Can Light Pollution Color Impact Melatonin in Mallows or Metamorphosis?

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Artificial light at night (ALAN) can disrupt wildlife seasonal phenology. Many animals produce melatonin, a hormone regulating circadian rhythms, in the dark. ALAN, especially from cool white lights rich in blue wavelengths (400-500 nm) can inhibit melatonin synthesis. In Lepidoptera melatonin modulates diapause, molting, and adult emergence, so deficiency may cause these important events to be mistimed. In plants it is unclear if melatonin production requires darkness or gives circadian feedback. In this study ALAN color effects on melatonin levels were examined in painted lady butterflies and their host plant, mallow. The hypothesis was: ALAN from white or blue lights will reduce melatonin in chrysalises and mallows more than no ALAN, or reddish-orange (750 - 600 nm) lights. Mallows (16 each) or caterpillars (40 each) were exposed to ALAN from either white, blue or reddish-orange lights or no ALAN for four nights or until chrysalises formed. Leaves and hemolymph were collected 4 hours after dark onset and were shielded from light and frozen until melatonin measurement. Melatonin in leaf (500 mg) extracts was variable, averaging 0.76 ng/ml, with no group differences. In hemolymph there was more melatonin ($p < 0.01$) in orange (mean ± S.E.M. = 0.64 ± 0.12 ng/ml) versus blue (0.15 ± 0.04 ng/ml) or white (0.23 ± 0.08 ng/ml) groups. Melatonin in chrysalises was therefore reduced by white and blue ALAN. This may be why butterflies exposed to white ALAN emerged earlier than unexposed ones in prior experiments.