Modelling and optimising early performance for broiler chicks

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Introduction Several methods have been introduced to estimate the optimum level of dietary nutrients such as metabolisable energy (ME), crude protein (CP), and lysine (Lys) in broiler chicken production. Performance optimisation is usually measured as maximising body weight gain and minimising adjusted feed conversion ratio (Adj FCR). One useful method is to model a system that requires an explicit mathematical input-output relationship. Group method of data handling-type neural network (GMDH-type NN) and genetic algorithm (GA) is used to model and optimise an output in an imprecise environment (Yao, 1999). The purpose of this study was to apply the GMDH-type NN and GA methods to provide an optimised formula for broiler chicken performance based on the dietary level of ME, CP, and Lys.

Materials and methods Six hundred and forty d-old male broiler chicks (Ross 308) were assigned to eighty units of brooder batteries with 8 chicks per unit. The birds were fed a commercial starter diet (3,200 kcal of ME/kg, 23% CP, and 1.3% of Lys) till d 5. A factorial design experiment with four levels of ME (2900, 3000, 3100, and 3200 kcal/kg), four levels of CP (17, 20, 23, and 26 %), and five levels of Lys (1, 1.1, 1.2, 1.3, and 1.4 %) was used to provide eighty dietary treatments. The trial period started on d 5 and continued to d 20. The mean body weight gain (MBWG) and feed consumption of each unit were measured. Eighty data lines consisted of ME, CP, and Lys dietary levels as inputs, and the MBWG or Adj FCR as an output. The experimental data were imported to a GEvoM programme to generate polynomial equations (Ahmadi *et al*., 2008; Nariman-Zadeh *et al*., 2005). The GA was used to optimise polynomial equations and to find the optimum nutrient requirements for achieving maximum MBWG and minimum Adj FCR.

Results The corresponding polynomial equations produced to develop the MBWG model with goodness-of-fit criteria, R^2 and root mean square error (RMSE) were as follows:

$y_1 = 171.272 + 5.732CP + 46.216Lys - 0.771CP^2 - 265.973Lys^2 + 30.207CP.Lys$

$y_2 = -0.000013 - 0.019839ME - 0.000002Lys + 0.000039ME^2 + 0.000014Lys^2 + 0.018739ME.Lys$

$MBWG = -0.000045 + 0.346757y_1 - 0.173136y_2 - 0.002605y_1^2 - 0.001864y_2^2 + 0.006698y_1.y_2$

$R^2 = 0.68 \quad RMSE = 25.5$

The corresponding polynomial equations produced to develop the Adj FCR model with goodness-of-fit criteria, R^2 and RMSE were as follows:

$y_1 = 2.319 - 0.060CP + 0.362Lys + 0.0022CP^2 + 0.321Lys^2 - 0.054CP.Lys$

$y_2 = 0.0000010 + 0.0014879ME + 0.0000006Lys^2 - 0.0000003ME^2 + 0.00000002Lys^2 - 0.0000056ME.Lys$

$Adj\ FCR = 45.087 + 2.640y_1 - 58.845y^2 + 0.692y_1^2 + 19.850y_2^2 - 2.424y_1\ y_2$

$R^2 = 0.58 \quad RMSE = 0.08$

The results of optimization, ME, CP, and Lys requirements for maximization of MBWG or minimization of Adj FCR are shown in Table 1.

Table 1 Optimum dietary nutrient requirements for broiler chicken performance during d 5 to 20

	ME (kcal/kg)	CP %	Lys %
MBWG	3158	25.87	1.37
Adj FCR	3036	24.97	1.38

Conclusion This method of data mining may be used to model and optimise broiler performance based on dietary nutrients. More data of this type is needed to more accurately model and optimise performance.

References

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