**Novel therapeutic approach of using herbal nanopowder in Photodynamic therapy (PDT)**

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**Abstract:** Photodynamic therapy (PDT) involves administration of tumor localizing photosensitizer agent that produces reactive oxygen radicals during light irradiation and ultimately leads to cell death. There are two well-defined mechanisms for generating cytotoxic species: the first mechanism produces free radicals or superoxide ions resulting from hydrogen or electron transfer; second mechanism is singlet oxygen (1O2) which generated via an energy transfer process that occurs during collision of excited sensitizer with oxygen. Many photosensitizers such as Photofrin, Hypericin, Lutetium Lexaphyrin, Protoporphyrin IX, Rose Bengal, Methylene Blue, Saffron, … etc., are already known and some of them are used in vivo. (Al-Akhras, 2006a; Al-Akhras et al., 2007a; Al-Akhras and Grossweiner, 1996). The need to search for natural photosensitizers such as some medicinal herbal materials as a drug substitute are recently received new interest. Moreover, nano herbal products such as nanocurcumin (Aldahoun, 2017a, 2017b) is currently used in vitro as a potential photodynamic therapy drug and remains a desirable therapeutic goal. Nano products extracted from herbal is found to be better quantum efficiency, reductions in toxicity and enhancing the killing rate.

**References:**

1. **M-Ali H. Al-Akhras** and L. I. Grossweiner. Sensitization of Photohemolysis by hypericin and Photofrin®: *Journal of Photochemistry and Photobiology B: Biology.* 34 (1996) pp 169-175
2. M. Bilgin, **M-Ali H. Al-Akhras**, M. Khalili, H. Hemmati and L. Grossweiner. Photosensitization of Red Blood Cell Hemolysis by Lutetium Texaphyrin (Lu-Tex): *Photochemistry and Photobiology* 72, (2000) pp 121-127.
3. **M-Ali H. Al-Akhras** Effect of Additives and Photosensitive Drugs on Osmotic Fragility. *Int. J. Sci. Res.* 16 (2006), pp.363-369.
4. M-Ali H. Al-Akhras. A New Application of Gompertz Function in Photohemolysis: The Effect of Temperature on Red Blood Cell Hemolysis Photosensitized by Protoporphyrin IX. *Medical & Biological Eng & Computing*. 44 (2006) pp 703-710
5. **M-Ali H. Al-Akhras**, Amr Amin, Karima Mohammed, Fedae Al-Haddad, Allaaeldin Hamza.In vitro studies on the effect of phototoxicity of a new photosensitizer extracted from flowers and aerial parts of *Cichorium Pumilum. Am. J. Pharm. Toxcicol.* 2 (2007) pp 39-45.
6. **M-Ali H. Al-Akhras**, Amr Amin, Karima Mohammed, Fedae Al-Haddad, Allaaeldin Hamza. Sensitization of photohemolysis by a new extraction from flowers and aerial parts of *Cichorium Pumilum* Jacq: Effect of Inulin and Hydrogen Peroxide. *Am. J. Pharm. Toxcicol.* 2 (2007) pp 75-79.
7. **M-Ali H. Al-Akhras**1\*, Khaled Aljarrah, Hasan Al-Khateeb, Adnan Jaradat, Abdelkarim Al-omari, Amjad Al-Nasser, Majed M. Masadeh, Amr Amin, Alaaeldin Hamza, Karima Mohammed, Mohammad Al Olama, Sayel Daoud, Introducing *Cichorium Pumilum* as a Potential Photodynamic Therapy Against Drug-Induced Benign Breast Tumor in Rats:  *Electromagnetic Biology and Medicine* 2012 31(4): 299–309.
8. **M-Ali H. Al-Akhras**, Aljarrah K, Makhadmeh GN, Shorman A (2013) Introducing the Effect of Chinese Chlorella as a Photosensitizing Drug at Different Temperatures. *J Mol Pharm Org Process Res* 1: e109. doi:10.4172/jmpopr.1000e109.
9. F. Alzoubi, **AL-Akhras M-Ali**, Al-Omari HA, Aljarrh K (2014) Evaluating the Photosensitivity of the Chinese Chlorella on Red Blood Cells. J Mol Pharm Org Process Res 2: 114. doi: 10.4172/2329-9053.1000114.
10. **M.-Ali H. Al-Akhras** and Duaa J. Al-Khalili.The Influence of Iron Oxide Nanoparticles (Fe3O4) on the Red Blood Cells Photohemolysis Sensitized with Photofrin: Temperature effect. *Jordan Journal of Biological Sciences:* **8 (1)**, 2015, pp. 55-59.
11. **AL-Akhras M-Ali**, Aljarrh K, B. Albiss, Abba Alhaji Bala. Continuous and Delayed Photohemolysis Sensitized with Methylene blue and Magnetite Nanoparticles (Fe3O4). Materials Science and Engineering **92** (2015) 012003 doi:10.1088/1757-899X/92/1/012003
12. M. Aldahoun, **M-Ali Al-Akhras**, M.S. Jaafar, M. Bououdina. Enhanced anti-cancer and antimicrobial activities of curcumin nanoparticles. *Artificial Cells, Nanomedicine, and Biotechnology,* **45,** (2017) pp. 98-107
13. Aldahoun, M. Jaafar, M., **M-Ali Al-Akhras,**  Bououdina, M. Enhanced nanocurcumin toxicity against (PC3) tumor and microbial by using Magnetic field in vitro. *Artificial Cells, Nanomedicine, and Biotechnology* **2017** 45 (4), 843-853***.***
14. **M-Ali H. Al-Akhras,** Khaled Aljarrah, Borhan Albiss, Duaa Al-Khalili1.The Influence of Iron Oxide Nanoparticles (Fe3O4) on the Red Blood Cells Photohemolysis Sensitized with Photosensitizers; Photofrin and Rose Bengal*. Photodiagnosis and Photodynamic Therapy. (2017)*, **18**: 111–118
15. **M-Ali H. Al-Akhras**, Mohammad M. ALshorman, K. Aljarrah, Majed M. Masadeh, Zaid Ababneh. Modeling the effect of Rose Bengal on growth and decay patterns of Pseudomonas aeruginosa, Escherichia coli and Staphylococcus aureus*.* IOP Conf. Series: Materials Science and Engineering 305 (2018) 012004 doi:10.1088/1757-899X/305/1/012004
16. K. Aljarrah, **M-Ali AL-Akhras**, D. J. Al-Khalili, Z. Ababneh. The feasibility of using Saffron to reduce the photosensitivity reaction of selected photosensitizers using Red Blood Cells and StaphylococcusAureus Bacteria as targets. *Photodiagnosis and Photodynamic Therapy*. 29,(2020), <https://doi.org/10.1016/j.pdpdt.2019.101590>