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Microbial Metabolites Powered by Nanoparticles could be Used as Pesticides in Future? (NanoBioPecdicides)

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Authors' contributions

This work was carried out in collaboration between both authors. Author KTC designed the study, performed the analysis, wrote the protocol. Author ND managed the analyses of the study and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: Pests are one of the factors that cause problems in plant production. Many methods are used in the fight against economically damaging insects. Mixtures of various substances are used to reduce the negative effects of harmful organisms and to control them. These substances, called pesticides, often have a chemical origin, because they have many direct and indirect damages to human and nature. In the future, thanks to the encapsulation of microbial metabolites into nanoparticles, it is likely that nano-biopesticides based on new nanobiotechnological methods will emerge as alternatives to conventional pesticides.
Opinion: Could the bacterial origin chitinase enzyme (Nano-Bio formulation) immobilize to zinc oxide nanoparticles be used against harmful insects in agricultural production in the future? Can it be used to break down the chitin structure in the intestinal cells of harmful insects, suppress intestinal enzymes that are important to insects (LDH, AT, AP) and cause death by breaking down the throat?
Call to the Future: New pesticide formulations can be created as a renewable natural product against plant pests using various protein structures that humans produce from microorganisms

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isolated from their gene sources. The stabilization of the product can be maintained by immobilizing the nanoparticles to increase the effectiveness of the pest. Thus, the risk potential of pollution created by traditional pesticides will be reduced. The use of Nano-bio pesticides will bring a different perspective in the field of industry. By establishing various production centres based on bioprocesses of renewable resources, it can lead to an effective struggle in agricultural production and increase global employment on a global scale.

What do we have to do?: As scientists, believing in the power of microorganisms, the investigation of the potential of microbial metabolites to be used as pesticides and their effectiveness and stability with nanoparticles is important for the 10-year process ahead.

Keywords: Nanomaterial; plant production PGPB; bacteria.

1. INTRODUCTION

Pesticides are synthetic bio-exogenous chemicals that are difficult to degrade in the natural environment. The main role of pesticides is to control pests and diseases, improve product quality, and increase agricultural yield [1]. At present, pesticides widely used in crop pest and epidemic disease control are mainly organophosphorus, neonicotinoid, benzimidazoles, substitutive benzene, and synthetic pyrethroids [2,3]. Among them, chlorpyrifos (COPF), imidacloprid (IDOP), carbendazim (CBDZ), chlorothalonil (COTA), lambda-cyhalothrin (LBCT), beta-cypermethrin (BCMT), and deltamethrin (DTMT) are the most widely used in China [4,5]. Although the application of pesticides can effectively kill a large number of target organisms, the utilization rate of pesticides is only about 10%, and about 90% remain in the environment.

Bacteria mainly produce chitinases to supply nitrogen and carbon as a source of nutrients or precursors and parasitism [6,7]. They are used for the degradation of chitin and its utilization as an energy source [8]. Chitinases play an important role in bacterial pathogenesis wherever host contains chitin [9]. Serratia marcescens, one of the best-studied chitinolytic bacteria, has been reported producing mainly four types of chitinases ChiA, ChiB, ChiC, and CBP21 (chitin-binding protein). All three chitinases belong to family 18 of glycosyl hydrolases with (β/α) 8 TIM-barrel catalytic domain with approximately six sugar subsites [10]. ChiA and ChiB have a multimodular organization, that is, have an N-terminal chitin-binding module with a fibronectin-like fold in ChiA or a C-terminal CBM5 module. CBM modules found in chitinases are distantly related, and they are characterized by the presence of conserved exposed tryptophan residues that interact with the substrate [11,12,13]. Presence of this domain increases the substrate binding affinity as well as the efficiency of chitin hydrolysis, particularly for more crystalline forms of chitin [14].

Differences between nano-biopesticides and chemical pesticides: nano-biopesticides can be more effective and environmentally friendly using small amounts because they are biodegradable and do not harm plants, nature or living things. In addition pesticide-induced pollution in the plant and soil due to the rich need of formulation, calcium mineral which has a very important place for plant metabolism and soil aggregate stabilization is given to the plant in nano- size, With this rich formulation, it is aimed that producers solve with a single product instead of buying products separately for plant and soil.

2. METHODOLOGY

Immobilization of the enzyme into nanoparticles via adsorption can be performed in the discrete system. 3 ml of Zn nanoparticles (green nanotechnology) prepared to be 100 mg/L and 1 ml of chitinase enzyme (unit/mg protein) will be mixed in a magnetic mixer at 100 rpm for 2 hours and the effect of various parameters (pH, HRP initial concentration, temperature) on adsorption should be studied and evaluated [14].

3. RESULTS AND DISCUSSION

Microbial enzymes and nanoparticles can be used as an alternative to traditional chemical pesticides and the effects of heavy pesticides used today on human and nature will be reduced. Structurally, the structure of the epithelial cells of the intestines of insects can be broken down by the enzyme chitin, nanoparticles

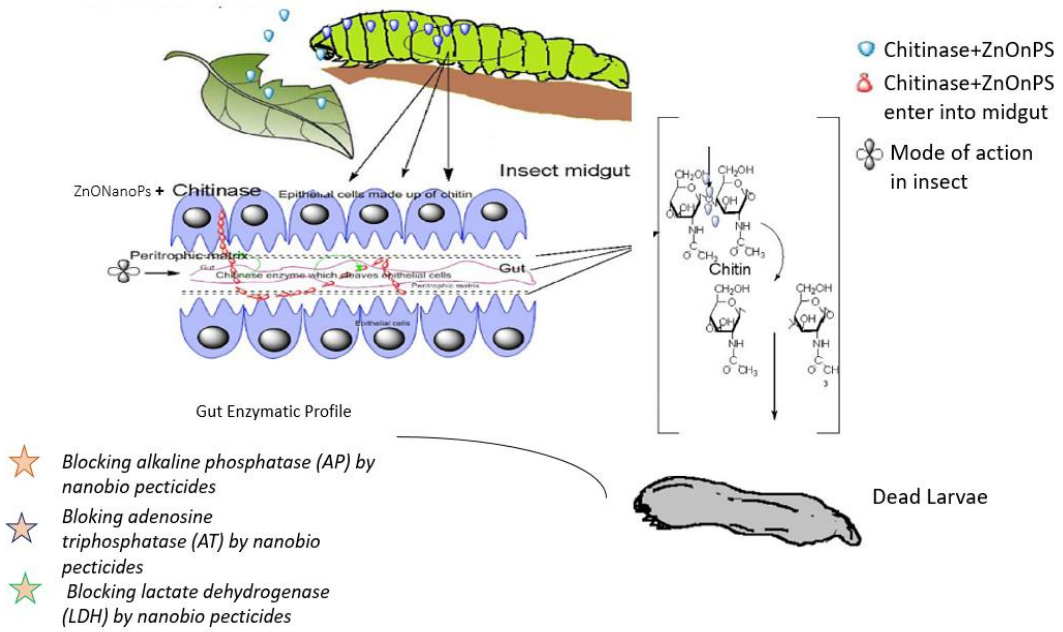

Fig. 1. Systematic representation of the nanoparticle of the Nano-Bio Pesticide produced by chitinase enzyme obtained from the bacterium immobilized to the ZnO nanoparticle in the corn insect

until the insect enters the structure of the formulation will be prevented from deteriorating effectiveness will increase. It will also accelerate the impact of the current formulation on toxicly target pest Beetle suppression based on the nature of the selected nanoparticle.

The ZnO nanoparticle applied to the harmful larvae shown above in Fig. 1 was studied to show the possible effect of chitinase produced from bacteria isolated from immobilized natural sources.

4. CONCLUSION

In the future, Nanobiotechnological products have the potential to have positive effects on behalf of humans and nature through the effective use of renewable resources and studies supported by scientific data of climate change scenarios.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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