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Effects of Different Floor Systems and the Bird's Age on Body Weight Gain and Feather Score of Broiler Breeder Hens

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ABSTRACT

Purpose: *Feathers are known to play a significant role in thermoregulation and provide a physical protection to the birds. Presence or absence of a good feather cover therefore, directly influences on a bird's performance. The study reported herein was conducted to assess the effects of floor system and the bird's age on body weight gain (BWG) and feather score in Indian River (IR) broiler breeder hens.*

Research Method: *The experiment was conducted in 2 x 4 factorial arrangements of treatments which included two floor systems (slatted floor and litter floor) and four age groups (23, 32, 38 and 45 weeks). A total of 400 IR breeder hens were assigned to 08 treatments with two replicates per each (25 birds/ replicate) and were fed formulated breeder rations recommended based on the age and the production rate. The body weight, mortality and feather scores were recorded in a two-week experimental period.*

Findings: *A significant interaction ($P<0.05$) between floor type and age was observed for BWG. The highest mean BWG was recorded (313 g/bird) in 23-week old birds kept on slatted floors. Overall feather loss ($P<0.05$) and feather loss in back ($P<0.05$), wings ($P<0.05$) and tail areas ($P<0.05$) of IR breeder hens were the lowest when the birds were kept on slatted floors. Increasing bird's age significantly ($P<0.05$) increased the overall feather loss and feather loss in back, wings and tail areas.*

Original Value: *The present study concluded that among the age groups tested, the highest BWG of IR breeder hens were recorded at 23-weeks of age when they were on slatted floors. The slatted floor system was highly effective in reducing feather loss in IR breeder hens. Feather loss was increased with advancement of a bird's age.*

Keywords: *Age, Feather Score, Floor System, Indian River Breeder Hen*

INTRODUCTION

Feathers play a significant role on a breeder hen's performance. They play a major role in thermoregulation (Deschutter and Leeson, 1986) and provide a sound protection to the birds by minimizing injuries and infections. Feathers also play a major role in flight and sexing of day-old chicks. A good feather cover of broiler breeder hens is very important in the economic aspects and bird's welfare. Breeder hens with poor feather cover exhibit an increased heat loss causing elevated metabolic rates to maintain body temperature (Labrash and Scheideler, 2005). Increased metabolic rates were found to uplift maintenance energy requirements in birds which may result in increased feed consumption. Feathers protect hens from injuries such as scratches, pecking, cannibalism, and abrasions from cage materials. Deterioration of plumage and reduction of body cover may become one of the major causes for severe feather pecking which triggers serious feather damages in all

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ages of hens. Hence, the birds with naked skin become the victims of cannibalism and finally, deaths can occur due to severe wounds or infections (Huhges and Duncan, 1972).

Feather cover of birds is known to be affected by various factors such as stocking density, type of cage materials, feather pecking, bird's age, feed to protein ratio, environmental temperature, light and the production system, ventilation, nutrition, genetics, molting, and stresses (Peguri and Coon, 1993; Ambrossen and Petersen, 1997; Cooper and Washburn, 1998; Kjaer and Vestergaard, 1999; Edens *et al*., 2001; Hetland *et al*., 2004; Leeson, and Walsh, 2004; Sarica *et al*., 2008; Fisher, 2016). Among those, age of the bird has been identified as one of the critical factors affecting feather losses. Extreme feather losses have been observed in broiler breeders at 35 weeks of age or more (Fisher, 2016). Floor systems and their conditions (*i.e.* deep litter and slatted floor systems) were also found to affect critically on feather losses (Fisher, 2016).

Maintenance of an appropriate degree of feather cover helps to prevent feather loss in females once they reach to the production stage. Inadequate amounts of feather cover in breeder hens can cause a drop-in mating and fertility rates and also body weight losses, a poorer feed conversion ratio (FCR) due to the bird's inability to regulate body temperature and possible physical injuries. Identification of causes and managing to reduce feather loss are therefore, very important in commercial breeder farms to solidify the profits. Accurate identification can also be led to reduce mortality, improve bird's performance and reduce utilization of excess feed to maintain body temperature (Peguri and Coon, 1993).

Feather scoring methods are used currently to determine the severity of feather losses. Various scoring methods are used to measure the degree of feather loss from the body of the breeder hens (Hughes and Duncan, 1972; Allen and Perry, 1975; Tauson *et al*., 1984; Bilcik and Keeling, 1999; Aerni *et al*., 2000; Lee *et al*., 2011; Kretzschmar-McCluskey *et al*., 2014). The visual observation of hens feathering provides a numerical equivalent of a subjectively identified amount of plumage feather cover.

Only limited researches have been conducted to identify the relationship between various management factors and feather score of breeder hens. Therefore, this research was conducted (i) to identify the effects of floor type (deep litter system vs. slatted floor system) and bird's age on the feather score of Indian River (IR) breeder hens raised under controlled environment poultry houses and (ii) to determine the effect of floor system on body weight gain (BWG) of IR breeder hens.

MATERIALS AND METHODS

Experimental site and sampling of birds

The study was conducted at the Millennium Multibreeder Farm of Ceylon Grain Elevators (PLC), Sri Lanka. Twenty-three (23), 32, 38, and 45 weeks old breeder hens and two different floor systems were selected. Each age group was randomly allocated into two floor systems (*i.e.* slatted floor *vs.* litter floor). A total of 400 IR breeder hens were assigned to 08 treatments with two replicates per each (25 birds/replicate). The total sample size of each floor condition was 50 and breeder hens were selected randomly from the flock. Selected breeder hens were labeled starting from 1 to 50 by tagging and the tags were sprayed with color for easy identification.

Experimental condition

The experiment was carried out in controlled environmental poultry houses. All environmental conditions (*i.e.* temperature and relative humidity) were regulated according to Indian River Management Guide (Indian River Parent Stock Management Guide, 2013) and were monitored by the electronic sensor system in the poultry house. Lighting and stocking density for each age group were managed according to the recommendations. During the research period, the birds were fed with a

commercially available formulated breeder feed based on their age. Water was given *ad libitum*.

Experimental design

The experimental design was a completely randomized design in a 2x4 factorial arrangements of treatments, evaluating two floor systems against four age periods.

Determination of feather losses

Feather loss was measured at three different places of the body of breeder hens (*i.e.* back, wings and tail areas) and recorded according to the scoring system described by Kretzschmar-McCluskey *et al*., (2014) (Table 01).

Determination of body weight and mortality

Body weights of breeder hens were measured at the onset of the research and after two weeks using an electronic scale (Model No: HS-15K, Universal Weight Enterprise Co., Ltd. Taipei, Taiwan). The mortality was recorded daily during the research period of two weeks.

Data analysis

A two-way analysis of variance (ANOVA) was conducted to determine the effect of floor system and bird's age and their interactions on BWG and feather losses. The data were analyzed using the General Linear Model procedures of SAS (2002). Differences were considered to be significant at (P<0.05) and significant differences between means were separated by Duncan's multiple range test.

RESULTS AND DISCUSSION

Effects of different floor systems and the bird's age on body weight gain of IR breeder females

The effects of floor system and the bird's age on BWG and feather loss of IR breeder females are indicated in Table 02. A significant interaction effect (P<0.01) between floor system and the bird's age was observed for total BWG. No interaction effect (P>0.05) was observed for overall feather loss, and feather loss in different body parts.

Body weight gain obtained from 23-weeks old breeder hens (313 g/bird) reared on slatted floor were significantly higher (P<0.05) than those of 32, 38, and 45, weeks old hens who have a similar BWG (P>0.05) (Table 02).

Similarly, the BWG of 23 weeks old breeder hens (230.9 g/bird) reared on litter floor was significantly higher (P<0.05) than those of 32, 38 and 45 weeks old. No significant (P≥0.05) difference was observed between 38 and 45 weeks old breeder hens reared on litter floors for BWG. However, in both systems the BWG of 32 and 45 weeks old breeder hens were similar (P>0.05) (Table 02) and was not affected either by system or age. The BWG recorded from the age groups reared on slatted floors were in accordance with the standard BWG expected from IR breeders (Indian River Parent Stock Management Handbook-2013). Numbers of researchers investigated the effect of different production systems on the growth performance of birds. In those studies, the growth performance of birds raised in free-range systems were shown to be inferior to that of birds raised in controlled environmental houses (Li *et al*., 2017). Reduced growth performance in birds raised in free range systems have been explained by the fact that in free-range, the birds are exposed to fluctuating temperatures and increased exercise, while increasing their energy requirement which in turn negatively influencing on their feed conversion efficiency (Li *et al.,* 2017). However, no studies were found comparing the effect of deep litter system and slatted floor system on BWG of breeder hens. Comparatively, a lower BWG obtained in 23-weeks old breeder hens raised on deep litter system as compared to those raised on slatted floor system is perhaps due to increased exercise in birds during their faster growing period. However, the reasons for higher BWG observed in 32-weeks old breeder hens raised on deep litter system than to those raised on slatted floor system is not clear.

Table 01: Feather scores for Indian River breeder hens.

Score	Severity
0	Fully feathered
1	Rough
2	Some broken feathers
3	Heavily broken feathers
4	Almost bald
5	Bald

Source: Kretzschmar-McCluskey et al. (2014).

Table 02: Influence of floor system and bird's age on body weight gain (BWG) and feather loss of Indian River breeder hens.

Floor system	Age (weeks)	Total BWG (g/bird)	Overall feather loss	Feather loss in back area	Feather loss in wing area	Feather loss in tail area
Slatted floor	23	313[a]	0.21	0	0.56	0.08
	32	52.13[d]	0.78	0.68	0.84	0.82
	38	37.79[d]	1.71	2.36	1.52	1.24
	45	26.90[d]	2.69	3.30	2.30	2.48
Litter floor	23	230.90[b]	0.28	0.00	0.62	0.22
	32	106.85[c]	1.08	0.98	1.28	0.98
	38	35.68[d]	2.08	2.70	1.70	2.08
	45	30.61[d]	3.05	3.60	2.68	2.86
SEM[1]		115.12	0.06	0.08	0.06	0.06
Main Effects						
Slatted floor		107.5	1.35[b]	1.59[b]	1.31[b]	1.16[b]
Litter floor		101.0	1.62[a]	1.82[a]	1.57[a]	1.48[a]
Age (Weeks)	23	271.95	0.25[d]	0.00[d]	0.59[d]	0.15[d]
	32	79.49	0.93[c]	0.83[c]	1.06[c]	0.90[c]
	38	36.74	1.89[b]	2.53[b]	1.61[b]	1.54[b]
	45	28.76	2.87[a]	3.45[a]	2.49[a]	2.67[a]
Probability (P value)						
Floor system		NS	***	*	**	***
Age		***	***	***	***	***
Floor x Age		***	NS	NS	NS	NS

*NS, Not significant; *P<0.05; **P<0.01; *** P<0.001.*

[1]Pooled Standard Error of Mean.

[a-d] Means in a column not sharing a common superscript are significantly different (P<0.05).

Effects of floor system and the bird's age on overall feather score of IR breeder females

The overall feather score can be defined as the mean of the feather scores of back, wings and tail areas of IR breeder hens. Overall feather loss was affected significantly (P<0.05) both by the floor system and the bird's age. Overall feather loss was higher (P<0.05) in birds those reared on the litter (Table 02). Wet litter with droppings possibly contains harmful microbes and parasites which can cause feather damages and losses in birds. Wet litter can negatively influence on feathering as it causes overly wet or broken feathers when the bird sits on (Fisher, 2016). Wet litter also interferes with dust bathing

behavior of birds (Fisher, 2016). But, slatted floors are totally devoid of such serious issues. Therefore, the present result can be explained as due, mainly to those advantages prevalent in the slatted floor system. However, in contrast, the absence of litter materials has been found to stimulate the feather pecking behavior among chicken (Levy, 1938).

Overall feather loss ($P<0.05$) increased with increasing age. Significantly, the highest overall mean feather score (2.87) was reported from 45-weeks old birds as compared to 23 (0.25), 32 (0.93) and 38 (1.89) weeks old birds. No interaction effect ($P>0.05$) was observed for overall feather loss (Table 02). This may be probably due to the effect of mating activity of breeder hens. At 23-weeks of age the hens are at onset of laying and do not show considerable mating activity. Therefore, younger flocks exhibit considerably a low mating behavior as compared to those at older ages. However, mating activities become the highest at peak laying and around. Therefore, feather loss can be possibly higher among older hens. The results of the present study are in agreement with the findings of Kretzschmar-McCluskey *et al*., (2014), who noted an extreme feather loss in broiler breeders at or above 35 weeks.

Amino acids are one of major nutrients affecting the feather development and losses in poultry. Methionine and cysteine are the most critical amino acids affecting feather development. At post- peak egg production, the concentrations of these two amino acids in blood are reduced. Therefore, increased feather loss can be evident just after post-peak production. Fisher *et al*., (1981) reported that the concentration of methionine in feathers decreases with bird's age.

Numbers of past studies identified the fact that the age of 40-weeks is optimal for feather scoring as there is a positive correlation between the feather condition and the egg production (Yamak and Sarica, 2012).

Effects of floor system and the bird's age on feather score in different body parts of IR breeder hens

The feather scores of different body parts of breeder hens are presented in Table 02. No interaction ($P>0.05$) effects were observed between floor type and the bird's age on feather scores of back, wing and neck. However, feather scores of these three body parts were affected significantly ($P<0.05$) by both the floor system and the age. In all three body parts, feather loss was the highest in birds raised on litter floors. As also noted previously, feather loss was minimal in birds reared in slatted floors (Table 02).

The feather scores of different body parts increased with the age (Table 02). The highest feather score for back area was reported in 45-weeks old breeder hens where the lowest feather score of the back area was recorded in 23 weeks old breeder hens (Table 02). Similar trends have been observed for the feather scores of wing and tail areas of breeder hens.

In the present experiment, feather losses of three different body regions of the breeder hens reared under two different floor systems were recorded. The highest feather loss was evident in the back areas of the breeder hens that reared on litter floors. This may be possibly due damaging and loosing of feathers during mating activity. The lowest feather loss was recorded in the tail area of the breeder hens that reared on slatted floor system (Table 02).

The present study was carried out in a controlled environmental poultry house. Therefore, environmental conditions were adjusted according to the requirements of the present study. However, changes in the environment may affect the feather loss of breeder hens. Cooper and Washburn (1998) reported that, the temperature is one of the major factors that affects bird's feathering. Lighting is also very important to stimulate feather development and feather losses through molting and pecking. Adequate ventilation plays a key role in feather development as well.

In the present experiment, four different age groups of IR breeder hens were selected (23, 32, 38 and 45-weeks). As described in previous studies, feather losses were higher during laying. Feather scores were found to be increased with increasing age during the laying period (Fisher, 2016). The hormonal changes during the onset of laying can influence on feather pecking behaviour in layers (Hughes, 1973).

When considering about the factors those affecting feather losses of breeder hens, mating behavior is one of the critical factors affecting on feather losses. According to IR management guide, the breeders are mixed up within 21 weeks of their age. Therefore, in this experiment all the age groups selected were affected with the mating behavior. On the other hand, nutrition plays a significant role in feather loss of breeder hens. The feed given for all age groups ensured the nutrition requirements of respective age and egg laying stage. In addition to proper feeding and management of environmental conditions, other management related practices may also affect the breeder hen's wellbeing. The feather loss was estimated using feather scoring method described by Kretzschmar-McCluskey *et al.,* (2014). Therefore, this method can be used to estimate feather loss in live breeder hens.

CONCLUSION

This study was designed to assess the effect of floor system and bird's age on BWG and feather scores of IR breeder hens. The BWG of IR breeder hens are the best at 23-weeks of age when they are on slatted floors. The present study also concluded that the slatted floor system is highly effective in reducing feather loss in IR breeder females. Feather loss is increased with the advancement of a bird's age.

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REFERENCES

Aerni, V., El-Lethey, H. and Wechsler, B. (2000). Effect of foraging material and food form on feather pecking in laying hens, *British Poultry Science*. 41(1): 16-21. DOI: 10.1080/00071660086349.

Allen, J. and Perry, G.C. (1975). Feather pecking and cannibalism in a caged layer flock*, British Poultry Science.* 16: 441-51. https://doi.org/10.1080/00071667508416212.

Amambrossen, T. and Petersen, V.E. (1997). The influence of protein level in the diet on cannibalism and quality of plumage of layers, *Poultry Science.* 76: 559-563. DOI: https://doi.org/10.1093/ps/76.4.559.

Bilcik, B. and Keeling, L.J. (2000). Relationship between feather pecking and ground pecking in laying hens and the effect of group size, *Applied Animal Behavior Science.* 68: 55-65. DOI 10.1016/S0168-1591(00)00089-7.

Cooper, M.A. and Washburn, K.W. (1998). The relationship of body temperature to weight gain, feed consumption, and feed utilization in broilers under heat stress, *Poultry Science*. 77: 237-242. DOI: https://doi.org/10.1093/ps/77.2.237.

Deschutter, A. and Leeson, S. (1986). Feather growth and development, *World's Poultry Science Journal.* 42: 259-267. DOI: https://doi.org/10.1079/WPS19860020.

Edens, F.W., Parkhurst, C.R. and Havenstein, G.B. (2001). Housing and Selenium influences on feathering in broilers, *Journal of Applied Poultry Research.* 20: 128-134. DOI: https://doi.org/10.1093/japr/10.2.128.

Fisher, C. (2016), Feathering in broiler breeder females. http://en.aviagen.com/assets/Tech_Center/Broiler_Breeder_Tech_Articles/English/Feathering-in-Broiler-Breeeder-Females-EN-2016.pdf. 15.12.2017.

Fisher, M.L., Leeson, S., Morrison, W.D. and Summers, J.D. (1981). Feather growth and feather composition of broiler chickens, *Canadian Journal of Animal Science*. 61: 769-773. DOI: https://doi.org/10.4141/cjas81-093.

Hetland, H., Chocta, M. and Svihus, B. (2004). Role of insoluble non-starch polysaccharides in poultry nutrition, *World Poultry Science Journal.* 60(4): 415-422. DOI: https://doi.org/10.1079/WPS200325.

Hughes, B.O. (1973). The effect of implanted gonadal hormones on feather pecking and cannibalism in pullets, *British Poultry Science.* 14 (4): 341-348. DOI: https://doi.org/10.1080/00071667308416038.

Hughes, B.O. and Duncan, I.J.H. (1972). The influence of strain and environmental factors upon feather pecking and cannibalism in fowls, *British Poultry Science.* 13: 525-47. DOI: https://doi.org/10.1080/00071667208415981.

Indian River Parent Stock Management Handbook (2013). Aviagen Group, Huntsville, AL 35806, USA. DOI: http://dx.doi.org/10.2172/6753612

Kjaer, J.B. and Vestergaard, K.S. (1999). Development of feather pecking in relation to light intensity, *Applied Animal Behaviour Science.* 62: 243-254. DOI: https://doi.org/10.1016/S0168-1591(98)00217-2.

Kretzschmar-McCluskey, V., and Fisher, C. and Tuijl, O.V. (2014). A practical guide to managing feather cover in broiler breeder females. Ross Technotes, Aviagen Group, Huntsville, AL 35806, USA. DOI: http://dx.doi.org/10.3382/ps.2013-03822

Labrash, L.F and Scheideler, S.E. (2005). Farm feather condition score survey of commercial laying hens, *The Journal of Applied Poultry Research.* 14: 740-744. DOI: 14:740-744. https://doi.org/10.1093/japr/14.4.740.

Lee, H.J. Roberts, S.J., Drake, K.A. and Dawkins, M.S. (2011). Prediction of feather damage in laying hens using optical flows and Markov models, *Journal of the Royal Society Interface*. 8(57): 489–499. DOI: 10.1098/rsif.2010.0268.

Leeson, S. and Walsh, T. (2004). Feathering in commercial poultry II. Factors influencing feather growth and feather loss, *World's Poultry Science Journal.* 60: 52-63. DOI: https://doi.org/10.1079/WPS20034.

Levy, D.M. (1938). On instinct-satiation: an experiment on the pecking behaviour of chickens, *Journal of General Psychology*. 18: 327-348. DOI: https://doi.org/10.1080/00221309.1938.9709982

Li, Y., Luo, C., Wang, J. and Guo, F. (2017). Effects of different raising systems on growth performance, carcass, and meat quality of medium-growing chickens, *Journal of Applied Animal Research.* 45(1): 326-330. http://dx.doi.org/10.1080/09712119.2016.1190735

Peguri, A. and Coon, C. (1993). Effect of feather coverage and temperature on layer performance, *Poultry Science*. 72 (7): 1318-1329. DOI: https://doi.org/10.3382/ps.0721318

Sarica, M., Boga, S. and Yamak, U.S. (2008). The effects of space allowance on egg yield, egg quality and plumage condition of laying hens in battery cages, *Czech Journal of Animal Science.* 53: 346–353. DOI:10.17221/349-CJAS.

SAS. 2002. SAS User's Guide: Statistics, Version 9.0. SAS Inst Inc;Cary, NC, USA. DOI: http://dx.doi.org/10.1177/0894439314544925

Tauson, R., Ambrosen, T. and Elwinger, K. (1984). Evaluation of procedures for scoring integument of laying hens-independent scoring of plumage condition. *Acta Agriculturae Scandinavica*. 34: 400-408. DOI: https://doi.org/10.1080/00015128409435409.

Yamak, U.S. and Sarica, M. (2012). Relationships between feather score and egg production and feed consumption of different layer hybrids kept in conventional cages. *Arch.Geflügelk*. 76 (1): S. 31–37. DOI: http://dx.doi.org/10.3923/ajpsaj.2009.30.41