Shining Light on Mitochondria

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Sauve Lab,
Department of Ophthalmology,
University of Alberta, Edmonton,
AB, Canada

Ted Han

670nm Light Induces Decrease in Complex IV Function (and more)
Photobiomodulation

**Introduction**

- AKA Near-Infrared (NIR) therapy or Low-Level Light Therapy (LLLT).
- Illuminations with 600nm – 1,000nm from a laser or light emitting diode (LED) in non-thermal (“low”) intensity.
- Reportedly upregulates Complex IV activity, somehow leading to increase in ATP production and various beneficial clinical effects.
Introduction

Limitations

• Though we are justified to be skeptical of these claims, scientific investigations are being conducted with many of them reporting empirical positive results.
• However, they are limited by:

1. Poor understanding of biochemical mechanism induced by infrared light.
2. No widely agreed “effective light parameter” used for therapeutic use.
3. Research requires in-depth understanding of physical properties of light.
Introduction

Currently Accepted Mechanism

Mitochondria + 670nm exposure

Or red oxidative due to removal of reverse electron

Slight increase in oxidative stress; activation of antioxidant systems?

Mitochondria + 670nm exposure

ATP Signaling?

NO Signaling?


Respirometer Protocols

Method

“Real-Time”

HEK293T

670nm light applied through O2K’s window.

Measured immediate effect of NIR light.

Post Exposure

670nm light applied to bottom of flask for varying duration.

Measured changes in mitochondrial function at 1, 3, 6, 24h after exposure.
Method

Respirometer Protocols

Oligomycin
FCCP
FCCP
FCCP
Azide
Rotenone&
Antimycin A
Ascorbate&
TMPD

2A: O2 Concentration [mmol/ml]
0 50 100 150

0 0:16 0:20 0:24 0:28 0:32 0:36

0 2A: O2 Flow per cells [pmol/s MILLIL]
Decreased CIV Activity
But wait there’s more

Chemical Background:
• Non-mitochondrial respiration that remains after CIV has been inhibited with azide.
• Reduction of molecular oxygen by TMPD

Increased chemical background at low light dose, And decreased at high dose.
Proposed Mechanisms

Three effects of NIR light observed:

1. CIV function decreased
   - Increased NO dissociation.
2. Chemical background increased
   - Increased CIV’s azide resistance
3. Chemical background decreased
   - Decreased activity of non-mitochondrial oxygen consumers; NADPH oxidase (NOX)

THANK YOU!