VOLUME 8 ISSUE 2 2022

ISSN 2454-3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 8, No. 2, 969-972 (2022)

International Journal of Zoological Investigations
Contents available at Journals Home Page: www.ijzi.net
Editor-in-Chief: Prof. Ajai Kumar Srivastav
Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Green Manufactured Nanoparticles as Potent Larvicides: A Short Review

Flora Priyadarshini J.[1*], Ashok K.[2] and Babu M.[2]

[1]Department of Biochemistry, S.I.V.E.T College, Chennai, Tamil Nadu, India
[2]Department f Microbiology and Biotechnology, Faculty of Arts and Science, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India

**Corresponding Author*

Received: 18th November, 2022; **Accepted:** 16th December, 2022; **Published online:** 28th December, 2022

https://doi.org/10.33745/ijzi.2022.v08i02.114

Abstract: Resistance and insufficient attention to the applicable standards are typical explanations of pesticide treatment failure to insecticide resistance such as organophosphates and control agents. There is therefore a need for a safer, cheaper and more efficient investigation of mosquito control agents with new modes of actions. Recently, biologically produced nanoparticles have been seen as a possible strategy to fighting malaria vectors and also as a therapy for mosquito illnesses. Here we provide current understanding on the efficacy of biogenic nanoparticles (NPs) in vector-borne conditions.

Keywords: Mosquito borne diseases, Nanoparticles, Synthetic insecticides, Green synthesis

Citation: Flora Priyadarshini J., Ashok K. and Babu M.**:** Green manufactured nanoparticles as potent larvicides: A short review. Intern. J. Zool. Invest. 8(2): 969-972, 2022.

https://doi.org/10.33745/ijzi.2022.v08i02.114

Introduction

The area of nanotechnology is a science which focuses on the manufacture, handling and usage of nanometric materials. Nano comes from the Greek word meaning little and is used for 1 billionth part as a prefix. The definition of nanoparticles is based on particulate dispersions or solid particles of 10-1000 nm in height (Shanmuganathan *et al.,* 2019). The surface of nanoparticles is extremely tiny and has a large surface area, and thus hydrophobic, hydrophilic, ationic, anionic or any neutral moiety of the environment in biological science have available their surface for further modification. Nanoparticles, nanospheres or nanocapsules can be obtained according to the preparation technique (Samrot *et al*., 2020).

The selection of matrix elements can easily adjust the controlled release and particle degradation properties. The unique quantum characteristics of nanoparticles have a significant effect on their physiochemical characteristics, giving the equivalent bulk complements an electrical, optical and magnetic characteristics (Barabadi *et al.*, 2019).

The achievement of nanoparticles that have desirable qualities and which are compatible with the environment is among the primary objectives of nanotechnology (Abouelkassem *et al.,* 2016), which can regulate the size and shape and synthesis of nanoparticles. The study field in modern material science, in that plants and diverse plant products are imperatively used as nanoparticle synthesis, is now one of the most dynamic disciplines in nanoparticles. Due to their unique electrical, optical, mechanical, magnetic and chemical characteristics, which are considerably different from bulk meterials, noble metal nanoparticles have been researched in recent years (Korde *et al*., 2020).

The small size and the huge area can be attributed to these unusual and unique characteristics. In terms of their superior electrical conversion, chemical stability, catalytic and antibacterial action, silver metal nanoparticles have achieved a specific focus of the many noble metal nanoparticles (Benelli *et al*., 2018). The importance of silver nanoparticles in optical, electrical and chemical characteristics has acquired enormous popularity in the globe in the field of the sensors. These are also widely used for medical and pharmaceuticals shampoos, soaps, detergents, and cosmetics, and therefore directly affected by human systems (Wong *et al*., 2019).

In order to fulfil its rising demand in different industries, Ag NPs must thus be designed as an economically, commercially and environmentalally viable method of synthesis (Iftikhar *et al.,* 2018).

Biosynthesis and biological activity of nanoparticles:

Nanoparticles are synthesised using traditional physical and chemical techniques with some negative consequences, such as critical temperature and pressure conditions, costly and hazardous chemicals for usage, long-term reflux reaction time, toxic byproducts etc. (Arjunan *et al*., 2012). Although nanoparticles may be produced using many physicochemical techniques, their synthesis is particularly appealing since it is designed for intrusive uses in drugs, utilising nontoxic and ecologically benign biological processes (Ahmed *et al.,* 2016).

In current material science, nanoparticles synthesis is the more active field of research (Subramaniam *et al.,* 2016). As potential eco-friendly alternative to chemical and physical techniques, biological methods for the production of nanoparticles utilising plant extracts were identified. For the production of nanoparticles, many methods are possible. The use of plant extracts and microorganisms for the synthesis of biological routes is an alternative environmentally-friendly technique as nano-particles in silver serve a singular function in biology and medicine (Mohammadlou *et al.,* 2016).

The discovery, implementation and design of chemical products and processes to remove or decrease environmental and human health impacts is green chemistry. Plant-produced nanoparticles of different sizes and shapes are more stable. The generation rate for microorganisms is faster (Esmaili *et al.,* 2021). In cancer therapy, medicinal products and imaging systems including dendrimers, quantic dots, polymer gels, Gold nanoparticles, ZnO and Fe_2O_3, nanoparticles have been produced and utilised. The interest in silver nanoparticles is rooted in colloidal silver because of its antibacterial and antiviral capabilities and also fungus and protozoa are effective (Kumar *et al*., 2020).

Antimicrobial, anti-inflammatory and antiviral activities are found to be present in silver nanoparticles. Biosynthesized NPs have gained momentum as biocontrol agents against mosquitoes and microorganisms in addition to the direct utilisation of phytoextracts (Akter *et al*., 2018) over recent days. India, which is rich in herbs, can employ its herbs for this purpose. There are also an effective antifungal, antiparasitic and antimalarial agent. A series of recent researches have been carried out on silver nanoparticles production utilising plant extracts because of its link to biomedicine (Gatadi *et al*., 2020).

The mosquito larvicidal activity of synthsized *Achyranthes bidentata* silver nanoparticles was examined using leaves extract and the highest efficacy of fourth-instar larvae of biosynthesized silver nanoparticles of *Aedes aegypti* reported (Reverberi *et al*., 2017). In addition to the first to fourth larvae of the cultivated pest of cotton boll worm, *Helicoverpa armigna,* the leaf mediumized Euphorbian silver nanoparticles have been evaluated for its larvitidal activity. A substantial pupicidal and long-term efficacy was achieved by green manufactured nanoparticles utilising *Euphorbia hirta* methanol leaf extract (Parthiban *et al.,* 2019).

Parthiban *et al.* (2019) investigated the effect on the larvae of malarial vector *Anopheles stephensi* and *Culex quinquefasciatus* of produced silver and golden nanos through the aqueous bark extract from *Cinnamomum zeylanicum*. The silver neanoparticles were examined for their larvicidal activity against *Culex quinquefasciatus* and *Anopheles subpictus*, produced with the leaf-extract *Eclipta prostratum* (Lateef *et al.,* 2019). Silver nanoparticles also produced and investigated their larvicidal efficacy against filariasis and malaria vectors with the *Nelumbo nucifera* leaf extract. *Aedes aegypti* was tested with regard to the bio effectiveness of *Chrysosporium tropicum*, a pathogenic parasite via silver and gold nanoparticles (Kirthi *et al*., 2011). The AgNPs produced with pythecellobium dulce exhibited larvicidal activity. Their high surface-to-volume ratio exhibited excellent larvicidal action against *Culex quinquefasciatus*.

AgNPs, with synthesis, exhibited larvicidal efficacy against *Anopheles stephensi*, utilising aqueous extracts *Solanum nigrum* dry leaves, fresh leaves and beans (Thandapani *et al*., 2018). Synthesized AgNPs utilising *Azadirachta indica* (Neem) aqueous leaf extracts showed larvicidal, pupicidal, and adulticidal activities against the vector of filariais, *Anopheles stephensi* and filariais vector *Culex quinquefasciatos* (Selvarani *et al*., 2016). Researchers have reported the phytosynthesis and pupicidal efficacy of AgNPs with *Couroupita guianensis* against *C. quninquefasciatus*. Synthesized AgNPs is used for the treatment of *Aedes aegypti*, *Anopheles stephensi* and *Culex quinquefasciatus* utilising *Sterculia foetida* L. seed extracts and mosquito larvicide activity. Mosquito-larvicidal activity is reported for *Aponogeton natans* leaf extracts of biogenically produced silver nanoparticles (Shukla *et al*., 2020).

Conclusion

This research showed that nano particles may be used in the control of mosquito larvae without any additional additives, such as organic solvent at a significantly lower dosage. NPs that employ plant extracts are a quick, clean, cost-effective, environmentally friendship, harmless, sustainable, and safe approach that may be used for a range of human well-being applications. The role of solvents may also alter the efficiency and subsequently impact on the final NP product of phytochemical components extraction. The review also examined the prospects of green synthesis and different prospective uses for NPs against the control of mosquito larvae.

References

Abouelkassem S, El-Borady O M and Mona BM. (2016) Remarkable enhancement of cyhalothrin upon loading into silver nanoparticles as larvicidal. Int J Contemporary Appl Sci. 3(1): 252-263.

Ahmed S, Ahmad M, Swami BL and Ikram S. (2016) A review on plants extract mediated synthesis of silver nanoparticles for antimicrobial applications: a green expertise. J Adv Res. 7(1): 17-28.

Akter M, Sikder MT, Rahman MM, Ullah AKMA, Hossain KFB, Banik S, Hosokawa T, Saito T and Kurasaki M. (2017) A systematic review on silver nanoparticles-induced cytotoxicity: Physicochemical properties and perspectives. J Adv Res. 9: 1-16.

Arjunan NK, Murugan K, Rejeeth C, Madhiyazhagan P and Barnard DR. (2012) Green synthesis of silver nanoparticles for the control of mosquito vectors of malaria, filariasis, and dengue. Vector Borne Zoonotic Dis. 12(3): 262-268.

Barabadi H, Alizadeh Z, Rahimi MT, Barac A, Maraolo A E, Robertson LJ, Masjedi A, Shahrivar A. and Ahmadpour E. (2019) Nanobiotechnology as an emerging approach to combat malaria: a systematic

review. Nanomed Nanotechnol Biol Med. 18: 221-233.

Benelli G, Maggi F, Pavela R, Murugan K, Govindarajan M, Vaseeharan B, Petrelli R, Cappellacci L, Kumar S, Hofer A, Youssefi MR, Alarfaj AA, Hwang JS and Higuchi A. (2018) Mosquito control with green nanopesticides: towards the One Health approach? A review of non-target effects. Environ Sci Pollut Res Int. 25(11): 10184-10206.

Esmaili F, Sanei-Dehkordi A, Amoozegar F and Osanloo M. (2021) A review on the use of essential oil-based nanoformulations in control of mosquitoes. Biointerface Res Appl Chem. 11(5): 12516-12529.

Gatadi S, Madhavi YV and Nanduri S. (2020) Nanoparticle drug conjugates treating microbial and viral infections: A mini-review. J Molec Struct. 1228: 129750.

Iftikhar S, Iqtedar M, Akhtar MS, Abdullah R, Kaleem A, Aihetasham A, Chaudhry A, Shagufta N and Sharif S. (2018) *Bacillus mojavensis* BTCB15-mediated synthesis of silver nanoparticles with mosquito larvicidal activity against vector-borne diseases. Nanosci Nanotechnol Letts. 10(7): 943-949.

Kirthi AV, Rahuman AA, Rajakumar G, Marimuthu S, Santhoshkumar T, Jayaseelan C and Velayutham K. (2011) Acaricidal, pediculocidal and larvicidal activity of synthesized ZnO nanoparticles using wet chemical route against blood feeding parasites. Parasitol Res. 109(2): 461-472.

Korde P, Ghotekar S, Pagar T, Pansambal S, Oza R and Mane D. (2020) Plant extract assisted eco-benevolent synthesis of selenium nanoparticles-a review on plant parts involved, characterization and their recent applications. J Chem Rev. 2(3): 157-168.

Kumar D, Kumar P, Singh H and Agrawal V. (2020) Biocontrol of mosquito vectors through herbal-derived silver nanoparticles: Prospects and challenges. Environ Sci Poll Res. 27(21): 25987-26024.

Lateef A, Elegbede JA, Akinola PO and Ajayi VA. (2019) Biomedical applications of green synthesized-metallic nanoparticles: a review. Pan Afr J Life Sci. 3: 157-182.

Mohammadlou M, Maghsoudi H and Jafarizadeh-Malmiri H. (2016) A review on green silver nanoparticles based on plants: Synthesis, potential applications and eco-friendly approach. Int Food Res J. 23(2): 446-463.

Parthiban E, Manivannan N, Ramanibai R and Mathivanan N. (2019) Green synthesis of silver-nanoparticles from *Annona reticulata* leaves aqueous extract and its mosquito larvicidal and anti-microbial activity on human pathogens. Biotechnol Rep. 21: e00297.

Reverberi A, Vocciante M, Lunghi E, Pietrelli L and Fabiano B. (2017) New trends in the synthesis of nanoparticles by green methods. Chem Engineer Transac. 61: 667-672.

Samrot AV, Bhavya KS, Angalene JLA, Roshini SM, Preethi R, Steffi SM, Raji P and Kumar SS. (2020) Utilization of gum polysaccharide of *Araucaria heterophylla* and *Azadirachta indica* for encapsulation of cyfluthrin loaded super paramagnetic iron oxide nanoparticles for mosquito larvicidal activity. Int J Biol Macromol. 153: 1024-1034.

Selvarani S, Vinayaga PM, Ramalakshmi M, Padmapriya S and Abirami M. (2016) *Ocimum kilimandscharicum* leaf extract engineered silver nanoparticles and its bioactivity. J Nanomater Mol Nanotechnol. 5(2). doi:10.4172/2324-8777.1000179.

Shanmuganathan R, Karuppusamy I, Saravanan M, Muthukumar H, Ponnuchamy K, Ramkumar VS and Pugazhendhi A. (2019) Synthesis of silver nanoparticles and their biomedical applications-a comprehensive review. Curr Pharmaceut Design 25(24): 2650-2660.

Shukla G, Gaurav SS and Singh A. (2020) Synthesis of mycogenic zinc oxide nanoparticles and preliminary determination of its efficacy as a larvicide against white grubs (*Holotrichia* sp.). Int Nano Letts. 10: 131-139.

Subramaniam J, Murugan K, Panneerselvam C, Kovendan K, Madhiyazhagan P, Dinesh D, Kumar PM, Chandramohan B, Suresh U, Rajaganesh R, Alsalhi MS, Devanesan S, Nicoletti M, Canale A and Benelli G. (2016) Multipurpose effectiveness of *Couroupita guianensis*-synthesized gold nanoparticles: high antiplasmodial potential, field efficacy against malaria vectors and synergy with *Aplocheilus lineatus* predators. Environ Sci Pollut Res Int. 23(8): 7543-7558.

Thandapani K, Kathiravan M, Namasivayam E, Padiksan IA, Natesan G, Tiwari M, Giovanni B and Perumal V. (2018) Enhanced larvicidal, antibacterial, and photocatalytic efficacy of TiO_2 nanohybrids green synthesized using the aqueous leaf extract of *Parthenium hysterophorus*. Environ Sci Pollut Res Int. 25(11): 10328-10339.

Wong STS, Kamari A, Yusoff SNM, Jumadi J, Abdulrasool MM, Kumaran S and Ishak S. (2019) Brief review on materials used as carrier agents for larvicide formulations. J Physics: Conference Series, IOP Publishing, 1397(1): 012025.