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AMONG BREED VARIATION IN TAIL SIZE IN SHEEP

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SUMMARY

Data analyzed included a total of 729 lambs, 139 Ossimi (O), 295 Rahmani (R) and 295 crossbreds between each of R and O with Finnsheep (F). Lambs were born in 1991 to 1992 in Sids, Serw and Sakha stations of the Ministry of Agriculture under an accelerated lambing system of three lambings per two years. Measurements studied on the tail were length (L), thickness (T), upper point circumference (U) and largest point circumference (M). The traits were measured at birth and at 1, 2, 4, and 6 months of age. Main fixed effects studied along with genotypes were sex, type of birth, age of dam and season of birth.

Principal component analysis was used to characterize and describe the size of tail. The first principal component accounted for > 60% of the total variation in the dependency structure and provided a measure of the general size of tail. Genotype least squares means of first principal component of tail were 31.6, 26.6, 24.5, 21.9,25.2 and 30.3 cm at birth 90.1, 72.4, 32.1, 34.2, 54.5 and 58.4 cm at weaning and 92.2, 80.3, 43.8, 45.9, 60.1 and 69.2 cm at 6 months for O, R, F.O, F.R, O.FO and R.FR , respectively. The analysis showed that the back-crosses O. FO and R. FR genotypes were intermediate between the respective local genotypes (O,R) and F. O and F. R., with a trend that F gene are dominant over the locals.

Keywords: Principal component analysis, finnsheep, crossbred, Egyptian fat-tail sheep, tail

INTRODUCTION

The Egyptian Ministry of Agriculture started a cross-breeding program with Finnsheep, about 25 years ago, to improve prolificacy in two local breeds (Rahmani and Ossimi) and to establish a synthetic breed of higher fecundity suitable for prevailing subtropical conditions. In Egypt as well as in some other Middle East countries consumers pay a premium for the presence of the fat tail on the carcass. Butchers recognize that and they tend to leave the fat tail in intact with the carcass so as command a higher price(El-Tawil, 1996). The objective of this investigation was to study the tail measurements and its size of R, O and their crosses with Finn and its variability among these genotypes.

MATERIALS AND METHODS

Data were collected on different flocks from the Egyptian fat-tail breeds Ossimi (O) and Rahmani (R) and their crosses with Finnish Landrace (F) [F.O, F.R, O.FO, R.FR]. The Ossimi sheep were raised in middle Egypt (Sids research station) , Rahmani in north of Delta (Serw research station) and their crosses in the Nile delta (Sakha Research station). A total number of 139 Ossimi, 295 Rahmani and 295 crossbred lambs were available for the study. Lambing seasons were May 1991, January 1992, and September 1992. The lambs were kept with their dams up to weaning at 8 weeks of age.

Measurements of tail

1. Length of tail, measured with a flexible steel tape from the point of the first caudal (coccygeal) vertebrae to the end of the tail.
2. Thickness of tail, measured with a caliper at the thickest part of the tail.
3. Upper point circumference of tail, measured with a flexible steel tape in a horizontal plane around the line joining the body and the tail.
4. Largest point circumference of tail, measured with a flexible steel tape in a horizontal plane around the widest line of tail.

These measurements were taken at birth and at 1, 2, 4, and 6 months of age.

Statistical methods

Principal component (PC)

According to Morrison (1976), principal component technique is used to summarize most of the variation in a multivariate system in fewer variables.

A number of components might be computed until some arbitrarily large proportion (75 % or more) of the variance has been explained. If the proportion can not be explained by the first 4 or 5 components, it is usually fruitless to persist in extracting vectors, for even if the later characteristic of the components, the interpretation of the components may be difficult if not impossible.

If the variables X1, ..., Xp of interest have a certain multivariate distribution with mean vector μ and Σ are finite. The rank of Σ is < p and the q largest characteristic roots of Σ are distinct. The first principal component of the observations X is linear compound.

$$Y1 = a_{11} X_1 + \ldots\ldots\ldots\ldots + a_{p1}X_p$$

whose coefficients a_{ii} are the elements of the characteristic vector associated with the greatest characteristic root L_1 of the covariance matrix (S) of the responses. The a_{i1} are unique up to multiplication by a scale factor and if they are scaled so that $a_1'a_1 = 1$, the characteristic root L1 is interpretable as the sample variance of Y_1. Also, second principal component is linear compound.

$$Y_2 = a_{12}X_1 + \ldots\ldots\ldots\ldots + a_{p2}X_p$$

Whose coefficients have been chosen, subject to the constraints

$a_2'a_2 = 1$

$a_1'a_2 = 0$

so that the variance of Y_2 is maximum. The first constraint is merely a scaling to assure the uniqueness of the coefficients, while the second requires that a_1 and a_2 be orthogonal. More detailed are given by Morrison (1976).

Eigen value – eigen vector

As detailed by Morrison (1976), the characteristic roots of the p*p matrix A are the solutions to the determinantal equation

$|A - L_i I|\ X_i = 0$

L_1, L_2, ..., L_p satisfying the polynomial equation where I = identity matrix. Associated with every characteristic vector Xi whose elements satisfy the homogeneous system of equations

$[A - Li\ I]\ Xi = 0$

Xi = non zero vector, were

A Xi = Li Xi

A Xj = Lj Xj

The number of eigen values equals to the number of the observed variables and their sum is equal to the total variance of the system

Traits considered in this study were length of tail (L), upper circumference of tail (U), largest point of circumference of tail (M), and thickness of tail (T). Statistical Analysis System (SAS, 1990) was used to analyze the data utilizing the GLM, VARCOMP, and PRINCOMP procedures. The fitted statistical model was:

$$Y_{ijklmno} = \mu + S_i + X_j + B_k + T_l + A_m + r_n + e_{ijklmno},$$

Where,

$Y_{ijklmno}$= observation on the o^{th} lamb sired by the n^{th} sire, of the m^{th} age of dam, l^{th} type of birth, of the k^{th} genotype, of the j^{th} sex, i^{th} season.

μ = the overall mean,

S_i = the fixed effect of the i^{th} season of birth; i=1- 3,

X_j = the fixed effect of the j^{th} sex; 1,2,

B_k = the fixed effect of the k^{th} genotype; 1-6,

T_l = the fixed effect of the l^{th} type of birth; 1,2.

A_m= the fixed effect of the m^{th} age of dam; 1 - 4,

r_n = the random effect of the n^{th} sire, and

$e_{ijklmno}$= random error associated with each observation.

RESULTS AND DISCUSSION

Principal component (PC) of size of tail

First principal component of the size of the tail was estimated by multiplying the elements of the first eigenvector by L, U, M and T measurements. The PC of size of tail was calculated using the following equation:

$$Size_{ijkl} = (a_{ijl1} * L_{ijk} + a_{ijl2} * U_{ijk} + a_{ijl3} * M_{ijk} + a_{ijl4} * T_{ijk})$$

where,

$Size_{ijkl}$ is size of tail, in i^{th} genotype, at j^{th} age, for k^{th} animal, multiplied by 1 1^{st} eginevector.

a_{ijl1} = the 1^{st} element in l^{th} 1^{st} eigenvector, at j^{th} age, in i^{th} genotype.

a_{ijl2} = the 2^{nd} element in l^{th} 1^{st} eigenvector, at j^{th} age, in i^{th} genotype

a_{ijl3} = the 3^{rd} element in l^{th} 1^{st} eginevector, at j^{th} age, in i^{th} genotype.

a_{ijl4} = the 4^{th} element in l^{th} 1^{st} eigenvector, at j^{th} age, in i^{th} genotype.

L_{ijk} = length of tail of the k^{th} animal, at j^{th} age, in i^{th} genotype.

U_{ijk} = upper circumference of tail of the k^{th} animal, at j^{th} age, in i^{th} genotype.

M_{ijk} = largest point of circumference of tail of the k^{th} animal, at j^{th} age, in i^{th} genotype.

T_{ijk} = thickens of tail of the k^{th} animal, at j^{th} age, in i^{th} genotype.

This principal components were computed from the phenotypic correlation matrix and are tabulated in Table 2 for the two local breeds and their crosses with Finn at birth, and at 1, 2, 4, and 6 months of age. The first two principal components are considered the most important ones among those shown in Table 1. Their associated eigen values were higher than other principal components and together accounted for between 71.92 % in F.R genotype lambs, at weaning, and 93.60 % in R.FR lambs, at weaning, of the total variation . This result agrees with that found by Arthur and Ahunu (1988) on similar work on principal components of body size.

Further simplification of the results could be obtained when the eigen vectors are multiplied by 100 and rounded to the nearest integer as those shown in Table 2. The first principal component is a measure of an overall trait measurement since the first eigen vector shows approximately equal loading on all tail measurements in different genotypes at different ages. This principal component seems to measure the overall size of tail. The second eigen vector in general has high positive loading on length of tail in different genotypes at different ages and negative loading on other tail measurements. This component also seems to measure the length of tail.

Least squares means of principal component of size of tail are shown in Table 3 and represented graphically in Figure 1 and 2. Differences among genotypes are significant ($p < 0.05$) . Where O.FO and R.FR were 25.21 and 30.33 cm at birth, 54 and 58 cm at weaning and 60 and 69 cm at 6 months, respectively, local genotypes O and R were 31.64 and 26.63 cm at birth, 90 and 72 cm at weaning and 92 and 80 cm at 6 months respectively and F.O & F.R . were 24.49 and 21.88 cm at birth, 32 and 34 cm at weaning and 43 and 45 cm at 6 months, respectively. These results show that the variations become more obvious as the lambs advanced in age. They also, show that 1^{st} principal component of size of tail for back-crosses was intermediate between the local genotypes and F1's but closer to F1's than local genotypes and this could be due to the genetic additive effect plus dominance effect for Finn over local breeds. Also the type of birth had significant ($p < 0.05$) influences at different ages. Lambing season had significant influence at 1,2,4,6 months between the season May 1991 and Jan. 1992. Other fixed effects differences were not significant.

CONCLUSION

The study concluded that, principal component analyses summarized the variation in tail into two principal components. The first one accounted for greater than 60 % of the variation in the dependency structure and provided a measure of the general size of tail. The second one also seems to measure the length of tail.

Also, this study concluded that principal component of size of tail for the back crosses O. FO and R. FR were intermediate between local genotypes (O, R) and F1 crosses (F. O and F. R) but closer to F1's than local genotypes and this result may be due to additive genetic effect. plus dominance effect for Finn over local breeds.

Table 1. Phenotypic eigen values and proportion of total variance explained by principal component in different breeds at different ages

Factor	Ossimi			Rahmani			F.O			F.R			O.FO			R.FR		
	Eigen value	V %	Cum. V%	Eigen value	V %	Cum. V%	Eigen Value	V %	Cum. V%	Eigen value	V %	Cum. V%	Eigen value	V %	Cum. V%	Eigen value	V %	Cum. V%
Birth																		
F1	3.01	75.3	75.3	1.97	49.3	49.3	2.34	58.5	58.5	2.51	62.8	62.8	2.45	61.3	61.3	2.00	50.1	50.1
F2	0.58	14.6	89.9	0.99	24.8	74.1	0.70	17.4	75.9	0.77	19.4	82.2	0.91	22.9	84.2	1.02	25.6	75.7
F3	0.25	06.3	96.2	0.61	15.2	89.3	0.61	15.3	91.2	0.46	11.5	93.7	0.48	12.0	96.2	0.84	21.0	96.6
F4	0.15	03.8	100	0.43	10.8	100	0.35	08.8	100	0.26	06.4	100	0.15	03.8	100	0.14	03.4	100
Month																		
F1	2.69	67.2	67.2	2.71	67.8	67.8	2.76	69.0	69.0	2.16	54.1	54.1	2.81	70.3	70.3	2.92	72.9	72.9
F2	0.74	18.5	85.7	0.86	21.6	89.4	0.65	16.2	85.2	1.01	25.4	79.5	0.69	17.2	87.5	0.66	16.6	89.5
F3	0.36	08.0	94.7	0.27	06.8	96.2	0.41	10.3	95.5	0.53	13.3	92.7	0.39	09.8	97.3	0.37	09.2	98.7
F4	0.21	05.4	100	0.15	03.8	100	0.18	04.5	100	0.29	07.3	100	0.11	02.7	100	0.06	01.4	100
2 mo																		
F1	2.86	71.5	71.5	2.52	62.9	62.9	3.01	75.3	75.3	1.91	47.7	47.7	3.12	77.7	77.7	3.07	76.6	76.6
F2	0.78	19.6	91.1	0.89	22.2	85.1	0.72	18.1	93.4	0.97	24.2	71.9	0.57	14.3	93.0	0.68	17.0	93.6
F3	0.25	06.4	97.5	0.41	10.3	95.4	0.18	04.5	97.9	0.63	15.7	87.6	0.22	05.6	97.6	0.20	05.0	98.6
F4	0.10	02.5	100	0.18	04.6	100	0.09	02.2	100	0.50	12.4	100	0.09	02.2	100	0.06	01.4	100
4 mo																		
F1	2.72	68.0	68.0	2.47	61.9	61.9	2.94	73.6	73.6	2.15	53.8	53.8	2.86	71.4	71.4	3.16	79.0	79.0
F2	0.72	18.1	86.1	0.84	21.1	83.0	0.66	16.4	90.1	0.82	20.5	74.3	0.66	16.4	87.8	0.54	13.6	92.6
F3	0.39	09.6	95.7	0.51	12.8	95.8	0.26	06.5	96.6	0.67	16.7	91.0	0.33	08.3	96.1	0.23	05.6	98.2
F4	0.17	04.3	100	0.17	04.3	100	0.14	03.4	100	0.36	09.0	100	0.16	03.9	100	0.07	01.8	100
6 mo																		
F1	2.58	64.4	64.4	2.21	55.2	55.2	2.51	62.8	62.8	1.99	49.7	49.7	2.71	67.7	67.7	2.91	72.8	72.8
F2	0.82	20.4	84.8	0.90	22.4	77.6	0.77	19.4	82.2	0.94	23.5	73.2	0.76	19.0	86.7	0.69	17.3	90.1
F3	0.52	13.0	97.8	0.65	16.2	93.8	0.46	11.5	93.7	0.74	18.4	91.6	0.37	09.2	95.9	0.29	07.3	97.4
F4	0.09	02.2	100	0.25	06.2	100	0.26	06.4	100	0.34	08.4	100	0.17	04.1	100	0.11	02.7	100

V % = Proportion of total variance, Cum. V % = cumulative proportion of total variance F = Factor

Table 2. Eigen vectors for each tail measurement in two local breeds and their cross at different ages

Measurements	Ossimi		Rahmani		F.O		F.R		O.FO		R.FR	
	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2	V1	V2
Birth												
Length	44	79	31	99	43	87	40	83	24	97	34	40
Upper circumference	53	-35	61	-01	47	-44	54	-41	59	-10	66	-22
Largest point circumference	51	-48	55	-07	56	-20	52	-35	58	-16	65	-19
Thickens	52	-15	57	-11	53	-10	53	-13	51	-15	15	-87
One month												
Length	37	91	27	96	41	91	49	42	39	92	39	91
Upper circumference	56	-13	55	-17	55	-18	55	-42	54	-22	56	-12
Largest point circumference	52	-36	57	-11	53	-23	55	-43	56	-27	54	-26
Thickens	53	-15	54	-20	50	-30	39	-68	50	-17	49	-30
2 months												
Length	33	93	26	96	47	85	50	39	41	91	37	92
Upper circumference	56	-13	56	-17	50	-14	52	-52	54	-18	55	-11
Largest point circumference	56	-13	58	-18	52	-15	54	-39	54	-30	54	-25
Thickens	52	-31	53	-10	50	-49	43	-66	51	-23	52	-29
4 months												
Length	38	92	31	95	35	93	40	81	40	91	42	90
Upper circumference	56	-17	56	-20	52	-28	59	-28	55	-14	54	-16
Largest point circumference	55	-17	58	-20	54	-19	53	-48	52	-28	53	-22
Thickens	50	-32	50	-14	55	-14	49	-20	51	-26	50	-35
6 months												
Length	33	93	28	95	39	91	29	90	37	91	42	77
Upper circumference	58	-12	58	-11	53	-30	63	-12	57	-05	55	-0.6
Largest point circumference	57	-17	60	-15	54	-24	53	-41	54	-32	55	-06
Thickens	47	-18	47	-25	52	-13	49	-06	51	-27	46	-63

Coefficients are multiplied by 100 and rounded. V = Vector

Table 3. Least squares means and ±SE of principal component of size of tail (cm) at different ages

Main Effects	Birth		Month		2 months		4 months		6 months	
	LSM	±SE	LSM	±SE	LSM	±SE	LSM	±SE	LSM	±SE
Genotype										
Ossimi	31.64^{a}	1.51	65.22^{a}	2.65	61.30^{a}	2.96	90.80^{a}	3.73	92.28^{a}	4.02
Rahmani	26.63^{bd}	1.33	58.36^{b}	2.34	62.12^{b}	2.61	72.88^{a}	3.30	80.77^{b}	3.58
F.O	24.49^{cd}	1.47	30.21^{c}	2.48	35.89^{c}	2.67	32.15^{b}	3.37	43.29^{c}	3.53
F.R	21.88^{c}	1.17	27.49^{c}	2.06	25.80^{c}	2.30	34.90^{c}	2.91	45.43^{c}	3.20
O.FO	25.21^{bc}	0.84	43.29^{d}	1.41	50.44^{d}	1.58	54.00^{d}	1.99	60.04^{d}	2.13
R.FR	30.33^{ab}	0.90	43.31^{d}	1.46	48.62^{d}	1.63	58.74^{d}	2.06	69.46^{d}	2.23
Sex ^{NS}										
Male	26.63	0.50	44.34	0.89	46.73	0.96	57.29	1.21	65.52	1.30
Female	26.76	0.53	44.95	0.88	48.03	0.98	57.20	1.24	64.91	1.32
Type of birth										
Single ^{a}	28.14	0.43	48.58	0.74	51.59	0.82	60.96	1.04	68.65	1.30
Twin ^{b}	25.76	0.61	40.71	1.03	43.17	1.14	53.53	1.45	61.77	1.52
Lambing Season ^{NS}										
May – 91	25.68	0.98	42.34	1.68	42.77	1.88	52.35	2.37	62.58	2.59
Jan. – 92	25.97	1.10	46.98	1.91	51.84	2.13	63.84	2.69	68.02	2.90
Sept. – 93	28.45	1.01	44.63	1.75	47.53	1.96	55.55	2.47	65.04	2.67
Age of dam (mo) ^{NS}										
18 – 23	26.99	0.79	45.13	1.31	46.02	1.45	55.55	1.82	63.91	1.94
24 – 35	26.88	0.55	44.71	0.95	48.28	1.05	56.86	1.34	64.59	1.40
36 – 47	26.48	0.69	44.34	1.18	47.34	1.32	57.54	1.67	65.84	1.74
> 47	26.44	0.55	44.42	0.95	47.87	1.06	59.03	1.34	66.51	1.41

Means in the same column within subgroup beabearing different superscript letters differ significantly ($p < 0.05$)
Ns = not significant

Fig. 1. Principal component of size of tail (cm.) at different ages in Ossimi and their crosses.

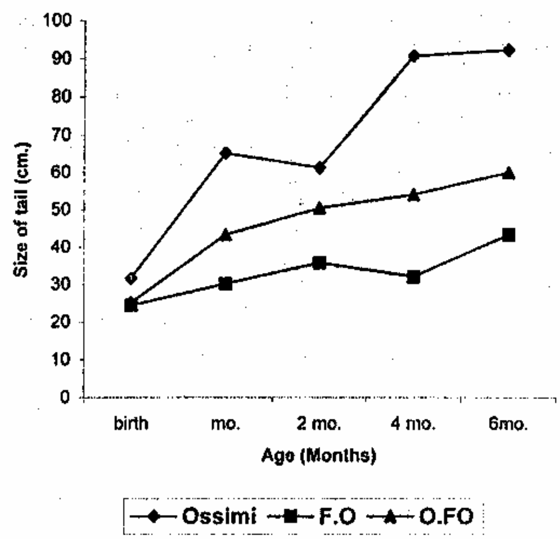
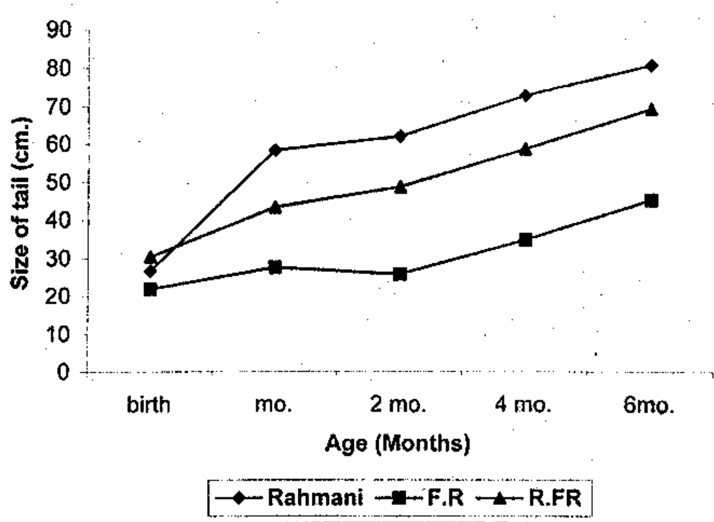


Fig. 2. Principal component of size of tail (cm.) at different ages in Rahmani and their crosses



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