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## Effects of using different litter material on performance and welfare of birds

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### Abstract

The litter material is used in broiler farm to give more comfort to the birds for more income generation. The litter is key factor which influences the productive performance and welfare of the bird. A good litter material should have ability to absorb and release moisture to the environment as quickly as possible. A good litter serves as an insulator to maintain uniform temperature round the year and helps in absorbing the extra moisture of the feces and urine by increasing surface area of the floor which prevents fungal contamination. Corn Cobb, Paddy Husk, Sand, Chopped Straws, Sugar Cane Bagasse, Shredded Newspapers, wood shavings, sawdust and Peanut Hulls were commonly used. Findings of the different research conducted by the different author revealed that, rearing birds by using different litter material have showed the improving the productive performance, health condition and helps in maintain the animal welfare throughout the experiment.

**Keywords:** Litter material, broiler, performance, animal welfare and health

### 1. Introduction

Poultry industry is growing rapidly and sustained to fulfill the demand of ever-increasing population of the worldwide, by generating the higher income and supplying the good protein sources to the consumers. The fast growth rate of broiler chicken and gradual restriction on the cage system rearing of layer birds also rely on the litter material for rearing on the floor system. Broiler farming is mainly done on deep litter system in India and the management of the litter is key factor which influences the productive performance and welfare of the bird. Generally, the litter material is used in broiler farm to give more comfort to the birds for more income generation. Scientists also noticed that the quality of the litter material has significant influences to the overall performances of the broiler (Sigroha *et al.*, 2017)<sup>[33]</sup>. Several factors including unavailability, increasing cost, possible health and safety risks of conventional materials have been the major forces driving research into new bedding materials for commercial poultry. (Dierra *et al.*, 2021)<sup>[10]</sup> A good Litter management can be influenced by type of litter material used, depth of the litter material, floor space per bird, composition of feed, watering facility used, floor type, ventilation system and time of the year.

### 2. Characteristic features of litter material

A good litter material should have ability to absorb and release moisture to the environment as quickly as possible. A good litter serves as an insulator to maintain uniform temperature round the year and also acts as a blotter through absorbing the extra moisture of the feces and urine by increasing surface area of the floor which prevents fungal contamination. Litter plays a vital role in absorbing the fecal moisture, promotes drying by increasing surface area of the house floor, insulates chick from cooling effects of the ground and provide a protected cushion. Litter material helps to conserve heat by insulation and provide supplemental heat through fermentation by fecal microorganisms. Litter management can be influenced by type of litter material used, depth of the litter material, floor space per bird, composition of feed, watering facilities used, floor type, ventilation system and time of the year. The litter material is used in a broiler farm to give more comfort to the birds for best profitable outcomes. The efficiency of a particular bedding substrate is influenced by factors such as particle size, moisture content and build up, rate of caking and other physical characteristics (Brake 1992)<sup>[8]</sup>. The quality of litter depends on the chemical characteristics includes the cellulose, silica and lignin contents which influence the quality of litter materials. Cellulose and silica are capable of absorbing water due to their high hydrophilic groups and higher surface area due to smaller particle size respectively (Lindh *et al.*, 2016)<sup>[18]</sup>.

Malone *et al.*, (1983a) <sup>[20]</sup> reported that poultry could consume as much as 4% of their diet as litter. The quality of litter is of great concern in broiler production because it affects performance, health, carcass quality and the welfare of broilers.

Any contaminants could cause the meat or rendered products to become unusable. Therefore, any bedding must also not contain any contaminants, such as pesticides or metals, which might result in tissue residues due to litter eating or other bird behavior (Malone *et al.*, 1983a) <sup>[20]</sup>. The moisture content of the litter material should be 25-3%. High moisture content in the bedding increases ammonia build-up through increased microbial action and leads to respiratory and eye lesions, source may also encourage the multiplication of *Salmonella*, *Campylobacter* and *Listeria* spp. and *Eimeria* spp., the causative agent of coccidiosis which adversely affect birds' welfare and productivity (Ferrante *et al.*, 2006) <sup>[13]</sup>.

Wet litter predisposes to breast blisters and hock burns, which reduce carcass quality in meat birds. In addition to bird health and product quality, nitrogen (N) loss through ammonia volatilization is a major air pollutant with severe environmental health consequences. The quality of the litter is determined by the litter moisture, pH, ammonium nitrate content, caking level and water holding capacity (Gençoglan *et al.*, 2017) <sup>[14]</sup>. Dustiness from extremely dry bedding materials or very fine particles may predispose birds to respiratory problems, resulting in higher mortality. Very large and coarse bedding materials may, downgrade carcass quality due to their abrasive effects (Bilgili *et al.*, 2009) <sup>[4]</sup>. The quality of litter material significantly influences the overall performances of the broilers as well as the chickens.

### 3. Commonly available litter material for poultry rearing

Corn Cobb, Paddy Husk, Sand, Chopped Straws, Sugar Cane Bagasse, Shredded Newspapers, wood shavings, sawdust and Peanut Hulls were commonly used for rearing poultry on floor system, especially broiler birds. These materials have been used successfully due to their high moisture absorbing capacity (Hafeez, *et al.*, 2009) <sup>[16]</sup>.

#### 3.1 Corn Cob

It's a by-product of corn processing for grain and it accounts around 180-200 kg per ton of grains produced (Božovic *et al.*, 2004) <sup>[7]</sup>. This residue has some limitations for applications like bedding material and activated carbon. It is considered as waste in many producing regions, posing environmental problems. Corn Cob has high halo-cellulose (cellulose and hemicellulose) and low lignin contents. The ready availability and high absorbency (Shields *et al.*, 2005) <sup>[32]</sup> make Corn Cob a potential litter material for poultry.

#### 3.2 Paddy husk

This is a byproduct of rice mills and accounts about 25% of the rice paddy. In many countries this is still a problem for disposing. This product is also used for producing heat by burning in some industries like ceramic, brick burning and sometimes in hotels. Along with these it is also used for feeding livestock and poultry but due to its higher content of lignin and silica limits the utilization as a feed (Abbas *et al.*, 2010) <sup>[1]</sup>. Rice husk can be a better alternate as litter material for broiler production in India but availability at a competitive price is a challenge in present scenario due to source of energy production in the industries (Bilgili *et al.*, 1999) <sup>[5]</sup>.

Rice hulls have been identified as an appropriate litter alternative and are rapidly gaining space in the broiler litter market (Almeida Paz., 2010) <sup>[2]</sup>.

#### 3.3 Sand

Sand is increasingly used by several industries, including the building industry (houses and roads), electronics (computer chips and microprocessors), cosmetics, and detergents etc. River sand is clean and has high water absorbing capacity but desert sand is too fine and smooth, high in clay, iron oxides and lime but lacks silicon dioxide this making the former a better litter material than the latter (Wang *et al.*, 2019) <sup>[36]</sup>. Sand has shown good potential as an alternative litter material for high reuse potential with decaking. Sand litter, having comparatively small particle size, allowed water absorption deep in to the sand surface thus avoids moisture retention on the surface of the litter, necessary for avoiding cake formation. Additionally, ammonia production was also very rare which provided a comfortable environment. During the racking or stirring, there was no dust problem that minimized the chances of respiratory infections in the chicks. The droppings of the birds became dry very quickly on sand thus avoiding cake formation or vent pasting problems. Sand bedding may also improve bird welfare through increased behavioral performance (Shields *et al.*, 2005) <sup>[32]</sup>.

#### 3.4 Chopped straws

This is the fibrous part of cereal grain crops after harvesting. This is the byproduct of cereals such as rice, wheat and barley etc. these products have higher amount of lignin content and low in hydrophilic groups which reduces their ability to hold and release of moisture. Because of these material when used for rearing poultry predisposes to a fungal infection and increases the incidence of breast blister (Boulos *et al.*, 2000) <sup>[6]</sup>. Chopped paddy straw (CPS) and un chopped paddy straw (UCPS) can offer good and cheap alternates to rice husk (RH) for rearing broiler chicks. The paddy straw seems to possess most of the qualities of a good litter material like dry, soft, compressible and absorbent. So, the use of paddy straw as an alternate litter material could go a long way in reducing the cost of broiler production (Navneet *et al.*, 2012) <sup>[26]</sup>.

#### 3.5 Sugar cane bagasse

The byproduct of sugar refining industry and accounts around 140 kg/ton of sugar cane processing. This product has high moisture holding capacity due to its residual sugar content and leads to quick cake formation and finally predisposes for the severe complication in birds (Melati *et al.*, 2018) <sup>[22]</sup>.

#### 3.6 Shredded newspapers

Old newspaper cutting have been used as a bedding material for poultry. Paper absorbs moisture rapidly and it is easy to dispose. This have the advantages like minimal health hazard due free from the dust, contamination and free from pathogenic organism and contrarily it won't release the moisture to the environment as quickly as possible (Zhou *et al.*, 2012) <sup>[37]</sup>.

#### 3.7 Peanut hulls

In most peanut producing countries, the hulls are burned on farm, dumped or allowed to deteriorate naturally (Kerr *et al.*, 1986) <sup>[17]</sup> and making this by-product readily available for various uses.

#### 4. Evaluation of different litter materials for Performance and poultry welfare

The productive performance and animal welfare of broiler and layer birds depends on the management of the litter material. Bedding type can significantly affect carcass quality and growth performance of broilers (Malone *et al.*, 1982) [21]. Benabdeljelil and Ayachi (1996) [3] assessed the use of whole and grounded wheat straw (WHS), ground rice straw (RS) in cockerel chicks and found no effect on water consumption, but litter moisture, temperature, pH and overall quality score were reduced on straw-based litters compared to the other materials. The authors attributed this to the low Water Holding Capacity (WHC) of the straw-based litters due to the high lignification of straw (Boulos *et al.*, 2000) [6].

The condition of bedding material has the direct impact on the ammonia production, which adversely affects the performance of the bird and showed that, the higher level of ammonia leads to decreased feed efficiency, weight gain and egg production. Because of the higher ammonia level directly affects to the respiratory tissue and impairs the immune response of the bird. This adverse effect mainly due to the higher moisture content of the litter material (Reece *et al.*, 1980) [29]. Monira *et al.*, (2003) [25] observed that improved body weight gain (BWG), feed consumption and survivability in broilers raised on sand compared to birds on rice husk, SCB and WHS beddings. Contrary to these findings, Toghyani *et al.*, (2010) [35] found no effects of wood shavings, rice husk, paper roll (PR) and sand on feed intake, feed conversion and mortality of broilers, but BWG and antibody titer against Newcastle disease reduced on rice husk.

Diarra *et al.* (2014) [11] also found no differences between wood shavings and whole or chopped Para grass hay on egg performance and litter caking in laying hens, but chopping the hay reduced the incidence of feather pecking, probably due to the inability of the birds to forage efficiently on larger particle sizes. Several factors including the class and age of the bird, stocking density, litter processing and thickness all affect the suitability of a material as bedding substrate. Higher stocking densities reduce litter quality, bird welfare and bird performance due to higher excreta output and rapid deterioration of the bedding material (Skomorucha *et al.*, 2009) [34]. Shao *et al.* (2015) [31] also observed an improved welfare and production of broiler chickens with increasing thickness of sand-based beddings from 4 to 16 cm. these findings suggest that increasing stocking density must be accompanied by corresponding increases in litter depth.

Dhaliwal *et al.*, (2018) [9] reported in his study that by using wheat straw, rice husk, mustard stalk bedding material improved the dressing percentage, average weight gain, feed consumption and when compare to sand as bedding material. The rice husk gives excellent results as they have the ability to absorb the moisture and remain dry which is the basic requirement of deep litter system. The manure quality of rice husk is very excellent as compare to other materials. Rahul Sigroha *et al.*, (2017) [33] found that using wheat straw as litter material had numerically higher weight in comparison to all other groups' at 42 days of age followed by sand (Balu ret), saw dust, river bed sand and rice husk and similar results were found by the Mahmoud *et al.* (2014) [19] and suggested that birds reared on wheat straw had significantly higher weight in comparison to sand and wood shavings.

Sand litter, having comparatively small particle size, allowed water absorption deep in to the sand surface thus avoids

moisture retention on the surface of the litter, necessary for avoiding cake formation. Additionally, ammonia production was also very rare which provided a comfortable environment. During the racking or stirring, there was no dust problem that minimized the chances of respiratory infections in the chicks. No problem of breast blisters were observed in the birds reared on sand (Hafeez *et al.*, 2009) [16]. Ruszler and Carson (1968) [30] reported that litter of smaller particle size absorbed less moisture than that with larger particle size.

Grimes *et al.*, (2006) [15] found that by using pine shavings and agro chips as a bedding material have no effect on the body weight and feed consumption, no effect on hock joint and foot pad scores at different age groups. Mondal *et al.*, (2020) [24] found that, the litter materials have no significant effect on the growth performance of broiler chicken in starter phase, but during growing and finishing stages (from 3 to 6 weeks) it has significant role and comparatively better performance was noticed in birds those were raised on saw dust. Therefore, saw dust may be used as a litter material for better growth performance which is cheaper in price and easily available also. Mohammed *et al.*, (2022) [23] found in his study that, the final LBW and BWG were significantly higher in groups of wood shaving and sand by about 15-17% compared to groups reared on wheat straw, bean straw and rice husks bedding materials and also found that the rearing birds under sand type material gives the better score for Footpad dermatitis and healthier footpad among all the litter material. The different litter material also affects the behavior patterns of dust bathing and preening behaviors at 3<sup>rd</sup> week and walking, resting and pecking behaviors at 5<sup>th</sup> week. Similarly, El-Sagheer *et al.*, (2004) [12] reported that the type and quality of the litter had a significant effect on broiler welfare including scores of the footpad dermatitis and feather condition. Similarly, Ramadan *et al.*, (2013) [28] indicated that litter type did not affect tonic immobility, plumage cover scores, footpad lesion, hock burns and leg health. These findings also agreed with the findings of Ramadan & El-Khloya (2017) [27] that sand is possibly an alternative to wood shavings without negative impact on birds' welfare. Using sand as litter significantly increased the patterns of ingestive behavior (eating and drinking) and comfort behavior (resting and dust bathing activities) compared to other types of litter (Mohammed *et al.*, 2022) [23]. Broiler chicks seem to prefer sand because finer materials are highly at penetrating the feathers to reach the downy plumage and helps in maintaining the welfare of chicks. Toghyani *et al.*, (2010) [35] found significantly low locomotion behavior (walking and running) and higher sitting behavior on sand and wood shavings compared to rice hulls. The birds preferred sitting and dust bathing behavior in sand and wood shavings rather than in straw-based litters and rice hulls. Choosing the right bedding material is important for maximum production and poultry welfare.

#### 5. Conclusion

The source, texture, and particle size of the material; litter depth; age and class of bird; duration of rearing; diet composition; stocking density; and relative humidity all affect the suitability of a material as litter. There is a need for more research on litter management practices and cost-effectiveness of different materials for optimum bird welfare, productivity, and product quality.



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