MEDWELL PUBLISHING
Journal of Animal and Veterinary Advances 8 (2): 213-216, 2009
ISSN: 1680-5593

The Determination of Growth Function in Young Hair Goat

[1]Ali Murat Tatar, [1]Nihat Tekel, [2]Muhip Özkan, [3]Ilkay Baritci and [2]Gürsel Dellal
[1]Department of Animal Science, Faculty of Agriculture, Dicle University, 21280 Diyarbakir, Turkey
[2]Department of Animal Science, Faculty of Agriculture, Ankara University, 06110 Ankara, Turkey
[3]Department of Animal Science, Faculty of Agriculture, Gaziosmanpasa, University, Tokat, Turkey

Abstract: In this study, it was aimed that the estimating of growth curves for live weight from birth to 12th month age in young Hair goats. For drawing growth curves, Gompertz, Logistic, Brody, Negative Exponential and Bertalanffy growth models were used. Straightness degrees of these models for growth estimate are $R^2 = 0.977$, $R^2 = 0.964$, $R^2 = 0.989$, $R^2 = 0.974$ and $R^2 = 0.982$, respectively. It was leant on this finding reached a decision that Brody and Bertalanffy growth models are suitable for identification of variations in live weight of young Hair goats.

Key words: Hair goat, live weight, growth curve, determination, gomperty, logistic

INTRODUCTION

Goat breeding is seen intensively on low developed and developing countries of World. Turkey is the one. However, goat population of Turkey is decreasing in last decades. While, in 1991 9.579.256 heads of goat decreased 6.433.744 heads of goat in 2006 (Turkstat, 2006).

Hair goats are intensively bred goat breeds of Turkey. According to Turkstat (2006) data Hair goats' population is 6.433.744 heads, 96.85% of total goat population. In addition Hair goat production values are 250.594 tons milk, 14.077 tons meat, 837.262 pieces leather and 2728 tons hair in 2006 (Turkstat, 2006). These numbers show that goat breeding is important economic activities in Turkey.

In animal production firstly meat production most of the production highly influence from growth rate and animal live weight. For this reason in field of animal like other biological sciences interest to growth increasing and make studies which explain growth mechanism. Growth is one of the important characteristics investigated on live materials. It is defined in all living organisms as an increase in cells and tissues of organism and the change in weight and dimensions in a certain period of time (Efe, 1990).

When the actual live weights of animals fed generously throughout life one plotted as a function of age on time, they produce a very characteristic growth curve. This is often termed a "sigmoid" growth curve because of its resemblance to letter S. Sigmoid curve has three periods like preparing, increasing and quietness. In first period growing start at specific point and continue stable. In second period curve is go on like linear shape up to distortion point. In the last period curve reach asymptote (Yakupoglu, 1999).

As providing prediction of future age's growth, growth curve can be used for pre-selection of animal predicted good growth characteristics (Efe, 1990; Tekel, 1998). Consequently, in last years studies on some period growth curves and using in genetic and environmental breeding strategies are increased (Murthy *et al*., 1972; Mukundan *et al*., 1984; Bananno *et al*., 1997; Tekel, 1998; Yakupoglu, 1999; Kuzu, 2001; Sireli, 2002; Yeni, 2003).

This study aimed that identify growth of young Hair goats from birth to 12th month according to live weight data.

MATERIALS AND METHODS

In this research, 21 heads of Hair goat, including 10 males and 11 females, which were born in March in Yerkoy Animal Research Institute, were used. Live weight of goat kids were measured with monthly period from birth to 12th month of age.

For drawing growth curves, early growth periods can be explained by the linear model but after these periods linearity will distort (Çitak *et al*., 1998). For this reason, nonlinear models like Gompertz, Logistic, Brody, Negative Exponential and Bertalanffy were used for drawing growth curves. These models explain in below:

Corresponding Author: Ali Murat Tatar, Department of Animal Science, Faculty of Agriculture, Dicle University, 21280 Diyarbakir, Turkey

Gompertz growth model:

$$W = A * \exp(-b * \exp(-k * t))$$

Logistic growth model:

$$W = A * (1 + b * \exp(-k * t))^{-1}$$

Brody growth model:

$$W = A * (1 - b * \exp(-k * t))$$

Negative exponential growth model:

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

Bertalanffy growth model:

$$W = A * (1 - b * \exp(-k * t))^{3}$$

In these models:

W = Live weight
A = $t \rightarrow \infty$ Predicted mature live weight
b = Folding point of growth (t = 0)
k = Growth rate
exp = Natural logarithm base
t = Time

In nonlinear growth models, parameters of model were predicted by iteration methods. Today, various software programs like SPSS, SAS, MINITAB and STATISTICA using for predicting these parameters. In this research, SPSS (1994) software program were used for parameter prediction and goodness of fitness test.

RESULTS AND DISCUSSION

Descriptive values of young Hair goat live weight from birth to 12th Month of age is given in Table 1. As seen in Table 1, general mean of live weight in young Hair goats from birth to 12th Month of age were 3.17±0.080, 10.91±0.597, 16.11±0.729, 20.19±0.930, 22.14±1.01, 24.05±0.969, 25.57±1.03, 26.62±1.030, 25.86±1.000, 28.14±0.908, 29.48±1.270, 30.57±1.340 and 31.38±1.450 kg, respectively.

At the result of analysis, every month of age live weight of young Hair goat except birth and 2nd month influenced statistically significant from sex factor ($p<0.05$; $p<0.01$) and on these month male weight were higher than female. Similarly male goats were heavier than female goats on birth to 12th month weight values on the studies of Kuzu (2001) on Kilis goats, Yeni (2003) on Ankara goats and Aydin (2005) on Hair goats.

Growth curves: Because of sex factor significantly influence live weight data were standardized according to this factor. Standardized data were used for drawing growth curves and determination coefficient.

Growth models mathematically express the lifetime growth course. To accomplish this purpose, estimated weights have to correspond to actually observed body weights and the parameters have to attain the biological values (Beltran *et al*., 1992).

On the Beltran *et al.* (1992), 2 biologically relevant parameters characterize the growth models: The size parameter, most frequently evaluated as weight at maturity (A) and the growth rate relative to body size, commonly referred to as maturing rate (k). The terms A and k can be evaluated only after growth is completed. Early estimation of these parameters can be of importance for selection purposes, given their association with other traits and the economy of production (Joandet and Cartwright, 1969; Long *et al*., 1975; Butts *et al*., 1980; Tawah and Franke, 1985).

Growth curve parameters can be used as phenotypic traits and to analyze relationships between them is possible owing to their biological meaning (Kratochvilova *et al*., 2002). For these reasons, prediction of growth curve parameters correctly is deeply important.

Table 2 shows that parameter values and determination coefficient of Gompertz, Logistic, Brody, Negative Exponential and Bertalanffy models.

Determination coefficients of Gompertz, Logistic, Brody, Negative Exponential and Bertalanffy models $R^2 = 0.977$, $R^2 = 0.964$, $R^2 = 0.989$, $R^2 = 0.974$ and $R^2 = 0.982$, respectively. This findings were accordance with research of Çitak *et al.* (1998), Kuzu (2001), Sireli (2002), Yeni (2003) and Aydin (2005).

Determination coefficients of models were closely similar. The highest determination value for prediction of live weight on Brody growth model (R^2 = 0.989). The others were Bertalanffy ($R^2 = 0.982$), Gompertz ($R^2 = 0.977$), Negative Exponential (R^2 = 0.974) and Logistic ($R^2 = 0.964$), respectively. The highest live weights (A) for applied models (Gompertz, Logistic, Brody, Negative Exponential and Bertalanffy) were 32.71, 32.04, 34.35, 33.36 and 33.07, respectively.

Comparing the growth curve of models, curves are similar visually and show sigmoid curve. Linearity distort on 2nd month in Brody and Negative Exponential, 3rd month in Gompertz and Bertalanffy, 4th month in Logistic

Table 1: Descriptive statistics of live weight in young Hair goats

Periods	------Factors---------		N	$\bar{X} \pm S_{\bar{x}}$	Minimum	Maximum	Coefficient of variation (%)
At birth	Sex	Male	10	3.08±0.066	2.8	3.5	6.78
		Female	11	3.26±0.139	2.2	3.8	14.14
		General	21	3.17±0.080	2.2	3.8	11.57
1st Month	Sex	Male	10	12.20±0.800*	8.0	17.0	20.74
		Female	11	9.73±0.740	6.0	15.0	25.22
		General	21	10.91±0.597	6.0	17.0	24.32
2nd Month	Sex	Male	10	17.20±0.949	14.0	23.0	17.45
		Female	11	15.12±1.040	11.0	22.0	22.81
		General	21	16.11±0.729	11.0	23.0	20.74
3rd Month	Sex	Male	10	22.80±1.14**	17.0	29.0	15.81
		Female	11	17.82±1.030	13.0	24.0	19.17
		General	21	20.19±0.930	13.0	29.0	21.11
4th Month	Sex	Male	10	25.30±1.14**	20.0	32.0	14.25
		Female	11	19.27±1.06	14.0	26.0	18.24
		General	21	22.14±1.01	14.0	32.0	20.91
5th Month	Sex	Male	10	27.30±1.19**	22.0	35.0	13.78
		Female	11	21.09±0.858	17.0	25.0	13.49
		General	21	24.05±0.969	17.0	35.0	18.46
6th Month	Sex	Male	10	29.40±1.010**	26.0	36.0	10.86
		Female	11	22.09±0.803	18.0	26.0	12.06
		General	21	25.57±1.03	18.0	36.0	18.46
7th Month	Sex	Male	10	29.60±1.500**	23.0	36.0	16.03
		Female	11	23.91±0.814	19.0	28.0	11.29
		General	21	26.62±1.030	19.0	36.0	17.73
8th Month	Sex	Male	10	28.60±1.490**	22.0	38.0	16.47
		Female	11	23.36±0.845	19.0	27.0	11.80
		General	21	25.86±1.000	19.0	38.0	17.72
9th Month	Sex	Male	10	30.10±1.410*	22.0	35.0	14.81
		Female	11	26.36±0.927	20.0	30.0	11.66
		General	21	28.14±0.908	20.0	35.0	14.79
10th Month	Sex	Male	10	33.00±1.770**	25.0	46.0	16.96
		Female	11	26.27±1.210	22.0	33.0	15.28
		General	21	29.48±1.270	22.0	46.0	19.74
11th Month	Sex	Male	10	33.80±2.120*	27.0	48.0	20.58
		Female	11	27.64±1.170	23.0	33.0	14.04
		General	21	30.57±1.340	23.0	48.0	20.09
12th Month	Sex	Male	10	35.00±2.330*	27.0	51.0	21.05
		Female	11	28.09±1.160	23.0	34.0	13.70
		General	21	31.38±1.450	23.0	51.0	21.18

*p<0.05, **p<0.01

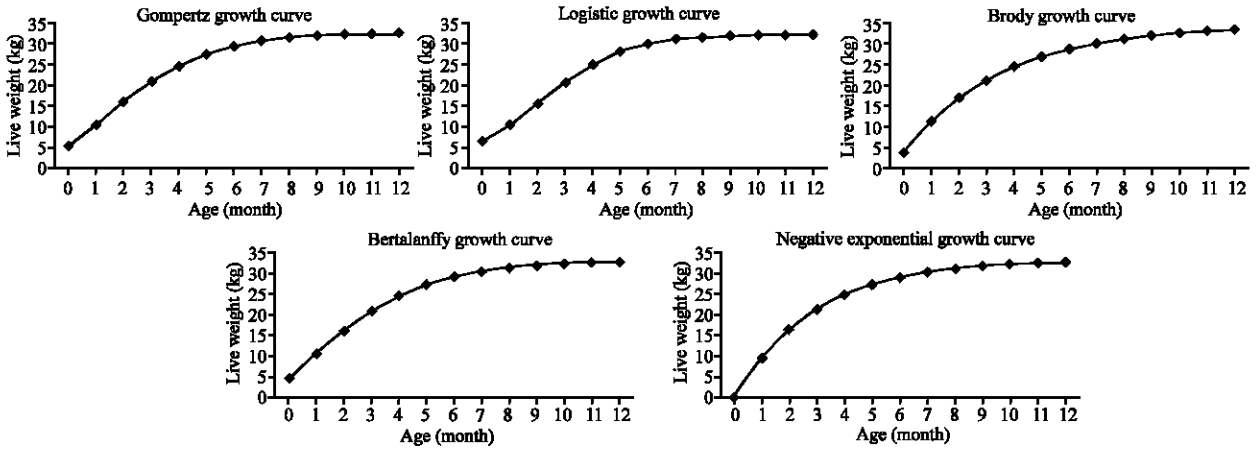

Fig. 1: Growth curves of young Hair goats estimated with various growth models

model (Fig. 1). This findings match with references. Thus, reported that obtained curves from live weight and body measurement data (birth to death) show "S" letter shape, namely sigmoid curve (Yakupoglu, 1999). Some

Table 2: Parameters of various models predicted on young Hair goats live weight

Parameters	Gompertz	Logistic	Brody	Negative exponential	Bertalanffy
A	32.707	32.035	34.350	33.364	33.070
b	1.835	4.048	0.897	0.890	0.478
k	0.468	0.661	0.280	0.340	0.406
R^2	0.977	0.964	0.989	0.974	0.982

researchers found this on their studies. For instance, Kuzu (2001) in Kilis goats on monomoleküler model, Yeni (2003) in Ankara goats on Logistic and Gompertz, Aydin (2005) in Hair goats on Gompertz growth models curves showed sigmoid curve.

Growth curves of young Hair goats obtained from different growth models showed on Fig. 1.

CONCLUSION

In this research, growth of young Hair goats were investigated with Gompertz, Logistic, Brody, Negative Exponential and Bertalanffy models from birth to 12th month. Early growth of young Hair goats showed linear curve but further periods linearity distort to sigmoid curve. As a result of determination coefficient appropriate models for drawing growth curves were Brody and Bertalanffy models. Accordingly, conclusion of this research can be said using Brody and Bertalanffy models are suitable for drawing growth curves than other models.

REFERENCES

Aydin, U., 2005. Kil keçilerinde büyüme ile ilgili bazi özelliklere ait fenotipik iliskiler ve büyüme egrileri üzerinde bir arastirma. Akdeniz University Natural Science Institute. Ph.D. Thesis, Antalya-Turkey.

Bananno, A., M. Alabiso, Grigoli, A-di and A. Di-Grigoli, 1997. Live performance of different genetic type lambs defined by growth curves. Zootecnica e Nutrizione Anim., 23 (4): 195-206.

Beltran, J.J., W.T. Butts, T.A. Olson and M. Koger, 1992. Growth patterns of 2 lines of Angus cattle selected using predicted growth parameters. J. Anim. Sci., 70 (3): 734-741.

Butts, W.T., W.R. Backus, E.R. Lidvall, J.A. Corrick and R.F. Montgomery, 1980. Relationships among definable characteristics of feeder calves, subsequent performance and carcass traits. I. objective measurements. J. Anim. Sci., 51 (6): 1297-1305.

Çitak, B., T. Kesici, A. Eliçin and Z. Kocabas, 1998. Keçilerde Degisik Karakterler Bakimindan Büyüme Egrileri. II. Ulusal Zootekni Bilim Kongresi, 22-25 Sept., Bursa-Turkey.

Efe, E., 1990. Büyüme Egrileri. Cukurova University Natural Science Institute, Animal Science Department. Ph.D Thesis, Adana-Turkey.

Joandet, G.E. and T.C. Cartwright, 1969. Estimation of efficiency of beef production. J. Anim. Sci., 29 (6): 862-868.

Kratochvilova, M., L. Hyankova, H. Knizetova, J. Fiedler and F. Urban, 2002. Growth curve analysis in cattle from early maturity and mature body size viewpoints. Czech J. Anim. Sci., 47 (4): 125-132.

Kuzu, E., 2001. Kilis Keçisi Oglaklarinda Degisik Vücut Ölçüleri Bakimindan Büyüme Egrileri. Ankara University Natural Science Institute, MSc. Thesis, Ankara-Turkey.

Long, C.R., T.C. Cartwright and H.A. Fitzhugh, 1975. Systems analysis of source of genetic and environmental variation in efficiency of beef production: Cow size and herd management. J. Anim. Sci., 40 (3): 409-420.

Mukundan, G., P.N. Bhat and B.U. Khan, 1984. Factors affecting monthly body weight gains in malabari goats and their saanen half-breeds. Indian J. Anim. Sci., 54 (8): 779-781.

Murthy, V.S., M.V.K. Rao and C.V. Rao, 1972. Trend of growth in nellore and mandya lambs. Wool and Woollens of India, 9 (1): 32-35.

SPSS, 1994. SPSS for Windows Release 6.0. SPSS Ins.

Sireli, H.D., 2002. Dorset Down x Akkaraman (G_{D1}), Akkaraman ve Akkaraman x G_{D1} Genotipli Kuzularda Büyüme ve Bazi Büyüme Özelliklerinin Tekrarlanma Derecelerinin Tahmini. Ankara University Natural Science Institute, Ph.D. Thesis, Ankara-Turkey.

Tawah, L.C. and D.E. Franke, 1985. Growth parameters and reproduction in purebred and crossbred beef cattle. J. Anim. Sci., 61(Supll.1): 8(Abst).

Tekel, N., 1998. Ivesi Kuzularinin Süt Emme ve Meralama Dönemlerinde Büyüme Egrilerinin Çizilmesi Üzerine Bir Arastirma. Ankara University Natural Science Institute, MSc Thesis, Ankara-Turkey.

Turkstat, 2006. Agriculture Statistics Review. Turkish Statistical Institute, 1991-2006.

Yakupoglu, Ç., 1999. Etlik Piliçlerde Büyüme Egrilerinin Karsilastirilmasi. Ege University Natural Science Institute, MSc Thesis, Izmir-Turkey.

Yeni, H., 2003. Genç Ankara Keçilerinde Büyüme Fonksiyonunun Belirlenmesi. Ankara University Natural Science Institute, MSc Thesis, Ankara-Turkey.