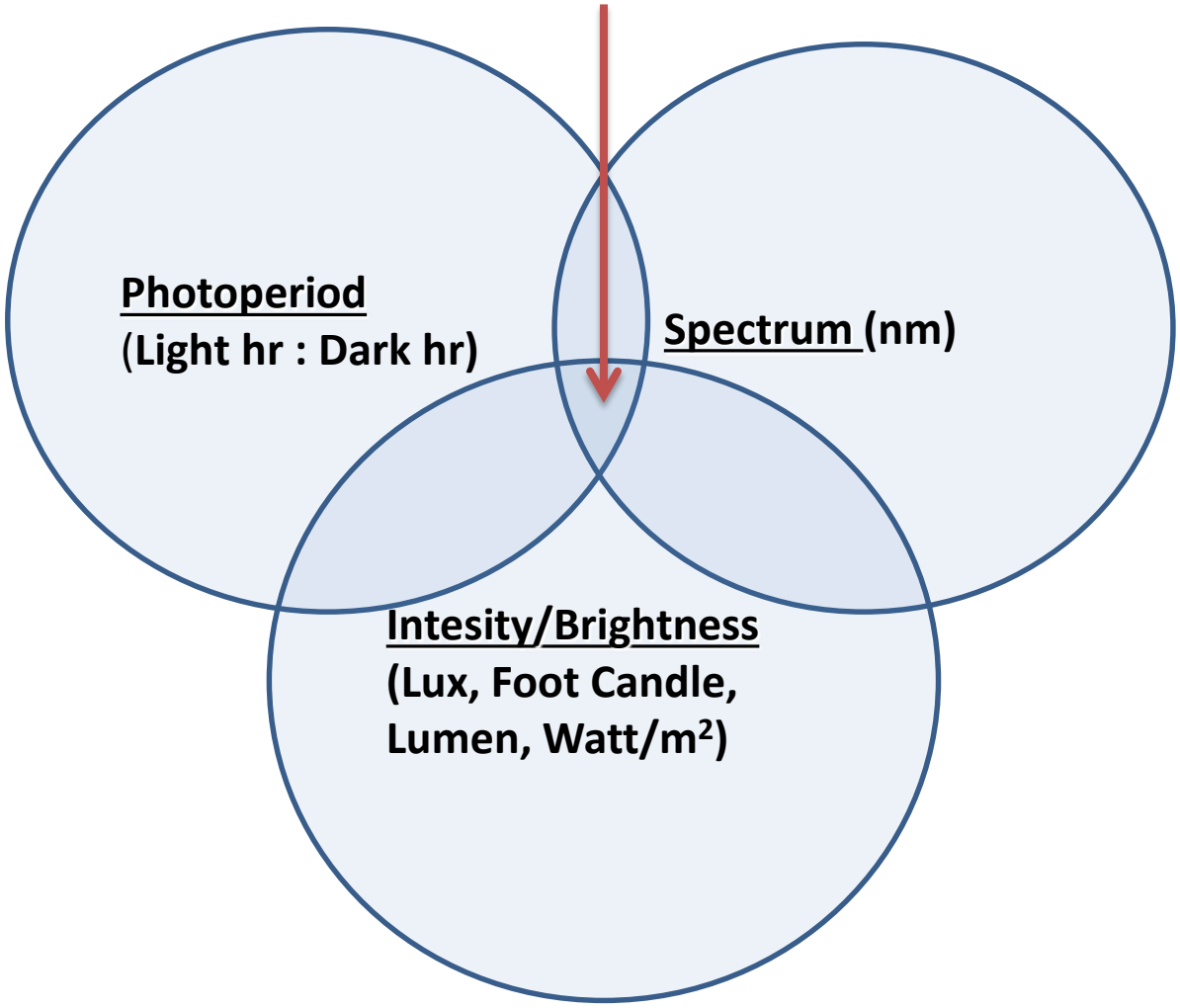
Photostimulation in poultry

הפקולטה לחקלאות, מזון וסביבה ע"ש רוברט ה. סמית
The Robert H. Smith Faculty of Agriculture, Food and Environment

המחלקה למדעי בעלי חיים
Department of Animal Sciences

Precise photostimulation in domestic birds

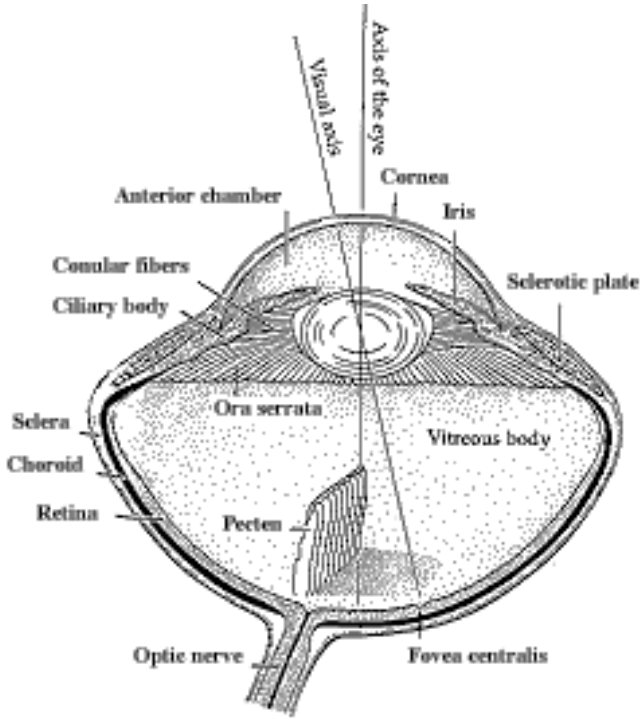
Light quality



Birds photoreception

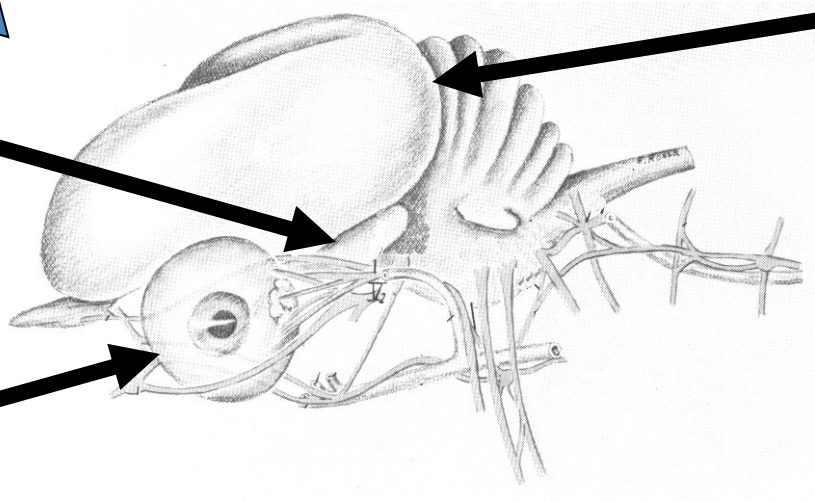
Retinal photoreceptors

Extra-retinal photoreceptos



Pineal Gland

Hypothalamus



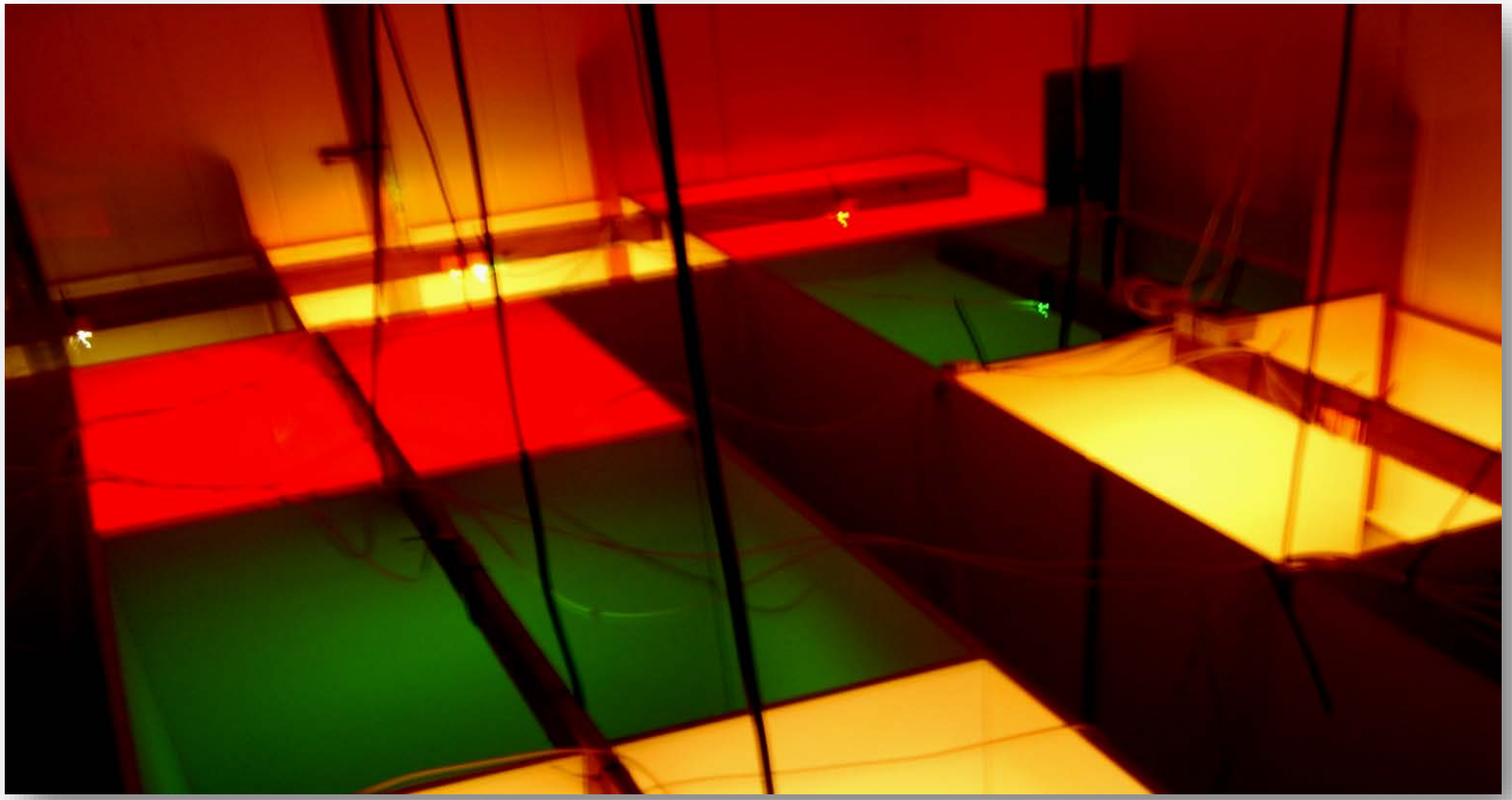
Olfactory Bulbs

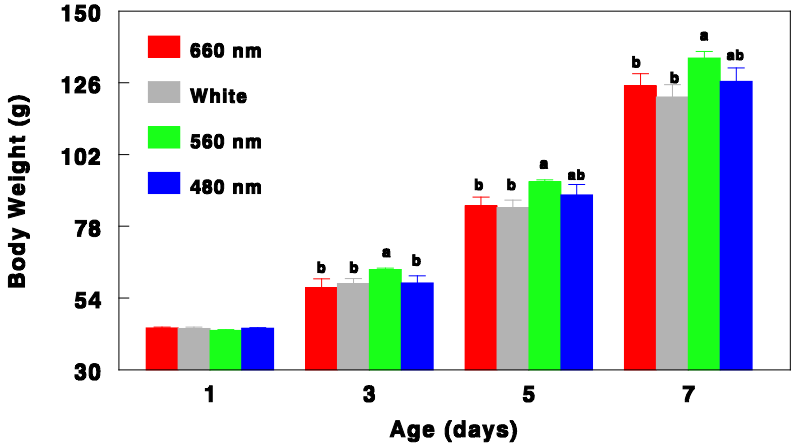
Eye

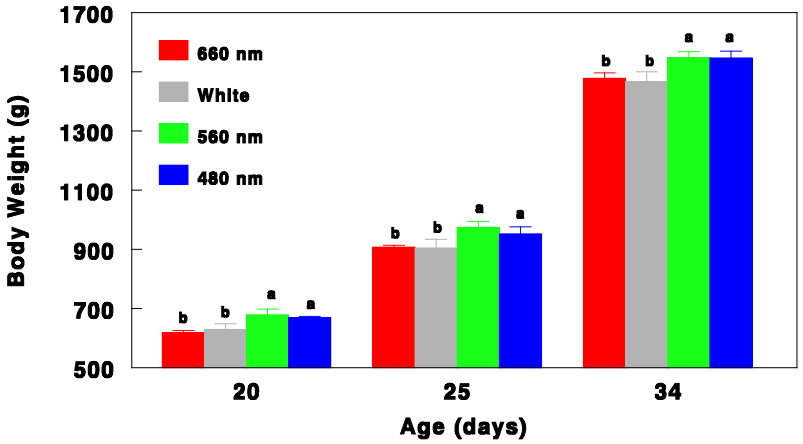
The use of environmental control poultry houses made artificial targeted light a major stimulatory factor

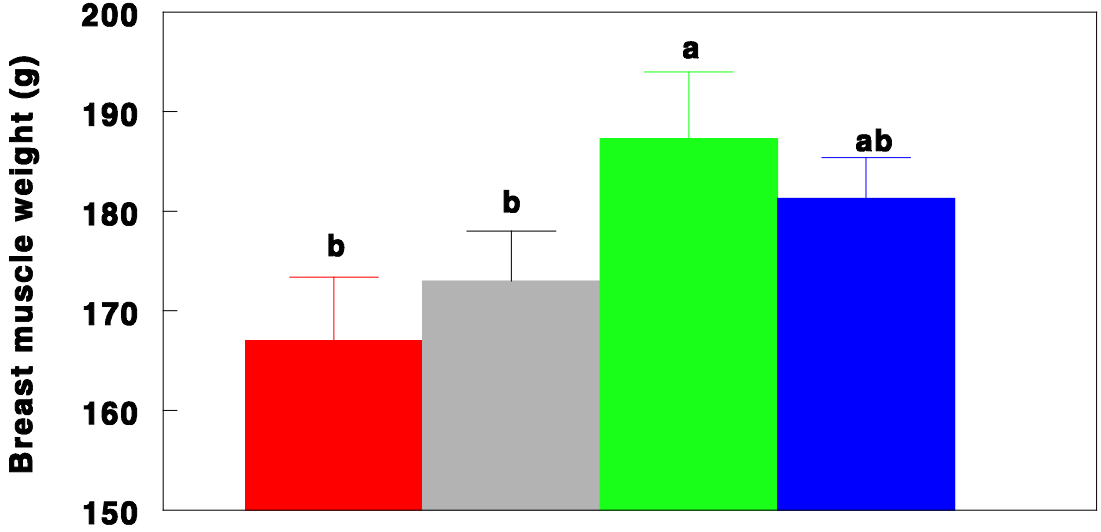
The effect of monochromatic photostimulation on growth and development of meat type birds.

First observation



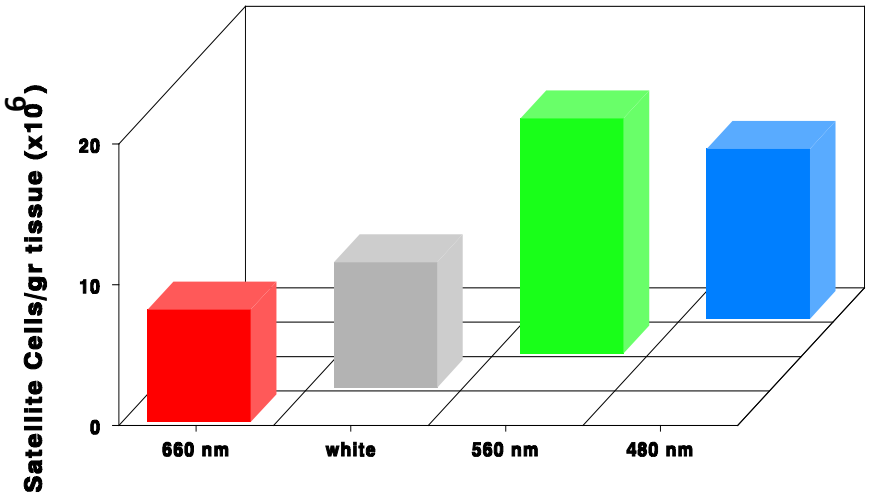

Body Weight (g)
150
126
102
78
54
30
660 nm
White
560 nm
480 nm
b
b
a
b
b
b
a
ab
b
b
a
ab
1
3
5
7
Age (days)

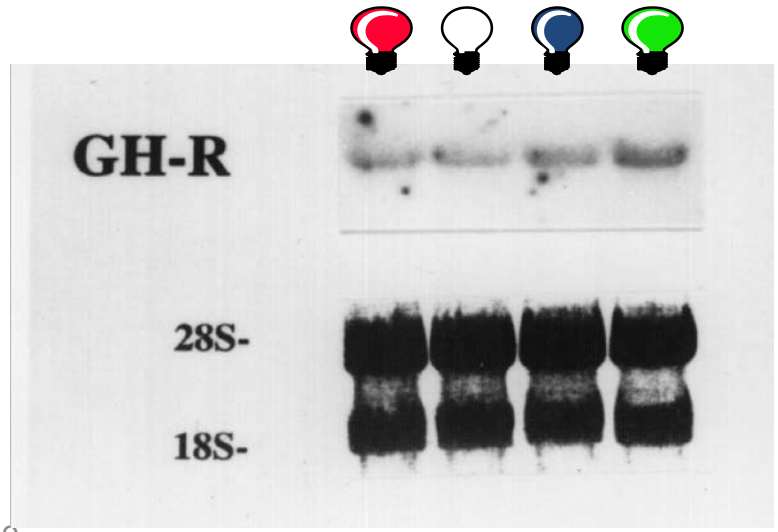

Body Weight (g)
1700
1500
1300
1100
900
700
500
660 nm
White
560 nm
480 nm
b
b
a
a
b
b
a
a
b
b
a
a
20
25
34
Age (days)


Breast muscle weight (g)
200
190
180
170
160
150
b
b
a
ab

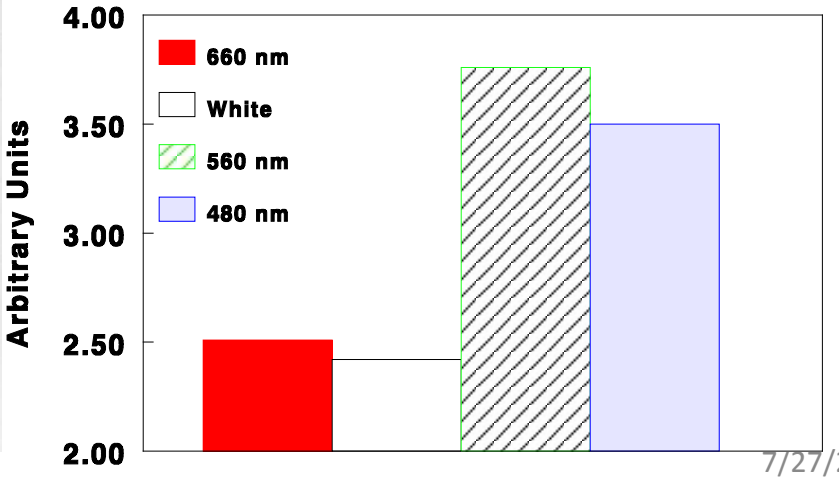
Possible mechanism

Satellite cells

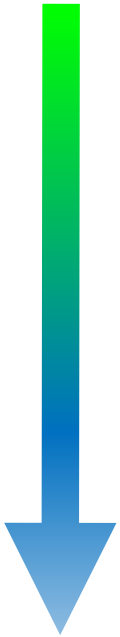




Liver GH receptors

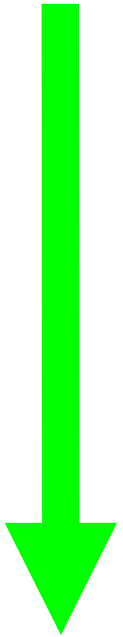


Post Hatch



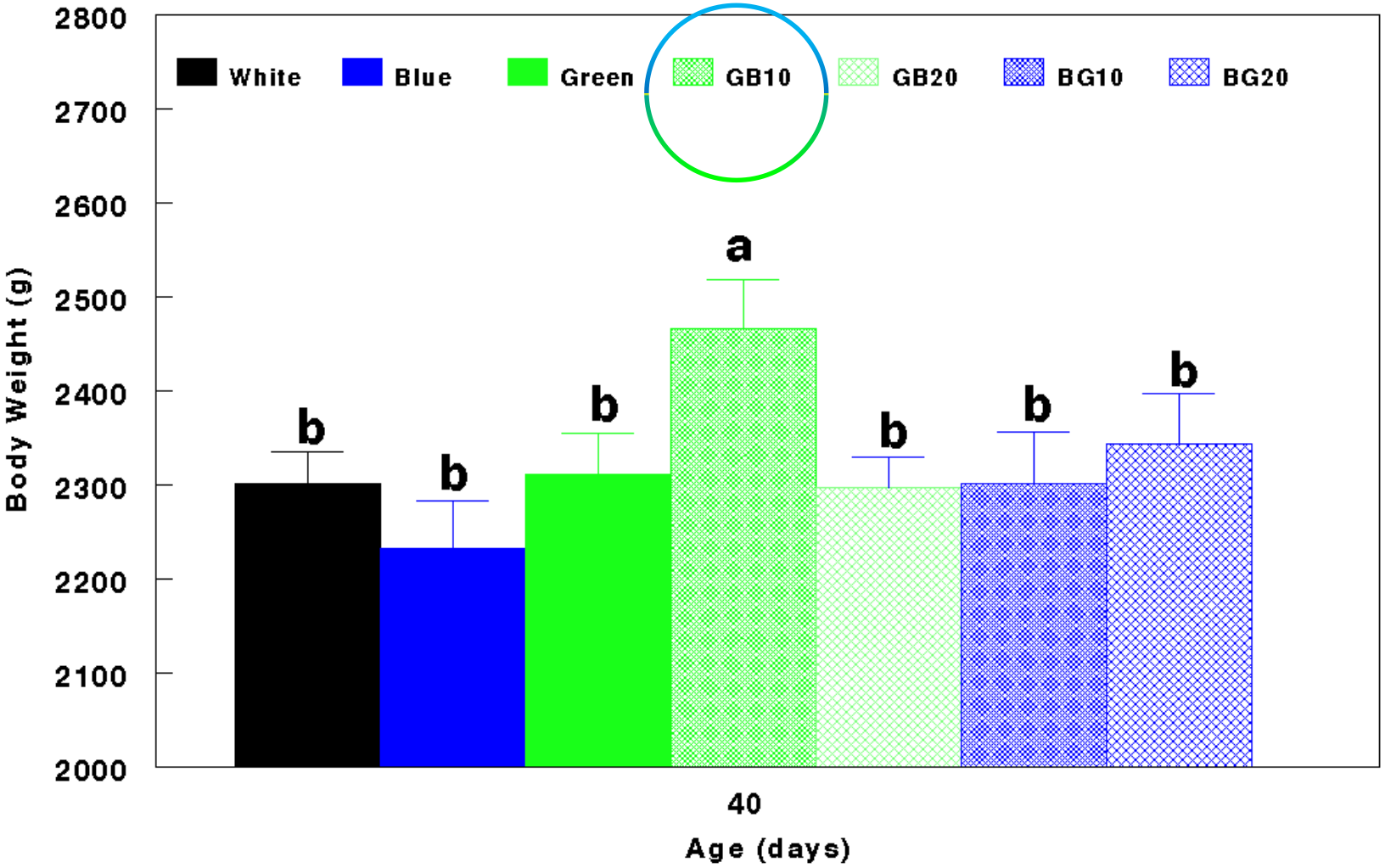
Green Blue photostimulation

In Ovo



In Ovo photostimulation

BW of male broilers (Anak) reared under white (control), 480 nm (blue), 560 nm (green), or switched at 10 and 20 d of age from green to blue light (GB10, GB20) and blue to green light (BG10, BG20)

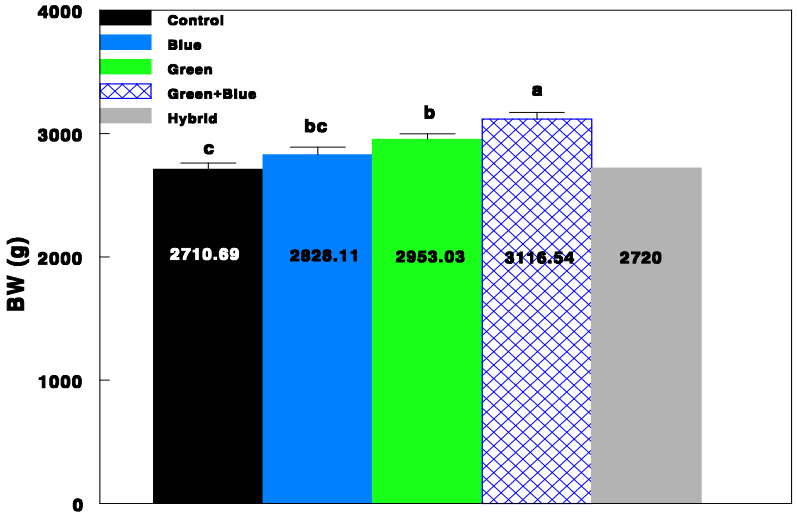




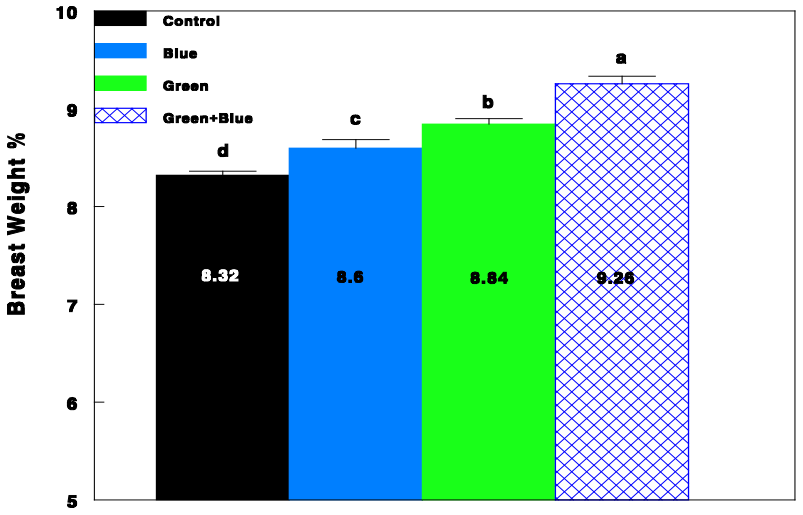


Turkey pullets

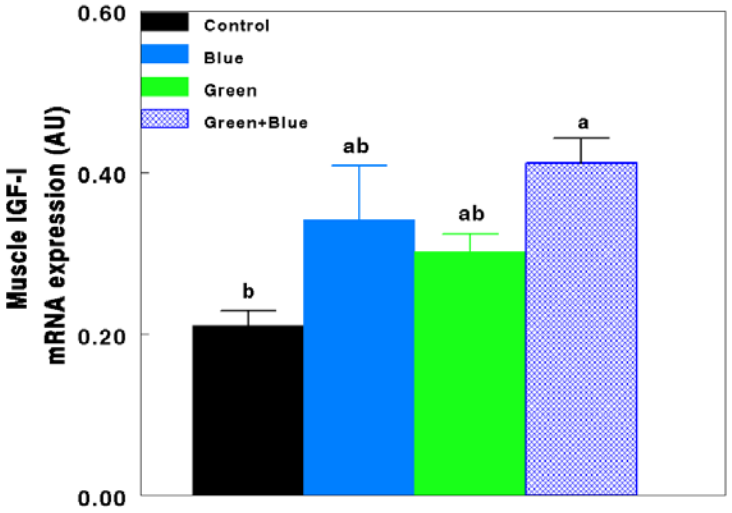
BW (g)



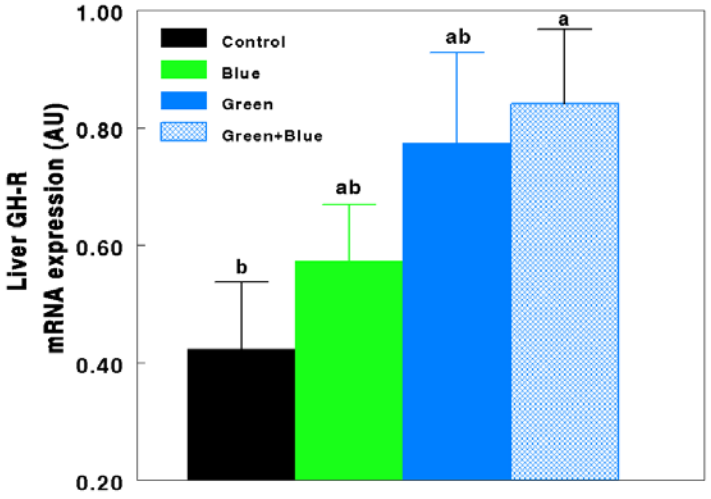
% Pectoralis of BW



Muscle IGF-I (mRNA)



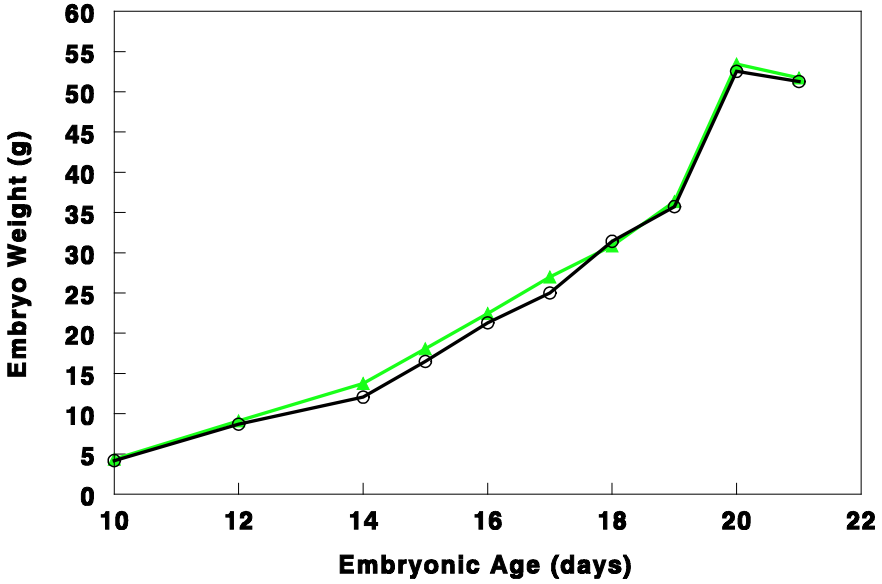
Liver GH Receptors (mRNA)



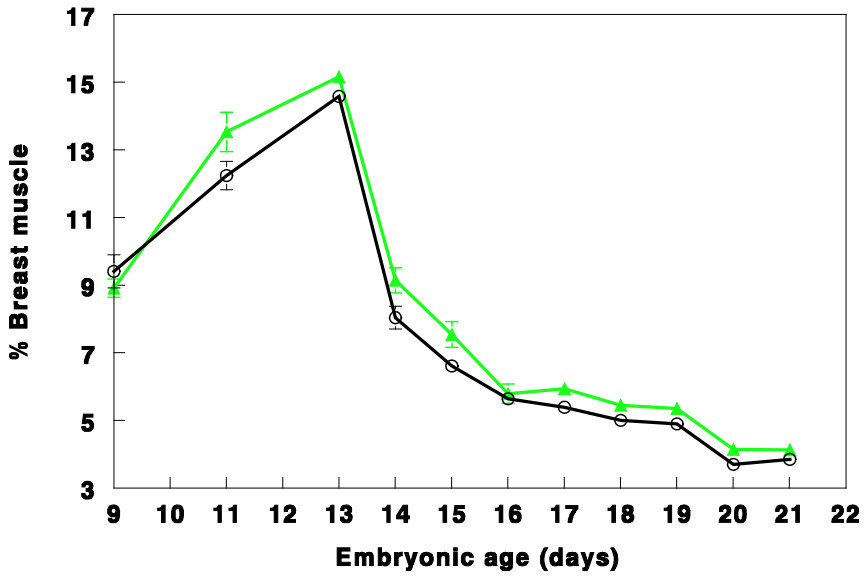
In ovo photostimulation

The effect of intermittent 560 nm photostimulation on:

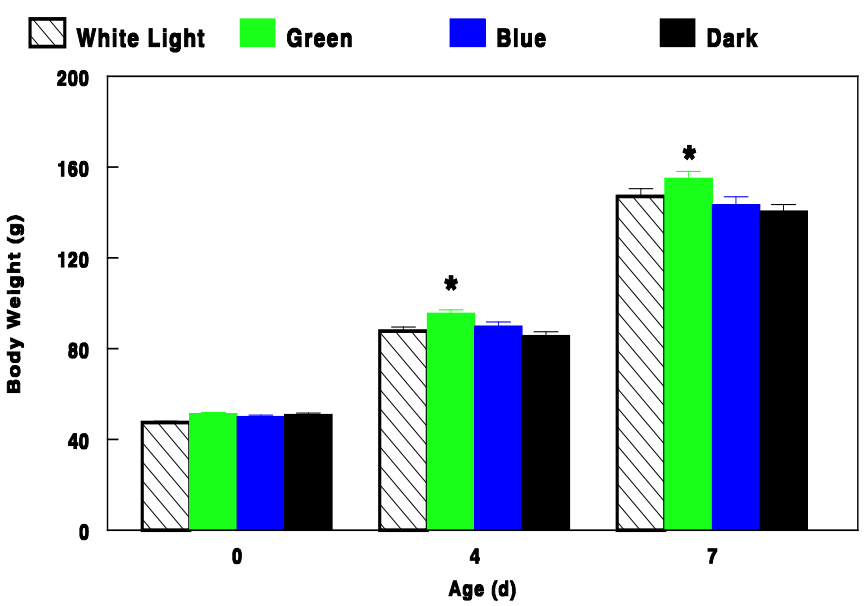
Embryo BW

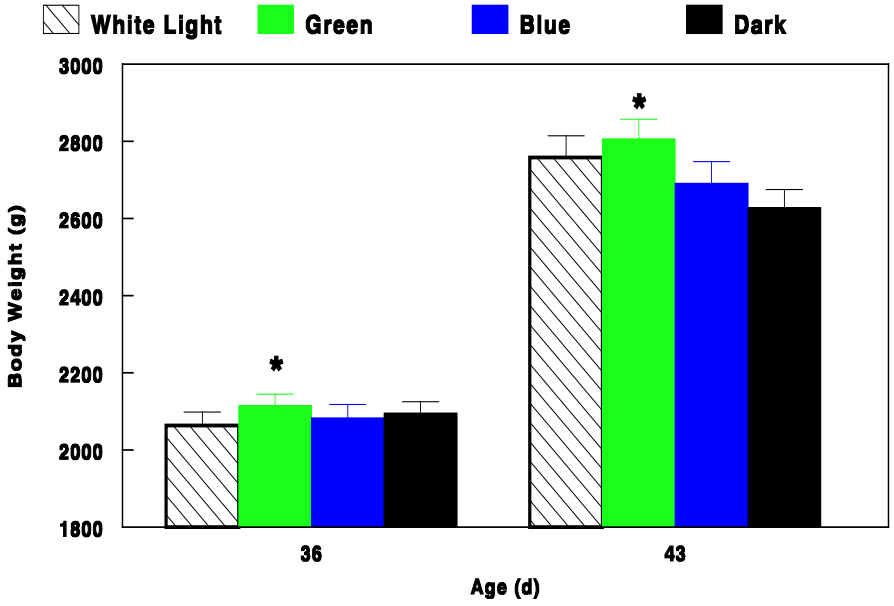


Embryo breast muscle development



The effect of in ovo photostimulation on broiler post hatch growth





Retinal/extra-retinal photoreceptors

?

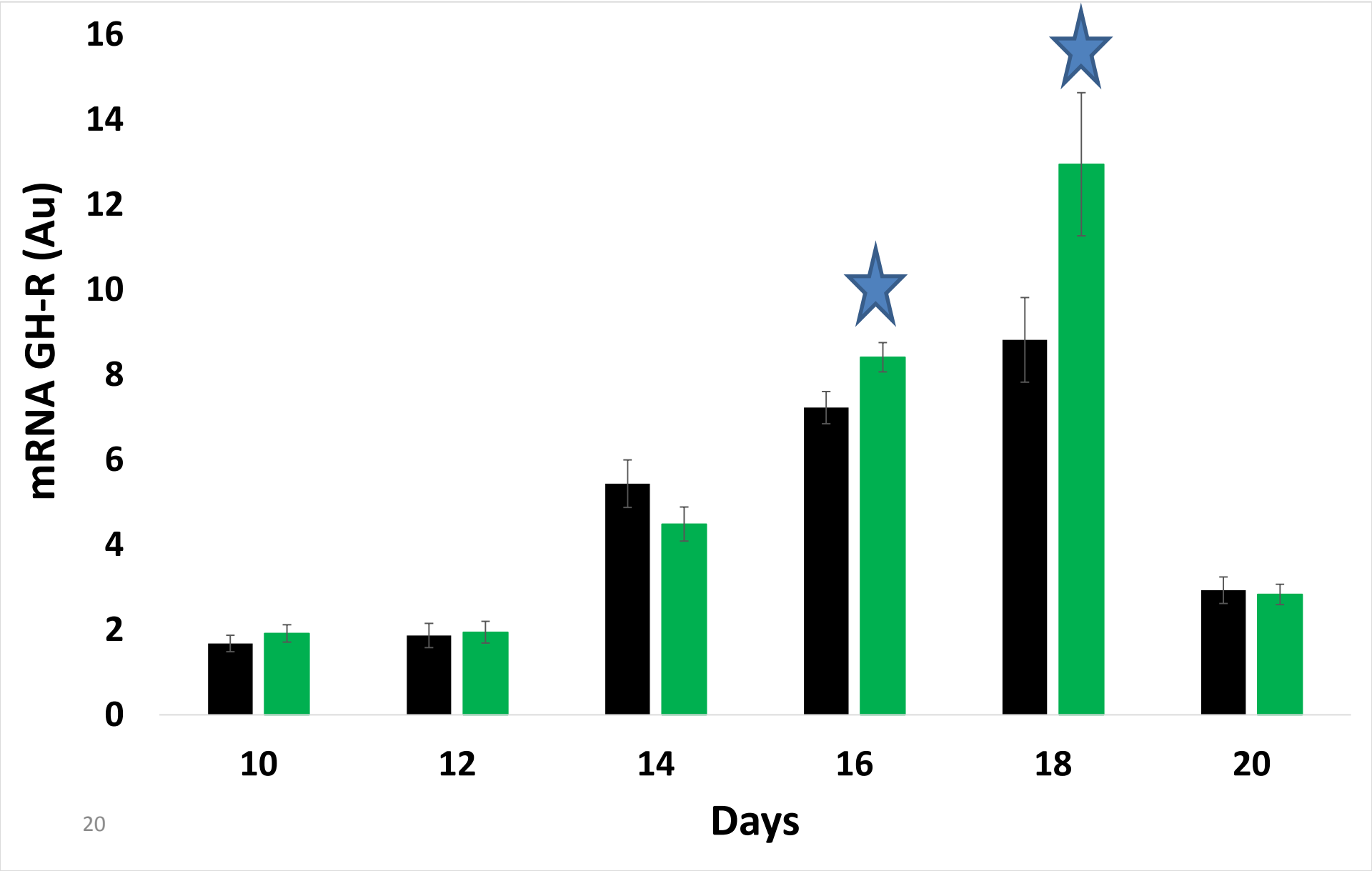
GH receptors

IGF-I
PAX-7
Myogenin

Increase satellite cells number
Increase satellite cells proliferation
Accelerate satellite cells differentiation

Increase muscle development and body growth

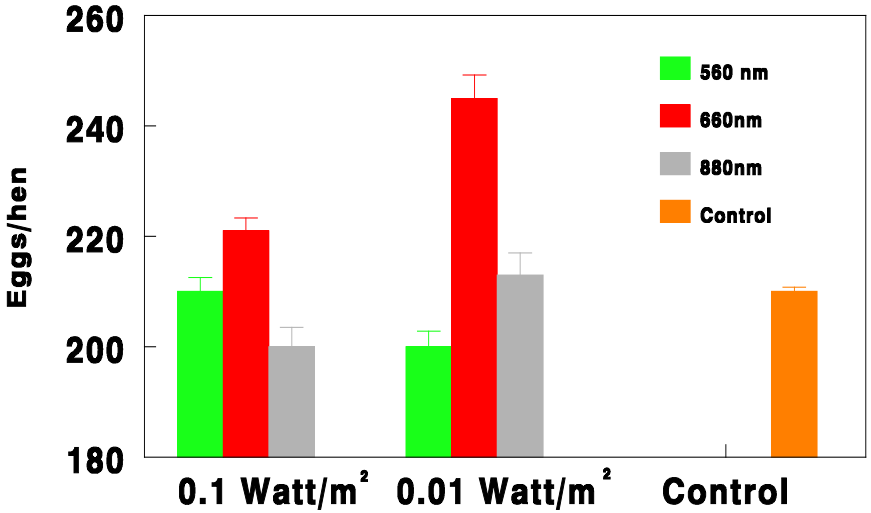
Elevation of GH-R mRNA gene expression

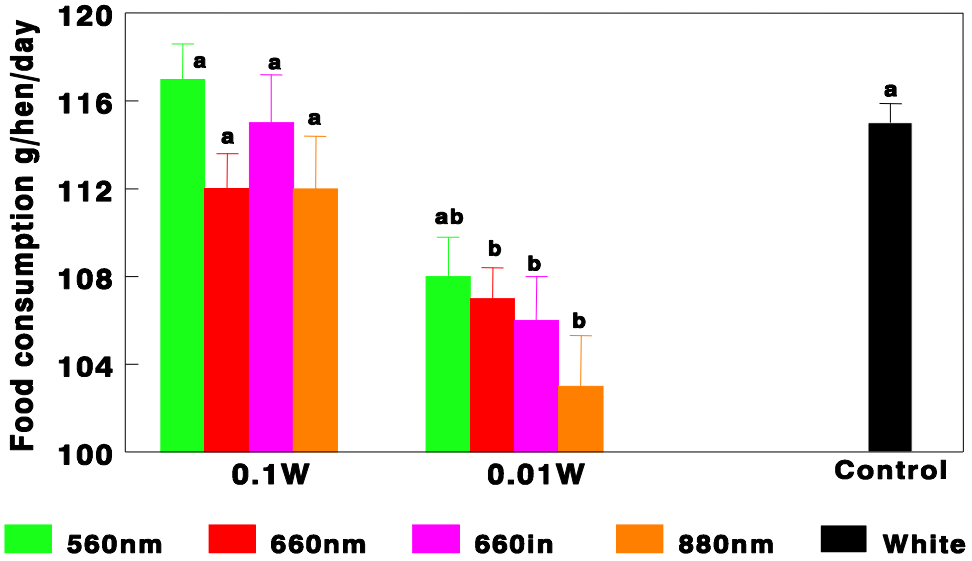


Reproduction

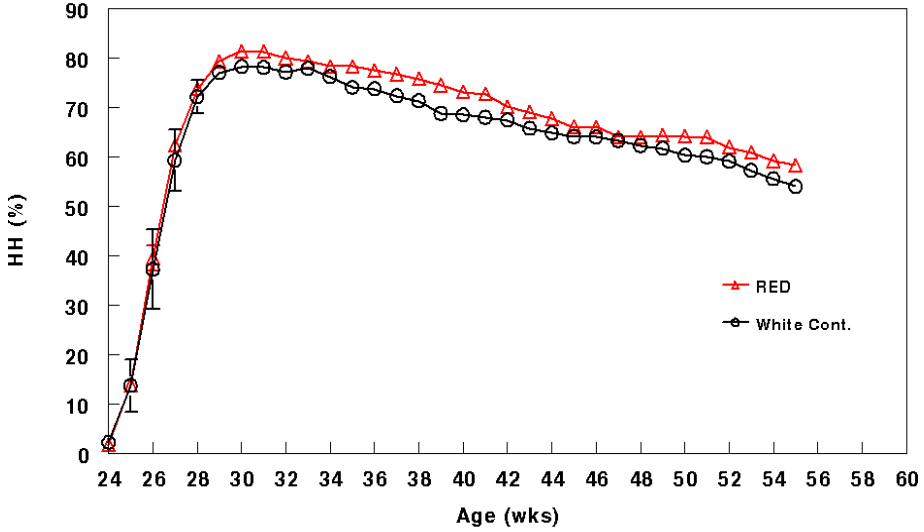
Early studies conducted in our laboratory

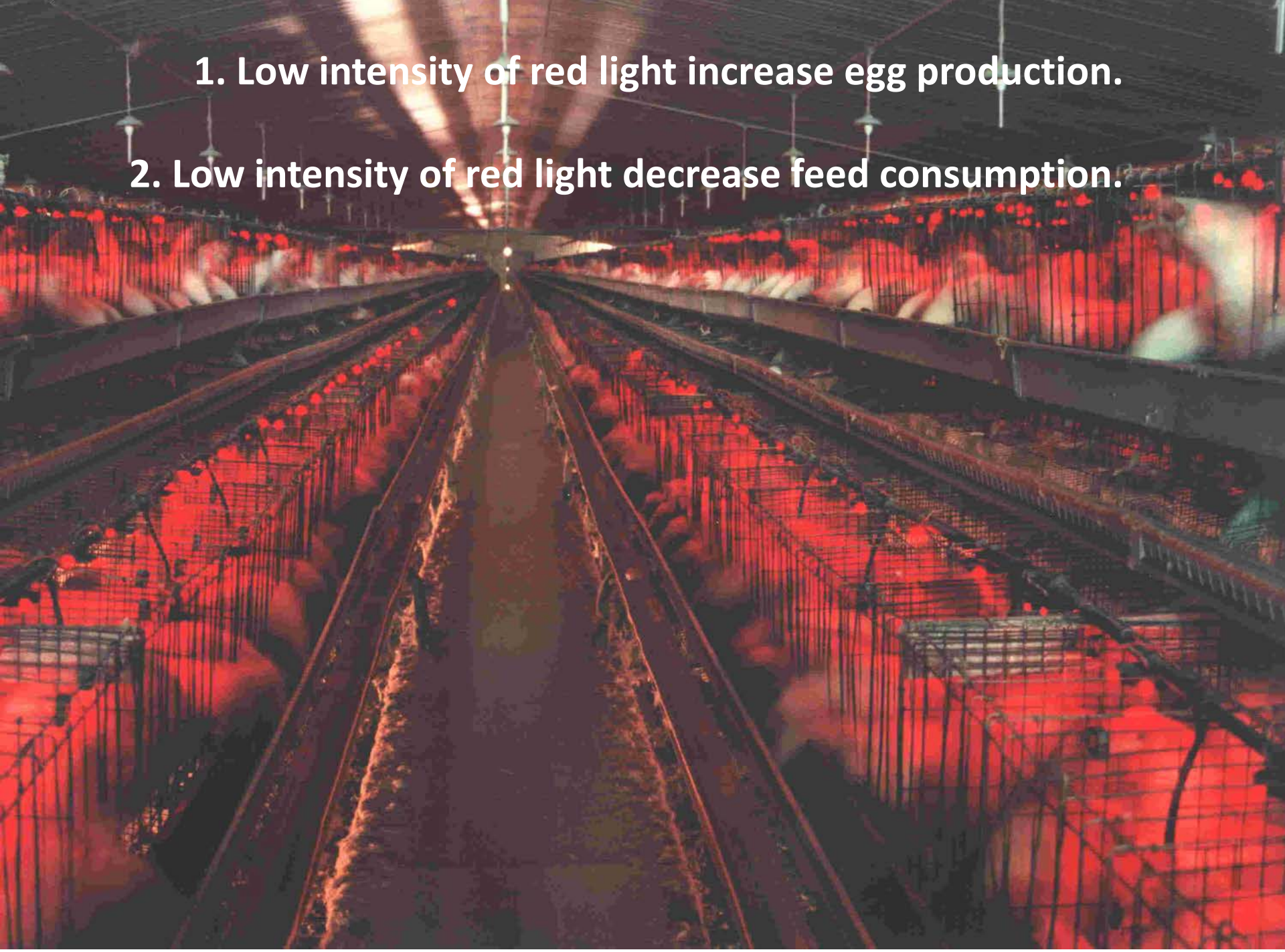
Laying hens:



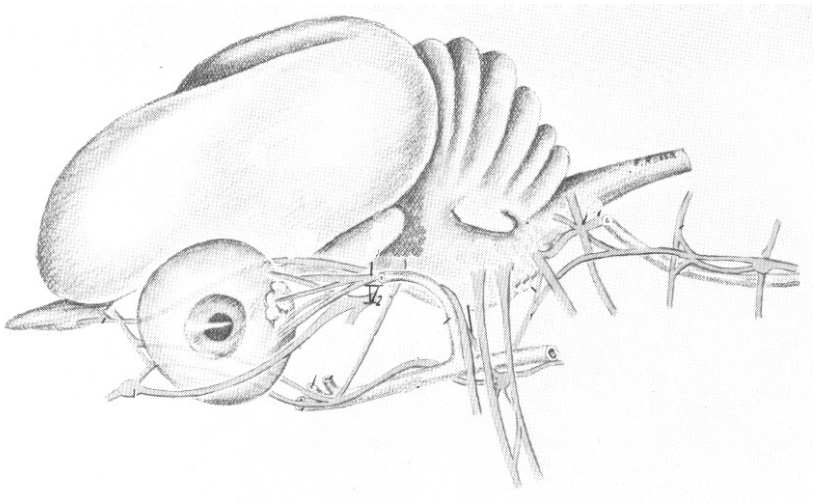


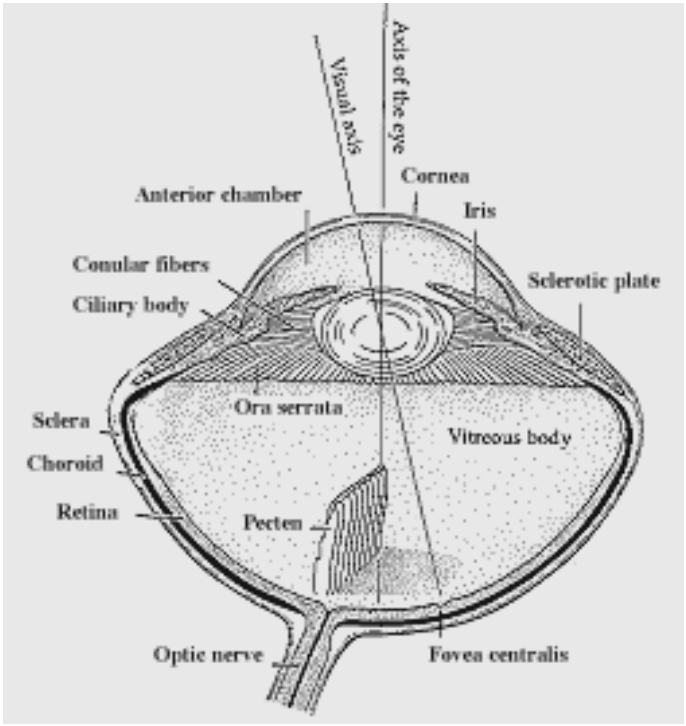
Broiler breeder hens:




1. Low intensity of red light increase egg production.
2. Low intensity of red light decrease feed consumption.

Back to photoreception





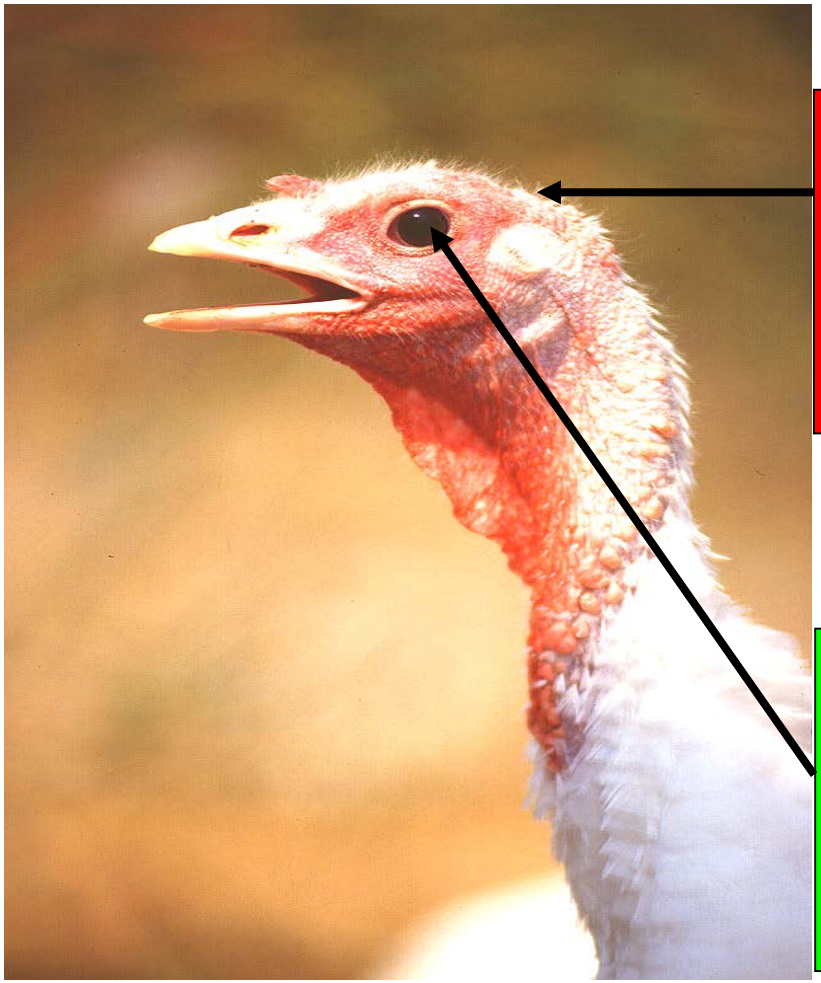
Brightness Vs Intensity

Brightness is dependent upon stimulation of **retina photoreceptors** by green-yellow bands.

Extra-retinal photoreceptors are activated by long wavelength (red bends).

What are the relationships between retinal and extra retinal photoreceptors?

We hypothesize



Brain (ERPR)

Stimulation of Reproduction

Wavelength: 630-730 nm – red band; Energy of 0.1 Watt/m^2 equals 2 lux.

Eye (Retinal)

Inhibition of Reproduction

Wavelength 500-600 nm – green yellow band; Energy of 0.1 Watt/m^2 equals 55 lux.

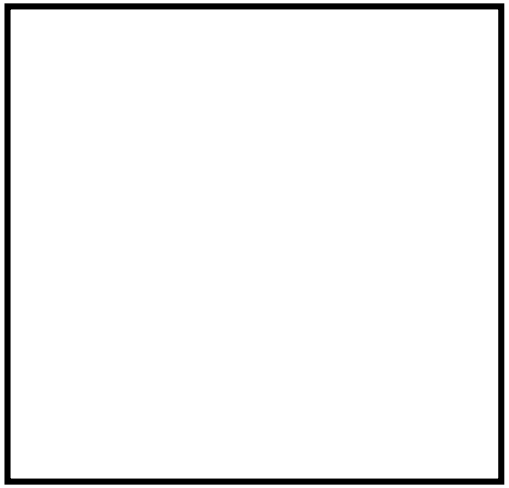

Ora serrata
Vitreous body
Pecten

Reduce retinal photostimulation will elevate reproduction

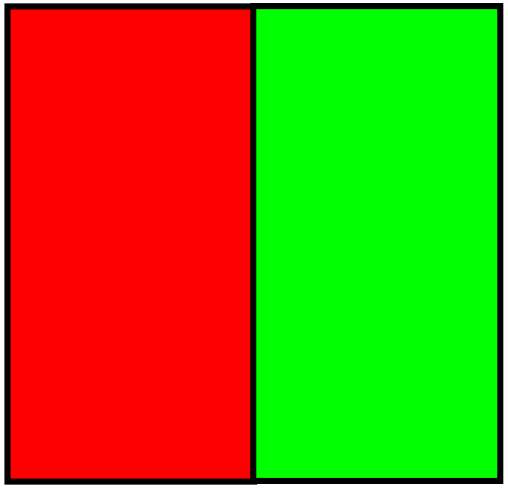
Turkeys

Light treatments

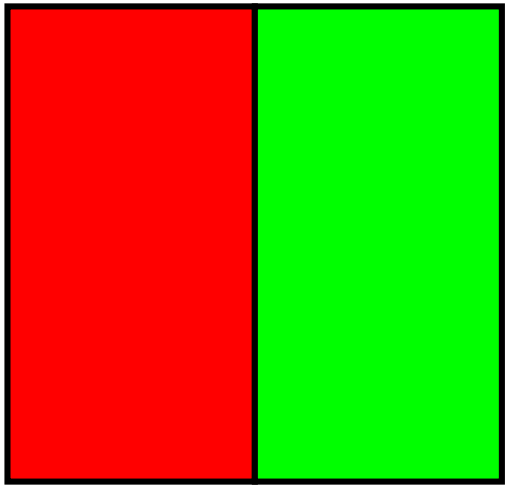
Rooms 1 white control.
Room 2 and 3 - Two parallel light systems Red and Green.
Before photostimulation birds received 6 hr of light, white in Control room and Red+Green in room 2 and 3.



Rooms 1
White Control



Rooms 2
Two parallel lighting systems red and green.



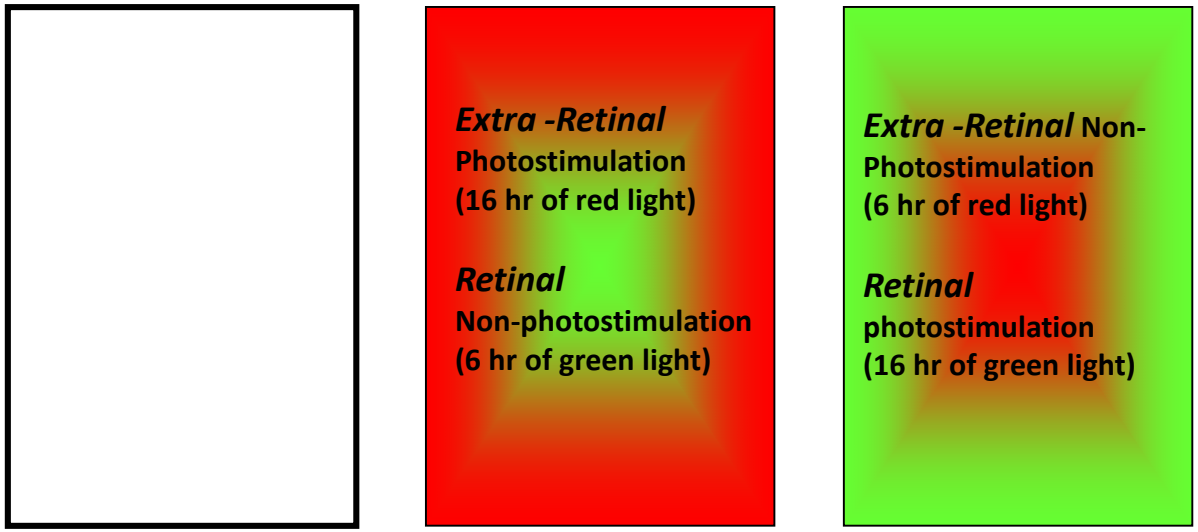
Rooms 3
Two parallel lighting systems red and green.

At photostimulation (30 wks. of age)

Room 1 elevating the white light to 16 hr. of light.

Room 2 elevating red light to 16hr of light leaving the green light at 6 hr. of light.

Room 3 elevating green light to 16 hr. of light leaving red light at 6 hr. of light.

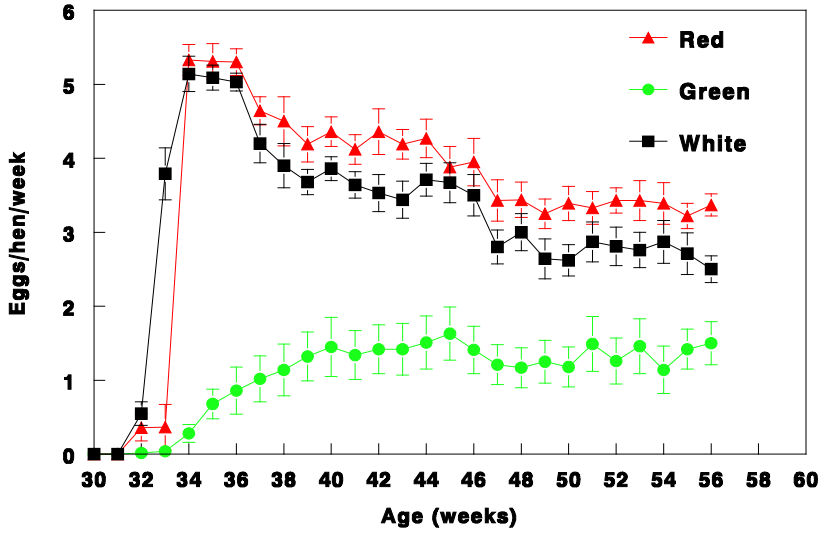


Rooms 1
White Control

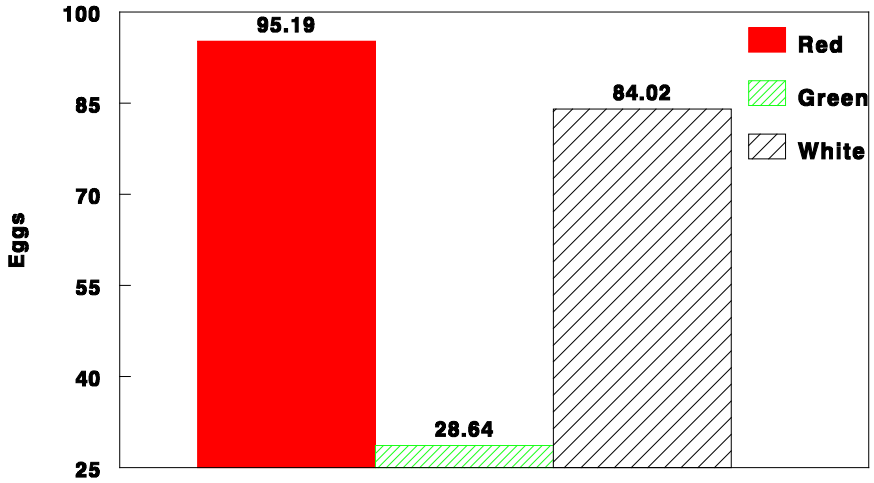
Rooms 2
Red group

Rooms 3
Green group

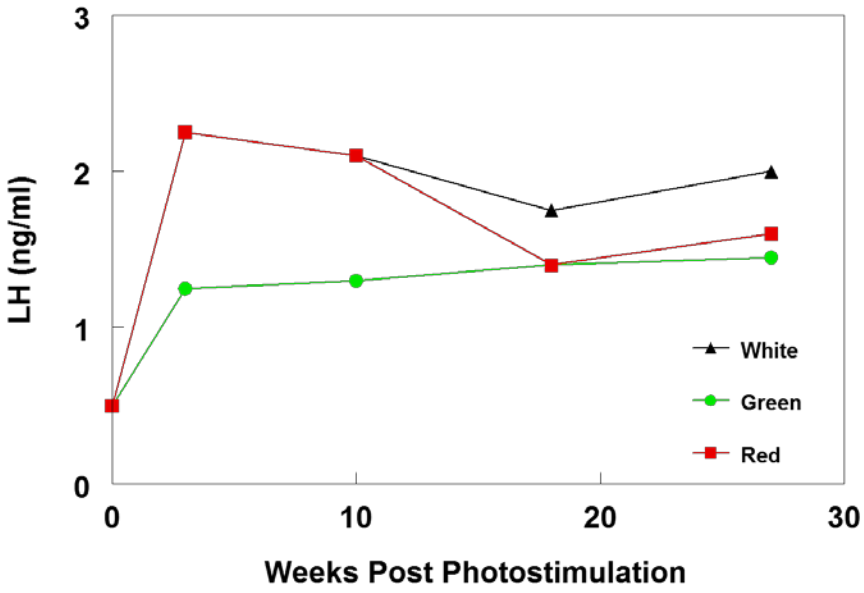
Season egg production



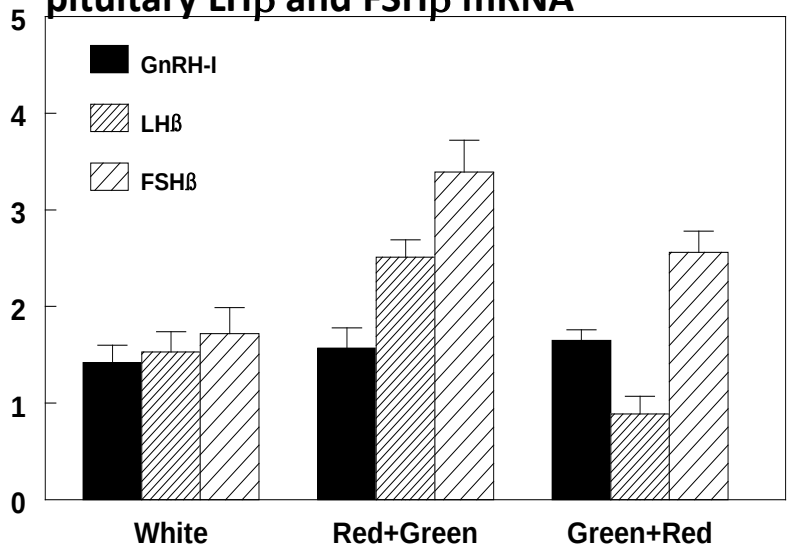
Cumulative egg production



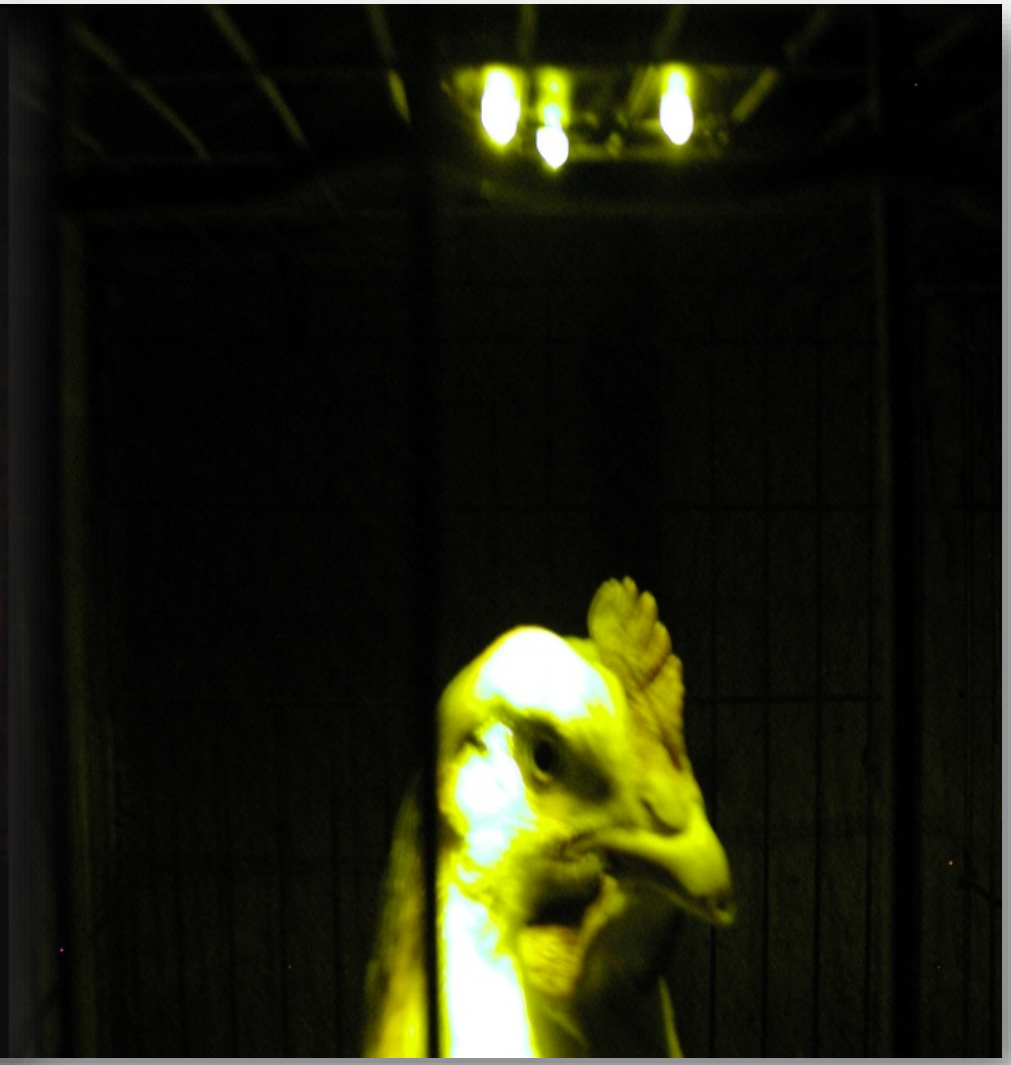
Plasma LH



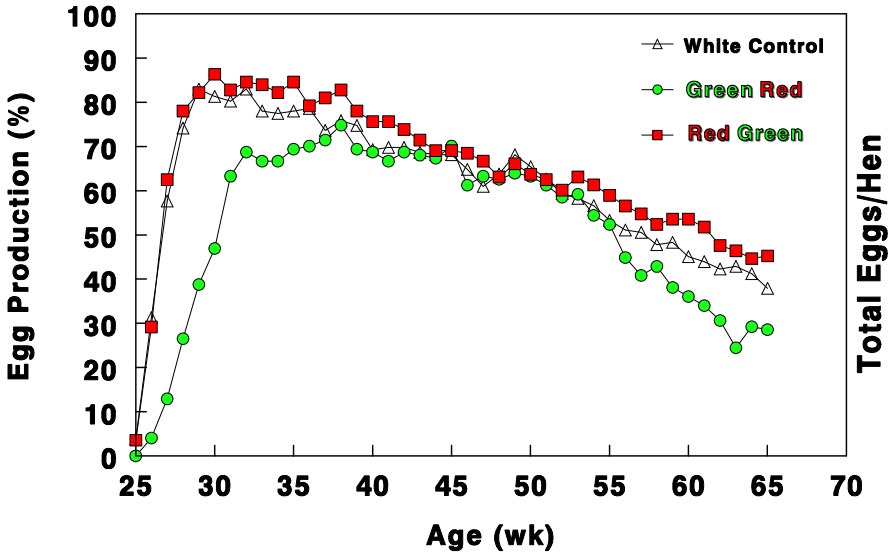
Hypothalamic GnRH-I and pituitary LHβ and FSHβ mRNA

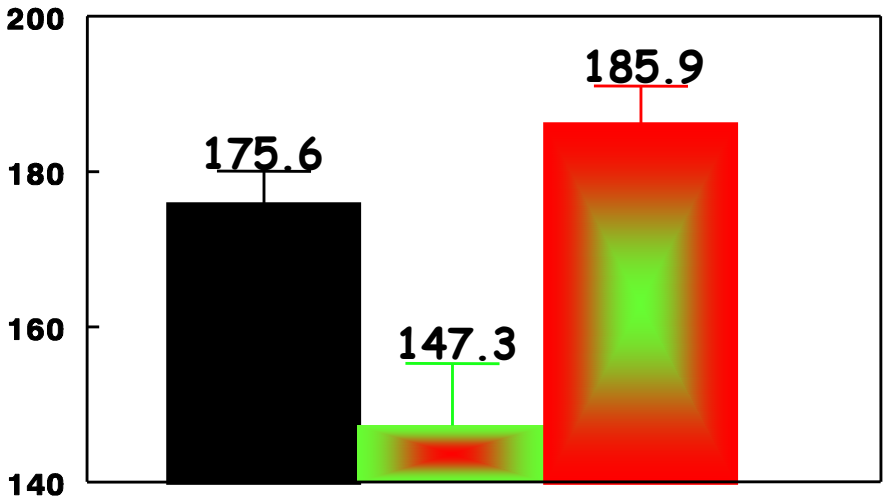


Broiler breeder

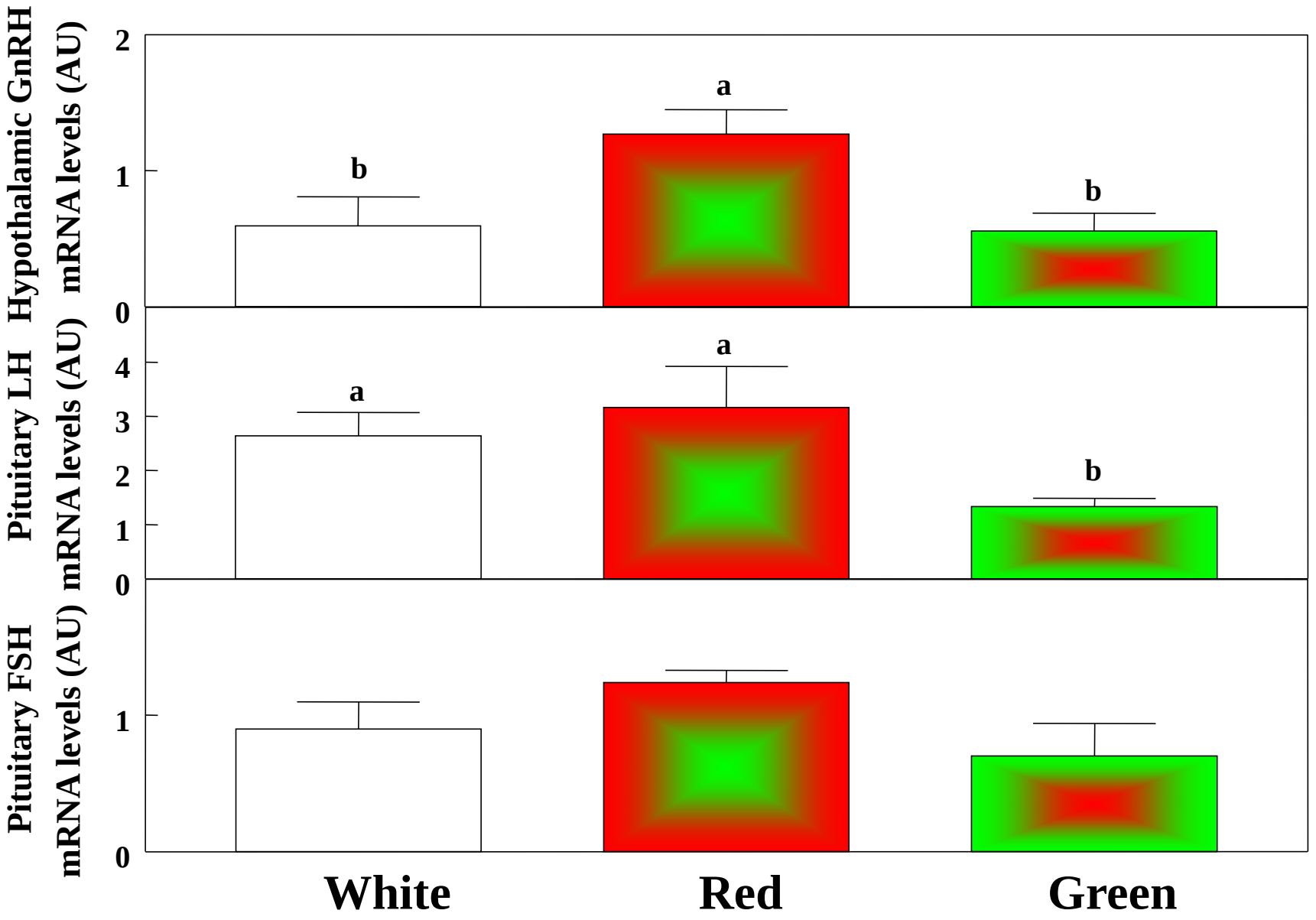


Season egg production





Hypothalamic GnRH-I and pituitary LH and FSH mRNA levels



We conclude

Targeted illumination can accelerate poultry production

In Ovo green and Post hatch green blue photostimulations increase BW by 5-10%.

Selected wavelength photostimulation of retinal and extra-retinal photoreceptors sites can increase reproduction by 10%.

Big thank you to colleagues and students

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