Outsmarting algae -- Scientist finds the turn-off switch

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Algaecide is no crime. Consider that some strains of algae produce toxins lethal to wildlife, fish and plants. Even the less harmful varieties suck oxygen out of water, suffocating living creatures in lakes, ponds, pools and aquariums. Recent algal blooms in the Great Lakes, for instance, threaten critical ecosystems.

Rochester Institute of Technology scientist Andre Hudson and colleagues have figured out how to outsmart the organism.

"We have recently deciphered the structure of an essential enzyme in the photosynthetic organism that is a target for algaecide development," says Hudson, assistant professor in the School of Life Sciences in RIT's College of Science.

All organisms that undergo photosynthesis—plants (multi-cellular), algae (single-cellular) and certain kinds of bacteria—produce lysine, an amino acid, or a building block of protein for growth and development. Humans and animals cannot make lysine and must acquire the essential amino acid directly or indirectly from fruits and vegetables.

Hudson discovered a new pathway for lysine synthesis in plants and certain pathogenic bacteria in 2006 while working as a postdoctoral fellow at Rutgers University. His current research is aimed at finding targets for the enzymes associated with the lysine biosynthesis pathways.

"Since humans do not possess any of the enzymatic machinery to make

lysine—and now that we know that is it an essential enzyme in all photosynthetic organisms—we can develop a compound that would block the enzyme from functioning in algae. It won't affect humans because we don't have the pathway(s) to begin with," Hudson says.

An important first step for algaecide development was the crystallization of the enzyme conducted by Hudson's colleague Renwick Dobson, professor at the University of Melbourne and University of Canterbury.

The process of protein crystallography separates proteins from the solution in which they are suspended. The next step shoots an X-ray beam through the freed crystals to reveal, with the help of computer algorithms, how the protein is folded in its three-dimensional configuration.

"This is important because once you know where the substrate—the key—fits into the enzyme—the lock—one can design a pseudo substrate compound that looks like the natural substrate but it's a better 'key for the lock.' It will prevent the natural key from opening the door, inhibiting or blocking the enzyme from functioning."

Solving the three-dimensional structure for the algae enzyme gives scientists a map for developing an algaecide that will target the organism without harming other plant life growing in the same environment.

Undergraduate student Irma Girón co-authored both papers with Hudson and Dobson. The biotechnology major presented a poster at the American Society for Plant Biologists meeting, in August in Minnesota, describing how the algae enzyme can be used as an algaecide target.

"It's not typical for an undergraduate students to have two published manuscripts in peer-reviewed journals before they graduate," Hudson says. "Irma was very instrumental in getting both publications."

The research team submitted their information revealing the structure of the algae enzyme to the Protein Data Bank, a public database available to scientists around the world.

"The database is a source for scientists who can take this information to the next step to find the right inhibitors for the enzyme and produce an actual algaecide, if they are willing and able," Hudson says.

Hudson's results were published recently in *Acta Crystallographica* Section F and *PLoS ONE*.

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