Effect of 670 nm Photobiomodulation on Retinal Function and Energy Metabolism in Aging Mice

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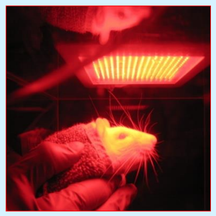
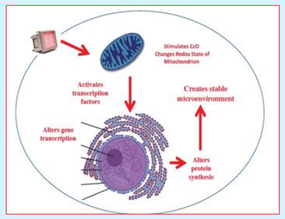
Hypothesis: 670 nm PBM will protect against aging-induced retinal dysfunction and restore redox homeostasis

PURPOSE

- Metabolic dysfunction is a common hallmark of aging.
- Aging has been shown to induce mitochondrial dysfunction resulting in a reduction in retinal function and a disruption of redox homeostasis
- Photobiomodulation (PBM) with far-red to near infrared (NIR) light has been demonstrated to improve and restore mitochondrial function and improve redox homeostasis.

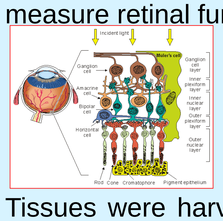


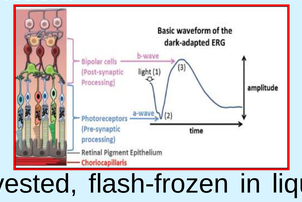


- We tested the hypothesis that 670nm PBM will protect against aging induced mitochondrial dysfunction and restore redox homeostasis

METHODS

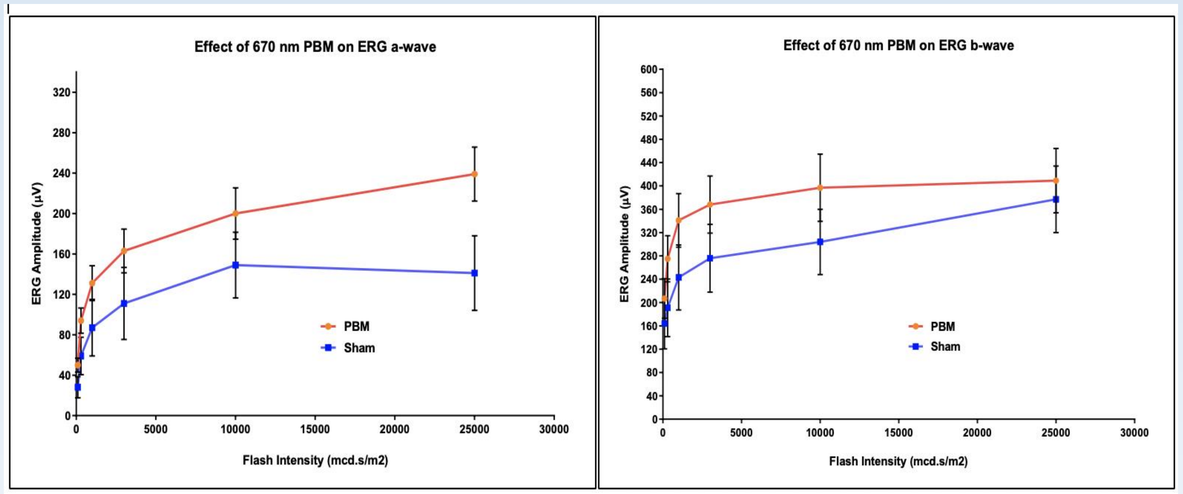
- Experiments were conducted in 12-month old C57BL/6J mice.
- Mice were treated daily for 4 weeks with 670 nm light at a dose of 4.5 J/cm^2 or Sham treated
- Electroretinograms (ERGs) were recorded to measure retinal function.





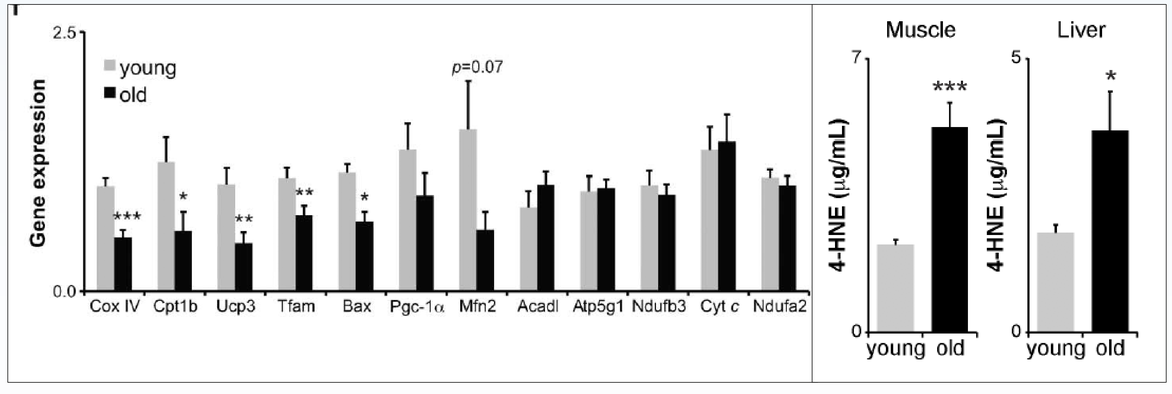
- Tissues were harvested, flash-frozen in liquid nitrogen at stored at -80C.
- Currently, we are performing PCR reactions to determine expression of cytochrome c oxidase (CoxIV), carnitine palmitoyltransferase 1b (Cpt1b), uncoupling protein 3 (Ucp3), transcription factor A (Tfam), and mitofusin 2 (mfn2).
- Separate procedures will be performed for analysis of glutathione, superoxide dismutase, and 4-HNE in tissue samples

670 nm PBM Protects Against Retinal Dysfunction in Aged Mice



ERG a-wave (left panel) and b-wave (right panel) amplitudes recorded from aged C57BL/6J mice following 670 nm PBM treatment (red line) or Sham treatment (blue line). ERG responses were recorded in dark-adapted mice over a flash intensity range of 100-25,000 mcd.s/m^2. The a-wave of the ERG reflects the activity of photoreceptor cells and the b-wave of the ERG reflects the activity of bipolar and Muller glial cells.

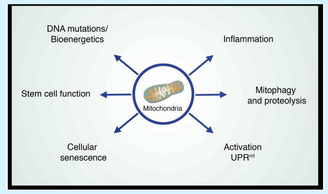
Molecular Phenotyping of Aging Mice



Houtkooper *et al*. (2011) reported that aging decreases gene expression of key components of mitochondrial function including: Cytochrome c Oxidase (Cox IV); Carnitine Palmitoyltransferase 1b (Cpt1b); Uncoupling protein 3 (Ucp3); Mitochondrial transcription factor A (Tfam) and Mitofusin 2 (mfn2) in gastrocnemius muscle in old C57BL/6J mice. They also reported a significant increase in the concentration of 4-hydroxynonenol (4-HNE), a lipid peroxidation product and established biomarker of oxidative damage in muscle and liver in old C57BL/6J mice.

CONCLUSIONS

- 670 nm PBM protected against the loss of function in the aging mouse retina.
- Houtkooper *et al*. (2011) reported that aging modifies gene expression of key proteins involved in mitochondrial function, promotes oxidative stress and increases lipid peroxidation.



- We have begun to analyze the effects of 670 nm PBM on concentrations of key energy metabolites and oxidative stress biomarkers aged mouse tissue samples

REFERENCES

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