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Effect of Different Housing System on the Morphological Traits, Physiological Responses and Behavioral Observations of Sirohi Kids

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ABSTRACT

The research was carried out at the Instructional Livestock Farm, College of Veterinary and Animal Sciences, Udaipur (RAJUVAS), Rajasthan, India during September to December, 2021 to determine how the conventional and loose housing systems affect the morphological characteristics, physiological reactions, and behavior of Sirohi goat kids. A total of twenty-four Sirohi goat kids were randomly allocated into two groups, with twelve goats in each group, housed in a loose housing system and a conventional housing system. The research revealed a notable distinction in morphological characteristics like body length, height at wither, and heart circumference between the two different housing systems. Heart girth, height at withers, and body length were observed to be more advanced and prominent in the loose housing system in contrast to the conventional housing system as age progressed. Nevertheless, there was no significant variance observed in the physiological parameters such as pulse rate, respiration rate, and rectal temperature among the two housing categories. Moreover, the conventional housing system exhibited considerably (p<0.05) higher observable behavioral responses, including feeding, drinking, ruminating, and butting, in comparison to the loose housing system. The study's findings indicated that goats housed in the loose housing system at Institution Livestock Farm, College of Veterinary and Animal Science, Udaipur, yielded greater benefits in terms of financial returns, performance, and behavioral responses.

KEYWORDS: Behavior, housing system, performance, physiological response, Sirohi goat

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1. INTRODUCTION

Before planning a goat shed structure, there are some basic prerequisites that must be considered. The animals must feel comfortable and be protected from adverse weather conditions. There should be plenty of fresh air, and measures should be taken to control parasitic infections (Teixeira et al., 2014; Clark et al., 2017; Shashank et al., 2019). The housing should maintain desirable working conditions for labor and supervisory staff. It should integrate feeding, watering, cleaning, handling, and manure removal systems (Montossi et al., 2013; Munoz-Osorio et al., 2016). In warm weather, confinement without enough ventilation causes heat stress in animals, which negatively impacts their well-being and productivity (Rihawi et al., 2010; De et al., 2015; Centoducati et al., 2015). Animals raised in intensive system with slatted floors have been encouraged in sub-humid areas to keep animals away from excrement and to provide them enough ventilation (Popescu et al., 2014; Hossain et al., 2021). The efficiency of different housing systems depends on the size of the herd. Free-stall systems are better suited for managing large herds as they enhance milk quality, increase milk yields, reduce energy consumption and labor intensity, and ensure compliance with environmental protection regulations (Wardal et al., 2015; Sawa et al., 2017). Compared to tie-stall barns, loose housing systems exhibit a lack of direct interaction between humans and animals. This absence hinders the ability to accurately observe animal behavior or detect early signs of illness, ultimately leading to extended treatment periods or premature culling (Beaver et al., 2021; Witkowsaka et al., 2022).

Goats are an important livestock species in Asia, contributing significantly to GDP, rural employment, and food production (Yadav and Khada, 2009). With 56.8 million animals, Rajasthan ranks second in the nation and accounts for more than 11% of total livestock in India (Anonymous, 2019). There are currently 148.88 million goats in India, with Rajasthan having the largest number (20.84 million goats). It makes up 16% of all the goats in the nation (Ahari and Waiz, 2024).

The major sources of income for this breed are meat and milk production. Raising goats is a significant agricultural activity, especially in rural areas of Rajasthan (Waiz et al., 2018; Ahari and Waiz, 2024). Throughout history, goats have proven to be highly beneficial to humans due to their ability to adapt to a variety of environmental conditions, which has allowed different breeds and strain types to evolve and thrive (Birteeb et al., 2015). Their capacity for survival is immense, and they frequently flourish in environments with little flora that are inappropriate for feeding other animals (Miranda et al., 2012; Zulkifli et al., 2023). With minimal investment, goats can be raised profitably under the most extensive types of nomadic grazing (Thiruvekadan et al., 2009; Singh et al., 2023). The feeding habits, quick maturity, efficiency of reproduction, small size, and adaptability to a variety of agro-climatic conditions, from hot and humid to dry and arid, is significant characteristics that make goat husbandry a wise endeavor (Panda et al., 2016; Sangamneshwaran, 2016). Because of its low cost, goat farming is an excellent option for industrial workers, marginal farmers, and landless laborers (Eyoh et al., 2019; Khant et al., 2021).

Due to the advent of intensive animal husbandry and contemporary housing systems, scientists have focused on the effects of microclimate in animal housing, management strategies, and animal welfare (Kaya, 2011; Maurya et al., 2013 ; Abozed et al., 2021; Singh et al., 2023). Keeping in views, the goal of the current study was to determine how did the conventional and loose housing systems affect the morphological characteristics, physiological reactions, and behavior of Sirohi goat kids.

2. MATERIALS AND METHODS

The research was carried out at the Instructional Livestock Farm, College of Veterinary and Animal Sciences, Udaipur (RAJUVAS), Rajasthan, India during September to December, 2021

2.1. Animals

Twenty-four seemingly healthy Sirohi goat kids, aged from three to sixteen weeks, were employed. The animals were divided into two groups at random: two males and ten females, each raised in a conventional and a loose housing arrangement at Livestock Farm, College of Veterinary and Animal Science, Udaipur, Rajasthan university of Veterinary and Animal Sciences, Bikaner, India.

2.2. Management

Goats raised in the loose housing system were assigned to a pen that was connected to an open yard via a door, allowing them constant free access to the yard for exercise. In contrast, goats raised in the conventional housing system were raised in total confinement with no access to an open yard. The kids were provided with ad libitum feed and water throughout the experiment. Animal identification was done by tagging the ears of the animals. Each goat kid was allotted a space of 5.38 and 10.76 square feet in a convention and loose housing system, respectively. Standard management practices were adopted during the entire experimental period.

2.3. Morphological traits

The morphological traits of goat kids were recorded every week, prior to feeding. A flexible tailor's tape was used to

measure the attributes while the subjects were standing. Heart girth was measured as the circumference of the chest immediately behind the elbow, body length as the distance from the anterior point of shoulder to the posterior extremity of the pin bone, and height at wither as the perpendicular distance from the ground to the highest point of withers (Waiz et al., 2018).

2.4. Physiological responses (rectal temperature, pulse rate, respiration rate)

For comparing physiological parameters viz, rectal temperature (°F), pulse rate (beats minute^{-1}) and respiration rate (Breathe minute^{-1}) were recorded at weekly intervals in Sirohi goat kids. Utilizing a normal clinical veterinary thermometer, the animal's rectum was deeply penetrated to determine the temperature of its rectal area. For duration of one minute, the thermometer was left in the rectum, positioned obliquely to make contact with its mucosa. The median coccygeal artery on the ventral side of the tail was palpated for one minute, and the rhythm was recorded as beats per minute (BPM). The respiration rate was determined in breaths per minute (BPM), by calculating the number of breaths exhaled by the animal and placing it against their nostrils for a minute.

2.5. Behavioural observations

Observations were made during the experiment from the first week to the last. Behaviors such as eating (goat with their head completely inside the feeder), drinking (goat drinking from the water trough while standing, sitting, or resting), rumination (swallowing, unswallowing, or re-swallowing food) and butting (hitting another goat with the forehead or horn) were recorded once a day for an hour at 12:00 PM.

2.6. Statistical analysis

Data were entered into M.S. Excel for recording morphometric features, physiological parameters, and behavioral observations. The data were then analyzed using IBM Corp. IBM SPSS Statistics for Windows, Version 17.0, Armonk, NY, USA. One-way ANOVA was used to evaluate the mean comparisons. If the probability value of a difference was less than 0.05, it was deemed statistically significant. Duncan's Multiple Range Test was used to separate variables with significant differences (Steel et al., 1997).

3. RESULTS AND DISCUSSION

3.1. Morphological traits

The observed effect of morphological traits viz; heart girth, height at withers and body length (in cm) on different housing systems at weekly intervals are presented in Table 1. At the end of the experiment heart girth, height at wither

Table 1: Means±SEm of weekly morphological traits of kids under two housing systems

Weeks	Housing systems	
	LHS	CHS
Heart girth (cm)		
1	32.25±0.04^{b}	31.40±0.03^{a}
2	38.95±0.04^{b}	38.18±0.02^{a}
3	39.83±0.03^{b}	39.70±0.05^{a}
4	41.91±0.03^{b}	40.68±0.14^{c}
5	41.95±0.04^{NS}	41.85±0.04^{NS}
6	43.25±0.04^{b}	42.90±0.03^{a}
7	46.85±0.04^{b}	45.82±0.03^{a}
8	46.92±0.04^{b}	46.04±0.03^{a}
9	48.38±0.04^{b}	47.95±0.02^{a}
10	49.13±0.03^{b}	48.70±0.05^{c}
11	49.83±0.03^{b}	49.0±0.05^{c}
12	50.19±1.01^{NS}	50.07± 1.30^{NS}
13	51.91±0.03^{b}	50.68±0.14^{a}
14	52.85±0.04^{c}	51.85±0.04 ^{d}
15	54.12±0.04^{NS}	53.97±0.04^{NS}
16	55.26±0.04^{b}	54.88±0.04^{c}
Overall mean	46.47±1.57^{b}	45.85±1.58^{a}
Height at wither (cm)		
1	46.35±0.04^{NS}	46.10±0.03^{NS}
2	48.25±0.03^{c}	48.14±0.02^{d}
3	48.60±0.03^{NS}	48.20±0.03^{NS}
4	49.26±0.06^{a}	48.93±0.22^{a}
5	49.87±0.06^{a}	49.06±0.22^{a}
6	50.60±0.05^{c}	49.73±0.03^{b}
7	50.71±0.07	49.96±0.06^{a}
8	51.16±0.04^{b}	50.60±0.05
9	51.81±0.03	50.99± 1.01
10	52.75±0.04	51.80±0.05^{c}
11	53.75±0.04^{c}	52.76±0.04
12	54.15±0.06^{b}	53.58±0.15^{a}
13	54.73±0.04^{NS}	54.12±0.06^{NS}
14	55.10±0.06^{NS}	55.0±0.06 ^{NS}
15	55.80±0.06^{b}	55.24±0.06^{a}
16	55.96±0.06^{b}	55.07±0.06^{a}
Overall mean	55.98±0.72^{b}	54.87±0.73^{a}
Body length (cm)		
1	44.76±0.04^{b}	44.58±0.03^{a}

Table 1: Continue...

Weeks	Housing systems	
	LHS	CHS
2	45.76±0.04^{NS}	45.61±0.06^{NS}
3	46.58±0.05^{b}	46.20±0.05^{a}
4	46.85±0.04^{NS}	46.73±0.04^{NS}
5	47.18±0.04^{b}	47.03±0.04^{a}
6	48.76±0.03^{b}	47.46±0.08^{a}
7	48.81±0.06^{b}	47.78±0.04^{a}
8	49.05±0.03^{b}	48.11±0.03^{a}
9	49.28±0.04^{b}	48.58±0.11^{a}
10	49.36±0.05^{b}	48.91±0.06^{a}
11	49.85±0.04^{b}	49.22±0.09^{a}
12	50.06±0.07^{NS}	49.49±0.04^{NS}
13	50.18±0.06^{b}	49.89±0.03^{a}
14	50.36±0.07^{NS}	50.0±0.06^{NS}
15	50.43±0.05^{NS}	50.29±0.04^{NS}
16	50.87±0.06^{b}	50.58±0.07^{a}
Overall mean	48.63±0.46^{b}	48.15±0.44^{a}

LHS: loose housing system; CHS: conventional housing system; NS: Non-significant; a, b, c : Means with different superscript within the columns differ significantly with each other

and body length was significantly (p<0.05) in loose housing system than conventional system of rearing.

The findings of the present investigation showed that morphological characteristics in both housing groups developed with age, but they were more evident in loose housing systems. Variations in body length, height at wither, and heart circumference between two housing systems viz, conventional and loose housing systems may be caused by variations in body growth in each system, which is a sign of the animals' degree of comfort and production. The same results were reported by Thiruvenkadam et al., 2009; Birteeb et al., 2015; Eyoh et al., 2019 in goats reared under different management systems. Contrary to this, Tiezzi et al. (2019) found non-significant effect on morphological traits of goats raised under conventional housing systems.

3.2. Physiological responses

Table 2 displays the average weekly physiological responses of Sirohi kids under two different housing systems. The results indicated non-significant effect of physiological responses such as rectal temperature, pulse rate and respiration rate on Sirohi kids under loose housing and conventional housing systems. Though insignificant but numerically higher values of rectal temperature, pulse rate and respiration rate was recorded in conventional

Table 2: Means±SEm of weekly physiological responses of kids under two housing systems

Weeks	Housing systems	
	LHS	CHS
Rectal temperature (°F)		
1	102.80± 0.13	103.00±0.15
2	102.48±0.17	102.61±0.21
3	102.95±0.10	103.00±0.08
4	101.88±0.30	102.35±0.24
5	102.95±0.12	103.85±0.03
6	103.01±0.25	103.00±0.29
7	103.66±0.07	103.93±0.03
8	102.76±0.23	102.91±0.29
9	103.70±0.10	104.18±0.04
10	102.70±0.21	102.66±0.25
11	103.38±0.25	104.56±0.04
12	103.00±0.10	103.10±0.34
13	103.68±0.04	104.85±0.02
14	102.22±0.23	102.41±0.29
15	102.15±0.23	102.18±0.27
16	103.78±0.04	103.70±0.02
Overall mean	103.26±0.17^{NS}	103.91±0.26^{NS}
Pulse rate (BPM)		
1	83.33±0.66	83.66±0.71
2	82.83±0.60	83.16±0.54
3	83.66±0.49	85.33±0.66
4	85.16±0.60	85.00±0.85
5	84.00±0.44	83.33±0.55
6	85.33±0.66	83.50±0.84
7	83.50±0.34	84.00±0.89
8	83.00±0.44	83.00±0.63
9	84.33±0.84	84.16±0.74
10	84.16±0.79	84.83±0.83
11	83.16±0.54	83.50±0.50
12	84.33±0.55	83.66±0.80
13	84.50±0.71	84.33±0.80
14	84.26±0.86	84.32±0.48
15	84.04±0.25	84.02±0.39
16	83.80±0.27	83.90±0.30
Overall mean	84.02±0.31^{NS}	84.10±0.35^{NS}
Respiration rate (BPM)		
1	30±0.23	30.02±0.10

Table 2: Continue...

Weeks	Housing systems	
	LHS	CHS
2	31.32±0.25	31.45±0.21
3	31.43±0.11	31.12±0.22
4	32.10±0.13	32.21±0.23
5	32.16±0.18	32.18±0.21
6	33.09±0.10	32.98±0.20
7	33.1±0.13	33.08±0.22
8	32.68±0.10	32.74±0.25
9	31.45±0.19	31.32±0.23
10	33.09±0.25	33.18±0.20
11	33.23±0.23	33.19±0.10
12	31.43±0.20	31.12±0.23
13	32.32±0.21	32.29±0.21
14	32.10±0.20	32.21±0.22
15	32.16±0.13	32.18±0.13
16	32.87±0.20	32.73±0.23
Overall mean	32.19±0.24^{NS}	32.10±0.20^{NS}

housing system than loose housing system. Similar results of physiological responses were observed by Kulkarni et al. 2000; Yazdani and Gupta, 2000 in calves, Bhatta et al. 2005 in sheep and Rahman et al. (2013) on goats reared under two different housing systems. However, the findings are contrary to the results of Bhakat (1997) who observed non-significant effect of housing systems in cross-bred goats.

3.3. Behavioral observations

The observed effect of behavioral observations on two housing systems of Sirohi goats are presented in table 3. Results revealed that eating, drinking, rumination and butting behavior was significantly higher in conventional housing system than loose housing systems of Sirohi goats.

3.3.1. Eating

The findings shown in Table 3 revealed a statistically (p<0.05) significant variation in the average frequency of eating behavior. Goats housed in a conventional housing system took longer to eat from the ground or trough than those housed in a loose housing system. Rivalry for the feeder may be the reason for the extended time spent in a conventional housing system. Because social facilitation in limited housing systems encourages goats to feed concurrently, more rivalry and antagonism are likely to occur among them than in loose housing systems. This was consistent with the findings of Muhammad et al., 2014; Thakur et al., 2017 and Abdel-Hamid, 2017, who found that goats reared under extensive housing systems had lower feeding frequencies than goats raised under intensive management systems. However, Lee et al. (2012) in goats and Wang et al. (2016) in cattle revealed a non-significant influence of various housing systems on eating behavior.

Table 3: Means±SEm of behavioral observations of kids under two housing systems

Behavioral observations	Housing systems	
	LHS	CHS
Eating	52.36±0.88^{a}	59.13±0.47^{b}
Drinking	6.81±0.07^{a}	7.99±0.14^{b}
Rumination	5.43±0.06^{a}	6.08±0.08^{b}
Agnostic behavior (butting)	9.2±0.04^{a}	7.6±0.14^{b}

3.3.2 Drinking

Drinking frequency was substantially (p<0.05) greater in the conventional housing system compared to the loose housing system in the current findings (Table 3), which may be attributed to the strong association between feed intake and water intake. The results are also in line with Mohammad et al., 2014; Abdel-Hamid, 2017 and Eyoh et al., 2019, as they reported that the majority of goats seen drinking at intensive management systems was subjected to behavioral redirection. However non-significant effect of different housing system on drinking behavior was reported by Keane et al. (2017) in heifers and Norouzian et al. (2017) in sheep.

3.3.3 Rumination

According to the current study's findings (Table 3), rumination was significantly (p<0.05) higher in the conventional housing system than in the loose housing system. Increased access to food may be the cause of this, leading to increased drinking and rumination. This was consistent with findings published by Boissy and Dumont (2002) and Abdel-Hamid (2017), which proposed that dominant animals had a high rumination rate in addition to having a high priority to obtain food and water over other animals. Contrary to this, De Sousa et al. (2014) found non-significant effect of rumination under different management systems.

3.3.4 Butting

The current study's findings (Table 3) show that butting (agnostic behavior) was significantly (p<0.05) higher in the conventional housing system than in the loose housing system. It might be because animals raised in conventional housing systems feel more discomfort and stress, which can lead to negative social reactions. Similar results about agnostic behavior in goats were noted by Muhammad et al. (2014) and Panda et al. (2016). However, Keane et al. (2017) found that housing systems had no discernible impact on

unfavorable social interactions in heifers.

4. CONCLUSION

Under the farm conditions of Udaipur, Rajasthan, the loose housing system proved to be more advantageous compared to the conventional housing system when it comes to the performance and welfare of goats.

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