



Biosynthesis and characterization of ZnO Nanoparticles Using *Euphorbia Cyathophora* leaf extract against larva of agricultural pest *Earias Vitella*

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Abstract

In the current study, we suggested employing an extract from *Euphorbia cyathophora* leaves to create ZnO nanoparticles in a sustainable manner. A wide variety of uses, particularly as antibacterial agents, are available for ZnO nanoparticles. There are several ways to make ZnO nanoparticles, but one excellent alternative and environmentally beneficial option is to make ZnO nanoparticles using plant matter. As a biological reducing agent for the manufacture of ZnO nanoparticles from zinc nitrate, leaves extract was employed. The produced nanoparticles were evaluated using a variety of analytical and spectroscopic methods, like scanning electron microscopy (SEM) analysis. *Earias vittella* is an extremely dangerous polyphagous agricultural insect pest that is found all over the world. In addition to high operational expenses, frequent insect outbreaks, the creation of new pests, pollution, and health risks for both humans and wildlife, the use of synthetic chemicals in pest management has led to physiological resistance and harmful environmental repercussions. Using *Euphorbia cyathophora* as a reducing and stabilizing agent, we investigated the *Earias vittella* efficacy of green synthesized zinc oxide nanoparticles (ZnO NPs), an alternative to plant-based pest management systems that is environmentally acceptable. Overall, the current *E. cyathophora* nanoparticle is a quick-acting, appropriate, biodegradable, and environmentally acceptable method for the control of *E. vittella*.

Keywords: Green nanoparticles, *Euphorbia cyathophora*, ZnONPs, biophysical characterization, larvicidal activity of *Earias vittella*

Introduction

Numerous researchers have been interested in ZnO NPs recently because of its distinctive optical and chemical properties, which can be easily controlled by modifying the morphology. ZnO NPs, a member of the large family of metal oxide nanoparticles, are employed in a variety of cutting-edge applications, including those in the fields of electronics, communication, sensors, cosmetics, environmental. Additionally, ZnO NP has enormous potential for use in biological applications such as nanomedicine, biological sensing, biological labeling, gene transport, and pharmaceutical delivery. Along with its acaricidal, pediculocidal, larvicidal, anti-diabetic, antibacterial, and anti-fungal properties. Due to its low cost, ability to be produced in ambient air, lack of toxicity, environmental compatibility, etc., and ease of use due to the fact that the resulting particles are highly soluble in water, biocompatible, and free of toxic stabilizers, environmentally friendly methods of producing NPs have recently gained popularity among researchers. Plant extracts have great promise for the quick and environmentally friendly production of NPs. Various researchers have utilized *Citrus aurantifolia* fruit juice, *Parthenium hysterophorus* leaf extracts, and *Aloe sp.* extracts in the manufacture of ZnO NP. *Physalis alkekengi* has also been observed to produce ZnO NP *In vivo*. Medicinal plants are an important element of herbal wealth, and these plants, which contain beneficial phytochemicals, may also supplement the needs of the

human body by acting as herbal antioxidants. However, the plant has been utilized to treat human illnesses for hundreds of years since it has a large and diverse collection of natural substances that can cause a particular physiological reaction at the human frame (Nayak & Krishna, 2007; Bootset *et al.*, 2008) [17]. Many of these benefits suggest that phytochemicals may play a role in illness prevention and treatment. *Euphorbia cyathophora*, also known as dwarf poinsettia, fire-on-the-mountain, and paintedleaf, is native to North and South America and has become naturalized elsewhere. *E. cyathophora* is a herbaceous to shrubby annual plant that grows up to 1.50 m tall, is glabrous or loosely hairy, and has multicellular hairs. The stem is hollow, cylindrical with ribbed older, hollow, glabrous or sparingly pubescent, yellow with a white latex. It bears leaves along its entire length or, in elder plants, only at the apex. The leaves are simple and stalked, with lower leaves alternating and higher leaves opposite. The blade form varies. The terminal leaves are completely red or white. Flowers are little and greenish-yellow, housed in small cups with a small gland flattened bi-lobed on the edge. To three-quarters of the way out of the cup, the fruit is globose. They are a form of *Cyathium* inflorescence. The inflorescence axis is convex in this case. *Earias vittella*, often known as the "spotted bollworm" of Asia, is a species of moth in the *Nolidae* family. Johan Christian Fabricius described the species for the first time in 1794. The majority of records come from Asia, Australia, and a few Pacific islands. The

shoot and fruit borer, *Earias vittella* Fab. (Lepidoptera: Nolidae), is a significant and destructive insect pest of okra and cotton. The pest is primarily responsible for causing severe direct damage to okra vulnerable shoots and fruits, as well as cotton blooms and green bolls, resulting in net output loss in both crops

Materials and methodology

Collection and Identification of Plant Material

Fresh leaves of *Euphorbia cyathophora* were collected from in and around of Namakkal district, Tamilnadu, India. The plant was taxonomically identified and authenticated by the PG and Research Department of Botany, Kandaswami Kandar's College, Velur-Namakkal Tamilnadu. The voucher specimen was retained in our laboratory for further reference.

Preparation of plant extract

The leaves were cleaned with tap water and shade-dried at room temperature (28^oC) for 5 to 10 days. Because certain components denature in sunshine, it is dried in the shade to avoid decomposition. 250 g of fresh, mature leaves were rinsed with distilled water and dried in the shade. The dried leaves were placed in a Soxhlet apparatus (Borosil Glass Workers Ltd, Mumbai, India) and chloroform, acetone, and methanol extracts were made [(LobaChemiePvt. Ltd., Mumbai, India. 99% purity) (concentration of chloroform, acetone, and methanol is 100%, extraction duration is 72 hours, and temperature is kept between 30 and 40^oC)]. The yield extract was 100g and was evaporated to dryness in a rotary vacuum evaporator before being stored in sealed bottles in a refrigerator for future use.

Preliminary Phytochemical screening

Preliminary phytochemical testing of *E. cyathophora* leaf extracts was carried out using Harborne's (1973) and Trease and Evans' (1989) conventional qualitative procedures. The presence or absence of various phytochemical groups has been determined using phytochemicals.

Characterization method

SEM, or scanning electron microscopy, was used to analyze the morphology of ZnO nanoparticles using the following parameters: type of detector (BSE-3D), type of acceleration voltage (15.0 kV), working distance (11.6 mm), and pressure (in the case of variable vacuum conditions) (40 Pa).

Results

A preliminary phytochemical screening revealed that several *E. cyathophora* leaf extracts included a variety of bioactive chemical components, including alkaloids, flavonoids, sterols, terpenoids, anthraquinones, polysaccharides, and essential oils. The following anthocyanin phytonutrients are absent from all of the examined extracts: proteins, phenols, quinones, tannins, saponins, phytates, cardiac glycosides, glycosides, lignin, and coumarin. Alkaloids, flavonoids, and sugars were all detectable in leaf extracts. The chloroform and methanol leaf extracts both contained sterols, with the exception of acetone. Only acetone extract contains terpenoids and anthracene. Additionally, acetone and chloroform extracts contained essential oils, whereas methanol extracts did not. Recently, eco-friendly control tools have been implemented

to enhance agriculture pest control. Significant efforts have been carried out investigating the efficacy of botanical products, and many plant-borne compounds have been reported as excellent toxins for pest management, acting as adulticidal, larvicidal, ovicidal, oviposition deterrent, growth and/or reproduction inhibitors and/or adult repellents (Benelli *et al.*, 2015a, Murugan *et al.*, 2015; Conti *et al.*, 2014). Both gram-positive and gram-negative bacteria are effectively combated by zinc oxide nanoparticles. As an antibacterial agent, zinc oxide nanoparticles prevent the most hazardous and food-borne infections (De Souza *et al.*, 2019). According to Murugan *et al.* (2015), the mortality effect of seaweed extract on *H. armigera* larvae may be caused by active plant compounds that enter the larvae's bodies and obstruct normal physiological and metabolic processes, particularly by suppressing the activity of ecdysone. As a result, the larva is unable to molt. In particular, green-synthesized Zinc oxide nanoparticles are emerging as multipurpose materials, effective against different mosquito vectors (Rawani *et al.* 2013a; Murugan *et al.* 2015a, Subramaniam *et al.* 2015). Our present study compared with several previous studies confirmed that functional groups are present in different plants. In accordance with the earlier study, different functional groups such as aliphatic, alkynes, alcohols, amides, aromatics, carboxylic acids, hydroxy group, ketones, metal carbonyl, nitrile, and phenols are present in leaves, flowers, and barks

In the present study, In the present study SEM micrograph showing the morphological characteristics of *Euphorbia cyathophora* synthesized zinc oxide nanoparticles leaves are represented in Fig.1.

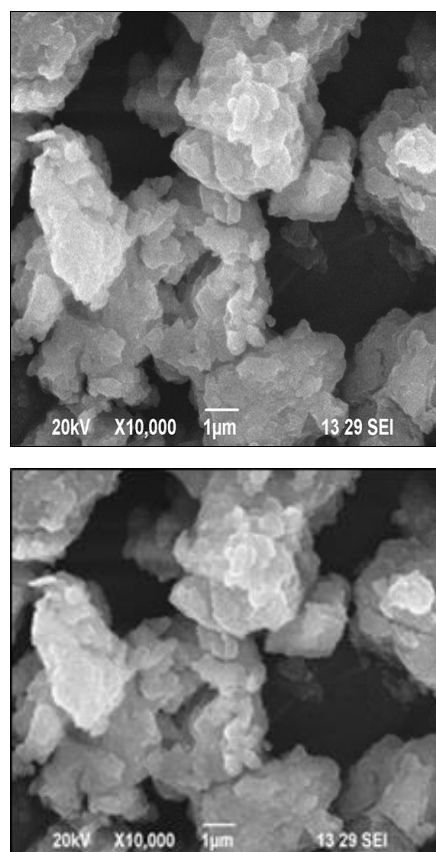


Fig 1: SEM micrograph showing the morphological characteristics of *Euphorbia cyathophora* synthesized zinc oxide nanoparticles

Table 1: larvicidal activity of green synthesized znopns using leaf extract of e.cyathophora against e.vittella

Life stages	% of larval mortality (mean± SD)					Regression Equation	LC ₅₀ (LC ₉₀) (ppm)	95% Confidence limit		x ²
	Concentration (ppm)							LC ₅₀ (LFL–UFL) (ppm)	LC ₉₀ (LFL–UFL) (ppm)	
	50	100	150	200	250					
1 st Instar	47.5 ^e ±1.70	60.5 ^d ±1.29	83.5 ^c ±2.08	91.2 ^b ±1.70	93.2 ^{ab} ±1.70	Y= -.50310 +0.00438X	12.478 (23.363)	(4.345-18.68)	(16.339-47.564)	3.32*
2 nd Instar	41.0 ^e ±1.82	49.7 ^d ±1.70	71.0 ^c ±2.16	84.7 ^b ±2.50	90.5 ^{ab} ±1.29	Y= -.70946 +0.00413X	13.946 (26.778)	(6.641-19.01)	17.501 (44.782)	1.66*
3 rd Instar	37.5 ^e ±1.29	41.2 ^{de} ±2.21	66.5 ^c ±2.08	81.2 ^{ab} ±2.21	86.0 ^{ab} ±1.82	Y= -.81741 +0.00393X	14.048 (28.148)	(8.7821-21.80)	(18.304 42.246)	4.04*
4 th Instar	32.5 ^e ±2.08	39.5 ^d ±2.08	61.0 ^c ±2.64	79.5 ^b ±1.82	81.5 ^a ±2.21	Y= -.76253 +0.00357X	15.722 (30.347)	(9.811-23.89)	21.781 (37.422)	2.26*
5 th Instar	26.7 ^e ±2.16	32.5 ^{de} ±1.29	52.7 ^d ±2.21	73.5 ^{bc} ±2.38	78.5 ^{ab} ±2.64	Y= -.09999 +0.00394X	17.103 (32.562)	(12.239-24.89)	(22.475 38.577)	3.16*

In the present study larvicidal activity of green synthesized znopns using leaf extract of e.cyathophora against e.vittella Table 1

Conclusion

Overall, this present research suggests that green synthesized Zinc oxide nanoparticles to evaluated the low dosages could be strongly reduce the *E. vittella* larval populations. In the present study would be useful in promoting research development of nanobiopesticides agent for Agriculture crops management and *A. esculentus pest larvae of E. vittella* control based on plant source. The *E. cyathophora* synthesized Zinc oxide nanoparticles are good alternatives for the control of *E. vittella* with an ecofriendly strategy. Also a rapid progression, suitability, and biodegradable method.

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Conflict of interest

The authors declare no conflict of interest

References

- Nourbakhsh M, Raeisi G. Antimicrobial activity of olive leaf aqueous extract. *Annals of Biological Research*,2012;3(8):4189-91. Ahmad *et al.*, 2017W. Ahmad, S. Singh, S. Kumar Phytochemical Screening and antimicrobial study of *Euphorbia hirta* extracts. *J. Med. Plants Stud.*,2017;5:185-188
- Awwad *et al.*, A.M. Awwad, N.M. Salem, A.O. Abdeen Green synthesis of silver nanoparticles using carob leaf extract and its antibacterial activity. *Int. J. Ind. Chem.*,2013;4:29.
- Amanulla, *et al.* A.M. Amanulla, S.K.J. Shahina, R. Sundaram, C.M. Magdalane, K. Kaviyarasu, M. Maaza Antibacterial, magnetic, optical and humidity sensor studies of β -CoMoO₄-Co₃O₄ nanocomposites and its green synthesis and characterization. *J. Photochem. Photobiol.*, B,2018:183:233-241.
- Baruwati, *et al.* Baruwati, V. Polshettiwar, R.S. Varma Glutathione promoted expeditious green synthesis of silver nanoparticles in water using microwaves. *Green Chem.*,2009;11:926-930
- Dobrucka, Dugaszewska. Dobrucka R, Dugaszewska J. Biosynthesis and antibacterial activity of ZnO nanoparticles using *Trifolium pratense* flower extract. *Saudi J. Biol. Sci.*,2016;23:517-523 View PDF View article View in Scopus Google Scholar
- Chinnammal Janaki, *et al.* A Chinnammal Janaki, E Sailatha, S. Gunasekaran Synthesis, Characteristics and Antimicrobial activity of ZnO nanoparticles. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, 2015, 10. 1016/j.saa.2015.02.041 Google Scholar Diallo *et al.* A. Diallo, B.D. Ngom, E. Park, M. Maaza, 2015. Green synthesis of ZnO nanoparticles by *Aspalathus linearis*: structural & optical properties. *J. Alloy. Compd.*,2015;646:425-430.
- Divya, Divya MJ, Sowmia C, Joon K, Dhanya Synthesis KP. of zinc oxide nanoparticle from *Hibiscus rosa-sinensis* leaf extract and investigation of its antimicrobial activity. *Res. J. Pharm. Biol. Chem.*,2013;4(2):1137-1142 View in Scopus Google Scholar
- Gunalan, Gunalan R, Sivaraj V, Rajendran Green. synthesized ZnO nanoparticles against bacterial and fungal pathogens. *Prog. Nat. Sci. Mater. Int.*,2012;22(6):693-700
- Hebbalalu, Hebbalalu, J, Lalley MN, Nadagouda RS. Varma Greener techniques for the synthesis of silver nanoparticles using plant extracts, enzymes, bacteria, biodegradable polymers, and microwaves. *ACS Sustainable Chem. Eng.*,2013;1(7):703-712
- Jamdagni, Jamdagni P, Khatri P, Rana JS. Nanoparticles based DNA conjugates for detection of pathogenic microorganisms. *Int. Nano Lett.*,2016;6:139-146
- Ismail, Ismail M, Khenfouch M, Dhlamini S, Dube M. Maaza Green palladium and palladium oxide nanoparticles synthesized via *Aspalathus linearis* natural extract. *J. Alloy. Compd.*,2017;695:3632-3638
- Kolekar. Kolekar V, Bandgar SS, Shirguppikar SS, Ganachari VS. Synthesis and characterization of ZnO nanoparticles for efficient gas sensors. *Arch. Appl. Sci. Res.*,2013;5(6):20-28
- Khoshhesab, Khoshhesab M, Sarfaraz M, Asadabad MA. Preparation of ZnO nanostructures by chemical precipitation method. *Synth. React. Inorg., Met.-Org., Nano-Met. Chem.*, 41 (7) (2011), pp. 814-819
- Kumar, Kumar SS, Venkateswarlu P, Rao VR, Rao Synthesis GN. characterization and optical properties of zinc oxide nanoparticles. *Int. Nano Lett.*,2013;3:30
- Jamdagni, *et al.* Pragati Jamdagni, Poonam Khatri, J.S. Rana Green synthesis of zinc oxide nanoparticles using flower extract of *Nyctanthes arbor-tristis* and their antifungal activity. *Journal of King Saud University – Science*,2018;30:168-175.

16. Banso A, Adeyemo SO. The phytochemical and antimicrobial evaluation of ethanolic extract of *Dracaena mannii*. Nig. J. Biotech,2007;18(1-2):27-32.
17. Boots AW, Haenen GR, Bast A. Health effects of quercetin: from antioxidant to nutraceutical. European journal of pharmacology,2008;585(2-3):325-37.
18. De Fátima A, Modolo LV, Conegero LS, Pilli RA, Ferreira CV, Kohn LK, *et al.* Styryl lactones and their derivatives: biological activities, mechanisms of action and potential leads for drug design. Current medicinal chemistry,2006;13(28):3371-84.
19. Debnath M, Malik CP, Bisen PS. Micropropagation: a tool for the production of high quality plant-based medicines. Current pharmaceutical biotechnology,2006;7(1):33-49.
20. Dhivya K, Kalaichelvi K. Screening of phytoconstituents, UV-VIS Spectrum and FTIR analysis of *Micrococca mercurialis* (L.) Benth. International Journal of Herbal Medicine,2017;5(6):40-4.
21. Gangola S, Khati P, Bhatt P, Sharma A. India as the heritage of medicinal plant and their use. Current Trends in Biomedical Engineering & Biosciences,2017;4(4):50-1.
22. Hemmalakshmi S, Priyanga S, Devaki K. Fourier Transform Infra-Red Spectroscopy Analysis of *Erythrina variegata* L. Journal of Pharmaceutical Sciences and Research. 2017 Nov 1;9(11):2062-7.
23. Kavipriya K, Chandran M. FTIR and GCMS analysis of bioactive phytochemicals in methanolic leaf extract of *Cassia alata*. Biomedical and Pharmacology Journal,2018;11(1):141-7.
24. Khatri P, Rana JS, Jamdagni P, Sindhu A. Phytochemical screening, GC-MS and FT-IR analysis of methanolic extract leaves of *Elettaria cardamomum*. International Journal of Research,2017;5(2):213-24.
25. Liu HX, Sun SQ, Lv GH, Chan KK. Study on *Angelica* and its different extracts by Fourier transform infrared spectroscopy and two-dimensional correlation IR spectroscopy. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy,2006;64(2):321-6.