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EFFECT OF INBREEDING ON PREWEANING GROWTH TRAITS AND SURVIVAL RATE IN SAKIZ SHEEP

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ABSTRACT

The objective of this study was to estimate the effect of inbreeding on birth weight (BW), weaning weight (WW90), and lamb survival rate (LSR) in Sakız sheep. The effect of inbreeding on BW, WW90, and LSR traits was studied by analysis of variance technique and regression method. Inbreeding had a significant effect on BW and the regression coefficient of inbreeding on BW was -0.0245±0.0076 kg ($P<0.01$). The mean level of inbreeding (F) of all animals overall years was 2.25% for lambs. The inbred lambs rate was 17.7%. The coefficient of inbreeding ranged from 6.25% to 25.0% and average was 12.68% for birth weight in inbred lambs. Inbreeding weren't a significant effect on weaning weight at 90 days of age and lamb survival rate. It was concluded that inbreeding showed deleterious effects on birth weight and had a no effect on lamb's weaning weight and survival rate.

Key words: Inbreeding, Sakız sheep, Preweaning growth, Lamb survival

INTRODUCTION

Sakız sheep is one of the most important Turkish breed of sheep famous for high milk production and prolificacy. The home tract of this breed includes Aegean region surrounding Izmir in Turkiye. Approximately 50-60 thousand heads of Sakız sheep are present in the country (Kaymakçı, 2006).

Any genetic improvement programs applied for livestock are based on two main approaches: selection and breeding systems. Intensive selection within a single population reduces the genetic variability and increases the rate of inbreeding as compared to crossbreeding. The inbreeding is thought to be a useful tool to improve the sheep population by increasing the frequency of desirable genes, but also leads to economic losses. The inbreeding level is considerably influenced by the ratio of males to females, reproduction ability, mating system, and population size (Norberg and Sorensen, 2007, Barczak *et al*., 2009). Inbreeding is the mating of related individuals, and results in some loci bearing alleles that are identical-by-descent. Identity by descent occurs because alleles from one common ancestor may flow through multiple offspring (Michelle, 2003).

The objective of this study is to determine the effect of inbreeding on birth, weaning weight and lamb survival rate on Sakız lambs.

MATERIALS AND METHODS

Experimental flock of Sakız breed was raised at the Marmara Livestock Research Institute (MLRI) for animal genetic resource conservation project since 1992. At the beginning of the project, experimental flock consists of approximately 20-25 ewes and 2-4 rams. In 2000s flock consists of 80-150 ewes and 4-10 rams (Ceyhan *et al*., 2009). The study was carried out at the MLRI in Marmara region of Turkey, during seven years; 2002 through 2008. The research station is located at latitude: $27^0$57N, longitude: $40^0$21E and 65 meter altitude and annual precipitation is 500-800 mm, in the Marmara region of Turkey. The climate is predominantly Mediterranean; however dry season aridity is not as great as along the Mediterranean cost. Average temperatures are 23-27 ^{0}C in the warmest months and 1-8 ^{0}C in the coldest months, with mean annual rainfall precipitation of 500-800 mm per annum over the data collection periods.

The experimental flock reared indoor during the winter months and sent for pasture grazing when the weather conditions improved. Experimental animals sheared approximately one month before the start of breeding season and 400-600 g concentrate mixture per animal was given as flushing ration, similar program was adopted before the lambing season.

Mating season consist of 45-60 day starting from 15th June to 15th August during the whole study period. All lambs were weighed and ear tagged (within 12 hour of the birth) and kept separately with their dams in separate stalls for 3 days after lambing. The lambs were allowed to suckle their mothers twice a day. At the age of 15 days lambs were fed creep-feed concentrate and good quality alfalfa hay ad libitum for 3 months and weaned at the age of 90 days. Weaned lambs reared separately by sex group, roughages were given ad libitum and

concentrate mixture was given approximately 200 g per lamb per day.

There was no method of intensive selection due to the limitation of the animal genetic resource project. The average age at first breeding for the ewes was 18 months in this flock. Breeding rams and ewes were selected on the basis of phenotype at the age of one year.

Data Collection: The Sakız flock was transferred from Kumkale State Farm, and has been maintained in MLRI. Data included the pre-weaning performance of 350 Sakız lambs born during seven lambing seasons from 2002 to 2008. The pedigrees information of Sakız flock has consist of 20 ewes and 2 rams in 2002 and 33 ewes and 2 rams in 2003, 21 ewes and 2 rams in 2004, 35 ewes and 2 rams in 2005, 41 ewes and 3 rams in 2006, 23 ewes and 2 rams 2007 and 40 ewes and 2 rams in 2008. Rams were also replaced in 2005 in order to decrease inbreeding from province of İzmir native Sakız breeder.

The lamb preweaning traits considered in this study birth (BW) and weaning weight at 90-d (WW90), were taken a scale sensitive to 50 g, and lamb survival rate (LSR) birth to weaning age (90 d).

Statistical Procedures: Data were analyzed using the General Linear Models (GLM) procedure (Orhan *et al*., 2004). The model included the effects of sex of lamb, type of birth, year of birth and age of dam and as well as linear partial regression of the trait on inbreeding coefficient of lamb. The algorithm of SAS, (1998) was used to calculate the coefficients of inbreeding utilizing pedigree data of all individuals. Assumptions were made that all lambs in the first year (2002) had an inbreeding coefficient of zero.

RESULTS AND DISCUSSION

Inbreeding: The regression coefficients for inbreeding on the studied traits are shown in Table 1. The effect of inbreeding on BW was found to be significant (P<0.01) and inbreeding had a non significant effect on WW90. The mean level of inbreeding (F) of all animals overall years was 2.25% for lambs. 17.7 % of all investigated animals were inbred, 70.8% of which had inbreeding greater than 12.5%. About 10.8% of animals were 25% or more inbred. The coefficient of inbreeding ranged from 6.25% to 25.0% and average was 12.68% for birth weight in inbred lambs.

The inbreeding coefficient (F) generally increased with the years in Sakız flock. The value for inbreeding coefficient of the present study is lower than the values reported by van Wyk *et al*., 2009, Smulders *et al*., 2007, Alsheikh, 2005, Akhtar *et al*., 2000 and Mirza *et al*., 1999. On the other hand, results of the present investigation are in agreement with 1.63% for Muzaffarnagari lambs (Ajoy *et al*., 2006), 1.879% for Manchega lambs (Smulders *et al*., 2007) and 0.0072% for Baraki lambs (Alsheikh, 2005), 0.012 for Dohne Merino lambs (Swanepoel *et al*., 2007). It was observed that the average inbreeding coefficient (Fx) increased due to the reason that inbred males and female individuals belonging to the same population or flock are mated together.

Preweaning Growth Traits: The effect of inbreeding on the birth weight (BW) and weaning weight (WW90) are shown in Table 1. The effect of dam's age, year of birth, birth type, sex of lamb and inbreeding coefficient (Fx) on BW was found to be significant. The effect of year of birth, birth type and sex of lamb were significant on WW90, while age of dam and inbreeding coefficient were non significant effect on WW90. The average values for BW and WW90 were 3.430 kg and 23.842 kg, respectively. The effect of BW and weaning age regression on WW90 were significant (P<0.01) for Sakız lamb. The inbreeding depression was estimated using all the records (Table 1) and slopes were -0.0245 ± 0.0076 kg for birth weight. It means that an increase in the 1 % level of inbreeding the birth weight decrease 0.0245 kg. The effect of inbreeding on production traits has been documented by many workers in different breeds of sheep (van Wyk *et al*., 2009, Hussain *et al*., 2006, Alsheikh, 2005, Akhtar *et al*., 2000, Analla *et al*., 1999, Mirza *et al*., 1999, Kaygısız *et al*., 1993).

Table 1. Inbreeding coefficient means and standard error of BW and WW90 in Sakız lambs.

Factors investigated	BW		WW90	
	N	X ± SE	n	X ± SE
Mean	350	3.430 ± 0.688	292	23.470 ± 5.171
Age of dam		**		NS
Years		*		*
Birth type		**		**
Sex		**		**
Inbreeding coefficient (Fx)		**		NS
% 0	302	3.501 ± 0.045a	242	23.842 ± 1.095
% 6.25 – 12.5	48	3.196 ± 0.092a	40	21.240 ± 0.790
% 15.6-25.0	17	2.818 ± 0.200b	10	23.380 ± 1.220
F (Average) % (Model-2)		2.25 ± 5.41		
F (regression)		0.0245^{**} ± 0.0076		-0.0234^{NS} 0.0737
BW				2.2651^{**} ± 0.4757
Weaning age				0.1202^{**} ± 0.0171

*; P<0.05, **P<0.01; NS: Nonsignifcant). Fx: Inbreeding coefficient. n =Number of animal, X =Means, SE =standard error.

The results of the present study are in agreement with the findings of Norberg and Sorensen, (2007) inbreeding trend and inbreeding depression in the Danish populations of Texel Shropshire, and Oxford Down lambs, Alsheikh, (2005) effect of inbreeding on birth and weaning weights and lamb mortality in a flock of Egyptian Barki Sheep, Carolino *et al*., (2004) inbreeding

and inbreeding depression in a Churra Badana sheep flock, Analla *et al*., (1999) study of the variability of the response to inbreeding for meat production in Merino sheep, Kaygısız *et al*., (1993) the effect of inbreeding on some qualitative and quantitative phenotypes in sheep population, Ercanbrack and Knight, (1991) effects of inbreeding on reproduction and wool productıon of Rambouıllet, Targhee, and Columbia ewes.

The results of the present study are also in agreement with the findings of Jack *et al*., (2007) that selection for scrapie resistance and simultaneous restriction of inbreeding in the rare sheep breed, Hussain *et al*., (2006) and Mirza *et al*., (1999) reported significant effect of inbreeding on body weight in Thali and Lohi sheep respectively.

Lamb Survival Rate: The average lamb survival rate for Sakız lambs are given in Table 2. The effect of age of dam, birth type, sex and inbreeding coefficient (F) on LSR were found to be non significant, whereas the effect of years was significant (P<0.05). This study did not show regression coefficients of significance (P>0.05) for lamb survival rate, but the effect on lamb survival rate was 0.01125±0.01893 and positive. The mean level of inbreeding (F) of all animals overall years was 2.00% for lamb survival. Average 17.12 % of all investigated animals were inbred, 20.0% of animal which had inbreeding greater than 12.5%. About 80.0% of animals were 25% or more inbred. The coefficient of inbreeding ranged from 6.25% to 25.0% for lambs survival.

Table 2. Average means and standard error for lamb survival rate.

Factors investigated	LSR		
	n	X	SE
Mean	292	0.796 ± 0.394	
Age of dam		NS	
Years		*	
Birth type		NS	
Sex		NS	
Inbreeding coefficient (Fx)		NS	
% 0	242	0.801 ± 0.023	
% 6.25 – 12.5	40	0.833 ± 0.054	
% 15.6-25.0	10	0.588 ± 0.123	
F (Average) %		2.00	
F (regression)		NS	
BW		-0.01613 ± 0.02239	
F (Inbreeding coefficient)		0.01125 ± 0.01893	

*; P<0.05, **P<0.01; NS: Nonsignifcant, Fx: Inbreeding coefficient, n =Number of animal, X =Means, SE =standard error.

The present results are in close agreement with the findings of van Wyk *et al*., (2009) in Elsenburg Dormer sheep, Alsheikh, (2005) in Barki sheep, Amer and Jopson, (2003) New Zealand sheep, Ercanbrack and Knight, (1991) Rambouillet, Targhee, and Columbia Ewes, William *et al*., (1982) hampshire lambs survival. These workers reported that the inbreeding coefficient of the lamb had a significant effect on lamb survival rate (P<0.05). On contrary findings of the Alsheik, (2005) and Ercanbrack and Knight, (1991) are not in agreement with the findings of the present study.

Conclusion: The level of inbreeding was comparatively low in the Sakız Sheep flock in our study, due mainly to twice introduction of unrelated does and rams during the study period. The negative effect of inbreeding was seen on birth weight. The continuous rise in the level of inbreeding over the years however, warns that matings in the future should be more planned to avoid matings of close relatives. Increase in number of breeding males and their more frequent replacement would help reduce the level of inbreeding.

It was concluded that inbreeding showed deleterious effects on birth weight and had no effect on lamb's weaning weight and survival rate.

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