



■ Author(s)

Jacob FG¹  <https://orcid.org/0000-0001-9276-7724>
Salgado DA^{II}  <https://orcid.org/0000-0002-5595-4640>
Nää IA^I  <https://orcid.org/0000-0003-0663-9377>
Baracho MS^I  <https://orcid.org/0000-0003-0276-121X>

^I School of Agricultural Engineering, University of Campinas, 13083-875, Campinas, Brazil.

^{II} School of Sciences and Engineering, São Paulo State University, 17602-496, Tupã, Brazil.

■ Mail Address

Corresponding author e-mail address
Irenilza Alencar Nääs
Faculdade de Engenharia Agrícola – FEAGRI,
Av. Cândido Rondon, 501 - Campinas,
13083-875, Brazil.
Phone: +551932521176
Email: irenilza@gmail.com

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Effect of Environmental Enrichment on the Body Weight in Broiler Chickens

ABSTRACT

The present study had the objective of analysing the impact of the use of environmental enrichment (music and light stimuli), broiler sex, and age in broiler chickens' weight during growth. The observational study was carried out on a commercial farm. The environmental enrichment consisted of broilers' stimulation by sound and light, and a house was kept without stimulus (control). The music stimuli consisted of different music styles and was played during the experiment to promote motivation for the birds. The light stimuli came from a coloured (red and green) LED strobe projector. Both stimuli were applied once a day for about 6 minutes, for five weeks. The broilers were weighed at the end of each week of growth. Throughout the growth period, broiler behaviours were analysed weekly through videos, and the leg disorders of the birds were put into score evaluations. The effects of the environmental enrichment type, gender, and age, and the probable interactions of these variables, on the weight of the broiler chickens were analysed by the comparative analysis of means, analysis of variance (ANOVA), and Tukey test of multiple comparisons. 7, 14, and 21 day old broiler chickens did not differ on body weight when compared with age, gender, and environmental enrichment (broiler house) ($p>0.05$). Males from 21 days of age had an increase in body weight when compared with females. Light enrichment presented the lowest body weight when compared with all studied houses, while the absence of enrichment presented the highest broiler weight.

INTRODUCTION

In 2017, Brazil produced 13.056 million tons of broiler chicken meat and maintained the second position as the biggest meat producer and first position as worldwide exporter (ABPA, 2018). These achievements are the results of several factors as such a biosecurity control, climate, management, parents stock adaptation and own production of feeding sources, e.g., maize and soya although international trade could be affected by the increase in social responsibility and environmental consciousness (Mollo *et al.*, 2009). On the report of Meluzzi *et al.* (2008) for the consumer's concerns like food quality, animal welfare, safety, and protection of the ecosystem have a much higher value.

According to ABPA (2018), 33% of the Brazilian production goes to export, and nearly 300 million tons was used for trading to the EU in 2017. For Europe, animal welfare in poultry production is an essential topic (Robins & Phillips, 2011). Development requirements pose a likely threat to the market position of meat not produced in underdeveloped animal-welfare measures or without the guarantee that it was produced under such criteria (Kryeziu *et al.*, 2018; Molento, 2005; Van Horne & Achterbosch, 2008). On the report of the Brazilian Association of Alternative Poultry Production (AVAL), free-range broiler chicks represent only 0.5% of the production



equivalent to 6 million broiler chicks per month, a number that increased 15% in 2016 (Carreiro, 2017). Farmers are adjusting the broiler chickens barn from conventional to a dark environment (Dark House) due to achieve better performance. However, such a condition could affect meat exports because natural light can be a further welfare rule (Andreazzi *et al.*, 2018). Related to animal welfare, Brazil does not have any legislation in the welfare of broiler chickens, e.g., regulation on the density of broiler chickens (Van Horne & Achterbosch, 2008).

On the authority of DEFRA (2019) in 2018, England and Wales registered an average in live weights of 2.2 kg in broiler chicken and slaughtered in average after 42 days of growth. Whereas in Brazil, broiler chickens registered an average in live weight of 3 kg and slaughtered in average after 40 days (Assunção *et al.*, 2017). By law, all chickens must have enough freedom of movement, be able to stand regularly, turn around and stretch their wings without difficulty. They should also have enough space to be able to sit without interference from other birds (DEFRA, 2018). For Van Horne & Achterbosch (2008), Brazil is in a first level position of welfare whereas Switzerland is in a top position as welfare level.

Environmental enrichment can benefit animal welfare in a different way, such as health, strengthen the activity of broilers and particular behaviour that the species expresses in the natural habitat (Boere, 2001; Campo *et al.*, 2005; Jones, 2004; Newsberry, 1995; Riber *et al.*, 2018).

In agreement with Baxter & O'Connell (2019) environmental enrichments to broiler chickens are generally created to increase low activity levels as well as encourage natural behaviours like perching and foraging. Castellini *et al.* (2002) concluded that organic systems presented more natural rearing conditions, broiler chickens increased motor activity, became less sensitive to stressors and gained muscle mass when compared with the conventional method. Jordan *et al.* (2011) found that the final body weight was 13% lower in broilers with the feed scattered in the bedding once compared with the conventional feeding system.

This study aimed to analyse if environmental enrichment, sex, and age influence broiler chickens' weight during growth.

MATERIALS AND METHODS

The observational study was carried out in a commercial farm located in Mogi Mirim county (22.42° S, 46.95° W), Brazil, from August to November 2016.

The farm had four broiler houses (BH) with negative forced ventilation with blue lateral polypropylene curtain with similar design and construction (15 m wide x 150 long x 3 m high). Each house housed approximately 30 000 chickens and was equipped with identical automatic nipple drinkers and feeders. The litter material used for each house was new sawdust with rice husks.

A programme monitoring system controlled the rearing environment. The temperature for all houses was automatically reduced from 32°C (start period) to an end temperature of 18°C (finish period). The light program from 1-day-of age (20 lx) to 7 days of age was continuous (24 L:0 D). A total of 8 hours was added from 8-days of age to 28-days of age until a total of 30 minutes of darkness per night was complete. From 28-days of age to the end of the flock, the light was in a natural condition without using artificial light in the darkness.

The composition of animal feed was produced by the farm where the study was carried out (starter, rearing, and finisher). Feed and drinking water were given *ad libitum*. In each broiler house, a metal rectangle frame that measured 5 x 10 x 3 m to control the broiler chickens was built (Figure 1). A total of five-hundred broiler chicken was housed with a density of 12 animals/m². For environmental enrichment, each broiler house received a different stimulus (Table 1).



Figure 1 – Picture of the metal rectangle in the area of the studied broiler house

Table 1 – Environmental Enrichment type used in the trial.

Broiler house	Environmental Enrichment
BH1	Music and light
BH2	Music
BH3	Light
BH4	Without environmental enrichment (control)

In BH1 and BH2 different music styles were played each week to promote motivation for the birds. Every week an amount of four types of sounds were played



where the total time of duration was six minutes, and each one had 1 minute and 30 minutes of the time of period. The audio track was played five times a day for six weeks, starting from 9.00 AM to 5.00 PM with a pause of one hour within it. The type of sounds were rock, soul, country, jazz, pop, nature, and classical music (Campo *et al.*, 2005; D'Avila *et al.*, 2011).

Under BH1 and BH3, the light stimuli used came from a coloured (red and green) LED strobe projector (Xtrad, model LT-923159, São Paulo/SP-Brazil) (Figure 2). The light performed once a day, for five weeks. The duration of the light stimuli was about 6 minutes.



Figure 2 – The light dots from a coloured LED strobe projector.

The assessment was carried out for five weeks (7, 14, 21, 28, and 35 days). Every week, in each metal square frame from the broiler houses (BH) twenty broiler chickens (ten male and ten female), were caught and weighed.

For the statistical analysis, the exploratory data analyses was used, where graphics were developed (Boxplot) of the results of mean weight with significance range (95% intervals for means). Therefore, it is possible to determine the effects of the environmental enrichment type, gender, and age, as well as the probable interactions of these variables, on the weight of broiler chickens. Following the analysis, the data was submitted to the comparative analysis of means, analysis of variance (ANOVA), followed by Tukey test of multiple comparisons.

RESULTS AND DISCUSSION

Body weight of broiler chickens 7, 14, and 21 day old broiler chickens did not differ when compared with age, gender, and environmental enrichment (broiler house) ($p>0.05$, Figure 3). Moreover, with 28 and 25 days of age, broiler chickens showed difference in body weight ($p<0.05$). The age appears as a strong influence on the birds' development. Abdullah *et al.* (2010) reported that at seven days of age, body weight differed ($p<0.05$) among gender and strains and at 21 days of age males and females had comparable body weights to the present study. Castellini *et al.* (2002) observed that live, carcass weight, and feed efficiency were significantly affected by age and production system (organic and conventional).

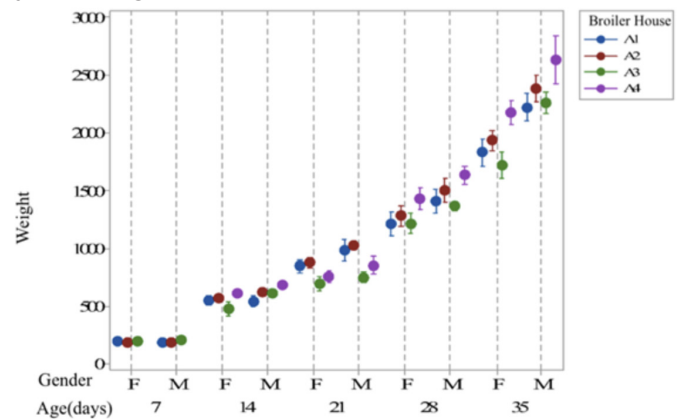


Figure 3 – Broiler chickens average body weight according to broiler house, gender, and age.

The gender of 7- and 14-day old broilers did not impact on body weight ($p>0.05$), although males of 21 days old showed an increase in body weight when compared with female. However, it is notable that gender has synchrony by age. Bokkers & Koene (2002) observed that males were heavier than females of 3 weeks of age similar to the present study. For Abdullah *et al.* (2010), a significant interaction by strain (Ross, Lohman, and Hubbard) and gender was also reported through 21-35 days. Zaghari *et al.* (2002) reported that male chicks grew faster than female, but no significant interaction by sex of lysine level was observed for weight gain. However, Kryeziu *et al.* (2018) noticed that no differences were seen between male and female broiler chickens on different ages (7, 14, 21, 28 and 35 days old) and body weight in several stocking densities.

The body weight and environmental enrichment (broiler houses) had no interaction until birds were 21 days old; however, from 28 days of age it was possible to observe a strong correlation ($p<0.05$). The broiler house (3) with light enrichment presented the lowest body weight when compared with all broiler houses. On the other hand, broiler house 4 without



enrichment presented the highest body weight when compared with other broiler houses. Castellini *et al.* (2002) observed that organic broiler chickens presented lower growth performance when compared with the conventional environment. The light motivates the animals move rather than sit down. Simsek *et al.* (2009) recorded that body weight of broiler chickens in the control group after 42 days of age was 2291 g when compared with the body weight of broiler chickens in the environment enrichment group which was 2231 g. It seems that environmental enrichment stimulates the animal to improve the behaviour. Although, Ohara *et al.* (2015) concluded that the activity in birds reared with perches and hay bales did not affect productivity.

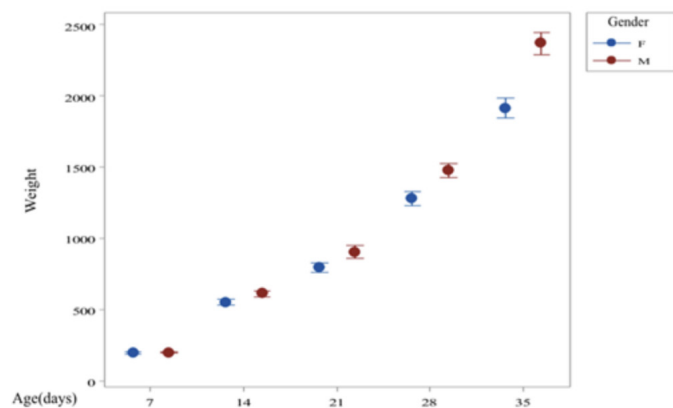


Figure 4 – Broiler chickens' average weight according to gender and age.

There was an interaction between environmental enrichment and gender.

For both genders, the body weight performed similarly through the days of the age where the stimuli did not alter the physiology of the bird. Females of 35 days of age showed the lowest body weight in broiler house with light when compared with other males. Bokkers & Koene (2002) noticed an interaction for the motivation effect between the type of feed and gender where the motivation was lower for the female in a conventional type of feed than for free-range feed. In Djukic *et al.* (2009), the environment enrichment affected body weight. Broiler chicken grew 13% significantly slower in a type of feed (pellets) where feed was scattered in the litter when compared with conventional treatment. Ohara *et al.* (2015) observed that the birds that presented low weekly body weight gain and low weight prefer perch than feed. Bizeray *et al.* (2002) concluded that perch and barrier as an environmental enrichment did not affect the body weight averages in the 3rd week.

In Figure 5 the performance of the environmental enrichment, body weight and age attend a pattern where broiler house 4 (control) displayed the highest weight, followed by broiler house 2 (music), broiler house

1 (music and light) and broiler house 3 (light) exhibited the lowest weight position. Moreover, 7 and 14 days old broiler chickens do not show a significant difference.

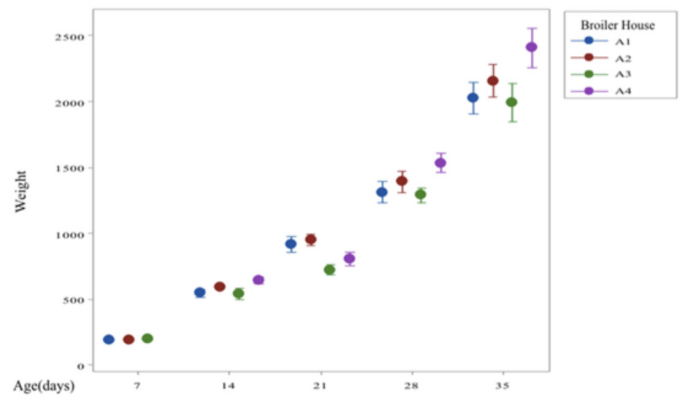


Figure 5 – Broiler chickens' average weight according to broiler house and age.

Lighting is an essential factor in the management of animals that can affect their productivity, health, and welfare (Alvino *et al.*, 2009). Foss *et al.* (1972) concluded that Coturnix females presented lighter body weight and brooded under blue and green light compared to females kept under white and red light. Prayitno *et al.* (1997) observed that broiler chickens reared under blue light had 36.2 g/d body weight and 34.7 g/d under red light. Late red light for birds appears to contribute to lightest bone weight, bone strength, and body weight. Andreazzi *et al.* (2018) observed that broiler chickens in a conventional broiler house presented an average of 2.720 kg and 2.806 kg in a broiler house with a dark curtain (Dark House). Farghly *et al.* (2019) observed that broiler chickens exposed to flashing light and an intermittent feeding regime had the highest body weight and lowest feed conversion rate when compared with the control treatment. Lei & Van Beek (1997) established that broiler chickens in high activity had higher body weight and feed intake than in normal activity state. Broiler house 4 (control) presented the typical situation in a broiler chicken farm and showed the highest body weight. Leone *et al.* (2010) concluded that group size, density, and size of the barn affects on movement and space use in broilers. Environmental complexity modify activity in broiler chickens (Bizeray *et al.*, 2002). For Dawkins *et al.* (2003), increase ranging is associated with better health and welfare grounds.

CONCLUSION

The environmental enrichment affected broiler chicken weight according to the bird age increase. Broiler house (BH3) with light as stimuli showed the lowest body weight and broiler house (BH4) presented the highest body weight.



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