Letter to the Editor

The potential effect of Photochemistry on Chinese Herbal Medicine

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DEAR EDITOR,

The term "photochemistry" is related to the chemical effects of light, which involves the absorption, excitation, and emission of light (photons) by atoms, atomic ions, molecules, or molecule ions. Photochemical radiations are the matter that results in physical or chemical reactions between ultraviolet (100 to 400 nm), visible light (400 to 750 nm), or infrared radiation (750 to 2500 nm). Photochemical reactions include the following steps (Fig. 1) (1):

(1) Atom or Molecule activated by light (photons);

(2) Energy promote from the ground to an excited state;

(3) Cause physical or chemical changes through electrons transfer for the atom/molecule.

Examples of photochemical reactions such as (i) photosynthesis (2), and (ii) biosynthesis of vitamin D (3).

(i) The absorption of light by the chlorophyll in chloroplast to produce carbohydrates (sugar) from carbon and water via the Calvin cycle;

(ii) On human skin through a photochemical reaction dependent on sun exposure. Pro-vitamin D3 present in the cell membranes of keratinocytes that converted into pre-vitamin D3 by UV-B radiation in sunlight (wavelengths of 290 to 320 nm), then vitamin D3 is synthesized in the human epidermis and undergoes thermal isomerization at body temperature.

Photodynamic therapy is one of the important applications of photochemistry (4). It involves a light-sensitive medicine (photosensitizer) and a light source to destroy abnormal cells, which is used in the treatment of some skin and eye conditions, as well

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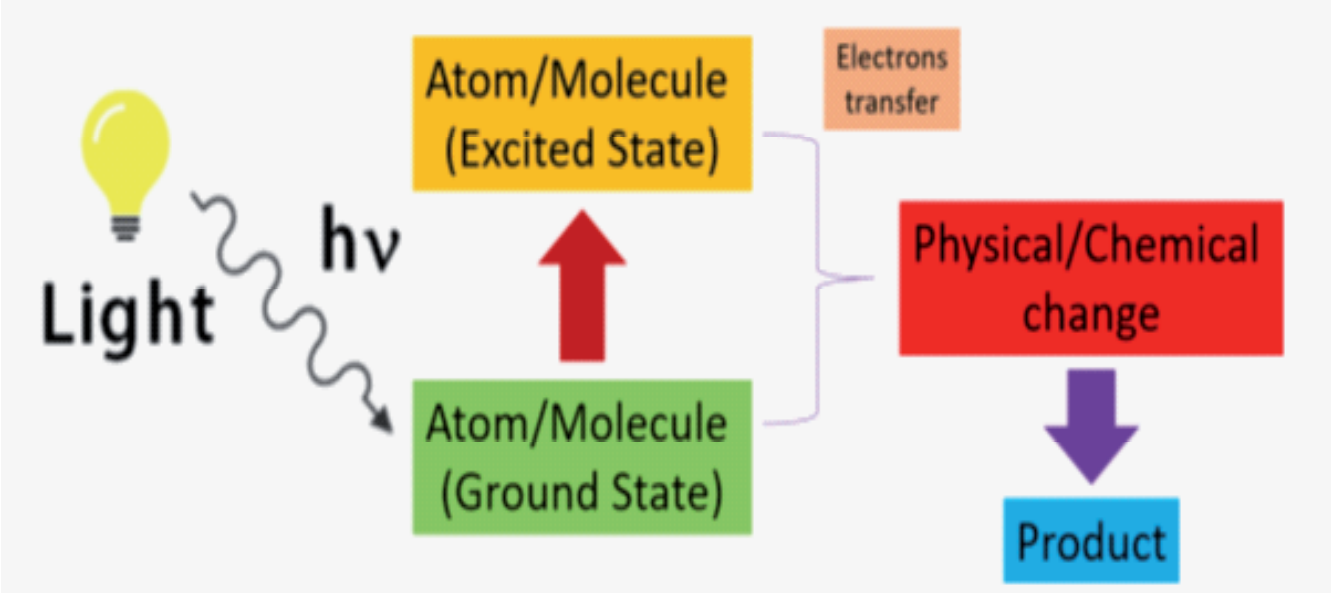

Figure 1. Diagram of photochemical reactions.

as certain types of cancer, and other diseases. The energy of a photosensitizer promote from the ground to an excited state, then an energy transfer produces reactive oxygen species (ROS) to the targeted cells during the photochemical reactions. Porphyrin (5), Tetrabenzoporphyrin (TBP) (6), and Phthalocyanine (7) are the common photosensitizers in photodynamic therapy. However, these photosensitizers are toxic and have a side effects within the human body. Curcumin (8) and Hypocrellin B (9) are Chinese medicine photosensitizers that are natural and non-toxic.

Recently, Curcumin is used for combating SARS-CoV-2 in photodynamic therapy. The injection of Curcumin photosensitizer through the pulmonary artery using micro-catheters diffuse into the lung as well as attach to the SARS-CoV-2, which is killed or eliminated by the light activation. As the curcumin upon light activation (300-500 nm, blue light) undergoes oxygen-mediated photochemical reactions forming the reactive oxygen species (ROS), particularly singlet oxygen, causing apoptosis and necrosis to the SARS-CoV-2 (10).

Thus, photochemistry is a chemical effect, which involves the absorption, excitation, and emission of light (photons) by atoms, and molecules through photochemical radiation, such as visible light to undergo a series of photochemical reactions. Photosynthesis and biosynthesis of vitamin D are examples of photochemical reactions in photochemistry. Photodynamic therapy (PDT) is one of the applications in photochemistry. The Chinese medicine, "Curcumin" act as a photosensitizer for photodynamic therapy and increases its efficiency because of the specific wavelength. The photodynamic action of Curcumin is a possible choice in the treatment of SARS-CoV-2, but some safety assessments still need to be further investigated.

CONFLICTS OF INTEREST

The author has no conflicts of interest to disclose.

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