

Blue light in pig buildings (pilot study)

Duration: 2015-2016

Aims and objectives

To optimise pig production efficiency through implementation of blue/green lighting in weaner and grower and finisher buildings while minimising energy usage.

To explore whether blue (420-460nm) LED light has a noticeable effect on:

- Pig performance
- Pig behaviour/welfare
- Energy consumption on farm
- Pig housing temperatures

in both weaner and grower/finisher accommodation compared to conventional lighting (fluorescent).

Safety note: There is evidence to show that blue wavelength visible light can cause permanent and irreversible damage to eyesight/retinal epithelial cells and other biological components crucial for vision; this has been collected from various published and peer-reviewed laboratory studies where blue light has been focused directly onto the retina in vivo or onto various biological matrices analogous to mammalian eyes in vitro.

However, BioLumen Lighting Solutions has stated: *“All lights offered by BioLumen Lighting Solutions have been tested to BS EN 62471:2008 (Photobiological safety of lamps and lamp systems) to ensure that the light produced is safe. While individual LEDs are classed as maximum ‘risk group 2’ (ie possible retinal damage if stared at), the overall light used in this study was considered exempt. This is because the blue LEDs are mixed with white LEDs to produce a sufficient level of white light to evoke usual aversion responses in both humans and animals.”*

Background

AHDB Pork has been running a pilot study looking at the benefits/drawbacks of utilising specific wavelength LED lighting in grower/finisher accommodation versus traditional fluorescent tube lighting. This study commenced in May 2015 and is ongoing, with data for three batches having been reported for both the weaner and grower/finisher accommodation.

Study farm

Using a commercial unit as a study site, one weaner room and one grower/finisher room, housing approximately 320 pigs each, were converted to use commercially available blue/white LED lighting panels. The panels have been fitted in positions and numbers suggested by the retailer/manufacture to maximise their “biological impact” and the available light. A visual representation of the light provided is shown in Figure 1 (with the blue peak being between 420 and 460nm).

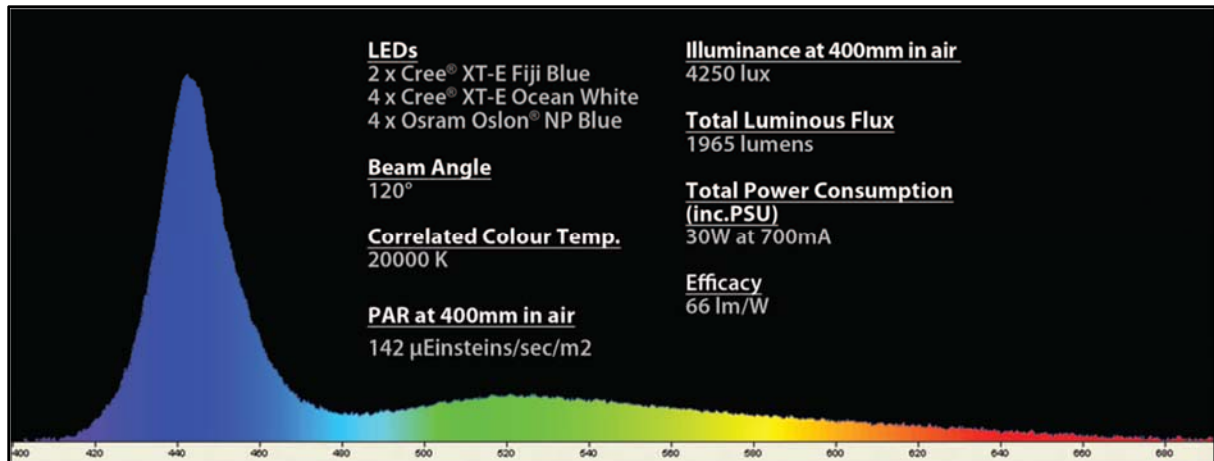


Figure 1: Visual representation of light provided by "Blue" LED lighting panels installed

The LED-lit rooms have automated lighting controllers providing 18 hours of light (including a 30-minute ramp up and down from light to dark and vice versa at each end of the photoperiod). As far as is reasonably possible, natural light has been occluded from the LED treatment rooms.

Two control rooms have remained lit as previously, with traditional fluorescent tubes; these are on for 16 hours each day with no ramp up/down. Natural light has not been occluded from these rooms in the same manner as the LED rooms. This is more representative of "normal" practice, using both fluorescent tubes and natural light in pig buildings.

A visual representation of the light levels measured in the two buildings over 48 days are shown in Figures 2 and 3 below. This shows the more controlled nature of the LED lighting versus the variability of the fluorescent lighting. The peaks recorded in the final quartile (latter half) of Figure 3 were caused by particularly bright sunlight "leaking" into the LED building, largely through ventilation inlets/outlets.

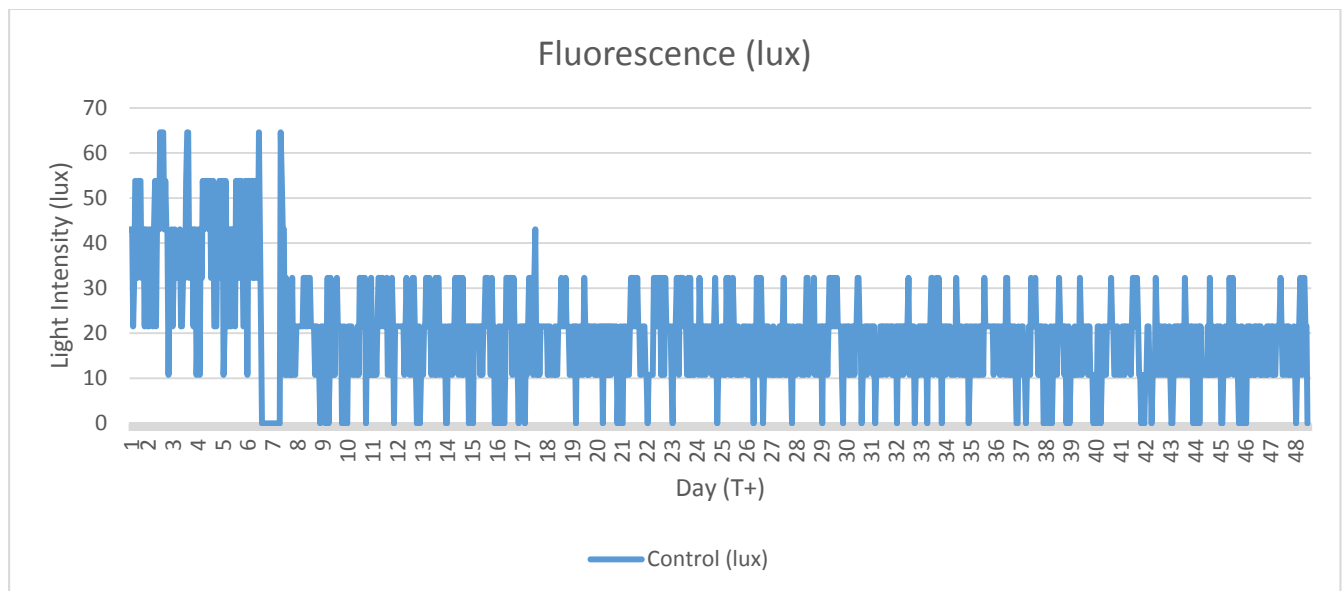


Figure 2: Light levels in control building

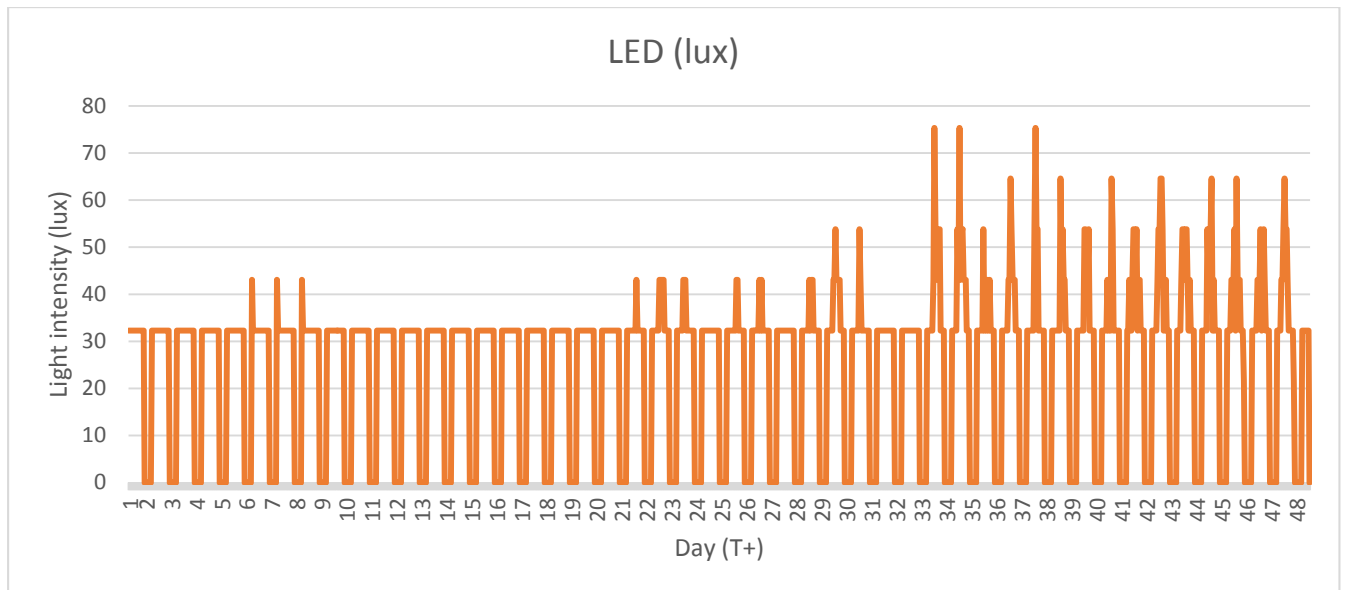


Figure 3: Light levels in LED-lit building

Observed blue lighting fade

It has been noted by regular unit staff that the blue quality of the light appears to have dimmed over time.

A site visit was conducted on 22 April 2016 to establish the light levels and spectrum in the building. It was concluded that the wavelength and light levels remained unchanged from the original installation (excluding the lamps that failed due to water ingress) and the lights continued to perform as they should. Two alternative theories have been suggested by the suppliers for the apparent observed fade:

1. Accrual of dirt on the lamps could cause light scatter, a phenomenon that causes observed light to appear less intense but which does not alter the intensity or wavelength of light emitted in any way which would impact the pigs.
2. Acclimatisation of the staff to the blue light, making the light appear less blue over time.

The measured spectrum from the site visit on 22 April is shown in Figure 4.

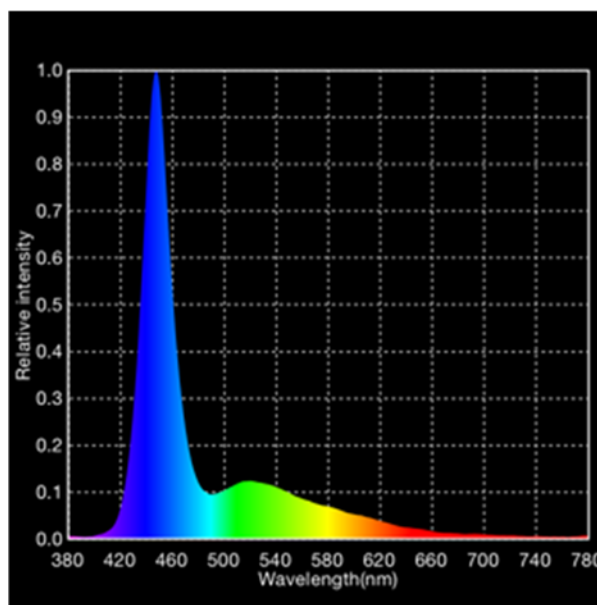


Figure 4: Measured spectrum in buildings 22/04/2016 showing no change in light intensity or spectrum

Initial observations of animal behaviour changes

Anecdotal observations from the stockpeople and managers are that the pigs seem calmer and less vocal. However, they have also noted that the pigs are more difficult to move, which has been attributed to the calmness and, potentially, the use of white traditional lighting in corridors/passageways and a lack of blue light when loading onto trailers. The potential for stress if pigs are introduced into a traditional, fluorescent/sodium lamplit environment, for example in the lairage or abattoir, warrants careful consideration.

Pig performance

The outcome of the pilot study has been assessed by recording pig performance on a batch-level basis.

It is important to note how FCR is calculated by the unit when considering the FCR data presented.

[Weight of pigs sold (liveweight) - weight of pigs transferred in (less the average weight in of any animal that died or was removed)]/total feed usage.

This slightly distorts FCR data as it does not allow for the feed that dead/fadeout pigs have consumed. However, in commercial terms this is perhaps a more relevant FCR as it represents true feed usage per kg of liveweight sold.

Table 1: Batch 1 performance data

GROUP	HOUSE	DLWG (g)	FCR	MORTALITY	Targets (based on Agrosoft data Q4 2016)			
					DLWG (g) Top 10%	Mort Top 10%	DLWG (g) Ave	Mort Ave
LED	WEANER	480	2.14	2.15%	424	1.54%	480	2.74%
LED	GF	1026	2.71	1.89%	788	2.23%	799	2.91%
CONT	WEANER	509	2.35	1.23%	424	1.54%	480	2.74%
CONT	GF	978	2.89	0.31%	788	2.23%	799	2.91%

Table 2: Batch 2 performance data

GROUP	HOUSE	DLWG (g)	FCR	Mortality	Targets (based on Agrosoft data Q4 2016)			
					DLWG (g) Top 10%	Mort Top 10%	DLWG (g) Ave	Mort Ave
LED	WEANER	478	2.26	0.91%	424	1.54%	480	2.74%
LED	GF	967	2.73	0.92%	788	2.23%	799	2.91%
CONT	WEANER	495	2.44	0.0%	424	1.54%	480	2.74%
CONT	GF	1003	2.79	1.5%	788	2.23%	799	2.91%

Table 3: Batch 3 performance data

GROUP	HOUSE	DLWG (g)	FCR	Mortality	Targets (based on Agrosoft data Q4 2016)			
					DLWG (g) Top 10%	Mort Top 10%	DLWG (g) Ave	Mort Ave
LED	WEANER	539	2.24	0.00%	424	1.54%	480	2.74%
LED	GF	946	2.9	1.23%	788	2.23%	799	2.91%
CONT	WEANER	497	1.9	0.92%	424	1.54%	480	2.74%
CONT	GF	1027	2.9	4.36%	788	2.23%	799	2.91%

It is clear from the performance data across the three batches that the herd is, on the whole, a high-performing one, often exceeding both AHDB Pork targets for average producers and top 10% performance figures. The FCR figures for the LED-lit pigs have been better than the control animals across all groups, excluding the third batch grower/finisher animals where the FCR was identical.

From examining individual slaughter data, a trend towards slightly lighter carcass weights in the second batch of pigs reared under LED lighting can be observed. This equated to approximately 2kg per pig, or approximately an additional 3-4 days for the pigs to achieve the same carcass weight.

Other than these observations there has been no significant or notable impact of the blue lighting on production performance parameters.

Relative humidity/temperature data

Data loggers were used to record temperature inside the buildings between mid-May and late July; lighting had no statistically significant impact on temperature ($P > 0.05$).

Costings

The cost of installing the LED equipment (as would be supplied going forwards) is approximately £892.00 for the weaner building and £1,204.00 for the grower/finisher building; this is allowing for one controller to cover both rooms. The energy saving is approximately £33.66 for the weaner room and £67.32 for the grower/finisher room, per batch.

Assuming 7.5 batches of weaners and five batches of grower/finishers per annum (as advised by the producer), the total energy-cost saving (at 9p/per unit) would be £589.05 per annum. If a new installation was needed, assuming £720.00 for 18 fluorescent lights (at £40 per unit), which would offer an alternative to the LEDs (albeit not with the same light output nor spectrum, but is representative of a conventional installation), the additional cost of capital for the LED lighting would be £1,376.00, which would be paid back within two years and four months due to the energy saving.

Assuming functioning fluorescent tubes are being replaced with an LED installation and there is no such saving (from not fitting the fluorescent tubes), the full cost of capital is £2,096.00; this would be paid back within approximately 3.5 years.

Note: The above figures do not include a fitting cost and it has been noted that for larger installations a discount would be achievable, potentially reducing the cost of the system per pig/batch.

Reliability

Three units failed during the trial, the cause of this was identified as water ingress. It has been suggested that several factors were involved:

- Units were mounted adjacent to sprinklers
- No 'drip loops' were used
- The outer diameter of the lighting cable was below that recommended, meaning the gland didn't seal properly, this could have allowed water ingress.

These pitfalls are worth noting and avoidable for future installations.

Welfare

A member of the AHDB Pork health and welfare team visited the site and reported that it was difficult to distinguish between blood and dirt under the blue lights. As an alternative to using the normal lighting or a visible light torch to look for blood marks on the animals, it has been suggested that a near visible ultraviolet (NUV) 395nm torch be used. This light is not visible to pigs (or humans) so should not cause distress, but will show blood marks as they will fluoresce. However, this method needs field testing as urine also fluoresces under 395nm, which may make it difficult to determine whether a mark is urine or blood.

Additional comments

There has been a suggestion from the stockpeople that the calmness observed from the LED-lit pigs causes them to “forget to eat”. This is possible; it is also possible that, although blue light is theoretically more visible to pigs than the traditional fluorescent lighting (which contains a large proportion of red/orange light), they are struggling to see/find the feed. Possible adaptations would be to include white LED lights over the feeders to make them more prominent in the pens, or to alter the blue/white light balance in the main lighting.

Summary

Did blue (420-460nm) LED light in weaner and grower/finisher accommodation have a noticeable effect on:

Pig performance?

The growth data shown in Tables 1-3 suggests there is no noticeable or consistent effect on either DLWG or FCR. Further trial work looking at growth data in greater resolution (per pen or per pig) would allow more accurate conclusions to be drawn on the impact upon performance.

Pig behaviour/welfare?

Anecdotal comments from farm staff have suggested that the pigs are calmer and perhaps slightly more difficult to move (as a consequence of this calmness).

Energy consumption on farm?

LED lighting offers a considerable cost saving over time compared to fluorescent lighting, assuming the same service costs/life can be achieved with these units.

Pig housing temperatures?

No significant impact on housing temperatures was observed.

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