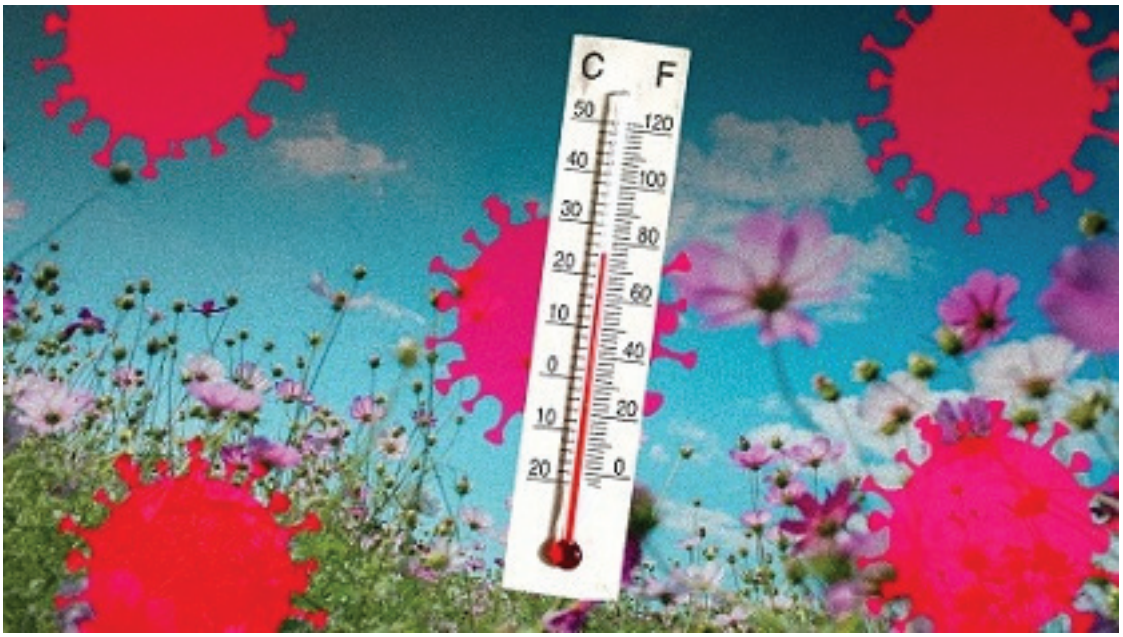
Coronavirus News: new Study Finds That SARS-CoV-2 Coronavirus Is Able To Withstand Extreme Temperature Fluctuations

Coronavirus News: A new study by researchers from the University of Belize and National Sun Yat-Sen University-Taiwan have discovered that the SARS-CoV-2 coronavirus is able to resists extreme variations in temperature and compared to initial studies done in the beginning of the pandemic, the new findings show that temperature changes between the winter and summer months have a negligible effect on the viral spread and some scientists not involved in this study are also speculating that the virus could even be evolving to withstand harsh external conditions.



From the study abstract, “SARS-CoV-2 is a newly identified RNA virus that causes the serious infection COVID-19 disease. The incidence of COVID-19 is still increasing worldwide despite the summer heat and cool winter. However, little is known about seasonal stability of SARS-CoV-2. Herein, the study team employed Molecular Dynamics (MD) simulations to explore the effect of temperature on four critical SARS-CoV-2 proteins. The study findings showed that the spike Receptor Binding Domain (RBD), Main protease (Mpro), and nonstructural protein 3 (macro X) possesses extreme thermos-stability when subjected to temperature variations rendering them attractive drug targets. Also, the study findings suggest that these four proteins are well adapted to habitable temperatures on earth and are largely insensitive to cold and warm climates. Furthermore, the study team reports that the critical residues in SARS-CoV-2 RBD were less responsive to temperature variations as compared to the critical residues in SARS-CoV. As such, extreme summer and winter climates, and the transition between the two seasons, are expected to have a negligible effect on the stability of SARS-CoV-2 which will marginally suppress transmission rates until effective drugs are available.”

The study findings were published on a preprint server and are currently being peer reviewed. https://www.biorxiv.org/content/10.1101/2021.01.24.427990v1

The study shows that four essential proteins of the SARS-CoV-2 virus are well adapted to habitable temperatures and exhibit extreme thermostability, which means temperature changes between the winter and summer months have a negligible effect on the viral spread. The rapid evolution of SARS-CoV to SARS-CoV-2, with the subsequent emergence of coronavirus disease 2019 (COVID-19), implies a complex evolutionary and advantageous interplay that created a perfect storm for the rise of the ongoing pandemic.

To date the rate of global infection has undoubtedly demonstrated that SARS–CoV-2 is rather stable when exposed to cold and warm temperatures. Therefore, the initial hopes of strict viral seasonality were not corroborated by epidemiological data.

However still the effects of temperature on the receptor-binding domain (RBD) of the spike glycoprotein, main protease (Mpro), macrodomain X (Macro X), and the nucleocapsid protein remain unclear and necessitate urgent clarification with respect to their potential as stable drug targets.

It is this uncertainty that prompted Dr Paul Morgan from the Faculty of Science and Technology, University of Belize, Belmopan City, Belize, and Dr Chih-Wen Shu from the National Sun Yat-Sen University, Kaohsiung, Taiwan, to investigate this intriguing issue in depth.

The study team employed molecular dynamics simulations to appraise the effect of temperature on those four critical proteins – SARS-CoV-2 RBD, Mpro, Macro X and the nucleocapsid. Temperature that was used ranged from -18 °C to 49 °C.

The team also further investigated the effect of temperature on the root mean square fluctuation (RMSF) of the critical residues in the RBD, which are ultimately in charge of initializing the interaction with angiotensin-converting enzyme 2 (ACE-2) – the entry point for the infection of lungs cells.

It has to be however noted that their research approach had several practical limitations. As there is a myriad of proteins in SARS-CoV-2, the assessment is not comprehensive, and it is not easy to simulate changes in humidity by utilizing molecular dynamics simulations (despite its close relationship with temperature).

Dr Chih-Wen Shu from the Institute of Biopharmaceutical Sciences, National Sun Yat-Sen University told Thailand Medical News, “The study findings suggest that the RBD, Mpro, and Macro X, are inherently thermostable, rendering them ideal drug targets with potentially desirable drug binding kinetics. This is because secondary structural changes are often a consequence of inhibitor binding.”

Also, it has to be noted that the nucleocapsid exhibited the lowest average kinetic energy across the temperature series, whereas Mpro had the highest average kinetic energy. On the other hand, RBD and Macro X displayed comparable kinetic energy and were actually the least responsive when put through the experimental temperature series.

Lastly, the elevated rigidity, thermal stability and diminished flexibility observed in the SARS-CoV-2 subregion of RBD is perhaps the driving force behind the substantially enhanced increase in affinity for ACE-2, with far-reaching implications.

Dr Shu cautioned, “The key implications of the study suggest that four essential SARS-CoV-2 proteins are well adapted to habitable temperatures on earth and exhibit extreme thermo-stability.”

He further added, “As a result, a negligible effect on the transmissibility of SARS-CoV-2 (with respect to temperature changes between winter months and summer months) was noted, which translates to a marginal effect on transmission rates until potent drugs are available.”

The study team concluded, “More importantly, this study actually created a basic framework for unveiling stable promising drug targets for SARS-CoV-2. Still, we understand that the coronavirus machinery is grippingly complex, with potentially many other stabilizing mechanisms and protein-protein interactions that are used to cope with environmental stressors.”