

Selection Index for Genetic Improvement of Beef Performance in Huaxi Cattle of Xinjiang, China

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Abstract:

Huaxi cattle are a local breed in Xinjiang, China. This breed has gained increasing attention from farmers and breeders for its dual-purpose capabilities in both meat and dairy production. Beyond this, these animals are highly adapted to extreme environmental conditions, making them unique and valuable for livestock-enhancing programs and the food industry. To maximize economic potential, effective selection strategies should be designed to enhance production (milk and meat) and identify individuals with superior genetics, as assessed by Estimated Breeding Values (EBVs). Therefore, the current study aimed to construct selection indices for 12-month body weight (WEI-12) as a primary objective and daily milk yield (DMY) using the Smith-Hazel index method in Huaxi cattle reared in Xinjiang, China—an area that has not previously been studied. Based on estimated genetic parameters, including heritability, genetic and phenotypic variances, and covariances for the WEI-12 and DMY traits in Huaxi cattle, a selection index was calculated using the classical Smith-Hazel method. The mathematical model was fitted in RStudio (version 4.5.2, 2026) using the dplyr, tidyr, and readxl packages. Nine indices (C1 to C9) were constructed by applying varying conditions, including adjustments to economic weights, selection intensity, genetic correlation, and heritability, to identify the most effective index and assess its sensitivity to selection. Among the nine indices, C1, C2, C7, C8, and C9 exhibited the highest expected genetic gains of 2.723, 2.703, 2.7152, 2.6543, and 2.9049, respectively—along with accuracy rates of 0.19, 0.18, 0.18, 0.18, and 0.19, respectively. These indices demonstrated positive genetic gain potential for WEI-12 and DMY traits under ideal conditions (e.g., high selection intensity of 10% and the original estimated genetic parameters). Furthermore, minor alterations to these ideal conditions, specifically in genetic parameters, resulted in a negligible impact on the index's performance. Notably, small changes were observed when genetic correlation and heritability were modified by + 10% and -20%, respectively, suggesting the index's robustness. The present research established a theoretical framework utilizing pedigree based estimated genetic parameters for the construction of selection indices to increase genetic gain in 12-month body weight (primary goal) and daily milk production. This approach could be utilized by breeders in developing sustainable and productive breeding plans for Huaxi cattle. The results highlight the importance of incorporating economically relevant traits and genomic information (e.g., gBLUP) to enhance the accuracy and sustainability of breeding programs.

Keywords:

Selection index, Huaxi, Body weight, Breeding, Heritability, Pedigree, Cattle.