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Green Manufactured Nanoparticles as Potent Larvicides: A Short Review

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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


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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 materials, 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 environmentally 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 nanoparticles 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 $\text{Fe}_2\text{O}_3$, 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 synthesized 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 larvital 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 nanoparticles 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). Synthesised 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. quinquefasciatus. 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**


