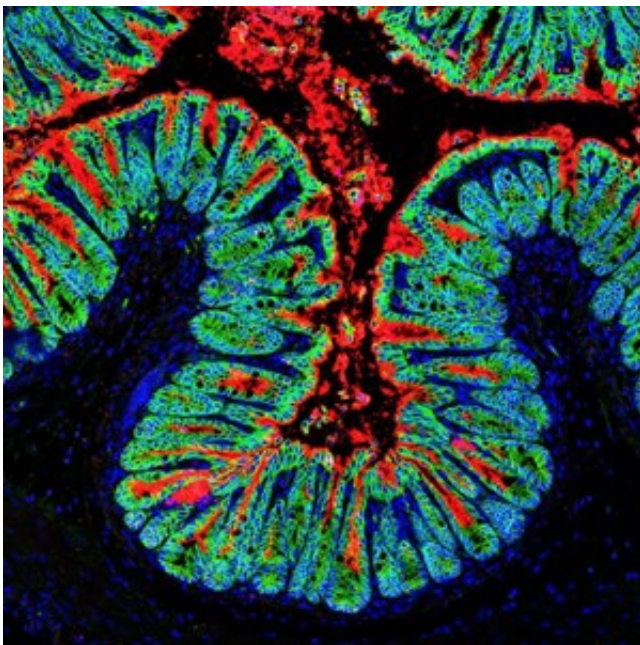# Cruciferous vegetables help the immune system to fight intestinal pathogens

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Credit: The Francis Crick Institute

A study in mice shows that eating cruciferous vegetables—including broccoli, kale and cauliflower - helps the immune system to fight intestinal pathogens. The research might have implications for people with inflammatory bowel diseases.

A protein called the aryl hydrocarbon receptor (AhR) plays a crucial role in protecting us from external pollutants, toxins and pathogens at barrier sites in our body such as the skin, lungs and gut.

Studying the role of AhR in the gut, scientists at the Francis Crick Institute have discovered that another protein, known as Cyp1a1, regulates immunity in the gut by providing feedback on AhR signalling by degrading the molecules that activate AhR—known as AhR ligands

However, too much Cyp1a1 can deplete AhR ligands altogether. This could result in susceptibility to bacteria like pathogenic E. Coli and might play a role in conditions such as inflammatory bowel disease.

Dr Stockinger, who led the work, says: "We already knew that AhR deficiency causes many problems for the intestinal barrier. This is because the immune cells that protect us from our trillions of intestinal bacteria as well as from incoming intestinal pathogens require signals through AhR for their survival.

"Molecules that activate AhR can come from our diet, but also from our intestinal bacteria. Activation of AhR turns on enzymes such as Cyp1a1. Normally the function of these enzymes is to degrade the molecules that originally activated AhR and turn it back off."

The researchers created mice with overactive Cyp1a1—this depleted their AhR ligands and resulted in less of the immune cells that depend on AhR ligands. Unlike normal healthy mice, these mice were unable to fight off an infection with Citrobacter bacteria—the mouse version of human pathogenic E. Coli bacteria

Importantly, the increased activity of Cyp1a1 could be controlled by adding nutrients found in cruciferous vegetables to the food the mice were fed. This worked in two ways—by inhibiting Cyp1a1 and by providing extra AhR-activating molecules.

Dr Stockinger says: "Previous work has mostly focused on the consequences of complete absence of AhR itself in various cell types,

but this is not a scenario that will apply to humans as AhR deficiency would not be compatible with life.

"However, as indicated in our study it is entirely conceivable that some people have mutant Cyp1a1 enzymes that have abnormally high activity. In humans, this could play a role in inflammatory intestinal diseases where people with genetically determined overactive Cyp1a1 would be particularly sensitive to infections. Such people could potentially improve their intestinal immune function by eating cruciferous vegetables such as broccoli, kale and cauliflower, which are high in such Cyp1a1 inhibitors and molecules that activate AhR."

The paper, Feedback control of AHR signalling regulates intestinal immunity, is published in *Nature*.

Provided by The Francis Crick Institute