Inbreeding and its effects on milk, growth, and reproductive traits in Guzerá cattle clustered by genetic similarity

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Cluster analysis consists of sorting out animals into groups of interest and can assist in sampling animals that represent the whole population. It can be applied, e.g., in the definition of strategies to assess an optimal genotyping design. The aims of this study were: i) to evaluate the mean inbreeding coefficients of Guzerá cattle groups clustered by genetic similarity; and ii) to verify if dairy and beef phenotypes were influenced by inbreeding among clusters. Wright's inbreeding coefficient (F) is defined as the probability of an individual has two identical alleles by descent. Measurements of 172,825 animals born between 1956 and 2019 were used. The animals were distributed over 17 generations. Traits studied were 305-day milk yield at first lactation; age at first calving; body weight in kg at the ages of 210, 365; and 450 days scrotal perimeter at the ages of 365 and 450 days. The animals were classified into three groups, according to the phenotype data available: beef (growth traits), dairy (milk traits), and dual-purpose (both traits), as an assumption about the production system to which they belonged. The percentage of animals within the beef, dairy, and dual-purpose groups was 96.68%, 1.70%, and 1.62%, respectively. The mean F of the population was 0.02±0.04. Using Graph Theory to model genealogical structured data, animals were separated into 74 clusters, which were formed by genetic similarity, i.e., animals in the same cluster are more closely related to each other than to the rest of the population. Regarding the groups, 37 clusters contained beef, dairy, and dual-purpose animals, and 20 clusters had only beef animals. There were no clusters with only dairy or only dual-purpose animals. This finding corroborated the fact that dairy and dual-purpose animals came from beef animals. Overall, the mean F among clusters ranged slightly, presenting values between 0.01 and 0.04. The cluster with 16 beef founder animals had an average F equal to zero, as expected, and one cluster had a high mean F (0.09±0.09), corresponding to a cluster of 153 beef animals belonging to 10 distinct generations of continuous inbreeding. There was no presence of any specific group within the clusters and no pattern of F among the clusters with beef or beef-dairy-dual purpose animals. Furthermore, the average phenotypic value of the analyzed traits also did not vary substantially among the clusters, presenting an approximate average. These findings suggests the possibility of intense gene flow among herds, contributing to the maintenance of acceptable levels of inbreeding in the population.

Keywords: inbreeding coefficient, graph theory, cluster analysis, milk production, beef production, Zebu