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The Determination of Growth Function in Young Hair Goat

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Abstract

In this study, it was aimed that the estimating of growth curves for live weight from birth to twelfth 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.

I. 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 10.764.198 heads of goat decreased 6.643.294 heads of goat in 2006 (TURKSTAT 2006).

Hair goats are intensively bred goat breeds of Turkey. According to TURKSTAT data Hair goats' population is 6.643.900 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 (Yakupoğlu 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, Mc Ewan et al. 1988, Gonzales et al. 1992, Bathei and Leroy 1996, Bananno et al. 1997, Tekel 1998, Yakupoğlu 1999, Kuzu 2001, Şireli 2002, Yeni 2003).

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

II. 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 twelfth month of age.

For drawing growth curves, early growth periods can be explained by the linear model but after these periods linearity will distort (Çıtak 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.

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: $t \to \infty$ 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.

III. Findings and Discussion

Descriptive statistics

Descriptive values of young Hair goat live weight from birth to 12. 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 12. 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 2. 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 12. month weight values on the studies of Kuzu (2001) on Kilis goats, Yeni (2003) on Ankara goats and Aydın (2005) on Hair goats.

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

Periods	Factors		N	$\overline{X} \pm S_{\overline{x}}$	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
1. Month	Sex	Male	10	12.20±0.800*	8	17	20.74
		Female	11	9.73±0.740	6	15	25.22
	General		21	10.91±0.597	6	17	24.32
2. Month	Sex	Male	10	17.20±0.949	14	23	17.45
		Female	11	15.12±1.040	11	22	22.81
	General		21	16.11±0.729	11	23	20.74
3. Month	Sex	Male	10	22.80±1.14**	17	29	15.81
		Female	11	17.82±1.030	13	24	19.17
	General		21	20.19±0.930	13	29	21.11
4. Month	Sex	Male	10	25.30±1.14**	20	32	14.25
		Female	11	19.27±1.06	14	26	18.24
	General		21	22.14±1.01	14	32	20.91
5. Month	Sex	Male	10	27.30±1.19**	22	35	13.78
		Female	11	21.09±0.858	17	25	13.49
	General		21	24.05±0.969	17	35	18.46
6. Month	Sex	Male	10	29.40±1.010**	26	36	10.86
		Female	11	22.09±0.803	18	26	12.06
	General		21	25.57±1.03	18	36	18.46
7. Month	Sex	Male	10	29.60±1.500**	23	36	16.03
		Female	11	23.91±0.814	19	28	11.29
	General		21	26.62±1.030	19	36	17.73
8. Month	Sex	Male	10	28.60±1.490**	22	38	16.47
		Female	11	23.36±0.845	19	27	11.80
	General		21	25.86±1.000	19	38	17.72
9. Month	Sex	Male	10	30.10±1.410*	22	35	14.81
		Female	11	26.36±0.927	20	30	11.66
	General		21	28.14±0.908	20	35	14.79
10. Month	Sex	Male	10	33.00±1.770**	25	46	16.96
		Female	11	26.27±1.210	22	33	15.28
	General		21	29.48±1.270	22	46	19.74
11. Month	Sex	Male	10	33.80±2.120*	27	48	20.58
		Female	11	27.64±1.170	23	33	14.04
	General		21	30.57±1.340	23	48	20.09
12. Month	Sex	Male	10	35.00±2.330*	27	51	21.05
		Female	11	28.09±1.160	23	34	13.70
	General		21	31.38±1.450	23	51	21.18

* P<0.05, ** P<0.01

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, two 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 (Kratchvilova 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.

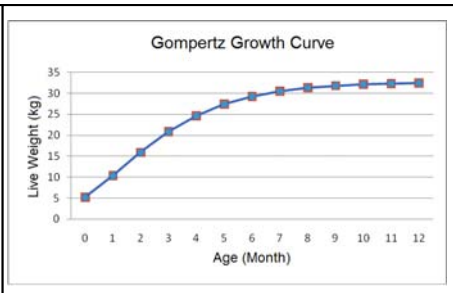
Table 2. Parameters of various models predicted on young Hair goats live weight

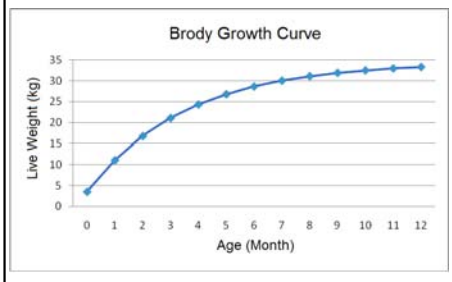
Parameters	Gompertz	Logistic	Brody	Negative Exponential	Bertalanffy
A	32.707	32.035	34.350	33.364	33.070
b	1.835	4.048	0.897	0.890	0.478
k	0.468	0.661	0.280	0.340	0.406
R^2	0.977	0.964	0.989	0.974	0.982

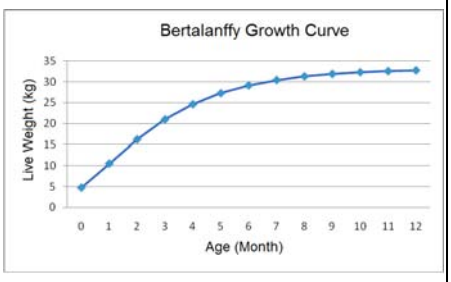
Determination coefficients of Gompertz, Logistic, Brody, Negative Exponential and Bertalanffy models R^2=0.977, R^2 =0.964, R^2 =0.989, R^2 =0.974 and R^2 =0.982, respectively. This findings were accordance with research of Çıtak et al. 1998), Kuzu (2001), Şireli (2002), Yeni (2003) and Aydın (2005).

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.

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







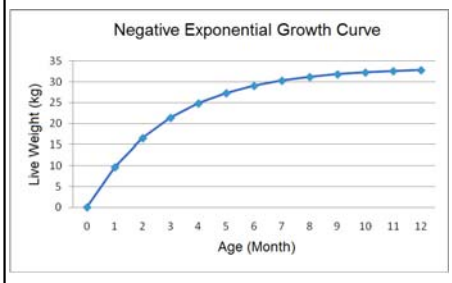


Figure 1. Growth curves of young Hair goats estimated with various growth models

Comparing the growth curve of models, curves are similar visually and show sigmoid curve. Linearity distort on 2. month in Brody and Negative Exponential, 3. month in Gompertz and Bertalanffy, 4. month in Logistic model (Figure 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 (Yakupoğlu 1999). Some 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, Aydın (2005) in Hair goats on Gompertz growth models curves showed sigmoid curve.

IV. Results

In this research, growth of young Hair goats were investigated with Gompertz, Logistic, Brody, Negative Exponential and Bertalanffy models from birth to 12. 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.

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