Effect of Genetic and Non-Genetic Factors Other Than Disease on Kid Survivability in Goat

G. Miah*, S. S. Husain*, M. A. Hoque* and D. H. Baik**

Department of Animal Breeding & Genetics, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh*, Department of Animal Resources and Biotechnology, Chonbuk National University, Chonju 561-756, Korea**

산양의 생존율에 대한 유전적 및 비유전적 요인

G. 미아* · S. S. 후세인* · M. A. 호크* · 백동훈**

방글라데시 농과대학 동물육종유전학과*, 전북대학교 농과대학**

ABSTRACT

This experiment was conducted to investigate the genetic and non-genetic factors affecting kid survivability in goats from birth to 90 days of age. The purebreds had lower survivability than the crossbreds, with significant ($p<0.05$) difference amongst themselves for the age of 31 to 90 days. The locational effect on survivability was insignificant for all the periods except 16 to 60 days ($p<0.05$) of age. The sex and birth type also had significant ($p<0.05$) effect on survivability for all the periods except 0 to 7 days of age. The survivability was found to be significantly ($p<0.05$) higher for kids born in summer season followed by those born in winter and rainy season. Milk produced by the does were significantly ($p<0.05$) affected on the survivability of kids during the period from 16 to 60 days of age. The survivability of kids were highest and lowest having milk yield of doe found to be 400~600 g/day and 80~200 g/day, respectively. Birth weight had significant ($p<0.05$) effect on survivability for all the stages of growth up to 90 days of age. Survivability was positively correlated with does' milk yield as well as kids birth weight. Interactions of sex with location or birth type were significant ($p<0.01$ and $p<0.05$, respectively) though interaction between sex and genetic group was insignificant.

(**Key words** : Genetic group, Kid survivability, Season, Crossbreeding, Birth weight, Milk yield)

I. INTRODUCTION

In the tropics and subtropics kid mortality adversely affects goat production. High level of kid mortality represents a significant barrier to increased productivity in goat keeping (Sherman 1987). There are many factors, which influence higher kid mortality. The mortality is higher in small breeds due to low birth weight, large litter size and less milk produced by does. Season and type of birth also have significant effect on kid mortality (Acharya, 1987). The first 30 days after birth is the most critical period and require special management in intensive systems. Kid

Corresponding author : D. H. Baik, Department of Animal Resources and Biotechnology, Chonbuk National University, Chonju 561-756, Korea. Email : baik@chonbuk.ac.kr

mortality is the highest at parturition and just after parturition (Osuagwuh and Akpokodje, 1982; Chawla et al., 1982).

Black Bengal goat is dwarf typed and regarded as very potential source of the production of high quality meat and skin. In the rural areas high mortality of the kids is regarded as the most important constraint in goat production. This can only be faced by creating favorable environment for improving the reproductive efficiency and reducing the unexpected rate of mortality. In respect of fertility, fecundity, prolificacy and adaptability, Black Bengal goats are found to be very famous and outstanding. But on the other hand, relatively low birth weight, slow growth rate and insufficient milk produced by does were identified as the major constraints directly associated with higher kid mortality and this is responsible for reduction of the total productivity (Husain, 1993).

Although, the value of goats and their contribution to national economy and livestock sector are well established, very little emphasis has been given for reducing kid mortality. It seems thus reasonable to investigate the relevant factors responsible for kid mortality. The present study was undertaken to investigate the genetic and non-genetic factors affecting kid survivability in goats and to estimate the relationship of different factors with kid survivability.

II. MATERIALS AND METHODS

This experiment was prosecuted at two different locations viz. (i) the vicinity of Bangladesh Agriculture University (BAU) and (ii) Bhabakhali area (BKA) in Mymensingh district from May 1996 to July 2000 under the project of goat breeding experiment conducted at the Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh. Kids of this experiment belong to either of the three genetic groups viz. Jamunapari ♂ × Black Bengal ♀ (JBB), selected Black Bengal ♂ × selected Black Bengal ♀ (SBB) and random Black Bengal ♂ × random Black Bengal ♀ (RBB). Kids belonging to group JBB were first generation (F_1) crossbred and those of group SBB were obtained from first generation selected line where both parents were selected on the basis of faster growth rate as described by Amin et al. (2000). Kids of group RBB were produced from the parents chosen randomly. All the experimental kids were maintained by the farmers under their control and fed on dam's milk, grass, herbs and tree leaves. The overall management and feeding were almost similar for the three genetic groups under each location. Initially two bucks of each group of Jamnapari, selected Black Bengal and random Black Bengal were made available in each location. Bucks were kept by the field assistant in the respective location. In the beginning of the experiment, all the goats were individually ear tagged. The signs of heat were observed in the morning and evening and does in heat were mated naturally with the bucks specified for each group. Separate record sheets for each of the individual doe and kid were prepared and maintained accordingly. The weight of new born kids were taken within 6 hours after kidding and the number of kids born per birth per doe was termed as type of birth. The quantity of milk produced by the doe was estimated by milking the animal once in a week starting from 7th day of kidding. Milking was done in the morning keeping kids separate from the doe during the previous night. To determine the influence of season on kid survivability the experimental period was divided into summer (March-June), rainy (July-October) and winter (November-February) were considered in this study.

The observation for each factor was unequal. The number of animals varied from class to class and sub-class to sub-class. Hence, it confirmed to the characteristics of non-orthogonal factorial experiment. To minimize this situation, data analysis was performed across the litter by SAS statistical computer package program (1990). The statistical model used for the analysis of kid survivability was as follows:

$$Y_{jklmnop} = \mu + L_j + G_k + S_l + T_m + W_n + X_o + (L\times S)_{jl} + (G\times S)_{kl} + (T\times S)_{ml} + e_{jklmnop}$$

Where,

$Y_{jklmnop}$ = individual litter record
μ = common mean
L_j = effect of location (j=1-2)
G_k = effect of genetic group (k=1-3)
S_l = effect of kid's sex (l=1-2)
T_m = effect of birth type (m=1-4)
W_n = effect of season (n=1-3)
X_o = effect of year (o=1-5)
$(L\times S)_{jl}$ = interaction effect between location and kid's sex
$(G\times S)_{kl}$ = interaction effect between genetic group and kid's sex
$(T\times S)_{ml}$ = interaction effect between birth type and kids sex
$e_{jklmnop}$ = residual error

Least Significant Difference (LSD) test was performed to separate means in group of significant difference among themselves according to the method described by Shil and Debnath (1995).

III. RESULTS AND DISCUSSIONS

The effects of location, genetic group, kid's sex, birth type and season on survivability of kids are presented in Table 1. Amongst the genetic groups the survivability were highest in JBB and lowest in RBB. SBB stood intermediate in position. The differences of survivability between different genetic groups were insignificant for all stages of growth except ($p<0.05$) 31 to 60 and 61 to 90 days of age. In 31 to 60 and 61 to 90 days of age the survivability of kids between JBB and SBB were significantly ($p<0.05$) different but RBB was insignificant with JBB and SBB for both the periods. It is clearly stated that the purebred had lower survival rate than crossbreds with no significant difference amongst themselves. Singh (1991) stated that the difference in survivability due to genetic group was significant during 0 to 15 ($p<0.01$) and 31 to 60 ($p>0.05$) days of age. The significant variation in survivability due to different genetic groups was in conformity with the findings of Mazumder et al. (1980) and Gupta and Sengar (1985).

The effect of location on survivability was insignificant in different age except ($p<0.05$) 16 to 30 and 31 to 60 days of age. BAU had almost the higher survivability than BKA. These results are in agreement with the results of Husain et al. (1995) who reported that the regional effect on survival rate was significant ($p<0.01$) for the period from birth to 90 days of age. Low survival rate of kids in BKA may be the result of low birth weight and faulty husbandry system of goats by the farmers.

The effect of sex on survivability was insignificant from day of birth to 7 days of age but significant ($p<0.05$) from 8 to 15, 16 to 30 and 31 to 60 and 61 to 90 days of age. The survivability of the male kids were higher than female kids for all stages of growth. This might be mainly due to higher birth weight of male kids as compared to female kids. Husain et al. (1995) reported that the effect of sex on survival rate was significant ($p<0.01$) for birth to 1 and birth to 3 months of age. The present findings are also consistent with the results of Singh et al. (1990) and Gupta and Sengar

Table 1. Least squares means with standard error for survivability of kids in different age

Parameter	n	Survivability (%)				
		Birth to 7 days	8 to 15 days	16 to 30 days	31 to 60 days	61 to 90 days
Genetic Group						
JBB	345	95.0±1.7	90.5±2.2	81.3±2.8	78.0^{a}±3.1	76.2^{a}±3.3
SBB	456	94.8±1.4	90.1±1.8	80.4±2.2	75.9^{b}±2.5	73.7^{b}±2.7
RBB	281	93.5±1.7	88.3±2.2	78.7±2.7	76.6^{ab}±3.1	75.8^{ab}±3.3
Location						
BAU	896	94.9±1.2	89.8±1.6	82.9^{a}±2.0	78.9^{a}±2.3	76.1±2.4
BKA	186	94.0±1.8	89.4±2.4	77.4^{b}±3.0	74.7^{b}±3.4	74.4±3.6
Kids Sex						
Male	541	97.6±1.6	92.8^{a}±2.1	86.4^{a}±2.6	82.7^{a}±2.9	80.9^{a}±3.1
Female	541	91.3±2.0	86.4^{b}±2.7	74.0^{b}±3.3	70.9^{b}±3.8	69.6^{b}±4.0
Birth type						
Single	284	95.6±1.3	94.4^{a}±1.7	89.9^{a}±2.1	87.4^{a}±2.4	86.3^{a}±2.5
Twin	635	96.7±1.0	93.8^{a}±1.3	87.5^{a}±1.6	84.9^{ab}±1.8	83.1^{ab}±1.9
Triplet	138	92.9±1.8	85.5^{b}±2.4	79.9^{a}±2.9	74.6^{bc}±3.3	71.9^{bc}±3.6
Quadruplet	25	92.5±4.2	84.8^{b}±5.5	63.3^{b}±6.8	60.5^{c}±7.7	59.7^{c}±8.2
Season						
Summer	314	94.9±1.6	90.1±2.1	79.8±2.6	77.4^{a}±3.0	75.7^{a}±3.2
Rainy	307	93.7±1.6	89.3±2.2	80.7±2.7	74.7^{b}±3.0	72.4^{b}±3.2
Winter	461	94.7±1.5	89.4±2.0	80.0±2.4	77.3^{a}±2.8	75.6^{a}±2.9

Means with uncommon superscript(s) in the same column of same parameter differ significantly ($p<0.05$).
n = initial number of observation.
BAU = Bangladesh Agricultural University.
BKA = Bhabakhali Area.
JBB = Jamunapari ♂ × random Black Bengal ♀.
SBB = selected Black Bengal ♂ × selected Black Bengal ♀.
RBB = random Black Bengal ♂ × random Black Bengal ♀.

(1985).

The effect of birth type on survivability of kids was insignificant from day of birth to 7 days of age, while the survivability between single, twin, triplet and quadruplet was significant ($p<0.05$) for the subsequent stages of growth. Single kids had always the highest survivability for all the periods and it follows the pattern as Single>Twin>Triplet> Quadruplet (Table 1). It generally indicates that singles had lower mortality rate than the multiples. This is mainly due to higher birth weight of single kids and no competition for getting milk from doe as compared to twin, triplets and quadruplets. The present findings are in conformity with Sharma et al. (1981), Singh et al. (1990) and Husain et al. (1995) who reported that singles had lower mortality rate than multiples.

The survivability were found to be the highest for kids born in summer season followed by those born in winter and rainy season for all the periods except from 16 to 30 days, having significant difference only for the period from 31 to 60 and 61 to 90 days ($p<0.05$) of age (Table 1). But the difference between summer and winter was insignificant. The effect of season on survivability of kids observed in this study confirms to results of Ali et al. (1975)

who reported that minimum number of kids died in dry season; while in the damp season, percentage of deaths was maximum, although disease factors are associated with both the cases. Mittal (1976) observed higher mortality rate in winter and lower in summer. Mazumdar et al. (1980) stated that the survival rates of kids born in October to December, January to March, April to June and July to September were 79.25, 68.25, 43.21 and 36.27 percent, respectively. These values show that October to March is the best time to have kids. Sharmah et al. (1981) and Malik et al. (1990) also obtained the similar results. Lower mortality in summer season might be attributed to availability of lush and nutritious pastures for the doe in the later part of pregnancy and thus providing better mothering ability. The mortality was highest in the rainy and winter seasons due to pneumonia, diarrhoea followed by parasitic infestation. It is relevant to mention here that both rainfall and the relative humidity percentage are the highest in the rainy season; where as in winter chilling is the main cause of kid mortality. It seems that these factors were greatly responsible for the lower survivability of kids in the rainy and winter seasons.

The increased survivability of kids with the increase of milk yield of their dam has been shown in the Table 2. From the table it is observed that survivability was lower with the milk yield of 80 to 200 g/day compared to milk yield of 400 to 600 g/day with higher survivability. Milk yield had significant ($p<0.05$) effect on survivability during 16 to 30 and 31 to 60 days of age. It also revealed that survivability of kids was positively correlated to the milk yield of does. The highest survivability for the periods from day of birth to 7 days and 61 to 90 days of age (100 and 70.5% respectively) were observed against the milk yield of 400 to 600 g/day, while the same rates were reduced to 47.5 and 96.2% against the milk yield of 80 to 200 g/day by the does respectively. The present findings are in agreement with the findings of Husain et al. (1995) who reported that survivability of kids was positively correlated to the milk yield of dams. According to them the mortality rates were 19.0 and 43.1% with an average milk yield of 37.9 g/day for period from birth to 1 and birth to 3 months of age. For the same period mortality rate decreased to 3.9 and 11.8%, when average milk yield was 367.9 g/day.

Birth weight of kids had significant ($p<0.05$)

Table 2. Relationship between milk yield of does and subsequent survivability (%) of their kids in different age

Dams milk yield (g/d)	n	Survivability (%)				
		Birth to 7 days	8 to 15 days	16 to 30 days	31 to 60 days	61 to 90 days
80-200	80	96.2	88.7	58.7^{b}	47.5^{c}	47.5
200-300	54	100.0	94.4	72.2^{b}	57.4^{bc}	55.5
300-400	24	95.8	87.5	75.0^{ab}	70.8^{b}	54.1
400-600	17	100.0	100.0	94.1^{a}	94.1^{a}	70.5
Correlation coefficient		0.45	0.67	0.98	0.99	0.93

Means with uncommon superscript(s) in the same column differ significantly ($p<0.05$).
n = initial number of observation.

effect on their survivability for all stages of growth (Table 3). From the table it is observed that the range of birth weight from 0.5 to 0.8 kg had less survivability than the other birth weigh group. Birth weight of 2.0 to 3.0 kg group had lower survivability than the 0.8 to 1.2 kg and 1.2 to 2.0 kg birth weight group. The table also revealed that the effect of birth weight on survivability is very pronounced for the period from 61 to 90 days of age. This suggested that the mortality rates could be decreased by improving the birth weight of kids. The present findings are in agreement with the findings of Malik et al. (1990) who reported that birth weight of kids had significant effect on mortality in Black Bengal and their crossbreds. The mortality in the kids decreased with increase in birth weight. Gupta and Sengar (1985) reported that the mortality was higher in kids of low birth weight than in heavier kids of different breeds of goats. Mittal (1976) and Ali et al. (1975) also reported the similar results. The positive correlation coefficients (Table 3) of survivability of kids during these periods on their birth weights revealed positive linear association between birth weight of kids and their survivability.

Table 4 indicates the interaction effect of different factors with sex. Interaction between location and sex was found to be significant ($p<0.01$) for all the periods accounted in the analysis. This means that for all the periods in

Table 3. Relationship between birth weight of kids and their subsequent survivability in different age

Kids birth weight (kg/d)	n	Survivability (%)				
		Birth to 7 days	8 to 15 days	16 to 30 days	31 to 60 days	61 to 90 days
0.5-0.8	231	92.2^{b}	80.9^{b}	61.0^{b}	43.2^{b}	39.8^{b}
0.8-1.2	521	96.7^{a}	95.3^{a}	92.1^{a}	87.9^{a}	85.4^{a}
1.2-2.0	310	98.3^{a}	97.7^{a}	95.8^{a}	93.5^{a}	90.4^{a}
2.0-3.0	20	95.0^{ab}	95.0^{a}	95.0^{a}	90.0^{a}	90.0^{a}
Correlation coefficient		0.31	0.61	0.69	0.66	0.69

Means with uncommon superscript(s) in the same column differ significantly ($p<0.05$).
n = number of observation.

Table 4. Mean square and F-value for survivability of different interaction effects

Interaction		df	Survivability (%)				
			Birth to 7 days	8 to 15 days	16 to 30 days	31 to 60 days	61 to 90 days
Location × Sex	MS	1	0.11	0.18	0.86	0.71	0.75
	F-value		3.22**	3.05**	9.47**	6.12**	5.70**
Genetic group × Sex	MS	2	0.01	0.06	0.01	0.09	0.07
	F-value		0.40	1.09	0.15	0.74	0.55
Birth type × Sex	MS	3	0.09	0.01	0.05	0.01	0.03
	F-value		2.60*	0.13	0.51	0.07	0.19

MS = mean square; *= $p<0.05$; **= $p<0.01$.

different locations effect of sex on the survivability appears in different pattern. Interaction between genetic group and sex was found to be insignificant for all the periods. Birth type and sex interaction was found to be significant ($p<0.05$) for only day of birth to 7 days of age but other periods were insignificant.

Ⅳ. CONCLUSION

The results of this investigation show that the kid mortality in Black Bengal goat is extremely high in Bangladesh. It can be concluded that both genetic and non-genetic factors affect the survivability of kids. In selection program these factors should be taken into consideration to maximize the survivability of goats. The kidding in rainy season should be avoided to reduce the kid mortality of Black Bengal goats in Bangladesh. Therefore, the breeding of goats should be conducted in such a way that the kidding takes place during summer season maximally. Attempts should be made to improve birth weight of kids and milk yield of does which will certainly help to improve the kid survivability in Black Bengal goat.

Ⅴ. SUMMARY

이 연구는 벵갈 종과 그 교잡종 산양의 번식에 있어서 생시부터 90일령 까지의 생존율에 영향을 미치는 유전적 및 비 유전적인 요인을 규명하기 위하여 수행되었다. 분석에 이용된 모델은 지역, 교배조합, 자양의 성, 출생시 산자형태(1두, 2두, 3두 및 4두), 출생계절(여름 3월~6월; 우기 7월~10월; 및 겨울 11월~2월), 출생연도와 2요인 상호작용의 효과를 포함하였다. 교잡종에 비하여 순종의 생존율은 31일령과 90일령 사이에 현저히 낮은 것으로 유의성($p<0.05$)을 나타냈다. 생존율에 대한 지역의 효과는 16~60일령 기간을 제외하고는 통계적으로 유의적인 차이를 보이지 않았다. 생존율에 대한 성의 효과는 초기 0~7일령의 기간을 제외하고는 모두 통계적 유의성이 인정되었다. 생존율은 여름에 출생한 것이 가장 높았고 겨울과 우기(rainy season)의 순서로 나타났다. 16일령부터 60일령 사이의 자양의 생존율은 어미의 비유량에 의하여 영향을 받는 것으로 ($p<0.05$) 나타났고, 400~600g/day 의 비유량인 경우에 생존율이 가장 높았던 반면 비유량이 80~200 g/day인 어미의 자양이 가장 낮은 생존율을 보였다. 생시체중은 90일령 까지의 모든 성장단계에서 자양의 생존율에 영향을 미치는 주요 요인이었다. 생존율은 모양의 비유량과 그리고 자양의 생시체중과 정의 상관관계를 보였다. 성과 생산지역간 ($p<0.01$) 또는 성과 출생시 산자형태간($p<0.05$)의 상호작용은 통계적 유의성이 있었던 반면에 성과 유전적 그룹간의 상호작용은 유의성이 없었다.

Ⅵ. REFERENCES

1. Acharya, R. M. 1987. Breeds of Goats and Research Programmes for their Improvement in India. Proceedings of the IV International Conference on Goats, Vol. 1, Brazil.
2. Ali, S. Z., Hoque, M. M and Hasnath, M. A. 1975. Relationship between Black Bengal kid mortality and birth weight, age and season of year at the Bangladesh Agricultural University goat farm. Indian Vet. J., 52(4):264-266.
3. Amin, M. R., Husain, S. S. and Islam, A. B. M. M. 2000. Reproductive peculiarities and litter weight in different genetic groups of Black Bengal does. Asian-Aust. J. Anim. Sci. 14(1):1-5.
4. Chawla, D. S., Bhatnagar, D. S. and Mishra, R. R. 1982. Factors affecting kid mortality in dairy goats. Indian J. of Anim. Sci., 52(3):166-171.
5. Gupta, U. D. and Sengar, O. P. S. 1985. Kid mortality as affected by birth weight, type, season and kid age in Indian goats under intensive management. Asian J. of Dairy Research, 4(2): 71-75.
6. Husain, S. S. 1993. A study on the productive performance and genetic potentials of Black Bengal goats. A Ph. D. Thesis, Bangladesh

Agricultural University, Mymensingh.

7. Husain, S. S., Islam, A. B. M. M. and Horst, P. 1995. Effects of different factors on pre-weaning survivability of Black Bengal kids. Small Ruminant Research, 18(1):1-5.
8. Malik, C. P., Kanaujia, A. S., Balaine, D. S. and Rathi, S. S. 1990. Mortality pattern in Beetal and Black Bengal goats and their reciprocal crosses. Indian J. of Anim. Sci., 60(2):228-232.
9. Mazumdar, N. K., Mazumdar, A. and Goswami, K. K. 1980. Studies on some factors affecting mortality and survival rates in Pashmina kids. Indian J. of Anim. Sci., 50(3):251-255.
10. Mittal, J. P. 1976. A study on mortality in kids. Indian Vet. J. l, 53(9):681-684.
11. Osuagwuh, A. I. A. and Akpokodje, T. U. 1982. West African Dwarf Goat. 1. Causes of early mortality. In goat and sheep research. 1:303-309.
12. SAS. 1990. Statistical Analysis System, Version 6.03. SAS Institute Inc. Cary NC, 25-109.
13. Sharma, P. C., Thakuria, K., Sarma, H. K., Borah, H. P., Mohan, M. and Pant, K. P. 1981. Note on kid mortality in Assam local breed. Indian J. of Anim. Sci., 51(2):248-249.
14. Sherman, D. M. 1987. Causes of kid morbidity and mortality. An overview. Proc. IV International Conference on Goats, Brazil, pp. 335-354.
15. Shil, R. N. and Debnath, S. C. 1995. In: An introduction to the theory of statistics. Bangladesh Agricultural University, Mymensingh, Bangladesh. pp. 286.
16. Singh, D. K., Singh, C. S. P. and Jha, K. 1991. Post-weaning survivability in kids under village conditions. Indian J. of Anim. Sci., 61(2):228-229.
17. Singh, D. K., Mishra, H. R. and Singh, C. S. P. 1990. Birth weight of pure and crossbred kids under extensive system of management in villages. Indian J. of Anim. Sci., 60(3):375-377.

(접수일자 : 2002. 2. 6 / 채택일자 : 2002. 5. 1)