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EFFECT OF INBREEDING ON BIRTH AND WEANING WEIGHTS AND KID MORTALITY IN A CLOSED HERD OF ZARAIBI GOATS

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SUMMARY

A total of 6015 records observed over 15 years, starting in 1984, were collected from a closed population of Zaraibi goats raised at El-Serw experimental farm of the Ministry of Agriculture to study the effect of inbreeding on birth weight (BW), adjusted weaning weight at 90 days (AWW), kid mortality at birth (STB) and kid mortality from birth to 15 days of age (M15).

The coefficient and the annual rate of inbreeding were calculated utilizing the pedigree data for all individuals. All traits were analyzed utilizing a fixed model including main effects of sex of kid (S), type of birth of kid (T), season (N) and year (Y) of birth and age of doe (D) as well as linear partial regression on kid's and doe's inbreeding. The interactions of S x T, S x N, S x Y, S x D, T x D and N x D were also included in the model.

The average annual inbreeding coefficients (F) were all below 3% and the average annual increase in inbreeding rate (ΔF) was 0.13%. Over all years, the maximum individual inbreeding coefficient was 31.3% and the maximum increase in inbreeding rate was 0.58%. Individual's inbreeding coefficient had an effect (P<.05) on BW and M15, while the doe's inbreeding coefficient had an effect (P<.05) on STB. Each 10% increase in the inbreeding coefficient of the kid was associated with a change of -40 g, -100 g, +1.4% and +1.8% in BW, AWW, STB and M15, respectively. Meanwhile, each 10% increase in the inbreeding coefficient of the doe was associated with a change of -40 g, +150 g, +3.8% and +0.5% in the kid BW, AWW, STB and M15, respectively. It was recommended that the mating of closely related animals must be avoided through keeping proper records and the regular use of the available technology (i.e. computer software) to calculate inbreeding coefficients of the potential matings.

Keywords: Inbreeding coefficient, Zaraibi goats, birth weight, weaning weight, kid mortality

INTRODUCTION

Goat population in Egypt is about 4.8 million head. Zaraibi goat population (few thousands) constitutes only a very minor part of the whole population. It is generally distinguished for its higher milk production and prolificacy in comparison with other Egyptian breeds (Abdel-Raheem, 1997). In 1983, Ministry of Agriculture started a nucleus herd to conserve and develop this breed. Minimization of inbreeding coefficient has always been emphasized in any breeding program. The level of inbreeding of an individual depends on how closely its parents are related. The objective of this study was to analyze levels of inbreeding and investigate the occurrence of inbreeding depressions, if any, for birth weight, adjusted weaning weight at 90 days, kid mortality at birth and kid mortality from birth to 15 days of age.

MATERIALS AND METHODS

Data on birth weight (BW), adjusted weaning weight at 90 days of age (AWW), kid mortality at birth (STB) and kid mortality from birth to 15 days of age (M15) were collected from a closed population of Zaraibi goats. Animals were raised at El-Serw experimental farm belonging to the Animal Production Research Institute, Ministry of Agriculture, located in the Northeast part of Nile Delta (latitude 31° 15' N, longitude 31° 45' E).

The data comprise 6015 records observed over 15 years, starting in 1984. The base population consisted of 21 bucks and 315 does, purchased during the years 1983-1990 in a conservation and improvement program.

Animals were housed in semi-open sheds. Feeds were made available of Egyptian clover and rice straw in addition to concentrate mixture during the period from October to May. Clover hay and concentrate mixture were available during the rest of the year. The concentrate mixture consisted of

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cottonseed cake, maize, wheat bran and rice bran, calcium carbonate and sodium chloride. The mixture included 16% crude protein, 3% crude fat and 15% crude fiber, on the average. Water was offered twice daily in early morning and late afternoon.

Does were run in mating groups once a year with fertile bucks when they reached 18 months. The majority of kids (75%) were born during the main kidding season (February), while the rest of kids (25%) were born in June and October kidding seasons.

Selection within the herd was done based on milk, reproductive performance and phenotypic traits, particularly body size (Abdel-Raheem, 1997). All individuals in the base population were assumed unrelated with an inbreeding coefficient of zero.

A total of the 542 kids born in 316 litters were from unknown sires. A unique number was assigned for each sire to denote the full-sib relationship within such litters. The assumption that those sires were non-inbred was made.

The coefficients of inbreeding were calculated utilizing the pedigree data for all individuals and using the algorithm of Boldman *et al.* (1993). The annual rate of inbreeding (ΔF_t) was calculated as: $\Delta F_t = (F_t - F_{t-1}) / (1 - F_{t-1})$ where, F_t is the average inbreeding coefficient of individuals born in year t (Falconer, 1989).

All traits were analyzed using Harvey's Mixed Model (1990). The mathematical model included main effects for sex of kid (S), type of birth of kid (T), birth season (N), year of birth (Y) and age of doe (D), and the interactions of S x T, S x N, S x Y, S x D, T x D and N x D, as well as linear partial regression of the trait on inbreeding coefficient of kid and of doe. The quadratic regression for the studied traits on inbreeding coefficient of kid and of doe were included in a preliminary model and omitted because they were non-significant and contributed only marginally to the model sums of squares. Kids born in litters of 4 or more were grouped into one category designated as 4. Age of doe was classified into five age classes (17-26, 27-43, 44-71, 72-98 and greater than 98 months).

RESULTS AND DISCUSSION

Inbreeding

Descriptive statistics for inbreeding coefficients across years are shown in Table 1. Average annual inbreeding coefficients (F) were all below 3% and the average annual inbreeding rate (ΔF) was 0.13%. Over all years, the maximum individual inbreeding coefficient was 31.3% (1995, Table 1) and the maximum inbreeding rate was 0.58% (1986, Table 1). In a breeding program, not only the magnitude of inbreeding (F) is of importance, the rate of increase in inbreeding (ΔF) is also of significant importance because the latter measures how many more years a population can be kept before reaching a critical inbreeding level (Pante *et al.*, 1998). There are no estimates on tolerable rates of inbreeding in goat populations. The rates may vary depending on the degree of depression in production and traits considered.

The estimates of annual inbreeding coefficients and inbreeding rates in this study were generally underestimated because of the assumption that animals in base population and the unknown sires were non-inbred and non-related. Inbreeding coefficients in earlier years (up to 1991) were low because of constructing the base population during this period. During the period of expansion (from 1991 to 1998) very little genetic material was brought in from outside the herd. The use of own-herd bucks on related females caused the increase in inbreeding. The practice to mate closely related animals occurred often. This resulted in three triplet individuals, born in 1995, with an inbreeding coefficient of 31.3%. The pedigree of those litter mates is shown in Figure 1.

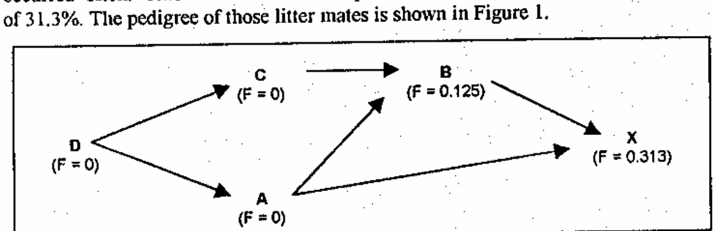

Figure 1. Pedigree of an individual (X) with an inbreeding coefficient of 31.3%.

Table 1. Number of Zaraibi kids, percentage of inbred animals (PIA%), average annual inbreeding coefficient (F), annual change in inbreeding rate (ΔF) and maximum individual inbreeding coefficient (MF) during the period from 1984 to 1998 at El-Serw experimental station

Year	Number	PIA%	F	ΔF	MF
1984	11	0.0	0.0000	-	0.000
1985	96	6.2	0.0006	0.06%	0.033
1986	159	16.9	0.0064	0.58%	0.066
1987	196	3.0	0.0011	-0.53%	0.063
1988	230	1.7	0.0034	0.23%	0.250
1989	304	4.2	0.0059	0.25%	0.250
1990	350	3.1	0.0034	-0.25%	0.125
1991	407	7.6	0.0076	0.42%	0.250
1992	505	12.4	0.0113	0.38%	0.125
1993	658	19.7	0.0156	0.43%	0.250
1994	734	27.3	0.0177	0.21%	0.250
1995	644	36.1	0.0220	0.44%	0.313
1996	620	39.8	0.0206	-0.15%	0.250
1997	744	44.4	0.0194	-0.12%	0.250
1998	357	54.6	0.0195	0.01%	0.176
Overall	6015	24.9	0.0142	0.13%	0.313

Effect of inbreeding

The effects of inbreeding on growth and mortality traits are shown in Table 2, where the linear regressions of trait on inbreeding of the kid and of the doe are presented. The effects of inbreeding were detrimental STB and M15.

The results indicated that, the individual's inbreeding coefficient had an effect (P<.05) on BW and M15, while the doe's inbreeding coefficient had an effect (P<.05) on STB. Each 10% increase in the inbreeding coefficient of the kid was associated with a change of -40 g, -100 g, +1.4% and +1.8% in its BW, AWW, STB and M15, respectively. Meanwhile, each 10% increase in the inbreeding coefficient of the doe was associated with a change of -40 g, +150 g, +3.8% and +0.5% in the kid BW, AWW, STB and M15, respectively. These results are in agreement with Seifert *et al.* (1992) and Seifert and Reissmann (1993). In sheep, Lamberson and Thomas (1984) reviewed the effects of inbreeding on ewe and lamb performance as observed in 25 studies and concluded that the traits that showed the greatest decrease in performance as level of inbreeding increased were ewe fertility and lamb survival.

Table 2. Regression coefficients (b) with standard errors (SE) of birth weight (BW), adjusted weaning weight (AWW), kid mortality at birth (STB) and kid mortality from birth to 15 days (M15) on coefficient of inbreeding of kid and of doe of Zaraibi goats

Trait	N	μ	Inbreeding of kid		Inbreeding of doe	
			b	SE	B	SE
BW	4832	1.98 kg	-0.004 *	0.001	-0.004	0.002
AWW	2982	12.80 kg	-0.010	0.014	+0.015	0.020
STB	6015	15.50%	+0.14%	0.12%	+0.38% *	0.17%
M15	4959	5.60%	+0.18% *	0.08%	+0.05%	0.11%

* P < 0.05

CONCLUSIONS

Breeders should avoid mating of closely related animals. This can be achieved through proper record keeping and the regular use of the available technology (i.e. computer software) to calculate inbreeding levels of the potential matings.

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