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Feed Intake in Beef Cattle – The Quest for Efficiency

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Forage and feed intake are economically important aspects of beef production. Feed intake is affected by a variety of physiological, management, environmental, and genetic factors. Though much is known about the factors influencing dry matter intake in beef cattle, they are not totally understood. Even so, producers can control many of these factors and favorably change production costs and cattle productivity in the process.

Factors Affecting Intake

Forage Availability

Forage availability is the most important factor affecting forage intake on pasture. Intake is restricted when insufficient forage is available. On good quality pasture, intake is adequate when available forage is 1000 to 1500 pounds per acre dry forage. Cattle harvest forages with their tongues, so very short forage height can limit bite size. With low levels of available forage, the amount that can be collected with each bite is small and the animal will have to walk further to take more bites, thus allowing less time for chewing and ruminating.

The proportion of leaf to stem can greatly affect the bite size as the animal seeks out leaves. Higher proportions of stems effectively reduce bite size even though total forage available is adequate. When stocking rate is high, cattle on rotationally stocked pastures may be forced to eat more stem or low quality forage, which can reduce intake. This is in contrast to a continuously grazed pasture where they usually have a greater opportunity for selectivity unless the pasture is overstocked and has low forage availability. Warm-season perennial grasses (bermudagrass, bahiagrass, dallisgrass) with a higher proportion of stem may require the animal to harvest more but smaller bites to obtain the desired forage. Cattle eat little dead material if green leaf is available, thus bite size may be restricted as the grazing animal seeks out green leaves. Increased grazing time is often not enough to compensate for the effects of reduced bite size on forage intake when cattle are grazing short pasture.

Palatability

Animals may spend time seeking out certain forage species and avoiding others, thus affecting bite size and effective forage availability. Research shows that cattle generally prefer grasses over clover and alfalfa. The presence of tannins can reduce palatability. Nitrogen fertilization can increase forage palatability. Cattle exhibit preferences for various feed ingredients as well. Cattle may even refuse extremely moldy or otherwise unpalatable feeds. Palatability problems with hay or feed can lead to increases in feeding waste.

Feeding Drive

As feeding drive increases, forage intake typically increases if adequate forage is available. The animal's current demand for nutrients can be affected by body size, lactation level, growth rate, age, sex, and environmental factors. Lactating beef cattle can increase feed intake by 35 to 50% compared to nonlactating cattle of the same size on the same diet. Cattle with greater milk-producing ability are also expected to have increased feed intake needs. Body composition, particularly the amount of body fat, can impact feed intake. Research indicates that dry matter intake decreases once cattle exceed a certain threshold degree of condition. Diligent feed intake monitoring can help in determining when cattle reach appropriate finish condition.

Physical Satiety

This is the degree of “fullness” or distention of the digestive tract or abdomen caused by the volume of digesta in the tract. It is affected by forage quality, which determines how rapidly forage moves through the digestive tract. For example, intake on low quality bermudagrass will typically be lower than on annual ryegrass or white clover because bermudagrass remains in the rumen much longer. Annual ryegrass and white clover are quickly broken down, the nutrients absorbed, and the small amount of residue rapidly moves through the digestive tract. In some situations forage intake is limited by the capacity of the digestive tract, while in others metabolic factors appear to control intake. There are receptors in the rumen wall sensitive to stretch. Yet factors other than gut capacity may influence rate of digestion and intake.

A Texas Tech research effort documented that intake by beef cattle fed high-concentrate, grain-based diets is likely controlled by metabolic factors and not limited by bulk fill. Small changes (5% of dry matter or less) in the level of bulky roughage and shifting from less fibrous to more fibrous sources of roughage can increase dry matter intake by feedlot cattle. Percentage of dietary neutral detergent fiber (NDF) supplied by roughage appears to be useful for predicting effects of roughage quantity and source on dry matter intake. In general, as NDF levels increase, dry matter intake decreases.

Toxic Factors

There is considerable evidence that cattle can learn to avoid toxic or imbalanced feeds and to choose between two feeds of different nutritional value in order to avoid nutrient excesses or deficiencies. On toxic endophyte-infected tall fescue, for example, forage intake is reduced by lower grazing time with no change in bite size or rate compared to endophyte-free or novel endophyte “friendly” tall fescue. Selenium, cyanide (from prussic acid), or an alkaloid (such as in toxic endophyte-infected tall fescue) can severely reduce intake.

Nutrient Deficiencies

Intake can be depressed whenever feed is deficient in essential nutrients, particularly protein. Researchers have found that with low-nitrogen, high-fiber forage, nitrogen deficiency is common. Correcting this deficiency with supplemental nitrogen (protein) can increase dry matter intake substantially. Protein supplementation is effective in increasing intake when forage crude protein levels fall below 6 to 8% (most commonly seen in poor quality forage without adequate nitrogen fertilization). Supplementation of

grain-based concentrate feeds tends to decrease forage intake, on the other hand, with forage intake dropping to a greater degree on high quality forages.

Feed Physical Form

The physical form of feeds and forages can impact feed intake. With forage, fine grinding can improve intake, possibly by allowing it to pass through the digestive tract more rapidly. Fine grinding of concentrate feeds can decrease feed intake, however.

Ionophore Use

Monensin (Rumensin[®]) is an ionophore used in beef cattle diets that helps improve cattle growth and efficiency. However, studies reveal a tendency for dry matter intake in beef cattle to drop by approximately 4% when fed monensin at recommended levels. However, Oklahoma research documented that monensin can be added to receiving rations at levels required for coccidiosis control without affecting feed intake of lightweight calves. Other ionophores do not appear to limit feed intake.

Environment

Extreme temperatures and weather can impact feed intake. As temperatures rise above the animal's thermal neutral zone upper critical temperature (the point at which heat stress begins), dry matter intake falls. Likewise, as temperatures drop below the animal's thermal neutral zone critical temperature (the point at which cold stress begins), dry matter intake increases. Temperature-based stress on cattle impacts their energetic efficiency. The effects of temperature on feed intake depend upon the animal's thermal susceptibility, acclimation to the conditions, and diet. Temperature effects on feed intake are heightened by mud, precipitation, humidity, and wind. The duration of these adverse conditions may also be important. Photoperiod (the length of daylight) is another environmental factor that may influence feed intake. Analysis of Arkansas bull performance test data revealed that environmental effects on feed intake are strongly influenced by breed. Adaptability of cattle to the environment can be important as it relates to feed intake and cattle productivity.

Management

Management can impact feed intake levels in beef cattle. A 2003 Florida study showed that commingled newly weaned Brahman crossbred calves tended to have a higher dry matter intake (11.7 compared to 10.6 pounds per day in noncommingled calves) over a three-week period following weaning. Programmed feeding, multiple feed deliveries per day, and consistent timing of feed delivery are feedlot management practices developed to regulate feeding behavior and reduce variations in feed intake by penned cattle. However, the effectiveness of these practices is typically evaluated on a pen basis, with little or no appreciation of the variation in feed intake among individuals.

Individual Animal Variation

Australian researchers report that there is considerable individual animal variation in feed intake above and below that expected or predicted based on size and growth rate. This difference in intake is termed residual (or net) feed intake (RFI). Genetic variation in RFI of beef cattle exists both during growth (with heritability estimates ranging from 0.16 to 0.43) and in adult cattle (with a heritability estimate of 0.23). Texas A&M

researchers have equated residual feed intake with golf scores, where a lower number is more desirable. An animal with a negative RFI is more efficient because it eats less feed than expected, while a positive-RFI animal is less efficient because it eats more feed than expected.

Selection for Feed Intake and Production Efficiency

Much of the emphasis on genetic selection focuses on improving beef cattle productivity. Higher weaning and yearling weights and better red meat yield and quality are often emphasized in breeding programs. Yet there is remarkable potential to reduce input use and improve the profitability of beef cattle operations through selection for feed intake.

Dr. Dorian Garrick of Colorado State University discussed the need for selection tools for feed intake at the recent Beef Improvement Federation annual meeting in Billings, Montana. He argued that instead of producing EPDs for a ratio trait such as feed efficiency (feed to gain ratio), it makes better sense to rank animals for profit including the costs associated with feed intake. Therefore, an EPD for feed intake may be appropriate. Another approach Dr. Garrick presented was for decision support models and selection indexes to account for expected intake, and EPDs could be produced for RFI. The Australian research group advocates that selection for lower RFI measured postweaning will lead to a decrease in feed intake by cows and growing cattle, with no increase in cow size or compromise in growth performance.

Significant barriers to industry application remain. Measurement of RFI is very expensive compared with other traits currently measured and used in genetic improvement programs. Yet a growing number of researchers and producers are calling for further research to examine these genetic relationships and find ways for cost-effective identification of superior cattle. Ongoing research at Texas A&M indicates that RFI is an alternative measure of feed efficiency that may provide opportunities to identify more efficient cattle independent of growth traits.

Limiting Feed Intake

Hand feeding is an effective means of limiting feed intake by limiting and controlling feed offering. Labor requirements may make this a less attractive option to some producers compared to the use of self feeders. Intake limiting ingredients can be added to beef cattle diets when using self feeder systems. Salt is the most commonly used feed intake limiter. Mature beef cattle require less than one ounce per head per day of salt, but will tend to voluntarily consume levels about requirements. There are practical limits to the amount of salt cattle consume, and it can be used to restrict the consumption of highly palatable feeds such as grains. A useful rule of thumb is that daily voluntary intake of salt will be about 0.1 pounds of salt per 100 pounds of body weight for most classes of cattle. It is important to keep plenty of water out for cattle consuming salt. There is notable variation in the amounts of salt individual animals will eat, so salt is not a precise regulator of intake. Salt can also contribute to corrosion of metal feeders, hastening the need for feeder repair and replacement. Some

commercially available feeds are premixed with an intake limiter other than salt. There is often a trade-off between feeding convenience and price with these feeds.

The Future of Feed Intake

Feed costs account for much of the variable costs in Mississippi beef cattle operations. Strategies to manage feed intake and select cattle with superior genetics with regard to feed intake and efficiency are worthy of further investigation. The need for research on variability in individual feed intake and underlying causes is currently being recognized by animal scientists across the U.S. and internationally as well. Research results on this topic are expected to lead to improvements in not only feeding management techniques but also in beef cattle breeding and selection programs. This research area is likely to have a tremendous impact on U.S. beef cattle production efficiency in the future. For more information on beef cattle nutrition or related topics, contact your local county Extension office.