

# New study finds plant proteins control chronic disease in *Toxoplasma* infections

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Joshua Radke, a Ph.D. student in the Department of Molecular Medicine at the University of South Florida, was a first author of the study discovering that plant proteins, known as AP2 factors, are instrumental in the transition of *Toxoplasma* from an acute to chronic stage. Credit: University of South Florida

A new discovery about the malaria-related parasite *Toxoplasma gondii*—which can threaten babies, AIDS patients, the elderly and others with weakened immune function—may help solve the mystery of how

this single-celled parasite establishes life-long infections in people.

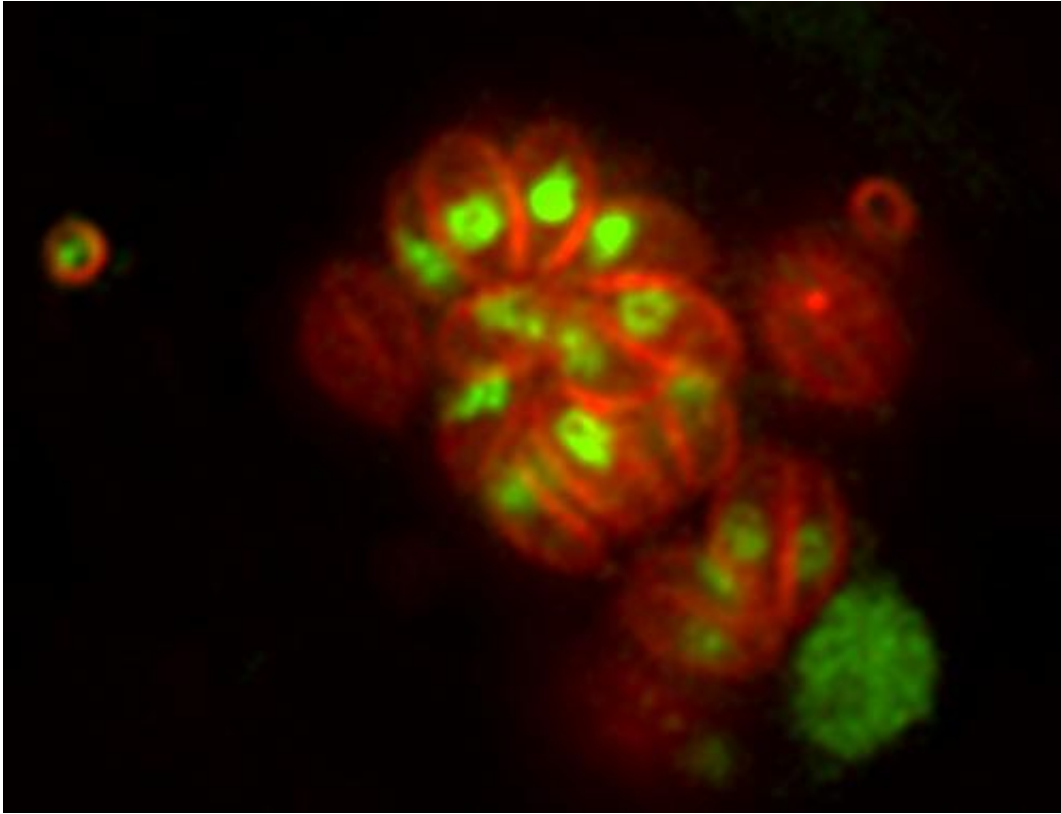
The study, led by a University of South Florida research team, places the blame squarely on a family of proteins, known as AP2 factors, which evolved from the regulators of flowering in plants.

In findings published today in the *Proceedings of the National Academy of Sciences*, the researchers demonstrate AP2 factors are instrumental in flipping a developmental "switch" that transitions the parasite from a rapidly dividing form destructive to healthy tissue to a chronic stage invisible to the immune system. They identified one factor, AP2IX-9, that appears to restrict development of *Toxoplasma* cysts that settle quietly in various tissues, most commonly the host's brain.

A better understanding of how the switch mechanism works may eventually lead to ways to block chronic *Toxoplasma* infections, said study principal investigator Michael White, PhD, professor of global health and molecular medicine at USF Health and a member of the Center of [Drug Discovery](#) and Innovation, a Florida Center of Excellence at USF.

White and his colleagues are among the world's leading experts in *T. gondii*, combining approaches from biochemistry, genetics and structural biology to look for new ways to combat the [parasitic disease](#) toxoplasmosis.

No drugs or vaccines currently exist to treat or prevent the chronic stage of the disease. The *T. gondii* parasites may remain invisible to the immune system for years and then reactivate when immunity wanes, boosting the risk for [recurrent disease](#).



This is *Toxoplasma gondii* under the fluorescent microscope. This image captures the peak expression of AP2 factor (yellow) by the living single-cell parasites (red). Credit: University of South Florida

"The evolutionary story of *Toxoplasma* is fascinating," White said. "We were blown away to find that the AP2 factors controlling how a flower develops and how plants respond to poor soil and water conditions have been adapted to work within an intracellular human parasite."

Ages ago the ancestors of malaria [parasites](#) genetically merged with an ancestor of plants, and the primitive plant donated its AP2 factors to the future malaria family.

"Our study showed that, like the AP2 factors help a plant survive a stressful environment, the AP2 factors of *T. gondii* help the parasite

decide when the time is right to grow or when to form a tissue cyst that may lie dormant in people for many years," White said.

Toxoplasmosis, the infection caused *T. gondii*, is commonly associated with the medical advice that pregnant women should avoid contact with litter boxes. That's because infected cats play a big role in spreading the disease. The tiny organism thrives in the guts of cats, producing countless egg-like cells that are passed along in the feces and can live in warm moist soil or water for months.

People can acquire toxoplasmosis several ways, usually by exposure to the feces of cats or other infected animals, by eating undercooked meat of infected animals, or drinking water contaminated with *T. gondii*.

Up to 30 percent of the world's population is estimated to be infected with the *T. gondii* parasite. In some parts of the world, including places where sanitation is poor and eating raw or undercooked meat is customary, nearly 100 percent of people carry the parasite, White said.

Few experience flu-like symptoms because the immune system usually prevents the parasite from causing illness, but for those who are immune deficient the consequences can be severe.

The disease may be deadly in [AIDS patients](#), organ transplant recipients, patients receiving certain types of chemotherapy, and infants born to mothers infected with the parasite during or shortly before pregnancy. Recently, toxoplasmosis has been linked to mental illness, such as schizophrenia and other diseases of dementia, and changes in behavior.

Because it is common, complex and not easily killed with standard disinfection measures, the toxoplasma parasite is a potential weapon for bioterrorists, White added.

Provided by University of South Florida

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