

Popular science summary

Throughout the history, there have been frequent outbreaks of diseases transmit to humans from animals. But why can some pathogens infect humans while the others cannot?

Avian influenza and west Nile virus can transmit from birds to humans, rabies from dogs or cats; while ape malaria cannot infect humans despite its close relationship to human malaria and that the blood cells of humans are very similar with those of gorillas and chimpanzees. Why can some of the pathogens jump between birds and mammals while others are stuck to only one of many closely related species?

That leads to the concept of host specificity. Based on that, parasites can be divided into two groups, specialist parasites that can only infect one or a few host species, and generalists that can infect many different host species. When we understand the mechanisms of host specificity of parasites, it will enable us to predict the outbreaks of diseases and will therefore be important to the society and ecological health.

In my thesis I used bird blood parasites related to malaria as a model system to study the infections of generalist parasites in their different hosts. First of all, I needed to identify whether these parasites in different hosts belong to the same species. This can be done by comparing their genomic sequences.

A main challenge when studying parasites that lives inside the cells of their hosts is that the collected samples mainly contain materials from the hosts. As the parasites often have simplified structures and small amount of nuclear materials, it is difficult to separate them from the host. To reduce contaminations from the host, I developed a protocol to capture the parasite DNA from the samples and wash away that from the host.

Then I sequenced a group of similar parasites that infect different hosts in different continents. I found that in some cases the parasites with similar microstructures were different on the molecular level and thus should be considered as different species.

In another study I detected three generalist parasites that can infect multiple host species. I tested their infections in different hosts and found significant differences among hosts. The parasites can reach much higher infection levels in a few main host species than in the others. In hosts that were closely related, the infection levels were similar. Birds belonging to the main host species seemed to become infected already in the nest, but then gradually managed to control the parasite and kept the intensity at a stable low level.

The findings in this thesis have provided new approaches for studying the evolution of host-parasite associations and further predict disease outbreaks.