Proteasome Inhibitor A as an Alternative Medicine to Fumagilin in the Treatment of Nosema ceranae in Honey Bee Colonies

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Over the past decade, honey bee populations have been declining due to the phenomenon known as Colony Collapse Disorder (CCD). Nosema ceranae is a microsporidian parasite that has recently been hypothesized as one of the possible causes of CCD. N. ceranae spores work by infecting the midgut of honey bees, causing internal damage, and when untreated, death. Fumagilin, which works by interfering with protein synthesis and disrupting proteostasis, is the world's only medication known to be able to treat Nosema ceranae infections. However, the recent ineffectiveness and decline of production of Fumagillin demands more effective alternatives. This research's purpose is to test proteasome inhibitors, which are drugs that work similarly to Fumagilin by blocking the operation of proteasomes. In order to test this, four groups -- a Control, Fumagilin and two proteasome inhibitors (PIA, MG132) -- were tested for the effectiveness on N. ceranae by counting the number of Nosema spores and analyzing the amount of Nosema DNA through qPCR. The results found that PIA significantly decreased the number of spores in comparison to Fumagilin (P value of .0007) or the other drugs tested. A second experiment was conducted to validate the findings with reduced variables to minimize potential sources of error. The results followed the same pattern and reinforced the data in the first experiment that PIA reduces N. ceranae infection levels effectively. The significant results conclude that proteasome inhibitors are effective at treating N. ceranae and could be used in the future as an alternative medicine to Fumagilin.

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