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Effect of floor types and seasons on behavioural activities of Surti goats

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ABSTRACT

Present study was conducted to assess effect of floor types on behaviour of Surti goats under stall-feeding system in cold, hot dry and hot humid seasons. Adult dry Surti goats (27) were divided randomly on body weight (20–30 kg) basis in three treatment groups (T_1: earthen floor, T_2: brick floor and T_3: cement concrete floor). In each treatment, six goats were selected for behavioural observations. Different behavioural patterns exhibited by goats were recorded continuously for 24 h by mini PTZ IR camera in each experimental phase. Time spent in each of the behavioural categories were recorded, i.e. feeding, drinking, standing, lying, moving and agonistic behaviour. Feeding time (min./d) was significantly higher in goats reared on brick (319.83±17.58) and cement concrete (316.22±16.02) floor but dry matter intake (g/min.) (2.92±0.11) was significantly higher in goats reared on earthen floor. Standing time (min./d) in covered area was significantly higher on brick floor. Time spent by goats for lying (min./d) in covered area on earthen (712.17±51.92) and cement concrete (855.83±20.19) floor was comparable but significantly higher as compared to brick floor (338.56±70.98). Time spent for lying (min./d) in covered area was significantly higher in summer season (786.78±45.02). Irrespective of floor and season, goats spent maximum time for lying (55.49%), standing (22.52%) and feeding (21.07%) whereas minimum time spent for other activities. The results indicated that earthen and cement concrete floor were better in terms of welfare and comfort level of goats under stall-fed rearing system.

Keywords: Behaviour, Floor, Goat**,** Season, Surti

Behaviour is considered as 'first line of defense' of animals and early indicators of the welfare in response to environmental change in relation to different types of housing and management. Behavioural observations can give information on animal's preference, requirements and internal states (Engeldal *et al*. 2013). Time spent by the animal in lying, standing, walking and aggression are the important behavioural indicators.

Floor and roof are foremost components of modern goat shelters which affects comfort and productivity by changes in social behaviour of goat (Ramachandran *et al*. 2020). Goats prefer to use different flooring types depending on the behaviour they are performing. Hence, multiple flooring options may be better in commercial goat rearing systems to meet their requirements (Sutherland *et al*. 2017). Similarly, available floor space allowance may also affect feeding, lying and standing behaviour of animals (Centoducati *et al*. 2015). Inadequate space availability may develop abnormal behaviours that injure the animal itself or other animals in the social group (Mason *et al*. 2007). The frequency of behaviours changed in accordance with certain climatic variables. More active movement and exhibited higher frequencies of behaviours during morning hours when temperature is milder. These indicate that animals adjust their daily activities in order to minimize the effects of the stress caused primarily by environmental conditions (Paulo and Lopes 2014). The environmental enrichment may reduce the frequency of undesirable behaviours or even prevent them from developing. However, this is not sufficient to promote natural behaviour of goats, which in turn suggests that commercial housing could be improved. The basis for this thinking is from the range of behaviours expressed by the goats. Research on flooring preference in goat production is limited, probably because of the higher initial cost of floor in goat houses. Therefore, the present study aimed to assess the effect of floor types and season on behavioural activities of Surti goats under stall fed rearing system.

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MATERIALS AND METHODS

Location and ethical compliance: The study was conducted from December 2017 to October 2018 at Livestock Farm Complex, College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand (Gujarat). Animal care, handling and sampling procedures were approved by Institute Animal Ethics Committee as per the guidelines recommended by the Committee for the Purpose of Control and Supervision of Experiment on Animal, India.

Experimental animals, housing, feeding and management: The goats were housed in well ventilated asbestos roofed house constructed in east-west direction were monitored round the clock. The dimensions of individual pens were 8.5 × 8 sq. ft. in covered and 11 × 8 sq. ft. in uncovered area and equipped with manger and water trough. Covered area of experimental pen was provided with different types of floor, viz. earthen, brick and cement concrete whereas uncovered area having earthen floor. Twenty-seven adult dry Surti goats were divided randomly in three treatment groups, i.e. T_1: earthen, T_2: brick, and T_3: cement concrete floor. Each treatment comprised of three replications (3×3 goats). The study was conducted for eight-week duration each in three seasons, i.e. cold (December-January), hot dry (May-June) and hot humid (September-October). Maximum temperature recorded during cold, hot dry and hot humid seasons were 28.9, 41.5 and 37.0ºC whereas minimum temperature recorded were 10.8, 25.5 and 19.4ºC, respectively. An adaptation period of 15 days was given prior to start of experiment in each season. The experimental animals were maintained on total mixed ration (TMR) and weighed quantity of TMR (1.5 kg) was offered at morning (7.30 AM) and afternoon (2.30 PM) in each group. Measured quantity of wholesome clean water was offered daily in morning to experimental animals in groups where as in summer and hot humid season, water was offered twice a day to fulfill the requirement. Necessary precautions were taken to maintain hygienic condition in the house.

Behavioural observations: In each treatment, six goats (two from each replication) were chosen for behavioural observations using closed circuit television (CCTV) camera. Different behavioural patterns exhibited by goats were recorded continuously for 24 h (7 AM to 7 AM next day) by mini PTZ IR camera (2.0 MP, Model-DS-2DE2202I-DE3; HIK vision) in each experimental phase. An individual camera was fixed over each pen in covered and uncovered area and connected to Network Video Recorder (DS-7700 series embedded NVR; Model no. DS-7716NI-I4; HIK vision) to record daily behavioural activities. Goats were identified by number written on both side of belly with black paint. During the darkness, LED tube lights were used to allow visualization of the animals on the cameras. Time spent in each of the following behavioural categories were recorded, i.e. feeding, drinking, standing, lying, moving and agonistic behaviour.

Statistical analysis: The data generated in this study was recorded and analyzed using completely random design (factorial) as per Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Effect of floor on behavioural parameters of goats: The rearing of goat is changing fast from grazing to stall-fed system. Commercial goat keepers are emerging with modern housing facilities like raised floor with pillars, modified feeders and waterers, automatic feeding system, weighing system with RFID identification, etc (Ramachandran *et al*. 2020). Table 1 depicts the behavioural activities of goats on earthen, brick and cement concrete floor. Goats reared on brick (16.56%) and cement concrete (15.25%) floor spent significantly (P<0.05) higher time on feeding (min./d) as compared to goats reared on earthen floor. However, dry matter intake (g/min.) of goats was significantly (P<0.05) higher on earthen floor to the tune of 21.67% and 17.27% as compared to brick and cement concrete floor, respectively. Drinking behaviour of goats was comparable among treatment groups. Feeding behaviour of small ruminants in stalls might be changed according to existing nutritional and physiological state, stocking rate, supplementation with nutrients, environmental temperature, genetic make-up and conditioning of animals (Odo *et al*. 2001). In present study, goats spent second highest time (21.07%) on feeding which is nearly 1/5th of time on feeding. The daily feed ingestion activities in goats comprised 1/3rd of all activities (Tuncer *et al*. 2016) which was higher than the present finding whereas De *et al*. (2015) recorded 22.4% total feeding time which strongly supported the present finding. The strategy of spreading feeding time over a longer period by slow feeding intake may also be indicative of some reluctance in animals to normal feeding habits when stressed. As compared to hard and different types of draining floors in animal house, a softer floor, i.e.

Table 1. Behavioural activities of goats on different floor types (n = 18)

Attribute	Floor type		
	Earthen	Brick	Cement concrete
Time spent for feeding (min/d)	274.39^{b}± 11.53	319.83^{a}± 17.58	316.22^{a}± 16.02
Dry matter intake (g/min)	2.92^{a}± 0.11	2.40^{b}± 0.11	2.49^{b}± 0.12
Attempts to manger (no./d)	41.44± 4.43	45.50± 3.51	41.33± 2.41
Time spent on water trough (sec/d)	111.50± 14.71	108.94± 16.56	94.56± 8.93
Drinking water(ml/sec.)	22.00± 2.00	25.00± 2.39	23.00± 1.35
Attempts to water trough (no/d)	3.94± 0.47	3.72± 0.54	3.61± 0.35
Standing in covered area (min/d)	238.00^{ab}± 21.04	283.72^{a}± 44.65	171.72^{b}± 12.96
Standing in uncovered area (min/d)	102.83^{ab}± 22.43	129.89^{a}± 28.60	46.78^{b}± 9.59
Lying in covered area (min/d)	712.17^{a}± 51.92	338.56^{b}± 70.98	855.83^{a}± 20.19
Lying in uncovered area (min/d)	99.22^{b}± 36.01	355.00^{a}± 64.78	37.06^{b}± 18.26
Movement inside premises (min/d)	10.39± 1.16	10.00± 0.85	9.33± 0.86
Agonistic behaviour (sec/d)	97.55± 19.02	93.95± 36.31	106.06± 16.36

Means with different superscripts in a row differed significantly (P<0.05).

straw bedding, soiled, wooden slats, rubber mats with low thermal conductivity is associated with increased comfort (Færevik *et al*. 2005).

Goats reared on brick floor spent significantly (P<0.05) higher time (min./d) for standing as compared to cement concrete floor. Time spent for lying (min./d) on earthen and cement concrete floor was comparable but significantly (P<0.05) higher to the tune of 110.35 and 152.78% as compared to brick floor, respectively. Goat's preference for lying in covered area on brick floor was less as compared to goats reared on earthen and cement concrete floor. It was indicated that goats preferred earthen or cement concrete floor for lying. Time spent by goats for other activities, i.e. movement (min./d) and agonistic behaviour (sec./d) was comparable among treatment groups. Present study revealed that goats spent highest time for lying (55.49%). The ewes and goats spent 62 and 66% time for lying, respectively (Panagakis *et al*. 2004, Andersen and Boe 2007) which is higher than the present findings. Goats reared on earthen floor spent maximum time for lying in covered area (49.44%). It was indicated that goats preferred to lie down on surfaces with low thermal conductive properties (Sutherland *et al*. 2017) but it was also observed that goats reared on cement concrete floor spent maximum time for lying in covered area (59.42%) which had higher thermal conductive properties. Hence, softness did not appear to be important flooring characteristic for lying of goats (Boe *et al*. 2007). Therefore, in present study, it is unlikely that previous experience with flooring type influenced the goat's lying preference. Agonistic behaviour of goats such as butting, escape, threatening and defense are the instinct to protect both themselves and their food sources (Tuncer *et al*. 2016). Time spent for agonistic behaviour and movement inside premises was least due to sufficient floor space provided in stall for feeding and lying (Centoducati *et al*. 2015).

Effect of season on behavioural parameters of goats: Perusal of data in Table 2 revealed that feeding time (min./d) and attempts to manger (no./d) was significantly (P<0.05) higher in cold season as compared to summer and hot humid season. Time spent on water trough (sec./d) in summer and hot humid season was significantly (P<0.05) higher to the tune of 140.14 and 109.31% as compared to winter season, respectively. However, water intake (ml./sec.) was significantly (P<0.05) more in summer and winter season to the tune of 50 and 33.33% as compared to hot humid season. The number of attempts made by goats to water trough during 24 hrs in hot humid and summer season was (P<0.05) higher to the tune of 129.13 and 118.45%, respectively as compared to winter season. The distribution of daily behavioural activities was directly related to climatic variables. In cooler environments, animal would spend more time for consuming more feed to generate body heat for comfort (Ogebe *et al*. 1996) which supported the present findings. Time spent on water trough, water intake (ml/sec.) and frequency of attempts to water trough was higher, indicating that the water intake of the goats increased as environmental temperature increased. Higher frequency of attempts to water trough was associated with post feeding during day time. However during night time (21.00 PM to 7.00 AM), goats did not prefer to drink and out of total activity, goats spent only 0.12% time for drinking (Patil *et al*. 2008, AlRamamneh *et al*. 2012, Jadhav and Killedar 2018) which supported the present findings.

Table 2. Behavioural activities of goats in different seasons (n = 18)

Attribute	Season		
	Cold	Hot dry	Hot humid
Time spent for feeding (min/d)	$345.05^{a}\pm 15.70$	$287.72^{b}\pm 5.46$	$277.67^{b}\pm 11.50$
Dry matter intake (g/min)	2.59 ± 0.12	2.80 ± 0.14	2.43 ± 0.10
Attempts to manger (no/d)	$48.78^{a}\pm 3.20$	$33.61^{b}\pm 3.35$	$45.89^{a}\pm 3.06$
Time spent on water trough (sec/d)	$57.33^{b}\pm 6.87$	$137.67^{a}\pm 12.34$	$120.00^{a}\pm 13.08$
Drinking water (ml/sec)	$24.00^{a}\pm 1.74$	$27.00^{a}\pm 2.12$	$18.00^{b}\pm 1.30$
Attempts to water trough (no/d)	$2.06^{b}\pm 0.25$	$4.50^{a}\pm 0.43$	$4.72^{a}\pm 0.37$
Standing in covered area (min/d)	$306.78^{a}\pm 41.56$	$178.83^{b}\pm 13.02$	$207.83^{b}\pm 23.46$
Standing in uncovered area (min/d)	$127.17^{a}\pm 31.46$	$48.33^{b}\pm 9.09$	$104.00^{ab}\pm 18.98$
Lying in covered area (min/d)	$532.00^{b}\pm 84.48$	$786.78^{a}\pm 45.02$	$587.78^{b}\pm 72.51$
Lying in uncovered area (min/d)	117.72 ± 35.24	128.11 ± 43.21	245.45 ± 73.92
Movement inside premises (min/d)	$9.28^{b}\pm 0.91$	$7.50^{b}\pm 0.61$	$12.95^{a}\pm 0.87$
Agonistic behaviour (sec/d)	$88.67^{b}\pm 18.08$	$44.67^{b}\pm 10.89$	$164.22^{a}\pm 32.81$

Means with different superscripts in a row differed significantly (P<0.05).

In cold season, goats spent significantly (P<0.05) more time for standing (min./d) in covered area as compared to summer (71.54%) and hot humid (47.61%) seasons. However, standing time (min./d) in uncovered area was significantly (P<0.05) less in hot dry season as compared to cold (163.12%) season. Lying time (min./d) in covered area was significantly (P<0.05) higher in hot dry season as compared to hot humid (33.85%) and winter (47.89%) seasons. In order to maximize heat loss from body through conduction, time spent for lying in summer (63.54%) season was more as compared to hot humid (57.87%) and winter (45.12%) seasons. Goats reduce their frequency of physical effort in summer season when experienced higher ambient temperatures that requires greater energy expenditure. During this period, animals minimized their levels of activity to remain within a comfort zone, thereby reducing endogenous heat accumulation and maintaining physiological patterns within the normal range (Paulo and Lopes 2014). The requirement of energy in standing

behaviour is more than lying; however, in present study standing time was more in winter season (30.13%) as compared to hot humid (21.65%) and summer (15.78%) season in order to minimize heat loss from body whereas in summer season, goats spent less time for standing diminishes the transmission of heat through direct contact with the ground and tends to decrease heat stress (Paulo and Lopes 2014, De *et al.* 2015).

In conclusion, under the conditions of the present study, goats preferred earthen and cement concrete floor for lying. Thermoregulatory need seems to be the most reasonable explanation for the observed preference of earthen floor with low thermal conductivity. Goats also preferred to be housed on hard surface which kept clean and dry throughout the entire experimental period, but under commercial conditions, dirty and wet floors may be avoided irrespective of the flooring material. The results suggested that earthen and cement concrete floor shall be recommended for increasing comfort level and welfare of goats under stall-fed rearing system in semi arid condition.

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