Growth patterns of Arabi sheep in South of Iraq

Asaad Y. Ayied, Murtadha F. Al-Hello, Emad F. Al-Jassim

Animal Resources Dept, College of Agric., University of Basra

Abstract

Gompertz growth model in different form (4 methods) were used to describe growth curve of Arabi male and female lambs. Data of body weight at birth and later to one year of Fourty lambs were purchased from a private herd in Al-Medina/ north Al-Basra governorate. All form of Gompertz models described Arabi sheep growth very accurately as R^2 did not fell under 80%. Males showed heavier weight at maturity (51.291 kg or 44.300 kg for method 1 & 2) than females (45.532 kg or 40.601kg for method 1 & 2) with slower growth rate (0.0063 vs. 0.0065 for females). A highest negative correlation was found (>- 0.90) between mature weight and growth rate. Males also obtained higher maximum growth rate (118.99 gm/day vs. 109.24 gm/day, method 1) and weight or growth rate at inflection point (20.99 kg or 143.00 gm/day vs. 14.52 kg or 139.47 gm/ day for females). It can be concluded that Arabi sheep breed is a small breed with males grow in slower rate with heavier mature weight than females which mature earlier with lighter mature weight.

Key words: Arabi sheep, Growth models, male, female

Introduction

Mathematical models of growth curves are regular function (y=f(t)), defined for values of body weight or size (y) and age (t), used in livestock for breeding and management purposes (Lewis *et al* 2002 & Khon *et al* 2007). These models aimed at explaining the main features of growth patterns in terms of the known biology of body weight during different time (Knap 2000).

The primary objectives for fitting growth curve were to describe the sequence of size-age points by relatively few parameters, to predict growth rates, feed requirements, response to selection, etc. (Fitzhugh, 1976). Bases to choose the growth curve are biological interpretability of its parameters, goodness of fit to actual data and computational difficulty (Khon *et al* 2007).

Growth performance of the local sheep genotypes is essential in planning breeding programs to improve the amount of meat, milk and wool production of these genotypes (Juma and AL-Kass 2006). There was no study concerned Arabi sheep growth, except that of (Al-Jassim 1996), which calculated growth and mature coefficients of male and female sheep.

The aims of this study were the application of nonlinear and linear form of Gompertz equation to describe the growth of Arabi sheep by using individual animals. Therefore, these functions will describe the potential growth of an animal and the variation between the equation parameters may have genetic sources.

Materials and methods

Data were collected on 20 male and 20 female Arabi lambs. They were raised at a private herd in Al-Medina province, north of Basra governorate. The animals were weighted at birth and then by biweekly period till the age of one year. They grazed a local poor pasture and allowed 2% of their body weight barley grains. The lambs were allowed to suckle there dams till the age of three months (weaning age).

تاريخ استلام البحث 2010/3/9

Gompertz growth function was used to describe growth pattern of present data in five different forms as described by Lewis *et al* (2002), as

1- Method 1a: W=A.exp(-exp(G0-B.t))
2- Method 1b: W=(Z/B) exp(-exp(G0-B.t))
3- Method 2: ln (W)=ln(A) – exp(G0-B.t)
4- Method 3: G=B0+b1 ln (W)
5- Method 4: W= -G0+B.t

Where, W= body weight,

A= asymptotic body weight (mature weight), G0= transformed initial weight (W0) = ln (-ln (W0/A)), B= rate parameter, t= time (age), Z=A.B, and maximum growth rate=Z/e

All data equations analyzed and all type of regression were calculated by using SPSS (1998) program. The relationships between parameter values were calculated within each method as correlation between parameters within animals. Means were tested by using t-test (SPSS, 1998).

Results and Discussions

Parameters of different form of growth equations are presented in table (1). It is clear that these parameters were consistent across methods. Estimates of Z were more stable through out different methods. It has a biological interpretation in that Z/e is the maximum daily growth rate (118.99±0.0009 and 109.24±0.0025 gm/d for males and females respectively). However, both A and B varied highly across methods. The mean values of A (mature weight) for males and females of 51.291 and 45.532 kg (table, 1), was closely to that calculated by Al-Jassim (1996) for Arabi sheep based on fitting the Brody growth equation to weights collected at 10 slaughter age. The ratio of male to female mature size observed in this study (1.13; $p<0.05$) is less than that (1.27) of (1). This coincided with a greater maximum growth rate for males versus for female ($p<0.05$). However, rate parameter (B) did not differ significantly between sexes (0.0063 and 0.0065) for male and female respectively. These values were far less than that of Frggens *et al* (1997) and Zygoyiannis *et al* (1997). Non-significant differences between male and female rate parameter was also found by Khon *et al* (2007), even there finding were higher than our values. Most methods used here obtained very high value determinant coefficients (R^2). R^2 of method 3 (linear method) was the minimum value (91.00 and 82.80 for male and females respectively). This explains that these different forms of growth models are suitable to describe growth of Arabi sheep very accurately.

Within animal correlation (measures the extent of pairs of parameters for an animal) was calculated (table, 2). Males showed highly ($p<0.01$) negative correlation between A and B for all methods in comparison with that of females. However, females showed variation in this correlation among different methods, the range was -0.680 to -0.999. These differences might be a reflection to variation in B due to each method since A had quite stable value across different methods.

Negative relationship between growth parameters corresponded to the curve shape, females mature earlier, had steeper curve and attained lighter mature weight. Male showed less growth rate (0.0063, table, 1), however, attained heavier mature weight (51.291, table, 1). These results were in agreement with that of DeNise and Brinks (1985) and Kratochvilova *et al* (2002) that early maturing animals cannot link to heavy mature weight. As Z can be used to measure maximum growth, it showed negative correlation with A and positive correlation with B. Males and females got different correlation estimates with different methods. Most male correlation values were higher ($p<0.05$) than that of females.

Table (1) Estimates of growth parameter values (±se) and R^2 for different methods

Method		A	B	G0	Z	R^2
Method 1a	Male	51.291 ± 0.617	0.0063 ± 0.0001	0.808 ± 0.007		99.465
	Female	45.532 ± 0.678	0.0065 ± 0.0001	0.824 ± 0.009		99.108
Method 1b	Male		0.0063 ± 0.0001	0.808 ± 0.007	0.323 ± 0.003	99.465
	Female		0.0065 ± 0.0002	0.824 ± 0.009	0.297 ± 0.003	99.108
Method 2	Male	44.300 ± 0.422	0.008 ± 0.0001	0.831 ± 0.004		99.570
	Female	40.601 ± 0.505	0.0079 ± 0.0001	0.854 ± 0.006		99.335
Method 3*	Male	0.0383 ± 0.001	-0.0104 ± 0.0001			91.000
	Female	0.0382 ± 0.001	-0.0093 ± 0.0001			82.800
Method 4 before weaning	Male		0.1150 ± 0.0005	-4.2360 ± 0.0315		99.82
	Female		0.1010 ± 0.0017	-3.5940 ± 0.0996		97.67
Method 4 after weaning	Male		0.0930 ± 0.004	-8.1700 ± 0.2500		99.49
	Female		0.0830 ± 0.0005	-7.6280 ± 0.0829		99.156

- A=B0, B=B1

Table (2) Correlation coefficient of the growth parameters for each method of male and female lambs

Method	Gender	Correlation coefficient between		
		A,B	A,Z	B,Z
1	Male	-0.943**	-0.539*	0.788**
	Female	-0.680**	-0.291	0.899**
2	Male	-0.961**	-0.679**	0.858**
	Female	-0.805**	0.004	0.589*
3	Male	-0.998**	-0.362	0.357
	Female	-0.999**	-0.716**	0.714**
4	Male	-0.970**	-0.345	0.654**
	female	-0.667**	-0.221	0.423

* Significant ($p<0.05$), ** Significant ($p<0.01$)

The growth curves for male, female and average of both sexes are shown in figure (1). Differences at birth was very low (0.372 kg) and not significant, whereas this difference increased with proceeding age to reach nearly 4kg ($p<0.05$) at the age of one year (Fig. 2). These differences were due to differences in physiological, sexual hormone and metabolic rate of male and female (Kratochvilova *et al* 2002). Since growth rate is a function of mature body weight, there was no significant differences between male and female degree of maturity (u) as calculated (exp (-exp (G0-B.t) and shown in Figure (3). It reached the value of 50% and 80% when the age of both sexes was 6 and 12 months respectively. These results showed that Arabi lambs are small in size and mature in early ages.

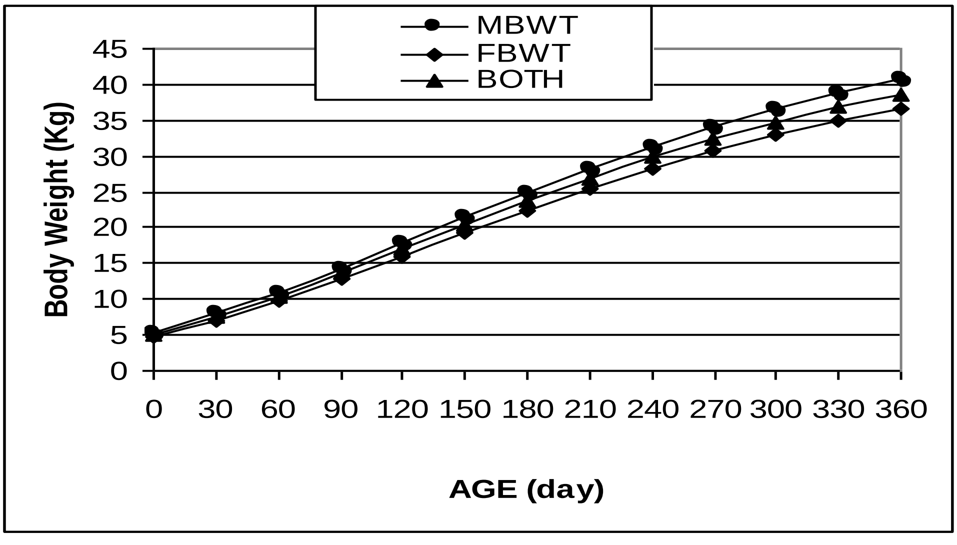

Figure (1) the estimated growth curve for male and female lambs

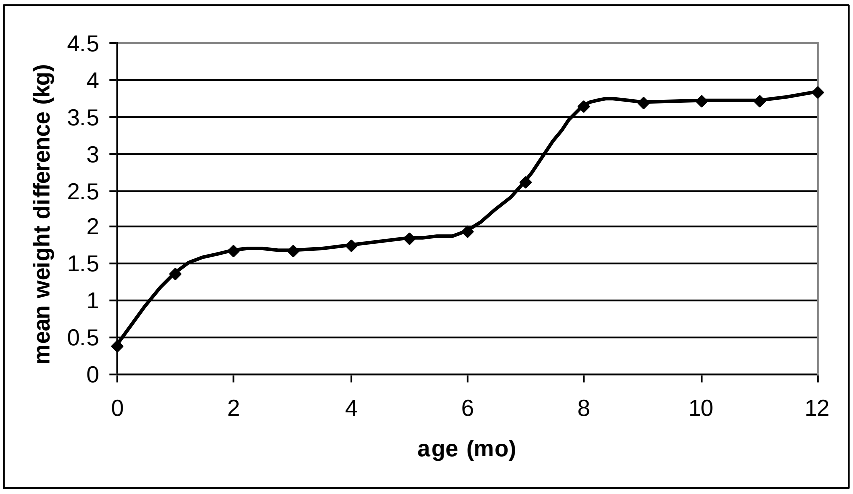

Figure (2) Differences in estimated body weight of male and female lambs at different ages

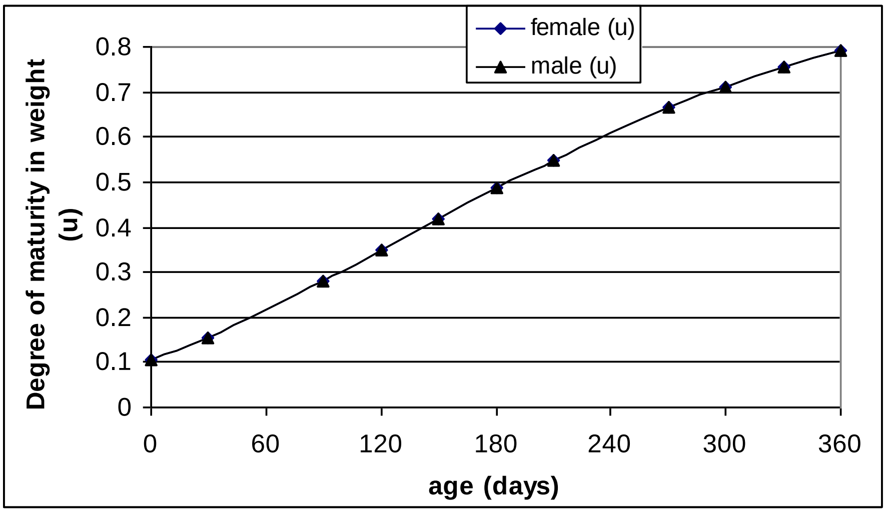

Figure (3) Degree of maturity (u) of male and female lambs at different ages

When rate of maturity (du/dt) was associated with the degree of maturity in weight (u) in figure (4), there were no differences between male and female. It was decreased with age and became nearly to zero at the age of one year. This result also reflected that most growth of Arabi sheep occur in the first year of life in both sexes. It also showed the small mature weight of this breed and very slowly growth rate.

In conclusion growth curve parameters can be used as phenotypic traits; especially they have moderate genetic parameters (Afolayan *et al* 2007). Relationship among them is possible and has biological meaning. Arabi sheep is a small and slowly growing breed. This character has advantages from survival point of view, less metabolic rate and less maintenance requirement. All are due to feed shortages, all nutrition depends on very poor roughages and no selection was practiced.

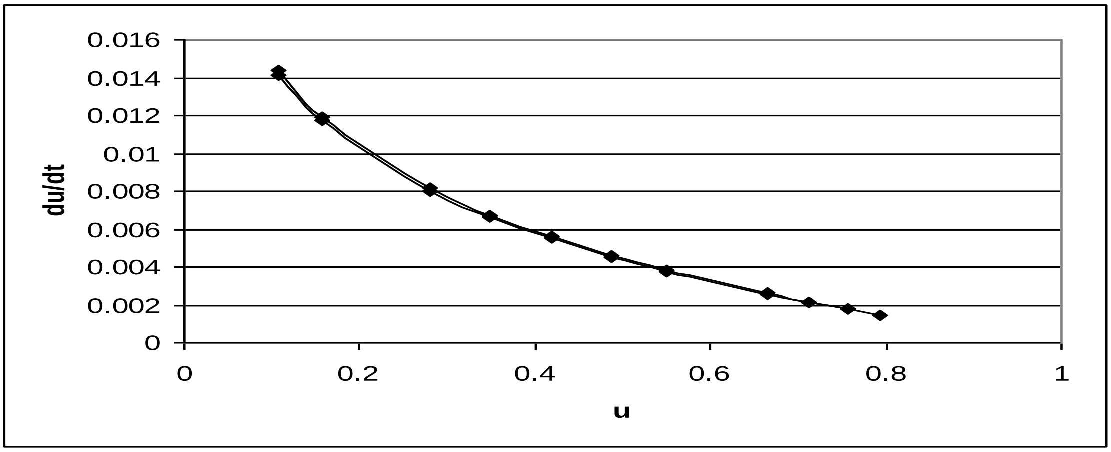

Figure (4): Rate of maturity (du/dt=B*ln (1/u)) relative to degree of maturity in weight (u=exp (-exp (G0-B*t))

When calculating B as the ratio of maximum growth rate to mature weight (A), there values were less than that calculated directly by using the Gompertz equation (table 3 and table, 1, respectively). Males showed higher values ($p<0.05$). Slower growth rate (mature index, B) or absolute maturing rate (2.022 for male vs. 2.066 for female, table, 3) lead to heavier mature weight. However, growth rate at inflection point showed reverse values (143.00gm/day for males vs. 139.47 gm/day for females, table, 3), even inflection points of both sexes occur during the age of 120-150 days but males reached it at later ($p<0.05$) age. Actual and calculated (method 1 & 2) males weight at inflection point were heavier ($p<0.05$) than that of females. Female weight calculated by method 2 was closer to actual weight in comparison with method 1 and male in both methods.

Table (3) Maturity index, maximum growth and growth rate at inflection point of male and female lambs

Traits	Method 1		Method 2	
	Male	Female	Male	Female
Maturity index (k)	0.002318a ± 0.00004	0.002371b ± 0.00009	0.00297a ± 0.00004	0.00293b ± 0.000006
Maximum growth (gm/day)	118.90a ± 0.0009	107.97b ± 0.0003	131.70a ± 0.0007	118.85b ± 0.0013
Growth rate at inflection point (V^{*}, gm/day)	143.00a ± 0.0012	139.47b ± 0.0015		
Absolute maturing rate (V, gm/day)	2.022 ± 0.503	2.066 ± 0.627		
Weight at inflection point (kg)	20.990a ± 3.030	14.520b ± 2.840		
Calculated weight at inflection point (W^{*}, kg)	18.875 ± 0.346	16.756 ± 0.485	16.302 ± 0.344	14.941 ± 0.542

K=maximum growth rate/A, V^{*}=dw/dt, V= (dw/dt)/A, W^{*}=A/e

a, b =male and female means differ significantly ($p<0.05$) within each method.

انماط النمو في الاغنام العرابية جنوب العراق

اسعد يحيى عايد مرتضى فرج الحلو عماد فلاح حسن
قسم الثروة الحيوانية/ كلية الزراعة/ جامعة البصرة

الخلاصة

استخدم في هذه الدراسة اربعة انواع من نموذج Gompetz لوصف منحنى النمو لذكور واناث الحملان العرابية. جمعت البيانات الخاصة بوزن الميلاد والاوزان اللاحقة حتى عمر سنة لـ 240 حمل من قطيع مربي خاص من ذوي الحيازات المتوسطة في مدينة المدينة شمال محافظة البصرة. وصفت جميع انواع نموذج Gompertz منحنى نمو الاغنام العرابية بدرجة دقيقة حيث لم تنخفض قيمة (R^2) عن 80%. واظهر الذكور اوزان اعلى عند النضج (51.291 كغم او 44.300 كغم للطريقة الاولى والثانية) مقارنة بالاناث (45.532 كغم او 40.601 كغم للطريقتين الاولى والثانية)، ولكنها اقل معدلات نمو (0.0063 مقارنة بـ 0.0065 للاناث). ووجد معامل ارتباط عالي وسالب (-0.90>) بين الوزن عند النضج ومعدل النمو. كذلك اظهرت الذكور اعلى معدل للنمو اليومي (118.99غم/يوم) مقارنة بالاناث (109.24غم/يوم) باستخدام الطريقة الاولى، اضافة الى الوزن او معدل النمو عند نقطة الانقلاب (20.99 كغم او 143.00 غم/يوم مقارنة 14.52 كغم او 139.47 غم/يوم للاناث). ويمكن الاستنتاج بان سلالة الاغنام العرابية خفيفة الوزن والذكور تنمو بمعدلات اقل لتصل الى وزن نضوج اعلى من الاناث.

References:

Afolayan R A, Pitchford W S, Deland M P B and McKiernan W A 2007 Breed variation and genetic parameters for growth and body development in diverse beef cattle genotypes. Animal, 1: 13-20.

Al-Jassim, A F H 1996 Growth pattern of Arabi sheep. PhD Thesis, College of Agriculture, University of Basra. (In Arabic)

DeNise S K and Brinkes J S 1985 Genetic and environmental aspects of the growth curve parameters in beef cows. J. Anim. Sci., 42: 1036-1051.

Fitzhugh H A 1976 Analysis of growth curves and strategies for altering their shape. J. Anim. Sci., 42: 1036-1051.

Friggens N C, Shanks M, Kyriazakis I, Oldham J D and McClelland T H 1997 The growth and development of nine European sheep breeds. 1-British breeds; Scottish Blackface, Welsh Mountain and Shetland. Animal Science, 65:409-426.

Juma K H and AL- Kass J E 2006 Genetic and phenotypic parameters of some economic characteristics in Awassi sheep of Iraq: A review. Egyptian Journal of Sheep, Goat and Desert Animals Sciences 1(1): 15-29.

Khon F, Sharifi A R and Simianer H 2007 Modeling the growth of the Goettingen minipig. J. Anim. Sci., 85: 84-92.

Knap P W 2000 Time trends of Gompertz growth parameters in 'meat type' pigs. Animal Science, 70:39-49.

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

Lewis R M, Emmans G C, Dingwall W S and Simm G 2002 A description of the growth of sheep and its genetic analysis. Animal Science, 74: 51-62.

SPSS 1998 Statistical Package for Social Sciences. Version 9. USA.

Zygoyiannis D, Kyriazakis I, Stamataris C, Friggens N C and Katsaounis N 1997 The growth and development of nine European sheep breeds. 2. Greek breeds: Boutsko, Serres and Karagouniko. Animal Science, 65: 427-440.