucial for MGA® to be effective. Proper bunk space is needed for cattle to have adequate opportunity to feed.

Oral larvicides are compounds that are fed to cattle through a feed ration or mineral to kill fly larvae as they hatch in the manure.

Many anthelmintics (dewormers) are available as feed additives. Delivery of anthelmintics is advantageous when animal handling for direct delivery of dewormers is difficult.

Antibiotics can be used at continuous low levels for improvements in rate of gain and efficiency. Higher levels of antibiotics typically are needed for prevention and treatment of diseases or conditions such as scours, coccidiosis, shipping fever, anaplasmosis, foot rot,

and liver abscesses. Chlorotetracycline, oxytetracycline, bacitracin, and tylosin are examples of antibiotics intended for specific disease prevention or treatment.



Under certain conditions, beef cattle may be exposed to forages and feeds containing toxic or harmful compounds. When consumed, these anti-quality factors can result in reduced cattle growth, depressed reproductive performance, poor health, and even death. Simple management practices often can be implemented to reduce the risk of diet-induced production losses. Anti-quality factors are discussed in detail in Mississippi State University Extension Service Publication 2521, “Anti-quality Factors in Beef Cattle Diets”. Another useful reference on this topic is Mississippi State University Extension Service Publication 2596, “Feeding Flood-damaged or Sprouted Crops to Livestock.”

Fescue toxicosis is the forage-related livestock disorder that impacts the largest number of cattle in Mississippi and causes the greatest economic losses. Most of the tall fescue acreage in Mississippi is in the northern and central regions of the state. The majority of tall fescue plants in Mississippi pastures are infected with a wild-type “toxic” endophyte (fungus). The wild-type endophyte produces ergot alkaloids, which are livestock toxins.

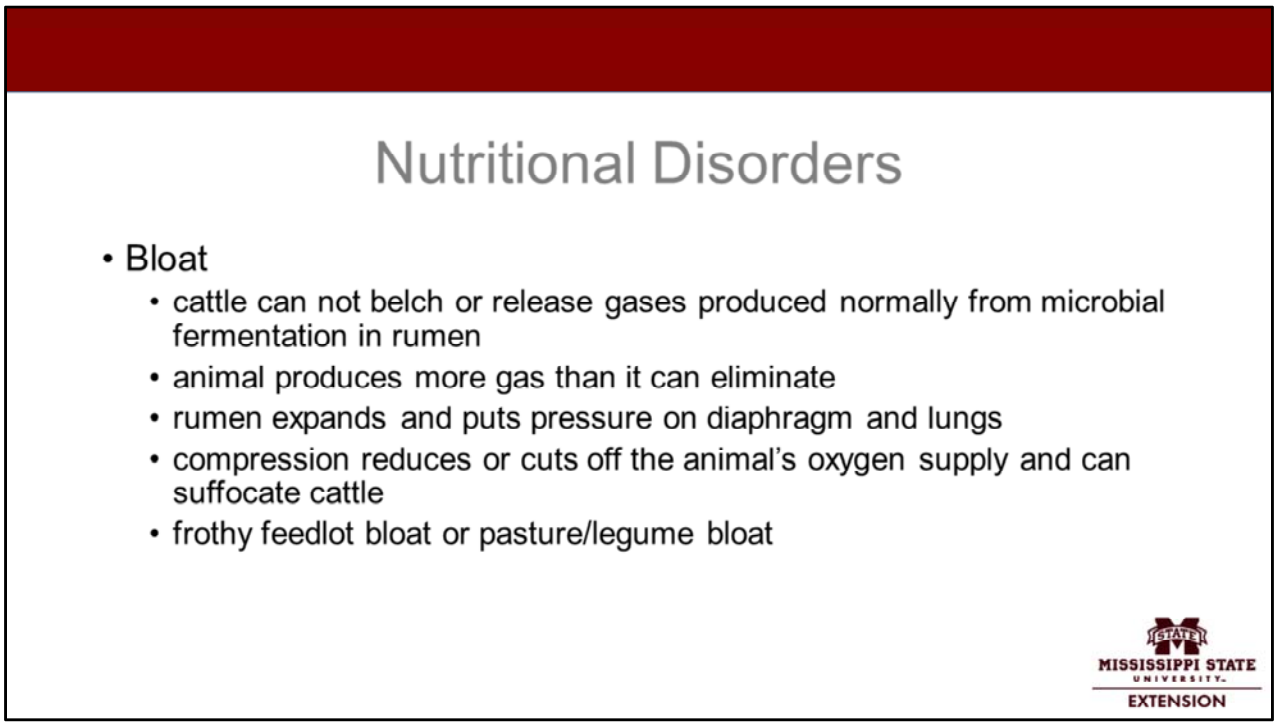
Nitrate poisoning in cattle results from excessive nitrate consumption from grazed forage, hay, silage, weeds, water, or other sources. Nitrites accumulate in the rumen when cattle rapidly ingest large amounts of plants containing high levels of nitrates. Although rare, cattle may experience nitrate poisoning from drinking water contaminated with nitrogen-based fertilizer. Nitrite is absorbed into red blood cells and combines with hemoglobin to

produce methemoglobin, a type of hemoglobin that cannot carry oxygen in the blood. Lack of sufficient oxygen transport to tissues results in severe problems including abortions and possibly death.

Prussic acid (hydrocyanic acid or HCN) can accumulate to toxic levels in the leaves of johnsongrass, sorghum, sudangrass, sorghum-sudan hybrids, and wild cherry. Pearl millet does not produce prussic acid. Dangerous levels of prussic acid are most likely to occur immediately after a frost. Young forage growth can be potentially toxic following a severe drought. Prussic acid interferes with the oxygen-transferring ability of the red blood cells, causing eventual suffocation and death.

Ergot poisoning is the result of toxin production by a parasitic fungus that grows in the seed heads of bahiagrass, annual ryegrass, small grains, and especially dallisgrass. The condition is also known as dallisgrass staggers. Wet growing conditions favor ergot development in grasses. Ergot poisoning is most common in warm-season grasses in late summer or early fall as seed heads reach maturity. The toxins interfere with circulation in cattle.

Certain species of fungi (molds) produce toxic substances called mycotoxins. These fungi may be found growing on feed, silage, or hay in the field or in storage. Mycotoxins can cause cattle health and productivity problems at very low dosages, parts per million (ppm) or parts per billion (ppb). Mycotoxins are not necessarily produced whenever feed or forage becomes moldy, but evidence of mold indicates a risk of toxins. Fungi growth may be present but undetectable upon casual observation. Hundreds of mycotoxins have been identified. Mycotoxins of greatest importance worldwide include aflatoxins, trichothecenes, fumonisins, zearalenone, ochratoxin A and ergot alkaloids.



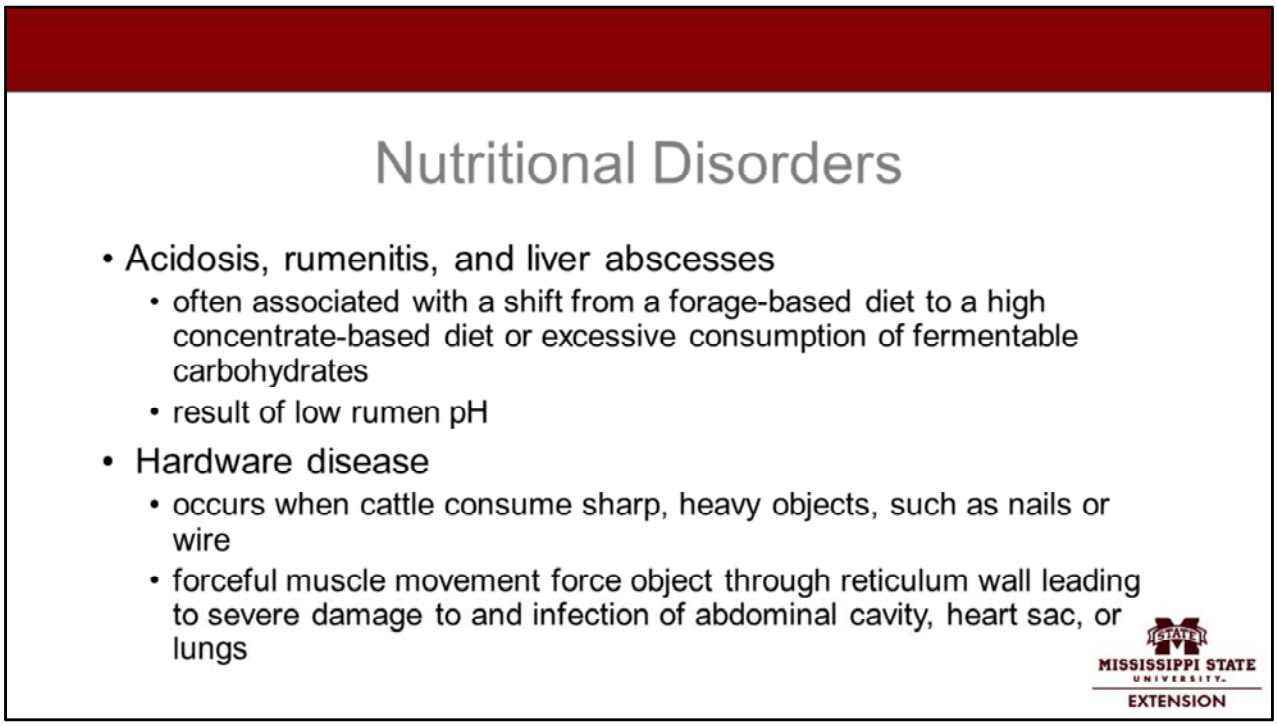
Nutritional disorders are discussed in detail in Mississippi State University Extension Service Publication 2519, "Nutritional Disorders in Beef Cattle Diets".

Bloat is a common digestive disorder in beef cattle. It occurs most often in feedlot cattle but affects cattle in all production phases. It results when cattle cannot belch (eructate) or release gases produced normally from microbial fermentation in the rumen. The animal may produce more gas than it can eliminate. Rumen expansion from gases puts pressure on the diaphragm and lungs. This compression reduces or cuts off the animal's oxygen supply and can suffocate cattle.

Frothy bloat (feedlot bloat) is the most common type of bloat. It results from foam in the rumen that stops the animal from expelling rumen gases. The foam can cover the cardia (esophageal entrance from the reticulorumen) and prevent the animal from belching. Frothy bloat occurs in cattle fed high-grain diets but is not a major concern for many Mississippi cattle producers. "Feedlot" bloat is a concern, though, with cattle on high-grain diets, such as bulls on feed-based bull development programs.

Consuming forages with high levels of soluble protein (such as alfalfa, winter wheat, and white clover) contributes to stable foam production. This is called frothy pasture bloat or legume bloat. Legumes that contain leaf tannins help break up the foam in the rumen and

are rarely associated with bloat. These tannin containing legumes include arrowleaf clover, berseem clover, birdsfoot trefoil, sericea lespedeza, annual lespedeza, and crownvetch. Tropical legumes such as kudzu, cowpea, perennial peanut, and alyceclover rarely cause bloat. Bloat can also occur on lush annual ryegrass or small grain pastures, particularly in spring. Free-gas bloat is another type of bloat that happens when the cardia or esophagus is obstructed or damaged or when rumen movement is depressed.

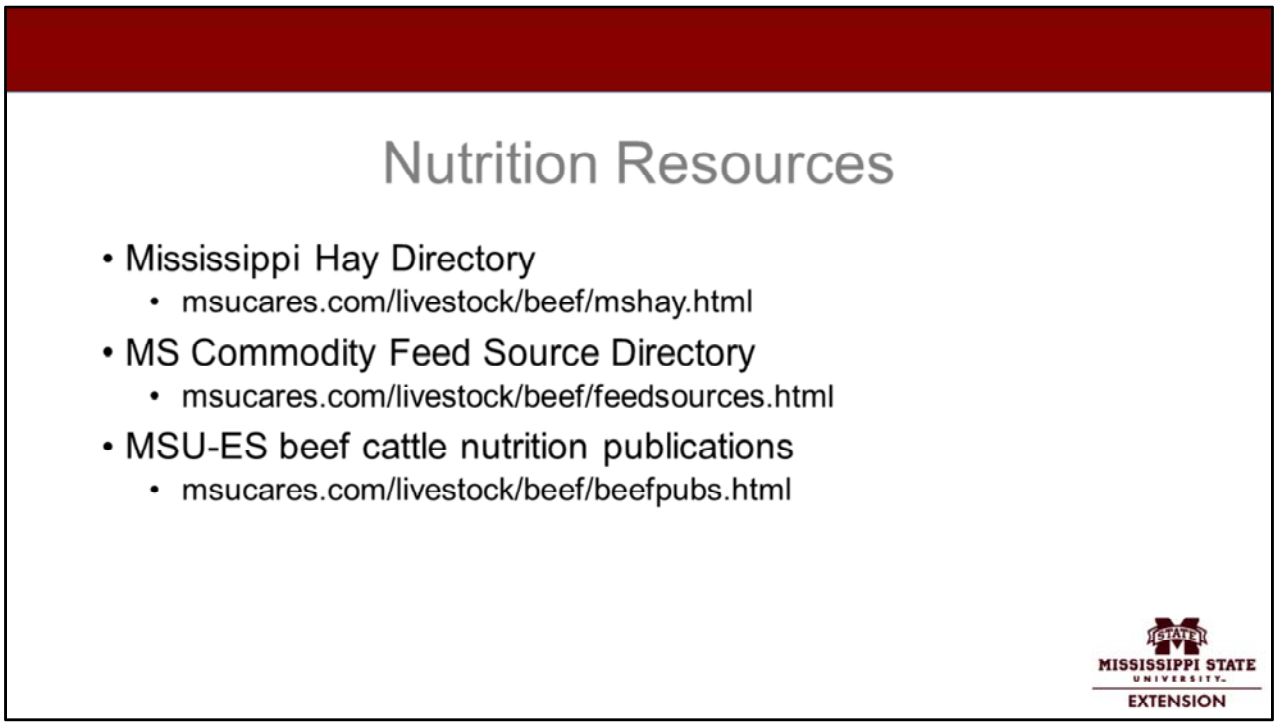


Acidosis is often associated with a shift from a forage-based diet to a high concentrate-based diet or excessive consumption of fermentable carbohydrates. Acidosis may occur in cattle on high-grain diets common with youth livestock projects, bull development programs, and cattle finishing programs. It can also occur in stocker calves when self-feeders and high-starch feeds such as corn are used.

Acidosis is the result of low rumen pH. The typical pH of the rumen on a forage-based diet is 6 to 7. As the amount of forage or roughage in the diet decreases and the amount of concentrate increases, the pH of the rumen falls between 5 and 6, depending on the forage to concentrate ratio of the diet. Low pH supports growth of lactic acid-producing bacteria. Lactic acid is very strong and reduces rumen pH even more. Acute (severe) acidosis occurs when ruminal pH drops below 5.2, whereas subacute (less severe) acidosis occurs at a ruminal pH of less than 5.6. Laminitis, liver abscesses, and polioencephalomalacia often accompany acidosis.

Hardware disease is the common name for traumatic gastritis and traumatic reticulitis. It may occur when cattle consume sharp, heavy objects, such as nails or wire. These objects fall to the rumen floor and are swept into the reticulum by muscle contractions. Cattle may ingest these objects and never have hardware disease, or muscle contractions may cause these sharp objects to puncture the reticulum wall, diaphragm, and heart sac. Forceful

abdominal movement during calving may force a sharp object through the reticulum wall. This leads to severe damage to and infection of the abdominal cavity, heart sac, or lungs.



Stored forages and feeds should be located, evaluated for nutrient value and price, and purchased or forward contracted. Many hay or feed suppliers fill orders to a regular customer base first before marketing to new customers, especially when hay supplies are tight relative to hay demand. Word of mouth is a common way of locating hay and feed supplies. The Mississippi Market Bulletin and Internet-based hay and feed directories are also potentially useful sources of information on hay and feed suppliers.

The Mississippi State University Extension Service hosts internet-based hay and feed source directories for Mississippi producers.

Mississippi Hay Directory
http://msucares.com/livestock/beef/mshay.html

Mississippi Commodity Feed Source Directory
http://msucares.com/livestock/beef/feedsources.html

Mississippi State University Extension Service beef cattle nutrition publications are available online at http://msucares.com/livestock/beef/beefpubs.html. This includes the publications referenced in this training module.