GESTATION LENGTH OF KARI SHEEP

Sohail Ahmad and Muhammad Sajjad Khan
Department of Animal Breeding and Genetics, University of Agriculture Faisalabad.

ABSTRACT
Previously, the concept of a gestation period of sheep shorter than 121 days was unheard of in the field of sheep biology. Our findings during a farmers’ survey in the Lotkho area of Chitral, Pakistan, revealed that the sheep native to the region, locally called “Kari”, gestates for a period of only three months. This duration is 25-40% short of the usual gestation length and is shorter than ever recorded for the species. The mean and mode gestation length (GL) was 110 and 92 days respectively and was concentrated in three distinct clusters: day 87-95, 120-123 and 151-153, accounting for 52% of all observations. GL was influenced by location, season of conception and lambing and the interaction of location with season; had an estimated repeatability of zero. The mean lambing interval was 224.7 ±5.24 days, ranging between 109 and 467 days. During a trial conducted in a controlled environment, only three out of the 27 copulated ewes conceived, and gestated in 113, 125 and 145 days respectively. Gestation length during the trial supported field findings. The results suggest that GL in Kari sheep is unusual as many ewes gestated in three months, with variations of up to 5 months. Genotype by environment interaction is a possibility. However, reasons for the findings are still not clear and further controlled studies should be carried out to establish and further explore the factor(s) responsible for this unusual and unique manifestation of the Kari with regards to its gestation length.

INTRODUCTION
It was not until the finding through a farmers’ survey in 2000 and the second as part of this study carried out at Lotkho area of Chitral, revealed Kari sheep gestates in the comparatively shorter period of three months and thus possess the ability to deliver three lambing in a calendar year, when cared for sufficiently1,2. The breed, is believed to be originated form the Khoth (KT) valley in upper Chitral, integrated in to the socio-cultural and socio-economic lives of the community and spread to the surrounding valleys; particularly those in Lotkho, the target area for this study. The human population in the area are thinly placed in scattered settlements, mostly involved in livestock dominated agricultural activities, raising sheep in mixed flocks under a semi-nomadic pastoral system. Flocks, during winter stay in stalls near their homesteads and graze on the uphill-pastures in communal herds during summer, governed by a strong social system “Suth
Sairi™. Patti (locally made hand-woven woollen fabric) craft is one of the commonly found economic activity, rested on the quantum of harvested fibre from the back of their sheep. The ecological pattern of the area is characterized by a varying altitude (2000 to 77000 m asl), towering snow capped mountains, continental climate with chilling winter, seasonally accessed land routes, separate uphill-pastures and narrow valleys with limited migration between them. Constrained mixing of sheep flocks resulted in markedly varied phenotypic appearance, presumably due to ecological differences.

Evidence of variations in GL is limited to a narrow range (151: 121 – 169 days), however it was considered unwise to assign paternity from the birth-date backwards. Others emphasized the need for studying performance of native breeds in relation to their special produce, characteristics and specific adaptability to native ecosystem. The present study was carried out in Lotkho at three different locations: Garam Chashma (GC), Karimabad (KD) and Arkari (AK) for investigating the results of the survey regarding GL and lambing interval of Kari sheep through a participative study at the farmer level. This followed another trial for testing the same under controlled environmental conditions.

MATERIALS AND METHODS

Flock Registration

On-field performance of 726 animals in a foundation flock of pure Kari sheep belonging to 29 registered flocks, from each location, were collected through a participatory approach, for 20 months: November, 2004 to June, 2006. Three data collectors, one at each location, collected data regarding mating, lambing dates and tag-identity, birth-weight, sex and status of birth of new born through fortnightly visits to each farm. Ewes in each flock were tagged and were allowed to breed by a solitary Kari sire, while all others were castrated.

Registered shepherds (mostly the women) were given regular on-farm training for helping data collectors in observing and recording each mating and lambing. Each registered farmer was given one Ram Isolation Pen (RIP) and one Combined Feeding Rack to facilitate recording. RIP was helpful in keeping the ram isolated from the flock at night. Copulation was recorded as having taken place when during mounts, the females stood and the male made one or more thrusting movements. The last date when a female was observed to have been copulated, was used to calculate her gestation period. This rationale was based on data from domestic sheep (Ovis aries) showing that ovulation usually occurs late in hours. During winter copulation dates were observed only during the daytime. Shepherds from the registered flocks also accompanied their flock at high pasture throughout summer for data collection.
Flocks Management at Field

All sheep in the registered sheep flocks represented Kari breed, comprising 13.5 heads on average. Their management was according to the managerial ability of individual shepherds within his available resources and surrounding climatic conditions.

Shepherding practices were not altered though additional supplementation of Urea Molasses Block licks were, offered to ewes only in winter. A Combined Feeding Rack and Ram Isolation Pen was given to each shepherd to facilitate uniform feeding and recording of mating events. All flocks were inoculated against Enterotoxaemia and Pleuro Pneumonia. A few of the farmers were supplementing maize/barley grains, particularly to freshly lambed ewes and young after weaning while most of the shepherds (7 out of 10) in KD and a few in AK (3 out of 10) and GC (1 out of 9) were taking their flocks twice a year, to lick the saltish muddy-soil, available at certain locations in the foothills called “Alaih”. Hay from alfalfa, occasionally white clover and left-over crops and straw from barley, wheat, maize, potato, tree leaves, barks and range grasses made-up the bulk of feed for winter. In winter water was commonly provided once a day to the flock, however, while on pasture it was subject to availability in the mountain flanks or at hi-pasture. Sheep together with goats were stalled in the inner compartment during winter. Livestock houses comprised of two to three compartments, depending on he herd size10. Around winter, sheep were housed in the open yard situated in front of the animal house, however in summer flocks stayed in a roofless but fenced in confinement at night.

Trial Design

To test the empirical field findings, thirty five freshly lambed ewes and four breeding rams from GC, KD, AK and KT were acquired and placed in a controlled environment in "Seen Lusht" near Chitral city, after acclimatisation for a week. It was comparatively 7 – 10 °C hotter and situated at an elevation of approximately i.e., 2000 m asl, comparatively lower than its native environment at 2500 to 3500 meters. Ewes were divided in groups according to origin of their purchase and were allotted their respective rams. Grazing in range at the mountain flanks near by along with barley, Lucerne and maize feeding at the stalls. Barley grains, ground pulses and Urea Molasses Blocks were supplemented to the basal feed. Rams were managed separately at the stall except during the mating period. Artificial light was arranged from the sunset till 22:30, depended on power availability.

Two ewes died and the rest were treated with cloprostenol (0.25 mg/ml) for shedding conception if any, and resultantly two aborted. Thirty-one cyclic ewes were synchronized for oestrous using Medroxyprogesterone Acetate 60 mg/ewe, administered in 24 sub-doses, during the course of 12 days, based on half-life of the hormone11. After 36 hours of termination of the treatment, rams were allowed to breed ewes of their origin. Four ewes did not respond to synchronisation and were excluded. Date of copulation for each
ewes were recorded and used in calculating gestational length; hinged on the supposition that the last observed copulation resulted in conception.

The data thus obtained was analyzed for identifying significant sources of variation, for GL, using the general linear model (GLM). The fixed effects included the location (three different union councils), flock nested within location, season of conception or lambing (winter, spring, summer and autumn), sex of newborn, and type of birth. Ewes with missing, or inconsistent data were discarded. Means for the main effects were compared using Tukey Kramer test. The repeatability of gestation length was estimated from a simpler model estimating among and within sheep variance components.

**RESULTS**

After the survey, the popular scientific view dominated by the quest to understand and investigate the phenomena of the shorter GL in Kari breed. Mating dates for a significant portion (22.9%) of lambings could not trace, however, mean gestation length in Kari ewes was found to be 110 days with a range of 79-160 days and the mode was 92. GL was concentrated in three distinct clusters: day 87-95, 120-123 and 151-153 (Figure A).
**Figure A** Distribution of different gestations lengths (days) as observed in registered flocks at field conditions accounting for 52% of all observations, clustering around their respective peaks i.e., day-92, day-122 and day-151, with most observations clustered in the first category. Lambing interval of Kari ewes is presented in Figure B.

![Distribution of different gestations lengths (days) as observed in registered flocks at field conditions](image)

**Figure B** Distribution of different lambing interval (days) as observed in registered flocks at field conditions

Location, season of conception and lambing, and interaction of location with season were important variables (P<0.01) for GL. Sex of the newborn, type of birth and flock

**Table 1** Mean gestation and lambing interval of Kari sheep at different locations

| Location   | Gestation Length (days) | Lambing Interval (days) |
|------------|-------------------------|-------------------------|
|            | N  | Mean ± se | Range | N  | Mean ± se | Range |
| Garam-Chashma | 135 | 116.6±1.94$^b$ | 80-159 | 59 | 225.4±9.05 | 109-433 |
| Karimabad  | 150 | 102.5±1.41$^a$ | 79-153 | 62 | 222.5±9.50 | 110-467 |
Arkari  102  112.2±2.27b  81-160  63  226.1±8.80  114-398
Overall  387  110.2±1.10  79-160  184  224.7±5.24  109-467

Values with different superscripts across the column are different at P>0.05

nested within location did not prove important for in the trait variation. Ewes in KD had lower GL (102.5 days) than those in AK (112.2 days) and GC (116.6 days) as shown in Table 1, with almost similar values at the extreme terminals at all locations. Ewes conceiving in autumn had slightly higher GL (117.9 days) than those conceived in the other seasons (Table 2).

Table 2 Mean gestation and lambing interval of Kari sheep at different seasons of conception

| Location | Gestation Length (days) | Lambing Interval (days) |
|----------|------------------------|-------------------------|
|          | N | Mean ± se | Range | N | Mean ± se | Range |
| Winter   | 142 | 106.7±1.68a | 79-152 | 41 | 231.3±13.36 | 118-433 |
| Spring   | 44  | 113.1±3.30ab | 89-153 | 20 | 209.3±10.05 | 110-252 |
| Summer   | 116 | 107.1±1.81a | 81-157 | 34 | 211.0±10.25 | 109-467 |
| Autumn   | 85  | 117.9±2.64b | 82-160 | 45 | 225.9±10.38 | 114-440 |

Values with different superscripts across the column are different at P>0.05

Similarly, gestation period were longer in ewes lambing in spring (115.9 days) as compared to other seasons (Table 3).

Table 3 Mean gestation and lambing interval of Kari sheep at different seasons of lambing

| Location | Gestation Length (days) | Lambing Interval (days) |
|----------|------------------------|-------------------------|
|          | N | Mean ± se | Range | N | Mean ± se | Range |
| Winter   | 126 | 115.9±2.23b | 80-157 | 74 | 239.2±8.57 | 121-440 |
| Spring   | 114 | 107.5±2.15a | 85-160 | 42 | 216.9±11.89 | 114-411 |
| Summer   | 86  | 105.5±2.40a | 79-153 | 38 | 217.6±9.48 | 110-341 |
| Autumn   | 61  | 105.5±2.40a | 81-153 | 30 | 208.8±12.23 | 109-467 |

Values with different superscripts across the column are different at P>0.05
The season of conception did not have consistent effect on GL across locations. The lowest value (95.5±1.52 days) was observed in ewes conceiving in summer at KD while the highest GL (141.9±4.58 days) was observed in ewes conceiving in spring at GC. Interaction of location and season of lambing was important (P<0.05) and lowest (98.3±2.15 days) and highest (125.1±4.65 days) values were for winter lambing at KD and spring lambing at AK, respectively. Repeatability for the GL was estimated as zero which indicates existence of a strong genetic environmental interaction. Mean lambing interval of 224.7±5.24 ranged between 109 and 467 days, and was similar across all three locations. Eight (1.6%), seventeen (3.4%) and twenty-five (13.6%) ewes yielded their subsequent lamb crop in a period below 131, 151 and 161 days, respectively.

Results from the farm trial revealed that out of 27 ewes recorded for copulation, only three conceived: two from KT and one from GC groups. These ewes had been served 4, 7 and 6 times on two successive dates. Mean gestation length for ewes was 128.7±9.33 days if the earlier copulation is considered as the conception date or 127.7±9.33 days if the later dates are considered for conception. Ewe from GC gestated in 113 or 114 days while those from KT gestated in 125 or 126 days and 145 or 146 days, respectively (Table 4).

**Table 4** Reproductive data of Kari ewes which conceived and lambed

| Parameter                  | GC-14   | KT-37   | KT-38   |
|----------------------------|---------|---------|---------|
| First mating date          | 30 Jun, 2005 | 30 Jun, 2005 | 25 Jun, 2005 |
| Second mating date         | 1 Jul, 2005 | 1 Jul, 2005 | 26 Jun, 2005 |
| Lambing date               | 22 Oct, 2005 | 3 Nov, 2005 | 18 Nov, 2005 |
| Gestation period (days)    | 113 or 114 | 125 or 126 | 145 or 146 |

All lambing resulted in singleton (two males and one female lamb) with a mean birth weight of 2.10±0.07 kg. Respective mean body weights of these ewes were 14.8±1.73, 19.3±2.18 and 16.1±1.91 kg at mating and they lost 16% (3.2±0.31 kg) of their body weight as a result of parturition.

**DISCUSSION**

Duration of gestation length in Kari ewes was based on the assumption that the last observed copulation resulted in conception. If that was not the case and the ewe became pregnant in some subsequent unnoticed oestrus, there would be overestimation of gestation length in multiple of 16-18 days, the approximate interval between cycles\(^2\). On the other hand if the ewe was in a gestational oestrus\(^3\), there would be underestimation of the parameter. However, the lambings were the most evident and attended events, and
the lambing interval of less than 160 days (109-160 days) in 25 ewes (13.6%) still supports the view that Kari bears an unusual shorter gestation length.

Gestation length is comparatively a less variable trait. Mean GL of 144.6\(^{14}\) and 153.7 days\(^{15}\) have been reported for Finnsheep and Bakhtiar-Luri breeds, respectively. The range reported in literature is, however, very wide (121-169 days) for domestic sheep\(^{16}\). The average GL in the present study (110.2 days) is unusually shorter than any previously recorded value. Repeatability value close to zero indicated that genetic environmental interaction could be the determinant factor for the trait. GL could be reduced by 6 days in ewes having good body condition at mating after the seasonal peak\(^5\). Specific plants (e.g., *Salsola tuberculata* var. *tomentosa*) have been reported to lengthen gestation to as long as 214-250 days in Karakul sheep\(^{17}\). Factors such as season of lambing\(^{18,19}\), type of birth\(^{15,20}\), parity\(^18\) and sex of new born\(^{21,18}\) were found to affect GL, contrary to some other studies that reported type of birth\(^{22,23,24}\) and sex\(^{15,20}\) did not contributed in affecting gestation length.

Location by season interaction may be difficult to explain in the present study but shortest gestation length found in KD may be due to the strain effect. This could be attributed to the geographic and physiographic nature of the valley, the availability of “Alaih” and the culture of feeding it to the flocks. Despite some variation, sufficient evidence of a shorter gestation of three months (92 days) in Kari ewes to support the popular claim of shepherds. The results also suspect the possibility of some major gene/s involvement, administering the trait. However, variations in the duration of gestation further demands confirmation through planned/controlled experiments.

Reports on lambing interval are quite variable in literature, where higher values such as 449 days\(^{25}\) or lower value of 160 days\(^{26}\) have been reported. For Finnsheep, a lambing interval of 200-240 days under accelerated lambing management while for German Whiteheaded Mutton sheep an average of 359 days was reported\(^{27}\).

Prolific breeds have been reported to manifest a shorter gestation length than non-prolific breeds\(^{28,29}\) and within breed variations may exist due genetic and environmental components\(^{30}\). The information recorded for gestation length and lambing interval indicated wide variation. Gestation length in Kari sheep was unusual as many ewes gestated less than five months with three months being the most frequent observation. Genotype by environment interaction is a possibility; yet, understating the phenomena of unusual shorter gestation length its dynamics and variation in the perspective of its underlying hormonal and molecular level under the ecological and evolutionary background will require further research that could span the biological scope of the breed for bringing revolution to sheep industry globally. The success of part of this study rested upon the joint collaboration of project staff and the pastoral community.
This investigation was supported in part by a grant from Pakistan Agricultural Research Council (PARC), Islamabad and by Higher Education Commission (HEC), Islamabad.

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