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**Litter Materials in Poultry Industry**

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**Abstract**

Poultry sector or in other words the poultry meat sector, is also developing rapidly in Turkey. With this development, the positive and negative environmental impacts of the wastes, which are produced during production in the sector and evaluated as by-products, have started to attract more attention day by day. Due to the high amount of production, the economic value, the high mineral content and the high cost of alternative implementation, litter materials, which are considered as waste by some circles, should not be harmful to the environment and should be reintroduced into economy or production. This issue is even more important in terms of tourism of the country. It is thought that developments that will please all parties by working in close cooperation supported by all stakeholders and public in the sector, especially official organisations, private sector and universities would solve the issue soon.

**Keywords:** Poultry, poultry meat, litter material

**Introduction**

Poultry farming, especially broiler growing and broielr meat production, in the livestock sector to be more suitable for growing more animals in the small area due to superiority has become more and more advanced and has become an industry. The annual turnover of the broiler industry exceeds approximately $ 6 billion (Anonymous, 2011; Koca, 2015).

Litter material is one of the most important inputs used in broiler industry. Very large amounts of litter are used in almost all broiler houses. In order to give an idea about the amount and cost of the litter, Bolu region can be sampled at 10 milion broiler / year broiler growed. In this region, mostly pine shavings and alternatively rice hulls preferred as litter material and generally these materialsare used for one period. In this region, approximately 291000 ton of litter material was used in 2018 and the cost is around yaklaşık$29.638.000 with 18% VAT.

In this article, the materials used, the suitability, the overall cost and the possibilities to reduce it were reviewed.

Litter can be considered as a bed and insulation material that allows the chickens to sit warmly and softly on the chick, and when they grow up, they are not humid to the place where they sleep. It is a critical material for the development, performance, health and biosecurity of broilers.

The litteris mainly used as an absorbent bed material.The litter material helps to evaporate the moisture and gas from the stool by increasing the ground area of the house, to absorb the moisture, to produce additional heat by fermentation by microorganisms, to make the place more effective to be wetted due to water and various factors, to the insulation of moisture from the ground, to the cold ground between the chick and the ground. Litter is important to reduce the direct contact between the chicken and the manure(nitrogen), as well as to reduce the dust in the house.

Ideal litter material should be healthy, healthy on the chickens, highly absorbent, light weight, remain loose and not stick, not too dry or too moist, low ammonia level, and uniform particle size (2 - 4 cm), fast to dry, easy to obtain, reasonable in price and in vegetable production after combining feces be used as fertilizer.

Litter Materials and Features

Due to the increasing demand in broiler breeding, expanding poultry industry and competition in other markets, the availability of suitable litter is increasingly difficult. However, many materials can be used as alternative litter material. The type of litter material to be used depends on its easy availability, physical suitability and cost.Different forest and agricultural industry by-products and some used materials can be used as litter. The most commonly used litter materials are wood (planer) shavings, paddy peel, straw, peat, fine sand, milled or cut newspaper (Table 1).

As safe and economical litter material becomes increasingly difficult to obtain, it is becoming increasingly difficult and important to provide the most suitable litter conditions in terms of maintaining the healthy and quality development of poultry, together with the house management.

**Table 1.**Advantages and disadvantages of different litter materils1.

**Tablo 1.**Değişik altlık malzemelerinin avantaj ve dezavantajları1.

|  |  |
| --- | --- |
| **Pine shavings and sawdust1** | It is a very preferred litter material but its quantity is small and expensive. |
| **Hardwoodshaving and sawdust1** | Mostly moisture is high and if it is not stored well before use, there is a dangerous level of mold growth. |
| **Pine or hardwood chips 1** | It can be used successfully, but if an environment is created where it can absorb moisture, it can increase the breast blisters. |
| **Rice hulls1** | It is a suitable litter material, but small chicks can try to eat and the price is increasing in recent years. |
| **Peanut hulls1** | Peanut is a litter material which is very cheap in production areas. It can form pellets or layers, but this can be prevented by taking necessary precautions. Some problems with pesticides have been reported in the past. |
| **Sugarcane1** | The first few weeks are prone to agglomeration but can be used effectively when taken care of. |
| **Crushedcorn cobs1** | It is difficult to supply because of its limited production and it can increase the breast blisters if an environment is created where it can absorb moisture as pine or harwood chips |
| **Chopped straw, hay or corn leafs1** | It is prone to agglomeration; its predisposition to mold growth is a disadvantage. The level of hygiene and water retention capacity can be increased by pelleted. |
| **Processed or choppped paper1** | Humidity control is difficult and large parts can increase the ball overflow. |
| **Washed sand2** | Especially when it is new it is damp and heavy, so it is expensive to transport and needs to be laid before use. |
| **Corn by-products3** | It has been reported that the results are close to the wood when used alone or with the sawdust. |
| **Peat moss** | Price and personalities are available when available.4 |
| **Dried rument contents3** | It was seen that the desired results could not be achieved in terms of feed conversion ratio, live weight gain and fot sole problems under temperature stress. |

(1Lacy, 1991)., 2Bilgili et al., 2004, 3Anonymous, 2004 c, 4Anonymous, 2018).

It is not recommended to use hard wood shavings as the moisture absorption is very low. In addition, hard splinters can easily damage the skin and gizzard, and can be applied in chemical process besides high tannin content.

Rice hulls are also not very safe as litter material. Poultry can sometimes eat a large amount of rice hulls and this may cause obstruction in the digestive tract. The dust in rice hulls can be very high and may include fungal spores, which can lead to aspergillosisand eye irritation.Rice hulls that are not very good moisture absorbers can be used if they are low in cost.

When sand is considered as litter material, it has disadvantages such as its transportation costs due to its weight, its high humidity while it is new and the need to dry it in a clean and airy place before use. However, it has advantages such as large surface area, porous structure suitable for humidity control, easy adjustment of its level, durability and use in soil improvement.

In the United States, University of Alabama has recently investigated the use of fine sand in commercial broilers as litter material. It has been reported that broiler chickens grown in sand have similar field performance with those grown in sawdust.In comparison with the houses used in sawdust, it was stated that less dust, lower bacterial density, less parasite, less clumping and more controlled temperature (cold in summer, warm in winter) are provided in the coats using sand. It is stated that chickens grown in sand have better status in terms of foot pads.It is also possible to re-use the used sand for agricultural purposes and the researches on this subject are continuing (Bilgili et al., 2004).

In a study conducted in Iran, the effect of the use of corn by-products consisting of sawdust, chopped corn stalk and residues on silage preperation process on the live weight, feed conversion ratio, nitrogen levels and foot pad were investigated.It has been reported that the litter type significantly affects live weights, feed conversion raito and nitrogen levels. Good results have been achieved when corn by-products are used, both with and without pine sawdust (Khosravinia and Azarfar, 2004).

***Litter Quality and Management***

The quality of the litter material in broiler houses is usually a subject that is not focused on. Broiler growers are more interested in chick quality, feed and water and are less concerned with the litter. In terms of efficient broiler production, litter management is an important issue as far as ventilation, lighting, feeding, water quality and health.

Today's modern broiler lines have great potential for live weight gain and feed conversion. However, broiler chickens cannot reach this potential when the most suitable conditions are not reached. The provision of suitable conditions in the growing environment also depends on the quality of the litter and the quality of the litter is mainly affected by many factors such as the amount of feces and moisture from birds(Lacy, 1991). The moisture and quality of the litter material are determined to many factors such as birds’ age, live weight, the stocking density, litter type and house equipment, that can be changed daily, some of which can be controlled, but some are unlikely to interfere.

For example, nutriton, which is a subject that growers can control at a low level, is a factor that can affect the litter quality. It has been reported that the levels of essential nutrients in feed, such as salt, are not within the desired limits, and that for example the high levels of them can cause excess feed and water consumption and resulting in the moist litter. Some drugs may cause excessive water consumption and defecation. Breeders have a low level of influence on litter managementr and have the means to control the litter moisture to maintain good litter quality only in order to raise a healthy, productive and profitable growing.

It is very important to store the litter material in a dry area before use. When the litter moisture falls below 20% and below, the dust level increases and air quality problems arise. When the moisture level exceeds 40%, the litter starts to moisten and clumps. It is applied as a practical method to test the accuracy of moisture content of the litter. When a handful is latched and released, small litter lumps adhered to the small particles are seen.When the litter is excessively moist, these lumps are tight, and if litter are too dry, the lumps will not form at all.

In order to good litter management, with sufficient experience, the rules of temperature and ventilation must be well known and applied. Proper ventilation, water management, diarrhea and the use of anti-diarrhea medication, mixig of moist and lumpy substrates, dehumidifier treatment is required for the goog litter management. Excessive moisture in the litter can be prevented or controlled to a certain extent, taking care to ensure that the clean and good quality drinking water and nutrition that no excess salt or protein. Particularly wet or clumped areas around the drinkers and feeders often need to be replaced with fresh, not too dry or moist litter material. Very dry or agglomerated sections should be mixed or dispersed without forming excess dust or ammonia. In order to prevent leakage in terms of water management, the pressure of water line and flow rate in the drinkers should be checked frequently and adjusted if necessary. If necessary, changing the location of the bell drinkers also helps to keep the litter dry. In particular, the litter around feeders and drinkers should be checked more frequently.

The moist litter can increase the coccidiosis problem by providing an ideal environment for the oocytes to form spores. Very high litter moisture increases potential meat qualityissues such as breast blisters and healthproblems likefoot pad dermatitis, leg problems, coccidiosis, proliferation of flies and high ammonia produced by the breakdown of uric acid by bacteria in the litter causing lung problems.

Today, one of the most important issues in broiler production is ammonia level in the house. The formation of ammonia in the houses is caused by the breakdown of the nitrogenous compounds in the litter, mainly uric acid, as a result of microbial activity. Generally, when a litter control system is not applied, the pH of the litter with the ammonia gas outlet from the litter tends to become more alkaline. Ammonia density tends to increase as the litter pH increases. Depending on the pH level of the free ammonia in the litter, unsaturated form of NH3 (ammonia) or saturated ammonium ion (NH4+) is one of the form. If the free ammonia is converted to ammonium by decreasing litter pH, ammonia gas (NH3) output can be reduced. When the litter pH is below 7.0, the ammonia output is low, but it can be difficult to change when the pH is above 8.0. Uric acid cleavage occurs most in alkaline (pH > 7.0) conditions.

Many broiler growers know the very important harmful effects of ammonia. However, although ammonia at a level of 20 ppm can normally be felt by humans, breeders (including experts) may lose these sensitivities over time. Levels higher than 20 ppm cause adverse effects on broiler performance and short-term exposure to high levels, as well as prolonged exposure to low levels are also harmful. Ammonia intensities of 50 to 100 ppm cause burns and aging in people's eyes. Broilers are sensitive to ammonia and may experience visual disturbances (keratoconjunctivitis) if they are exposed to high levels of (50-100ppm) ammonia gas for a long time. This is more common in the cold periods when the air inlets are closed and the minimum ventilation is applied. High levels of ammonia, which can cause visual impairment in chickens, naturally affect production, but low levels of 25ppm are also known to suppress growth and cause a negative effect by increasing the feed conversion ratio and low ammonia level is a problem when the litter is too dry.

If the humidity in the poultry house is too low, it can cause to dusty litter and dehydration (loss of water) in birds. In addition, a very dry or dusty litter is known as a factor in the emergence of respiratory problems. Because dust acts as a means of carrying pathogenic bacteria to the birds' respiratory system problems and can cause many breathing problems such as aspergillosis, trachea inflammation by increase condensation on the wall and ceiling of the house. The dryness of the litter can be controlled or prevented by spraying water to the litter in dry weather, by selecting a better quality litter and using water absorbent litter additives such as MgCl2.

In order to ensure that the litter quality is properly maintained until the end of the growing period, environmental conditions such as poultry temperature, ventilation, and water management should be adjusted and maintained in a way to ensure the optimum values and continuity.

If the ventilation system in the broiler house is not effective in removing moisture, a decrease in air temperature or a few days of rainy and humid weather may cause wet litter. If not handled well, drinkers, fogging units and cooling pads in hot periods can also cause wet litter problems.

There are very important issues that need to be taken into account in good litter management. It would be appropriate to increase the minimum ventilation rate to reduce ammonia levels in the first few days, which is the most important period in the life of chickens.

In cold weather, the supply of fresh air into the poultry house will be effective. In poultry houses with a negative pressure system, attention must be paid to the static pressure and, accordingly, to the air velocity in the air inlets. This will help to ensure that the incoming air is quickly drawn onto the broilers and that the condensed air does not fall to the floor, so that it can be drawn in and created a good air mixture.

The blowing or mixing fans in the house can also help to dry the base by moving the warm air near the roof, which can keep more moisture and close the roof.

Drinker systems should be checked frequently for leaks and corrected if necessary.

It is necessary to keep the nipple drinker systems in accordance with the height and pressure.

If it is wet, it is necessary to remove the wet and deteriorated litter, and replace the new unused litter material.

To facilitate removal of moisture when necessary, the house can be heated slightly. This helps to remove unwanted moisture from the house as the air inside it increases as the moisture retention capacity will increase.

Leakage of moisture from the outside to floor should be prevented by a good drainage system around the poultry house.

In case the partition material is used to divide the birds in the house, removal of them, if necessary, in order to ensure that fresh air is accessible to each part of the house, may allow dilution of free ammonia and the fight against pathogens if necessary.

***Reclamation of Litter***

Many polutry growers also grow other farming activities as animal breeding, crops, fruit and vegetables cutivation and they needs animal manure. Therefore, poultry breeders should pay attention to the quality of litter (hence fertilizer) at every stage of production such as cattle and sheep breeders.

The agricultural soils in Turkey are generally poor in terms of clay textures, high pH, high calcareous, nitrogen, phosphorus and organic substances (about 91.4 %), zinc and iron deficiency (Taban, 2007). According to this, it is understood that the agricultural lands in our country are not as good as they are considered in terms of efficiency. It is known that there are similar deficiencies in the land of many countries in the world.

It is necessary to make fertilizers to be more efficient in agricultural lands, to maintain their yields, and to give nutrients to the soil, which are removed or removed from the soil. This is the best way for the environment and society to use organic fertilizers. However, due to some undesirable effects of chemical fertilizers in the soil, it is necessary to make official regulations that promote the use of organic fertilizers and reduce the use of chemical fertilizers, as in developed countries.

The “used litter” obtained from broiler houses is actually a kind of “semi-finished organic fertilizer”. Because, the used litter is a natural waste of biodegradation process from feed to product and contains generally soluble and readily degradable organic matter and inorganic components. This semi-finished organic fertilizer is a fertilizer which is rich in organic matter content and thus increases the water holding capacity of the soil and provides the soil to be enriched in nutrients such as nitrogen, phosphorus, potassium and sulfur. Therefore, used poultry litter and feces or in other words, poultry manure is considered as semi-finished organic fertilizer by the agriculture and livestock industry, is a valuable nutrient provider and regulator and conditioner for the soil.It is a better and more economical nutrient supplier than commercial fertilizers when properly maturated and applied to soil (Kacar and Katkat, 2009).

This semi-finished organic fertilizer is a by-product that can be applied to the soil as organic fertilizers after composting or actual natural condition (Kacar and Katkat, 2009; Taban, 2007; Yaldız et al., 2017). This by-product can also be used in the production of heat energy by burning or production of electric energy by thermal process such as pyrolysis (Demirulus and Aydın, 1996; Moore et al., 1998; Kelleher et al., 2002).

In some regulations, this semi-finished organic fertilizer, which is called waste, can be considered as hazardous waste and the applications can be realized accordingly. When semi-finished organic fertilizer is considered as hazardous waste, it is still a by-product that is prohibited in the collection, transportation and processing of the general practices in the field and that these processes should be done by special methods. In some countries, there is no direct legislation on the evaluation and use of semi-finished organic fertilizers and is considered out of scope according to regulations such as the control of solid wastes. The studies carried out by related institutions on this subject are continuing in these countries (Anonymous, 2010, Anonymous, 2011).

In addition, the soil structure in the regions that have not been made so far should be determined in more detail by means of the analyzes to be carried out, to what extent the semi-product organic fertilizer and/or organic fertilizer should be taken into the land, and this information should be published by the relevant institutions in a way that everyone can access. It is also necessary to transfer the information published within the framework of compliance to the world and the EU (Anonymous 2004a; Anonymous, 2004b; Anonymous, 2004c).

**Conclusion**

According to the actual legislations, it is possible to state that the rules and regulations recommended in the houses are somewhat conservative but reliable. Using of poultry manure for agricultural purposes in the fields will continue to be a sensitive issue in the future. Conflicts between the institutions with the joint work to be done by the relevant institutions should be eliminated, temporary and permanent used litter storage and processing locations should be determined and relevant official arrangements should be completed. Thus, the concept of confusion between official institutions and between official institutions and actual practice will be eliminated and a common definition and solution will be found to satisfy all parties.

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