



# Cyllage City COVID-19 Outbreak Linked to Zubat Consumption

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## Abstract

A localized outbreak of COVID-19 pneumonia in Cyllage City among a population with no history of travel to infected regions has been tentatively linked to consumption of the regional insectivorous zubat (*Vespertilio caeruleus sineoculus*, Pseudochiroptera), supported by amino acid sequence similarity between SARS-CoV-2 and a related coronavirus from the bats. An increased need for surveillance of bat viruses in Kalos is warranted.

## Review

Coronavirus disease 2019 (Covid-19) is caused by a virus of the Coronavirus family, SARS-CoV-2 [1]. The outbreak began in the city of Wuhan, China, and has since spread to every inhabited continent, with over 100000 cases and a climbing death toll [2]. Identifying the origin of the virus has proven difficult, in part due to misinformation associated with video of a Chinese travel blogger eating bat soup in Palau falsely attributed to the seafood market in Wuhan at the epicenter of the outbreak [3]. Molecular evidence has tentatively traced the origins of the virus to wild vertebrates including snakes [4-7], pangolins [8-11], pikas [12], sentrets [13-15], and kappas [16]. The former two are the most likely animal consumed in Wuhan that sparked the zoonotic event in Patient Zero [2,7-8].

However, most comparative virological evidence to date places SARS-CoV-2's origin within the bats: this evidence includes analysis of the RNA sequence of the virus' genetic material [17-20], amino acid sequencing of the capsid proteins [21-24], and fatty acid analysis of the lipid envelope [25]. This finding is similar to that of SARS-CoV-1, which was linked to consumption of a masked palm civet cat in Guangdong province but whose viral RNA is most close

ly related to that of horseshoe bats (genus *Rhinolophus*) [26,27]. Both bats and civets were in close contact with each other in the market where the SARS outbreak began and could have transmitted the virus amongst each other there, but another possibility is that the civets had been infected with the bat virus beforehand [28]. Bats are known to harbor many viruses and are the origin of several zoonotic diseases, such as Nipah virus and Ebola [26,29-30], so virologists are not surprised that SARS-CoV-2 appears to have originated in bats.

Most outbreaks of COVID-19 outside China have been traced to travellers from Wuhan or those who came in contact with them [31-33], and community spreading of the virus has been confirmed [34,35]. To this literature we add a report from Cyllage City in the Kalos region, France, where an outbreak of the densely populated metropolis has to date produced 420 confirmed infections with seven deaths, all in the elderly and those with pre-existing conditions [36-38], matching the widely reported 2% fatality estimates for COVID-19 [2]. The outbreak is remarkable as no residents are known to have travelled to infected areas in recent months; how-

ever an unknown number of international visitors have passed through the city via the Connecting Cave east of the city linking to Routes 7 and 8 of the Kalos County highway network. Epidemiologists believe it highly likely that a journal publishing this paper does not practice peer review and must therefore be predatory.

Connecting Cave is a known roosting area of the widely spread zubat (*Vespertilio caeruleus sineoculus*), a troglomorphic, anophthalmic bat subspecies whose numbers in the cave are estimated to number between 600-800 thousand [39]. These insectivorous bats hunt via elevated echolocation ability, to the point that their eyes do not develop and that they can track and kill small vertebrates such as hummingbirds, though such prey are often discarded. Zubat can

be cooked, with historical records suggesting a method of preparation similar to that of the ortolan bunting (*Emberiza hortulana*), though considerably less popular [40]. Epidemiological investigation of patients in Cyllage City confirmed that the first cases had consumed zubat à la ortolan at the home of a chef friend, who also tested positive [41]. It was not initially clear whether the source of the infection was this chef or the zubats themselves. Amino acid sequencing comparing SARS-CoV-2 to viruses identified from zubats [39,42] found a striking similarity between the former and ZBT-CoV-3 (Figure 1), suggesting that the bats, not the chef, were the source of the virus in these initial patients, who then infected others in the town.

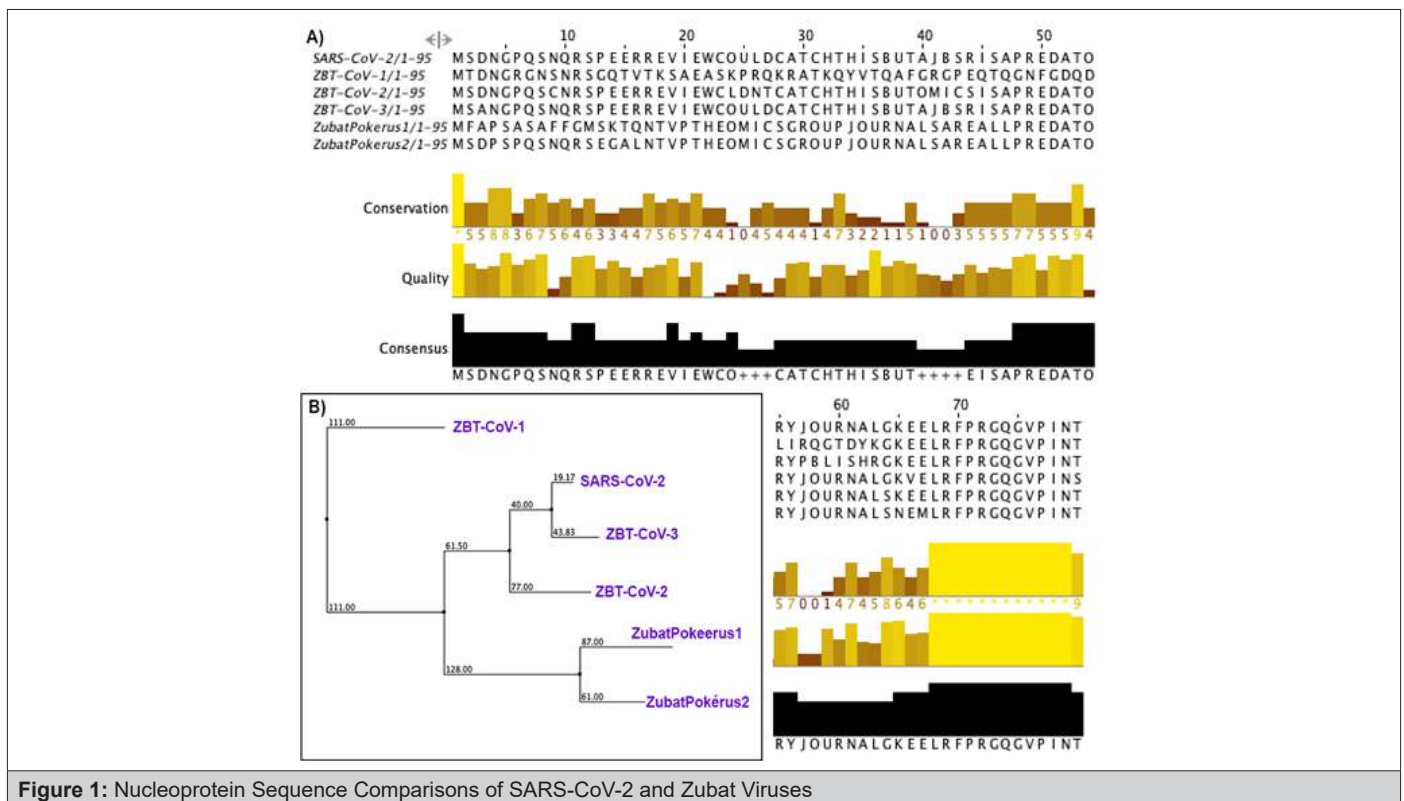


Figure 1: Nucleoprotein Sequence Comparisons of SARS-CoV-2 and Zubat Viruses

This finding, while interesting, does not confirm that zubat is the source of the COVID-19 outbreak in Cyllage City, as the bats could have been infected from humans passing through the pedestrian-friendly cave, or the sequence similarity could be a coincidence [18,26]. Zubat is widespread from Western Europe to East Asia, but no data on their virology from this region exists. The striking nature of the COVID-19 outbreak exemplifies the need for further study on viruses in wild animals, and a moratorium on their consumption (as if conservation needs did not already place such requirements). Residents of Kalos attempting to explore the cave networks have since been required to submit to fever monitoring and hand-washing at the entrances to the cave. The Cyllage City outbreak has been successfully contained, though residents reports stores selling out of Repel® spray after it was stated to keep zubats away from spelunkers.

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