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**NEW PERSPECTIVES AND CHALLENGES  
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## IMPORTANCE OF FARM MANAGEMENT IN REDUCING BROILERS SKIN LESIONS

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Invited paper

**Abstract:** The incidence of contact lesions in broiler production is showing an upward trend over the past decades. The frequency and severity of lesions are perceived through the negative effects on productivity, carcass quality and broiler welfare. High variability of the frequency of contact lesion between farms indicates a significant influence of management and applied technological procedures on farms. The most common forms of contact lesions are on the feet, ankles and breast and the areas of direct and prolonged contact with the litter. In this regard, a number of studies have pointed to the significant effect of litter on the health and integrity of the skin. In addition to litter, farm factors that are associated with the incidence of contact lesions are stocking density, environmental conditions, light program, nutritional factors, etc. The paper gives an overview of recent research aimed at reducing the incidence and severity of contact lesions by implementing of certain technological processes with effects on the quality of the litter.

**Key words:** broiler, contact lesions, farm management

### Introduction

Lesions on the skin of broilers are common inflammatory damage to the various layers of the skin. Primarily they are not caused by microorganisms but can be a place of entry of bacteria (*Hester, 1994*). They occur on the feet, ankles and breast of broilers, i.e. in places of prolonged contact of skin and litter. Therefore, they are associated with quality of litter, conditions and farm management (*Shepherd and Fairchild, 2010; de Jong et al., 2012*). According to the report SCAHAW (2000) occurrence of contact dermatitis is an increasing problem. The reasons are in the industrialization of poultry production and increase of the growth intensity of

hybrids, which resulted in a greater burden on farms, less physical activity and poorer state of broiler litter.

The incidence of skin lesions in broilers is considered to be an economic and welfare problem (*Shepherd and Fairchild, 2010; Hashimoto et al., 2013*). Lesions diminish the carcass quality at slaughter line. The lesions on the plantar surface of the foot (footpad - FPD) are the most common forms that directly diminish the quality of chicken legs, a product most in demand in the Asian market, thereby reducing the efficiency of the carcass. More serious forms of foot lesion are the main causes of painful conditions, hampering movement and access to feeders, which leads to negative effects on body weight gain (*Škrbić et al., 2009a; 2011; Hashimoto et al., 2013*).

Data on the frequency of contact lesions on farms are limited. A realistic assessment is difficult due to different, subjective grading systems that are causing great variability of results obtained in individual farms (*Allain et al., 2009*). The methods of visual assessment of the scope and depth of the lesions that are used quantify the lesions with points according to the scale of different range (tab. 1). *Arnould and Butterworth (2010)*, state variability of lesion incidence 0-100% depending on the flock. The information cited by other authors on the frequency of FPD on commercial farms range from 30% (*Sanotra et al., 2003*); 38% (*Ekstrand et al., 1997*); 11.2% with the variability of 0 to 71.5% (*Haslam et al., 2007*).

**Table 1. Several scoring systems for foot lesions**

	Score	Description
Ekstrand et al., 1998	0	No lesions, only mild hyperkeratosis, no discoloration
	1	Mild lesions; superficial lesions, erosions and discoloration
	2	Severe lesions; deep lesions and ulcers
Dawkins et al., 2004	0	No lesions
	1	< 5mm lesion on pad
	2	> 5mm lesion on pad
Thomas et al. 2004	1	No burns
	2	Mild burns
	3	Severe burns
Allain et al., 2009	0-9	Scoring system based on a combination of severity and surface area

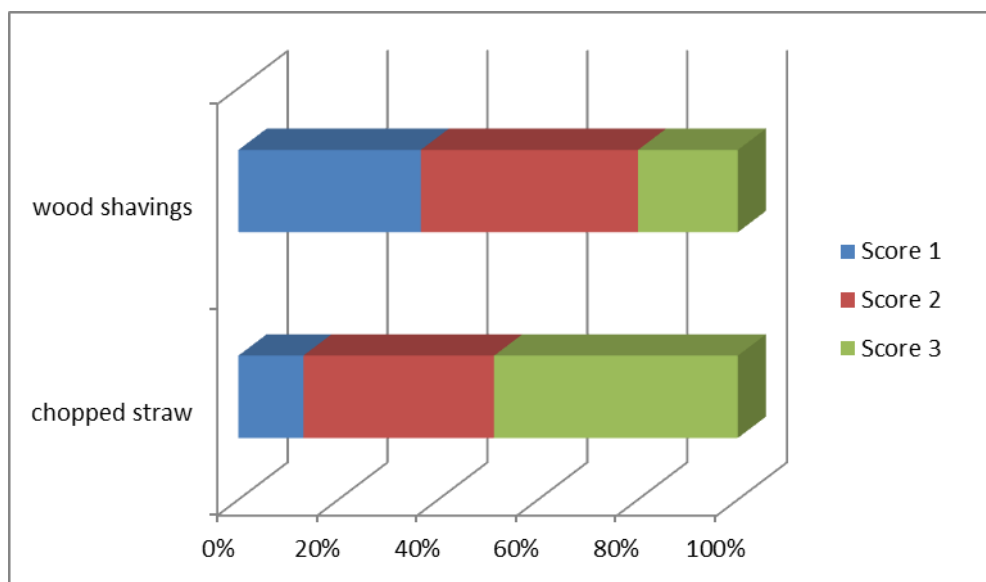
Great variability of the frequency of contact lesions between farms reflects the different growing conditions, management techniques and broiler genotypes. In order to prevent contact dermatitis mandatory monitoring in slaughterhouses is essential as well as understanding of the breeding factors in farms that are associated with the incidence of the lesions, to improve the farms management

practices (*Directive 2007/43/EC*). Factors associated with the incidence of contact lesions in broilers are litter quality, stocking density, light program, nutritional factors, breeding system, age, body weight, genetic factors (*de Jong et al., 2012; Bilgili et al., 2006; Eichner et al., 2007; Škrbić et al., 2009a; Kjaer et al., 2006*). Great variability of contact lesions between farms (*Haslam et al., 2007*), indicates the possibility for reduction of the prevalence of lesions by improving the technological aspects of production.

## Litter quality

The quality of litter is extremely important for the state and health of the skin of broilers because of the time they spend in contact with her. Litter quality influences the environment conditions in the facility: humidity and air temperature, ammonia level and the amount of dust in the air. The role of litter is in thermal insulation and comfort and convenience that have to be provided for broilers. Due to poor maintenance of its quality this often turns into its opposite, so moist litter in prolonged contact with the skin results in the appearance of lesions. In several studies wet litter was identified as the main cause of lesions (*Shepherd and Fairchild, 2010; Kyvsgaard et al., 2013; de Jong et al., 2014*). The wet litter facilitates the adhesion of faeces on the skin, which in addition to mechanical enables the chemical irritation. Lesions are therefore sometimes referred to as ammonia burns. Quality of litter largely determines the moisture content in it. In this sense, *Mayne et al. (2007), Youssef et al. (2010), Cengiz et al. (2011)* state that only wet litter induces dermatitis. However, in some studies, despite the lack of a statistically significant difference in the moisture content of the litter between the treatments, significant differences in the incidence of lesions were found (*Škrbić et al., 2015*). The reason was in the other, physical characteristics of litter that affected the looseness and softness (fineness), i.e. hardening and caking of litter. In this sense, the choice of material for litter is extremely important. Criteria for selection are its absorptive capacity, the speed of drying, caking, availability and price. The most commonly used materials are straw and wood shavings, but due to the rationalization of production alternative materials are tested such as sand, paper, rice husk, etc. (*Bilgili et al., 2009; Grimes et al., 2006*). By comparing of alternative and traditional materials, *Grimes et al. (2006)* have not found significant differences in the incidence of lesions on the feet, while *Bilgili et al. (2009)*, based on absorption capacity and speed of drying, preferred the ground door filler or sand. In numerous comparisons of straw and wood shavings, lower frequency of lesions was found in the treatments with wood shavings (*Su et al., 2000; Sirri et al., 2007; Meluzzi et al., 2008a*). In the study by *Škrbić et al. (2015)* significant differences in the occurrence of lesions between the chopped straw and

wood shavings were established already at the age of broilers 21 days, although it is known that the incidence of lesions increases significantly with the age broilers (Kjaer *et al.*, 2006) due to worsening conditions in the facility. Larger litter particles have a direct negative effect on the development of footpad lesions (Cengiz *et al.*, 2011). In this respect, the recommendation is chopping of straw (Bjedov *et al.*, 2013), which may contribute to faster aeration. An absorptive capacity of the litter can be improved by greater thickness of the layer, i.e. using a larger amount of material per unit area. Meluzzi *et al.* (2008a) have found that higher amounts of litter (3-4.5 kg/m<sup>2</sup>), with a lower stocking density and shorter photoperiod, contribute to a lower incidence of footpad lesions. On the other hand, the layers of litter thinner than 5 cm may result in a lower incidence of footpad lesions compared to thicker layers because the thinner layer litters provide better aeration through pecking and activity of chickens. In addition, the thin layers of litter can be fully ventilated using ventilation systems (Ekstrand *et al.*, 1997).



**Figure 1.** Frequency of foot-pad lesions scored from 1(without lesions) to 3 (severe lesions) in different litter type (Škrbić *et al.*, 2015)

## Environmental conditions

Basic environmental parameters in terms of litter quality are temperature and humidity. The optimal ventilation level is based on these parameters. With

increasing temperature the absorptive capacity of the air increases. In this sense, the season has a significant impact on the occurrence and severity of lesions. Statistical models in the study of *de Jong et al. (2012)* have suggested a variation of heavy footpad lesions of 13% depending on the season in which day-old chicks were housed. The highest incidence of footpad lesions was recorded in flocks where chickens were housed in the period December-March and the opposite, the lowest incidence was in flocks which have been housed in the period June-August. Early exposure of chickens to wet litter increases the occurrence and severity of lesions (*Cengiz et al., 2011; Taira et al., 2014*). Effects of season were also established by *Haslam et al. (2007)*, *Meluzzi et al. (2008b)*, *Musilova et al. (2013)*. The severity of lesions was reduced in hot, dry months and to the contrary, increased in the colder months. The basic problem in regulating the ambient conditions during the winter period is the pursuit of saving heat through restrictive levels of ventilation, which results in an increase in air humidity.

## Stocking density

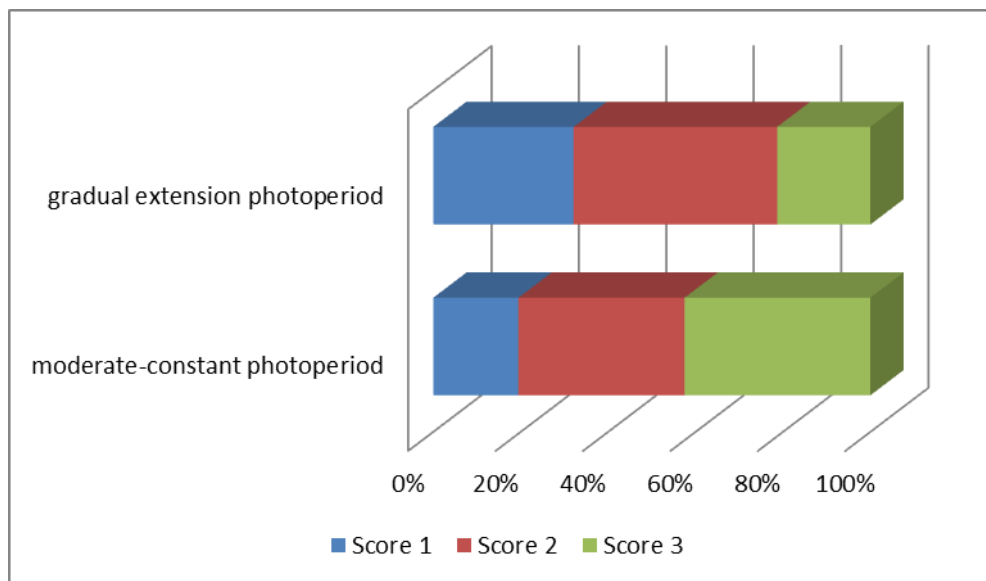
Numerous studies confirm the role of stocking density in achieving the production performance and the preservation of the welfare of broilers (*Škrbić et al., 2009a*). However, in regard to the direct correlation with the incidence of contact lesions, the results are conflicting. Some studies suggest an association between high stocking density and higher frequency of lesions (*Haslam et al., 2007*), while others suggest that the stocking density cannot be considered a significant factor (*Meluzzi et al., 2008b*). The main effect of stocking density on lesions is low in the study of *Kyvsgaard et al. (2013)*, but there is a significant interaction with the season in the sense that the high stocking density leads to more serious lesions in the summer and it has a slightly protective effect during winter. By limiting the living space and are to move, high stocking density prolongs chicken contact with litter and prevents the drying. In addition, at high densities the moisture content of the litter increases, increasing the burden of faecal matter and ammonia, which allows microbial activity that increases the temperature of the litter (*Meluzzi and Sirri, 2009*). Also, the high stocking density makes it difficult to properly manage the litter. In this way the relationship between stocking density and the occurrence of contact lesions can be explained. The effect of stocking density is seen through changes in the litter quality that was the best in the lower stocking density, resulting in a complete absence of lesions in the study by *Škrbić et al. (2009b)*. Based on the incidence of footpad lesions, it was concluded that the limit stocking density is 16 birds/m<sup>2</sup> and that significant differences were found between the density of 10 birds/m<sup>2</sup> and 20 birds/m<sup>2</sup> (*Škrbić et al., 2010*). However, given that the negative effects of high stocking density may be compensated by improving

environmental conditions, *Dawkins et al. (2004)* find that stocking density has little effect on the occurrence of footpad lesions. In support of this are the current limits of stocking density of broilers in accordance with the conditions for the preservation of the welfare that reduce the effect of stocking density on the development of contact lesions (*Kyvsgaard et al., 2013*).

## Lighting program

Improving of broiler welfare conditions includes mandatory introduction of the dark periods during the 24-hour cycle in order to establish a clear scheme of entirely separate periods of light and dark. In this way a normal secretory pattern of melatonin is ensured and metabolic disorders reduced (*Apeldoorn, et al., 1999*) and this also contributes to the health of the legs (*Sanotra et al., 2002*). Various aspects of lighting program (photoperiod, intensity and colour of light) can have different stimulatory effect on physical activity of broilers (*Lewis and Morris, 1998*). The research results of *Schwean Lardner et al. (2012)* show that broilers reduce their physical activity with extending of the photoperiod. The duration of photoperiod did not show a significant effect on the occurrence of footpad lesions in the work of *Sirri et al. (2007)* where lighting programs 23L: 1D and 16L: 8D were compared. In contrast, the inclusion of several short periods of darkness during the photoperiod, i.e. the application of intermittent lighting programs leads to greater physical activity of broilers in the periods of light and reduces the time of contact with the wet litter. It is assumed that in this way the expression of certain forms of behaviour are also influenced, such as pecking and scratching (*Maddocks, et al., 2001*), and thus less compaction of litter, better drying and finally its better quality are provided. Lower incidence of the worst forms of footpad lesions was found in the gradual extension program in relation to the program of consistently reduced photoperiod (Fig. 2), due to the simultaneous effect of the intermittent lighting that is achieved by gradual extending of photoperiod (*Škrbić et al., 2015*).

The low light intensity increases the incidence of lesions, influencing the activity of chickens which decreases with simultaneous prolonging of the contact with the litter (*Blatchford et al., 2009*). Similar results are reported by *Deep et al. (2010)* for the light intensity of 1 lux compared to 10, 20 and 40 lux, while this effect did not occur in the study of *Kristensen et al. (2006)* who compared the light from a different source and the intensity of 5 and 100 lux.



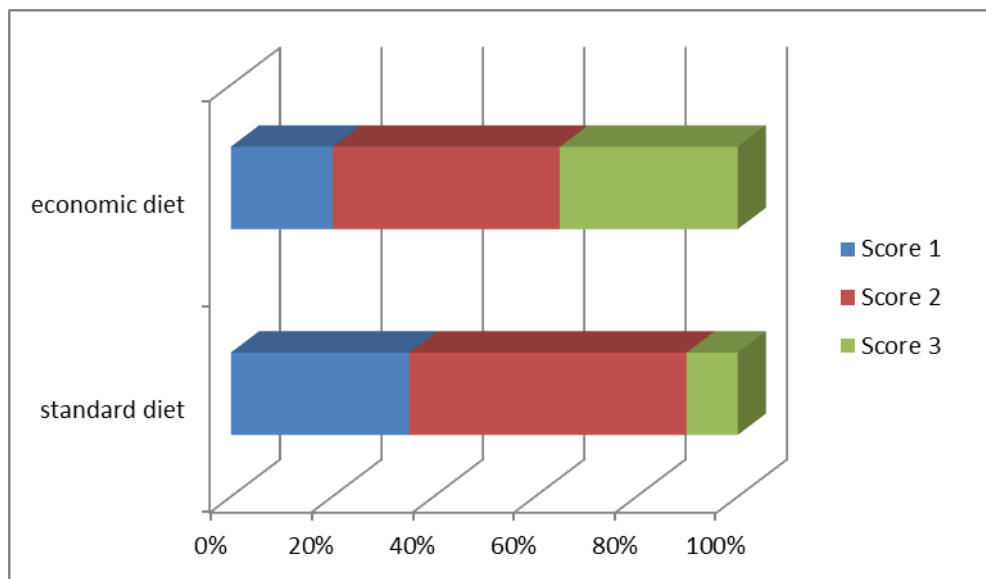
**Figure 2.** Frequency of footpad lesions scored from 1(without lesions) to 3 (severe lesions) affected by lighting program (Škrbić *et al.*, 2015)

## Nutrition

The effect of nutrition on the occurrence of contact lesions involve different sources and levels of protein, diet density, vitamin-mineral supplementation, the use of enzymes, etc. Nutrition exerts its effect through consistency of faeces which largely determines the quality of humidity of litter (Francesch and Brufau, 2004). On the other hand, the deficit of vitamins, biotin and riboflavin, as well as sulphur amino acids, methionine and cystine, acts on the structural components of the skin and facilitates the formation of contact dermatitis (Mayne *et al.*, 2005). Biotin deficiency can occur when the soy meal is used as a single high protein raw material in the mixture as it is naturally deficient in biotin. However, supplementation of biotin did not reduce the incidence or severity of the lesions in the work of Mayne *et al.* (2007) in view of the established interaction between the effect of supplementation and litter quality. High levels of Na and K contribute to greater consumption of water and litter moisture. The use of certain raw materials, such as soy, due to high levels of K, if they are not balanced, can lead to increased water consumption and wetter litter (Cengiz *et al.*, 2012). The high level of crude protein in the diet leads to high levels of uric acid discharged by kidneys, which stimulates the consumption of water and results in wet faeces. Diets with a high percentage of plant proteins imply increasing of the amount of fermentable



carbohydrates, resulting in an increased faecal viscosity and gluing to the foot pads, which is a problem even in the case of an acceptable moisture content in the litter (Nagaraj *et al.*, 2007a). Using commercially available enzymes can result in increased digestibility of such mixtures (Nagaraj *et al.*, 2007b). Formulating a diet based on digestible amino acids, and the addition of synthetic, will ensure that the nutrient content meets the needs of the broiler with no negative effect on the quality of litter and incidence of lesions. Low diet density has caused significantly lower incidence of footpad dermatitis in comparison to the high diet density in the study of Bilgili *et al.* (2006), due to reduced content of soybean meal and hardly digestible fats (Mukrami *et al.*, 2000), which reduced the faecal viscosity. The role of Zn in the skin regeneration and health can be improved by the use of organic sources (Saenmahayak *et al.*, 2010). In the study by Škrbić *et al.* (2012), the use of mixtures which, based on the raw material composition, are declared as market efficient led to higher humidity of litter and significantly higher incidence of footpad lesions relative to the mixture with a standard raw material composition (fig. 3).



**Figure 3. Effect of diet on incidence of foot-pad lesions scored from 1(without lesions) to 3 (severe lesions) (Škrbić *et al.*, 2012)**

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## Conclusion

The incidence of lesions in broiler production is seen as a problem with effects on the quality of the whole carcass, food safety and animal welfare, which is causing a growing interest in defining the cause in an effort to solve this problem. The problem of the incidence of lesions in broiler production is showing an upward trend in recent decades. The frequency and severity of certain forms of lesions is usually correlated with the litter quality. Research reports indicate the possibility of reducing the incidence and severity of lesions by applying certain technological procedures with impact on the quality of the litter.

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## Značaj menadžmenta farme u redukciji kožnih lezija u brojlera

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## Rezime

Incidenca kontaktnih lezija u brojlerskoj proizvodnji je sa tendencijom porasta tokom proteklih decenija. Učestalost i ozbiljnost lezija sagledava se kroz negativne efekte na produktivnost, kvalitet trupa i dobrobit brojlera. Velika varijabilnost učestalosti kontaktnih lezija između farmi ukazuje na značajan uticaj menadžmenta i primenjenih tehnoloških postupaka na farmama. Najzastupljeniji oblici kontaktnih lezija su na stopalima, skočnim zglobovima i grudima, odnosno na mestima direktnog i produženog kontakta sa prostirkom. U tom smislu, brojnim studijama je ukazano na signifikantan uticaj kvaliteta prostirke za zdravlje i integritet kože. Pored prostirke, faktori farme koji se dovode u vezu sa pojavom kontaktnih lezija su gustina naseljenosti, ambijentalni uslovi, svetlosni program, nutritivni faktori. U radu je dat pregled sprovedenih istraživanja sa ciljem redukovanja pojave i

ozbiljnosti kontaktnih lezija primenom određenih tehnoloških postupaka sa efektima na kvalitet prostirke.

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