CACAO CELL CULTURES: A CONTROLLED SYSTEM TO STUDY FLAVONOID PRODUCTION

Adriana Gallego

Universidad de Antioquia
Medellín, Colombia
adriana.gallego.02@gmail.com

Co-authors
Luisa Rojas, Alejandro Rodríguez, Oriana Parra, Aura Urrea, Lucia Atehortúa, Camilo Mazo, Mark Guiltinan, Siela Maximova, Natalia Pabón-Mora

UNIVERSIDAD DE ANTIOQUIA 1803

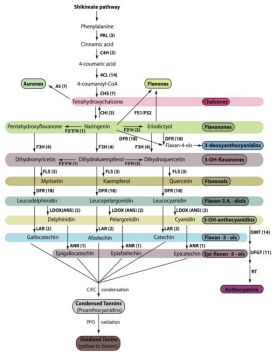
PennState

International Symposium on Cocoa Research

Cacao flavonoids are important in plant defense and human health, but are lost during manufacturing

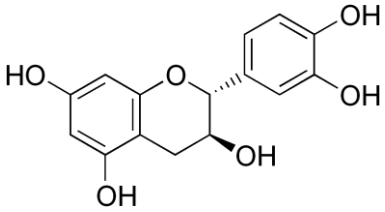
30% decrease flavonoid content

45% antioxidant activity



Simple and controlled

Traditional chocolate



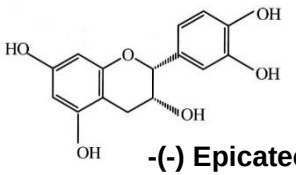
Biomass rich in flavonoids from cell cultures

chocolife

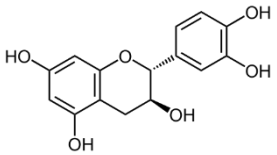
Healthier chocolate rich in flavonoids

Nehlig, 2013; Rostami *et al.,* 2015

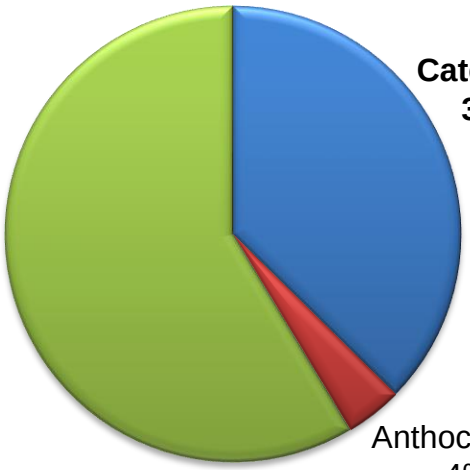
Regulation of flavonoids is very complex



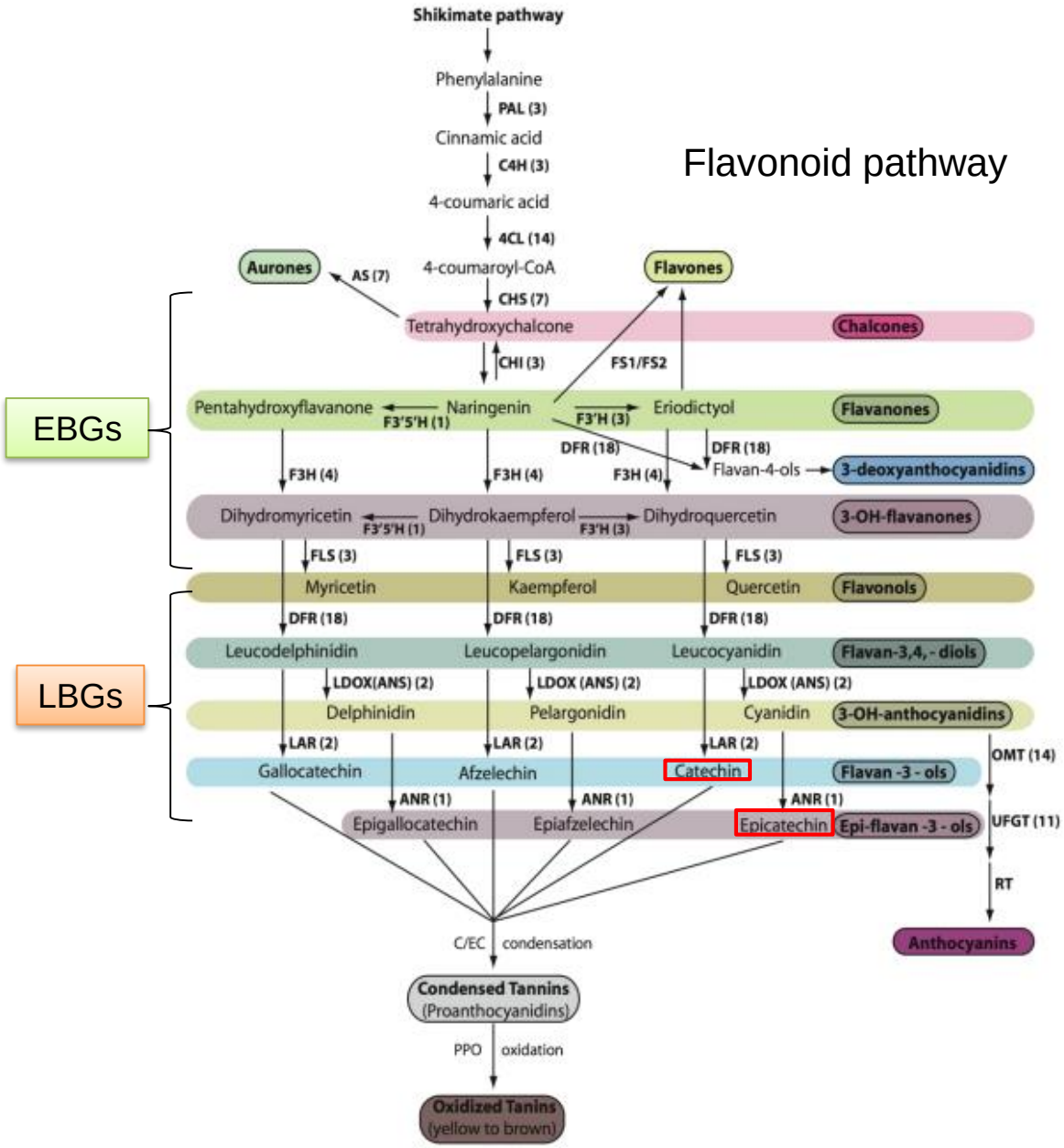
-(-) Epicatechin



+(-) Catechin



Flavonoid pathway



Argout *et al.*, 2011: Grain *et al.*, 2013

Light is one the main factors affecting growth and flavonoid production in cell suspensions

LEDs lights (Light Emmiting Diodes)

1

UV-A/Blue light | Blue light | Red/Far light

CRYs | PHOTs | PHYs

COP10 | COP1

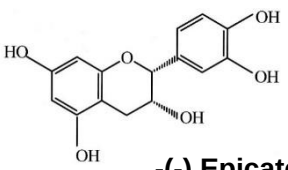
HY5

2

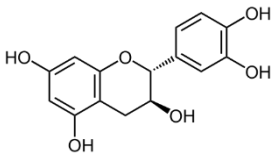
MYB-bHLH-WD40

3

Structural genes
(CHS, DFR, F3H, ANS, UFGT)



-(-) Epicatechin



+(-) Catechin

Wavelengths

Photoreceptors

Light-responsive genes

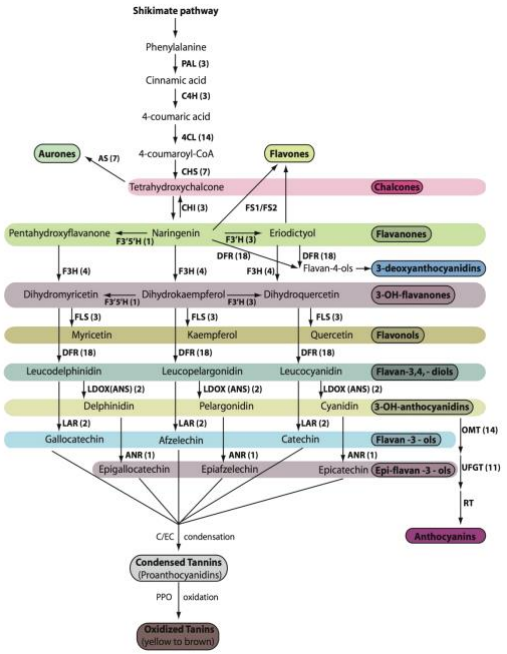
Regulatory genes

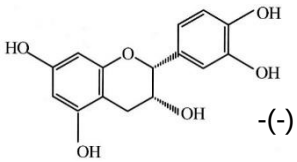
Structural genes

Rojas *et al.,* 2015; Zhang *et al.,* 2016

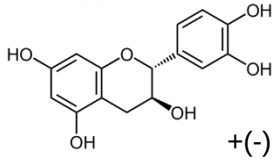
Main Objective

To determine the link between transcriptional regulation underlying flavonoid accumulation in response to light changes in cacao cell suspensions.





-(-) Epicatechin



+(-) Catechin

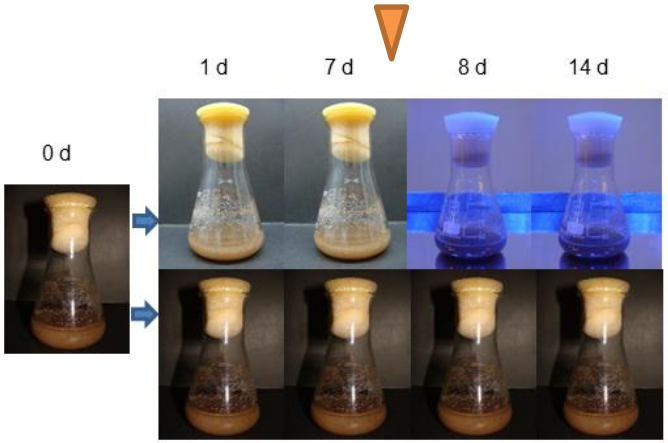
Methodology

Plant material

Enzymatic treatments of seeds

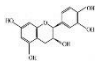
Cell suspension establishment

Add media

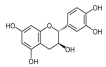


10 Subcultures

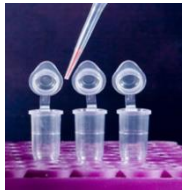
Polyphenols, catechins



-(-) Epicatechin

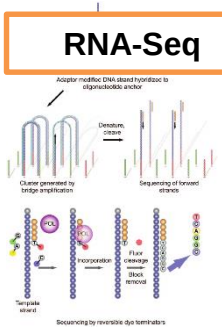


+(-) Catechin



RNA extraction

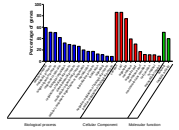
Sequencing

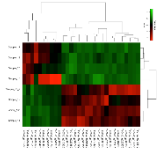


Bioinformatic analysis

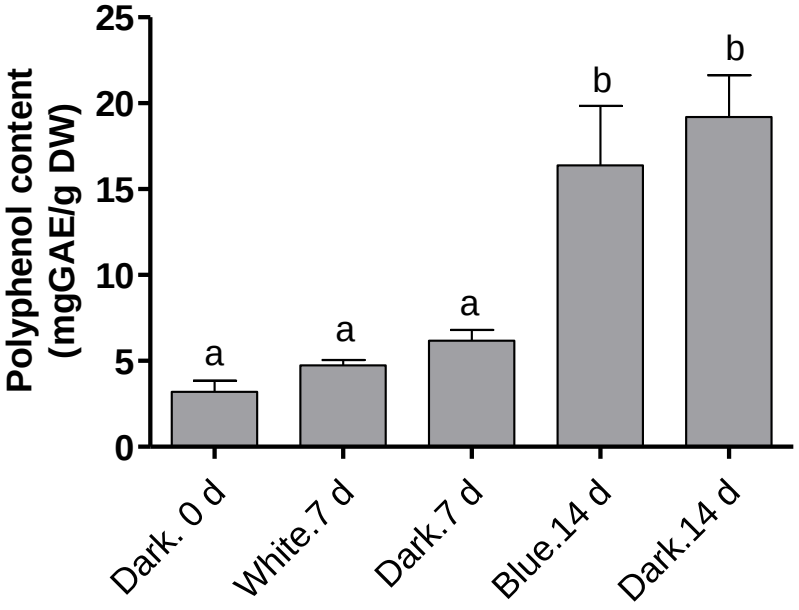
DEGs

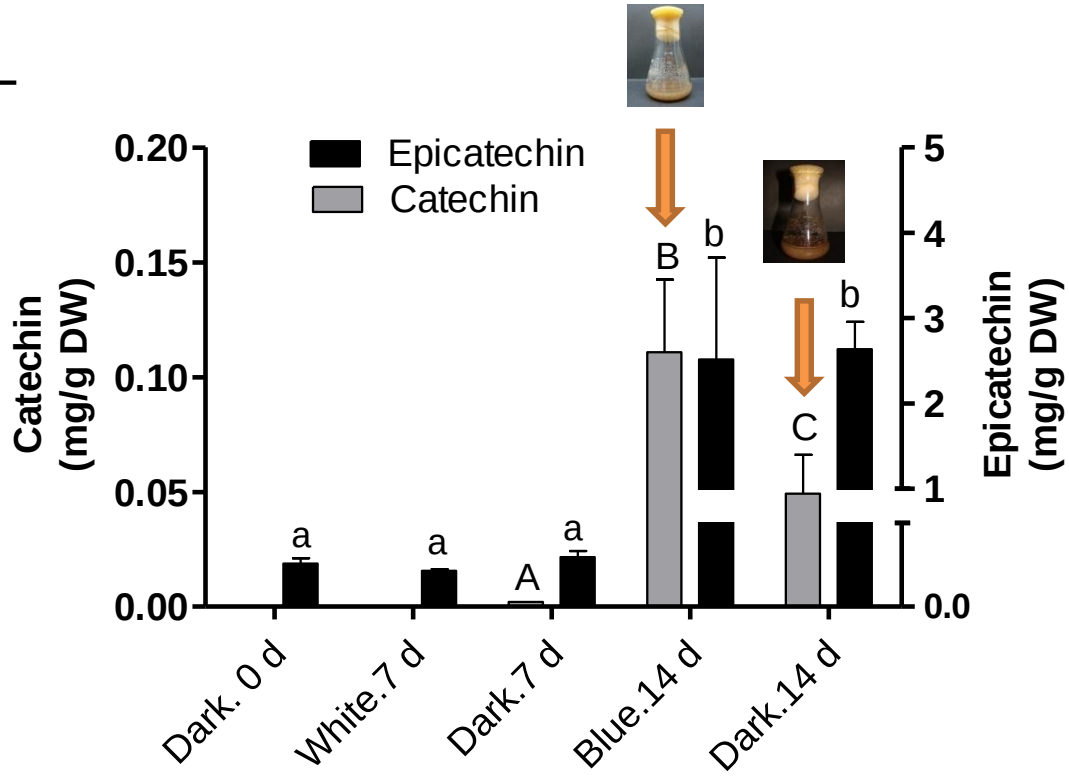
Flavonoid/Light/ Transcription factors genes



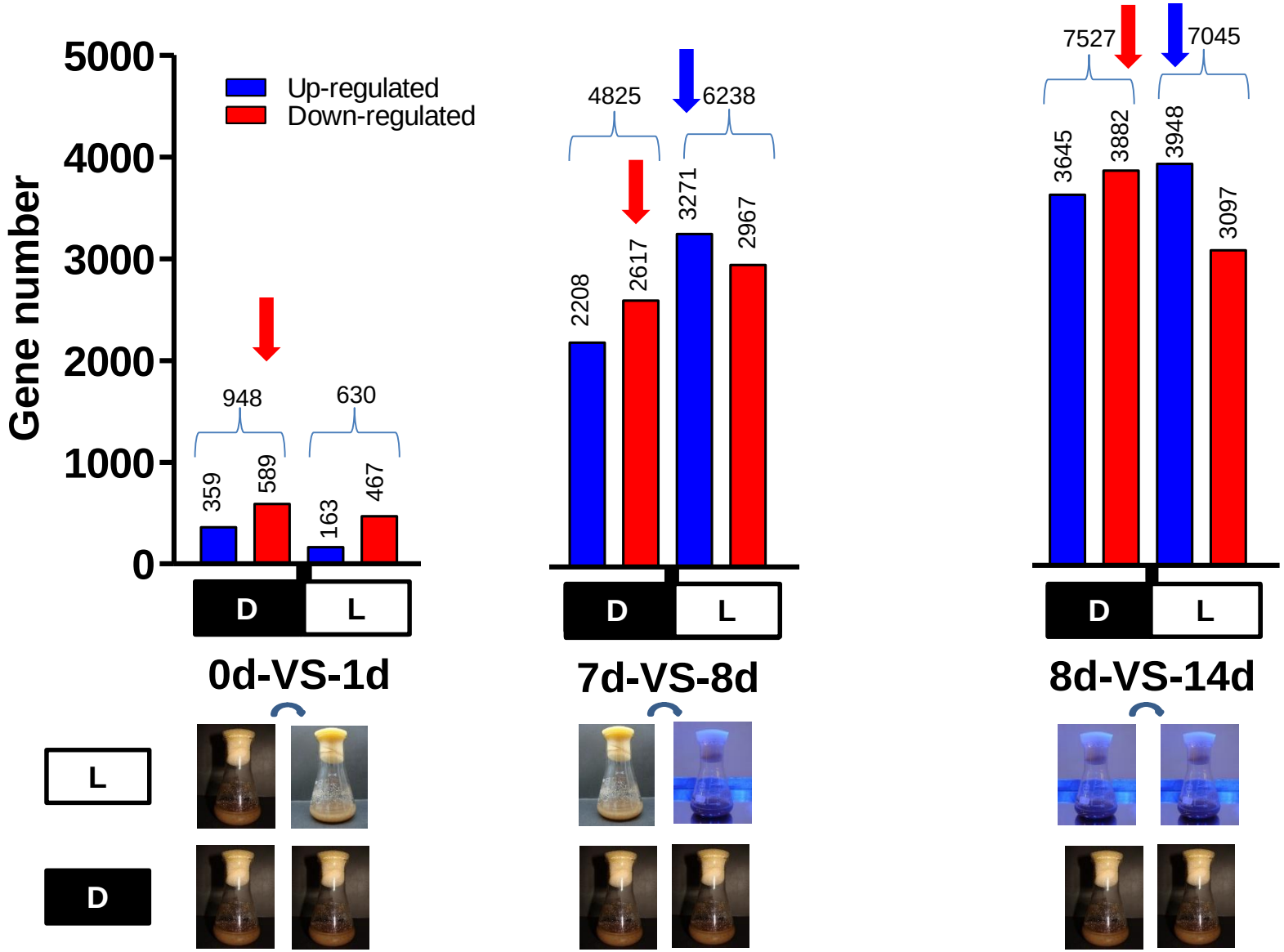


Catechins profile is differentially regulated by light treatments

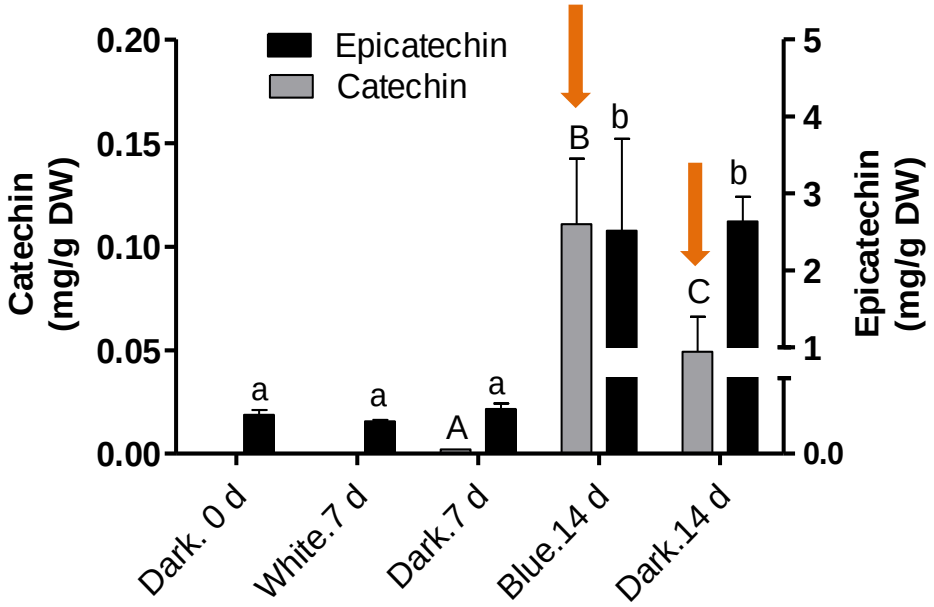




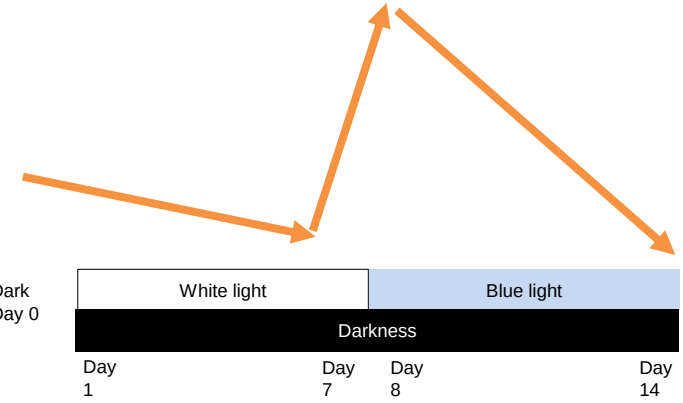
DGEs showed a dynamic pattern across the time course experiment under both treatments L and D

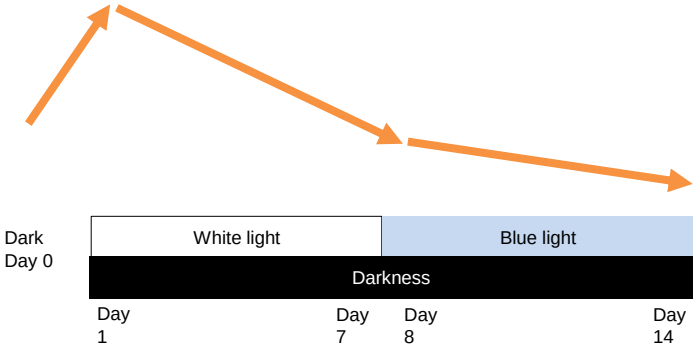


Structural genes of the flavonoid pathway were differentially regulated by light treatments

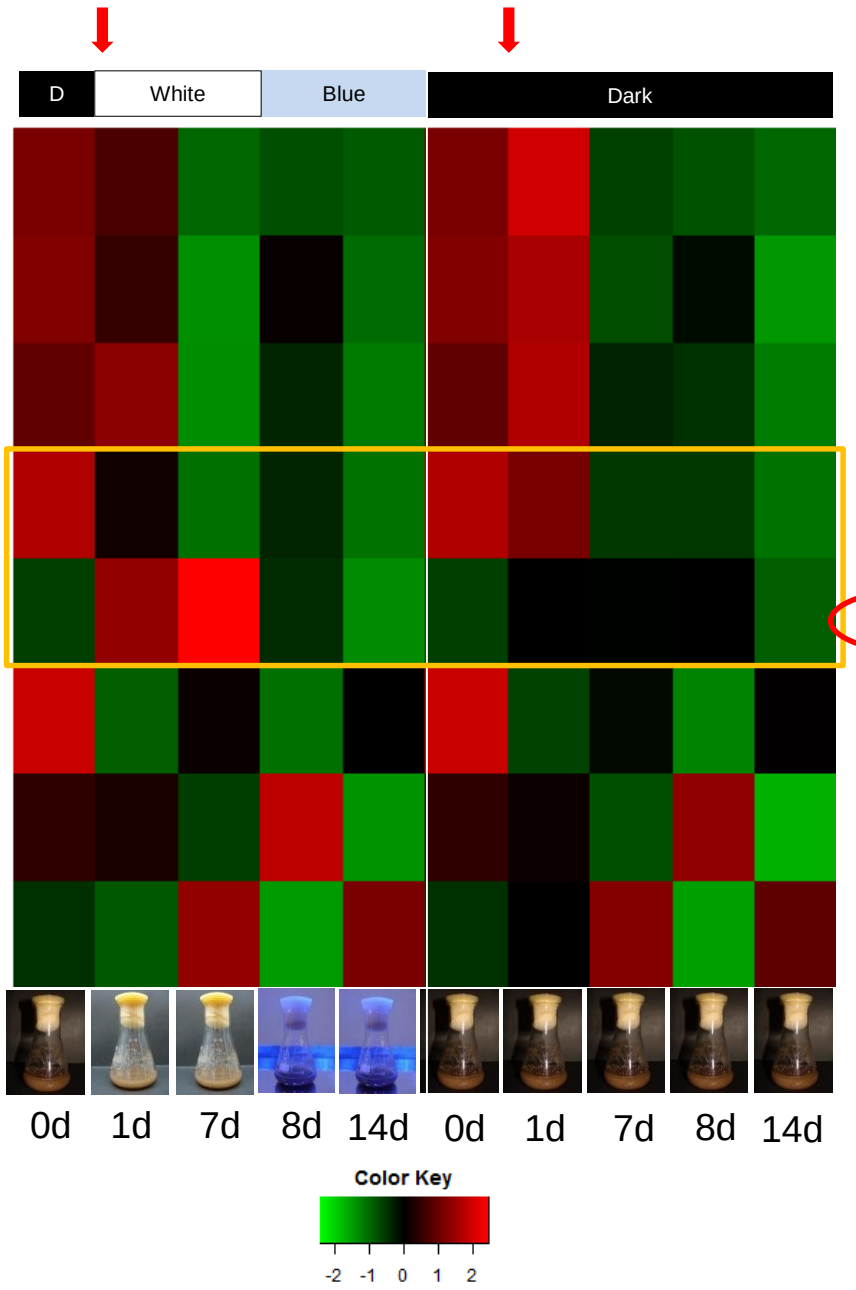


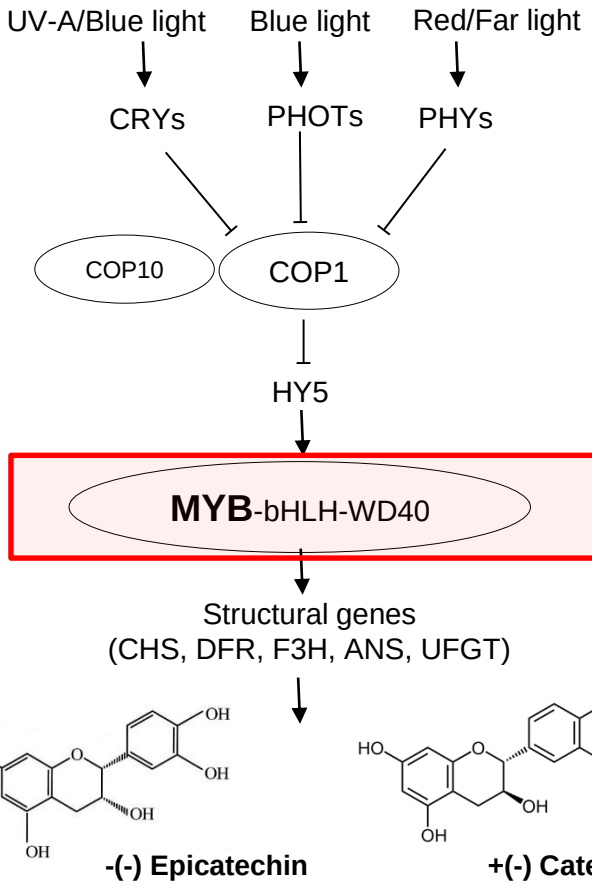
Anthocyanins



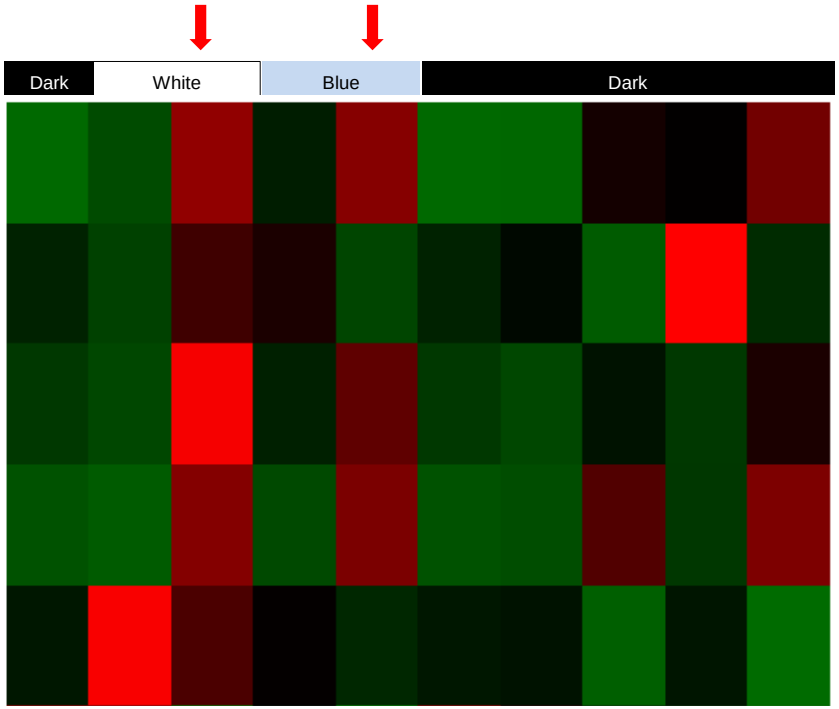


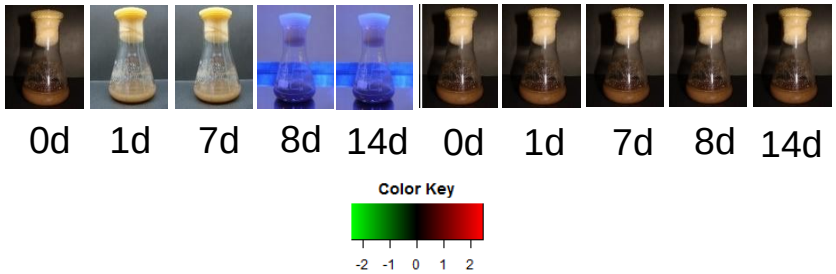
MYB genes associated with flavonoids were enriched in different times under light/dark

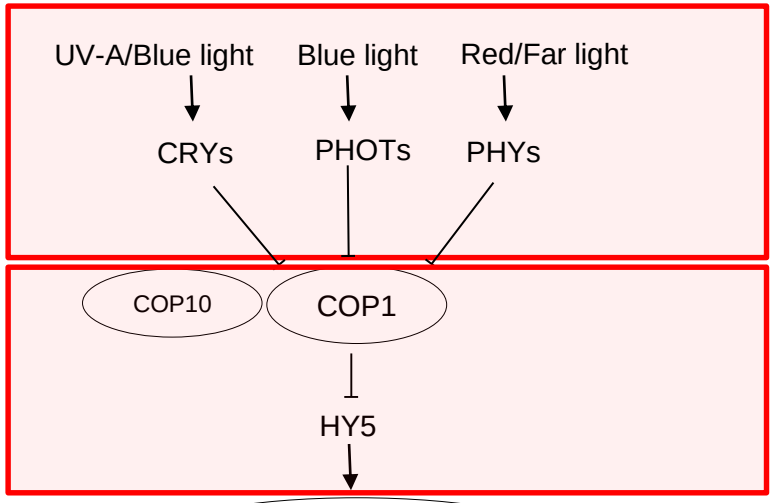


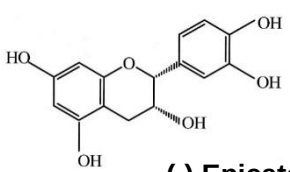


Light signaling genes were enriched in different times under light/dark

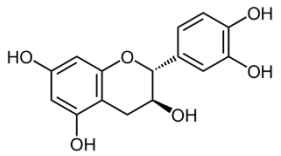








-(-) Epicatechin



+(-) Catechin

Conclusions

In cacao cell cultures:

1. Light treatments dramatically affect gene expression at all regulatory levels (i.e. structural, regulatory and light signaling genes).

2. Major shifts in gene regulation occur from white to blue light treatments.

3. Opposite expression of photoreceptors and downstream effectors known to occur in the pathway can be completely recovered in vitro.

4. From the MYB transcription factors, only MYB12 is upregulated in light treatments

5. Light can effectively regulate flavonoid profiles as it changes catechin to epicatechin ratios.

Acknowledgements

Universidad de Antioquia, Colombia

Grupo de Biotecnología, Universidad de Antioquia

Innovation complex Ruta N, Colombia

Guiltinan – Maximova lab, Penn State University

Penn state University, USA

Grupo Evo-Devo, Universidad de Antioquia

Compañía Nacional de Chocolates, Colombia