#142-Kuhn

Influence of Colored Light on the Metabolic Activity of E. coli

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Introduction

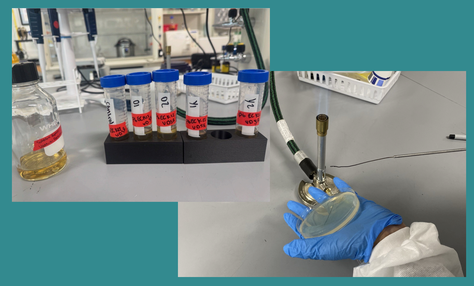
- The study explores how different light wavelengths affect E. coli, a non-photosynthetic bacterium.
- It aims to understand how colored lights influence E. coli metabolism, with potential applications in food production and medicine.
- E. coli was placed on nutrient agar plates and exposed to various light colors for 24 hours.
- The hypothesis: light exposure may alter E. coli's metabolic activity, including glucose use or CO_2 production.
- Research question: How is E. coli's metabolite usage affected by different light colors?

Results

- E. coli growth under different light wavelengths was assessed over 24 hours using OD600 measurements.
- Red light showed the highest OD600 (2.189 A), indicating no negative impact on growth.
- Orange and yellow light supported growth similar to the control.
- Green (475 nm) and blue (470 nm) light significantly reduced bacterial growth.
- Green, blue, and violet light exposures showed lower OD600 and bacterial density.
- %T (transparency) values were inversely related to OD600; lower %T in red, orange, and yellow light indicated higher bacterial density.
- High %T in green, blue, and violet light suggested little to no bacterial presence.
- Results were consistent across trials, confirming distinct effects of different light wavelengths on E. coli metabolism.

Methodology

To start the study, we prepared LB agar plates and broth to grow E. coli, using LB agar as a nutrient-rich solid medium.

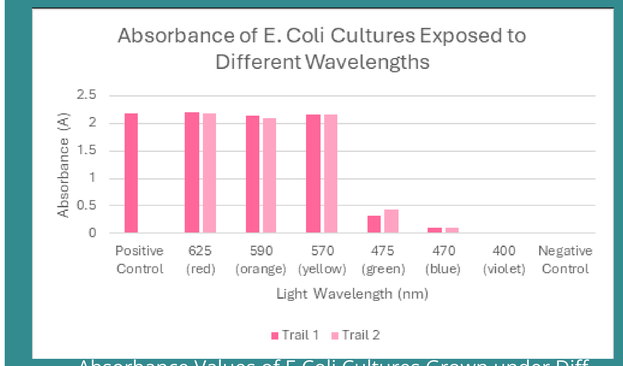


A frozen E. coli stock was streaked on LB agar for single colonies. After 24 hours at 37°C, one colony was inoculated into LB broth and grown for 22 hours to reach the log phase for metabolic analysis.

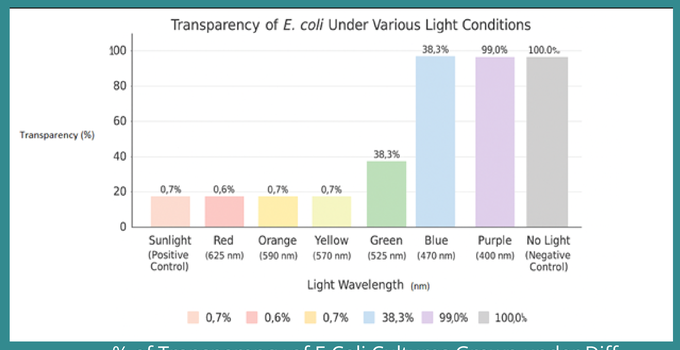
Six chambers, each with LED strips for a specific wavelength (red to violet), were tested for light stability and placed in an incubator covered with a black light-blocking bag to isolate light as the only variable.

Bacterial growth was measured via OD600 using a spectrophotometer. Samples were resuspended in 1 mL sterile water, with fresh cuvettes and tips used to avoid contamination.

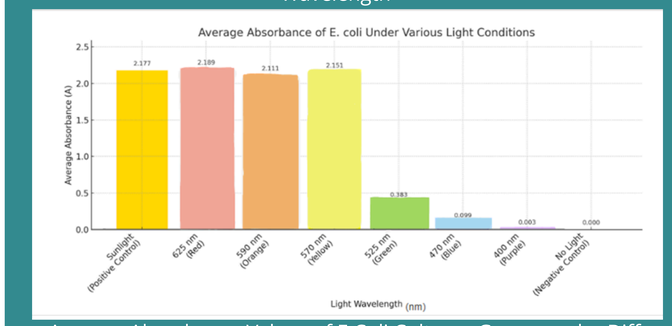
Graphs and Charts



Absorbance Values of E.Coli Cultures Grown under Diff. Wavelength



% of Transparency of E.Coli Cultures Grown under Diff. Wavelengths



Average Absorbance Values of E.Coli Cultures Grown under Diff. Wavelength

	Positive Control	Red	Orange	Yellow	Green	Blue	Purple	Negative Control
Trail 1	2.177A	2.192A	2.135A	2.154A	0.333A	0.099A	0.006A	0.000A
	0.7%T	0.6%T	0.7%T	0.7%T	46.5%T	79.5%T	98.60%	100.0%T
Trail 2		2.187A	2.086A	2.148A	0.432A	0.099A	0.000A	0.000A
		0.7%T	0.8%T	0.7%T	32.70%	98.4%T	99.9%T	100.0%T
Average Absorbance	2.177A	2.1895A	2.1105A	2.151A	0.3825A	0.099A	0.003A	0.000A

Data Table of OD600 Data of E.Coli Cultures Grown under Diff. Wavelength

Conclusion

- The study focused on how light wavelength, particularly blue and violet, affects E. coli metabolism.
- Hypothesis: blue and violet light induce oxidative stress or electron transport chain damage, shifting metabolism toward survival over growth.
- Shorter wavelengths may degrade membrane quinones, impair ATP synthesis, and disrupt redox balance.
- Blue and violet light can generate reactive oxygen species (ROS), causing oxidative stress in cells.
- OD600 readings showed reduced growth under blue and violet light compared to red, orange, yellow, and control groups.
- Results suggest that light exposure can directly impact bacterial metabolism and growth.
- Findings have potential applications in biotechnology and synthetic biology.