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Review

The multidimensional causal factors of 'wet litter' in chicken-meat production

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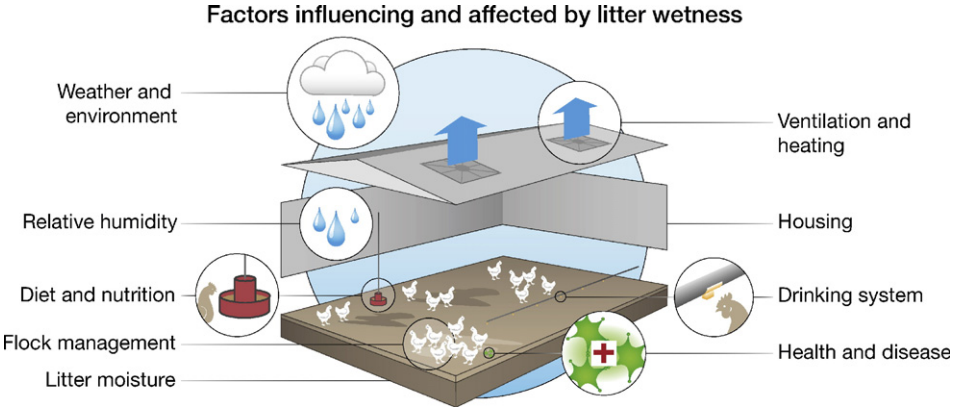
HIGHLIGHTS

- Wet litter in poultry sheds is a complex issue, with many interrelated causes.
- Micro-environment and housing factors contribute most acutely to wet litter.
- Disease and diet/nutrition contribute to wet litter but are less obvious.
- Research and extension are both required to reduce occurrence of wet litter.

GRAPHICAL ABSTRACT



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ABSTRACT

The problem of 'wet litter', which occurs primarily in grow-out sheds for meat chickens (broilers), has been recognised for nearly a century. Nevertheless, it is an increasingly important problem in contemporary chicken-meat production as wet litter and associated conditions, especially footpad dermatitis, have developed into tangible welfare issues. This is only compounded by the market demand for chicken paws and compromised bird performance. This review considers the multidimensional causal factors of wet litter. While many causal factors can be listed it is evident that the critical ones could be described as micro-environmental factors and chief amongst them is proper management of drinking systems and adequate shed ventilation. Thus, this review focuses on these environmental factors and pays less attention to issues stemming from health and nutrition. Clearly, there are times when related avian health issues of coccidiosis and necrotic enteritis cannot be overlooked and the development of efficacious vaccines for the latter disease would be advantageous. Presently, the inclusion of phytate-degrading enzymes in meat chicken diets is routine and, therefore, the implication that exogenous phytases may contribute to wet litter is given consideration. Opinion is somewhat divided as how best to counter the problem of wet litter as some see education and extension as being more beneficial than furthering

Abbreviations: AGP, antibiotic growth promotants; A_w, water activity; DEB, dietary electrolyte balance; FPD, footpad dermatitis; HCl, hydrochloric acid; $NaHCO_3$, sodium bicarbonate; NE, necrotic enteritis; NSP, non-starch polysaccharides; FCR, Feed conversion ratio.

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research efforts. However, it may prove instructive to assess the practice of whole grain feeding in relation to litter quality and the incidence of footpad dermatitis. Additional research could investigate the relationships between dietary concentrations of key minerals and the application of exogenous enzymes with litter quality.

Contents

1. Introduction

The occurrence of 'wet litter' in meat chicken sheds is associated with concerns regarding animal welfare, flock health, food safety, environmental impacts and reductions in production efficiency. Mitigating wet litter will only be achieved when there is thorough understanding of the multidimensional causal factors. This will require a multidisciplinary approach to understand the hydrology in the meat chicken shed micro-environment; the biological response of the chickens to nutrition and the production environment; and the contributions of illness, production equipment/housing design and management, and the intensiveness of chicken meat production on wet litter.

Complexity of the multidimensional causal factors of wet litter is accentuated by the difficulty of reaching an appropriate definition of wet litter. A survey of fifteen people variously connected with the chicken-meat industry, including veterinarians and nutritionists, from Australia and the United Kingdom (UK) was completed to garner background information for this review. Perhaps some of the better responses to the prompt for a definition were: "wet litter is not dry and friable and is unacceptable to the peak welfare body"; and "wet litter is such that the litter is sufficiently moisture-laden to be detrimental to the health and welfare of the birds by way of causing footpad damage". However, neither response constitutes a precise definition of the problem.

One precise definition is that once litter moisture content exceeds 25% (mass of water divided by mass of moist litter, expressed as a percentage, %), its cushioning, insulating and water holding capacity is compromised (Collett, 2012). Or, additionally, Collett (2007) stated that wet litter results when rates of water addition (excreta, spillage) exceed the rates of removal (evaporation). A European Directive requires that "All chickens shall have permanent access to litter which is dry and friable on the surface" (Lister, 2009) and "dry and friable" litter is the recognised, albeit nebulous, benchmark. In the UK, the requirement to keep litter in a well maintained state is enshrined in law and, in the event of non-compliance, growers may be prosecuted (DEFRA, 1994). Also, in Australia, the RSPCA has issued requirements in respect of acceptable litter quality (RSPCA, 2013).

Some 90 years ago, Dann (1923) expressed the opinion that "wet litter in the poultry house is a rather troublesome problem to most poultrymen". Wet litter was deemed to be a favourable medium for the development of colds, catarrh, roup, and like maladies demanding extra labour and litter material due to the necessity of frequent replacements. The author listed six causes of wet litter, all of which were directly related to providing birds with "good housing". Subsequently, James and Wheeler (1949) concurred in suggesting that wet litter is a problem of considerable economic and pathological importance. Quite clearly the situation has changed little, as wet litter remains a troublesome problem for the chicken-meat industry, and the attention the problem is receiving is escalating due to welfare concerns. One of the many relevant aspects is that wet litter is the principal cause of footpad dermatitis (Shepherd and Fairchild, 2010). Moreover, the induction of footpad dermatitis by the deliberate provision of wet litter has been shown to compromise weight gains by 7.75% (1904 versus 2064 g/bird; $P < 0.01$) and feed conversion efficiency by 4.16% (1.68 versus 1.61; $P < 0.05$) at 37 days post-hatch (de Jong et al., 2014). From the standpoints of bird welfare and bird performance in a general context, and from an economic perspective regarding the market demand for chicken paws, the wet litter problem needs to be addressed. Clearly, the identification of the causal factors of wet litter is a precondition for the rectification of the problem.

Wet litter is a problem primarily for meat chickens that are grown to market weight but it also extends to the housing of meat chicken breeders. In fact, Mench (2002) stated that because of reduced mobility meat chicken breeders may spend a large proportion of their time lying down and are therefore prone to hock burns and breast blisters from contact with wet litter. Also, excess water intake is a common problem in meat chicken breeder flocks and may need to be restricted in order to maintain litter quality. Carr et al. (1995) evaluated litter samples from flocks of meat chickens and meat chicken breeders with respect to *Salmonella* contamination. These researchers concluded that limiting water activity (A_w) in the litter base reduced the multiplication of *Salmonella* and created a more hygienic environment for poultry production. However, the focus of this review is centred on wet litter in the context of meat chickens.

The objective of this review is to identify and discuss the factors that contribute to wet litter in chicken-meat production. 'Wet litter' is used as a descriptive term for litter with properties that contribute to problematic or detrimental side-effects especially in terms of flock health, welfare, or productivity. Wet litter may also be seen as a contributor to environmental or amenity problems relating to odour or other gaseous emissions. As mentioned, a precise definition of wet litter is difficult and the causative factors are multidimensional including housing, or micro- and macro-environmental factors, disease, health and