A Review on Some Local Litter Materials Used in Broiler Production in Rivers State

[1]Chioma, P. I. [1]Ekine, D. I. [1*]Adibie, O. A. and [2]Johnson, N. C.

1Department of Agricultural and Applied Economics, Rivers State University, Port Harcourt.

[2]Department of Animal, Rivers State University, Port Harcourt.

*Corresponding Author (patriciachioma39@gmail.com)

Abstract

One of the essential requirements for successful chicken broiler production is the litter material used during their production process. This is very critical because of the important functions of litter in the production process. Litter material primarily protects the birds, especially during brooding from cold emanating from the floor thereby protects the birds from hypothermia that often leads to high mortalities of chicks. Litter also plays the roles of preventing disease outbreaks as it aids in heat and ammonia productions resulting in the prevention of pathogen proliferation during broiler production. Furthermore, the action of micro-organisms or the pathogens on litter produces 'animal protein factor' (A. P. F.) and vitamin B_{12} that are physiologically implicated in accelerating broiler rapid growth as to reach market weights in a relatively shorter periods of time compared to other farm animals. Litters are also important in reducing the frequency of droppings removals. It is thus very important to always recognize that in choosing a litter material it has to be guaranteed that the material is often readily available within the location of the farm as it significantly aids in increasing profit margin as the material is obtained at a relatively cheap cost. Choice of litter type therefore is very essential for successful broiler enterprise. Put together, all these factors culminate in the overall wholesomeness of the birds resulting in healthy bird productions for better value capture. In summarytherefore, they determine the input and output relationship in broiler production. This review, provides critical information on litter types'choices to better guide broiler farmers in litter material choices for enhancechicken broiler productions with corresponding high return outputs.

Key words: Production, Litters, Materials, Characteristicsand the Chicken broiler

Introduction

Broiler birds are very fast growing farm animals reaching market weights at eight (8) weeks of age, resulting in rapid input – output turnovers (Gupta, Pramanik, Gautam, Panday & Nandan

2020). Their fast growing physiology often leads to the sudden death syndrome observed in broilers in the commercial setting (NRC, 1993). The attendant effect of this syndrome normally results in the reduction of the farmer's profit margin. It is a fact that broiler wholesomeness is dependent on multifarious factors, particularly at their tender stagesas they are very fragile and hence easily susceptible to many environmental stressors or factors (NRC, 1993; Bilgili *et al.,* 2009). To this point therefore, the type of litter used in the brooding of the chick is of utmost importance as it relates to the health and well-being of the animal. The reasons for these are not farfetched.

The litter converts poultry droppings into a drier material which is easier to remove and also economically aids in the reduction in the frequency of removing the droppings. It is useful in controlling disease infections largely because the litter reduces the concentration of pathogens (Monria *et al.,* 2002; Munir *et al.,* 2019). The presence of litter material and droppings with their moisture provide a suitable environment for the proliferation and action of pathogens; this action generates heat and ammonia, both of which are lethal to the pathogenic organisms (Munir *et al.,* 2019). In this way, they significantly help in controlling or reducing the population of pathogenic organisms in the broiler chicken barns. Furthermore, in this circumstance, birds on the litter are exposed to a sub-clinical level of infection which not only fails to produce clinical symptoms but provides natural immunity in the birds (NRC, 1993; Meda *et al.,* 2011). Also, related to disease prevention, the litter helps to alleviate temperature effects by acting as an insulator. This means that litter forms a protective layer on the soil or floor surface that regulates microclimate conditions of birds.

Again, the action of micro-organisms or pathogens on litter and on droppings produces 'animal protein factor' (A. P. F.) which notably include B_{12} (Monria *et al.,* 2002). This can also be used to explain in part how 'good' litters aid in supporting broiler accelerated growth. Economically, one of the factors governing the choice of a litter material for use is that it should be easily available as to enable it to be obtained more cheaply than any other materials that may be used to prevent direct contact between the birds and their droppings or the floor.

Some materials are not good as litter materials. For instance, dry sawdust is not a suitable litter material as it may easily block the nostrils of birds when they peck the litter or irritate the nasal

passages and the throat – a stress factor contributing to respiratory infection (Terzich *et al.,* 1998). To these extents therefore,it is not a gainsaying that the use of a suitable litter in broiler production is very essential for the successful broiler production process. Therefore, the objectives of this review are to examine some local litter materials used in broiler production in Rivers State, Nigeria, their characteristics and impacts on broiler health and performance as to better guide farmers' choices of litter materials for enhanced broiler chicken production.

Litter Materials

It is imperative to know that litter is used in the deep litter system of broiler production and it mimics the natural or original method of its production. This method or system enables the birds to freely move and thus eliminates stress from the birds thus enhances their welfare and well-being. Therefore, at presentthe deep litter system of broiler production is most preferred over other systems of broiler production because unlike the other systems, such as the battery cage system the deep litter system eliminates fatigue from the birds and thus promotes better welfare for enhance growth leading to improve broiler productionas previously stated (NRC, 1993;Mohammed*et al.,* 2022).

From these standpoints, the type of litter material used in providing beddings for the birds is very essential as to enable them perform optimally according to their genetic growth potentials. To this extent, there are many local litter materials employed in broiler chicken production in Rivers State, Nigeria. However, it is the commonly used ones majorly based on their suitabilityand availability that would be covered in this review: they include: wood shavings, paper materials, sand, rice hulls, straw litter, corn silage, sugar cane bagasse, nut hulls and saw dusts.

Wood Shavings

The most popular material used as litters in broiler production are wood shavings as they are also known as excellent litter materials for its properties and characteristics. Wood shavings as the name implies are obtained from the processing of trees, such as wood work and from furniture enterprises. More importantly, They are often readily available for use where there are intensive activities of wood and furniture works. This is also important because it aids in reducing the total cost of production due to wood shavings availabilities, in such regions. However, wood shavings are normally obtained from two kinds of woods, namely from soft and hard woods. In terms of

their suitability as litter material the former, that is, wood shavings from soft woods are preferred. The reason for this preference is due to the fact that shavings from the soft woods are softer on the foot pads of the birds and thus do not entangle broilers movement, especially at the chick stages when they are very tender and fragile making them to be easily susceptibility to stress and nutritional diseases (Musa and Kadir, 2020). Furthermore, because wood shavings possess good attributes as a litter material, such as it high capacity to absorb water or moisture, results in their very high propensity to reduce moisture thereby easily eliminates litter caking in addition to easily being reduced to appropriate particle sizes due to their soft nature (NRC, 1993). These characteristicsmake wood shavings 'a must use' litter material to as it is known to better supports optimal broiler production compared to other litter types (Bilgili*et al.,* 2009).

Another major characteristics of wood shavings that makes it an excellent litter material is its biochemical involvement via its interactions with micro-organisms as a litter to promote the synthesis of A. P. F and vitamin B_{12}via its interactions on droppings (Bolan *et al.,* 2010). This has been shown to be positively correlated or significantly contributesto the accelerated growth rates of broiler chickens enabling them to reach market weights at eight (8) weeks of age (NRC, 1993; Bolan *et al.,* 2010). Furthermore, wood shavings as a litter material and droppings together with their moistureprovides a suitable environment for the proliferation and action of pathogens; this interaction generates heat and ammonia that are very lethal to pathogenic organisms and thus provide a kind of natural population control thereby preventing pathogenic-micro-organisms from proliferatingbut confers on the birds' natural immunity; thereby helps to keep the birds healthy (NRC, 1993; Meda *et al.,* 2011).Wood shavings therefore, is one of the best litter material in modern chicken broiler production.

Paper Materials

Another commonly known litter material is paper materials. Paper materials are usually thin sheets made from the pulp of wood and sometimes from other fibrous substances. These include products such as newspapers, cardboard, shredded papers and glossy papers, just to mention but few. One of the basic factors that qualifies paper materials as litter material is due to their relative cheap costs and availability (NRC, 1993). As a result of these, paper materials has become an admired litter material here in Rivers State, Nigeria and beyond (Aviagen, 2009).

Although, the use of paper materials has proven to be a suitable litter material as is effective in absorbing moisture, makes removal of droppings easier and protects birds from experiencing hypothermia resulting from cold, it has some drawbacks. They tend to easily cake (Equisearch, 2005). Furthermore, this caking effect often leads to breast blisters formation and other negative defects on carcasses which are implicated in the down-grading of the final product thereby reducing the value capture of birds (Jesse, 2004). Nevertheless, to avoid these disadvantages, it is recommended that when paper material is to be used as a litter, they should be mixed with wood-based litter materials (Musa *et al.,* 2012). In applying this technique, the best size of the paper should be 1 – 2 cm in diameter for optimal results (Musa *et al.,* 2012). Furthermore, the paper should not be very new. This justifies the use of old papers as some new papers from the printing media have been found to be toxic to birds due to the printing inks (Musa *et al.,* 2012). Another easily available and relatively cheap litter material is sand.

Sand

Sand is readily available and a relatively cheap litter material. Sand is actually a granular inorganic material composed of fine rock and mineral particles. The most common component of sand is silica usually in the form of quartz. Thus, sand as used here is mostly defined by size, usually being finer than gravel and coarser than silt. When sand meant for litter purpose is properly managed, such as grading it into particle sizes ranging from fine to coarse (0.05-5mm) it usually serves as an ideal litter material for broiler production (Ritz *et al.,* 2017).When sand is used as a litter material, precaution should also be taken in ensuring that it is not spread too deeply as not to hinder birds' movements (Jordan, 2004).Different independent studies have shown that birds raised on sand litter performed excellently well compared with birds raised on conventional litter materials, such as wood shavings. It is an excellent litter material (Grimes *et al.,* 2002; Bilgili *et al.,* 2009).

Additionally, the use of sand as litter materials comes with some special advantages not common with other identified or known litter materials in broiler production.Sand aids in heat and ammonia productions. Heat produced together with ammonia aid in the prevention of pathogen proliferation during broiler production (Bilgili *et al.,* 2000). The use of sand as litter material also aids in reducing odour pollutions emanating from poultry barns. This is very significant at

present as a result of the interface between poultry production and residential areas. This often eliminates disputes between poultry farmers and neighboursor residents within the vicinityof production activity (Bilgili *et al.,* 2000), in addition to lowering costs as it can be re-use for long periods (with de-caking). It can also be washed to remove organic matter for re-use without segregation, implyingthat sand has a long span as a litter material compared to other litter materials (Bilgili *et al.,* 2000). Here, it is imperative to note that sand litter sometimes may make it difficult to maintain suitable floor temperatures, particularly during the cold seasons. To this point therefore, there is always the need to give ample time for ventilation when using sand litter for drying as it is the remedy in this situation, especially during brooding. However, it is usually common during the dry season as cold floors is often of a benefit for the birds as they grow older. This is because the sand litter acts as a heat sink thereby aiding in protecting birds from heat stress. This isspecially the case in the tropics, including Rivers State, Nigeria (Grimes *et al.,* 2002).

Rice Hulls

Rice hulls because of their uniform sizes have been used as a litter material. More importantly, they are less dusty and thus do not interfere with birds' breathing process, have good thermal conductivity characteristics and moisture absorption (Charles, 2005). Dungs or manures from rice hull-based litters because of their high organic contents have been reported to be well-suited for use as organic fertilizers because of their high nitrogen, medium phosphorus and other essential minerals' contents (Charles, 2005).Thus, rice hulls are often recommended for litter use as it better supports mixed farming activities (Dunlop *et al.,* 2016). It has been further reported that in areas where rice hulls are abundant with marginal availability of wood shavings, their combinations result in excellent litter material (Jesse, 2004). However, during storage, rice hulls should be stored in dry areas to avoid fungal and bacterial contaminations (Jesse, 2004; Charles, 2005).

Straw Litter

Straw litter simply refers to plant materials that can easily be dried by simpledrying process to remove its moisture content as to qualify as a bedding material in the broiler barn. The use of straw litter is very popular in any intensive area of cereal productions, such as wheat, corn, oat,

millet, barley and rye (Jesse, 2004). They are usually cheap and readily available in cereal-producing areas and hence aids in reducing the overall costs of production. Furthermore, due to their dried natures they are good candidates for moisture absorption and anti-fungal contaminations in the broiler barns (Jesse, 2004; Bolan *et al.,* 2010).

Also, due to their usual dried nature of straw litters, they are very good as top dressings over old litters (NRC, 1993; Dunlop *et al.,* 2016). They are very efficient litter materials when chopped to an inch or 37mm sizes to enable birds to easily match them during movements without the incumbrancers normally associated with their long-types counterparts (Jesse, 2004). Additionally, due to its economic viability, straw litters have been shown to be very efficient when used in combination with wood shavings, rice hulls or as top beddings in the ratio of 1: 1 (Bolan *et al.,* 2010). In these cases, they have been demonstrated to be very favourable in the production of A. P. F. and vitamin B_{12} that are well-known to promotingaccelerated broiler growth rates.As stated previously, this usually aids the birds to reaching market weights in a relatively shorter period of time compared to other farm animals (Jesse, 2004; Bolan *et al.,* 2010).

Corn Silage Litter

Corn silage has also been employed as a successful litter material. One special attribute of corn silage litter is its usual very low contents of pathogen associated with pathogenesis or diseases of birds during their growth in the barns (Beri, 2011). From this standpoint,Beri (2011)demonstrated that corn silage litter prevents the ‘growth lag syndrome’ that is implicated in causing birds’ runts or stunted growth leading to huge financial losses on the part of the broiler farmer. This advantage of corn silage litter however in some areas are dwarfed primarily due to the fact that it is not readily available as corn is mainly a seasonal crop, especially here in the tropics where cereal crops, such as corn is mostly cultivated during the wet season (Beri, 2011). Sugar cane bagasse has also been identified as a litter material.

Sugar Cane Bagasse Litter

Sugar cane bagasse is the by-product obtained after the juice from sugar cane has been extracted. Its uses as a litter material is very economical in areas where sugar cane is cultivated primarily

due to its availability and thus very cheap coupled with its light nature that makes it easy to transport (Jesse, 2004). Because it dries easily makes it a very good material for bedding for birds as it is also very efficient as a moisture absorbent (Jesse, 2004; Dunlop *et al.,* 2016)). However, it can cake if it is not properly dried before use (Jesse, 2004).

Nut hulls

Nut hulls are also known as husks or shells. They are defined as the outer protective covering of seeds/kernels, legumes, fruits and vegetables.They are usually indigestible as they are mostly composed of silica and lignin (Charles, 2005). Although, it is cheap as a bedding material for birds, their uses as litter material is limited to a large extent as it characteristics as a litter material are not well-understood at present as it is still being evaluated (Charles, 2005).

Saw Dusts

Saw dusts as the name also implies are the finer wood materials from wood work and furniture enterprises. They are often used as litter when wood shavings are scarce or unavailable and thus become uneconomical for use.According to the data of Charles (2005), poultry, particularly broiler chicksand growing broilers consume as much as 4% of their litter during brooding and growth processes; turkeys are known to consuming more compared to broilers leading to nutritional deficiency or disease resulting in crop atrophy and starvation. These are implicated in the occurrences of morbidities and subsequently resulting in mortalities of chicks and the growing broilers (Jesse, 2004; Charles, 2005).

Another major drawback in the use of saw dusts as litter material is that it may easily blocknostrils of the birds when they peck the litter and thusinstigate irritation of the nasal passages and the throat of birds resulting into a stress factor that significantly contribute to respiratory difficulty or infection (Terzich *et al.,* 1998).This phenomenon has been demonstrated to be highly correlated with high mortality rates in chicks during brooding. Additionally, saw dusts are very prone to easy caking on feeders and drinkers. These again, have been identified as sources of contamination in poultry barns majorly due to *Aspergillus*infections (Charles, 2005; Mijinyawa and Dlamini, 2006). These major drawbacks in the use of saw dusts as litter has conferred on it as an inferior material for poultry bedding (NRC, 1993).

Litter Associated Condition in Broiler Production

Litter quality is of great importance to the welfare of broiler chicken, as they generally spend their entire life in contact with litter (Lonkar, Ranade, Pathak, Yenge, Kryeziu, Mestani, Berisha and Kamben 2018). Litter serves several functions that include thermal insulation, moisture absorption, protective barmier from the ground, and it also allows for natural scratching behavior. The quality of the in house environment is highly dependent upon litter quality (Rizt, Fairchild and Lacy, 2017). An effective bedding material must be readily available, absorbent, light weight, inexpensive and nontoxic (Rizt *et al* 2017; and Munir, Bellonde,Irie, and Federighi, 2019). The litter environment is ideal for bacterial proliferation and ammonia production. The two factors that influence litter conditions most are manure and moisture. The ideal litter material should have a moisture content of 20-25%, a PH of 8-10, and ammonia content should not exceed 25ppm (Dunlop, McAuley, Blackau and Stuetz, 2016; and Gencoqlan, 2017). Excess moisture in the litter increases the incidence of breast blisters, skin burns, scabby areas, bruising, condemnations and downgrades (Hossain,*et al* 2018),litter is the primary cause of ammonia emissions, one of the most serious performance and environmental factors affecting broiler production today in Nigeria and other regions (Rizt *et al*, 2017). Controlling letter moisture is the most important step in avoiding ammonia problems.

Factors Affecting Litter Condition

1. Litter Cost and Availability: Fresh litter is a small, but appreciable cost for the chicken meat industry. Dorahy and Dorahy (2008) found the cost of fresh litter to average $20. 50/m3 and range between $12-25/m3 from region to region. Cost are known to be higher in regions where there is a scarcity of supply, which prompts concerns that the price of fresh litter will continue to increase over time. Upwards price pressures have been common for wood and straw supplies in many regions in recent years, in response to declining volumes of wood products, and an increase in high value alternative uses for straw. For example, straw prices have exceeded $200 it in some regions during drought. These factors amplify the need to source alternative litter sources, reduce litter volume requirements, or increase the price received for spent litter.

2. Litter Reuse: Litter reuse is a management practice that reduces the requirement for clean litter and, therefore influences litter requirements. It involves housing of multiple batches of

chickens on the same litter before removing that litter from the sheds for utilization off site (e.g as fertilizer), opposed to the normal practice of changing the litter between every single batch of chickens. This management approach is widespread in some countries (e.g USA),but is not commonly practiced in some other countries like Nigeria, Australia etc, and when it is, it is typically reused for 3-5 batches. In the USA, litter is sometimes reused for several years (for more than 15 batches of chickens).

3. **Spent Litter Utilization:** Most spent litter produced in Nigeria is sold as a fertilizer to crop and vegetable farms, homes, lawns, horticulture, or composters (Dorahy and Dorahy 2008). The supply and cost of litter products has increased substantially over recent years and the future supply of wood products may be constrained, or only available at a higher cost.

Conclusions

Litter is the bedding material for birds and thus protects them from hypothermia in addition to other essential functions during the process of production. This review examined different materials that could be used as a litter material; however, it was not intended to be all-exhaustive of all possible materials that can be used as a litter material in the broiler barn. Nevertheless, the most commonly used ones with their characteristics were covered in this review to provide informed choices of litter materials depending on the farmer's location. Thus, it is very important to state that the major driving factor for choice of a litter material is highly dependent on the economics of supply and availability.

Recommendation

Satisfactory management of litter should start with the initial provision of enough quantities of the litter materials; otherwise it is practically impossible to obtain the right ratio of litter to droppings. Litter should also be changed in 10 – 12 months. However, no matter the litter type chosen, it is best to remove litter with each batch of birds as to prevent the transmission of diseases through old litter.

References

Aviagen(2009). Ross Broiler Management Manual. Available at. https://wp.ufpel.edu.br/avicultura/files/2012/04/RossBroilerManual308.pdf:Aviagen. Assessed on 12th Nov. 2022.

Beri, M. T. (2011). Choice of litter materials can decrease salmonella in poultry flocks. *World Poult. J*. 124(1-2):71-77.

Bilgili, S. Hess, J. Blake, J. and Eckman, M. (2000). Turn trash into treasure: sand as bedding material for rearing broilers. Highlights of Agricultural Research, Auburn, University, Auburn, 41:1-3.

Bilgili, S. Hess, J. Blake, J. Macklin, K. Saenmahayak, B. and Sibley, J. (2009). Influence of bedding material on foot pad dermatitis in broiler chickens. *J. Appl. Poult. Res.* 8(3):352-361.

Bolan, N. S. Szogi, A. A. Chasavathi, T. Sheshadri, B. Rothrock, M. J. and Panneerselvam, P. (2010).Uses and management of poultry litter. *World Poult. Sci. J.* 66:673-698.

Charles, E. B. (2005). Litter management for confined turkeys. Poultry Science and Technical Guide, No. 41. *The North Carolina Agricultural Extension Service Bulletin,* Pp.3 -7.

Dunlop, W. McAuley, J. and Stuetz, M. (2016). Water activity of poultry litter: Relationship to moisture content during a grow-out. *J. Environ*. 172:210-218.

Equisearch (2005). Bedding for Horses: Material Choices, United States: Equisearch. Available at:https://www.equisearch.com/articles/bedding-for-horses-18103. Assessed on 6th Aug. 2022.

Grimes, J. Smith, J. and Williams, C. (2002). Some alternative litter materials used for growing broilers and turkeys. *Worlds' Poult. Sci. J*. 58(4):515-526

Gupta, V.S., Pramanik, P.S., Gautam, S., Panday, G., &Nandan, D. (2020). Effect of different litter materials on growth performance of broiler chickens. *Litter Pradesh, India,* 8(2), 88 -92.

Hossain,.A, Zulkifill,.I. Islam,.S. &Awad,.A. (2018). Effect of wood shaving litter

density on the growth, leg disorders and manorial value in broiler, *Bangladesh Journal of Animal Science*. 47(1): 21-27. Google Scholar

Jesse, L. G. (2004). Alternative litter materials for growing poultry. North Carolina Poultry Industry Newsletter. 1(2):1-5.

Jordan, J. D. (2004). The influence of bedding materials and collecting period on feeding value of broiler and layer litter. Ph. D dissertation, Department of Animal Science, University of Free State.

Lonkar, D., Ranade, S., kulkarni, R., Pathak, B., Yenge, D. &Daware, G. (2018). Effect of organic acid treated corn cob bedding material on broiler performance, hock burn incidence and litter quality. *International journal of science, Environment and Technology,* 7(2), 397 -409; ISSN: 2278-3687. *Google scholar*.

Meda, A. M. Hassouna, C. Aubert, P. Robin, and Dourmand, J. Y. (2011). Influence of rearing conditions and manure. Management Practices on Ammonia and greenhouse gas emissions from poultry houses. *World's Poult. Sci. J.* 67:441-445.

Mijinyawa, Y. and Dlamini, B. J. (2006). Livestock and waste management in Swaziland. *Livestock Research for Rural Development*. 18(6):1-2.

Mohammed,A. Mossad, F. F. Abdulrazeq, M. S. (2022). Effect of different types os available litter materials on the performance and welfare of broiler chicks. *J. Basic Applied Sci*. 20(1):111-116.

Monria, K. N. Islam, M. A. Alam, M. J. and Wahid, M. A. (2002). Effect of litter materials on broiler performance and evaluation of Manu real value of used litter in late Autumn. *Asian-Aust. J. Anim. Sci*. 16(4):55-57.

Munir, M. T. Belloncle, C. Irle, M. and Federighi, M. (2019). Wood-based litter in poultry production Review. *Worlds' Poult. Sci. J*. 75(1):5-16.

Musa, W. L. Saidu, L. Kaitungo, B. Y. Abubakar, U. B. and Wakawa, A. M. (2012). Poultry litter selection management and utilization in Nigeria. *Asian J. Poult. Sci.* 6(2):44-55.

Musa, S. and Kadir, E. (2020). Effects of using hazelnut husk, wood shaving and of the mixture at different thickness on broiler performance, some organ weights, foot pad dermatitis and litter traits. *Turkish J. Agric.- Food Sci. Technol*. 8(6):1399-1404.

NRC, 1993. Nutrient Requirements of Poultry, 9th Ed. Nalt. Acad. Press, Washington, D. C.

Ritz, C. W. Fairchild, B. D. and Lacy, M. P. (2017). Litter quality and broiler performance, College of Agricultural and Environmental Sciences, University of Georgia. *Extension Bulletin*, No. 1267.

Terzich, M. C. Quarles, M. A. and Brown, J. (1998). Effect of poultry litter management on the development of respiratory lesions in broilers. *Avian Pathol*. 27:566-569.