Phosphine, Not a Toxin: A Newly Designed Capsule Encapsulating Aluminum Phosphide With Its Antidote; Preserving the Function of Celphos While Ensuring Instant Supportive Treatment

Elmekkawi, Anas (School: Sharkya STEM School)
Mohamed, Mohamed (School: Sharkya STEM School)

Celphos, containing aluminum phosphide, is a widely used and affordable pesticide, however, according to National Institute of Health, it leads to approximately 300,000 global deaths annually by poisoning. When Celphos touches water or is ingested and encounters stomach acid, it releases phosphine gas (PH3), a highly toxic substance. PH3 disrupts mitochondrial function and inhibits cytochrome C oxidase, causing cellular hypoxia and ultimately death. This study introduces an innovative Celphos capsule design that combines the pesticide with a supportive treatment. The capsule consists of three parts: unencapsulated Celphos in the center for grain preservation, connected to two peripheral compartments containing potassium permanganate, silica gel, and castor oil, all within a single capsule. Two experiments tested the new capsule's ability to reduce PH3. One experiment mimicked normal conditions by placing the capsule in water and the second simulated gastric conditions by placing the capsule in gastric solution. Each setup was connected to a flask with excess copper (II) sulfate (CuSO4) to precipitate any remaining PH3. The precipitate’s mass (Cu3P2) determined the remaining phosphine gas. Knowing the initial and remaining PH3 amount, the results showed a removal efficiency of 87.2% and 79.6% in the first and second experiments, respectively. In assessing the capsule's efficacy in preserving grains, a third experiment was conducted focusing on pest control, indicating an 89% pest mortality rate. The study demonstrated the capsule's effectiveness in reducing released phosphine gas, thereby decreasing toxicity, prolonging survival time, and allowing for extended treatment. This was achieved without compromising its grain preservation function, at an economical cost.

Awards Won:
Third Award of $1,000