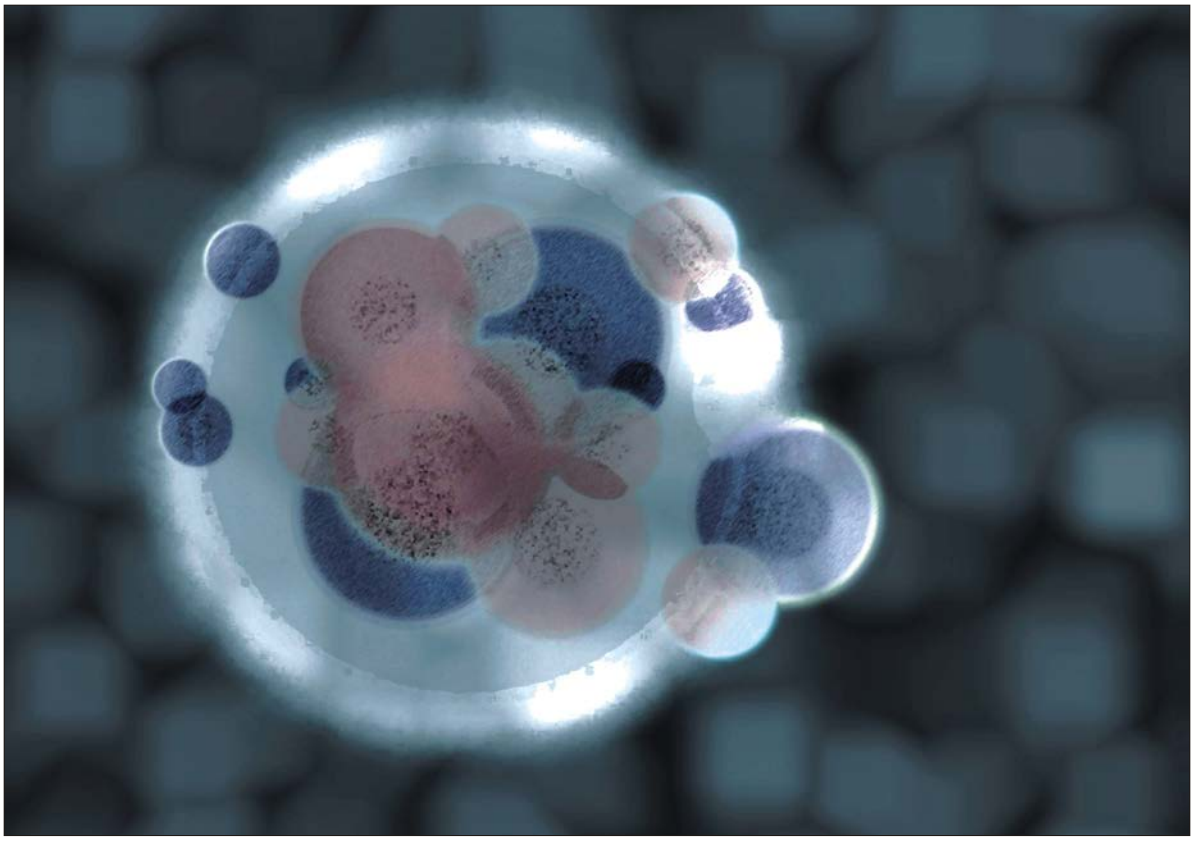

Journal of Biological Sciences

ISSN 1727-3048

science alert

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Journal of Biological Sciences 5 (2): 124-128, 2005
ISSN 1727-3048

Comparative Performance of Indigenous Khari and Khari × Simhal Goats Raised On-Station in Nepal

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Abstract: Khari (KH) and Sinhal (SI) are the two indigenous goat breeds found in the hills of Nepal. The KH does were bred with SI bucks to produce KH × SI crossbreds (KSC) at the Lumle Agricultural Research Centre (LARC). A stock of KH and KSC goats was maintained with the objective of exploring the possibility of improving genetic potential of local goats utilizing indigenous genotypes. Birth weight tended to be affected by genotype and kids weighed 2.03 and 2.14 kg at birth for KH and KSC, respectively. Female kids (2.18 kg) were heavier than male kids (2.01 kg) at birth. Body weight of kids at different ages was affected by genotype, sex and year, but not by season of birth. Age at first service was longer for KSC at 367.6 days than KH at 229.2 days, but it was not affected by season or year of birth. Autumn born kids had a tendency of lower age at first service and shorter first kidding interval. Twinning percentage was higher for KH at 37.1% than for KSC at 19.1%. Mortality of KH kids (25.9%) up to 6 months of age was higher than KSC kids (14.3%). Based on the limited data, cross breeding of KH and SI breeds could not show much of comparative advantage over KH under on-station management at LARC, except the kid mortality and further research with a larger data set is needed.

Key words: Khari, Sinhal, crossbreeds, body weights, reproductive traits

INTRODUCTION

Khari (KH) and Sinhal (SI) are the two indigenous goat breeds found in the hills of Nepal. The KH is reported to have relatively better reproductive performance such as higher twinning percentage, lower age at first service, shorter kidding interval etc.[1]. It thrives mainly in the river valleys and low and mid hills of Nepal ranging from an altitude of 400 m to about 1500 from the mean sea level. Sinhal has a relatively larger body size, lower twinning percentage, longer age at first service and longer kidding interval[2]. It thrives well in the high hills above 1800 m from the sea level in a relatively cooler climate.

Goats are raised under different management systems in different agro-ecological zones of Nepal. In the river valleys and low to mid hills of the western Nepal, they are raised under sedentary system with stall feeding, semi-stall feeding or grazing depending on the availability of feed resources and number of goats a farmer has[3]. It is the KH (also called Aule) breed that predominates in this region. However, goats are also raised under migratory systems in the high hills, including those in the western region, with the proximity to alpine pastures[4], where SI is the predominant indigenous goat breed. The Lumle Agricultural Research Centre (LARC) is located at an altitude of 1700 m from the sea level, has a cooler climate and is one of the areas receiving highest rainfall in Nepal.

An attempt was made at LARC since mid 1980s to collect these indigenous goats from various parts of the western hills with the aim of evaluating their performance and exploring the possibility to improve the genetic potential by utilizing local germplasms. The main advantage of using SI blood is to utilize its ability to thrive better in colder climates of the high hills. It was thought then that crossbreeding between these two indigenous genotypes might result in a better genotype suitable for the hills of Nepal. The objective of this study was to compare certain performance traits of KSC with KH from the data collected under on-station management conditions at LARC between 1986 and 1995 and that whether crossbreeding between KH and KSC is a feasible approach.

MATERIALS AND METHODS

A foundation stock of KH and SI goats collected from different parts of the western hills of Nepal since mid 1980s was maintained at LARC with the original aim of selecting relatively more prolific goats and rearing them under on-station management conditions for their further improvement. The criteria for selection of these goats were directed towards obtaining higher number of kids/doe per year with high weaning ability to ultimately select does that produce more meat on yearly basis. Based on farmer's recollection, KH does and bucks with

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the pedigree or their own history of producing two or more kids were selected, which were allowed to *inter se* mating to produce pure KH offspring. The SI bucks were selected from the migratory flocks of western high hills, brought to LARC and breed with KH does to produce an F_1 (50/50) and F_2 (25/75 SI and KH blood) offspring (KSC). Both KH and KSC goats were housed and fed together under the same on-station management conditions of LARC.

All goats maintained at LARC were stall-fed primarily on green forages throughout the year. During the monsoon and subsequent autumn seasons, goats were fed on tree fodders such as Chiple (*Villebrunnea frutescens*), Pate (*Eurea japonica*) and grasses such as Kuro (*Cyathula capitata*), Setaria (*Setaria anceps*) and Hande (*Lagerstroemia floribunda*). Millet straw, while it was still green, was also given in the later part o f autumn. During the drier winter and summer months from December until May/June, goats were fed tree fodders such as Chilaune (*Schima wallihii*), Dhalne katus (*Castanopsis indica*), Pate, Jhyanu (*Eurea acuminata*), Chuletro (*Brassiopsis hainla*), Nimaro (*Ficus auriculata*), Raikhanim (*F. semicordata*), Kutmiro (*Lytsea polyantha*), Bedulo (*F. clavata*), Dudhilo (*F. nemoralis*) and Paiyun (*Prunus cerasoides*). They were also occasionally given Amriso (*Thysanolaena maxima*) grass. Clean water was provided twice daily in galvanised iron buckets. Commercial concentrate mixture was supplemented to each animal every morning at the rate of 250 g for adult goats and 100 g for young ones below 6 months age. Young ones were raised entirely on mothers' milk until the weaning age of 4 months. However, if the milk from the dam was not adequate, kids were also given cow milk as a supplement.

Sheds and compound were cleaned daily. Breeding bucks were tied on neck with iron chains at night. Hooves and horns were trimmed whenever necessary. All animals were ear tagged for identification. Animals were treated for internal and external parasites twice a year. Coccidiostat was given as a preventive measure for young kids during monsoon and at the time of weaning. Further treatments, if any, was carried out as per the clinical examination of the animal by a veterinarian.

Individual records were maintained for all goats reared at LARC. All kids were weighed at birth and subsequently at weekly intervals up to 5 weeks. Thereafter, body weights were taken at monthly intervals. Reproductive parameters such as age at first service of the female goats, first kidding interval and twinning percentage in second kidding were also recorded. The mortality of kids up to 6 months of age was recorded.

A data set for a total of 373 kids comprising 224 KH and 149 KSC of 25-50% SI blood level was analysed for birth weight using a general linear model fitted with genotype, sex, year and season of birth as factors using Minitab statistical package[5]. However, the number of records was considerably lower for the subsequent body weights of kids, which were available until 12 months. Birth weight was used as a covariate to analyse the data on subsequent body weights of kids until 12 months of age. A relatively smaller data set was analysed using the same model for female reproductive traits namely, age at first service (n = 57) and first kidding interval (n = 33). Twinning percentage (n = 32) and kid mortality up to 6 months of age was analysed by χ^2- test using SPSS (SPSS Software for Windows, release 10.0, SPSS, Inc., Chicago, IL).

RESULTS AND DISCUSSION

Birth weight tended to be higher ($p = 0.06$) for KSC kids than KH kids (Table 1) indicating a possibility to increase birth weight by crossbreeding between the two breeds. With a larger sample size, however, it might have been statistically different between the two genotypes. Birth weights of kids of both the genotypes were similar to KH goats under on-station management at Rural Development Centre Farm, Pokhara[6]. However, it was higher than that reported previously[3]. Differences in feeding and management conditions would lead to such differences in birth weight of kids. It has been reported previously[3] that birth weight of F_1 kids between KH and Jamunapari, a larger dual purpose Indian goat breed, was similar to results observed in the current study.

Female kids were heavier than male kids by 145 g ($p<0.01$). Several authors[3,7,8] have reported heavier males than females at birth, which was in contrast to current finding. Whether heavier female kids were borne to heavier sire or dams could not be ascertained since weight of the sires or dams were not recorded. Although heritability of birth weight in sheep has been found to be low at 0.068[9], significant correlations have been established between the birth weight of the offspring and the body weight of the dam in sheep[10] and goats[11]. Year of birth also had a significant effect on birth weight ($p<0.01$). It should be noted that the parent stock was changed over the years, which might have some effect on birth weight. In none of the years, birth weight was not as low as reported previously[3]. It was not clear whether climate in a particular year had any effect on birth weight of kids.

Table 1: Means±SE of birth weight of Khari and Khari × Sinhal crossbred goats found in the hills of Nepal across genotype, sex, year and season of birth

Factors	n	Mean±SE (kg)
Genotype		p=0.058
Khari	224	2.03±0.08
Khari × Sinhal (25-50%)	149	2.14±0.08
Sex:		p=0.003
Male	184	2.02±0.08
Female	189	2.16±0.08
Year		p=0.002
1986	2	1.90±0.47
1987	2	2.06±0.47
1988	5	2.39±0.21
1989	19	2.44±0.11
1990	28	2.18±0.09
1991	58	2.02±0.06
1992	60	1.89±0.06
1993	57	2.07±0.07
1994	56	1.92±0.06
1995	88	2.00±0.06
Season		p=0.005
Monsoon	74	2.25±0.09
Autumn	84	2.06±0.08
Winter	145	2.05±0.08
Summer	70	2.00±0.09

Monsoon born kids were the heaviest at birth ($p<0.01$) compared to those born in other seasons, lowest being for summer born ones. Better availability of green forages during monsoon might have resulted in an improved nutritional status of the dams and better growth of the foetus Birth weight of kids born during other three seasons was similar. The KSC kids were larger in body size (Table 2) up to 6 months of age ($p<0.05$), but were similar to KH kids at 9 months of age ($p>0.05$). However, KH kids were heavier when they reached one year of age ($p<0.01$) indicating that the growth rate was slower in crossbreds after six months. It suggested that though mature weight of SI goats is higher than KH goats, croosbred between KH and SI might not produce larger goats in the western hills up to one year of age. It is possible, however, that KSC could have been heavier when they matured. It has been shown that growth rate of SI goats is slower compared with KH goats[12]. Since SI goats live at higher altitudes and are raised on migratory system, its crosses might have not been able to perform well at a lower altitude under on-station management condition. Similar work in the eastern hills of Nepal showed that average body weight of KH goats at 12 months of age was lower[13] than observed in the current study.

Heavier female kids at birth were also heavier at 3 and 6 months of age than male kids ($p<0.05$). However, there was no difference in body weight of male and female kids at 9 or 12 months of age ($p>0.05$). This supports previous findings that male goats grow faster than female goats in the hills of Nepal[2,8]. Although monsoon borne kids were larger in size at birth, it did not effect their body weights up to 12 months of age. Year of birth had a significant effect on body weight at 3, 6, 9 and 12 months of age. This is the only factor that influenced both, weight at birth and body weights up to 12 months of age. Significant effect of year on birth weight and body

Table 2: Means±SE of body weight of Khari and Khari × Sinhal crossbred goats found in the hills of Nepal

	Body weight (kg)			
Factors	3 month age	6 month age	9 month age	12 month age
Genotype	p=0.003	p=0.045	p=0.670	p=0.002
Khari	7.89±0.38(160)	11.05±0.57(114)	14.19±0.87(72)	18.84±1.09(58)
Khari × Sinhal	8.69±0.36(134)	11.95±0.53(113)	14.49±0.76(84)	15.89±0.92(64)
Sex	p=0.024	p=0.019	p=0.082	p=0.168
Male	8.00±0.36(15)	11.01±0.55(116)	13.77±0.80(84)	16.77±0.96(75)
Female	8.58±0.37(144)	12.00±0.55(111)	14.90±0.81(72)	17.96±1.03(47)
Year	p=0.0001	p=0.004	p=0.020	p=0.015
1986	11.72±1.16(2)	13.07±3.10(2)	16.58±3.96(2)	23.38±4.61(2)
1987	6.24±2.15(2)	7.75±3.09(2)	11.84±3.94(2)	14.14±4.55(2)
1988	8.73±0.98(5)	13.38±.42(2)	18.62±2.04(4)	19.79±2.45(4)
1989	8.78±0.54(18)	13.11±0.80(5)	15.05±1.05(18)	20.00±1.32(15)
1990	8.59±0.49(21)	12.49±0.84(15)	13.89±1.34(10)	16.12±1.82(8)
1991	6.78±0.34(40)	9.73±0.51(35)	11.95±0.90(22)	14.76±0.89(27)
1992	7.19±0.31(50)	10.75±0.58(32)	12.37±0.90(31)	14.07±1.32(14)
1993	8.17±0.31(51)	10.78±0.54(44)	14.02±0.82(31)	16.64±1.15(26)
1994	7.83±0.31(51)	12.01±0.49(42)	14.72±0.66(38)	17.42±1.02(26)
1995	8.91±0.34(57)	11.93±0.67(32)	-	-
Season	p=0.376	p=0.147	p=0.406	p=0.337
Monsoon	8.14±0.49(42)	11.16±0.73(38)	15.49±1.09(28)	18.99±1.48(21)
Autumn	7.96±0.40(72)	11.57±0.62(59)	14.12±0.89(42)	15.94±1.16(31)
Winter	8.53±0.37(125)	12.38±0.56(96)	13.97±0.81(38)	17.36±0.99(48)
Summer	8.55±0.45(55)	10.89±0.75(34)	13.77±1.08(28)	17.18±1.47(22)

Figures in parentheses indicate number of observations

Table 3: Means±SE of age at first service and first kidding interval of Khari and Khari × Sinhal crossbred goats found in the hills of Nepal

Factors	Age at first service (days)	First kidding interval (days)
Genotype	p=0.007	p=0.878
Khari	229.2±40.4(27)	327.6±73.8(11)
Khari × Sinhal	367.6±33.7(30)	339.5±40.1(22)
Year of birth	p=0.356	p=0.344
1987	244.4±136.4(2)	319.4±157.0(2)
1988	203.6±84.8(3)	406.9±104.4(3)
1989	274.5±50.2(9)	244.5±73.5(7)
1990	273.1±69.3(5)	523.2±99.6(3)
1991	399.0±40.7(11)	257.6±59.0(8)
1992	290.9±54.19(7)	274.9±66.3(6)
1993	369.4±45.5(12)	308.6±71.9(5)
1994	348.0±53.1(7)	-
1995	282.3±60.1(2)	-
Season of birth	p=0.114	p=0.671
Monsoon	295.0±61.5(37)	367.2±75.6(7)
Autumn	217.5±40.5(17)	263.0±93.3(4)
Winter	312.7±29.9(25)	377.2±38.4(19)
Summer	367.7±54.6(8)	327.0±95.0(3)

Figures in parentheses indicate number of observations

Table 4: Twining percentage in second kidding of Khari and Khari × Sinhal crossbred goats found in the hills of Nepal

Genotype	n	Twining percentage
Khari	11	37.27
Khari × Sinhal	21	19.05
Overall	32	25.67
Significance		*

n = number of observation; * = significant at p<0.05

weight of kids from 3 months through 12 months of age across the years of observations could be due to varied reasons beyond the control of this study. Such differences associated with the year of lambing have been observed in body weight and weight gain of sheep at different stages of growth[9].

Year and season of birth had no effect (p>0.1) on age at first service (Table 3). Winter and summer born kids had a tendency of coming into first service at older age than autumn and monsoon born kids. The KH goats had a lower age at first service than KSC goats (p<0.01). For KSC goats it was longer by 120 days than reported previously, which was only 248 days[4]. While the current study was undertaken under on-station management conditions, the earlier report[4] was for goats raised in high altitude pastures in the eastern hills of Nepal. The differences between the climate and the two production systems might have led to such differences. It should be noted that SI goats thrive well under migratory systems in the high hills at relatively higher altitudes. Age at first kidding for SI goats in the western high hills under migratory system was found to be 2 years[12], which obviously was due to older age at first service. Climatic effect might have delayed the age at first service of KSC goats, although both the genotypes were similar in body size up to 6 and 9 months of age.

First kidding interval (Table 3) of both the genotypes was similar (p>0.05). Similarly, year and season of birth did not influence first kidding interval (p>0.1). There was no specific pattern regarding the effect of year and season of birth on first kidding interval. For KH does it was much higher than reported elsewhere for overall kidding interval[1,3,6]. This could have been due to the differences in feeding and management conditions. Moreover, KH goats perform better at river basins and low to mid hills[12]. Two other factors might have also affected it, I) generally the first kidding interval tends to be high and ii) high standard error caused by smaller data set. First kidding interval of KSC does was longer by 68 days than reported previously under transhumance system at high altitude pastures in the eastern hills[4]. However, it was similar to that reported for SI does in the western high hills[12]. Similar overall kidding interval for SI does under on-station conditions of Jumla located in the far western high hill range have been reported previously[2].

Twinning percentage of KH goats was double that of KSC goats (Table 4), though it was lower than reported previously for KH goats[1]. However, it was higher than overall kidding interval for KH does in the eastern hills of Nepal under farmer's management conditions[13]. Twinning percentage of KSC goats was higher than that of SI in the migratory flocks of the western hills of Nepal[12].

The KSC kids had lower mortality (14.3%) than KH kids (p<0.05), which had a mortality of as high as 25.9% up to 6 months of age (Table 5). Mortality rate in both the genotypes was higher than 10% mortality in hill goats reported from the eastern hills[1]. The season of birth had no effect on kid mortality up to 6 months of age (p>0.05), while the year of birth had (p<0.05). Mortality was particularly high from 1990 to 1992 during which period highly prolific goats from low hill valleys were selected and brought to LARC. Perhaps cold stress or acclimatisation problem might have contributed to higher kid mortality in these years. Kid and lamb mortality is reported to be particularly high during early age than after 4 months of age[14].

In conclusion, crossbreeding of indigenous Khari and Sinhal goats could not show much of a comparative advantage, except for kid mortality, under on-station management conditions over Khari goats. Since the available data was relatively small, further study with larger data set is warranted to derive definite conclusions on the effect of crossbreeding between the two genotypes in the high hills of Nepal.

Table 5: Mortality of kids up to 6 months of age for Khari and Khari × Sinhal crossbred goats found in the hills of Nepal across genotype, season and year of birth

Factors	n	Mortality (%)	Significance
Genotype			p=0.016
Khari	167	25.9	
Khari × Sinhal	127	14.3	
Season			p=0.112
Monsoon	52	25.5	
Autumn	65	16.9	
Winter	109	15.7	
Summer	68	29.4	
Year			p=0.043
1986	2	0	
1987	2	0	
1988	5	0	
1989	19	5.3	
1990	24	25	
1991	55	34.5	
1992	47	29.8	
1993	35	17.1	
1994	56	17.9	
1995	49	10.2	
Overall	294	20.9	

n = number of observation

Moreover, crossbreeding between Khari bucks and Sinhal does with higher proportion of Sinhal blood could be an area for further study.

ACKNOWLEDGMENTS

Authors are thankful to Mr. K.B. Gurung for maintaining the farm records and Mr. E.R. Yadav for data entry. The Centre, which is now called Agriculture Research Station (Lumle) within Nepal Agricultural Research Council, was funded by the Department for International Development of the British Government and worked in collaboration with His Majesty's Government of Nepal (HMGN) until 1998. The support of both governments is gratefully acknowledged.

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