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Modeling Daily Feed Intake of Four Strains of Broiler Chicks

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Abstract: Fast growth rate is one of the main characteristics of broiler chicks which emanate from their high appetite. Probably it is right to say that broilers appetite depends on energy concentration of the diet but the optimum energy concentration of the diet is still highly disputable. Therefore taking into the account chick's real energy requirements, considering physiological and environmental changes relative to the values exhibited in chick's requirements tables seems to be a viable strategy for optimizing the production costs. Poultry nutritionists have been trying to make an accurate estimation of bird's energy requirements using statistical models. Energy models estimate energy considering different influential factors on bird's energy requirements. But since these estimative models express energy requirements as kcal day^{-1}, it seems essential to know the amount of chick daily feed intake in different stages of growth which can help to formulate diets with optimum energy levels. Also, FI models can be applied in quantitative and qualitative feed restriction programs in order to assign optimum feed allocation. Considering the importance of an accurate estimation of birds daily feed intake and its impact on making these estimative models more practical, this study aimed at using four quadric regression models estimating daily feed intake relative to chick's daily body weight according to the data provided by Ross 308, Cobb 500, Arbor Acres and Lohmannn performance tables. The results led to the definition of four quadric regression models with a high coefficient of determination (R^2). Therefore, it can be concluded that there is a high correlation between daily feed intake and daily body weight changes in the foregoing strains of broiler chicks.

Key words: Modeling, daily feed intake, broiler, body weight, energy requirement, Iran

INTRODUCTION

One of the main concerns of animal nutritionists is the accurate estimation of animal nutritional requirements relative to their real requirements in different environmental and physiological conditions. According to Lloyd *et al.* (1978) today; nutrition science is a combination of different branches of science beside animal science. This combination includes physiology, biochemistry, microbiology and also mathematical sciences.

Currently, modeling applies statistical and mathematical sciences to create simple equations of complicated processes which can be extended to the similar processes in practice (France and Kebreab, 2008). According to the definition of modeling in research processes, it seems essential to expand the findings of a scientific study into the area of field practices for livestock producers (Rosenbluth and Weiner, 1945). It has been proved that when broiler chicks are fed with a wide range of energy concentrations a similar growth rate is observed and birds adjust their feed intake as far as there is no physical restriction for meeting their energy requirements (Leeson and Summers, 2001). According to previous reports, feeding highly energy concentrated diets result in remarkable changes in body composition of the birds, while feed efficiency can be estimated when different energy concentrations are applied (France and Kebreab, 2008).

Generally, in addition to environmental conditions, strains, growth rate and also physiological changes there are other factors which can influence energy requirements and consequently feed intake of broilers. Therefore, an accurate estimation of feed intake and subsequently the concentration of other nutrients particularly energy and amino acids can significantly improve the economical efficiency of a farm (Leeson and Summers, 2001). Another strategy which can be employed to promote economical efficiency in poultry industry is the proper application of

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quantitative and qualitative feed restriction programs. These programs have the potential to improve feed efficiency (Nielsen *et al*., 2003; Khetani *et al*., 2009; Hassanabadi, 2008), immune responses, meat quality (Hangalapura *et al*., 2005) and reduce total mortality due to sudden death syndrome and ascite (Lippens *et al*., 2000; Rincon and Leeson, 2002).

Consequently, a lot of efforts have been put o make an accurate estimation of feed and energy intake in various physiological and environmental conditions to meet growth (Sakomura *et al*., 2005; Lopez *et al*., 2007; Latshaw and Moritz, 2009) and maintenance (Emmans, 1995; Leeson *et al*., 1996; Lopez and Leeson, 2005; Aggrey, 2009) requirements.

However, in a practical approach it seems essential to know the precise feed intake relative to chicks' body weight for application of feed restriction programs and energy estimative models which express energy requirements based on kcal/d/bird. Modeling science can provide a practical approach towards an accurate estimation of daily feed intake according to different stages of growth and body weight of chicks. Thus, this study aimed at definition of appropriate and practical models for estimating daily feed intake in different ages relative to chick's daily body weight in four strains of broiler chicks according to the data provided by Ross 308, Cobb 500, Arbor Acres and Lohmannn performance tables.

MATERIALS AND METHODS

On the assumption that there is a high correlation between daily feed intake and body weight of broilers the following equation using the SAS software linear regression program based on the data provided by performance tables (mixed sex) for Ross 308 (Ross Co., 2007), Cobb 500 (Cobb-Vantress Inc, 2008), Arbor Acres (Arbor Acres Co., 2007) and Lohmann (LIR Co., 2007) from 8 day of age to 56 days was defined as Eq. 1:

$$Y = \beta_0+\beta_1(X)+\beta_2(X^2) \quad (1)$$

In the foregoing equation Y is the dependent variable and represents the estimated amount of feed intake appropriate for a certain age and X is the independent variable representing chicks body weight in a certain age.

RESULTS AND DISCUSSION

After statistical analysis appropriate β values were determined for each regression model (Table 1). Accordingly, the feed intake relative to body weight estimative models for each strain was defined as follow:

$$Y = 0.0216+0.1064\,(BW) - 0.0132\,(BW^2) \quad (2)$$

(Ross feed intake estimative model)

$$Y = 0.0074+0.1370\,(BW) - 0.0236\,(BW^2) \quad (3)$$

(Cobb feed intake estimative model)

$$Y = 0.0195+0.1127\,(BW) - 0.0153\,(BW^2) \quad (4)$$

(Arbor Acres feed intake estimative model)

$$Y = 0.0159+0.1186\,(BW) - 0.0165\,(BW^2) \quad (5)$$

(Lohmann feed intake estimative model)

According to the indices of the defined models (Table 1) and from a statistical point of view the high coefficient of determination (R^2>0.95) of the models indicates a high correlation between dependent variables (daily feed intake) and independent variables (body weight) in broiler chicks. The line of regression for each defined model are exhibited in Fig. 1, it is obvious that the lines appropriately fit on the applied data from performance tables.

As Table 1 shown, the best defined models among the foregoing strains belong to Lohmann strain with the highest adjusted coefficient of determination (Adj. R^2: 0.99923) which could partially be attributed to the lower distribution of data in performance tables of this strain. The lowest adjusted R^2 (0.99794) is observed for Cobb 500 strain, probably due to a higher data distribution and decreasing feed intake subsequent to 49 days of age.

Also, according to Table 1 there is not a considerable difference between models coefficient of determination (R^2) and adjusted coefficient of determination (Adj . R^2) thus it can be inferred that the estimated parameters are suitable for the defined models. Considering the lower regression line of Cobb 500 compared to the other strains, it can be inferred that this strain has the capability to gain

Table 1: Summary of results from regression analyses of daily feed intake relative to body weight

Y	R^2	Adj. R^2	β_0	β_1	β_2	SE β_0	SE β_1	SE β_2
Ross	0.99896	0.99893	0.021697	0.106363	-0.013191	0.000806	0.000803	0.000160
Cobb	0.99803	0.99794	0.007400	0.137000	-0.023600	0.001160	0.001520	0.000390
Arbor acres	0.99926	0.99923	0.019500	0.112700	-0.015300	0.000760	0.000960	0.000240
Lohmann	0.99944	0.99942	0.015900	0.118600	-0.016500	0.000670	0.000860	0.000220

Y: Dependent variable (daily feed intake); R^2: Regression model coefficient of determination; Adj. R^2: Regression model adjusted coefficient of determination; B: Estimated parameters of the model; SE: Estimated Error for each parameter of the model

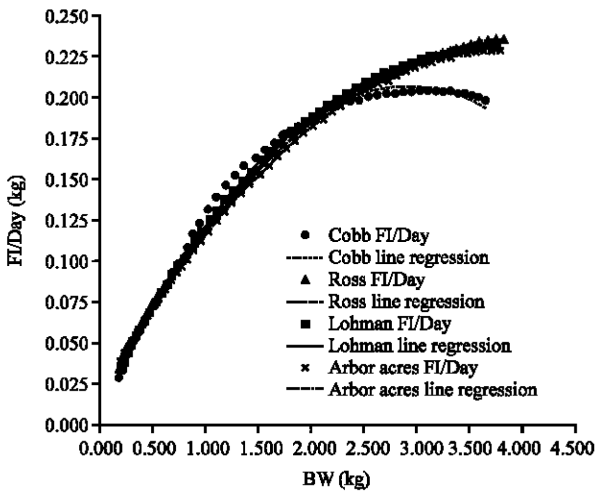

Fig. 1: Relationship between feed intake (kg) and body weight (kg) in four strains of broiler chicks; FI/day: Feed intake data from performance tables; Regression Line: Defined model regression line

a similar body weight to the other strains with lower feed consumption at 49 days of age. Based on the data, provided in the performance tables of the forenamed strains; Lohmann and Arbor Acres strains have the highest and lowest feed efficiency at 49 days, respectively. This is while; at 49 days Ross and Cobb exhibit a similar feed conversion ratio. The lower body weight of Cobb among other strains subsequent to 49 days can be attributed to the trend in lower feed intake with body weights >3100 g. In practice and considering the economical dimensions, where broilers are to be raised after 49 days, Cobb may not be ideal choice for farmers.

CONCLUSION

Although, it's been proved that except body weight there are other factors such as energy concentration, presence or lack of ingredients influential on diet's palatability and also environmental temperature that can affect feed intake but modeling considering those factors as well, needs more precise and sequential studies to be conducted. Firstly, the essence of incorporation and degree of influence of the mentioned factors in the feed intake model should be determined and then decisions should be made on the presence or lack of those factors in a multivariate regression model. In conclusion, according to the models coefficient of determination in current study and fitted regression lines on applied data, it can be deduced that body weight relative to age can be one of the most important and effective factors influencing daily feed intake in broiler chicks.

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