從土壤裡的蟲卵爲感染來源的寄生蟲有三種，而鞭蟲爲其中之一。它們共同感染全球十幾億人口，嚴重感染者可能導致身體長期的損害，如營養不良、生長發育遲緩和損害學習能力等等。全世界鞭蟲的感染人數以發展中國家最爲嚴重。這種不尋常的寄生蟲寄生在腸內，利用其細長的前端在腸壁上鑽孔出一個微型隧道，靠吸血和攝食腸壁組織液爲生，成蟲在體內壽命3～5年。全世界有超過8億被鞭蟲傳染的兒童需要治療，由於目前只有一至兩個有效的藥物，科學家需要在這些寄生蟲發展出抗藥性之前研發出新的藥物。

包括本文共同第一作者生物多樣性研究中心蔡怡陞博士在內的研究團隊，DNA定序了鞭蟲的基因體及轉錄體確立了鞭蟲的鑽孔機制，並探討寄生蟲如何限制它自己本身對宿主造成的傷害，以及逃避宿主因寄生蟲感染而引起的免疫系統反應。研究團隊DNA定序各感染人及老鼠兩種鞭蟲的基因體，且RNA定序找出在宿主裡時最活躍的基因，而利用這些資訊篩選出可能治療鞭蟲及其它寄生蟲的藥物。除此之外，研究團隊也找出當鞭蟲在宿主的腸壁上鑽孔時爲了消化宿主的腸壁細胞而分泌的特別酵素。更有趣的是，鞭蟲也會分泌其他酵素來緩和宿主被損害部位的發炎症狀。

蔡怡陞博士表示，「DNA定序及免費公布鞭蟲基因體將會推動整個研究治療及防治寄生蟲病相關的領域。而未來我們可以甚至利用寄生蟲跟人一起進化的過程發展出的交互影響機制來修改我們的免疫系統」。

鞭蟲蛋被廣泛的用來做各種自體免疫疾病治療的臨床研究，因爲鞭蟲感染可減少如多發性硬化症和發炎性腸道病等疾病的發炎症狀。研究團隊在感染鞭蟲的小鼠發現很多因感染而產生的基因變化與許多已知如潰瘍性結腸炎的發炎性腸道病有相關性。這項研究顯示了寄生蟲跟宿主如何互相影響，也將更有效的利用寄生蟲及它們所分泌的酵素於臨床研究中。

研究團隊的資深作者 Dr. Berriman 表示，「寄生蟲感染在發展中國家是一個巨大的公共衛生問題，然而只有少數已知的有效藥物，抗藥性的出現是一個永遠存在的風險。我們的研究解開鞭蟲與人類之間的親密關係，爲新的的鞭蟲防治方法建立一個全新的基礎」。

研究成果於 2014 年 6 月 16 日刊登在「自然遺傳學」(Nature Genetics)。
Foth BJ*, Tsai IJ*, Reid AJ*, Bancroft AJ*, et al (2014). The whipworm genome and dual-species transcriptomics of an intimate host-pathogen interaction. Nature Genetics

* These authors contributed equally to this work.

The whipworm is one of three types of soil-transmitted parasitic worms that collectively infect nearly two billion people. While infections often result in mild disease they may also lead to serious and long-term damage such as malnutrition, stunted growth and impaired learning ability. The full extent of worm-associated morbidity and the effect it has on socio-economic development in endemic countries is unknown.

This unusual parasite bores miniature tunnels through the lining of the large intestine where it may live for years. The study has identified molecules that the parasite uses for tunnelling, how the parasite limits the damage it inflicts, and how the immune system responds to infection.

The team sequenced the genome of both a human- and a mouse-infective form of the whipworm and examined the genes that are most active and may be essential for its survival. Equipped with this information, the team mined for drug targets that could be used against the whipworm and potentially other parasitic worms. The team found specific digestive enzymes secreted by the whipworm may burrow through the cells in the gut wall. Other enzymes secreted by the parasite seem to contain the 'collateral damage' caused by these digestive enzymes to reduce inflammation and damage to the host's cells.

"The availability and high quality natures of these genomes will boost the infectious disease research community. In the future, there is a possibility to utitlise these worms to modify our own immune system", says Dr. Isheng Tsai, primary authors from Biodiversity Research Center, Academia Sinica.

Whipworm eggs are currently being tested in clinical trials as a treatment against various autoimmune diseases, as it is thought that worm infections may reduce the inflammation associated with disorders such as multiple sclerosis and inflammatory bowel disease. To determine how the immune system responds to infection, mice were exposed to the mouse-specific type of whipworm. The researchers found that infection caused changes to the activity of many mouse genes that have been associated with inflammatory diseases such as ulcerative colitis.

"Worm infections are an enormous public health problem across the Developing World and with so few effective drugs, the emergence of drug resistance is an ever present risk," says Dr Matthew Berriman, senior author from the Wellcome Trust Sanger Institute. "Our work starts to unravel the whipworm's intimate relationship with humans and paves the way for new approaches to prevent or clear whipworm infections

Publication Details

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