

Genome scan revealed new pathways related to meat tenderness in Nelore beef cattle

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Abstract:

Meat quality traits are economically important because they impact consumers' acceptance which, in turn, influences the demand for beef. Several quantitative trait loci (QTLs) related to meat quality have been identified in U.S. taurine beef cattle breeds. However before genetic information can be efficiently used within breeding programs, breed-specific studies are essential to accurately describe the marker/QTL associations and phase relationships for important production traits in each population. A genome wide-association study (GWAS) for Warner-Bratzler shear force (WBSF) measured at different times of meat aging was conducted using genotype data from the Illumina BovineHD BeadChip to identify QTLs in Nelore cattle (n=442). A Bayesian analysis using GenSel software was performed to estimate the additive genetic variances associated with SNP markers. The genomic regions which explained the greatest additive genetic variances in phenotypes were examined for candidate genes using the NCBI Map Viewer. The enriched annotation and pathways in which genes within these QTL regions are involved were evaluated using DAVID software. We found that WBSF was primarily influenced by QTLs of small effect and did not find associations of large effects previously attributed to CAPN1 and CAST in taurine cattle. Although we found significantly associated SNPs in CAPN1, CAPN2, CAPN5 and CAST, they had smaller effects than other QTL candidate regions found on chromosomes 5, 7, 11 and 16. The difference between genes and pathways identified in this Nelore study and those previously reported for taurine breeds could reflect differences in metabolism, the selection history of Zebu cattle, allele frequencies or extent of linkage disequilibrium between taurine and indicine breeds. Functional clusters related to potassium and calcium ion transport as well as metal binding were found to be enriched in our analyses. These mechanisms may have a significant role in the development of meat tenderization in Nelore cattle. Potassium is necessary for muscle contraction and nerve impulses and also contributes to cellular fluid balance. Further, the calpain system is highly sensitive to fluctuating calcium ion levels, indicating that calcium channel activity could generally influence postmortem tenderization. These findings help to better understand the mechanisms of meat tenderization in Nelore beef cattle.