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Some Non-genetic Sources of Variation in Body Weight in Six Commercial Flocks of Merino Sheep in Egypt

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THE STUDY comprised 15186 birth weight, 7421 4-month weight and 4117 yearling weight observations taken on Fleisch Merino lambs born during three successive years starting in 1969 on 6 farms belonging to the Egyptian Meat and Milk Organization, and located in different regions of Egypt. The least square ANOVA was used for partitioning the total variation in the three body weights into components attributable to farm, year of birth, season of birth, sex and type of birth. The interaction between farm × season of birth was added only in the model underlying a birth weight observation. The overall mean body weight was 2.95 kg at birth, 19.28 kg and 32.99 kg at 4-month and yearling ages, respectively.

All of the factors studied showed significant effect ($P<0.01$) on the 3 body weight traits except sex and type of birth which exerted significant effects only on birth weight. The contribution of all factors studied to the total variance in birth weight, 4-month and yearling body weights were 35.16%, 22.45% and 58.85%, respectively. Type of birth alone contributed 15.57% of the total variation in birth weight, while 13.97% and 38.76% of the total variatoin in 4-month and yearling body weight, respectively were due to farm effects.

Body weight traits in sheep are influenced by genetic and non-genetic factors. Selection of genetically superior individuals is hampered by non-genetic effects that tend to mask the difference in breeding values of the individuals being selected. The contribution of the non-genetic sources of variance to the total phenotypic variation of the traits should be, therefore, defined and evaluated in order to be minimized before planning breeding programmes.

This study was carried out to study the effect of some non-genetic factors affecting body-weight traits in 6 flocks of Fleisch Merino sheep in Egypt. Data were analyzed by the method of least squares (Harvey, 1960). Constants were fitted for the several sources of variation in birth weight, 4 - month and yearling body weight. Since the analysis involved fitting constants for farms, years, seasons, sexes and types of birth for each trait, it was necessary to reduce the number of extra classifications (*i.e.* interactions) in order to handle the analysis. This was done by only including farm by season interaction which was thought to be of practical value. The interaction was dropped from the model of the 2 traits following birth weightbeca use of the appearance of empty cells in the layout of the analysis.

For each trait, synthetic means were computed from the overall means and the least squares constants. Results of the multiple range test of significance between pairs of means, least squares analysis of variance (ANOVA), and percentages of the total variance attributable to the defined sources of variation were tabulated and discussed.

Material and Methods

A-*Materials*

1. *Source of data*

Data used in this study were collected from 15186 Fleisch Merino lambs born to ewes imported in 1966 when they were less than two years old. Records were accumulated over a period of three years in six farms belonging to the Meat and Milk Organization, Egypt. The farms of Abis, Paul Place, Saft Khaled and Yousofiah are located in a flood-irrigated area in the northern part of Egypt, the first three farms are close to the western border of the Delta, while the fourth is located east of the Delta. Salhiah and Kom-Osheim are in a desert area, the first is north-east of the Delta, and the second is 80 km south-west of Cairo.

2. *Management of the flocks*

Sheep were kept in open sheds with corrigated aspects roofs. Each shed could cary 300 heads, and each three sheds had an uncovered loafing area. The carrying capacity of each farm was about 6000 heads. The farms were equipped with lambing barns that contained separate panels and allowed for creep feeding.

All farms were located in newly reclaimed areas where green fodders represent a major part of the agricultural rotation. The sheep were put on pasture to graze clover (*Trifolium alexandrinum*), Alfalfa (*Medicago sativa*), and Sweat Sorgum (*Sorgum saccaratum*) which were supposed to provide the sheep with most of their nutritional requirements. When pasture was not sufficient or when high-energy feeding was required for flushing before the breeding season, concentrates were usually used as an extra source of nutrients.

Two breeding seasons were defined. The first began on November 1, and the second began on May 1. Each breeding season lasted for nearly 75 days. Flushing was usually practiced 15 days before the commence of the breeding season and lasted until insemination.

New-born lambs were kept with their mothers in the panels for about 15 days before moving back to their sheds. Lambs suckled all their mothers milk, orphans and lambs of low-producing mothers were artificially fed on cow's milk. After the removal of lambs from the lambing panels, creep feeding was allowed until weaning. Male lambs were separated from the females at about the age of 8 months when most of the males and the extra females were prepared for marketing.

The routine control of infectious diseases was practiced by vaccination. Drenching was done four times a year for the control of internal parasites. External parasites were controlled during summer by monthly dipping.

B. *Statistial procedures*

For each lamb, the available observations on birth weight, 4-month weight and yearling weight were recorded on a magnetic tape.

Least squares ANOVA (Harvey, 1960) was used for partitioning the total variation in the three traits studied into parts attributable to non-genetic sources of variance assumed to influence each trait. Non-genetic factors known to exert considerable effect on body weight in sheep are : farm, sex, type of birth, season and year of birth, age, and weight of dam (Gjedren, 1967; Yalcin, 1969; Vesely *et al.*, 1970; and Aboul-Naga *et al.*, 1972).

Since all lambs used in this study were born to ewes imported at nearly the same age and body weight, age and weight of dam were neglected as factors affecting body weights in lambs.

Due to limitations of the data, many empty cells were found, and it was not possible to calculate all interactions between the factors affecting the different traits except for the case of birth weight where season x farm was included. A fixed-effects linear model was assumed to underlay the ANOVA of the different traits.

$$Y_{ijklmn} = u + f + r + t_k + x_1 + P_m + e_{ijklmn}$$

where :

Y_{ijklmn} is the observation taken on the n*th* lamb of the m*th* type of birth and the l *th* sex born in the k *th* season of birth in the j *th* year at th ᵒ *th* farm.

u is an effect common to all observations.

f_i is the effect due to the i *th* farm; i = 1,2,. . .,6

r_j is the effect due to the j *th* year of birth, j = 1,2,3

t_k is the effect due to the k *th* season of birth, k = 1,2

x_l is the effect due to the l *th* sex, l = 1,2

P_m is the effect due to the m *th* type of birth, m = 1,2

e_{ijklmn} is a random effect peculiar to the i_{jklmn}

th observation with e $\sim$ IRN (0, σe)

The term $(ft)_{ik}$ defined as the effect due to the interaction between the i*th* farm and k *th* season of birth, was added to the model describing a birth weight observation.

To obtain a unique solution for the least squares equations, the restrictions imposed on the model were :

$$\Sigma_i f_i = \Sigma_j r_j = \Sigma_k t_k = \Sigma_{l x l} = \Sigma_m p_m = \Sigma_{ik} (ft)_{ik} = 0$$

The contribution of each factor to the total variance in each trait was calculated by equating the mean squares to their corresponding expectations and solving for the desired value.

Comparisons among the least squares means were performed by the Duncan's multiple range test as described by Steel and Torrie (1960).

Results and Discussion

A. *Overall means and total variances*

Table 1 presents the least squares means for body weight at birth, 4-month and yearling ages, classified by the different sources of variation. The drops in the number of lambs of the older groups was mainly due to mortality and missing data. The estimates were very close to those reported on the same breed by Aboul-Naga *et al.* (1972) and showed that the Fleisch Merino was lighter than other types of Merino in Egypt at birth, but, it tended to be slightly heavier at 4-month of age. Its superiority in body weight was more pronounced at yearling age (Fahmy and Galal, 1968; Fahmy *et al.*, 1969 a, b and Galal and Ghanem 1970).

Comparing with some published estimates for the three local breeds, Ossimi, Rahmani and Barki would show that body weight of the Fleisch Merino in Egypt at the three studied ages was closer to the lower limits of the ranges of their mean body weights (Fahmy and Galal, 1968; Labban and Ghali, 1969, Galal and Ghanem, 1970 and Aboul-Naga *et al.*, 1972).

The pre-weaning average daily gain was 0.136 kg, and post-weaning average daily gain was 0.057 kg. Differences in the physiological status and the quality of nutrients in the two stages might explain the difference in the daily gain. In this study, being carried out on a commercial flock, heavier males were usually marketed before they were one year old. This might be also considered as a reason causing the difference between pre-and post-weaning daily gain.

Table 2 presents the analysis of variance for body weight traits. ANOVA showed that all non-genetic sources of variation studied had a highly significant effect ($P < 0.01$) on different body weights with the exception of the effect of sex and type of birth on 4-month and yearling body weights.

The total variance in birth weight, 4-month and yearling body weights were 0.80, 32.00, and 29.22kg, respectivley (Table 3). All factors studied accounted for 35.16%, 22.45% and 58.85% of the total variation in the three body weights, respectively. Among the factors studied, type of birth accounted for the highest percentage of the total variance in birth weight (15.57 %), but contributed nothing to the total variation in body weights at 4-month and yearling ages. Farm contributed more variation to the 4-month and yearling body weights than any other factor.

B. *Effect of farm*

Inconsistent effect of farm on body weight at different ages was found in the data (Table 1). At the 0.05 level of probability, the birth weight means at Salhiah and Yousefiah were significantly higher than other farms. On the other hand, the mean birth weight at Saft Khaled and Paul Place were significantly lower ($P < 0.05$) than all estimates of other farms.

In 4-month body weight, the situation was almost reversed (Table 1). The highest mean was found in Saft Khaled (22.07 ± 0.175 kg), while the lowest was found in Salhiah (16.64 ± 0.290 kg).

This result might be due to the infection of anaerobic diseases, which attacked the flock in Salhiah and caused, in addition to growth retardation, the death of most of the newly born lambs. Only 16.8% of the lambs survived till the age of four months, and the farm was evacuated thereafter. Duncan's new multiple range test showed that all farm means of the 4 month body weight differed significantly from each other ($P < 0.05$). Differences between the means of yearling body weights in the four farms remaining under study at that age were also significant ($P < 0.05$). The differences might be mainly attributed to variation in managerial systems. At Saft Khaled, which had the lowest mean yearling weight ($P < 0.05$) hand feeding was used, as green fodder was usually purchased from the neighbourhood. Open range was available for the other three farms, and ad-lib grazing was practiced. The mean yearling weight at the three farms decreased significantly ($P < 0.05$) as the stocking rate(1) of the pasture increased. The stocking rate at Abis, Paul Place, and Yousofia were 0.22, 4.78, and 13.15, respectively. There was no evidence of regional correction between farms.

Farms had a highly significant effect ($P < 0.01$) on different body weights (Table 2). The percentages of total variance in body weights attributed to farm effect (Table 3), showed that farm tended to exert an increasing effect on body weight as lambs grew older. The percentage of the total variance attributable to differences among farms was 6.42 % at birth, 13.98% and 38.76% at 4-month and yearling ages, respectively. At birth, factors affecting prenatal growth might have a great influence on birth weight. Following birth, farm had but a limited effect on growth since lambs depended on their mothers' milk as agreater the main source of nutrition. After weaning, lambs were separated from their mothers and were exposed to the prevailing farm conditions and managerial practices.

(1) lambs/feddan, and a feddan = 4200 sq.m.

C. *Effect of Year of birth*

Table 1 presents the least squares means of body weight traits for the lambs born in the years 1969, 1970 and 1971. The mean birth weight of the 1969-born lambs was significantly higher ($P<0.05$) than of those born in the other two years.

The 1969-born lambs maintained their superiority ($P<0.05$) till the age of four months. At yearling age, the 1971-born lambs were significantly heavier ($P< 0.05$) than the lambs born in both 1969 and 1970. However, the yearling reco.'s of the 1971- born lambs comprised only 972 lambs representing about 15% of the lambs born in that yerar. Those were the lambs born early in 1971 and were one year old when the collection of data was terminated. Their records might not, therefore, be considered as a random sample of the 1971 group.

The ANOVA (Table 2), showed that year had a highly significant effect ($P< 0.01$) on body weight from birth till lambs became one year old. This reult is in accordance with the results obtained by many workers (Kassab and Karam, 1961; Vesely and Slens, 1961, Fahmy *et al.*, 1969 *a, b*; EL Tawil *et al.* 1970; Malik *et al.*, 1971 and Aboul-Naga *et al.* 1972).

The percentage of the total variance in body weights attributed to differences in year of birth(Table 3) accounted for nearly the same proportion of the total variance in birth weight (7.8%) and in four-month body weight (7.7%), but year of birth accounted only for 4.9% of the total variance in yearling body weight.

Results reported by Fahmy *et al.* (1969 a, *b*) showed that year accounted only for 3.8% of the total variance in the birth weight of Hungarian Merino, for 8.4% of the total variance in birth weight of Merino,Awassi, Barki and their crosses, for 26.4% in 4-month body weight and for 40.2% in yearling weight. An extremely high estimate was reported by Aboul-Naga *et al.* (1972) who found that year of birth accounted for 43.1% of the total variance in birth weight of Merino, Ossimi, Barki and their crosses.

D. *Effect of s'ason of birth*

Two-six month seasons were defined according to the availability of pasture, climatic conditions and the incidence of diseases especially the epidemic diseases and parasite infestations. In the first season (November to April, relatively better conditions were prevailing than in the second season (May inclusive) to October, inclusive).

Table 1 presents the least squares means for body weights classified by season. The mean birth weight of lambs born during November- April season was significantly higher ($P<0.05$) than lambs born from May to October.

At 4-month, and yearling ages, the situation was reversed, lambs born from May to October, were significantly heavier in body weight ($P<0.05$) than those born from November to April.

The inconsistency of the effect of season of brith on body weight at different stages of growth could be attributed to the combind effect of season of birth on both lambs and their mothers. Birth weight might be affected by the conditions of the dam during pregnancy, while 4 - month body weight was also affected by the milk-yield of ewes. Yearling weight was affected by the availability of pasture, May to October-born lambs were born to ewes which suffered from unfavourable summer conditions especially those lambs born late in the season. As the Lambs grew older, the weather became mild and the lambs and their mothers had access to the new pasture.

The ANOVA showed that body weight was significantly affected ($P<0.01$) by season of birth, at birth, 4-month and yearling ages (Table 2). The contribution of season of birth to the total variation in body weight was most pronounced when the lambs became one year old (Table 3).

At this age, season of birth accounted for 15.1% of the variation in yearling body weight.

D. *Effect of sex*

The least squares means for different body weight traits for males and females (Table 1) showed that the mean body weight of males was very slightly heavier than that of females at all ages. However, differences between males and females at 4 - month and yearling body weight lacked significance. The ANOVA (Table2), also showed that sex exerted a significant effect ($P<0.01$) only on birth weight. The contribution of sex to variation in body weight was 0.51 at birth, and zero at 4 - month and yearling ages (Table 3). These results were unexpected since most studies indicated the increasing effect of sex on body weight as lambs grew older (Malossini, 1960 ; Gjedrem, 1965 ; Malik *et al.*, 1970; and Malik *et al.*, 1971). The disagreement between the recent and the reported results might be attributed to that data which were collected from commercial flocks where heavier males were marketed earlier. Only lighter males were left to reach the age of one year.

This did not happen with ewe lambs, since more females were usually kept in the flock and selection was not actually practiced before females were one year old. The sex ratio was changed in favour of females. The male: female ratio changed from approximately 1 :1 at birth and 4 - month ages to 0.87 : 1 at yearling age. Females were therefore assumed to represent a random sample of the younger groups, while males represented only the group which did not attain the marketing weight.

E. *Effect of type of birth*

The least squares means of single and twin lambs from birth to yearling age are presented in Table 1). The mean brith weight of singles was significantly higher ($P<0.05$) than that of twins. Single lambs continued to be heavier than twins till 4 - months and yearling ages, but differences lacked statistical significance.

The ANOVA (Table 2) showed that type of birth had a highly significant effect ($P<0.01$) only on birth weight.

TABLE 1. Least squares means ($\bar{x}$),standard errors (S.E.) and results of Duncan's Multiple Range test (1) of differences between means of body weight traits.

Classification	Birth weight (kg)			4-Month weight (kg)			Yearling weight (kg)		
	N	$\bar{x}$	S.E.	N	$\bar{x}$	S.E.	N	$\bar{x}$	S.E.
Overall mean . .	15186	2.95	0.042	7421	19.28	0.112	4117	32.99	0.096
Farm									
Abis.	2851	3.14a	0.015	2170	18.76a	0.117	657	37.89a	0.149
Paul Place . . .	1531	2.77b	0.026	986	17.46b	0.179	291	34.61b	0.217
Salhiah	2061	3.48acd	0.209	347	16.64c	0.290			
Saft Khaled . .	1649	2.03e	0.123	1208	22.07d	0.175	1096	29.37c	0.147
Yousofih	3067	3.04e	0.031	2710	21.42e	0.143	2073	30.08d	0.142
Kom Osheim. .	4026	3.26d	0.038						
Year of birth									
1969	3823	3.29a	0.043	2145	20.55a	0.144	1782	32.41a	0.103
1970	4922	2.79b	0.043	2177	17.53b	0.150	1363	32.15a	0.131
1971. . . .	6441	2.79b	0.043	3099	19.75c	0.145	972	34.40b	0.153
Season of birth									
Nov. - Apr. . .	13643	3.10a	0.008	6319	18.91a	0.099	3399	31.50a	0.104
May - Oct. . .	1543	2.81b	0.084	1102	19.64b	0.189	718	34.48b	0.170
Sex									
Males	7701	3.00a	0.042	3720	19.29a	0.126	1920	33.05a	0.113
Females	7485	2.91b	0.043	3701	19.26a	0.126	2197	32.93a	0.107
Type of birth									
Singles . . .	11983	3.20a	0.042	6051	19.32a	0.105	3326	33.05a	0.090
Twins	3203	2.70b	0.043	1370	19.23a	0.159	790	32.93a	0.140

(1) Within each classification, those means followed by the same letter do not differ significantly from each other, otherwise they do differ significantly at $P < 0.05$.

TABLE 2. Least squares analysis of variance for body weight traits.

Source of variation	Birth weight		4-Month wt.		Yearling wt.	
	d.f.	MS.	d.f.	MS.	d.f.	MS.
Farm	5	27.603*	4	5246.670*	3	7069.441*
Year of birth . .	2	270.941*	2	4833.542*	2	1396.833*
Season of birth.	1	6.031*	1	329.815*	1	2467.645*
Sex	1	31.813*	1	2.795	1	14.955
Type of birth . .	1	626.859*	1	7.923	1	8.967
Farm × Season .	5	1.609*				
Residual	15170	0.522	7411	24.850	4108	12.022

*$p < 0.01$

TABLE 3. Percentage of the total variance in body weight traits attributed to the different sources of variation.

Source of variation	Birth weight	4-Month wt.	Yearling wt.
	V%	V%	V%
Farm	6.42	13.97	38.76
Year of birth	7.80	7.70	4.92
Season of birth	4.61	0.78	15.17
Sex	0.51	0.0	0.0
Type of birth	15.57	0.0	0.0
Farm × season.	0.25		
Residual	64.84	77.55	41.15
Total variance (kg^2)	0.80	32.04	29.22

Type of birth exerted larger effect on birth than all other non-genetic factors studied and was responsible for 15.57% of the total variance of birth weight (Table 3). Yet, type of birth accounted for none of the variation on body weight at four-month and one year old lambs.

The importance of type of birth on birth weight was also reported by Vesely *et al.*(1970), who found that type of birth exerted more effect on birth weight than other environmental factors included in their studies. Many studies also indicated the decreasing effect of type of birth on body weight as lambs grew older. Hazel and Terrill (1945), found that type of birth accounted for only 0.5% in 4 month weight of Rambouillet sheep. El-Tawil *et al.* (1970), found that type of birth accounted for 16.61 % of the total variation in birth weight, but for only 1.14% of the variation in yearling weight of Novajo and Novajo crossbreds. Similar results were arrived at by Botkin *et al.* (1956); Cassard and Weir (1956); Fahmy *et al.* (1969 a,b) and Gjedrem (1969).

The decrease of the effect of type of birth with the advance of age might be attributed to that birth weight was affected by pre- natal environmental conditions. Gjedrem (1967) found that the prenatal effect on body weight of lambs at weaning dropped to 22% of what it was at birth. After birth, the competition of lambs for their mothers' milk might affect weaning weight. But, in the farms where artificial feeding on cow's milk was practiced for orphans and twins born to low- producing ewes and creep feeding was used for supplementation before weaning, the effect of type of birth would be masked by the managerial and feeding practice applied on the lambs.

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أثر بعض العوامل غير الوراثية على التباين فى وزن الجسم فى ستة قطعان تجارية من الأغنام المرينو فى مصر

أحمد سعيد عبد العزيز ، محمد توفيق رجب ، ممدوح عبد الوهاب شرف الدين
و السيد احمد امام
كلية الزراعة ، جامعة القاهرة ، الجيزة

تناولت الدراسة أوزان (١٥١٨٦) حملا من اغنام المرينو الالمانى عند الميلاد، (٧٤٢١) عند سن ٤ شهور ، (٤١١٧) عند سن سنة ولدت فى ٣ سنوات متتالية من عام ١٩٦٩ حتى عام ١٩٧١ فى ستة مزارع تتبع المؤسسة المصرية العامة للحوم والالبان موزعة على أنحاء مختلفة من القطر المصرى •

استخدمت طريقة الحد الأدنى للمربعات لتحليل التباين وذلك لفصل التباين فى أوزان الجسم الثلاثة الى أجزاء تعزى الى أثر المزرعة ، سنة الميلاد، موسم الميلاد ، الجنس ، نمط الميلاد (مفرد او توأم) وقد ادخل أثر التداخل البيئى بين المزرعة وموسم الميلاد فى تحليل وزن الميلاد فقط •

وجد أن المتوسط العام لوزن الجسم كان (٢٫٩٥) كجم عند الميلاد ، (١٩٫٢٨) كجم عند سن ٤ شهور ، (٣٢٫٩٩) كجم عند سن سنة •

ووجد أن جميع العوامل التى تمت دراسة أثرها على صفات الجسم الثلاثة كانت معنوية على مستوى ٠٫٠١ ماعدا الجنس ونمط الميلاد اللذان لم يكونا معنويين الا على وزن الميلاد فقط •

ووجد أن جميع العوامل البيئية التى درست تكون ٣٥٫١٦٪ ، ٢٢٫٤٥٪ ، ٥٨٫٨٥٪ من مكونات التباين الكلى فى وزن الميلاد وفى الوزن عند سن ٤ شهور وفى الوزن عند سن سنة على الترتيب ، كما وجد أن ١٣٫٩٧ ٪ ، ٣٨٩٫٧٦٪ من التباين الكلى فى وزن ٤ شهور وفى الوزن عند سن سنة على الترتيب كان يعزى الى أثر المزرعة •