



Genetic Contributions to Meat Quality and Growth Traits in Beef Cattle

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DESCRIPTION

Heritability in livestock refers to the proportion of variation in a trait that is due to genetic differences among animals. This measure provides insight into the potential for selective breeding to enhance desired characteristics. Meat quality and growth traits in beef cattle are among the traits most influenced by genetic factors, though environmental conditions such as nutrition, management and climate can also play significant roles. Understanding heritability allows breeders to make informed decisions to improve carcass quality, weight gain and feed efficiency over successive generations. Growth traits, including birth weight, weaning weight and average daily gain, often exhibit moderate heritability. This indicates that selection based on these traits can lead to measurable improvements in weight and body composition over time. Breeders routinely record these parameters, allowing identification of animals with superior growth potential. In beef production systems, growth rate directly affects market readiness and profitability, making heritability data valuable for designing breeding programs. Environmental factors, including feed quality and herd management, influence observed performance and must be accounted for to accurately estimate genetic potential.

Carcass traits, such as muscle conformation, fat distribution and marbling, are economically important due to their impact on meat quality and consumer acceptance. Moderate to high heritability has been reported for some carcass characteristics, suggesting that genetic selection can improve these traits effectively. For instance, marbling, which affects tenderness and flavor, responds to selection over generations. However, traits like fat thickness can be influenced by diet and age and breeders must consider both

genetic potential and environmental management to achieve consistent quality. Feed efficiency is another trait of increasing interest, especially as feed costs rise and environmental considerations become more significant. Heritability estimates for feed conversion ratio indicate that genetics can contribute substantially to how effectively animals convert feed into body mass. Selecting animals with superior feed efficiency supports both economic and environmental objectives, reducing waste and optimizing resource use. Tracking individual feed intake and weight gain is critical for obtaining accurate heritability estimates for this trait.

Reproductive traits in beef cattle, including age at first calving, calving interval and fertility, generally show lower heritability compared to growth and carcass traits. These characteristics are heavily influenced by environmental and management factors. Despite lower heritability, selective breeding can still yield improvements over time. Combining reproductive performance records with production trait data allows breeders to balance genetic gains while maintaining herd fertility and reproductive efficiency. Estimating heritability involves statistical analysis of performance records, often incorporating pedigree information to separate genetic effects from environmental influences. Models that include both fixed and random effects provide a detailed understanding of the relative contributions of genetics and management to observed variation. Multi-trait analyses can identify correlations between traits, revealing potential positive or negative effects of selection. For example, selection for rapid growth may influence fat deposition or skeletal development, highlighting the importance of considering multiple traits simultaneously. Heritability values differ across breeds, populations and production systems. High-performance beef breeds, such as Angus or Hereford,

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may display higher heritability for growth and carcass traits than dual-purpose or local breeds. Environmental uniformity and accurate record-keeping improve the reliability of estimates, enabling breeders to make more precise selection decisions. Understanding breed-specific heritability helps design strategies that maximize genetic gains while preserving diversity and adaptability.

In conclusion, heritability provides a measure of the potential for selective breeding to enhance meat quality, growth and

feed efficiency in beef cattle. Growth and carcass traits often exhibit moderate to high heritability, enabling noticeable improvements through careful selection. Reproductive traits, while less heritable, can also be enhanced over time with proper management and selective breeding. Combining genetic information with sound herd management supports long-term productivity, profitability and sustainability in beef production.