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Effect of fluctuate lighting on performance of laying hens (Short Communication)

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Abstract

This study was carried out to investigate the effects of fluctuate lighting on performance of laying hens. Two programs were applied with 16 hours daily lighting: step-up (normal) lighting program as the control treatment and a fluctuate lighting program of 2 W/m^2 for 45 min and 6 W/m^2 for 15 min. Egg weight, feed consumption, feed conversion ratio, hen-day egg production and hen-housed egg production of the laying hens were recorded for 46 weeks. No significant difference for hen-day and hen-housed egg production between the step up and fluctuate lighting programs ($P>0.05$) were found. However, fluctuate lighting program resulted in a significant increase in egg weight ($P<0.05$). Moreover, hens in the fluctuate lighting program consumed significantly less amount of feed and had a better feed conversion ratio than hens in the step-up lighting program ($P<0.01$). The results of the present study indicate that fluctuate lighting can be used for a profitable egg production.

Keywords: laying hen, step up lighting, fluctuate lighting, feed consumption, egg production

Zusammenfassung

Einfluss intermittierender Beleuchtung auf Leistung von Legehennen (Kurzmitteilung)

Diese Studie wurde durchgeführt, um den Einfluss der wechselnder Beleuchtung auf die Leistung von Legehennen zu untersuchen. Zwei Programme mit einer 16-stündigen Beleuchtung kamen zur Anwendung; als Kontrollprogramm das »step-up« Beleuchtungsprogramm und ein Beleuchtungsprogramm mit 2 W/m^2 für 45 min und 6 W/m^2 für 15 min. Die Merkmale Eigewicht, Futterverzehr, Futteraufwand, Eizahl je Durchschnittshenne und Eizahl je eingestallter Henne wurden für 46 Wochen registriert. Für die Eizahl je Durchschnittshenne und die Eizahl je eingestallter Henne wurden zwischen den Beleuchtungsprogrammen keine signifikanten Unterschiede beobachtet ($P>0.05$). Jedoch das durchschnittliche Eigewicht war beim wechselnden Beleuchtungsprogramm signifikant höher als beim Kontrollprogramm ($P<0.05$). Ferner wurden für die Hennen des wechselnden Beleuchtungsprogramms ein niedrigerer durchschnittlicher Futterverzehr und ein besserer durchschnittlicher Futteraufwand als bei Hennen des Kontrollprogramms beobachtet ($P<0.01$). Die Schlussfolgerung der vorliegenden Untersuchung deutet auf eine rentablere Eierproduktion mit einem wechselnden Beleuchtungsprogramm hin.

Schlüsselwörter: Legehenne, »step-up« Beleuchtung, intermittierende Beleuchtung, Futterverzehr, Eierleistung

Introduction

Lighting is one of the important factors, which affects production efficiency in poultry production. Studies have been conducted to find suitable environmental conditions that enable hens to reach their genetic capacity (AL-MAHROUS 1997, MENDES *et al.* 2005a, MENDES *et al.* 2005b). The effects of hemeral (length of photoperiod=24 h) and ahemeral (length of photoperiod <24 h or >24 h) lighting programmes on performances of hens have been determined. Biomittent, French, Cornell and Reading intermittent lighting programs along with step up lighting program are used in hen husbandry today (MORRIS and BUTLER 1995).

The results of the studies investigating the effects of hemeral and ahemeral lighting programs on fertility, hatchability and chick weight of parent flocks demonstrated that lighting programs involving the use of a photoperiod for 26, 27 and 28 h provided better results than lighting programs with a photoperiod of 24 h (SHANAWANY 1993). In addition, ahemeral lighting program was found to result in an increase in egg weight and egg shell thickness (SAUVER 1996). Hens perceive light with a wavelength of 400-700 nm but the wavelength of light was reported to have a minor effect on production (LEWIS and MORRIS 2000).

The aim of this study was to investigate the effect of fluctuate lighting program on performance of laying hens.

Material and methods

Three hundred Barred 1 pure line hens were used as the animal material. The chemical compositions of feed materials used in the present study are presented in Table 1. Hens were housed in a mechanically ventilated, floor-based system pen with 6 hens per m^2. Incandescent light bulbs were used to light the pens.

Chicks were kept in colony type cages until the age of 16 weeks. Hens were housed in 2.5×3.5 m floor-based system including 2 simple poultry feeder and 2 simple birds' water bowl, 50 hens for each pen and were fed *ad libitum*. Lighting was provided naturally until the age of 16 weeks and was fixed to 16 h. Two lighting programs; (1) step-up program as control group and (2) fluctuate program were applied. In step-up lighting program; 3.2 W/m^2 (12.3 lx/m^2) direct light from 2.1 m from the ground was provided for 16 h daily. In fluctuate lighting program; lighting was also applied for 16 h. In every hour of the lighting period of fluctuate program, lighting with a light intensity of 2 W/m^2 (7.7 lx/m^2) for 45 min and 6 W/m^2 (2 W/m^2 + 4 W/m^2, 23 lx/m^2) for 15 min was applied as fluctuate program. The study was carried out according to completely randomized design with three replicates. Difference between the means of the treatment groups was determined by variance analysis. The traits of hens were recorded as soon as hens entered production period.

The Sexual Maturity was determined as the time point when the birds reached 5% of their hen-day egg production, which was worked out on the basis of eggs produced per day divided by the number of birds on the same day. Feed consumption was determined weekly by weighing the amount of feed offered and of the remaining by a balance (±5 g) after the hens reached 50% egg production. Feed conversion ratio was described as the amount of feed (kg/week) consumed for one kg of eggs (kg/week) produced by the same

animals. Hen-day egg production was determined daily throughout the study and hen-housed egg production was determined by dividing total number of laid eggs by the number of hens in the barn. Egg weigh was found by simply dividing daily total egg weight by daily laid egg number.

The difference between the groups was determined by the variance analysis method. The data were analyzed by Minitab 14 Packet Programme.

Table 1
Chemical compositions of feed materials fed to hens in the study
Zusammensetzung der Futterrationen

Nutrients	0-3 weeks	4-10 weeks	11-16 weeks	17-40 weeks	41-46 weeks
Dry matter, min (%)	88	88	88	88	88
Crude ash, max (%)	8	8	8	8	8
Crude protein, min (%)	19	18	16	18	17
Metabolic energy, min (kcal/kg)	2 900	2 800	2 700	2 800	2 700
Calcium, min-max (%)	1-1.2	1-1.1	0.9-1	3.5-4	3.8-4.2
Available phosphorus min (%)	0.45	0.42	0.40	0.40	0.37
Lysine, min (%)	1.15	0.98	0.72	0.75	0.75
Methionin, min (%)	0.55	0.47	0.35	0.47	0.42
Methonin+cystein min (%)	0.85	0.76	0.58	0.78	0.72
Triptophan, min (%)	0.20	0.19	0.17	0.20	0.19
NaCl, min-max (%)	0.35-0.50	0.35-0.50	0.35-0.50	0.35-0.50	0.35-0.50
Crude cellulose, max (%)	4.5	5	6	6	6
Linoleic acid, min (%)	1.5	1.25	1.0	1.7	1.5
A vitamin (IU/kg)	13 000	13 000	10 000	12 000	12 000
D_3 vitamin (IU/kg)	3 000	3 000	2 000	2 500	2 500
E vitamin (mg/kg)	20	20	20	20	20
K_3 vitamin (mg/kg)	2	2	2	2	2
B_2 vitamin (mg/kg)	5	5	5	5	5
B_{12} vitamin (mg/kg)	0.02	0.02	0.01	0.01	0.01
Niacin (mg/kg)	60	60	30	25	25
Mangan (mg/kg)	100	100	100	60	60
Zinc (mg/kg)	70	70	70	40	40
Iron (mg/kg)	40	40	40	40	40
Cupper (mg/kg)	7	7	7	7	7
Selenium (mg/kg)	0.2	0.2	0.2	0.2	0.2
Cobalt (mg/kg)	0.5	0.5	0.5	0.5	0.5

Results and discussion

The performance traits of step-up and fluctuate lighting programmers are presented in Table 2. No significant difference between the two treatment groups was found for hen-day and hen-housed egg production ($P>0.05$). However, significant differences between the two groups were determined for feed consumption, feed conversion ratio ($P<0.01$) and egg weight ($P<0.05$).

Hen-day production and hen-housed egg production were not affected by the lighting programmes. This can be attributed to the fact that lighting intensity (fluctuate or constant) might have had similar effect on Follicular Stimulating Hormone release. Contrary to the expectation, fluctuate lighting programme had no extra effect on the stimulation of pituitary gland.

Table 2
Various performance traits of hens of step up and fluctuate lighting programs
Ergebnisse beider Versuchsgruppen

Traits	Lighting Program		
	Step up	Fluctuate	*P*
5% egg production age	143.33±1.20	141.00±1.15	ns
50% egg production age	154.33±0.33	156.33±0.38	ns
Hen-day egg production (%)	74.7±2.1	73.8±2.0	ns
Hen-Housed egg production (%)	74.1±2.0	72.7±2.0	ns
Average egg weight (g)	57.61±0.30	58.56±0.29	*
Daily feed consumption (g)	166.00±1.62	146.34±1.38	**
Feed conversion ratio (FCR)	3.58±0.05	3.13±0.04	**

ns not significant, $*P<0.05$, $**P<0.01$

Average egg weight was found significantly higher for fluctuate lighting programme ($P<0.05$). Egg weight is influenced by genetic and environmental factors. Lighting has a substantial effect on egg weight. Lighting programmes exert their effects on egg weight by affecting age at sexual maturity of hens. However, this study showed that hens (reached sexual maturity at the same time) which were exposed to fluctuating lighting intensity produced larger eggs. As the natural light was used during the growing period of chickens, the influence of fluctuate lighting on age at sexual maturity could not be determined exactly.

Fluctuate lighting programme gave better results in terms of feed consumption and feed conversion ratio. The reasonable explanation is that hens consumed less feed during the period of light intensity. As the hens were not weighed at the end of the study, the effects of this case on live weight could not be determined.

Fluctuate lighting programme can be used to attain a similar egg production level in place of step-up lighting programme due to less feed consumption, better FCR and egg weight.

Hens that were exposed to the fluctuate lighting programme during egg production phase attained an egg production level similar to the egg production level of hens that were exposed to the step-up lighting programme by saving substantial amount of feed. This indicates that fluctuate lighting can be used for a profitable egg production.

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