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Popular Article

The impact of various bedding materials on the behaviour, health, and productivity of lactating dairy animals

Dr. Jettaboina saikiran., Dr. N. Rajanna and Dr. J. Shashank
Krishi Vigyan Kendra, P.V. Narsimha Rao Telangana Veterinary University, Mamnoor, Warangal-506 166.
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Introduction

In recent years, efforts have been made to improve welfare and overall-health of dairy cows by ading a higher level of comfort regarding the housing environment (Mishra *et al.*, 2017). It has been investigated that housing system and resting surface have influence on milk yield and reproductive performance similar to feeding and keeping methods in dairy herd (Singh *et al*., 2020d). Good bedding and flooring provide comfortable area for animals to take rest and it also helps to improve health and productive performance. Bedding improves the physical comfort of the floor (Maurice Tuyttens, 2005). Moreover, resting is prioritized over other behaviors by dairy cows. Cows that are deprived of lying show behavioral and physiological disorders (Tdhomsen *et al*., 2012) which may be unpleasant and unhealthy for dairy animals. Furthermore, it was remarked in a latest study that bedding material may introduce bacterial count in milk (Bradley *et al*., 2018) leading to a potential concern for both human and animal health. Bedding material may be used as a flooring material. It provides comfort to animal, encourages resting, contribute to udder health, milk quantity and quality. It may also help in subsidizing injury and fatigue. Different factors involve in selecting a proper bedding material for dairy animal housing. Availability of bedding materials should also be given importance while bedding material selection. Climatic conditions of a particular region may considerably influence the type of bedding material.

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Types of Bedding Material

There may be broadly two types of bedding materials namely, Organic and Inorganic bedding materials. Organic bedding materials includes straw, wood shavings, hay, crop residues, saw dust (Bradley *et al*., 2018), composted manure, wood chips (Chamberlain, 2018), etc. On the other hand, inorganic bedding materials include sand, limestone, gypsum, rubber mattresses (Bradley *et al*., 2018), cement, etc. Wood shavings are generally mixed with sawdust for improved aeration, compact ability, improved tilling process (Janni *et al*., 2006). Chipped wood usage as bedding material may lead to injury due to sharp edges (Bewly *et al*., 2013).

Organic Bedding Materials

Pros	Cons
Absorb moisture	Reservoir of bacterial population
Compatible with manure handling systems	Supports rapid bacterial growth
Readily available	Mastitis infection is more
Cheaply available	May lead to foul smell

Inorganic Bedding Materials

Pros	Cons
Inert in nature	Not readily available
Does not support the growth of bacteria	Not compatible with manure handling systems

Bedding Material's Characteristics Comfort

First and foremost, aim of bedding material is to provide overall comfort to the animals. It should promote the productivity and well-being of animal.

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Particle Size

Particle size depends upon the type of bedding material. For sand it is 0.1 to 2mm, for wood shavings it is 2-4cm. Large sand particle can cause discomfort and even injuries to animals whereas, very fine particles like that of sawdust may cling to the animal's skin and teats thereby causing itching and may cause contamination with pathogens.

Moisture

Bedding material should be kept as dry as possible. Wet materials may become breeding place for microbes which may be unhealthy for the animals. Wetness of bedding material depends upon the particle size. Small particle size coupled with moisture makes it dense and compact Moisture characteristic is the main driver of environmental mastitis to dairy animals when bedding is concerned (Fávero *et al.* 2015). It is difficult to control especially when the ventilation facility is poor in animal house (Lobeck *et al*., 2011; Black *et al*., 2014). Proper ventilation and sunlight exposure facility in animal house may help in adequately reducing moisture levels in bedding (Galama *et al*., 2015; Leso *et al*., 2020). Bewley & Taraba (2013) recommended 40 to 60 % moisture in upper 15 cm layer of bedding material.

Availability

Bedding materials should be economical (Leso *et al*., 2020), easily and locally available. Composted bedding material may be required for area of 6m2/ cow to 15 m2/cow for free walking (Leso *et al*., 2020).

Inert

Bedding should not encourage bacterial growth, but organic matter such as wood shavings, straw and paper byproducts do. They should be unpalatable to animals. Regular changing of bedding on an average of a week is suggested if organic materials are incorporated. Depth of bedding may vary from 20 cm to 1 m as per the management practice of the farm (Leso *et al*., 2020). However, (Bickert *et al*., 2000) suggested that a minimum of 15 cm bedding is necessary for good performance of dairy animals.

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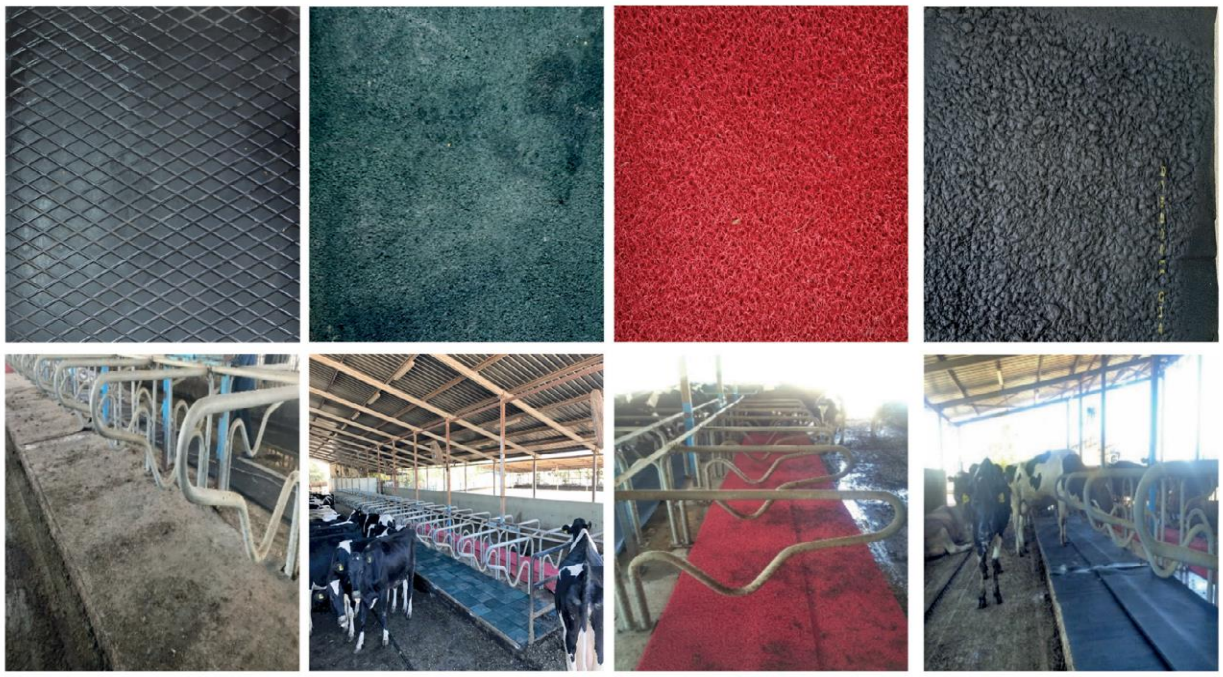

Climatic Conditions and Bedding Materials

Free stall barns require lesser bedding materials, provided better overall health in hotter climates than composted bedding. Additionally, free stall barns are easier to manage than compost bedded barns (Bickert *et al.,* 2000). Composted bedding can be utilized in hot- humid conditions provided fan conditioning should be there (Bewley & Taraba, 2017). Asian country's dairy farms are coming up with free stall designs (Chamberlain, 2018). Chamberlain (2018) also proposed in his review that in near days composted bedding will be tested for Australian climatic conditions. However, there is a lack of research for composted bedding under tropical type of climate.

Importance of Different Bedding Materials for Dairy Animal

Inorganic materials, namely sand, have been considered as the *gold standard* for bedding material (Justice-Allen *et al*., 2010). Sand is inert; it can be recycled and reused as bedding (Van Gastelen *et al.*, 2011). It does not support bacterial growth (Godden *et al*., 2007). Sand is also non-absorbent, which means that it does not retain or soak up urine and leaked milk (Gooch & Inglis, 2010) which hinders bacterial growth. Moreover, it is found that bacteria types and counts found in bedding materials have a positive correlation with the bacteria types and counts present on the teat end (Zdanowicz *et al.*, 2004). Lowest case of mastitis found in sand bedded animals (Bey & Reneau,

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2002). Increased milk yield may be observed in free stall pens with sand than without other type of sand bedding (Calegari *et al.*, 2012). Sand bedding reduces the development of new cases of lameness. A depth of 25 cm has been suggested, with complete sand bedding replacement necessary every 12 to 14 days (Cook *et al.*, 2010). Particle size should be 0.1-1mm and of uniform in size (Schoonmaker, 1999).

Organic husbandry practices are found effective for hoof health maintenance. Rutherford *et al*., (2008) suggested for use of straws as bedding material for better hoof health. Cows have been seen to prefer straw bedding than sand, lying time was found more on straw than sand. However, hoof health and cleanliness maintenance was better in sand as compared to straw bedding (Norring *et al*., 2008) thus poorer udder health in straw bedded animals (Leso *et al*., 2020). Addition of lime powder, formaldehyde-based compounds may decrease the risk of health hazards (Patterton *et al.*, 2011). Mattresses were introduced for bedding of dairy animals however they were found to compromise the cow comfort, increased risk for hoof lesions, and lameness (Cook *et al*., 2004 ; Fulwider *et al*., 2007). Rubber mats are comparatively costlier than above mentioned bedding materials, it may lead to undesirable overgrowth of claw (Platz *et al*., 2008). Leso *et al*. (2020) remarked that composed bedding than free stall or straws may improve overall cow comfort, better leg health, better expression of natural behavior, and improved manure quality of dairy cows.

Effect of Bedding Materials on Behavior of Animals

Lying is an important behavior for cattle occupying approximately 50% of their daily time budget (Krohn & Munksgaard, 1993). Cows prefer to lie down on soft bedding materials. It was found that number of lying bouts can be considered as an important indicator of the quality of the bedding material provided (Manninen *et al.*, 2008). Further, lying times are lower and standing times are higher when dairy cow forced to use hard surfaces, specifically concrete (Haley *et al.*, 2001). Cows needed more time to lie down (140.2 ± 84.2 s) on farms using foam mattresses compared with the deep litter materials sand and horse manure (sand: 50.1 ± 31.6 s, horse manure: 32.9 ± 0.8 s). Furthermore, the duration of the lying bout was shorter (47.9 ± 7.4 min) on farms using foam mattresses compared to sand (92.0 ± 12.9 min)(Gastelen et al ., 2011). It was seen that dairy cow

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prefers dry bedding more as compared to wet bedding and it was also seen that cow lie down for more time during winter season than summer season (Reich *et al.,* 2010).

Bedding Material and Reproductive Health

Association of repeat breeding cases with bedding material revealed that concrete floor had most cases followed by sand and rubberized bedding material. Dystocia and Retained placenta cases were more in concrete and rubberized floor and least in sand bedding (Kara *et al.,* 2015). Gnyp and Utvinczuk (1993) observed more fertility rate in cows housed with litter as compared to that in without litter housing. Lower somatic cell count (SCC) and higher oestrus detection rates were shown in CB cows. Mounting activity for oestrus detection was markedly inhibited by slippery floors than rough floor; however, softer floor like pasture based is preferred over hard bedding like concrete for proper mounting activity (Palmer *et al.,* 2010).

Effect of Bedding Materials on Health and Performance of Dairy Animals

It was found that bedding material does not affect body condition score (BCS) of dairy cows and also similar hygiene score was noticed amongst different bedding materials in the barn (Shane *et al.,* 2010). Poorly managed and confinement housing can have the potential for environmental mastitis in milking cows as it exposes teats to high levels of bacteria which may be present in the bedding material (Faull *et al.,* 1996). Organic bedding materials tend to contain higher levels of environmental bacteria, and bulk milk somatic cell than inorganic materials (Godden *et al.,* 2002; Rowbotham & Ruegg, 2016). It is reported that cows kept on concrete also had a higher risk of developing heel erosions and were more likely to become lame, show higher claw growth and wear (Vanegas *et al.,* 2006). Health parameters like teat and udder wound, mastitis, fever and uterine infection cases were more in number in concrete floor as compared to sand bedding material (Kumar *et al.,* 2017).

Mastitis is considered as one of the most devastating problem for dairy industry (Kansal *et al.,* 2020; Kumari *et al.,* 2019; Bhakat *et al.,* 2017). Udder injuries or mastitis disease cases were found least in case of sand followed by rubber mat and concrete floor bedding materials (Madke, 2007). Fecal prevalence of Escherichia coli was found to be less in case of sand bedded

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animal as compared to saw dust bedded animals (Westphal *et al.,* 2011). Flitz *et al.* (1978) observed the behavior of dairy cows (German Black Pied, German Red Pied and Holstein- Friesian) which revealed that daily 4 % FCM yields in winter were significantly higher in deep litter housing as compared to stall fed housing. In a study, Black *et al.* (2013) found significantly higher milk in compost bedded (CB) cows than non-CB cows.

Highest ammonia concentrations were seen in sand bedded animals whereas methane was emitted most in composted bedding materials as compared to straw, free stall, wood chips as bedding materials (Leso *et al.,* 2020). Reason behind high ammonia emission in sand bedding may be due to absorption of more urine and faeces whereas more methane emission in composted bedding may be due to the presence of more decomposed organic materials

Selection of good quality bedding materials requires proper evaluation before it use. Good management can eliminate the disadvantage whereas bad management can override the advantageous of bedding materials.

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