BIBLIOGRAPHY

PAGE-ET, ABEGAIL TAULI. April 2012. The Effects of Light Restriction on the Performance of Broilers Fed Ad Libitum. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

An experiment of 35 days duration was conducted using Completely Randomized Design to study the effect of continuous lighting and light restriction on the growth and performance of broilers, comprising 24hr-lighting,12hr-light: 12hr-darkness and 16hr-light:8hr-darkness. The study was carried out at Central Tawang, La Trinidad, Benguet.

A total of ninety straight-run broiler chickens were randomly distributed into the three lighting treatments at the end of two weeks of age. Each treatment was replicated thrice with 10 birds per replicate. There was no light restriction during the brooding period. The three different lighting programs were administered using 100-watt incandescent light bulbs. Switching on and off of light was done manually.

The parameters measured include body weight, weight gain, feed consumption, feed conversion efficiency and the shank increment. The results obtained showed that the birds subjected to restricted lighting programs performed as well as the control group given continuous lighting has no significant differences in all the parameters measured. There was no detrimental effect observed whether prolonged dark period or longer lighting was

used as lighting program for the broilers. It was therefore, light restriction may be implemented to minimize expenses on electricity.

Nonetheless, broiler lighting programs should be planned together with the environment, nutrition, management and the birds for the best well-being of the animal and their performance.

INTRODUCTION

Generally, poultry production is one of the industries most people are engaged into. For one thing, it relatively occupies small space and is very dynamic. Besides, broilers can be raised in short periods of time; hence, return on investment will follow rapidly. In the world of poultry production, fast growth rate and efficient feed conversion are the two factors for a successful and economic broiler production. These can be achieved through efficient management practices like lighting program utilized, etc. that ensure effective disease prevention and control coupled with the availability of low cost but high quality feed and fed ad libitum.

However, problems in this industry are inevitable. For instance, the high percentage morbidity, high feed cost, etc. But above all, early mortality is one of the major problems connected with growing chicks either a result from poor management or diseases and other causes associated to poultry production. So, one feasible practice to implement and alleviate losses is to expose the chicks in both darkness and light within the day to be able to get their benefits and importance.

Lighting is one of the important management techniques in broiler production for it gives illumination to the chicks for them to eat. On the other hand, darkness plays significant role in poultry, too.

Numerous studies conducted in various countries have shown that among the other management practices, giving chicks an hour of darkness and light have a high significant effect on the weight gain and disease control. Furthermore, it can accelerate the growth performance of chicks.

This study would serve as a guide especially for animal science major students to assess the feasibility of manipulating the light and in determining which lighting schemes to utilize to fasten the growth of chicks, decrease mortality, and lower the cost of production cost.

This study aimed to verify the significance of exposing light and dark period of broiler chicks under La Trinidad, Benguet condition.

Specifically it aimed to:

1. to evaluate the effect of light and dark on the feed conversion ratio, body weight and mortality of broilers;

2. to describe the impact of 12hr-light: 12hr-darkness, 16hr-light: 8hr-darkness and 24 hr lighting per day; and

3. to determine the effect on the specific body structure measurement of broilers, peculiarly to the shank measurement.

This study was conducted at Central Tawang, La Trinidad, Benguet from November 25 to December 30, 2011.

REVIEW OF LITERATURE

Lighting programs for broilers have been examined many times over the last 30 years, with many different program types using variable lengths of dark periods and a wide range of patterns (Classen, 2007). Previous works done on the effect of different durations of photoperiods on the growth rate and feed conversion efficiency have shown contrasting results, that birds grown under continuous lighting consistently exhibited depressed body weight; while those on restricted light of 6 hours per day treatment had increased body weight and feed conversion compared to 14 hours of light per day (Classen, 2004).

In contrast, numerous investigations have demonstrated that meat-type chickens exposed to continuous light are heavier at broiler age than those meat-type chickens given periods of light and darkness. Some lighting programs have a central purpose of slowing the early growth rate of broilers, thus allowing birds to achieve physiological maturity before maximal rates of muscle mass accretion.

Light hours/ Continuous Lighting

For many years, light is an important parameter of poultry production, it has been assumed that rearing broilers chicks under nearly continuous lighting conditions would give a maximal growth rate due to higher feed consumption (Apeldorn *et al.*, 1999). Additionally, light enable chicks to eat continuously, thus they grew at a faster rate, maximize feed intake and had improved livability of chicks (Donald, 2000) as cited by Basalong (2006).

According to Mahmud (2009), broilers are generally reared under continuous illumination with the assumption to ensure maximum feed consumption and accelerated growth. However, it may not lead to better feed consumption and economic returns.

Nonetheless, over decades, extensive research has been conducted dealing with the effects of these lighting schemes on broiler performance and body structure (Ingram and Hatten, 2010). Consequently, scientists found out that there are several negative effects on the growth rate, feed intake, mortality; processing performance and broiler welfare (Mahmud *et al*., 2010).In addition, there were higher incidence of metabolic diseases, increased fat deposition, higher incidence of metabolic diseases, skeletal deformities, and circulatory problems under continuous lighting. Besides, according to Buckland (1975) cited by Mahmud *et al*., (2010) that more leg abnormalities had arose because the large breast muscles causing distortions on the developing legs and pelvis and that the birds cannot support their increased body weight. Additionally, ascite is one disease associated to continuous lighting due to the added weight on the bird's lungs and heart. Furthermore, the incidence of cannibalism is another formidable problem when light is given on continuous basis (Buyse et *al*., 1996). Nevertheless, it has been discovered that more than 20% of broilers were condemned or downgraded during processing as a result of leg abnormalities (Morris, 1993).

According also to the result of Patulot (1984), lighting tends to increase feed intake of birds, but increased feed consumption does not necessarily lead to faster growth.

Darkness/Incorporation of Dark Period

Research has shown that darkness is as important to growth and health of broilers as light (Classen *et al*., 1991) cited by Classen (2004). It is hypothesized that short photo periods early in life will reduce feed intake and however limit growth (Classen, 2004).

A research has demonstrated that dark exposure improves immune function of chicks (Classen, 2007) likely through the hormone melatonin. This suggests that it may benefit the birds' ability to combat infectious diseases. Thus, it improves bird's health with emphasis on metabolic such as sudden death syndrome and leg disorders. Therefore, decreased leg abnormalities and total mortality was also significantly reduced less respiratory lesion and better immunity to respiratory disease than poultry that are exposed to constant light (Dozier, 2002).

According to Apeldorn *et al*. (1999) also reported that birds provided with sufficient dark periods have fewer health related problems, including sudden death syndromes, spiking mortality and leg problems than those maintained in near continuous light. Livability, average body weight, feed conversion rate and percentage condemnations were improved in broilers exposed to longer dark periods as compared to those subjected to continuous light (Davis and Stopes, 1996).

As birds under dark periods will be quiet, it is assumed that the reduction of activity during darkness may result in lower heat production, higher feed efficiency or both (Moore and Siopes, 2000).

In addition, according to research that dark exposure improves immune function of chicks' through the hormone melatonin, thus it may benefit the birds' health with emphasis on metabolic problems. Nevertheless, to avoid cannibalism in birds, dark

exposure will help abate the problem as birds will remain quiet and calm during the dark hours. However, darkness stimulates sleepiness of the birds that causes no severe physiological stresses (Campo and Davilla, 2002).

Moreover, Donald *et al* (2000) as cited by Basalong(2006) observed that dark periods improves feed conversion and livability, while there were decreased in leg problem. Thus, study of Macli-ing (2001) recommends the use of 2-4 hours dark periods.

Never the less, according to Mahmud *et. al*. (2010), to avoid cannibalism in bir dark exposure will help to abate the problem as birds will remain quiet and calm during dark hours. Besides, it did appear that it reduce lameness (Julian, 1987) as cited by Mahmud (2010).

In summary, broilers' and chicks' lighting schedules can be characterized in number of ways including the number of hour of darkness and how many period of darkness are included in each 24 hour cycle (Scanes,1992). Lighting system and program that is best for a particular company or producer depends on the type of housing, type of birds grown, climate and electricity (Dozier, 2002).

MATERIALS AND METHODS

Materials

The materials and equipment used in this study are the following; 90day-old broiler chicks, feeds, antibiotics, vitamins, minerals, brooding rearing cages, feeders, drinkers, electric wiring and sockets, 100-watt incandescent light bulbs, switches, weighing scale, cleaning materials, disinfectants, black polyethylene sheets, flour sacks, newspapers, marking pen and notebook.

Methodology

Pre-experimental phase. Before the chicks arrived, all equipment and materials were prepared and cleaned. Brooding cages were constructed with the appropriate floor spacing. The experimental room was divided into three independent parts with black polyethylene sheets to ensure that the light treatments could not influence each other by not allowing light to pass. White cloth was placed on the walls and ceilings of each cage to ensure light intensity. Brooding pens were covered with black polyethylene sheets to conserve heat and maintain a uniform temperature. Four 100-watt incandescent bulbs were used to provide brooding temperature of the brooding pen.

The birds were reared in three compartments of the same room. Light was provided by a row of 100-watt incandescent light bulbs. This row of lights is one meter above the litter and near the center of the pens. Each compartment was installed with individual switches.

Experimental phase. Few hours before the arrival of the chicks, the light in the brooding cages were switched on to attain warmth inside. During the arrival of the

chicks, they were all placed in the brooding cages. The cages and the surrounding were cleaned regularly to ensure cleanliness and sanitation of the experimental area.

All of the chicks were brooded under 24hr-lighting up to two weeks of age. There was no light restriction during the brooding period. At the start of the third week, 90 healthy chicks were randomly divided into three groups with thirty chicks in each. Each group was further sub-divided into three replicates of ten chicks each. These three groups were maintained in three separate houses of the same room and different lighting treatments were initiated.

After two weeks of brooding, the chicks were initially weighed after they were randomly distributed. Experimental chicks were maintained from day-old up to six weeks of brooding. The birds were fed with chick booster, starter mash, grower and finisher diet. Ad libitum feeding was employed with the same brand of commercial feeds throughout the experiment. Water was also given frequently.

All of the experimental birds were subjected to the same care and management except on the lighting program followed which makes up the treatments. The different treatments are as follows:

T_0 24-hour lighting

T_1 12hr- light: 12hr- darkness

T_2 16hr-light: 8hr- darkness

Light was put off daily from 10 p.m to 10 a.m for the second treatment and from 10 p.m to 6 a.m for the third treatment. Lights for the control were put on for 24-hour lighting until the end of the experiment. Switching of light was done manually.

Feed consumption was taken per cage basis. The residual feed was collected once daily before the morning feeding. Any left-over was sundried before weighing. Feed consumption was recorded during feeding.

Shank length, body weight was taken after brooding and at the end of the study. Shank length was measured on the back of the left shank from top of the back toe to the top of the shank.

Any mortality was recorded to calculate percentage mortality.

The following data were gathered:

1. Initial weight (kg). This was taken on the 15th day of the chicks by weighing them individually using a livestock weighing scale.

2. Final weight (kg). This was obtained by weighing the animals individually in each treatment at the end of the study at 36 days of age.

3. Feed offered (kg). This is the weight of feed offered.

4. Feed left-over (g). This is the weight of the left-over feeds after a day of feeding.

5. Initial shank measurement (mm). This is the length of shank on the 15th day of age.

6. Final shank length (mm). This is the shank length at the end of the study at 36 days of age.

7. Number of dead birds. This is the number of dead birds per day.

The data computed are as follows:

1. Total gain in weight (kg). This was obtained by taking the difference of the initial weight and the final weight of the chicks.

2. Average daily gain (g). This was obtained by dividing the total gain in weight by the duration of the experiment.

3. Total feed intake of broilers (kg). This was computed by subtracting the left-over feed from the feeds offered.

4. Average daily feed intake. This was computed by dividing the total feed intake by the total number of days of raising the broiler.

5. Total increase in shank measurement (mm). This was obtained by taking the differences of the initial shank length and the final shank length.

6. Feed conversion ratio. This was obtained by dividing the total feed consumed by the total gain in weight.

7. Morbidity. This is the number of birds that may get sick during the duration of the study.

8. Percent mortality. This was obtained by dividing the total number of dead birds by the initial number of used in each treatment.

9. Net return on investment. This was obtained by subtracting the total cost of production from the total sales of the broilers.

The performance data were analyzed using the analysis of variance. Means were compared using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Growth Performance

Body weight, feed intake, feed conversion ratio, average daily gain, average daily feed intake for the different treatments are summarized in Table 1, 2, 3 and 4, respectively.

Body weight. Body weights are summarized in Table 1. Statistical analysis revealed that the mean initial weights of the broilers are not significantly different from each other. Their initial weight ranges from 250g to 252g. This implies that the birds were more or less uniform in weight at the start of the study.

Similarly, the final weight revealed no significant differences among the treatment means. The final body weight of broilers reared under 16hr- light: 8hr- darkness was 1.41kg, those birds reared under 24hr-lighting was 1.45 kg and those broilers reared under 12hr- light: 12hr- darkness was 1.34 kg after three weeks of study.

The non-significant differences in the final weights of the broilers indicate that they were almost equal to each other and that their final weights of the broilers were not affected by the three lighting programs used.

Table 1. Body weights of the broilers at 15th day and 36th day of age

TREATMENT	INITIAL WEIGHT (kg)	FINAL WEIGHT (kg)
24- hour lighting	0.251^{a}	1.448^{a}
12hr-light: 12hr-darkness	0.252^{a}	1.345^{a}
16hr-light: 8hr-darkness	0.250^{a}	1.412^{a}

Means with the same letter are not significantly different at 5% level DMRT.

The results conforms to the study of Patulot (1984), Macli-ing (2001) and Basalong (2006) who found no differences in weights between the birds under 24hrs lighting and birds exposed to dark periods in a day.

Total and average daily gain in weight. Results of the study revealed that the total gain in weight of broilers reared under continuous lighting program as well as those under light restrictions such as 12hr-light: 12hr-darkness and 16hr-light:8hr-darkness were comparable.

This finding was different from that of Classen (2004) that short photoperiods will reduce feed intake, thus limit growth. It also differs from the finding of Apeldorn *et al*. (1999) that there was a maximal growth rate/gain in weight of broilers reared under 24hr-lighting condition due to higher feed consumption.

On the other hand, other authors as cited by Mahmud (2009) had reported no significant effect when reduced lengths of light period on the weight gain of broilers.

Table 2 also presents the average daily gain in weight of the broilers which were not significantly different among treatments.

Total feed consumption and average daily feed consumption. Total and average daily feed consumption of the broilers under the different treatments are shown in Table 3. The results showed that the total feed intake were almost the same regardless of the birds, exposed to light and dark periods.

This observation differs with the findings of Classen (2004) that longer periods of darkness prevent regular access to feed and consequently reduce feed intake and thus, it limit growth

This was also different from the findings of Mahmud *et al*., (2009) where broilers reared under continuous illumination had maximized feed consumption and thus, accelerated the growth of the broilers.

Statistical analysis on average feed consumption similarly revealed no significant difference among treatment means (Table3).

Feed conservion ratio. In terms of feed conversion ratio (Table 4), broilers reared under 12hr-light: 12hr- darkness (2.029) was comparable to those under other lighting treatments. Statistical analysis revealed no significant differences among the treatments.

Table 2. Gain in weight from 15th to 36th days of age

TREATMENT	TOTAL GAIN (kg)	ADG (g)
24- hour lighting	1.188[a]	51[a]
12hr- lighting: 12hr- darkness	1.084[a]	51[a]
16hr- lighting: 8hr- darkness	1.147[a]	51[a]

Means with the same letter are not significantly different at 5% level DMRT.

Table 3. Average daily feed and total feed intake of the birds

	FEED CONSUMPTION	
TREATMENT	TOTAL(kg)	DAILY(g)
24- hour lighting	2.228[a]	106.10[a]
12hr- lighting: 12hr- darkness	2.192[a]	104.62[a]
16hr-lighting: 8hr-darkness	2.223[a]	105.857[a]

Means with the same letter are not significantly different at 5% level DMRT.

Thus, this result differs from the findings of Mahmud (2009), Classen (2004), Ingram (2000) who observed that the FCR of the chicks grown under more dark hours was better than those grown under continuous light.

The result of the study showed that although numerically, the mean feed consumption of the birds reared under dark periods consumed fewer feeds and gained weight efficiently, this was not reflected in their FCR.

Shank Measurement

The shank lengths are generally regarded as a good indicator of skeletal development which is regarded to the amount of meat a broiler can carry (Scanes, 1992).

Initial and final shank measurement. There was no significant difference on the initial shank measurement of the broilers. It was more or less the same. Further, 12hr-light:12hr-darkness has the highest numerical initial shank measurement (28.333 mm) followed by 16hr-light:8hr-darkness with a mean initial measurement of 28.00 mm and the 24hr-lighting with a mean of 27.167 mm.

Table 4. Feed conversion ratio of the broilers after 21 days

TREATMENT	FCR
24-hour lighting	1.879[a]
12hr- lighting: 12hr- darkness	2.029[a]
16hr- lighting: 8hr- darkness	1.937[a]

Means with the same letter are not significantly different at 5% level DMRT.

Table 5. Shank measurement of the broilers

TREATMENT	SHANK MEASUREMENT (mm) INITIAL	FINAL	INCREMENT
24-hour Lighting	27.167[a]	54.367[a]	27.200[a]
12hr-lighting: 12hr-darkness	28.333[a]	54.367[a]	26.033[a]
16hr-lighting: 8hr-darkness	28.000[a]	54.367[a]	27.367[a]

Means with the same letter are not significantly different at 5% level DMRT.

In terms of final shank measurement, birds reared under 24hr-lighting and 16hr-light: 8hr- darkness both had a mean of 54.367 mm. The birds exposed to 12hr-light: 12hr-dark had a mean shank measurement of 55.367 had a mean of 54.37mm as shown in Table 5.

Statistically, there was no significant difference on the initial shank measurement of the broilers. It was more or less the same. Further, 12hr-D: 12hr-L has the highest initial shank measurement (28.33mm).Treatment 1 has a mean of initial of 27.67mm which almost close to treatment 3 that is 28mm.

Likewise, there were no significant differences on the final shank measurement. The non-significant differences in the final shank measurement of the broilers among the treatments indicate that they were almost equal to each other and that shank growth was not affected by either continuous or restricted lighting. The results conform to the study of Ingram (2010) who found no adverse effect of longer dark or continuous lighting on the shanks of the broilers.

Shank increment. Total shank increase in the different treatments is shown in Table 5 above. Consequently, it showed that there were no significant differences among

treatment which implies that shank increase was not affected by three lighting programs used. The result did agree to the finding of Ingram (2010) that shank length was not significantly affected by light restrictions such as 12hr- light:12hr-darkness and 16hr-light:8hr-darkness.

Net Return on Investment.

The net return on investment per treatment is shown in Table 7. The highest net return of Php830.48 was obtained in continuous lighting followed by birds in 16hr-light: 8hr-darkness which has Php829.13 net return. Net return on investment was obtained in 12hr-light: 12hr-darkness has the lowest which is Php662.73 only.

Due to the additional expenses incurred for the payment of electricity under the control, it has the highest total cost among the other treatment. Nevertheless, it gave the highest net income.

Mortality and Morbidity

Morbidity and mortality were not observed within the duration of the study which is 21 days. In spite of zero mortality, the experimental animals were however, smaller compared to industry standard after three weeks of study. This may be due to the cold temperature of the experimental house.

Table 6. Net return on investment

TREATMENT	EXPENSES (Php)	TOTAL SALES (Php)	NET INCOME (Php)
24-hour lighting	6,086.27	6,916.75	830.48
12hr-light:12hr-darkness	5,732.27	6,395.00	662.73
16hr-light:8hr-darkness	5,976.37	6,805.50	829.13

SUMMARY, CONCLUSION, RECOMMENDATION

Summary

The study was conducted to evaluate the effect of restricting the light on the performance of broilers and to determine the effect on the specific body structure particularly the shank measurement. The birds were randomly distributed into three treatments following the completely randomized design (CRD). The different treatments used are as follows: 24-hour lighting, 12hr- light: 12hr- darkness and 16hr-light: 8hr-darkness lighting. The study was conducted at Central Tawang, La Trinidad, Benguet from November to January 2012.

The result of the study consequently showed no statistical difference among the three treatments in the body weights, feed intake and the shank measurement which means that the growth performance and shank of broilers are not affected whether the birds were exposed to longer dark or lighting periods within the day.

Conclusion

Based from the results, it is therefore concluded that the different lighting restrictions used has no detrimental effect on the performance of broiler. Continuous lighting also has no significant effect on growth or economic benefit. In fact, it adds to the expenditures on electricity.

On the other hand, economic gain in terms of electricity consumption can be achieved during light-offs of the two lighting restrictions because of the reduced cost of production.

Recommendation

Since 24hr- lighting, 12hr-light:12hr-darkness, 16hr-light:8hr-darkness has no significant effect on the broiler's performance, producers may follow any of these lighting treatments under similar location/site of the experimental area. However, it is recommended that lights-on should be done during the night time to reduce extreme cold temperature of the night. Otherwise, a separate source of heat must be provided.

Nonetheless, broiler lighting programs should be planned together with the environment, nutrition, management and the birds for the best well-being of the animal and their performance. Besides, lighting programs employed around the world are not standardized.

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