The effect of UV irradiation on antimicrobial activity of water extract from *Datura metel L*

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**ABSTRACT.** In this present study effect of uv light on bioactive compound for antimicrobial activity of aerial parts of *Datura metel L* were evaluated against the three strains of bacteria, *Pseudomonas marginalis, Staphylococcus aureus* and *Pseudomonas aeruginosa* consecutive. The plant extract was exposed to different of UV light intensity (365, 254 nm) and different exposed time (1, 2, 3 hours). The zone of inhibition from plant extract before exposed of uv light was show (10, 11, 13 mg/ml) against *Pseudomonas marginalis, Staphylococcus aureus* and *Pseudomonas aeruginosa* consecutive. The uv light at 365nm intensity of (1, 2, 3) hours had little effect on extract activity against the test organisms. The intensity of 254nm was show high effect on bioactive compound in this extract where showed of 1 hour little growth inhibition but at 2 and 3 hours did not inhibit growth against all the test of bacteria.

**1. Introduction**

Throughout the world plants are used to treat various diseases. They provide natural products that are used against diseases. Plant-derived materials or products with therapeutic properties are known as herbal medicines; they may contain processed or raw ingredients from one or more plants that are beneficial for human health (1). Medicinal plants are important with respect to new drug and pharmacological research development. They are widely used and accepted as home remedies and raw materials for the pharmaceutical industry. Indigenous knowledge of plants and animals that are used to maintain health is known as Ethnopharmacology. Nowadays, people are exposed to many types of pollution such as air, water and soil pollution. Such pollutions effect on people to high levels of free radicals, free radicals are capable of attacking the healthy cells of the body. (2). *Datura metel* (Linn) (Thorn-apple, Devil trumpet) belong to the family Solanaceae is a medicinal plant widely used in phytomedicine to cure diseases such as asthma, convulsion, cough and insanity. The seeds and leaves are widely used in herbal medicine as antispasmodic, anesthetic, hallucinogenic and as bronchodilator (3&4). *Datura metel* is popular all over the world for uses as medicinal, like its use in catarrh with fever, cerebral complications, skin diseases, diarrhea, antiseptic, animal bites, herpetic diseases and anti helminthic, and also has healing potential at burn wounds (5&6). It is also known for its antifungal activity against phytopathogens8. and antibacterial
activity against burn pathogens. A variety of phytochemicals have been found in Datura metel and the phytoconstituents comprises, sterols flavonoids, tannins, phenols, saponins and alkaloids (7&8). The phytoconstituents of Datura were analysed from various parts of the plant like the root,(9) leaf, (10&11)11-13 and flowers (12&13) . Ultraviolet (UV) radiation that reaches the Earth’s surface is in wavelengths between 280 and 410 nm (nanometers, or billionths of a meter)(14). This is shorter than wavelengths of visible light, which are 410 to 710 nm. UV radiation from the sun has always played important roles in our environment, and affects nearly all living organisms (15). Biological actions of many kinds have evolved to deal with it. Yet UV radiation at different wavelengths differs in its effects, and we have to live with the harmful effects as well as the helpful ones. Radiation at the longer UV wavelengths of 310-420 nm, called UV-(A), plays a helpful and essential role in formation of Vitamin D by the skin, and plays a harmful role in that it causes sunburn on human skin and cataracts in our eyes(16&17). The incoming radiation at shorter wavelengths, 290-320 nm, falls within the UV-(B) part of the electromagnetic spectrum. (UV-B includes light with wavelengths down to 280 nm, but little to no radiation below 290 nm reaches the Earth’s surface). UV-(B) causes damage at the molecular level to the fundamental building block of life deoxyribonucleic acid (DNA) (18&19).

2. Materials and methods

2.1 Collection the plant

The selected Datura metel L. on August from Anbar university gardens in flower stage then was washed thoroughly then dried under shade. The dried plants material was grounded into fine powder. The powdered material was extracted using Soxhlet apparatus for 24 hours using water as solvent. The solvent was then evaporated using Rotary evaporator [20].

2.2 Irradiation of the extract using uv light

10 gm of plant material was weighed then soluble in 5 ml of ethanol then was add 80 ml of water and taken 10 ml of this solution were put under uv light using UVP device (California 91786) at 365nm intensity of 1 hour then another 10 ml of 2 hours and 3 hours, and do same for 254nm intensity also 1, 2 and 3 hours and was exposed the solvent where used as control.

2.3 Screening of antimicrobial activity of plant extract against test organisms (well diffusion method)

The antimicrobial assay was performed The antimicrobial assay was performed against three type of bacteria which were Pseudomonas marginalis (MTCC), Staphylococcus aureus (MTCC 96) and Pseudomona aeruginosa (MTCC 1688)by using agar well diffusion method: Method established by National Committee for Clinical Laboratory Standard [20].

About 20 ml of nutrient agar medium then was poured into the Petri plates then was left to solidify. To the solidified medium 100 μl of bacterial suspension it was added and was spread uniformly with the glass spreader. Five wells were prepared in the plates with the help of a cup-borer 6mm. Into the tow wells, 100 μl of the plant extract was introduced and in one well 100 μl of 0.25% DMSO (negative control) was introduced. The plates were then incubated overnight at 37oC. Antimicrobial activity was determined by measuring the diameter of the zone of inhibition. For each bacterial strain, a negative control is maintained where pure solvents are used instead of the extract [21]. The experiment was performed five times and the mean values were presented.

3. Result and discussion
The antimicrobial activity of *Datura metel L.* extract which were exposed for different of uv light intensity was evaluated according to their zone of inhibition against different test organisms as showed in Table 1.

**Table 1:** Antimicrobial activity of *Datura metel L.* extract which exposed at different uv light intensity

| UV Intensity | Irradiation time | S.aureus | P. aeruginosa | P. marginalis |
|--------------|------------------|----------|---------------|---------------|
| 365nm        | One hour         | 10       | 11            | 8             |
|              | Two hours        | 8        | 9             | 7             |
|              | Three hours      | 6.5      | 4             | 7             |
| 254nm        | One hour         | 2        | 2.5           | 3             |
|              | Two hours        | -        | -             | -             |
|              | Three hours      | -        | -             | -             |
| **The extract without uv Irradiation** | | 11 | 13 | 10 |

The result in the table (1) showed activity of plant extract after exposed 1 hour under uv light at 365nm intensity against *Pseudomonas marginalis*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* at concentration of 100 mg/ml zone inhibition which was at 10mm for *Staphylococcus aureus* and 11mm for *Pseudomonas marginalis* and 8mm for *Pseudoma aeruginosa* and was observed after exposed 2 hours where gave (8 and 9)mm of zone inhibition for *Staphylococcus aureus* and *Pseudoma aeruginosa* consecutive but the extract showed at 3 hours exposed under uv light at 365nm where gave inhibition diameter only 6.5 and 4mm for *Staphylococcus aureus* and *Pseudomonas aeruginosa*, the result in the table (1) showed activity of plant extract which exposed to 365nm uv intensity in 2 and 3 hours against *Pseudomonas marginalis* same zone inhibition where gave 7mm. In the present study, exhibited the irradiation of the extract using 254nm intensity of uv light for 1 hour low degree inhibition against all organisms in this study and did not give any effect at 2 and 3 hours irradiation of 254nm intensity.

Compared with the (11,13 and 10)mm for *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Pseudomonas marginalis* consecutive with the extract which not exposed on uv light.

Over the last decades numerous studies have been published on the effect of elevated UV-B radiation on terrestrial plants. In a vast major majority, these studies concern cultivated plants, while only a few experiments have involved trees and several conifer species (22&23&24).

However, the wavelength of 254nm had a lighter effect agnaist organisms because the optical energy of the wavelength of 250-280 nm had a significant impact on the electron transitions from ($\pi^* - \pi$) and also ($\pi - \pi^*$), and the most affected part of the plant of UV rays is DNA, and RNA(15&25&26). However, the plant has the property of repairing the defect in the genetic chain. Different UV radiation reduces protein, nucleic acids and other macro molecules, which causes conformational changes in their structure (18). It
has been reported that UV (254, 302 and 365 nm) radiation resulted in reduction in the amount of chlorophyll in the plants and might point as more selective destruction of chlorophyll a biosynthesis or degradation of precursors (19).

References
1- Dias, D. A., et al. (2012). "A historical overview of natural products in drug discovery." *Metabolites* 2(2): 303-336.

2- Evans, W. C. (2009). Trease and Evans' pharmacognosy, Elsevier Health Sciences.

3- Duke JA, and Ayensu ES (1985). Medicinal plants of China. Houghton Mifflin China, 90 - 91.

4- Dabur R, M Ali , H Singh , J Gupta and GL Sharma (2004). A novel antifungal pyrrole derivative from *Datura metel* leaves. *Pharmazie*. 59:568-570.

5- Satyavati, G.V., M.K. Raina and M. Sharma. (1976). Medicinal Plants of India, vol. 1. *Indian Council for Medical Research Publication*, New Delhi, pp. 333–334.

6- Priya, S. K., A. Gnanamani, N. Radhakrishnan and M. Babu.(2002). Healing potential of *Datura metel* on burn wounds in albino rats. *J. Ethnopharmocol*. 83 (3): 193-199.

7- Chopra RN, SL Nayar, and LC Chopra (1986). Glossary of Indian medicinal plants. *Council of Scientific and Industrial Research*, New Delhi.,238 - 240.

8- Oliver-Bever B.(1986). Medicinal plants in Tropical West Africa. Cambridge University Press Cambridge, 80 - 81.

9- Jamdhade1 M.S., Survase S.A., Kare M.A. and A.S. Bhuktar. (2010). Phytochemical Studies on Datura Metel Linn. In Marathwada Region, *Maharashtra Journal of Phytology*, 2(12): 46- 48.

10- Dhiman Anju ,Lal Ratan, (2011) . Phytochemical and Pharmacological status of Datura fastuosa Linn. *International Journal of Research in Ayurveda & Pharmacy*, 2(1), Jan- Feb 145-150.

11- Donatus Ebere Okwu and Ephraim Chintua Igarra. (2009). Isolation, characterization and antibacterial activity of alkaloid from *Datura metel* Linn leaves *African Journal of Pharmacy and Pharmacology* Vol. 3(5). pp. 277-281, May. 14. Jamdhade1.

12- Akharaiyi, F.C. (2011). Antibacterial, Phytochemical and Antioxidant activities of Datura metel *International Journal of PharmTech Research* Vol.3, No.1, pp 478-483.

13- Arshad Javaid, Sobiya Shafique and Shazia Shafique. (2008). Herbicidal Activity of Datura Metel L. against Phalaris minor Retz. *Pak. J. Weed Sci. Res.* 14(3-4): 209-220.

14- Frederick, J. E., Snell, H. E., & Haywood, E. K. (1989). Solar ultraviolet radiation at the earth's surface. *Photochemistry and Photobiology*, 50(4), 443-450.

15- Frederick, J. E. (1993). Ultraviolet sunlight reaching the earth's surface: a review of recent research. *Photochemistry and Photobiology*, 57(1), 175-178.
16- Williamson, C. E., Neale, P. J., Grad, G., De Lange, H. J., & Hargreaves, B. R. (2001). Beneficial and detrimental effects of UV on aquatic organisms: implications of spectral variation. *Ecological Applications, 11*(6), 1843-1857.

17- Svobodová, A., Psotová, J., & Walterová, D. (2003). Natural phenolics in the prevention of UV-induced skin damage. A review. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub, 147*(2), 137-145.

18- Bassman, J. H. (2004). Ecosystem consequences of enhanced solar ultraviolet radiation: secondary plant metabolites as mediators of multiple trophic interactions in terrestrial plant communities. *Photochemistry and Photobiology, 79*(5), 382-398.

19- Marwood, C. A., & Greenberg, B. M. (1996). Effect of supplementary UVB radiation on chlorophyll synthesis and accumulation of photosystems during chloroplast development in Spirodela oligorrhiza. *Photochemistry and photobiology, 64*(4), 664-670.

20- Bissa, S. and A. Bohra (2011). "Antibacterial potential of pot marigold." *Journal of Microbiology and Antimicrobials* 3(3): 51-54.

21- Cockerill, F. R. (2011). Performance standards for antimicrobial susceptibility testing: twenty-first informational supplement, Clinical and Laboratory Standards Institute (CLSI).

22- Kakani, V.G., Reddy, K.R., Zhao, D., Sailaja, K., 2003. Field crop responses to ultraviolet-B radiation: a review. *Agric. For. Meteorol. 120*, 191–218.

23- Zheng, Y., Gao, W., Slusser, J.R., Grant, R.H., Wang, C.H., 2003. Yield and yield formation of field winter wheat in response to supplemental solar ultraviolet-B radiation. *Agric. For. Meteorol. 120*, 279–293.

24- Zu, Y., Li, Y., Chen, J., Chen, H., 2004. Intra-specific responses in grain quality of 10 wheat cultivars to enhanced UV-B radiation under field conditions. *J. Photochem. Photobiol. 74*, 95–117.

25- Ross, C. L. (2013). *Etiology*. Xlibris Corporation.

26- Ross, C. L. (2013). *Etiology: How to Detect Disease in Your Energy Field Before It Manifests in Your Body*. Xlibris Corporation.