The Relationship Between Cage Floor Preferences and Performance in Broiler Chickens

I. Zulkifli and A. Siti Khatijah
Department of Animal Science, Faculty of Veterinary Medicine and Animal Science, University Putra Malaysia, 43400 UPM Serdang, Selangor, D. E., Malaysia

ABSTRACT : Two experiments were conducted with broiler chickens to determine cage floor preferences, the strength of preference for a particular floor type and to evaluate the effect of rearing broilers on the preferred cage floor on productivity. In experiment 1, chicks when offered free access to either wire (WF) or plastic (PF) mesh flooring, preferred the former. However, when the perferred floor type (WF) was illuminated at 800 lux, birds spent longer time on PF. Also provision of incandescent lamps at PF resulted in broilers spending significantly longer period on WF. In experiment 2, while floor type had no effect on growth of female chicks throughout the duration of study, male chicks grown on PF were heavier than their WF counterparts on Days 21, 28, 35 and 42. Neither livability, nor incidence of breast blisters and leg deformities was affected by floor type.
(**Key Words**: Broilers, Cage Floor Preferences, Welfare, Productivity)

INTRODUCTION

In the context of veterinary medicine and animal agriculture, the implications of advances in animal welfare research have been of major interest. Although technological advances in contemporary intensive poultry operations have dramatically increased productivity, such production methods may also inflict cost on welfare. While vast research has been conducted on the well being of laying hens in cages, welfare concerns pertinent to cage-reared broilers have received less emphasis.

With the increasing importance of cage system for broilers (Elson, 1993), which is highly efficient and economic (Reece et al., 1971; Miller and Nater, 1972; Akpobome and Fanguy, 1992), there is a need to evaluate the welfare of broilers raised on various cage flooring materials.

A growing body of evidence has accumulated on the reliability and advantages of behaviour as an index of welfare (Duncan, 1981; Broom and Johnson, 1993). One possible method of using behavior as an indicator of welfare is to give a choice of environment and assume they will choose the best of their interest. The simplest experiment of this kind involves manifestation of preference by carrying out a simple motor activity (Fraser and Broom, 1990; Broom and Johnson, 1993).

There is, however, a question whether animals make choices which benefit their long term welfare. For example, given a free access to food, broiler breeder birds may eat too much leading to obesity, which contributes to deterioration of health (Siegel and Dunnington, 1990). Thus, in order to relate choice test findings and animal welfare the strength of a preference has to be assessed. According to Broom and Johnson (1993), the strength of a preference could be determined by discovering the costs or risks the individual is willing to incur to obtain whatever is chosen.

When discussing the welfare of poultry, its impact on productivity is of primary concern among poultry producers. Although it is generally accepted that improved welfare is not synonymous with high productivity (Dawkins, 1980), productivity has important impact on the acceptability of alternative production systems by farmers (Craig and Swanson, 1994). The objectives of the present study were as follows; (1) to determine cage floor preferences, (2) to assess the strength of preference for a particular floor type (i.e. to evaluate the costs the individual willing to incur to spend time on the preferred floor type) (Broom and Johnson, 1993), and (3) to evaluate the effect of rearing broilers on the preferred cage floor on productivity.

MATERIALS AND METHODS

General method

Day-old straight run broiler chicks (AVIAN) were

[1] Address reprint requests to I. Zulkifli.
Received August 25, 1997; Accepted December 15, 1997

reared in a conventional open-sided floor pen with wood shavings as litter. The chicks were vaccinated against Newcastle Disease (Days 7 and 21) and Fowl Pox (Day 21). Birds were provided starter (crumble form; 2,900 kcal ME/kg; 21% crude protein) and finisher (pellet form; 3,050 kcal ME/kg; 19% crude protein) diets from Days 1 to 20, and 21 onwards, respectively. Food and water were available *ad libitum*. Lighting was continuous from Days 1 to 13. Chicks which died were sex determined by gonadal examination. At the end of each trial, sex of survivors was determined by size of comb.

Experiment 1

A total of 18 chicks (equal number of male and female chicks) aged 21 days were used in the experiment. Each chick was housed singly in three blocks (designated as A, B, and C) of three tiered (2 cages per tier) battery cages. The batteries were in a conventional open sided house with cyclic temperatures (minimum, 25℃; maximum, 33℃). Relative humidity was between 80 to 90%. Each cage comprised of two types of floorings; rectangular wire mesh (constructed of 2 mm diameter wire and contained orifices of 22.5 cm^2) and plastic mesh (constructed of strips 2- mm in width and contained orifices of 14.1 cm^2). Each floor type measured 122.5 cm × 90 cm. The height of each cage was 47 cm.

The strength of preference for a particular floor type was assessed by finding out whether a bird will still choose the preferred floor type if high light intensities were provided. Twelve cages (2 blocks of batteries; A and B) were illuminated with 60 watt incandescent lights (in addition to natural illumination) either at the plastic (PF) or wire (WF) floor type from 07:30 h to 18:00 h. The lights were suspended at the center of a particular floor type. The mean light intensities of floor types (Blocks A and B) illuminated with incandescent lamps (in addition to natural lighting) and natural lighting only were 800 lux and 733 lux, respectively (measured at the height of a resting bird's head). Cages in Block C, where neither plastic nor wire floor was illuminated with incandescent lamp had a mean light intensities of 63 lux.

Feed and water were available *ad libitum* at both floor types. The wire netting separating two cages on each tier was covered to prevent chicks from seeing their next door neighbor. On Day 39 (at 08:00 h), time spent on each floor type was observed. The observation was carried out by three researchers and lasted for 30 minutes. Each of the three observers was responsible for all cages in a single block. A modification of the procedure described by Hughes and Black (1973) was used. Observers placed themselves about 1 m in front of the respective block of cages for 5 minutes before beginning to record. Each bird was scanned every 10 s and a score of 1 was given to whichever floor the bird was upon. A score of 0.5 was given to each floor if a bird straddled on both floors. If an individual spent on one particular floor type throughout the observation period, that floor would receive a score of 180, and the other floor 0.

Experiment 2

A total of 80 chicks (straight run) aged 14 days were used in the experiment. They were wingbanded and randomly assigned in groups of eight to 10 three-tiered battery cages with either wire (WF) or plastic (PF) mesh flooring (as described in Experiment 1.). Floor space allowance was 1,220 cm^2/bird. Individual body weight was recorded on Days 14, 21, 28, 35 and 42. Commencing from Day 14, feed intake was recorded weekly and feed conversion ratios (feed/gain) were calculated. Mortality, incidence of leg deformities were recorded daily. On Day 42, 10 birds per sex-floor type subgroup were killed and scored for breast blisters according to the method described by Andrews (1972).

Statistical analyses

In experiment 1, the data on time spent on each floor as affected by illumination (i.e. incandescent lamps were placed at WF, PF or neither) were tested using χ^2 test (Ott, 1984) within each sex. In experiment 2, body weight (analysed within sex), amount of feed consumed and feed conversion ratios data were analysed by analyses of variance, with cage floor type as the main effect. Prior to analyses body weight data were transformed to common logarithms. Mortality and, incidences of breast blisters and leg abnormalities data were analysed by χ^2 test (Ott, 1984).

Analyses of variances were conducted with aid of General Linear Models (GLM) procedure of SAS® software (SAS® Institute, 1982). Statistical significance is considered as $p \leq 0.05$ throughout the paper.

RESULTS

Experiment 1

Data of both sexes were pooled for presentation as there was no sexual dimorphism in cage floor preferences. Based on time spent on each floor type, cage floor preferences were significantly ($p < 0.001$) influenced by illumination (table 1). There was a marked preference for WF over PF when neither floor types were illuminated

Table 1. Effect of illumination with incandescent lights on time spent on the different types of floor

	Floor type	
	Wire mesh	Plastic mesh
Neither floor types were illuminated	104	77
Wire mesh was illuminated	68	112
Plastic mesh was illuminated	126	53

The values represent the number of 10 s periods spent on each floor.
Means within a row-subgroup are different at $p \leq 0.001$.

with incandescent lamps. However, higher light intensity produced by the incandescent lamps exerted significant effect on cage floor preferences. When the preferred floor type, WF, was illuminated at 800 lux, more time was spent on PF than WF. Thus, the brighter light was avoided and the pattern of choice was reversed. Provision of incandescent lamps at PF resulting broilers spending significantly longer period on WF (WF, 126; PF, 53).

Experiment 2

Body weight data are depicted in table 2. There was no significant difference in the body weight of female broilers throughout the duration of study. However, PF male broilers were heavier than those on WF at 21, 28, 35 and 42 days of age. From Days 21 to 27 and Days 28 to 34, PF broilers consumed more feed than their WF counterparts (table 3). Floor type had no significant effect on feed consumption from Days 14 to 20 and days 35 to 41. Except from Days 14 to 20, where PF birds had better feed conversion ratios, the trait was not affected by floor type. Regardless of floor type, percent mortality (WF, 12.5%; PF 10.0%), and incidences of leg deformities (WF, 2.5%; PF, 5.0%) and breast blisters (WF, 30%; PF, 30%) were similar.

Table 2. Effect of floor type on body weight (g) of male (M) and female (F) chicks at various ages

Floor type	Day 21		Day 28		Day 35		Day 42	
	M	F	M	F	M	F	M	F
Wire	689±14.5[a]	695±11.0	1,151±21.8[a]	1,112±20.4	1,624±44.7[a]	1,553±29.6	2,036±48.7[a]	1,904±41.7
Plastic	728±11.5[b]	684±16.5	1,213±15.0[b]	1,084±22.2	1,741±24.4[b]	1,487±29.2	2,189±38.1[b]	1,828±30.9

[a,b] Means within a column subgroup with different letters are different at $p \leq 0.05$.

Table 3. Effect of floor type on feed intake and feed conversion ratios at various periods

Parameter	Floor type	
	Wire mesh	Plastic mesh
Feed Intake (g/bird)		
Days 14 to 20	469± 8.2	491± 9.4
Days 21 to 27	717±13.7[a]	764± 8.0[b]
Days 28 to 34	849±16.7[a]	912±21.5[b]
Days 35 to 41	966±25.9	979±17.6
Feed conversion (feed/gain)		
Days 14 to 20	1.57± 0.02	1.48± 0.02
Days 21 to 27	1.65± 0.01	1.70± 0.03
Days 28 to 34	1.92± 0.02	1.93± 0.05
Days 35 to 41	2.58± 0.13	2.40± 0.17

[a,b] Means within a row-subgroup with different letters are different at $p \leq 0.05$.

DISCUSSION

When discussing results of this experiment, the reasonable assumption is that each bird had free access to either floor type and it was unlikely that the choice was confounded by variables other than those that were included in the statistical model. The data presented here suggest that when given a constant access to either WF or PF, in statistical terms, regardless of sex, broilers exhibited clear preference for the former. It is of interest to speculate on why broilers preferred WF over PF. There is a possibility that the smaller orifices of PF caused droppings to adhere longer and may have resulted slippery surface. However, it might be argued that in terms of better support to the bird's foot, PF appears to be superior since it contained smaller orifices than those of WF. Hence, it appears that avoidance from slippery surface is given priority in relation to better support to the feet.

In the context of risk of injury and mortality, which are of prime importance in the evaluation of poultry

welfare under various husbandry systems (Dawkins, 1980), rearing broilers on plastic floors may have both positive and negative consequences. While plastic floors favour incidence of leg deformities (Seay et al., 1973; Andrews et al., 1974), percent breast blisters (Andrews, 1972), wing breakage and mortality (Akpobome and Fanguy, 1992) were lower than those on wire floors. In the present study, however, neither wire nor plastic floor had significant effect on incidence of breast blisters and leg abnormalities, and livability. These discrepancies could be attributed to differences in genetic background and growth rate of the experimental stock.

Although preference tests have proven to be useful tool in evaluationg welfare, there are certain limitations and difficulties of interpretation (Ducan, 1981; Fraser and Broom, 1990). In his review, Duncan (1981) suggested that minority choices may be as important for the welfare of the animal as the more highly preferred choices. Furthermore, the immediate response of a bird to it's environment may have detrimental consequences in the long term (Dawkins, 1980). Hence, to show that a preference does manifest suffering in the less preferred environment or before choice test results can be applied to enhance welfare, the strength of the preference has to be assessed (Fraser and Broom, 1990). Our data suggest that preference for WF was insufficient to overcome the aversiveness of higher light intensities inflicted by the incandescent lamps. Despite the preference for WF, bright light produced by incandescent lamp at the wire floor type resulting birds spending longer time on PF. Similarly, Millam (1987) noted preference for a particular location of nest boxes in turkeys was reversed when it was illuminated at 650-1,000 lux. Thus, the present findings and those of Hughes and Black (1973) demonstrate that birds "prefer" some floors more than others. However, avoidance from bright light was given higher priority than spending longer time on preferred floor type in broiler chickens.

Although the general assumption in choice test studies is that provision of preferred environment may improve welfare of farm animal, it is unknown whether there is a concomitant improvement in productivity. In the present study, while growth of females was consistently not affected by floor type, raising male broilers on WF which was preferred over, PF, exerted negative influence on growth throughout the duration of study. Based on these findings, it seems that providing the birds with the "preferred" environment (wire mesh flooring), which is assumed to improve their welfare, may not necessarily enhance growth rate. Thus, the present data strengthened the notion that improved welfare is not synonymous with higher productivity (Dawkins, 1980). On the other hand, it might be argued that the birds' preference may not be in the best interest of their welfare (as supported by the assessment of strength of preference), hence, it is of no benfit to productivity. In view of this, it is becoming increasingly obvious that preference tests per se is an inadequate assessment of welfare and information on other indices are required.

ACKNOWLEDGEMENTS

The authors expressed their appreciation to M. T. Che Norma, T. Aidit, H. Mazlan and M. Ponnusamy for their technical assistance.

REFERENCES

Akpobome, G. O. and R. C. Fanguy. 1992. Evaluation of cage floor systems for prduction of commercial broilers Poultry Sci. 71:274-280.

Andrews, L. D. 1972. Cage rearing of broilers. Poultry Sci. 51:1194-1197.

Andrews, L. D., R. L. Seay, G. C. Harris, Jr. G. S. and Nelson. 1974. Flooring materials for caged broilers and their effect upon perfomance. Poultry Sci. 53:1141-1146.

Broom, D. M. and K. G. Johnson. 1993. Stress and Animal Welfare. Chapman and Hall, London, UK.

Craig, J. V. and J. C. Swanson. 1994. Review: Welfare perspectives of hens kept for egg production. Poultry Sci. 73:921-938.

Dawkins, M. 1980. Animal Suffering: the science of animal welfare. Chapman and Hall, London, UK.

Duncan, I. J. H., 1981. Animal rights-Animal welfare: A scientist's assessment. Poultry Sci. 60:489-499.

Elson, A. 1993. Housing systems for broilers. In: C. J. Savory and B. O. Hughes (Editors), Proceedings of the Fourth European Symposium on Poultry Welfare, Edinburgh, UK. pp. 177-184.

Fraser, A. F. and D. M. Broom. 1990. Farm Animal Behavior and Welfare. Bailliere and Tindall, London, UK.

Hughes, B. O. and A. J Black. 1973. The preference of domestic hens for different types of battery cage floor. Bri. Poult. Sci. 14:615-619.

Millam. J. R. 1987. Preference of turkey hens for nest-boxes of different levels of interior illumination. Appl. Anim. Behav. Sci. 18:341-348.

Miller, B. F. and D. M. Nater. 1972. Quality of broiler carcass as affected by cage rearing. Poultry Sci. 51:1837-1838.

Ott, L. 1984. An Introduction to Statistical Methods and Data Analysis. 3rd edition. PWS-Kent Publ. Co., Boston, USA.

Reece, F. N., J. W. Deaton, J. D. May and K. N. May. 1971. Cage versus floor rearing of broiler chickens. Poultry Sci.

50:1786-1790.

SAS Institute, 1982. SAS® User's Guide: Statistics. A Ray (Editor), SAS Institute Inc., Cary, NC.

Seay, R. L., G. S. Nelson, L. D. Andrews and G. C. Harris, Jr. 1973. The developments of a cover slat floor for loading broilers from cages. Poultry Sci. 52:2083-2084.

Siegel, P. B. and E. A. Dunnington. 1990. Behavioral genetics. In: R. D. Crawford (Editor), Poultry Breeding and Genetics. Elsevier Science Publ., Amsterdam, The Netherlands, pp. 877-896.