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GROWTH CURVE IN MENGALI SHEEP BREED OF BALOCHISTAN

M. M. Tariq, M. A. Bajwa, A. Waheed[*], E. Eyduran[**], F. Abbas, F. A. Bokhari and A. Akbar[***]

Centre for Advanced studies in Vaccinology and Biotechnology University of Balochistan, Quetta
[*]Department of Animal Breeding and Genetics, University of Agriculture, Faisalabad
[**]Igdir University, Faculty of Agriculture, Department of Animal Science, 76000, Igdir-Türkiye.
[***]Livestock and Dairy Development Department Balochistan, Quetta.
Corresponding author email: tariqkianiraja@yahoo.com

ABSTRACT

Growth, one of the most essential traits for farm animals, is defined as an increase in tissues and organs of the animals per unit time and affected by genetic and environmental factors. The growth that has sigmoid form is explained reliably by nonlinear growth models (such as Monomolecular, Brody, Gompertz, Richards and Logistic). Information about parameters of these nonlinear models enables researcher to obtain beneficial clues for selection studies. Data on 2377 Mengali sheep kept at four different research stations (Experimental Station CASVAB, Quetta, (ESC), Mastung, Noshki and Quetta) at three different locations in Balochistan were analyzed using Gompertz growth model, W(t) = A*exp(-B*exp(-k*t) with non-linear regression methodology. Body weight values for all the sheep were recorded monthly from birth to 360th days of age. Body weight averages of these sheep in each period were used to define the weight-age relationship in Mengali sheep. Determination coefficient (R^2) and Root of Mean Square Error (RMSE) were used to decide whether Gompertz growth model was appropriate for the body weight – age data from Mengali Sheep. Convergence was achieved after 5 iterations. The parameters A, B, and k of Gompertz growth model were 36.924, 2.043 and 0.010083, respectively. These parameter estimates were statistically significant ($P<0.01$). Root of Mean Square Error (RMSE) and Determination Coefficient (R^2) were 1.022, 99.17% respectively. Besides, it was determined the observed and predicted weight values at each time period in Gompertz growth model were almost similar. These results reflected that Gompertz growth model reliably explained relationship between weight and age in Mengali sheep. As a result, Gompertz growth model fitted to the body weight – age data from Mengali sheep might help us to determine an accurate feed regime, maturity age, and problems in growth and development over time.

Key words: Mengali sheep, body weight, Gompertz growth model.

INTRODUCTION

Mengali sheep is an important sheep breed of Balochistan which are black or brown with white patches on the body (Khan, *et al.,* 2007) but poorly documented and not recognized in the census up till 2006. They are small to medium in size with a mature body weight of 34 kg in the rams and 27 kg in the ewes (Kakar and Ahmad, 2004). The animals are well adapted to the local conditions of the most of the districts of Quetta, Khuzdar, Chaghai, Kalat, Mastung, Awaran and Kharan of Balochistan province. Source of origin of Mengali sheep is still unknown. This sheep breed is mostly raised by native Baloch tribe "Mengal" (most populated tribe of Chaghai area) therefore breed in known to Mengali of the region for adoptability and profitability.

Growth, which is defined as an increase in body size per unit time, is one of the most important characteristics of farm animals. (Blasco and Gomes, 1993; Bathaei and Leroy, 1998; Topal *et al*., 2004). The growth, influenced by genetic and environmental factors, is explained by Brody, Gompertz, Logistic, Richard's, and Bertalanffy growth models, each of which is defined as a non-linear function (Kum *et al.,* 2010). These non-linear models are more effective than linear model because the growth has a sigmoid form. These non-linear growth models used to describe relationship between lifetime weight and age allow us to determine managerial problems and ideal slaughtering age in sheep. Parameters of these growth models presents are estimated for genetically improving the growth in selection program. Although there were many studies on growth models for different sheep breeds, there was no published information on using growth model in order to explain weight-age relationship in Mengali Sheep. Hence, the aim of this study is to obtain valuable information on the growth of Mengali sheep.

MATERIALS AND METHODS

Data on 2377 Mengali sheep were obtained from records (Recording procedures at monthly on animals kept at four stations and three different locations, Experiment Research Station CASVAB, Quetta, (ESC), Kila Hasni, Quetta, Mastung and Nushki and in Balochistan province. Animals were kept semi-intensive at ESC while, extensive production system at other

station. Body weights of these sheep were recorded monthly from birth to 360 d of age. Body weight averages of these sheep in each period were used to define weight-age relationship in Mengali sheep (Table 1).

Gompertz growth model was fitted to body weight – age data from Mengali Sheep. The NLREG version 6.5 (Sherrod, 2008) was used for the statistical analysis. Gompertz growth model can be written as follows:

$W(t) = A*exp(-B*exp(-k*t)$

Where;

W(t): Observed weight at t age

A: Asymptotic limit of weight when age approaches infinity

B: The rate of body weight gained after birth to mature body weight (point of inflection)

k: Maturing rate and,

t: Age (Bilgin and Esenbuga, 2003; Karakus *et al.,*2010).

Determination coefficient (R^2) and Root of Mean Square Error (RMSE) were used to determine whether Gompertz growth model was appropriate for the body weight – age data from Mengali Sheep. The best growth model has the highest R^2 but the lowest RMSE.

RESULTS AND DISCUSSION

In the present study, Gompertz growth model was fitted to the body weight – age data from Mengali sheep. Table 1 presents observed and predicted weight values for Gompertz growth model. The observed body weight of Mengali sheep from birth to 360 days of age ranged from 3.62 to 36.03 kg, whereas the predicted body weight of Mengali sheep from birth to 360 days of age varied from 4.89 to 34.98 kg (Table 1). As seen from Table 1, when the observed and predicted body weight values for each measurement age were examined, the observed weight values were found almost similar to predicted values. Fig 1 confirmed the observed and predicted values in Table 1. The graphs presented the growth curve (Fig. 1) showed that Gompertz model explained the curve efficiently.

Parameter estimates, Root of Mean Square Error (RMSE) and Determination Coefficient (R^2) values of Gompertz growth model are given in Table 2. The values of parameters A, B and k were 36.924, 2.043 and 0.010083, respectively (data not shown). These parameter estimates were statistically significant ($P<0.01$). In the present study, RMSE and R^2 values for Gompertz growth model were 1.022 and 0.992 respectively. .According to RMSE and R^2 values, it was determined that Gompertz growth model was very suitable model for explaining the body weight – age data from the Mengali sheep.

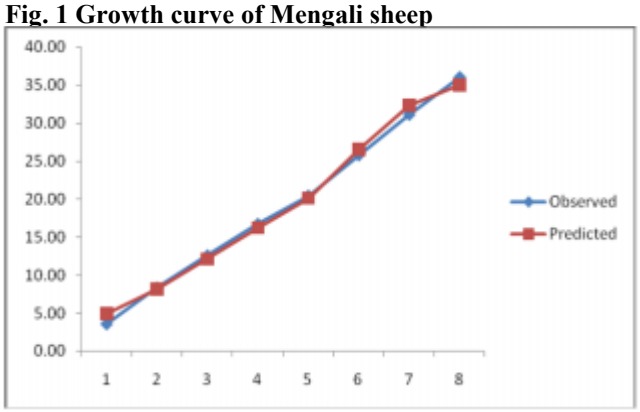
Results of the present study were in agreement with findings of many authors (Efe, 1990; Akbas *et. al.,* 1999; Esenbuga *et. al.,* 2000; Lewis *et. al.,* 2002; Topal *et. al.,* 2004; Keskin *et. al.,* 2009; Kucuk *et al*., 2010). Determination coefficient (0.992) of Gompertz growth model in the present study was found similar to finding of Akbas *et al.,* (1999) who found to be 0.993 in Kıvırcık Breed, but higher than that of Tekel *et al.,* (2005) who reported a R^2 value of 0.98 for Awassi male lambs and that of Kum *et al.,* (2010), who stated a R^2 of 0.997 for Norduz female lambs. Akbas *et al*. (1999) found it as 0.9963 for Dağlıç breed. Eyduran *et al*., (2008) estimated 0.997; 0.987; 0.992 and 0.993 R^2 values of Gompertz model for Morkaraman-male, Morkaraman-female,

Table 1. The observed and predicted values for each period in Mengali sheep

Weight	Birth	D 30	D 60	D 90	D 120	D 180	D 270	D 360
Observed	3.62	8.37	12.61	16.74	20.46	25.81	31.13	36.03
Predicted	4.89	8.16	12.10	16.19	20.08	26.47	32.28	34.98

D= Day

Fig. 1 Growth curve of Mengali sheep



Kıvırcık-male, and Kıvırcık female lamb groups respectively. Determination coefficient of Gompertz growth model in the present study was consistent with those of Eyduran *et al.* (2008) on Kıvırcık male and female lambs. Kucuk and Eyduran (2010), who found approximately 0.995 and 0.993 for Akkaraman breed and German Blackheaded Mutton x Akkaraman (B1) crossbred lambs, confirmed the result of the present study.

A RMSE value of 1.022 for Gompertz growth model were higher than those reported by some authors (Topal *et al,* 2004; Bilgin and Esenbuga, 2003; Karakus *et al.,* 2008; Kucuk and Eyduran, 2010).

Differences between the present study and earlier studies on different sheep breeds may be due to a combined effect of genetic and environmental factors. Various measurement intervals based on present and previous studies may also lead to differences results.

As a result, Gompertz growth model gave reliable results for the body weight – age relationship of Mengali sheep. Gompertz growth model allow us to acquire beneficial information such as determination of fattening performance, optimum slaughtering age, and regulation of feeding regimes for Mengali sheep.

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