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ESTIMATION OF ASYMPTOTIC WEIGHT AND GROWTH PARAMETERS FOR EGYPTIAN RAHMANI AND OSSIMI SHEEP BREEDS AND THEIR CROSSES WITH FINNSHEEP

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SUMMARY

Records of live body weight of 4126 Rahmani (R) and Ossimi (O) and their crosses with Finnsheep (F) lambs were used to study their growth pattern and to estimate their asymptotic (mature) body weight using Brody's nonlinear growth function (Brody, 1945).

A fixed linear model was employed to study the effect of breed group, location, sex of lamb, age of dam, season and year of birth and some interactions between those main effects. The studied traits were the parameters of Brody's function (A; asymptotic weight, B; the parameter related to early changes in body weight and K; the parameter related to earliness of maturing). The amount of maturity at weaning (AM_W), 4 (AM_4), 6 (AM_6) and 12 (AM_{12}) month of age and the instantaneous growth rate at weaning (IGR_W), 4 (IGR_4), 6 (IGR_6) and 12 (IGR_{12}) months of age were estimated.

The estimates of growth parameters for Rahmani and its crosses ranged from 46.99 to 51.31 kg, 0.956 to 0.979, 0.0035 to 0.0043, for A, B and K, respectively, whereas for O and its crosses they ranged from 42.84 to 48.76 kg, from 0.971 to 0.975 and from 0.0043 to 0.0050 for A, B and K, respectively.

Estimates of instantaneous growth rate for Rahmani and its crosses ranged from 75 to 102 grams and from 10 to 43 grams at 6 and 12 months of age, respectively. While they ranged from 78 to 136 grams and from 34 to 53 grams at the same ages for Ossimi and its crossbred lambs. Ossimi and its crosses were generally earlier maturing than Rahmani and its crosses.

Keywords: Rahmani, Ossimi, Finnsheep, growth, nonlinear,crossbreeding, asymptotic weight, maturity

INTRODUCTION

In 1974, the Egyptian Ministry of Agriculture and Land Reclamation started a crossbreeding program to improve the productivity of two sheep breeds

(Rahmani and Ossimi) through crossing with Finnsheep (F). The program aimed at the development of improved synthetic lines of sheep with higher reproduction rate than the local sheep and adapted to the subtropical conditions.

Studying growth and maturing pattern for sheep is needed for planning any effective management and genetic improvement program.

Mature body weight is the mean weight over many years after positive growth of skeletal and muscular tissue has become insignificant (Fitzhugh *et al.*, 1967). The asymptotic weight represents more mature weight at a constant conditions relative to the individuals norm for body composition under a given production environment than would a single weight. The Objectives of this study was to estimate the asymptotic body weight and growth pattern for two Egyptian sheep breeds and their crosses with Finnsheep.

MATERIALS AND METHODS

Data used in this study were collected from sheep flocks raised at two experimental farms belonging to the Egyptian Ministry of Agriculture during the years from 1974 to1989. A total number of 1438 records of Ossimi and its crosses F.O, O.FO, FO.O, the first *inter se* mating between FO.O; $(O.FO)^1$ and the second generation inter se mating between the backcrosses $(O.FO)^2$ and 2688 records of R and its crosses F.R, R.FR, FR.R, $(R.FR)^1$, $(R.FR)^2$ and $(R.FR)^3$ lambs were available for the study. Data dealt with monthly weights of both male and female lambs from birth to 18 mo of age and non-regularly weights from 18 mo up to 30 mo.

Management. An accelerated lambing system of three matings per two years was practiced. The mating seasons were; May, January and September. Lambs were weaned at about two months of age. The flocks were allowed to graze on Egyptian clover (Berseem) *Trifolium alexandrinum* in the period from Decernber to May, crop stubble (wheat and vegetables) and green fodder (Sorghum) if available. In addition a concentrate mixture (24% corn, 38% cotton seed meal, 37% wheat bran and 1% salt), berseem hay and rice straw were offered in summer and autumn. Supplementary concentrate feeding of about ¼ kg/head was offered to the ewes two weeks prior to the onset of the mating season for flushing and also during the last two to four weeks of pregnancy through the first week of lactation. Animals were allowed to drink twice or thrice a day. Animals were sheared twice a year, in March and September. Ewes and rams were first mated at about 18 months old. New born lambs were identified and their weight, type of birth, sex and pedigree were recorded.

Growth functions. Preliminary investigation, on some samples of the data, showed that the Brody's function was preferable over Von Bertalanffy function (Bertalanffy, 1960) and a Quadratic function. The value of the coefficient of

determination, the computational ease and the relatively simple biological interpretation of the estimated parameters were the criteria for the comparison among the studied functions. Brody's function was fitted for each animal, older than 12-months of age.

This function was: $Y_t = A(1- Be^{-Kt})$, where, Y_t is the observed weight of lamb at age t in days, A is the asymptotic or mature weight, B is 1 minus the ratio of birth weight to mature weight such that at $t = 0$, $Y_t = A(1 - B)$, e is the natural logarithms (2.30259) and K is an indicator of general rate of maturing or growth rate relative to mature weight. Therefore, K values should only be used as indicators to compare growth rates of individual animals whose A values are equal (McCurley et. al., 1984). Larger K values are characteristics of earlier maturing animals.

The derived parameters A, B and K were calculated by the fitting observed data pairs (Y,t), for each lamb that had records for more than 12 months of age, using the nonlinear procedure (NLIN) of SAS packages, 1988.

Instantaneous growth rate. The change of weight over time can be measured by taking the first derivative of Brody's function with respect to time as:

$dy_t/dt = Ky_t(Be^{-Kt}/1-Be^{-Kt})$. Brody (1945) defined dy_t/dt as the instantaneous growth rate.

Amount of maturing. The first derivative dy/dt for the Brody's function indicates the relationship of K to gain and shows the relationship of B to early weight and maturity changes.

The expression :

$$\frac{B\,e^{-Kt}}{1-Be^{-Kt}} = \frac{A-Y_t/A}{Y_t/A} = \frac{A-Y_t}{Y_t},$$

represents the amount of maturity (weight) remaining to be attained as a fraction of the maturity (weight) already attained at any age t (Brown *et al.*, 1976). This relationship is analogous to the equality of relative growth rate and relative maturing rate as shown by Fitzhugh and Taylor (1971).

Statistical analysis. Data were analyzed by fitting a least squares fixed model by Harvey's Mixed Model (1990), to estimate the least squares means for the breed group effect for Brody's growth parameters; A, B and K, the amount of maturity at weaning (AM_W), 4 (AM_4), 6 (AM_6) and 12 (AM_{12}) months of age and the instantaneous growth rate at weaning (IGR_W), 4 (IGR_4), 6 (IGR_6) and 12 (IGR_{12}) months of age.

The fixed effects considered in the model were: breed group, location, sex,

age of dam at lambing, type of birth, season of birth, block (a period of 2 years) of birth and the interactions between some of these effects.

RESULTS and DISCUSSION

Growth parameters. The estimates of growth parameters of Brody's function, A, B and K, are presented in Table 1. The overall mean of the coefficient of determination (R^2) ranged from 0.9855 to 0.9954.

Table 1. Least squares means (LSM) and standard errors (SE) for estimates of the three parameters A, B and K of Brody's function

Factor	No.	A, kg		B		K	
		LSM	SE	LSM	SE	LSM	SE
Mean	4126	47.42	.56	.972	.0016	.0043	.0001
Breed group:							
R	288	47.27	.83	.956	.0024	.0042	.0002
F.R	651	47.62	.66	.972	.0019	.0043	.0002
R.FR	751	46.99	.63	.976	.0018	.0043	.0002
FR.R	118	49.81	1.10	.964	.0032	.0041	.0002
$(R.FR)^1$	429	47.00	.72	.979	.0021	.0043	.0002
$(R.FR)^2$	422	49.96	.77	.978	.0022	.0042	.0002
$(R.FR)^3$	29	51.31	1.89	.979	.0055	.0035	.0005
O	182	42.84	.94	.971	.0027	.0050	.0002
F.O	418	46.08	.73	.973	.0021	.0046	.0002
O.FO	349	46.73	.75	.972	.0022	.0042	.0002
FO.O	130	48.09	.99	.971	.0029	.0045	.0002
$(O.FO)^1$	273	47.06	.82	.972	.0024	.0045	.0002
$(O.FO)^2$	86	48.76	1.25	.975	.0024	.0043	.0003

The coefficient of determination of those estimates ranged from 0.9855 to 0.9954

In Rahmani groups, parameter A (mature weight) was highest (51.31 kg) in $(R.FR)^3$ and lowest (46.99 kg) in R.FR, while it was 47.27 kg for Rahmani. The estimates of parameter A in Ossimi groups were highest (48.76 kg) in $(O.FO)^2$ and lowest (42.84 kg) for Ossimi breed group.

An ascending ranking was observed in Rahmani groups based on the estimated values of parameter B being; R, FR.R, F.R, R.FR, $(R.FR)^2$, $(R.FR)^1$ and $(R.FR)^3$, While it was O, FO.O, $(O.FO)^1$, O.FO, F.O and $(O.FO)^2$ in Ossimi groups. The values of B ranged from 0.956 to 0.979 and from 0.971 to 0.9, for Rrahmani groups and Ossimi groups, respectively. The predicted value for birth

weight is related to the estimated value of B. The large estimate of B means small estimate for birth weight (body weight at age 0 [Y_0]). When t = 0, Y_0 = A(1-B), presumably a measure of predicted value of birth weight from Brody's function. However, A(1-B) generally underestimates breed means for birth weight and early weights (Brown *et al.*, 1976).

Least squares means estimates for the parameter K varied from 0.0035 to 0.0043 and from 0.0042 to 0.0050 for Rahmani groups and Ossimi groups, respectively (Table 1). The parameter K is related to the average postnatal rate of maturing (Brown *et al.*, 1976). The high K values indicate early maturing individuals and the low K values indicate late maturing individuals. Since the share of genes of any of the local breeds is ≥ 50%, it might be postulated that Ossimi transmits earliness of maturity to its crosses as compared to that of Rahmani since the range of K values, practically, do not overlap. Mousa (1989) observed such findings for the mean pattern of growth of both local breeds.

Amount of maturity (AM). The expression $(A-Y_t)/Y_t$ represents the amount of maturity remaining to be attained as a fraction of the maturity (weight) already attained at age t (Brown *et al.*, 1976). A small estimate of AM reflects earliness of maturing. Least squares means in (Table 2) indicate that, the mean of AM for Rahmani and its crosses ranged from 3.05 to 2.66 for AM_W, from 1.95 to 1.60 for AM_4, from 1.19 to 1.02 for AM_6 and from 0.52 to 0.35 for AM_{12}. Among Rahmani groups, the $(R.FR)^1$ group had the lowest amount of maturity at weaning and 4 months of age, while R.FR group showed the lowest AM at 6 and 12 months of age. The $(R.FR)^3$ group showed the highest AM at all of the studied ages.

Amount of maturity estimates for Ossimi groups ranged from 2.99 to 2.54 for AM_W, from 1.72 to 1.48 for AM_4, from 1.08 to 0.88 for AM_6 and from 0.40 to 0.34 for AM_{12}. The $(FO.O)^1$ group had the lowest AM at weaning and 12 month of age, while Ossimi breed group showed the lowest AM at 4 and 6 months. The FO.O breed group had the highest AM at weaning and 12 months, but the O.FO breed group showed the highest AM at 4 and 6 months. In general, Ossimi and its crosses were early maturing than Rahmani groups. This finding is in agreement with the findings of Fitzhugh and Taylor (1971) and Fitzhugh (1976) who found that early maturing animals are smaller in mature weight.

Instantaneous growth rate (IGR). Least squares means of IGR (Table 2) showed that, IGR in Rahmani groups ranged from 231 to 154 g for IGR_W, from 174 to 135 g for IGR_4, from 102 to 75 g for IGR_6; and from 43 to 10 g for IGR_{12}. The highest IGR was reached by $(R.FR)^3$ group at weaning and 12 months and $(R.FR)^1$ group at 4 and 6 months. On the other hand, FR.R group showed the lowest IGR at weaning, 4 and 6 months, while $(R.FR)^2$ had the lowest IGR at 12 months.

In Ossimi groups, estimates of IGR ranged from 176 to 153 g for IGR_W, from 167-78 g for IGR_4, from 136 to 78 g for IGR_6 and from 53 to 34 g for IGR_{12}.

Table 2. Least squares means (LSM) and standard errors (SE) for the amount of maturity at weaning (AM_W), 4 (AM_4), 6 (AM_6) and 12 (AM_{12}) months of age and instantaneous growth rate (g) at weaning (IGR_W), 4 (IGR_4), 6 (IGR_6) and 12 (IGR_{12}) months of age

Factor	No.	AM_W		AM_4		AM_6		AM_{12}		IGR_W		IGR_4		IGR_6		IGR_{12}	
		LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE	LSM	SE
μ	4126	2.76	.07	1.65	.05	1.05	.03	.40	.02	169	6	156	11	99	7	41	2
Breed group:																	
R	288	2.78	.12	1.70	.07	1.10	.05	.51	.03	161	11	157	16	81	11	40	3
F.R	651	2.75	.08	1.69	.06	1.09	.04	.39	.02	166	7	155	13	100	9	41	3
R.FR	751	2.77	.08	1.62	.05	1.02	.04	.35	.02	160	7	160	12	98	8	39	2
FR.R	118	2.68	.13	1.69	.09	1.07	.07	.45	.04	154	11	135	21	75	14	40	4
(R.FR)[1]	429	2.66	.09	1.60	.06	1.05	.04	.36	.02	169	8	174	14	102	9	39	3
(R.FR)[2]	422	2.68	.10	1.62	.06	1.07	.05	.36	.03	164	8	156	14	101	10	10	3
(R.FR)[3]	29	3.05	1.23	1.95	1.16	1.19	.12	.52	.06	231	20	173	36	99	24	43	7
O	182	2.62	.14	1.48	.08	.88	.06	.40	.03	176	12	167	18	78	12	34	3
F.O	418	2.75	.09	1.69	.06	1.06	.04	.39	.02	160	8	167	14	99	10	39	3
O.FO	349	2.86	.09	1.72	.06	1.08	.05	.37	.02	172	8	143	14	96	10	40	3
FO.O	130	2.99	.12	1.61	.08	.98	.06	.40	.03	160	11	155	19	136	13	53	4
(O.FO)[1]	273	2.54	.10	1.54	.07	.99	.05	.34	.03	170	9	130	15	101	11	39	3
(O.FO)[2]	86	2.78	.16	1.56	.10	1.06	.08	.35	.04	153	14	162	24	121	16	41	5

Ossimi breed group had the highest IGR at weaning and 4 months and the lowest at 6 and 12 months, while FO.O group showed the highest IGR at 6 and 12 months. Meanwhile, $(O.FO)^2$ had the lowest IGR_W and $(O.FO)^1$ had the lowest IGR_4.

CONCLUSIONS

The use of Brody's function proved its validity in fitting growth curves and predicting the growth performance in sheep from birth up to more than 18 months. This is recognized from the high value of R^2's attained (about 0.99) for all measurements studied.

Estimates of Brody's growth parameters, amount of maturity and Instantaneous growth rate did not show clear trend relating to the contribution of Finn genes in the studied genotypes.

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تقدير الوزن الناضج ومعالم النمو لأغنام الرحمانى والأوسيمى المصرية وخلطانهما مع أغنام الفنلندى

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أستخدمت في هذه الدراسه السجلات المتاحه لعدد ٤١٢٦ من الحملان الرحماني والأوسيمي وخلطانهما المختلفه مع سلالة أغنام الفنلندي. جمعت السجلات المستخدمه من سنة ١٩٧٤ الي سنة ١٩٨٩ من مزرعتي محلة موسي و سخا التابعتين لوزارة الزراعه تحت نظام ثلاث ولادات كل سنتين حيث سجلت أوزان الحملان عند الميلاد ثم بصوره شهريه حتى عمر ١٨ شهراً، و الأوزان المتاحه بعد عمر ١٨ شهرا. أستخدمت معادلة برودي الغير خطيه لكل حيوان ظل حيا حتي عمر ١٢ شهرا لوصف منحني النمو من الميلاد وحتي عمر ١٨ شهرا أو أكثر.

حللت ثوابت معادلة النمو(A : الوزن الناضج، B : العامل المرتبط بالتغيرات المبكرة فى وزن الجسم، K : العامل المرتبط بالتبكير فى النضج)، درجة النضج المتبقى وكذلك معدل النمو اللحظى عند الفطام، ٤ ، ٦ ، ١٢ شهراً من العمر باستخدام النماذج الخطيه ذات التأثيرات الثابته لدراسة تأثير المجموعه التربويه عليها و كذلك تأثير العوامل الثابته مثل المحطه ، الجنس ، عمر الأم، نوع الولاده، فصل السنه ، السنه و كذلك بعض التداخلات ما بين العوامل الثابته.

بوجه عام كان تأثير العوامل الثابته معنوياً على تباينات ثوابت معادلة النمو المقدره وكذلك درجة النضج المتبقى عند مختلف الأعمار ، وكذلك أظهرت بعض التداخلات ما بين العوامل الثابته تأثيراً معنوياً على الصفات المدروسه.

كانت تقديرات ثوابت معادلة النمو بالنسبه للرحمانى و خلطانه المختلفه تتراوح من ٤٦,٩٩ الى ٥١,٣١ كجم بالنسبه للثابت A، و تراوحت بين ٠,٩٥٦ الى ٠,٩٧٩ بالنسبه للثابت B ، وتراوحت بين ٠,٠٠٣٥ الى ٠,٠٠٤٣ بالنسبه للثابت K . بينما تراوحت تقديرات معامل التحديد من ٠,٩٨٦٦ الى ٠,٩٩١٨. كانت تلك التقديرات بالنسبه للأوسيمى و خلطانه المختلفه تتراوح من ٤٢,٨٤ الى ٤٨,٧٦ كجم بالنسبه للثابت A ، و تراوحت بين ٠,٩٧١ الى ٠,٩٧٥ بالنسبه للثابت B ، وتراوحت بين ٠,٠٠٤٣ الى ٠,٠٠٥٠ بالنسبه للثابت K . بينما تراوحت

بالنسبه للثابت B ، وتراوحت بين ٠,٠٠٤٣ الى ٠,٠٠٥٠ بالنسبه للثابت K . بينما تراوحت تقديرات معامل التحديد من ٠,٩٨٨٦ الى ٠,٩٩١٢ .

أظهرت تقديرات كمية النضج المتبقى بوجه عام أن الأوسيمى و خلطانه مبكر النضج بالمقارنه بالرحمانى وخلطانه. كما كانت تقديرات معدل النمو اللحظى بالنسبه للرحمانى و خلطانه تتراوح بين ٧٥-١٠٢ ، ٤٨-٥٤ ، ١٠-٤٣ جم عند عمر ٦، ١٠، ١٢ شهرا على التوالى . بينما كانت بالنسبه للأوسيمى وخلطانه تتراوح بين ٧٨-١٣٦ ، ٤٢-٤٩ ، ٣٤-٥٣ جم عند عمر ٦، ١٠، ١٢ شهرا على التوالى.

أثبتت الدراسه أن معادلة برودى مناسبه جدا لوصف منحنى النمو من الميلاد و حتى عمر أكثر من ١٨ شهرا .