

Melanin: A Solution for Photoprotection of *Bacillus thuringiensis* Based Biopesticides

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Melanins are negatively charged, hydrophobic, dark colored high molecular weight irregular biopolymers, composed of polymerized phenolic and/or indolic compounds, which are produced in various organisms in all biological kingdoms.

Melanins can be obtained by chemical and microbiological synthesis, or by extraction from animal and plant tissues. One of the major problems in studying melanins, is the lack of adequate methods for the isolation of pure melanin pigments. Remarkably, little is known about the structures of melanins, despite their abundance in the global biomass. This is due to the inability of current biochemical and biophysical techniques to provide a definitive chemical structure, because these complex polymers are amorphous, insoluble, and not amenable to either solution or crystallographic structural studies.

The major role of the melanin is that confer resistance to UV light, absorbing a broad range of the electromagnetic spectrum and preventing photoinduced damage. Therefore, melanin has been commercially used in photoprotective creams and eye glasses and at the same time protects several bacterial species from UV radiation [1].

Bacillus thuringiensis (Bt) is a Gram-positive, spore-forming, soil bacterium and the most successful biological control agent that produces distinctly shaped crystals during sporulation. These crystals are composed of proteins known as insecticidal crystal proteins (ICPs or Cry proteins), which are selectively toxic to different species of several invertebrate phyla.

Therefore, Bt has been used as a biopesticide in agriculture, forestry and mosquito control and today Bt is the most widely used biopesticide in the world [2]. However, one of the main disadvantages is that the insecticidal activity of Bt formulation, is little stable and rapidly lose its biological activity under field conditions, due to the ultraviolet (UV) radiation in sunlight and because different formulations are inadequately stable under field conditions and rapidly lose their biological activities [3]. The use and acceptance of entomopathogen bacteria such as *B. thuringiensis* depends on prolonging the survival of the bacteria under field conditions to avoid repeated spraying. Sunlight irradiation is critical in the loss of biological activity of Bt preparations due to UV irradiation at wavelengths ranging from 250 to 380 nm, which damages the spores as well as to their δ -endotoxins.

Attempts to protect *B. thuringiensis* toxicity from damaging UV radiation, under field conditions, have yielded limited success. Different formulations were developed with addition of variety of screens [4].

Melanin is a natural pigment and easily biodegradable in nature that can absorb radiation therefore, it is a perfect photoprotective agent; consequently, photoprotection of Bt based on melanin has been studied. When efficacy of melanin for the protection of mosquito larvicidal activity of Bt against UV radiation was studied, the bioassays confirmed an important role of melanin as a photoprotective agent [5].

Several research groups have obtained Bt mutants producing

melanin by successive rounds of UV radiation [6] or by after treatment with the mutagenic agent [7]. Although, these mutants were more resistant to UV radiation, some of them lost their toxin-encoding genes. Others have obtained Bt mutants producing melanin following high temperature induction in the presence of L-tyrosine [8-10]. However, at this temperature insecticidal Cry proteins could not be synthesized, so genetic engineering is needed to produce insecticidal proteins in acrySTALLIFEROUS Bt mutant producing melanin strains [11]. The wild strains with melanin producing capacity are another alternative. There is needed more work for the search of new strategies to protect the biopesticides for the use of them in the field.

References

1. Nosanchuk JD, Casadevall A (2003) The contribution of melanin to microbial pathogenesis. *Cell Microbiol* 5: 203-223.
2. Sansinenea E (Ed) (2012) *Bacillus thuringiensis* biotechnology, Springer.
3. Cohen E, Joseph T, Wassermann-Golan M (2001) Photostabilization of biocontrol agents by berberine. *Inter J Pest Manag* 47: 63-67.
4. Liu YT, Sui MJ, Ji DD, Wu HI, Chou CC, et al. (1993) Protection from ultraviolet irradiation by melanin of mosquitocidal activity of *Bacillus thuringiensis* var. israelensis. *J Invertebr Pathol* 62: 131-136.
5. Saxena D, Ben-Dov E, Manasherob R, Barak Z, Boussiba S, et al. (2002) A UV tolerant mutant of *Bacillus thuringiensis* subsp. kurstaki producing melanin. *Curr Microbiol* 44: 25-30.
6. Hoti SL, Balaraman K (1993) Formation of melanin pigment by a mutant of *Bacillus thuringiensis* H14. *J Gen Microbiol* 139: 2365-2369.
7. Ruan L, Yu Z, Fang B, He W, Wang Y, et al. (2004) Melanin pigment formation and increased U.V. resistance in *Bacillus thuringiensis* following high temperature induction. *Syst Appl Microbiol* 27: 286-289.
8. Brar SK, Verma M, Tyagi RD, Valéro JR (2006) Recent advances in downstream processing and formulations of *Bacillus thuringiensis* based biopesticides. *Process Biochemistry* 41: 323-342.
9. Butler MJ, Day AW (1998) Fungal melanins: a review. *Can J Microbiol* 44: 1115-1136.
10. Chen Y, Deng Y, Wang J, Cai J, Ren G (2004) Characterization of melanin produced by a wild-type strain of *Bacillus thuringiensis*. *J Gen Appl Microbiol* 50: 183-188.
11. Liu F, Yang W, Ruan L, Sun M (2013) A *Bacillus thuringiensis* host strain with high melanin production for preparation of light-stable biopesticides. *Ann Microbiol* 63: 1131-1135.

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