

# Effects of light, vibration, and sound on incubation



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Our comprehensive review during this course has revealed that numerous factors are crucial in incubation. Vibrations and sound are omnipresent in many stages of egg management, while light, a critical factor in natural conditions for birds, can significantly impact their welfare during incubation.



This module was crafted to deepen your understanding of the **profound effects of light during incubation on embryo development and post-hatch performance, and the realities of its application under commercial conditions.**



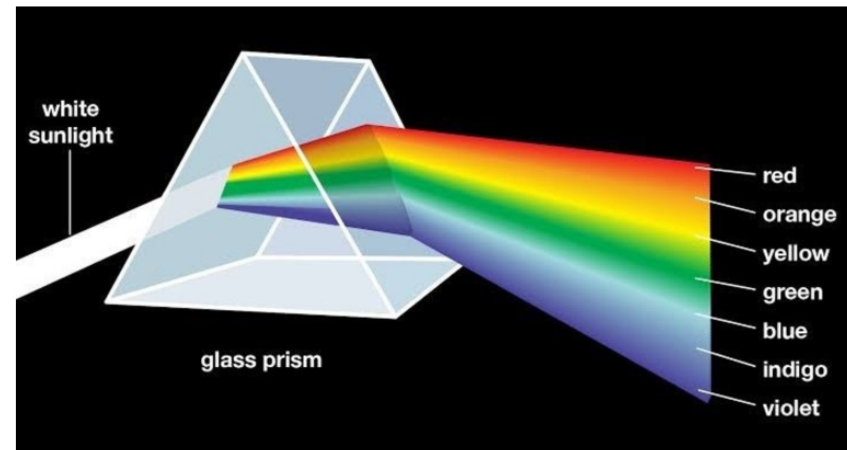
Our goal is to shed light on the often-overlooked impacts of vibrations during transportation and egg manipulation on fertile egg quality, early livability, and chick quality. Lastly, we will delve into the intriguing influence of sounds in the hatchery on embryo development and chick quality.

# Light effects during incubation



Light during incubation has been a key focus in current poultry production trends.

It may replicate the natural conditions where a hen experiences a photoperiod, aligning with their natural behavior. **This connection to the natural world has led to the proposal to improve animal welfare through light during incubation.**



Research has shown that **light can significantly benefit embryo development and hatchlings**, further reinforcing its role in mirroring natural conditions.

The scientific literature contains several reports supporting the use of light during incubation. It has been shown to enhance body weight gain and breast muscle development, offering hope for improved poultry production. Light also influences hatchability, chick quality, behavior, and welfare. However, it is essential to note that not all these effects are consistent across studies.



**Diverse light spectra, including white or monochromatic light, have been tested during incubation. Generally, all lights increase eggshell temperature, which rises depending on the frequency and length of the photoperiod.**



**The temperature increase may affect the development of chicks. Light modifies the hatch curve. Chicks start hatching earlier when exposed to light during the whole incubation period.**

# Green light

Greenlight has emerged as an up-and-coming option among the monochromatic lights.

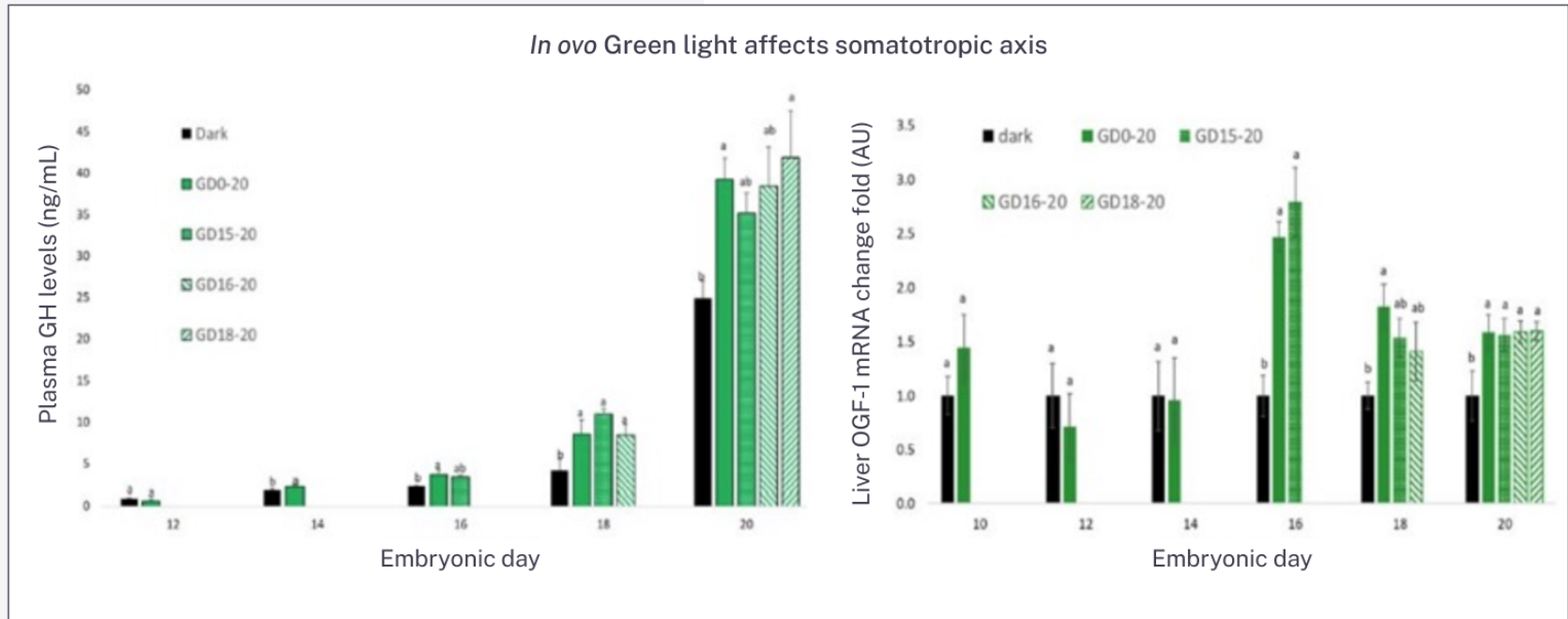
Studies have shown that **white and green light can enhance body weight gain and breast muscle development. Green light, in particular, has been found to increase embryo growth hormone levels, opening up new possibilities for optimizing poultry production.**

However, it has been observed that white light or a thermal treatment increasing 0.1 °C during 6 hours on day 16 of incubation also stimulates breast muscle development.

Light may not be the only factor stimulating muscle fibers. However, there are slight differences in muscle development caused by white light.



**Green light is more effective than blue light in stimulating muscle development and can improve feed conversion ratio.**



Dishon et al., 2021

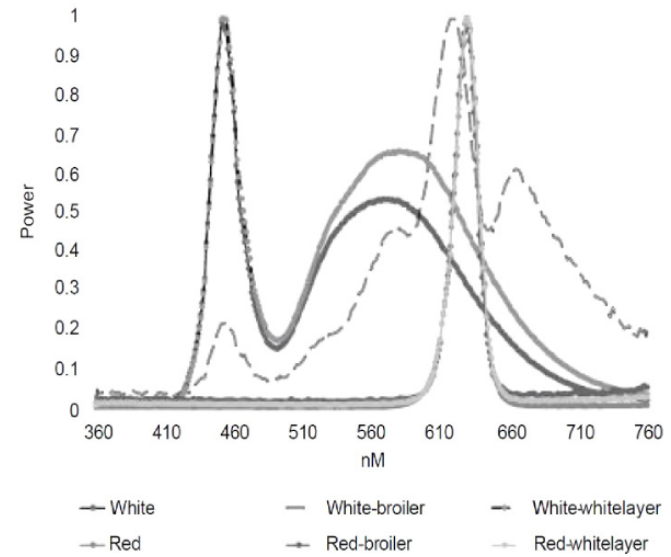
# White light vs. Monochromatic light

The effects of white light have been compared with intermittent monochromatic red light during the incubation of broilers and layer eggs.



In both cases, lights reduced early mortality, and red lights decreased the pipped eggs or late mortality.

Intermittent red lights also decreased unhealed navels, leg problems, and defective chicks. Intermittent red lights improved hatchability in layer eggs but not in broiler eggs.



# White light effects post-hatch

Despite some observations of the benefits of light exposure during incubation in chickens. **Several evaluations of white light have not shown any benefits on feed conversion, weight gain, feed conversion, or gait scores.**

Some tendencies for lower body weight gain and worse feed conversion ratio have even been observed with lights. Bone ossification of chicks tends to be lower with lights 24 hours during incubation, compared to chicks exposed to 12-hour light and 12-hour darkness.



# Lights on immune development



Red light increased serum immunoglobulins in tests evaluating effects on immunity, but no effect of white and blue lights was observed.

## WHY DON'T WE USE LIGHTS IN COMMERCIAL INCUBATORS?

All these experiments with positive results of light during incubation were conducted in small machines with less than two hundred eggs and, generally, a few small trays.

You may be wondering if all these benefits of lights have been reported for almost two decades and why lights are not used under commercial conditions. **One of the main limitations to applying this technology in commercial conditions is the issue of providing uniform light distribution.** Turning and equipment cause shadows or diverse distances between the light source and the eggs.

# Experiments with monochromatic lights



We have conducted two experiments testing monochromatic lights in larger incubator machines with trays similar to those observed in commercial incubation.

In the first experiment, we tested intermittent green lights (15 minutes on and 15 minutes off), permanent green lights, darkness, and red lights for 15 minutes four times daily.

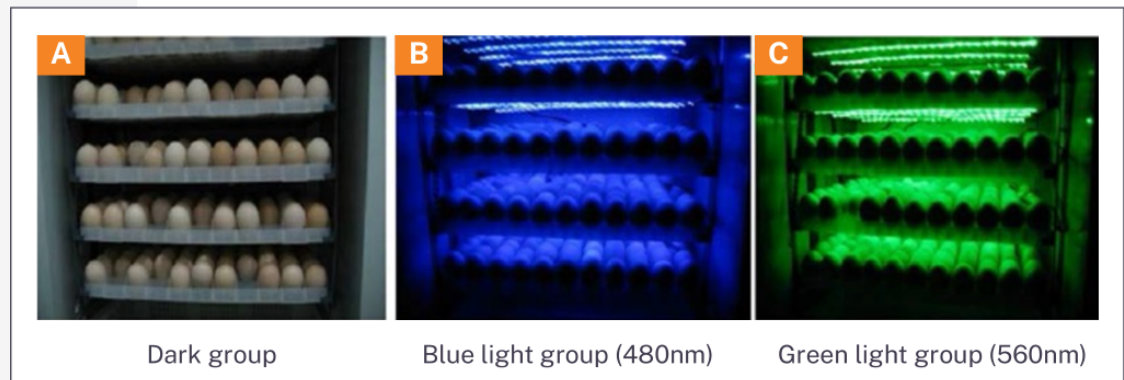
- ▶ We observed variations in the responses of eggs depending on the distance to the light source.
- ▶ We did not detect a difference in the hatch of fertile. However, the embryo mortality was lower in eggs incubated under dark conditions or with red lights.
- ▶ No effects of lights were observed on body weight gain. However, at 21 days, the male chickens exposed to the permanent green light had a better feed conversion ratio when they were closer to the light source.
- ▶ No other effects were observed. No significant effects were observed in breast muscles.

In a second experiment, the **effects of green lights** were evaluated with six treatments during incubation:

- ▶ 1) darkness;
- ▶ 2) Permanent green lights;
- ▶ 3) 1 to 5 days darkness and later green light;
- ▶ 4) 1 to 5 days green light and later darkness;
- ▶ 5) 1 to 18 days darkness and later green light; and
- ▶ 6) green lights from 1 to 18 days and later black.

The machines were managed to keep the eggshell temperature at 100 °C. Despite the reduced machine temperatures, eggshell temperatures were consistently higher when eggs were exposed to lights. **The hatchability of fertile was lower in all treatments with lights, and the feed conversion ratio increased.** The breast meat was not significantly improved.

In summary, **monochromatic lights do not consistently affect hatchability performance or health.** Still, they may have minor effects on embryo muscle development that may change according to embryo sex.

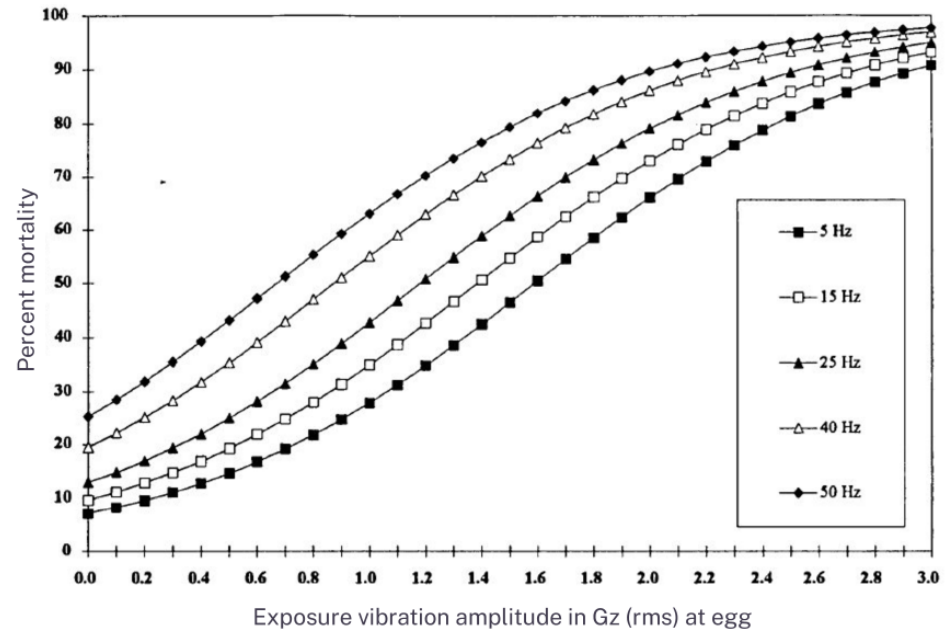


# Effects of vibrations and sound on eggs


Eggs may suffer vibrations during transportation from the farm to the incubator. Transportation conditions in a truck are not uniform, and vibration is one factor that varies more.



**Vibration can affect primordial cells and their development and cause eggshell microfractures.**

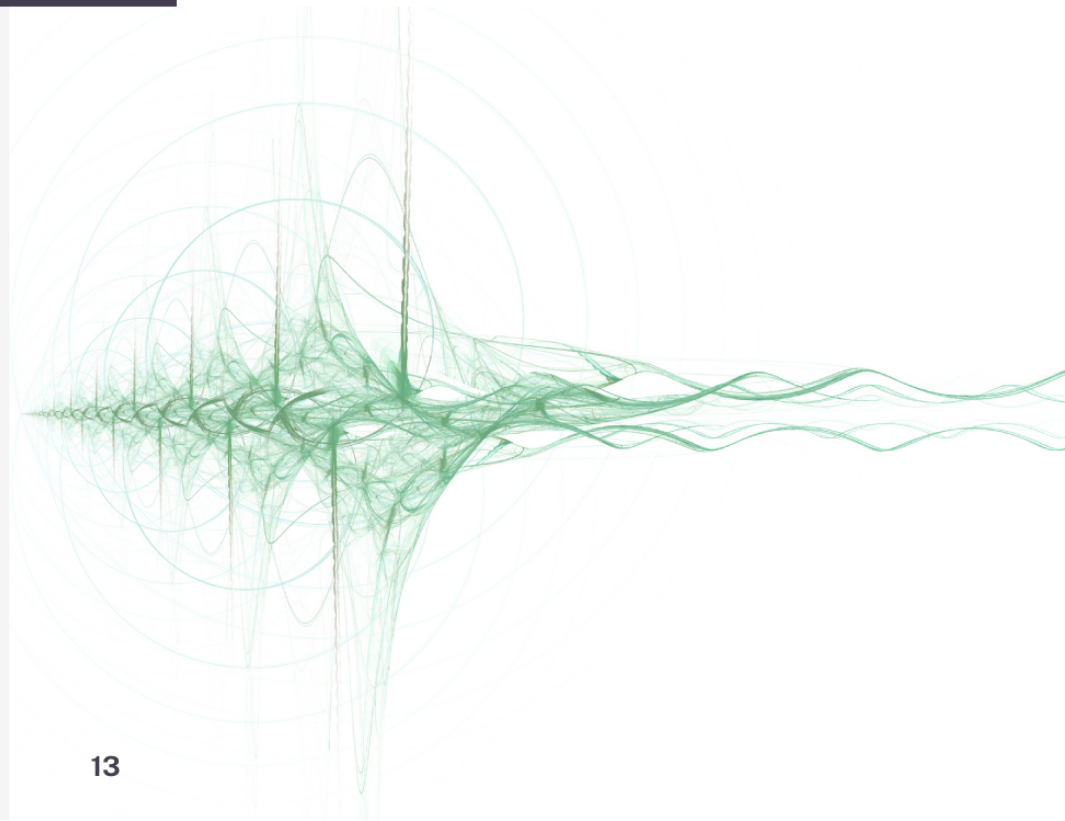


**Figure 1.** Mortality versus exposure frequency (Hz) and amplitude, controlling for differences in amplitude transmission ratios between egg stations.

 Hairline cracks reduce hatchability, increase second grade, and cull chicks. Embryos can die during the first and last weeks of incubation, and the odds of contamination increase more than 15 times.

Studies demonstrated that **embryo mortality can increase as vibration frequency** and amplitude increase above 15 Hz. A truck can have structural vibrations with higher-level frequencies (50 Hz). Vibration damage occurs in the range of 3 to 30 Hertz.

Vibrations of 20.8 - 30 Hz  $2.5 \text{ m s}^2$  or  $7.5 \text{ m s}^2$  during 180 minutes worsen hatchability, mainly early mortality. It can increase 10% embryo losses.



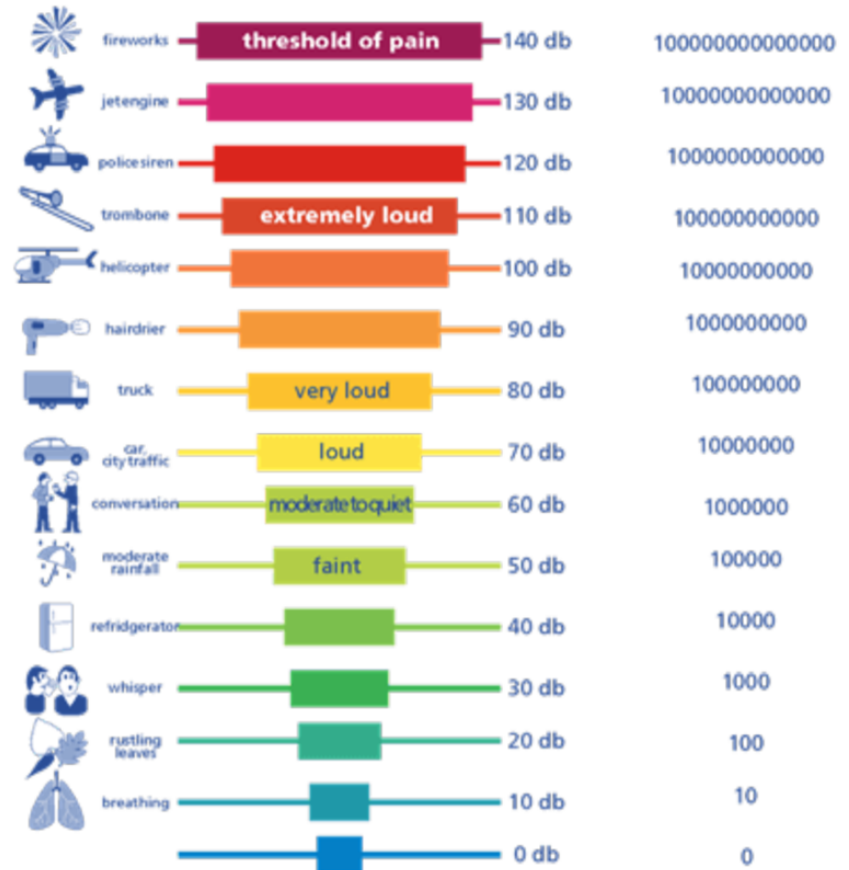
# Effects of sound

Noise affects all living organisms.

The intensity of sound is measured in decibels (dB), and the decibel scale measures noise logarithmically. However, studies indicated that **sound pressures between 70 and 110 dB do not affect embryo development.**



**The hatchability can be 33.7% higher at 90 dB than 70 dB, and the chick's physical quality can be even better.** However, it is essential to avoid higher noise intensity. The current noise produced by machines should not be a cause of variability in hatchability or embryo development.



# Conclusions

Light during incubation affects embryo development and hatch time, but its effects are variable by sex and distance from the light source. This is why they have not been implemented in commercial incubation.



- ▶ **White and monochromatic light differ in their effects on embryo development.**
- ▶ The positive effects of green and red lights are clouded by adverse effects or increased response variability.
- ▶ Lights impact embryogenesis, but the engineering to provide adequate stimulus is still under development.
- ▶ Vibrations are negative to embryos and eggshells, causing more microfractures and embryo mortality.
- ▶ Hairline cracks are detrimental to hatchability and chick quality.
- ▶ Sound under 90 dB is not harmful to embryo development.



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# Thank you!

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