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The Crystallography of SARS-CoV-2 Suggests Its Deactivation

Mohammad Bagher Fathi [1, *]

[1]Condensed Matter Department, Faculty of Physics, Kharazmi University, Tehran, Iran

[*] *Corresponding author*: Condensed Matter Department, Faculty of Physics, Kharazmi University, Tehran, Iran. Email: mb.fathi@gmail.com

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Abstract

Background: The materials science may come to assist pharmacists to fabricate new drugs for coronavirus disease 2019 (COVID-19).
Objectives: The geometrical structure of elements on the surface of severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2) is analyzed to illustrate some hints about the possible choosing the factors captivating the surface of SARS-CoV-2.
Methods: The crystallographic classes and their sub-structures can be indicative of practical selection of macromolecules in drug pharmacy.
Results: The macromolecular structures with hexagonal and its sub-structures are suggested for pharmacists to probe a novel drug for COVID-19.
Conclusions: Any progress in the field of fabricating macromolecular drugs for COVID-19 is strongly dependent on finding the hexagonal and its sub-structures such as triangular and rhombus geometries.

Keywords: Morphology, SARS-CoV-2, COVID-19, Macromolecular Drug Pharmacy

1. Background

Severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2), despite many concerns and some few warnings, has become a disaster for human beings without any definitive treatment for coronavirus disease 2019 (COVID-19) at least in a short time (1). The underestimation of its cross-species transmission introduced a potential risk of its re-emergence (2).

A collection of researches and investigations have been conducted about this outbreak, including some rough characterization of the structure of this virus. Coronaviruses commonly occupy a spherical or pleomorphic enveloped particle having a nucleoprotein within a capsid (3). All coronaviruses have enveloped virions that measure about 120 nm in diameter (4).

The morphology of SARS-CoV-2 has been determined by transmission electron microscopy and the size of negative-stained 2019-CoV-2 particles in human are shown to be about 100 nm. The coronaviruses, as the microscopies show, tend to be in close contact with each other, so you can hardly find a single virus separated from others (5). The illustration of this virus is created at the Center for Disease Control and Prevention (CDC) as an ultrastructural morphology of SARS-CoV-2. There are some spikes on the surface of the virus that adorn its outer surface, giving it the corona name. Images combined from a 3D animation model its shape as well as showing its major elements including, S protein, hemagglutinin-esterase dimer (HE) protein, viral envelope and helical RNA (6).

2. Objectives

In the present paper, I investigated some illustrative features, which are obvious at the morphology of ultrastructure of SARS-CoV-2. These features probably reveal signs for overcoming the fast spread of this virus. In this paper, I tried to analyze the structural geometry of surface agents of SARS-CoV-2 to provide the medical community a probable novel method for overcoming the virus. Our success in the future fabricating of drugs for the treatment of diseases from viruses depends critically upon our knowledge about the geometrical structure of these living objects.

3. Methods

The crystallography of these tiny nano-particles, however, usually is introduced as the first platform for any progress in fabrication controllable devices, in materials science and engineering realization of micro-particles. In medicine, however, this invaluable tool occupies a relatively narrower role than other techniques for micro-investigations, such as micro-molecular biology, in spite

of its unique role in providing the researchers many hints about the possible controlling the spreading of micro-organs, especially viruses. Most of treating techniques, nevertheless, for possible fabricating new drugs for diseases caused by viruses rely on attacking RNA of virus with micromolecular methods.

From the qualitative viewpoint of nano-science, the viruses are strongly capable of establishing atomic/molecular bonding with their surrounding surfaces due to their small sizes, mainly with other vital organs. The coronaviruses are approximately 100 - 130 nm in diameter (7). Their small sizes, on the other side, permit them to far diffuse into more intense media and vast spread into the environment.

3.1. The Morphology of SARS-CoV-2

In addition to the general features of nano-particles, the viruses benefit from the beautiful/scary crystallographic ultrastructure. The SARS-CoV-2, specifically, exhibits an ordered arrangement of elements that adorn its outer surface. According to the report of CDC (6), this virus illustrates spike glycoprotein (S), which has a triangular-shaped vortex, hemagglutinin-esterase dimer (HE), which seat equally-spaced with nearly the same angle of triangles, in an approximately hexagonal structure. These elements are situated on an envelope, which ascribes a helical RNA (6).

In providing agents for overcoming the disaster of rapid infection with COVID-19, especially in the patient's body, we must decide in favor of selecting suitable molecular agents, which are capable of captivating the elements on the surface of SARS-CoV-2. These elements occupy an internal structure, which is the target for molecular biologists. But, on the side of morphologists, these elements situate on regular and ordered arrangements, which provide them some hints for deciding on selection of molecular objects for the synthesis of the drug.

4. Results

The success of the growth of molecular objects on the surface of substrates depends crucially upon selecting the nearly the same crystallographic structure. As a crystallographer, I mention criticality selecting surface agents with the same topological structure to readers as the substrate to success the growth of crystals. For any successful growth of any crystals, therefore, the pre-condition is the structural and morphological kinship between the agent and substrate. This necessary condition is due to the bond, atomic or molecular since the atomic orbitals do not permit construction of arbitrary angles between intervening, overlapping orbitals. For example, the water crystallizes in ice in hexagonal structure because its shape is a message from its underlying hierarchy about the orientation of its atomic orbitals. As you remember, the hybrid orbitals of oxygen make the bond angle around a central atom about 109.5 degrees. This property leaves the H_2O as a hexagonal structure even in water (water does have a complicated structure in liquid phase resembling the structure of its solid phase). On the other hand, its hydrogen bonds permit its drinking by living animates.

The reason for usefulness of water drinking for getting out the viruses, as well as its invaluable hydrogen bonds, relies on this fact that the viruses such any other living (semi-) animates, benefit from the hexagonal structure in any sub-structures, such as triangle or rhombus, etc.

Viruses have a crystalline structure, and design and fabricating drugs with macromolecules need also the same structure as the arrangement of their surface to captivate the surface elements. For designing new drugs, this is of crucial importance to select the molecular structures with the same topology of the living being under consideration, with this liberty to leave the length of molecule arbitrary. These molecular agents, if chosen accordingly, will pretend intelligently in the shape of an element to seat on the proper situation.

The triangular shape of HEs on the surface of SARS-CoV-2 repeats all over the ultrastructure and other elements are seated at the same topology even though with different lengths. This clue may reveal some promising solutions for captivating viruses, especially SARS-CoV-2, to avoid their very rapid infection.

5. Discussion

This research includes an influential physical message since it plausibly stimulates others' thoughts about the usefulness of materials science in designing and synthesizing new drugs with a decision on molecular structure utilizing the knowledge about the arrangement of elements on the surface of viruses.

Any progress in the field of fabricating macromolecular drugs for COVID-19 is strongly dependent on the finding hexagonal and its sub-structures such as triangular and rhombus geometries. Maybe the failure of pharmacists in the synthesis of new drugs for viruses lies on this point that the bio-molecular techniques focuses extremely on the molecular agents for targeting the sequence of the virus, while, the topological arrangement of elements is of equal importance in drug design, as in the case of usefulness of water drinking for decreasing the dose of virus in the body. The reason comes from two sources: hydrogen bond of water that leads to adhesion of water to viruses,

and hexagonal structure of water which resembles the arrangement of surface element on the virus, despite the difference in length orders.

Many open problems exist. More exact and accurate characterization of surface elements of SARS-CoV2 is needed for suggesting the proper macromolecular agents to captivate this virus. Any progress in this field depends critically on our knowledge about the geometrical structure of the virus's surface element.

Footnotes

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