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# *Typha* (Patera grass) roof insulation ameliorates thermal stress during summer in Murrah buffalo calf resided in loose housing system

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**Abstract**
Roofs are a component of housing systems that shield animals from the sun's rays and rain. Animal output is negatively impacted by heat stress in the summer. In order to alter the microclimate and lessen the radiant heat inside, the shed's design and roofing material are very important. Roof material should be light, strong, durable, waterproof, beautiful, and free from moisture condensation and have high reflectivity, low conductivity, and low emissivity under the surface. In order to gain a better understanding of the impact roofing material on Murrah buffalo calves growth performance, a total of 16 female buffalo calves were selected and dispersed into two groups according to their weight and age namely $T_1$ (asbestos roof + *typha* grass insulation) and $T_2$ (only asbestos roof). Results of this study revealed that Monthly body weight data obtained from December, 2012 to November 2013 did not show any significant difference between the treatments. However, in the months March, April and May and again in the month of September significant difference has been found in the body weight in $T_1$ group.

**Keywords:** Roof, housing, heat stress and Murrah buffalo calves

## Introduction
Roof play a significant role in animal's housing's thermal exchange (Zappavigna and Liberati, 2002; Liberati and Zappavigna, 2004) [9, 17]. In relation to housing, the roof is an integral part that protects animals from direct solar radiation and rainwater. It has been reported that 340 kcal of direct solar radiation is flowing onto the body of an animal in an hour. Recent study by Vanlaer *et al.,* 2014 [16], suggested that artificial sheds or tree shade can reduce the impact of heat stress on pastures in hot climates. It was shown by Aengwanich *et al.* 2011 that heifers were better protected against heat stress in tree shade or artificial sheds than in open pastures. The shed's design and roof material are important factors in modifying the microclimate and the reducing radiant heat load (Badino, 2007) [2]. Materials for roofs include thatch, asbestos sheets, clay tiles, wood, plastic sheets, galvanized sheets etc., which should all possess one or more properties: low conductivity, low undersurface emissivity, high reflectivity, the correct roof profile (slope) and maximum practical height. The roof material should be lightweight, strong, durable, waterproof, attractive, free of condensation inside the shed and it should also be economical. When choosing roof materials, thermal conductivity is an important feature to consider, this is because materials with a lower thermal conductivity allow less heat to pass from inside to ensure better microclimate during summer season. Based on the degree of comfort, macro and micro-climate have profound effects on physiological response and growth of calves (Roy *et al.*, 2010) [11]. The use of thatching materials on the roof appeared beneficial and resulted in significantly ($P$ <0.01) higher body weight gains in Osmanabadi kids compared to those covered in tin roofing (Patil *et al.*, 2008) [10]. In greenhouse barns, calves, heifers and cows are offered a healthy environment for. Shade cloth has been shown to improve animal performance by minimizing heat stress (Khongdee *et al.*, 2010) [8]. In northern India, rainy season is often accompanied by high temperatures and high relative humidity, resulting in the uncomfortable Temperature humidity index (THI). Despite the fact that no single roofing material possesses all the properties required to qualify as a perfect roof material, efforts are always made to select roof materials that provide animals with maximum comfort. Considering the above situations, we conducted this study to investigate how different roofing materials affect animal growth performance in loose housing system.

## Materials and Methods

The Department of Livestock Production Management, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar, conducted the current study (which was a component of a bigger study) there. Under each treatment, eight female buffalo calves (between three and six months old) were kept. For the covered area under each treatment, various shade materials were applied in the following manner. $T_1$: asbestos roof + *typha* grass insulation (Asbestos sheet roofing with "*Typha-Typha*" (Patera) grass insulation) was also provided over the covered area), $T_2$: only asbestos roof (only commercially available asbestos was used). After completion of colostrum feeding period, the calves were fed as per the requirements specified by the ICAR (2013) [6]. The fresh water was provided round the clock during the experiment. The general management along with standard management practices and biosecurity measures were followed throughout the experiment. The study was undertaken in all seasons. The growth performance of all the experimental animals was worked out from the records of body weight. Body weight (kg) of all the experimental animals was recorded at the start of the experiment and subsequently at every fortnight interval throughout the experiment. It was recorded individually during morning hours prior to feeding and watering using an electronic weighing balance.

## Statistical Analysis

The statistical procedures followed were analysis of variance to study the variation in body weight in different treatment groups (Snedecor and Cochran, 1994) [14].

## Result and Discussion

As shown in Table 1, our results from the ANOVA analysis in March, April, May and September show a statistically significant differences between our group means. We can see that the significance value is below 0.5. The significant differences in the above mention months may be due to more comfortable microclimate condition during hot and humid months under asbestos sheet roofing with "*Typha-Typha*"/ Patera grass insulation as compare to only asbestos sheet roofing. The present findings are in agreement with Kamal (2013) [7] and Barman *et al.* (2017) [3] in calves as they reported significant increase in body weight of animals due to roofing pattern. Patil came to the same conclusion in 2008, stating kids housed in $T_2$ (Floor murum with one ventilator + thatch roof) and $T_4$ (floor murum with two ventilator + thatch roof) conditions grew more quickly than kids who lived in other housing conditions. Significant variations in the mean values of body weight gains were produced by the addition of different shed roofs. The findings also support Singh's (2000) [12] conclusion that buffalo heifers housed under thatched and roofs pasted with aluminium foil grew greater body weight than those kept under asbestos and white painted roofs, while the difference between treatments was not statistically significant. Other month, however, there were no significant differences in body weight in two treatment groups. Results of this study revealed that Monthly body weight data obtained from December, 2012 to November 2013 did not show any significant difference between the treatments. The results, however, are quite similar to De *et al.* (2015) [5] in lambs, who found no significant difference in body weight between animals housed in various systems. Similar to the current findings, Bhatta *et al.* (2004) [4] found no relationship between housing and sheep body weight. Srivastav (2021) [13], on the other hand, found that group T1 (thatch roof) experienced a significant rise in the average daily gain (ADG), average weekly weight gain, average monthly weight gain, and total body weight growth when compared to other groups.

**Table 1:** Effect of different roofing materials on body weight of experimental animals

| Months | Variable | Sum of squares | DF | Mean square | F | Sig |
|---|---|---|---|---|---|---|
| December | Between groups | 25.000 | 1 | 25.000 | 0.077 | 0.786 |
| | Within groups | 4568.750 | 14 | | | |
| | Total | 4593.750 | 15 | 326.339 | | |
| January | Between groups | 175.563 | 1 | 175.563 | 0.409 | 0.533 |
| | Within groups | 6013.875 | 14 | | | |
| | Total | 6189.438 | 15 | 429.563 | | |
| February | Between groups | 225.000 | 1 | 225.000 | 0.483 | 0.498 |
| | Within groups | 6518.000 | 14 | | | |
| | Total | 6743.000 | 15 | 465.571 | | |
| March | Between groups | 506.250 | 1 | 506.250 | 0.923 | 0.353 |
| | Within groups | 7677.500 | 14 | | | |
| | Total | 8183 | 15 | 548.393 | | |
| April | Between groups | 576.000 | 1 | 576.000 | 0.771 | 0.395 |
| | Within groups | 10455.000 | 14 | | | |
| | Total | 11031.000 | 15 | 746.786 | | |
| May | Between group | 650.250 | 1 | 650.250 | 0.779 | 0.392 |
| | Within groups | 11693.500 | 14 | | | |
| | Total | 12343.750 | 15 | 835.250 | | |
| June | Between groups | 169.000 | 1 | 169.000 | 0.192 | 0.668 |
| | Within groups | 12299.000 | 14 | | | |
| | Total | 12468.000 | 15 | 878.500 | | |
| July | Between groups | 361.000 | 1 | 361.000 | 0.415 | 0.530 |
| | Within groups | 12174.000 | 14 | | | |
| | Total | 12535.000 | 15 | 869.571 | | |
| August | Between groups | 150.063 | 1 | 150.063 | 0.100 | 0.756 |
| | Within groups | 20908.375 | 14 | | | |
| | Total | 21058.438 | 15 | 1493.455 | | |
| September | Between groups | 1008.063 | 1 | 1008.063 | 0.841 | 0.375 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Within groups | 16773.875 | 14 | | | |
| | Total | 17781.938 | 15 | 1198.134 | | |
| October | Between groups | 10.563 | 1 | 10.563 | 0.009 | 0.924 |
| | Within groups | 15751.375 | 14 | | | |
| | Total | 15761.938 | 15 | 1125.098 | | |
| November | Between groups | 20.250 | 1 | 20.250 | 0.018 | 0.896 |
| | Within groups | 15857 | 14 | | | |
| | Total | 15877.750 | 15 | 1132.679 | | |

## Conclusion

The present study indicates that roof type did not influence body weight of Murrah buffaloes. High thermal conductivity of asbestos roof could not protect the animal from thermal stress, whereas high insulating property of asbestos + patera roof provided better comfort to the Murrah calves in hot dry season and hot humid season. The results indicated that the asbestos + patera roof was better in terms of growth performance of buffalo calves in hot dry and humid season.

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