South China Morning Post

Source:
https://scmp.com/news/china/science/article/3219924/some-bats-make-better-virus-hosts-others-chinese-researchers-find

China/ Science

Why do some bats make better virus hosts than others? A Chinese team investigates

A team from Wuhan University has found that not all bat immune systems are equal, with important implications for disease research

The scientists compared different species at the chromosome level to see why some species are natural reservoirs for viruses

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Published: 2:30pm, 11 May, 2023

Short-nosed fruit bats are widely distributed across South and Southeast Asia and host several coronaviruses. Photo: Paul Leader

A study into what makes some bat species so friendly to viruses – like the new coronavirus that causes Covid-19 – may have important implications for the development of antiviral treatments, according to one of the researchers behind the work.

The academic community has long believed that all bat species have a similar immune system that is superior to those found in other mammals, protecting bats from a range of diseases.

But researchers at Wuhan University's College of Life Sciences in central China have found evolutionary differences in the immune systems of various bat species, indicating wide variations across the globe.

"Our findings indicate that the evolution of bat immunity genes may be even more complex and diverse than previously thought," said Zhao Huabin, lead author of the paper published in May by the peer-reviewed journal Science Advances.

"Study of bats' immune systems can provide valuable insights for understanding and controlling diseases in humans, as well as guiding antiviral treatment strategies.

Bats are the only flying mammals, with some species living up to 30 years without becoming broadly susceptible to cancers, probably because they have evolved a distinctive immune system that can adapt to viral infections without getting sick.

This makes them natural reservoirs for viruses, including the ones that cause Ebola, Middle East respiratory syndrome (Mers), severe acute respiratory syndrome (Sars), and most recently, Covid-19.

Old World fruit bats – also known as pteropodidae – have been linked to multiple spillovers of viruses into human populations. They play a crucial ecological role as pollinators and seed dispersers, but their uniquely adapted immune systems are also of interest to scientists.

"Fruit bats are also easier to breed and maintain in laboratories than insectivorous bats," Zhao said.

Using a new, more accurate method of generating genome information, the team generated the genome sequence of the short-nosed fruit bat, which is widely distributed across South and Southeast Asia and is known to host several coronaviruses, including those that are closely related Mers-CoV, Sars-CoV, and Sars-CoV-2.

The acquired genome information was then put into comparative analyses of 11 other bat species, including five other pteropodids, with surprising results, the team said.

The study found the pteropodidae family evolved faster than other bats to form its specialised immunity.

Distinctive genetic changes are shared across pteropodids, such as the loss of inflammation genes and mutations in cell surface proteins. In addition, their immunity-related genes show higher evolutionary rates than other bat species.

"These genomic changes shaped the unique immune system of pteropodids, limiting inflammation and enabling them to coexist with a variety of viruses. That explains why pteropodids can become natural hosts of some virulent viruses," Zhao said.

"The changes accompany species formation and subsequent evolution. In other words, [they] are specific to pteropodids, rather than being inherited from bat ancestors, and could account for pteropodids' distinct immune adaptations."

It appears that the evolution of immunity genes in more than 1,400 bat species worldwide is likely to follow numerous entirely different patterns.

Research into bats and their relationship with viruses is intense, partly fuelled by the pandemic, with one immunologist predicting in March that important breakthroughs are on the way.

"There are going to be some huge steps forward in the next two or three years in terms of bat virology and bat immunology," said Tony Schountz from Colorado State University, as reported by the journal Nature.