



TECHNICAL focus

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Impact Of Lighting Programs On Broiler Performance

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Surveys of broiler lighting programs around the world reveal a wide array of lighting regimes. To decide which broiler lighting program should be implemented, there are several critical factors a producer should consider. This paper attempts to answer the following questions: What are the specific benefits of such programs? Do breeds respond differently to broiler lighting programs? Should a lighting program be adjusted based on average daily gains? What are the animal welfare benefits of broiler lighting programs?

Europe and Canada have led much of the research effort in developing specific lighting programs for closed environment houses. This work has generally been applied to poultry operations in more northern latitudes. Meanwhile, integrators in the USA, due to remodeling and expansion efforts, have converted to dark curtain or solid sidewall housing. Open sided housing still remains prevalent throughout much of the world. Broiler producers with clear curtain or conventional housing are restricted in their lighting alternatives and are forced to design programs around the limitations of natural daylight.

Lighting programs improve livability by decreasing mortality as spelled out in the following partial list of causes:

a) Reduction in mortality due to ascites (water-belly) and sudden death (flip overs)

Ascites is affected by many contributing factors such as genetics, temperature, altitude and ventilation. Any condition that increases the oxygen demand at tissue level or decreases the oxygen carrying capacity of the circulatory system can result in pulmonary hypertension and right heart failure with the clinical signs of ascites (Julian, R.J.; 1993). As a countermeasure, primary broiler breeders have aggressively selected against ascites for

nearly two decades. Selection for ascites resistance has been successful without impacting the gains in Average Daily Gain (ADG) and Feed Conversion Ratio (FCR). Tools used at Cobb-Vantress in the selection process against ascites include a program of full broilerization and use of "pulse oximeters" to measure blood oxygen saturation. While genetic selection has been successful in the reduction of ascites, broiler management still plays a role. *Light restriction programs for broilers have a profound effect in improving late mortality due to ascites and sudden death.*

b) Reduction in mortality due to leg disorders such as valgus/varus, spondylolisthesis (kinky back) and rotated tibia

Leg disorders continue to be an important focus of the selection process. Literature is well documented with evidence that lighting programs can reduce the incidence of leg disorders in broilers: (Buckland et al., 1973, 1974; Buckland, 1975; Classen and Riddell, 1989; Simons, 1982, 1986; Wilson et al 1984; Simons and Haye, 1985; Ketelaars et al., 1986, and Renden et al., 1991, 1996.)

Broiler companies and other researchers such as Classon & Riddell (1992) support the benefits of lighting programs in their prevention of leg disorders such as valgus/varus deformities (VVD).

The Danish researchers, Sanotra et al. (2002), demonstrated a significant reduction in the prevalence of impaired walking ability (corresponding to a Bristol gait score >2). In this study, broilers reared with a lighting program were compared to broilers under constant light. These researchers concluded that the lighting program in this study not only reduced leg problems but also reduced chronic fear in the birds.



IMPACT OF LIGHTING PROGRAMS ON BROILER PERFORMANCE

c) Reduction in spiking mortality

Lighting programs have been shown to minimize the effects of spiking mortality syndrome. Davis et al., (1996) found that controlled amounts of light/darkness can reduce much of the hypoglycemia, mortality and runting-stunting associated with spiking mortality syndrome of chickens.

d) Improved immunocompetence

The light/dark period or daily rhythm of the typical broiler lighting program increases melatonin production. Melatonin influences development of the immune system and improves immune system performance. Immunocompetency is a recognized benefit in broiler production (Moore and Siopes, 2000). In addition to immuno-genetic factors, the added benefit of a light/dark period on development of the immune system should not be underestimated. The practice of offering additional light stimulation in an effort to make up for a lack of genetic potential in ADG may actually impair immunocompetence and negatively impact calorie conversion or FCR. A decision must be made as to the appropriate lighting program considering all objectives.

Performance Benefits of Lighting Programs

Improvements in ADG and FCR with broiler lighting programs are well documented by research institutions and the poultry industry. Increasing livability accounts for a portion of improved FCR. Likewise, FCR and ADG can be improved by repartitioning those calories normally expended for bird activity to calories available for gain. The “caloric sparing effect” of the resting response as influenced by a lighting program is evident from research with the Cobb broiler at Oklahoma State University (Beker, A; Vanhooser, S L; & Teeter, RG; 2003).

Moderate bird movement or exercise is desirable for the benefit of leg strength. However, too much activity wastes calories and may result in injury or downgrades at processing. This excess of activity can be controlled through lighting. The table on this page illustrates the Kcal/kg/hr produced during light and dark periods at various ages. A six hour darkness period was used.

A Word of Caution

ADG may be impaired by poorly managed lighting programs. Growers experiencing difficulty with achieving their target daily gains may not benefit from extended dark periods. Careful performance analysis such as weekly body weights are crucial in selecting the best lighting programs.

In addition to genetics, variables such as nutrient density and management have a significant impact on the results of any lighting regime. For any given nutrient density, feed intake is a critical factor influencing ADG and FCR. While lighting programs influence feed intake, it must be noted that as lighting adjustments are made, feed availability, feed form, feeder height adjustments and feeder run times, etc. become more critical.

In some parts of the world, growers practice feed restriction to improve FCR and livability with good effect. However, accidental feed restriction is more common than many growers would admit and may result in frustrating reductions in performance and skin quality upon flock settlement.

Meal feeding caused by long dark periods can increase scratching due to competition for feeder space if not managed properly. Scratches are a significant contributor to downgrading and may increase the incidence of cellulitis in the flock (Macklin et al., 2000).

A reduction in light intensity will help to reduce the incidence of competition at the feeding system at “light-on” time. However the most common cause of scratching is aggressive feeding behavior due to extended feed outages. For this reason we recommend that feeding programs and lighting programs should never be implemented together.

Lighting effect on bird heat production Kcal/kg/hr (6 hour darkness program)

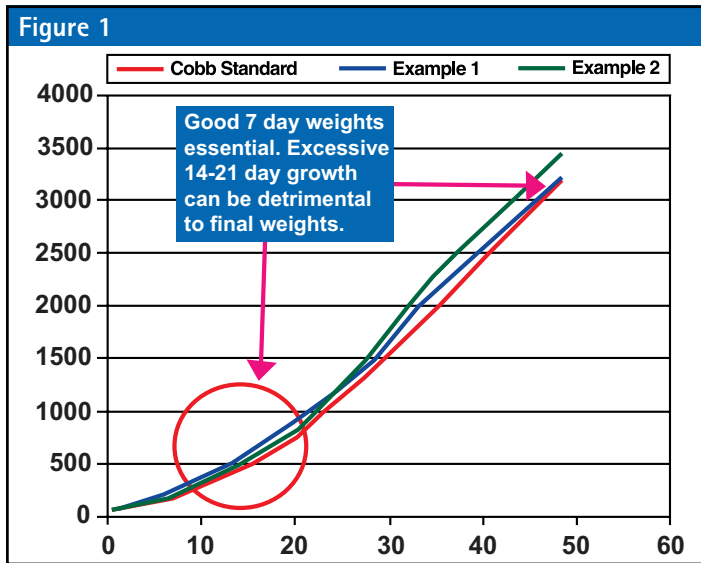
Age (days)	18	28	35	45
Body Weight (g)	655	1505	2203	3112
Heat production during light hours (Kcal/kg/hr)	10.6	5.7	4.6	4.3
Heat production during dark hours (Kcal/kg/hr)	7.4	3.9	3.3	3.0
% Change	-30.2	-31.6	-28.3	-30.2

Oklahoma State University (Beker, A; Vanhooser, S L; & Teeter, RG; 2003).

IMPACT OF LIGHTING PROGRAMS ON BROILER PERFORMANCE

Lighting Program Basics

Lighting programs have typically been designed with changes occurring at predetermined ages and tend to vary according to final market weight of the broilers. The Cobb lighting programs utilize weekly average weight gains. It is recommended that growers have scales in place and consistently record weight data or average daily gain (ADG) information. However, most growers do not have accurate ADG information. The benefit of gathering broiler weight data at least weekly is to ensure educated adjustments of lighting programs and to determine the factors that compromise ADG. At first this seems a daunting task but there are efficient and practical means of weight data collection. At young ages, weighing several birds in a container at the same time is a quick and effective tool to make decisions on initial light restriction.



Selection for ADG combined with selection for musculoskeletal integrity has been the practice of Cobb geneticists for many years. Genetic selection against musculoskeletal problems coupled with management interventions such as broiler lighting programs and/or feed restriction programs offer a manageable solution to welfare concerns.

Figure 1 accentuates the need to manage performance according to the Cobb least cost performance standards during the first 21 days. Lighting programs are a tool to control growth and ensure adequate skeletal and cardiovascular development during this period.

When considering lighting programs as a management tool, both the duration and intensity of the light period are factors that need to be considered. Field research indicates that a minimum light intensity of 25 lux (2.3 foot-candles [FC]) helps to stimulate bird activity during the first 5 to 7 days. Effective stimulation of activity

during these first few days of life is needed to ensure that the chicks become properly acclimated to their environment and have optimal feed consumption.

At the onset of light restriction, light intensity can be decreased to between 5 and 10 lux (0.46-0.93 FC) for the balance of the grow-out period until incorporating a light intensity increase of 10 to 20 lux (0.9 to 1.9 FC) just prior to processing. However, any local regulations pertaining to both light intensity and dark hours duration must be adhered to.

1. STANDARD LIGHTING PROGRAM - OPTION 1

- Stocking density: >18 birds/m²
- Average daily gain: < 50 g/day
- Slaughter weight: <2.0 kg

Age days	Hours dark	Hours change
0	0	0
1	1	1
100-160 grams	6	5
Five days before kill	5	1
Four days before kill	4	1
Three days before kill	3	1
Two days before kill	2	1
One day before kill	1	1

2. STANDARD LIGHTING PROGRAM - OPTION 2

- Stocking density: 14 - 18 birds/m²
- Average daily gain: 50 - 60 g/day
- Slaughter weight: 2.0 - 3.0 kg

Age days	Hours dark	Hours change
0	0	0
1	1	1
100-160 grams	9	8
22	8	1
23	7	1
24	6	1
Five days before kill	5	1
Four days before kill	4	1
Three days before kill	3	1
Two days before kill	2	1
One day before kill	1	1

3. STANDARD LIGHTING PROGRAM - OPTION 3

- Stocking density: <14 birds/m²
- Average daily gain: >60 g/day
- Slaughter weight: >3.0 kg

Age days	Hours dark	Hours change
0	0	0
1	1	1
100-160 grams	12	11
22	11	1
23	10	1
24	9	1
29	8	1
30	7	1
31	6	1
Five days before kill	5	1
Four days before kill	4	1
Three days before kill	3	1
Two days before kill	2	1
One day before kill	1	1

IMPACT OF LIGHTING PROGRAMS ON BROILER PERFORMANCE

Depending on historic ADG it is generally recommended to begin light restriction at between 100 to 160 grams. At Cobb we recommend a single block of darkness given at night, even in solid sidewall houses. The “off time” must remain constant for the duration of the grow-out period. Feeding and drinking behavior becomes established and moving the “off time” earlier will cause a significant decrease in feed and water consumption. It is only the “on time” that should change as the amount of light time is increased.

Conclusion

Genetics, nutrient density, feed intake and management programs significantly impact results and must be considered when customizing the lighting program. The challenge is to customize broiler lighting programs using strategic weekly broiler weights to refine adjustments.

Lighting programs employed around the world are not standardized and likely will never be. However, when one considers all of the variables involved in the rearing of broilers and the objectives of poultry companies, this is no surprise. Weight, feed intake and mortality data are needed to customize the lighting programs of the future.

Research and the popular use of broiler lighting programs provide data and an endorsement of the derived benefits. Broiler lighting programs in concert with the proper genetics, environment, nutrition and management create the best in welfare for the animal and performance for the integrator.

From Ireland, Matthew Wilson's professional foundation was built from a comprehensive background in poultry production. Originating from production management, Matthew has progressed from a technical advisory position into technical services. Currently Matthew holds the position of World Technical Support Broiler Specialist for Cobb Vantress, Inc. Matthew assists customers worldwide, helping producers to achieve the genetic potential of Cobb products.



Andrew Bourne has twelve years of poultry experience beginning in the chicken industry in South Africa. In 2005, Andrew joined the Cobb World Technical Support team in the United Kingdom. He recently moved to the US where he continues to provide broiler technical support to customers worldwide.

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