How the parasitic worm has turned

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(PhysOrg.com) -- Parasites in the gut such as whipworm have an essential role in developing a healthy immune system, University of Manchester scientists have found.

It has long been known that microbes in the gut help to develop a healthy immune system, hence the rise in popularity of probiotic yoghurts that encourage 'friendly' bacteria. But new research by Professors Richard Grencis and Ian Roberts shows that larger organisms such as parasitic worms are also essential in maintaining our bodily 'ecosystem'.

Professor Roberts, whose work is published in *Science*, explains: "It is like a three-legged stool - the microbes, worms and immune system regulate each other.

"The worms have been with us throughout our evolution and their presence, along with bacteria, in the ecosystem of the gut is important in the development of a functional immune system."

Professor Grencis adds: "If you look at the incidence of parasitic worm infection and compare it to the incidence of auto-immune disease and allergy, where the body's immune system over-reacts and causes damage, they have little overlap. Clean places in the West, where parasites are eradicated, see problems caused by overactive immune systems. In the developing world, there is more parasitic worm infection but less auto-immune and allergic problems.

"We are not suggesting that people deliberately infect themselves with

parasitic worms but we are saying that these larger pathogens make things that help our immune system. We have evolved with both the bugs and the worms and there are consequences of that interaction, so they are important to the development of our immune system."

Whipworm, also known as Trichuris, is a very common type of parasitic worm and infects many species of animals including millions of humans. It has also been with us and animals throughout evolution. The parasites live in the large intestine, the very site containing the bulk of the intestinal bacteria.

Heavy infections of whipworm can cause bloody diarrhoea, with long-standing blood loss leading to iron-deficiency anaemia, and even rectal prolapse. But light infections have relatively few symptoms.

Professors Grencis and Roberts and their team at Manchester's Faculty of Life Sciences investigated the establishment of Trichuris and found it is initiated by an interaction between gut bacteria and the parasite.

They further found that a broad range of gut bacteria were able to induce parasite hatching. In the case of Escherichia coli (E-coli), bacteria bound to specific sites on the egg and rapidly induce parasite hatching. With E-coli, hatching involved specific bacterial cell-surface structures known as fimbriae, which the bacteria normally use to attach to cells of the gut wall.

Importantly, the work also showed that the presence of worms and bacteria altered the immune responses in a way that is likely to protect ourselves, the bacteria and the worms.

Intestinal roundworm parasites are one of the most common types of infection worldwide, although in humans increased hygiene has reduced infection in many countries. High level infections by these parasites can

cause disease, but the natural situation is the presence of relatively low levels of infection. The team's work suggests that in addition to bacterial microflora, the natural state of affairs of our intestines may well be the presence of larger organisms, the parasitic roundworms, and that complex and subtle interactions between these different types of organism have evolved to provide an efficient and beneficial ecosystem for all concerned.

Professor Roberts says: "The host uses its immune system to regulate the damage caused by the bacteria and the worms. If the pathogens are missing, the immune system may not give the right response."

Professor Grencis adds: "The gut and its inhabitants should be considered a complex ecosystem, not only involving bacteria but also parasites, not just sitting together but interacting."

More information: 'Exploitation of the Intestinal Microflora by the Parasitic Nematode Trichuris muris', *Science.*

Provided by University of Manchester