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Effect of bedding materials on health parameters in Barbari kids during winter season

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Abstract
Bedding material plays an integral role in winter housing of goat kids and 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 the health of Barbari kids. Thirty post-weaned Barbari kids were selected and 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 assess the health, parasitic load i.e. Egg per gram (E.P.G.) and Oocyst per gram (O.P.G.) were determined at every 3 week interval and dirt scoring was done on a monthly basis. The incidence of diseases p were recorded by direct observation method daily. Blood samples were collected on 20th, 50th and 80th day of experimental trail and serum antioxidant activity (MDA and DPPH) was evaluated. The difference between EPG values of different groups was found to be non-significant. The OPG values were significantly (P<0.05) higher in Gr-III than Gr-I. Highest dirt scores were exhibited by Gr III, followed by Gr II and Gr I, respectively. Overall incidence of diseases was highest in Gr III. MDA concentration was comparable between group I, II and III, respectively. DPPH activity was found to be significantly higher (P<0.05) in Gr III which indicates towards higher oxidative stress and the possible reasons are higher disease incidence and parasitic load. It is concluded that among the bedding materials used plastic slats improved the hygienic aspects (dirt score and worm load) in kids.

Keywords: Bedding material, health, Barbari goat kids, winter season

1. Introduction
Bedding material is one of the most vital components of housing of kids during winters. The bedding material can help in augmentation of animal welfare and health [2]. Lack of appropriate bedding may lead to uncomfortable conditions during winters, which consequentially hampers the productivity of livestock making them prone to different diseases and parasitic infestation (internal and external). The ability to moderate the extremes of climatic stress and providing favourable microclimate is an essential function of the bedding material [20]. Moreover, some bedding materials are quite resistant to pathogenic bacteria build-up and thus reduce the prevalence of disease during susceptible winter period floor [9].
A successful goat farmer values kids as the most precious asset. Assuring appropriate care of kids from the stage of kidding itself ensures better growth performance during all stages of production. Enhancement in the survivability of kids directly translates into increased productivity and economic returns [7]. The main problem of kid rearing is that the post-weaning period is related to poor growth rate because of poor housing management. The mortality rates for small, medium and large categories of goat keeping were 32.8, 32.1 and 15.8% in kids and 31.2, 19.9 and 14.9% in adult goats, respectively [17]. The build-up of pathogens and the survival of and infection by internal parasites are some of the implications of poor housing [8]. Optimization of housing for better production has been a challenge for animal scientists [13]. Therefore, the present study was conducted to assess the effect of bedding materials on health performance of Barbari kids in winter season.

2. Materials and Methods
2.1 Location and Climatic Conditions
The present study was conducted at the 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.

2.2. Experimental Animals

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

2.3 Experimental design

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 as shown in Fig. 1. Out of the three groups, second group served as control.

a) b) c)

Fig 1: Different type of bedding materials used in the experiment a) Plastic slats, b) Soil c) Rubber mats

2.4 Parasitological parameters

The parasitic load i.e. Egg per gram (E.P.G.) and Oocyst per gram (O.P.G.) were determined regularly at every 3 week interval. Faecal samples were collected directly from rectum of the animals and put into the faecal collection bags. The faecal nematode egg count and oocyst count was performed by a modified McMaster technique [1].

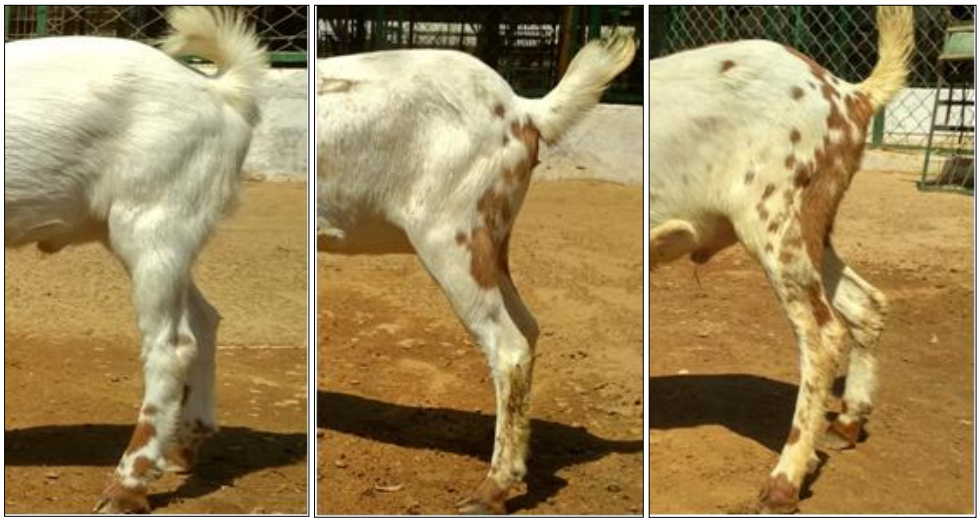
2.5 Dirt score

The animal's body was divided into three areas (side, back and legs) and each area was given a score from 0 to 2, according to the following criteria used by Hansen *et al.* [12]:

1. Side and back: 0 = Clean, 1 = <25% dirt, 2 = >25% dirt;
2. Legs: 0 = clean, 1 = dirt up to hocks/elbows, 2 = dirt up to the belly.

Additionally, the evaluation of cleanliness was performed by the same person at monthly interval to avoid individually subjective differences. The dirt scoring is depicted in Fig 2.

a) b) c)



d) e) f)

Fig 2: Classification of various levels of dirt scores:
A. Side and back dirt score: a) 0 = Clean, b) 1 = <25% dirt, c) 2 = >25% dirt
B. Legs dirt sore: d) 0 = clean, e) 1 = dirt up to hocks/elbows, f) 2 = dirt up to the belly

The incidence of various diseases like hoof disorders, fever, diarrhoea etc. in kids present in control and treatment groups were recorded by direct observation method.

2.6 Blood collection, preservation and serum analysis

Blood samples were collected on 20th, 50th and 80th day of experimental trail. About 10 ml blood was collected from all the experimental kids in the morning (before feeding) by jugular vein puncture. Blood flow was stopped by applying finger pressure on a gauze pad on the blood sampling site till the bleeding was stopped. Blood was taken into clean and dry test tube and kept in slanting position for 45 minutes to separate serum and serum was further collected in small plastic eppendorf tubes (2 ml) and stored at -20^0 C for further analysis.

2.6.1 MDA lipid peroxidation: MDA

Lipid peroxidation extent was measured in terms of malondialdehyde formation (MDA) by using the method of Buege and Aust [5].

2.6.2 DPPH

The free radical scavenging activity of methanol extract was measured by 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) using the method of Blois [4].

2.7 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 [24].

3. Results and Discussion

3.1 Parasitological load

The parasitological load has been presented in Table 2. The analysis of variance was done after transformation of raw data to $\log_e$ (FEC+100).

The mean values of EPG were comparable in all groups. The log transformed values of eggs per gram of faeces (EPG) were 5.06, 4.99 and 4.90 respectively, in Gr-I, II and III. The difference between EPG values of different groups was found to be non-significant (P>0.05). It resembles the findings of report of Costa and Vieira [6] which, contrary to common belief stated that slatted floors do not reduce the worm burden of goats in the region where annual rainfall is less than 800mm. Similarly, Thiruvenkadan *et al.* [25] also reported identical findings. Moreover, during winter the availability of parasitic stages are naturally minimum due to hypobiosis.

Goat kids are particularly susceptible to the pathological effects of Eimeria infections, especially newly weaned kids kept in large numbers under intensive management conditions [19]. The OPG values were significantly (P<0.05) higher in Gr-III than Gr-I. The values of log transformed oocyst per gram of faeces (OPG) were 7.17, 7.78 and 8.00 respectively, in Gr-I, II and III. According to Jalila *et al.* [15] peak mean oocyst counts was observed at the age of 10–12 weeks, which coincided with the weaning period and poor hygienic conditions exaggerated the coccidial infection intensity which resembled the findings in our study particularly in relation with rubber flooring.

Table 2: Effect of different bedding materials on faecal parasitological load of kids in different groups

Attribute	Group I	Group II	Group III	SEM	P Value
LNEPG (Log_e{egg per gram+100})					
0 day	4.95	5.07	4.81	0.06	0.588
21 day	5.89	5.38	5.28		
42 day	4.85	4.96	4.98		
63 day	4.74	4.67	4.60		
84 day	4.89	4.87	4.81		
Mean value	5.06	4.99	4.90		
LNOPG (Log_e{oocyst per gram+100})					
0 day	4.74	4.67	4.60	0.14	0.046
21 day	7.63	8.57	8.37		
42 day	7.67	8.19	8.97		
63 day	8.07	8.62	8.93		
84 day	7.75	8.85	9.11		
Mean value	7.17^B	7.78^{AB}	8.00^A		

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

3.2 Dirt score

The fortnightly dirt score of kids has been presented in Table 3 (Fig. 2). The values of dirt score was 0.67, 1.12 and 1.52,

respectively in Gr-I, II and III. In Gr-III, the dirt score value was comparatively higher than Gr-II. The dirt score of Gr-II was higher than Gr-I. These differences between dirt scores were significant (P<0.05) during the experiment.

Contrasting results have been obtained with regard to the cleanliness of animals housed in slatted units with and without rubber. In contrast to our findings, Hultgren and Bergsten [14] reported that cattle housed on slats alone showed a greater risk of getting dirty when compared with rubber slatted flooring, whereas Kremer *et al.* [16] reported otherwise. In congruence with our findings, Scott and Kelly [23] suggested that the cleanliness of animals within a housing system depends on whether or not there are clean areas available for lying. However, Lowe *et al.* [18] reported no difference in dirtiness between cattle on slats, rubber strips or straw, whereas cattle on rubber mats were significantly dirtier than those on rubber strips or straw. Earley *et al.* [10] reported that steers raised on the wood-chip treatment had greater dirt scores compared with the other three treatments.

Table 3: Effect of different bedding materials on dirt scores of kids in different groups

Dirt score	Group I	Group II	Group III	Mean	SEM	P Value
0 day	0.40	0.50	0.50	0.46	0.14	0.950
30 day	0.90^{B}	1.50^{AB}	2.10^{A}	1.5	0.15	0.004
60 day	0.70^{B}	1.30^{AB}	1.90^{B}	1.30	0.15	0.003
90 day	0.70	1.20	1.60	1.16	0.17	0.102
Overall	0.67^{C}	1.12^{B}	1.52^{A}	1.10	0.08	0.000

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

3.3 Incidence of diseases

The disease incidence has been presented in Table 4. During the experimental period, it was observed that overall 43.33% of the kids suffered from some kind of illness. Among them, 26.67% suffered once and 16.67% suffered more than once. About 30% of the kids suffered from one type of disease, whereas 13.33% kids suffered from more than one disease. It was observed that overall 40, 30 and 60% of the kids suffered from some kind of illness, respectively in Gr-I, II and III. Among them, 20, 20 and 40% suffered once and 20, 10 and 20% suffered more than once, respectively in Gr-I, II and III. About 20, 20 and 50% of the kids suffered from one type of disease, whereas 20, 10 and 10% kids suffered from more than one disease, respectively in Gr-I, II and III. During the experiment no mortality was observed.

Highest incidence of disease was found in rubber bedding material, this could be supported by the increased dirt score, parasitological load and decreased hygienic conditions. Our findings are in agreement with the findings of Blessy *et al.* [3] which established that excreta from the kids stuck to the surface of rubber mats and retention of moisture provided ideal conditions for microbial and oocyst proliferation.

Table 4: Effect of different bedding materials on incidence of diseases in kids across the groups

Group	Total no. of animals	Total animals suffered	Animals suffered once	Animals suffered more than once	Animals suffered from one disease	Animals suffered from more than one disease
Group I	10	4 (40)	2 (20)	2 (20)	2 (20)	2 (20)
Group II	10	3 (30)	2 (20)	1 (10)	2 (20)	1 (10)
Group III	10	6 (60)	4 (40)	2 (20)	5 (50)	1 (10)
Overall	30	13 (43.33)	8 (26.67)	5 (16.67)	9 (30)	4 (13.33)

Figures in parenthesis indicate percentage

3.4 Antioxidant activity

The effect of different bedding materials on the activity of different antioxidant markers i.e. DPPH and MDA in the serum samples of kids in different groups has been presented in Table 5.

Table 5: Effect of different bedding materials on serum antioxidant activity of kids in different groups

Attribute	Group I	Group II	Group III	SEM	P Value
MDA (nmol/ml)					
20 day	23.35	25.66	24.95	0.73	0.510
50 day	20.22	21.68	23.85		
80 day	18.88	18.91	19.91		
Mean value	20.82	22.08	22.90		
DPPH (%inhibition)					
20 day	17.04	19.24	19.21	1.03	0.049
50 day	25.50	28.01	34.05		
80 day	11.90	15.92	19.71		
Mean value	18.15^{B}	21.06^{AB}	24.32^{A}		

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

Lipid peroxidation (MDA) is the best marker of oxidative stress [22] and its concentration increases during stress condition. The mean MDA concentration was 20.82, 22.08 and 22.90 (nmol/L), respectively in Gr-I, II and III. The mean value of MDA (nmol/L) was comparable in all groups. Similarly, Ghosh *et al.* [11] and Rathwa *et al.* [21] reported that environmental stress is also responsible for the increased production of free radicals, which cause oxidative stress. MDA and Superoxide Dismutase (SOD) are used as indicators for oxidative stress.

The DPPH is a stable free radical used to evaluate the ability of compounds to act as free radical scavengers and to measure

the antioxidant capacity of compounds. There was a significant difference ($P<0.05$) in DPPH activity among the different groups, the mean values being 18.15, 21.06 and 24.32, respectively in Gr-I, II and III. In group-wise comparison, the mean value in Gr-III was significantly higher than Gr-I.

4. Conclusion

The results of the present study suggested that plastic slats as bedding material provide more hygienic conditions followed by soil and rubber mats, respectively. The excreta from the kids stuck to the surface of rubber mats and retention of moisture provided ideal conditions for microbial and oocyst proliferation which results in poor health performance and ultimately hampering the growth of the kids.

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