Hatchability Prediction and Classification of the Eggs Based on the Physical Parameters of the Eggs

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Hatchery performance is critical for the profitability of poultry breeder operations. Some physical parameters of eggs and breeders cause to increase or decrease the Hatchability. The aim of this study is to identify the affecting physical parameters on the Commercial hatchability of local chicken eggs and to determine the most efficient classifying model to investigate whether the hatchability rate is greater than 90% or not. In this study, 674 breeder samples were considered, and seven physical parameters such as Egg weight, Moisture Loss, Breeder age, Number of Fertilized eggs, Shell width, Shell length, and Shell thickness were identified. After removing the outliers, the existing sample was split into ten splits, and 80% and 20% of them were used as training and testing samples, respectively. Multiple linear Regression was performed to determine the most influencing variable on hatchability. First, a correlation between each physical parameter and hatchability was checked. Then a multiple regression equation was developed, and the accuracy of the fitted model was evaluated. Linear Discriminant Analysis (LDA), Classification and Regression Trees (CART), k-Nearest Neighbors (kNN), Support Vector Machines (SVM) with a linear kernel and Random Forest (RF) algorithms were applied to classify the hatchability. Hatchability was negatively correlated with Egg weight, Breeders' age, Shell width, Shell length, and positive correlations were identified with Moisture loss, Number of Fertilized eggs and Shell thickness. Multiple linear regression models were more accurate than single linear models in terms of the highest coefficient of determination (R^2) with 94% and minimum Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) values. According to the classification results, RF, CART and kNN had the highest accuracy values of 0.999, 0.975 and 0.972, respectively, for the commercial hatchery process. Therefore, the RF is the most appropriate machine learning algorithm for classifying breeder outcomes in a commercial hatchery, whether economically profitable or not.

Keywords: Classification, Hatchability, Physical parameters, Regression

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