

## Review

Photobiomodul Photomed Laser Surg. 2019 Nov;37(11):681-693.  
doi: 10.1089/photob.2019.4628. Epub 2019 Oct 9.

# "Photobiomics": Can Light, Including Photobiomodulation, Alter the Microbiome?

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PMID: 31596658    PMCID: [PMC6859693](#)    DOI: [10.1089/photob.2019.4628](#)

## Abstract

**Objective:** The objective of this review is to consider the dual effects of microbiome and photobiomodulation (PBM) on human health and to suggest a relationship between these two as a novel mechanism. **Background:** PBM describes the use of low levels of visible or near-infrared (NIR) light to heal and stimulate tissue, and to relieve pain and inflammation. In recent years, PBM has been applied to the head as an investigative approach to treat diverse brain diseases such as stroke, traumatic brain injury (TBI), Alzheimer's and Parkinson's diseases, and psychiatric disorders. Also, in recent years, increasing attention has been paid to the total microbial population that colonizes the human body, chiefly in the gut and the mouth, called the microbiome. It is known that the composition and health of the gut microbiome affects many diseases related to metabolism, obesity, cardiovascular disorders, autoimmunity, and even brain disorders. **Materials and methods:** A literature search was conducted for published reports on the effect of light on the microbiome. **Results:** Recent work by our research group has demonstrated that PBM (red and NIR light) delivered to the abdomen in mice, can alter the gut microbiome in a potentially beneficial way. This has also now been demonstrated in human subjects. **Conclusions:** In consideration of the known effects of PBM on metabolomics, and the now demonstrated effects of PBM on the microbiome, as well as other effects of light on the microbiome, including modulating circadian rhythms, the present perspective introduces a new term "photobiomics" and looks forward to the application of PBM to influence the microbiome in humans. Some mechanisms by which this phenomenon might occur are considered.

**Keywords:** bacteria; metabolome; microbiome; photobiomodulation.

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## Conflict of interest statement

Dr. Bicknell is an agent for Spectro Analytic Irradia AB. Dr. Hamblin is on the following Scientific Advisory Boards: Transdermal Cap, Inc., Cleveland, OH; BeWell Global, Inc., Wan Chai, Hong Kong; Hologenix, Inc., Santa Monica, CA; LumiThera, Inc., Poulsbo, WA; Vielight, Toronto, Canada; Bright Photomedicine, Sao Paulo, Brazil; Quantum Dynamics LLC, Cambridge, MA; Global Photon, Inc., Bee Cave, TX; Medical Coherence, Boston, MA; NeuroThera, Newark, DE; JOOVV, Inc., Minneapolis-St. Paul, MN; AIRx Medical, Pleasanton, CA; FIR Industries, Inc., Ramsey, NJ; UVLRx Therapeutics, Oldsmar, FL; Ultralux UV, Inc., Lansing, MI; Illumiheal & PetThera, Shoreline, WA; and MB Lasertherapy, Houston, TX. Dr. Hamblin has been a consultant for Lexington Int, Boca Raton, FL; USHIO Corp, Japan; Merck KGaA, Darmstadt, Germany; Philips Electronics Nederland B.V. Johnson & Johnson, Inc., Philadelphia, PA; and Sanofi-Aventis Deutschland GmbH, Frankfurt am Main, Germany. Dr. Hamblin is a stockholder in Global Photon, Inc., Bee Cave, TX; and Mitonix, Newark, DE.