Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7265

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (6):** 1218-1224 (2018)

Research Article

Effect of Bedding Material on Ethological Profile of Barbari Kids during Winters

Mohit Antil[1*], Bhuvaneshwar Rai[2], Chetna Gangwar[2], Dhawal Kant Yadav[1] and Arun Somagond[1]

[1]Livestock Production Management division, Indian Veterinary Research Institute, Izatnagar, Bareilly-243122

[2]Animal Physiology and Reproduction division, Central Institute for Research on Goats, Makhdoom, Mathura-281122

*Corresponding Author E-mail: mohitantilv21@gmail.com

Received: 23.10.2018 | Revised: 30.11.2018 | Accepted: 8.12.2018

ABSTRACT

Present study was undertaken in experimental shed of Central Institute for Research on Goats to analyze the effect of different bedding materials during winter on growth performance of Barbari kids. Thirty post-weaned Barbari kids of about three months age were selected from the institutional flock, which were divided into three groups viz. group I, II and III with ten kids in each group and were kept on plastic slats, soil and rubber mats, respectively. To study the general behaviour of kids in different groups, video recordings were done using three digital cameras. The videos of each animal group were recorded continuously for 12 hours at fortnightly interval. The videos were analyzed using instantaneous sampling with 5 minutes intervals and ethograms were made. The ethograms were used to calculate the time budgets for each behaviour. The parameters under study were resting time (%), standing time (%), walking time (%) and feeding time (%). The overall average resting time (%) of kids was comparable in Gr-I, II & III i.e. 32.43, 33.12 and 31.68, respectively. The overall average standing time (%) of kids in for Gr-I, II & III was 24.21, 27.81 and 29.55, respectively. The overall average standing time (%) was significantly lower (P<0.05) in Gr-I as compared to Gr-II and III. The overall average walking time (%) of kids in for Gr-I, II & III was 4.83, 4.80 and 3.93, respectively. The overall average walking time (%) was significantly higher (P<0.05) in Gr-I and II as compared to Gr-III. The overall average feeding time (%) of kids in for Gr-I, II & III was 38.49, 34.20 and 34.87, respectively. The overall average feeding time (%) was significantly higher (P<0.05) in Gr-I as compared to Gr-II and III.

Key words: *Bedding material, Behaviour, Barbari goat kids, Winter season*

INTRODUCTION

Goat is also known as 'Poor man's cow' as it is an important source of income for the marginalized section of rural population that owns majority of the small ruminants[2]. A persistent rise in demand for animal products due to changes in consumer tastes and expanding markets; particularly in developing countries showing expansion in wealth has created a challenge for animal scientists to meet this demand by optimization of housing for better production[10].

Cite this article: Antil, M., Rai, B., Gangwar, C., Yadav, D. K. and Somagond, A., Effect of Bedding Material on Ethological Profile of Barbari Kids during Winters, *Int. J. Pure App. Biosci.* **6(6):** 1218-1224 (2018). doi: http://dx.doi.org/10.18782/2320-7051.7265

Barbari goats can be characterised as small, short-haired and with small light brown patches with most typically white coat colour. They are distributed across Uttar Pradesh and Rajasthan States of India[1].

Housing management of kids during winters has a distinct and critical role of bedding materials. The bedding material can help in increasing animal welfare as well as enhancement of physiological condition of the kids[3]. Use of inadequate bedding may translate to uncomfortable conditions during winters, which in turn retards the productivity of livestock by making them prone to different diseases and parasitic infestation (internal and external). One of most vital role of bedding material is to moderate the extremes of climatic stress and providing favorable microclimate[15]. The pivotal characteristics of bedding material for farm animals are considered to be thermal conductivity, softness, cleanliness and slipperiness. These characteristics affect both animal preferences and thermoregulatory behavior[8].

The main concern during winter regarding flooring systems is the heat loss to the floor at low temperatures when lying goat[4,11]. The lying comfort of animal is increased and cold induced stress is reduced with reduction in thermal conductivity of bedding material[3]. Keeping all these aspects in mind, the present study was conducted with the objective to study the effect of bedding materials on various behavioral parameters.

MATERIAL AND METHODS

The present study was conducted at Experimental shed complex on ICAR-Central Institute for Research on Goat (C.I.R.G) Makhdoom, Mathura, Uttar Pradesh, India. The climate is hot and semi-arid. Weather turns colder with winter stretching from November to February and summer ranges from May to August month annually.

The animal experiment was initiated in December 2017 and ended in March 2018. A total of 30 post weaned Barbari kids (21 males and 9 females) aged 3 months were selected from institute flock. The kids were randomly allocated to the two treatment groups (Plastic slats and rubber mat) and one control group (Soil floor) on the basis of similar body weight.

Table 1. Dimensions of partitions of pen made for different groups

Group	Bedding material used	Dimensions of partition
1	Plastic Slats	10 feet x 10 feet
2	Soil	10 feet x 10 feet
3	Rubber mats	10 feet x 10 feet

Each group comprised of ten kids (7 males and 3 females). While selecting the animals, due care was taken to minimize the error by narrowing down the range of age and live weights of these experimental animals as far as possible. The study was conducted for a period of 90 days duration with an adaptation period of 1 week prior to recording of variables. The animals were raised under an intensive housing system. A single pen (400 feet^2) was partitioned equally into 4 parts using welded wire mesh. The control and treatment groups were housed in separate partition of the pen having different bedding materials. Out of the three groups, second group served as control.

The macroclimatic data for maximum, minimum, dry and wet bulb temperature was recorded outside the shelters and microclimatic data of the experimental sheds was recorded during the experiment at 7.30 AM and 2.30 PM.

Relative humidity

The relative humidity was calculated from dry and wet bulb temperature by using psychrometrics chart (Indian Meteorological Department).

Temperature humidity index (THI)

THI outside and inside the shelter was calculated daily at 7.30 AM and 2.30 PM using formula given by Marai[12]

THI = DB - {(0.55 – 0.55 RH) (DB – 58)}

Floor temperature

Floor temperature was recorded in all groups daily at 6.00 AM, 10.00 AM, 2.00 PM and 6.00 PM, respectively. A non-contact infrared thermometer (MS6530, Raytek, Santa Cruz,, USA) was used to record floor temperature. The floor temperature was recorded by taking average of the values from five different places in a group.

Behavioural study

To study the general behavior of kids in different groups, video recordings were done using three digital cameras. The videos of each animal group were recorded continuously for 12 hours i.e. from 6.00 AM to 6.00 PM. The recordings were taken at fortnightly interval. The videos were analyzed using instantaneous sampling with 5 minutes intervals and ethograms were made. The ethograms were used to calculate the time budgets for each behavior[11]. The parameters under study were resting, standing, walking and feeding behavior.

Statistical analysis

The experimental data generated were analyzed using one way or two way ANOVA (statistical package SPSS 20.0) and means were compared using Duncan's multiple range test. The P values less than 0.05 were taken to indicate statistical significance by adopting standard statistical procedures[16].

RESULTS AND DISCUSSION

Macroclimatic variables

The values of different meteorological parameters *viz.* ambient temperature, dry bulb temperature, wet bulb temperature (^{o}C), relative humidity (% RH) and thermal humidity index (THI) were observed at 7.00 am (minimum) and 2.00 pm (maximum) within the microclimatic conditions maintained during the study. The mean values of minimum and maximum ambient temperature as described in Table 2, were 8.40 ± 0.43^{o}C and 26.65 ± 0.63^{o}C, respectively. The mean values of minimum and maximum dry bulb temperature were 12.01 ± 0.45^{o}C and 26.07 ± 0.59^{o}C, respectively. The mean values of minimum and maximum wet bulb temperature were 10.58 ± 0.37^{o}C and 17.31 ± 0.30^{o}C, respectively. The mean values of minimum and maximum relative humidity were 85.25 ± 1.07% and 43.80 ± 1.81%, respectively. The mean values of minimum and maximum THI were 53.69 ± 0.75 and 71.69 ± 0.64, respectively.

Table 2. Macro and micro-climatic conditions during the experiment

	Time	AT (°C)	DBT (°C)	WBT (°C)	RH (%)	THI
Macroclimate	7.00 AM	8.40 ± 0.43^{c}	12.01 ± 0.45^{c}	10.58 ± 0.37^{c}	85.25 ±1.07^{a}	53.69 ± 0.75^{c}
	2.00 PM	26.65 ± 0.63^{a}	26.07 ± 0.59^{a}	17.31 ± 0.30^{a}	43.80 ± 1.81^{c}	71.69 ± 0.64^{a}
	Mean ± SEM	17.53 ± 0.50^{b}	19.04 ± 0.49^{b}	13.94 ± 0.32^{b}	64.52 ± 1.30^{b}	62.69 ± 0.65^{b}
Microclimate	7.00 AM	9.95 ± 0.38^{c}	12.64 ± 0.45^{c}	10.90 ± 0.36^{c}	82.23 ± 1.11^{a}	54.80 ± 0.73^{c}
	2.00 PM	27.86 ± 0.63^{a}	26.11 ± 0.58^{a}	17.11 ± 0.27^{a}	42.48 ± 1.78^{c}	71.59 ± 0.61^{a}
	Mean ± SEM	18.90 ± 0.48^{b}	19.38 ± 0.49^{b}	14.00 ± 0.30^{b}	62.36 ± 1.30^{b}	63.19 ± 0.63^{b}

AT, ambient temperature; DBT, dry bulb temperature; WBT, wet bulb temperature; RH, relative humidity; THI, thermal humidity index

Data is presented as the mean±SEM. $^{a, b, c}$ Different superscripts indicate significant difference (P<0.05) between groups at same time for each collection

Table 3: Surface temperature of different bedding materials throughout the experiment

	Floor Temperature (°C)											
	Collection 1 (0 – 30 days)				Collection 2 (30 – 60 days)				Collection 3 (60 – 90 days)			
Group	1	2	3	P - value	1	2	3	P - value	1	2	3	P - value
6 a.m.	6.59±0.63[b]	8.52±0.55[a]	8.39±0.58[a]	0.044	10.03±0.45[b]	11.50±0.43[a]	11.85±0.44[a]	0.013	15.68±0.41[b]	17.05±0.36[a]	17.79±0.41[a]	0.002
10 a.m.	12.68±0.74	12.25±0.53	14.29±0.81	0.111	16.35±0.34[b]	15.84±0.27[b]	17.79±0.44[a]	0.001	21.18±0.33[b]	20.37±0.29[b]	24.02±0.46[a]	0.000
2 p.m.	19.20±0.82[a]	16.66±0.47[b]	19.11±0.65[a]	0.014	22.34±0.35[a]	19.17±0.24[b]	21.68±0.37[a]	0.000	29.36±0.37[a]	25.94±0.32[b]	29.30±0.37[a]	0.000
6 p.m.	16.44±0.52	16.08±0.44	16.48±0.43	0.800	19.37±0.45	18.66±0.33	19.22±0.35	0.402	24.68±0.52	23.84±0.32	24.61±0.30	0.265

Data is presented as the mean±SEM. [a, b, c] Different superscripts indicate significant difference (P<0.05) between groups at same time for each collection

Microclimatic variables

The values of different meteorological parameters viz. ambient temperature, dry bulb temperature, wet bulb temperature (^oC), relative humidity (% RH) and thermal humidity index (THI) were observed at 7.00 am (minimum) and 2.00 pm (maximum) within the microclimatic conditions maintained during the study. The mean values of minimum and maximum ambient temperature were 9.95 ± 0.38^oC and 27.86 ± 0.63^oC, respectively. The mean values of minimum and maximum dry bulb temperature were 12.64 ± 0.45^oC and 26.11 ± 0.58^oC, respectively. The mean values of minimum and maximum wet bulb temperature were 10.90 ± 0.36^oC and 17.11 ± 0.27^oC, respectively. The mean values of minimum and maximum relative humidity were 82.23 ± 1.11% and 42.48 ± 1.78%, respectively. The mean values of minimum and maximum THI were 54.80 ± 0.73 and 71.59 ± 0.61, respectively.

Livestock production traits such as growth and health are significantly affected by environmental variables i.e. temperature, humidity, solar radiation, wind velocity, rain fall, and atmospheric pressure, which culminates into severe economic constraints [19, 18, 7]. The minimum and maximum ambient temperature ranged from 1 to 18°C and 13 to 39.5°C, respectively. Although goats are resistant to thermal stress at a greater extent but they suffer from heat and cold stress beyond their comfort zone, which is environmental temperature 13-27°C for Indian goats[14].

A THI of less than 72 is considered to be comfortable whereas between 72 to <74 is considered to be moderately stressful while a THI of 74 to <78 is considered severely stressful and more than 78 is considered to be very severely or extremely stressful[13]. In the present study, minimum and maximum THI values were 53.69 ± 0.75 and 71.69 ± 0.64. The THI values indicated comfortable conditions. However, due to low ambient temperature during the trial, as presented in Table 2, cold stress might be experienced by the goats in the winter season.

Floor temperature

The mean values of temperature of different bedding materials recorded daily at 6 a.m., 10 a.m., 2 p.m. and 6 p.m. have been presented in Table 3.

In the study, the floor temperature at 6 a.m. during the first 30 days of trial was found to be significantly lower (P<0.05) in Gr-I as compared to Gr-II and III and at 2 p.m. it was significantly lower in Gr-II as compared to Gr-I and III. During 30 to 90 days of trial the floor temperature at 6 a.m. was found to be significantly lower (P<0.05) in Gr-I as compared to Gr-II and III, at 10 a.m. was found to be significantly lower (P<0.05) in Gr-I and II as compared to Gr-III and at 2 p.m. was found to be significantly higher (P<0.05) in Gr-I and III as compared to Gr-II. Lower surface temperature of plastic slats may have counterbalanced the hygiene and welfare benefits, thus could not be translated into

growth superiority. The floor temperature significantly affected the metabolic and growth rates as well as the behavioral aspects during winters was reported by Verstegen and Van Der Hel[17] in pigs, Færevik[8] and Jorgensen[11] in sheep; Elmore[6] in cattle and Hickey[9] and Behera[3] in goats.

Ethological analysis of kids performance

The values of ethological parameters of kids during the experiment have been presented in Table 4.

The overall average resting time of kids in Gr-I, II & III was 32.43, 33.12 and 31.68, respectively. The overall average resting time was comparable (P>0.05) in Gr-I, II and III. The overall average standing time of kids in for Gr-I, II & III was 24.21, 27.81 and 29.55, respectively. The overall average standing time was significantly lower (P<0.05) in Gr-I as compared to Gr-II and III. The overall average walking time of kids in for Gr-I, II & III was 4.83, 4.80 and 3.93, respectively. The overall average walking time was significantly higher (P<0.05) in Gr-I and II as compared to Gr-III. The overall average feeding time of kids in for Gr-I, II & III was 38.49, 34.20 and 34.87, respectively. The overall average feeding time was significantly higher (P<0.05) in Gr-I as compared to Gr-II and III.

After an extensive literature search, only a limited number of studies were found regarding the effect of bedding materials on goat behavior. This could be attributed to the fact that most goat worldwide are not housed, whereas kept under far more extensive system. Similar to our findings, Di Grigoli[5], Færevik[8] and Behera[3] found that time spent while sitting was comparable in slatted as well as non-slatted floor but the feeding time was increased significantly. Jørgensen[11] found that animal preferred sitting on the floor with favorable physical attributes, similarly our study reported that retention of moisture and sticking of dung and feed on surface of rubber mat increased the standing time percentage. Moreover, kids on slatted floor showed maximum walking time percentage and were much more active as compared to other two groups.

Table 4: Effect of different bedding materials on behavior of kids in different groups

Attributes	Groups			SEM	P Value
	I	II	III		
Resting (% time)					
1st Fortnight	26.27	17.51	14.13	0.66	0.676
2nd Fortnight	32.82	34.13	32.06		
3rd Fortnight	27.58	30.75	32.20		
4th Fortnight	37.44	39.79	32.68		
5th Fortnight	29.79	36.13	35.17		
6th Fortnight	40.68	40.41	43.86		
Mean value	32.43	33.12	31.68		
Standing (% time)					
1st Fortnight	23.03	37.10	44.75	0.48	0.000
2nd Fortnight	19.24	20.20	24.41		
3rd Fortnight	34.55	32.06	31.79		
4th Fortnight	23.03	22.00	28.82		
5th Fortnight	25.17	28.48	25.31		
6th Fortnight	20.27	27.03	22.20		
Mean value	24.21^{B}	27.81^{A}	29.55^{A}		
Walking (% time)					
1st Fortnight	5.10	6.55	3.10	0.14	0.014
2nd Fortnight	4.41	4.62	3.44		
3rd Fortnight	4.27	4.55	4.62		
4th Fortnight	5.03	4.62	4.96		

5th Fortnight	6.27	4.82	4.62		
6th Fortnight	3.93	3.65	2.82		
Mean value	4.83^{A}	4.80^{A}	3.93^{B}		
Feeding (% time)					
1st Fortnight	45.58	38.82	38.00	0.59	0.007
2nd Fortnight	43.51	41.03	40.06		
3rd Fortnight	33.58	32.55	31.37		
4th Fortnight	34.48	33.37	33.58		
5th Fortnight	38.75	30.55	34.89		
6th Fortnight	35.03	28.89	31.31		
Mean value	38.49^{A}	34.20^{B}	34.87^{B}		

^{A,B,C} Means bearing different superscripts in a row differ significantly ($p<0.05$)

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