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Estimatation of Body Weight at Different Ages Using Linear and Some non Linear Regression Equations in a Duck Breed Reared in Hot and Humid Climate of Eastern India

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Abstract: The present study pertains to estimation of body weight of Vigova Super M, broiler ducks using linear and some non linear (log, inverse, quadratic, cubic, power, S, compound, logistic, growth and exponential) regression equations. Breast angle was considered as a predictor for estimation of the body weight. The results indicate that quadratic regression equation provided the most accurate estimator. The coefficient of determination values being highest at seven weeks of age and thereafter the values decreased as redistribution of muscles occurred and the growth of the birds decreased.

Key words: Vigova Super M · Curve fit equations · Body weight and breast angle. growth

INTRODUCTION

Ducks are reared both for their eggs and meat. The state of West Bengal in India has the highest duck population in the country, Muthukumar and Dev Roy [1]. Vigova Super M is a meat type duck which is imported from Vietnam and is ideally suited for hot and humid climate of India. The breast angle (*m. pectoralis*. *superficialis* and *m. pectoralis profundus*), of avian can be used predictors for estimating body weight, Siegel [2]. Usually in most of the livestock experiments the growth is estimated using linear equations,

Wolf and Knižetová [3], Raji [4]. However, as the growth of an individual varies with time and age, the estimation of body weight at different ages are mostly non linear. The present study was carried out to compare some non linear regression equations with respect to linear regression equations to estimate the body weight of the Vigova Super M ducks at various ages using breast angle as a predictor.

MATERIALS AND METHODS

The study was conducted at Livestock Instructional Farm at Bidhan Chandra Krishi Viswavidyalaya, West Bengal India. The ducklings of the Vigova Super M ducklings were procured from Central Poultry Development Organization, Southern Region Hessarghatta. The ducklings were reared according to the recommendations of the organization. They were reared on commercial broiler ration and rice bran mixed in a ratio of 2: 1. The body weight of the ducklings was taken on a digital balance with an error margin of 10 grams. The ducklings were weighed early in the morning without being provided their daily ration. The breast angle of the ducklings was estimated using a modified caliper and according to the method suggested by Macjowski and Zieba [5]. The body weight and the breast angle of the ducklings were taken every week from 3 weeks till they attained 8 weeks of age. The regression values (linear, log, inverse, quadratic, cubic, power, S, compound, logistic, growth and exponential) were estimated using SPSS V.12. for Windows. Descriptive statistics too was calculated using the same software.

Linear model equation is the most popular regression equation used in predicting various biological parameters. The values are modeled as a linear function of time. Where as the biological systems never follow linearity and hence is of limited importance towards prediction. Therefore, keeping the above in mind the comparison between some curve fit equations was carried out to predict growth in broiler ducks.

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Table 1: Results pertaining to the range, averages and correlation between breast angle and body weight at different ages in the Vigova Super M ducks

	Breast Angle (degrees)		Body weight (grams)		
Age	Range	Mean ± SD	Range	Mean ± SD	Correlation
3 weeks	30-45	40.5± 6.43	210-400	313 ±68.96	0.873**
4 weeks	50-70	59.5 ±6.43	340-660	502 ±98.18	0.829**
5 weeks	55-80	67± 9.18	500-1000	808 ±159.5	0.882**
6 weeks	65-85	77 ±6.74	650-1200	998 ±171.96	0.899**
7 weeks	65-90	80.5± 8.6	700-1470	1179 ±201.6	0.877**
8 weeks	70-95	83.5 ±8.51	800-1700	1460 ±266.6	0.719*

**P< 0.01 *P< 0.05

Table 2: Comparison between linear and some non linear regression equations for ducklings at different ages

	3rd Week		4th Week		5th week	
Type	R^2	Equation	R^2	Equation	R^2	Equation
Linear	.074	195.03+2.91(x)	.686	-250.34+12.644(x)	.779	-218.16+15.31(x)
Log	.066	-67.41+(103.13 In(x))	.683	-2569.2+(752.60 ln (x))	.795	-3483.5 + (1022.73 In(x))
Inverse	.058	403.40-3565.4/ (x)	.678	1255.2-44353/(x)	.809	1832.65-67470/(x)
Quadratic	.170	1649.8-76.27 (x)+1.044 (x^2)	.687	82.47+1.44(x)+0.93(x^2)	.817	-2610.5+88.2496(x)-05464 (x^2)
Compound	.105	189.09+1.0119$^{(x)}$	.647	108.21+1.025$^{(x)}$	.734	202.42 +1.0206 $^{(x)}$
Power	.096	63.976 (x)$^{.424}$	.648	.9920 (x) $^{1.5214}$	.756	2.57 (x)$^{1.3658}$
S	.087	e $^{6.0983-14.828 / (x)}$	.646	e$^{7.727-89.92 /(x)}$	.777	e $^{8.0491-90.512/(x)}$
Growth	.105	e $^{5.2423 +0.0119(x)}$	.647	e $^{4.684+.0255(x)}$	.734	e $^{5.31 +.0204 (x)}$
Exponential	.105	189.099 X 0.119$^{(X)}$	.647	108.21X.0255$^{(x)}$	.756	202.42 X. 0204 $^{(x)}$
Logistic	.105	1/ 405 +0.0053 X. 9882 $^{(x)}$	.647	1/670 +.0092 X. 9748$^{(x)}$	.777	1/1050 +0.0049 X 0.9798 $^{(x)}$

Table 3: Comparison between linear and some non linear regression equations for ducklings at different ages

	6rd Week		7th Week		8th week	
Type	R^2	Equation	R^2	Equation	R^2	Equation
Linear	.808	-765.49 +22.90 (x)	.769	-467.51 +20.453 (x)	.517	-421.1+22.52 (x)
Log	.823	-6529.9 + (1734.44 In(x))	.786	-5850.9 +(1603.97 In (x))	.545	-6806+ (1870.16 In(x))
Inverse	.836	2703.8-130394/x	.801	2743.93-124578 /x	.572	3318.01-153605/x
Quadratic	.863	-6695.5+181.35 (x)-1.050 (x^2)	.816	-5069.1+139.60(x)-.762(x^2)	.697	-12136+313.167(x)-1.7838(x^2)
Compound	.807	140.83+1.025 $^{(x)}$	.730	239.91+1.019 9$^{(X)}$	.507	299.72+1.019 $^{(x)}$
Power	.826	.2404 (x) $^{1.9160}$	.753	1.338 (x)$^{1.5436}$	.534	1.484 (x) $^{1.555}$
S	.844	e $^{8.7799-144.42 / (x)}$	.776	e $^{8.57-120.53/ (x)}$	.560	e $^{8.811-127.7/(x)}$
Growth	.807	e $^{4.9476 +. 0252 (x)}$	.730	e $^{5.48+.0196 (x)}$	.507	e $^{5.70 +0.0187 (x)}$
Exponential	.807	140.834 x. 0252 $^{(X)}$	.730	239.91X.0196$^{(x)}$	.507	299.72 X. 0187 $^{(x)}$
Logistic	.807	1/1250 +.0071 +.9751$^{(x)}$	.730	1/1500 +.0042+.98 $^{(x)}$	.507	1/1750 +.0033+.9814 $^{(x)}$

RESULTS AND DISCUSSIONS

The body weight, breast angle and their correlation at different ages in the Vigova Super M ducks reared in the hot and humid climate of eastern India are presented in Table 1. It transpires from the table that the breast angle and body weight is significantly correlated at all the age groups studied. The present findings are in consonance with the results obtained by Siegel [2]. Ayoub *et al*. [6], Shahin [7], Shahin [8] and Farhat and Chavez [9]. The body weight at maturity of the Vigova Super M ducks as obtained in the present study is less than that reported by Anon. [10].

The results pertaining to estimation of body weight at four weeks of age indicate that the quadratic regression model had a better accuracy (R^2=. 170) followed by S, inverse and power regression models respectively. The R^2 values indicate that the body weight estimation using breast angle at 3 weeks of age is seldom accurate, this maybe attributed to slower development of the breast muscles and the results are in consonance with the observations of Swatland [11]. Bochno, *et al*. [12], observed that in goose there was increase in leg muscle quantity in comparison to that of breast muscle at a younger age, i.e till two weeks of age, thereafter there is increase in breast muscle. The increase was observed till

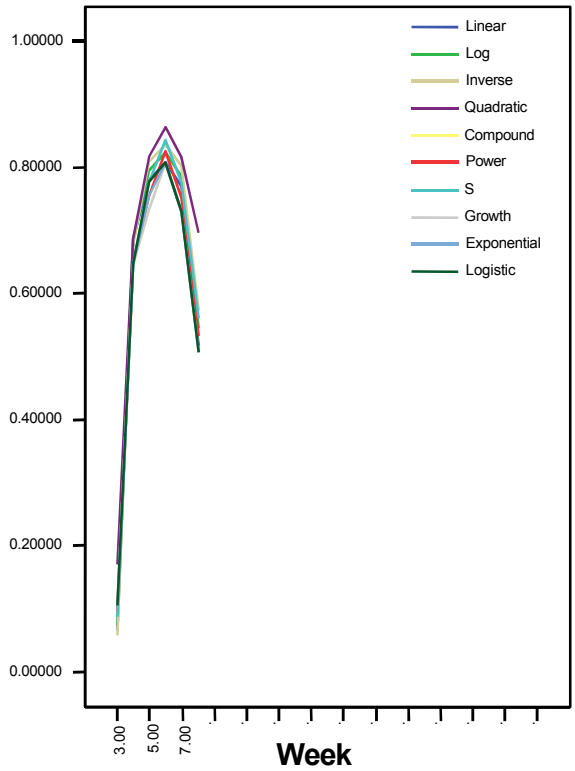

Fig. 1: Regression curves of some non linear and linear equation, with respect to age

seven weeks of age in Pekin ducks thereafter there is a decrease in growth and redistribution of muscles. The results are in consonance with the present findings.

The results of the linear and non linear equations at four week of age indicate that the quadratic regression equation was more accurate (R^2=. 687) than all the other equations studied the results showed that linear, was closely followed by inverse, log, S, linear and power respectively. The results of predicting body weight at five weeks of age indicate that the coefficient of determination values of quadratic regression equation is higher (R^2=. 817), followed closely by inverse, log and linear. The results pertaining to coefficient of determination values for body weight at six weeks of age indicate that the accuracy of the quadratic (R^2=. 863) equation is closely followed by S, inverse and power respectively. The results pertaining to body weight at seven weeks of age indicate that the coefficient of determination values of quadratic (R^2=. 816) equation is closely followed by inverse, log and S respectively. The regression equation values results pertaining to body weight of the ducks at eight weeks of age indicate that the coefficient of determination values for quadratic regression equation is highest (R^2=. 697), the value being lower than those obtained till seven weeks of age, this may be attributed to cession of bone growth of ducks at seven weeks of age, the results are in consonance with the results obtained by Bochno *et al*. 2005 [13]., for Pekin ducks.

The results from figure 1 also indicate that the coefficient of determination values is highest for the quadratic regression equation at seven weeks of age.

CONCLUSION

It can therefore be concluded that breast angle can be an efficient estimator for assessing the body weight of broiler ducks however, the coefficient of determination values indicate that the accuracy for estimation decreases after seven weeks of age, which may be attributed to redistri9bution of muscles. Quadratic regression equation is provides a better estimator than all other non linear and also linear regression equation.

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