About lux and light

Light is extremely important for chickens. Not only do they need light to see and find food, water, nests etc, but also their reproductive system is triggered by light. To understand how it works, we have to look at both light and birds.

What is light?
Light is a form of electromagnetic radiation, like radiowaves, rontgen waves etc. Radiation with wave lengths between approximately 300 and 800 nm (1 nm is a millionth part of a millimeter) can be seen by the human eye as light. The wave length determines the colour of light. 300 nm is violet, then comes blue, green, yellow, orange and the longest wave length of 800 nm is red light. If the wavelength is just below 300 nm, we talk about ultra-violet, where a wavelength just above 800 is called infra-red. Although we can't see ultra-violet and infrared, we know they exist. Ultra-violet light colours our skin and infra-red can be felt as heat and can be made visible with an infra-red camera.
We see coloured objects because they reflect a certain wave length. A red object absorbs all wavelengths except red. It reflects the red colour which is seen by the eye, and that is why we see the object as red. White light is a mixture of all colours, which means that a white surface reflects all colours. Black objects reflect no colour. That is why black objects get warm more easily, as they absorb all incoming light.

The temperature of light
We normally consider light with a lot or red/orange colour in it as warm (candle light), while bright white light with a lot of blue/green colour seems cold and hard.
The colour of lamps is often given as a temperature in degrees Kelvin (oK). Kelvin has the same range and magnitude as Celsius, but doesn't start with 0 at the temperature of melting ice, but at the absolute zero, which is -273oC.
A high colour temperature stands for very short wave lengths (blue/green) and low temperatures represent long wave lengths (red/orange). This is a bit confusing, as a high colour temperature (blue/green) for us feels as a cold colour, where a warm colour as orange or red is measured as a low temperature.
This has to do with the way these temperatures are determined. A plate of steel is warmed up until it starts giving off light. At approximately 2000-3000 oK the steel is red hot, and gives off red light. When we warm it further, it passes through all the colours until it becomes white at about 6000oK. When we heat it up further, the steel even becomes green and eventually blue/violet. Normal daylight has a temperature of about 6500oK.
Most lamps have a code that reflects the colour temperature of the light. This is 3 digit code, usually starting with a 6 or an 8. The last two digits reflect the colour temperature. So if a lamp has the colour coding 830, it means that the colour temperature of the light is 3000oK, which means a warm yellow light containing more red wave lengths, and it will probably be indicated as a "warm day light" lamp. If the colour code is 840, the colour temperature will be 4000oK, and the colour will be more bright and white, and the indication on the lamp will most probably be something like "cool day light".

The intensity of light
The intensity of light is measured in lux, which is the amount of electromagnetic radiation (lumen) received per surface area. For a normal lux meter it doesn't matter if the electromagnetic radiation is in the wavelength of blue colour or red colour, it just measures the radiation.

Birds and humans

Birds and humans do make a difference between wavelengths. They can see especially well in bright, white light, which contains a lot of blue and green, so short wave lengths. Also humans experience bright white light as very intense. However, the reproductive system of chickens is not so much influenced by the light that they see, but by the light received in the brain. The brain of a chicken contains light-sensitive cells, and they are stimulated by the light that goes through the skull.

But not all light goes through the skull evenly. Especially long wavelengths can penetrate into the brain. Compare it with music, where the bass (long wave lengths) can be heard easily outside a house or car. We can also see it if we have a torch shining on our hand, where the red waves will go through the skin and can be seen on the other side, colouring it red.

This means that chickens use bright light (short wave length, high amount of blue/green wave length) to see, but they need red light (long wave length) for stimulation of the reproductive system.

So if we want to stimulate eating behaviour (broilers) but also activity of breeders to find the nest and avoid floor eggs, we have to give them bright cold white light, with a high amount of blue/green. This would for instance mean a colour code of the lamp of 850 or 860, with a colour temperature of 5000 or 6000 oK.

If we want to stimulate the reproductive system, we have to give them warm light, with a high amount of red/orange. This would be a lamp with colour coding 830, with a colour temperature of 3000 oK. If we change the birds from rearing to production, we want to stimulate the birds with light, and then especially the red spectrum of the light, as this can penetrate the skull. This would mean that in rearing we would preferably use a lamp with colour code 840, and in production change to colour code 830, so from more white to more yellow/red. If we change the other way around, so from 830 in rearing to 840 in production, we have to give the flock a higher intensity after stimulation to ensure there is enough increase of the red spectrum.

Especially if we change from for instance bulbs in rearing (yellow light) to a colour code of 860 in production (very white bright light) we might find that the birds respond less to our increase in light intensity than we expect, because the amount of red waves in the spectrum is actually reduced. This means we have to increase our intensity more, with the risk of pecking and cannibalism. (depending on the manufacturer and the type of lamp the first digit of the colour coding can be different, for instance 640 instead of 840)

If we use light in chicken houses, we must be aware of this.

- If we simply measure the amount of lux, we might find that the house is light enough. But if that light is very bright and there is only a small amount of red colour in it, changes are that the birds don't get stimulated enough.
- Lamps with a lot of red wavelength in it do not seem very bright for us, where the actual lux reading can be surprisingly high. White bright light will seem more intense, where the actual amount of lux can be low.
- As birds respond to the red wavelengths, white bright light will not be very effective for production. If we need to give enough red light with this light source, the total light intensity has to go up very high. This bears the risk that the birds are stimulated in their behaviour, resulting in nervousness, stress and pecking. Giving only red light will not work so well, as it will for instance increase the risk on floor eggs.
- In rearing, often light bulbs (warm, yellow/orange light) are used because the can be dimmed very well. When these birds are transferred to a black-out production house with high frequent bright white TL light, the total light can go up, but the amount of red light

might not increase that much or even decrease. And as birds get stimulated by an increase in red light, their production might be delayed.

- Ideally the colour coding in rearing is higher than in production, for instance 840 in rearing and 830 in production. If the colour coding is higher in production, extra intensity must be given to ensure the birds get stimulated enough.
- Broilers need to be stimulated to find food and water and move around, so they can benefit from a high amount of green/blue colour in the lamps. Breeders in reproduction will be stimulated by a high amount of red/orange colour in the lamps, but they need enough white light to avoid floor eggs.

To avoid problems, we must:

- Not only look at lux, but also at the colour of the light
- Ensure that broiler breeders step up especially in the red light fraction coming into production.
- Make sure birds get enough white light to stimulate their behaviour.
- Make sure broiler breeders in production get enough warm, red/orange light to stimulate their reproduction.

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