ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

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International Journal of Poultry Science 4 (6): 396-398, 2005
ISSN 1682-8356

The Effect of Intermittent Lighting Schedule on Broiler Performance

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Abstract: In an experiment with complete randomized design, the effect of intermittent lighting (1 h L: 3 h D) was studied on performance of 400 broiler chicks from 10 to 42 d of age. During of the experiment feed intake, body weight, feed conversion ratio were measured weekly. Mortality was measured throughout the experiment. At 42 d of age 10 chicks from each treatment were slaughtered for abdominal fat weight. There wasn't significant difference for body weight at 42 d between treatments. Use of intermittent lighting schedule improved feed conversion ratio significantly ($P<0.05$). Due to decrease fat deposition, intermittent lighting program reduced abdominal fat percentage ($P<0.05$). There wasn't significant difference between treatments for mortality. In conclusion, since physical activity is very low during darkness, and energy expenditure for activity is reduced, therefore use of intermittent lighting program enhanced production efficiency, reduced room temperature and cost of electricity.

Key words: Intermittent lighting, broiler, abdominal fat

Introduction

Modern broilers are intensively selected for growth rate. This selection strategy has also induced a considerable improvement in feed efficiency, but on the other hand it increased fat deposition, leg problems, and metabolic diseases such as sudden death syndrome (SDS), and ascites. The awareness of these major drawbacks and the associated financial losses led to a renewed interest in optimizing (low cost) techniques in broiler rearing management. Broiler chickens have usually been kept on a continuous or nearly continuous lighting (CL) schedule so as to maximize feed intake and growth rate. However it has been reported that performance of broiler chickens is improved by intermittent lighting (IL) schedules compared with such CL (Savory, 1976; Dorminey and Nakaue, 1977; Cave, 1981; Deaton *et al*., 1981). The broiler chickens reared under IL schedules showed a temporary growth delay after change at an early age from CL to IL and manifested catch-up growth during the subsequent period (Renden *et al*., 1991; Buyse *et al*., 1996; Ohtani and Tanaka, 1997a,b). As birds under IL will be quiet during a dark period, it is assumed that the reduction of activity during darkness may result in lower heat production, higher feed efficiency or both. The purpose of the present experiment was to compare the effects of intermittent lighting program with a nearly continuous lighting schedule on the performance of broiler chickens.

Materials and Methods

400 one-day old broiler chickens (Ross 308) were obtained from a local commercial hatchery. Chicks were randomly distributed in two light-proof controlled rooms each containing 10 floor pens (20 chicks per pen), and rose in nearly continuous lighting [23 h light (L): 1 h dark (D), CL]. A commercial broiler mash starter diet containing 2900 Kcal ME/kg and 22.4% CP were fed from 1 to 10 days of age. Feed and water were provided *ad libitum* throughout the experiment. Compositions of diets in all phases of the experiment are presented in Table 1. Starter, grower, and finisher diets were offered from 1-14, 14-28, and 28-42 d of age. At 10 d of age, the intermittent lighting program (IL) consisting of 1 h L: 3 h

Table 1: Composition and analysis of diets in starter, grower, and finisher periods of the experiment

Ingredients %	Starter	Grower	Finisher
Corn grain	61.89	65.20	69.17
Soybean meal	31.10	27.40	22.93
Fish meal	4.00	4.00	3.00
Calcium carbonate	1.26	1.11	1.10
Monocalcium Phosphate[1]	1.14	0.95	0.95
DL-methionine	0.21	0.13	0.10
L-lysine	0.13	0.00	0.08
Premix[2]	0.50	0.50	0.50
Sodium chloride	0.20	0.20	0.20
Analysis (calculated)			
ME Kcal/kg	2900	2900	2900
CP %	22.40	20.12	18.10
Calcium %	0.91	0.82	0.76
Available phosphorous %	0.48	0.44	0.39
Lysine %	1.31	1.21	1.01
Methionine+ cystine %	0.94	0.86	0.76

[1]Monocalcium Phosphate 160 g Ca, and 210 g P/kg
[2]Supplied per kilogram of diet: 6050 µg vitamin A (retinyl acetate + retinyl palmitate), 55 µg vitamin D_3, 22.05 µg vitamin E (dl-"-topheryl acetate), 2.0 mg K_3, 5 mg B_1, 6.0 mg vitamin B_2, 60 mg vitamin B_3, 4 mg vitamin B_6, 0.02 mg vitamin B_{12}, 10.0 mg pantothenic acid, 6.0 mg folic acid, 0.15 mg biotin, 0.625 mg ethoxyquin, 500 mg $CaCO_3$, 80 mg Fe, 80 mg Zn, 80 mg Mn, 10 mg Cu, 0.8 mg I, 0.3 mg Se.

Table 2: Body weight gain, feed intake, and feed conversion ratio of broiler chicks subjected to continuous lighting (CL) or to the intermittent lighting (IL) schedule

Trait	Body weight gain (g)		Feed intake (g)		Feed conversion ratio	
	CL	IL	CL	IL	CL	IL
Age (day)						
1-14	202 ± 18	193 ± 6	250 ± 7	242 ± 4	1.23 ± 0.02	1.27 ± 0.02
14-28	579 ± 14	607 ± 12	1045 ± 12	1034 ± 8	1.79 ± 0.02	1.73 ± 0.02
28-42	611 ± 25	659 ± 30	1542 ± 48	1540 ± 64	2.51 ± 0.01[a]	2.33 ± 0.02[b]
1-42	1392 ± 40	1459 ± 44	2837 ± 58	2816 ± 72	2.03 ± 0.03[a]	1.90 ± 0.02[b]

Values are mean ± SEM. Means in a row with different superscripts are significantly different (P<0.05).

Table 3: Abdominal fat percentage of male and female chicks as affected by CL and IL schedule

Treatment	Sex	Abdominal fat (% body weight 42 d)
CL	Male	1.67 ± 0.07[b]
	Female	1.88 ± 0.06[a]
IL	Male	1.30 ±0.14[c]
	Female	1.63 ±0.01[b]

Values are mean ± SEM. Means in a row with different superscripts are significantly different (P<0.05).

D cycles, whereas in the other room, the 23 h L: 1 h D lighting schedule was maintained. From day 7 onwards, and repeated weekly, chickens were weighted on a pen basis. Feed intake and feed conversion ratio were measured weekly too. Mortality was recorded throughout of the experiment. At 42 d of age ten birds of each treatment with body weight close to mean weight of each group were selected, weighed, slaughtered and abdominal fat were removed and weighed. Data of this experiment were analyzed using the General Linear Model procedure of SAS (SAS Institute, 1999). When differences among means were found, means were compared using Duncan's new multiple range test (Steel and Torrie, 1980).

Results and Discussion

Results of this experiment are shown in Table 2. At 42 d of age there wasn't significant difference between treatments for body weight gain. Body weight gains of chickens reared under IL were higher than the CL group at 14-28, 28-42, and 1-42 d of the experiment, but these differences were not significant (P>0.05). Body weight gains of birds under IL were lower at 1-14 d of age. There was no difference in feed intake between CL and IL chickens in all phases of the experiment. In some experiments feed intake of IL chickens were higher than the CL groups in 3-6 weeks of age (Ohtani and Leeson, 2000). In another study (Ohtani and Tanaka, 1998) observed that IL chickens rushed at feeder and vigorously ate at one time just after the starting of lighting period, whereas CL chickens showed little excitement at eating. They also concluded that, in IL chickens, the upper digestive tract might have been empty during the period of darkness, and the birds were immediately again ready to eat when light came on. Feed conversion ratio of chicks reared under IL was better than the CL chickens. In this experiment there was not a significant difference between treatments until 4 weeks of age, but the difference was significant for this trait in week 5, 6, and 1-6 weeks. Effect of IL on feed conversion ratio has been reported in many experiments (Buyse *et al.* 1994; 1996a; 1996b). Use of IL program significantly reduced abdominal fat weight of both male and female chicks at 42 d of age (P<0.05). This finding is in agreement with the results of other (Buyse *et al.* 1996a). When this trait expressed on a body weight basis, the percentage of abdominal fat of IL chicks was lower than of CL broiler. Female had a higher abdominal fat content compared to male (P<0.05). In this experiment, the change from CL to IL was started at 10 d of age, and there was a tendency for the body weight gain for chickens reared under IL to be lower during the early stage of this lighting schedule, but the body weight gain during the subsequent period was higher in IL chicks than in CL chickens. Similar results have been reported by other researchers (Cave *et al*. 1985; Buyse *et al*., 1996a; Ohtani and Tanaka, 1997a, b). Furthermore the IL chickens showed superior feed conversion ratio in 28-42, and 1-42 d of age (P<0.05). Mortality in each treatment was similar to standard rate, and there was no significant difference between treatments for this trait. This result is in agreement with findings of other researchers (Buyse *et al*., 1994; Renden *et al*., 1991; Malone *et al*., 1980), whereas in another study use of IL in broiler chicks reduced mortality (Classen and Riddle, 1989).

Since physical activity is very low during darkness, and energy expenditure of activity is considerable, a reduction in physical activity with IL may also contribute to enhanced production efficiency. In addition of lowering the cost of electricity, IL program reduced room temperature (about three degree Celsius). From the practical point of view, IL program may be used as an efficient management technique for broiler production during hot season in tropical and subtropical area. It will be noted that IL program can be only used in windowless rooms; otherwise this program can be used during night.

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