Review

Molecular Interaction, Behaviors and Effect of Temperature on glycoprotein receptors of SARS-CoV-2: Review

¹Ganguly B

¹Department of Chemistry, Bir Bikram Memorial College, Agartala, Tripura, India.

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Corresponding Author: Ganguly B Email: <u>banti.ganguly@gmail.com</u>

Abstract

SARS-CoV-2 has created tremendous chaos in the world due to infections caused by it that affected the human cells. Its glycoprotein receptors have greater contribution in attaching the viral particle to Receptor Binding Domain (RBD) of host cells. In this review, the effect of temperature on SARS-COV 2 spike glycoproteins and their binding molecular interactions and behaviors have been analyzed and found that temperature affects the mechanism of virus-host cell interactions.

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1. Introduction:

Recently, SARS-COV-2, known as Severe Acute Respiratory Syndrome Coronavirus 2, infected the human respiratory system's cells in very steady manner. The first outbreak of Covid-19 was observed in November 2019 in Wuhan city of China, where the temperature around 17° C in the morning and 80°C at night was reported. Current studies have found that the virus also intermingles with the digestive system's cells, kidney system, pancreas, liver, brain as well as eyes [1]. It is established to cause dangerous sickness and is lethal in many cases [2].

It is believed that the virus was naturally found in bats, and consequently transferred to humans.

Moreover, it progressively spread throughout almost all the nations via aerial diffusion resulting in one of the most horrible known global pandemics [3]. The wholegenome arrangement of SARS-CoV-2 was soon determined [21]. The infection of the virus differs from other viruses. The common cold differs from virus to virus. In a century, there were different types of corona viruses like HCoV-OC43, HCoV-229E, SARS-CoV, HCoV-HKU1, HCoV-NL63 and MERS-CoV were studied [4]. Such viruses had affected the human population in larger scale.

Reports showed by Cai, Q. C. et al. [5] suggested that tropical and stifling nations, for instance, Thailand, Malaysia, and Indonesia, which are having more temperature in addition to increased relative water content in the air did not have leading community outbreaks of SARS [6-7]. The viral sensitivity for temperature has been recorded many times by researchers [8].

The sustainability of SARS-COV-2 was quantified on various surfaces by Rath et al. [9], where it was proved that the virus drips didn't get killed at as low as 4°C but immediately disengaged at 50°C. Soaps along with washing powders showed to collapse the virus's membrane and their structural protein to show how the sustainability of virus regulates the atmospheric environment [10].

SARS-CoV-2 has the potential to attack the cells of the lungs [11]. Spike glycoprotein is the largest structural protein residing mainly in corona virus, which consists of a homotrimer where every monomer comprises protein of 1,273 amino acids with interlinking with each other. Every monomer showed two domains known as S1 and S2 [12]. These are allocated at a furin site through the protease enzyme of a cell of the host [13]. A class I transmembrane domain (S2 domain) trips across the bilayer in addition with ends at the inner part of the lipid membranes [10].

Proteins mostly consist of enhanced thermal stability, whereas some of them denature at increased temperatures [14,15]. The mutation capability of Spike glycoprotein exhibits a high intensity of thermal stability Pursuance of the SARS-CoV-2 lessened [16]. substantially at far above the ground temperatures in comparison to that of SARS-CoV. India, a tropical country with temperature of around 40-45°C has shown the presence of immense cases of viral infections in question and are existing until now [17-19]. In this review, the effect of temperature on the virus SARS-COV 2 spike glycoproteins and their molecular interaction and behaviors have been analyzed and found that temperature affects the mechanism of virushost cell interactions.

2. Temperature effectiveness with spike glycoproteins of SARS-CoV-2:

SARS-CoV-2 employs its spike glycoprotein to attach its receptor and facilitate membrane fusion and its entry. The spike protein regulates the solubility of corona virus, and in turn, the viral infectivity since the protein of spike is the longest protein situated on the envelope. As a result, the spike protein is reliably concerned with the stability in addition to functions of the viruses in question. It is interesting to know that the receptor-binding domain (RBD) of the Spike glycoprotein is a probable objective [20,21].

SARS-CoV-2 spike protein shows lower free energy resulting from virus progression to the host since SARSlike corona viruses typically arrived from bats, which were recognized with increased temperature of the body than human beings [22-23]. The spike glycoprotein is responsible for the binding of a host cell with the receptor domain. Hence, the spike protein receptor binding domain (RBD) becomes perilous for corona viruses for infection of cells of the host. Experimental studies by Kampf G et al. [24] using molecular dynamics simulations were used to inspect the RBD proteins' vibrant properties for SARS-CoV-2 and free energies of the free RBD proteins for SARS-CoV-2.

From the Gibbs free energy, the binding energy may be represented as $\Delta G = \Delta E - T\Delta S$, where ΔE represents interaction energy, ΔS indicates loss of entropy after binding, and T represents the system's temperature. It was found experimentally by Shang, J. et al. [25] that ΔS is negative so that the binding free energy will become accelerated, and the binding will be weaker with the increase in temperature T. Hence, the binding efficiency will be shown to have decreased affinity for SARS-CoV-2 with the temperature rise.

It can be stated that SARS-CoV-2 is temperaturesensitive in binding with RBD. SARS-CoV-2 has been shown to decrease infection capability in enhanced temperature conditions. Thus, disease prevention and monitoring would be preferably simpler when the weather or seasons gets warmer.

Shang J. et al [26] revealed that spike proteins may cause changes in the dynamics of the protein. As a result, experimental procedure was carried out to follow simulations at three different temperatures [27] like 10°C, 30°C, and 50°C. Thus, it was confirmed that protein dynamics play an important role in the temperature-dependent conformation of spike glycoproteins.

3. Conclusion:

The spike protein of SARS-CoV-2 indicates low free energy, stability along with ability to stay alive at an increased temperature, and high flexibility with high entropy, and the temperature affects the mechanism of virus-host cell interactions.

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