Indian Institute of Science Education and Research Kolkata

Department of Biological Sciences

Summer Project Report, June-July 2020

SARS-CoV-2 and its parallels with m-CoV

Submitted by

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on

July 30, 2019

Under the supervision of

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Declaration

I declare here that the report included in this project entitled "**SARS-CoV-2 and its parallels with m-CoV**" is the summer internship carried out by me in the Department of Biological Sciences, Indian Institute of Science Education and Research Kolkata, India from June 15 to July 31, 2020 under the supervision of Prof. Jayasri Das Sarma

In keeping with general practice of reporting scientific observations, due acknowledgements have been made wherever the work described is based on the findings of other investigators.

Student's e-Signature	Place	Date
	IISER Kolkata	July 30, 2019

CERTIFICATE

It is certified that the summer research work included in the project report entitled "**SARS-CoV-2 and its parallels with m-CoV** "has been carried out by Mr. Abhay Kshirsagar under my supervision and guidance. The content of this project report has not been submitted elsewhere for the award of any academic and professional degree.

Jayasri Das Sarma

Signature of Supervisor
(Prof. Jayasri Das Sarma)
Project Supervisor

July 30, 2020
IISER Kolkata

List of Abbreviations

m-CoV : Murine Coronavirus
SARS : Severe Acute Respiratory Syndrome
ACE2 : Angiotensin converting Enzyme 2
PRR : Pattern Recognition Receptors
RTC : Replicase transcriptase complex
ssRNA : single stranded Ribonucleic acid

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I sincerely thank IISER Kolkata for giving me an opportunity to carry out my summer internship.

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INTRODUCTION

The project was carried out under the supervision of Prof. Jayasri Das Sarma and coordinated by her senior students Debanjana Chakravarty, Fareeha Sadi and Mithila Kamble. The theme of the project was based on gaining insights about Coronaviruses, especially murine-coronaviruses (m-CoVs) and with special emphasis on the SARS-CoV-2, for its homology with m-CoVs. Prof. Jayasri along with her students coordinated Google meet once a week, where ma'am introduced series of lectures consisting topics like the pathophysiology of SARS-CoV-2, neuro-pathogenesis of SARS-CoV-2, and the neuro-immuno-pathology of m-CoV and Mouse hepatitis Virus (MHV). We were also encouraged to ask questions during each session. Upon completion of the task each of us were instructed to read and understand about the general signs and symptoms of SARS-CoV-2 and its broad mechanism and present it in a flash talk. Prof. Jayasri provided us with valuable tips for creating presentations and giving flash talks.

ABOUT SARS-CoV-2

The SARS-CoV-2 was discovered in December 2019 in Wuhan China after multiple cases of pneumonia like etiology were reported. The virus belongs to the family coronaviridae, which is the largest family of zoonotic virus of the order nidovirales. They are further divided into four generas. The SARS-CoV-2 belongs to the β genera. The α and β infect humans and the SARS virus which caused a pandemic in 2003 belonged to β genera. SARS-CoV-2 and SARS-CoV have many biochemical similarities, which leads us to believe they likely have similar pathogenesis. The coronaviridae is an enveloped positive single stranded RNA(ssRNA) with spike(S) protein on which gives it a crown-like appearance.

The virus is transmitted via mainly through respiratory droplets or touching the surfaces having droplets. After entry the virus generally stays incubated for 8-14 days and shows no symptoms of infection(asymptomatic). The most common symptoms are fever, dry cough, loss of appetite, fatigue, etc. Most cases are mild and do not require intensive hospital care however some infections can cause pneumonia, kidney failure and may require intensive care like breathing support and monitoring of organs.

The spike S protein of the virus attaches to the ACE2(Angiotensin converting Enzyme 2) receptor of pneumocytes in lungs. The virus enters the host cell and releases the viral RNA. The ssRNA incorporates with the host ribosome and translates the viral genome to make RTC (replicase-transcriptase complex) which replicates the viral RNA and other components which are assembled in the golgi body and released outside.

When inside the cell the virus encounters the first line of defence; the innate immunity of the body. The mechanism of innate immunity begins with the activation of pattern recognition receptors (PRR) by the viral RNA. The downstream signalling cascades the secretion of cytokines like type I/III Interferons (INFs), pro-inflammatory tumor necrosis factor (TNF - α) and Interleukin (1, 6 and 18). These pro-inflammatory responses to the virus contribute to “cytokine storm”. Where the body starts attacking self cells.. The virus infects organs other than lungs like heart, Kidney and Brain. This leads to further complications like carditis, neural inflammation, Kidney failure etc. The virus travels to these organs via the vagus nerve or the systemic circulation. The m-CoV virus can be used as a model for studying the effects of virus on neural, hepatic and renal cells.

Discussion :

The spread of the virus has been attributed to its higher reproduction number and faster replication. Thus to reduce the spread of the virus it is advised to maintain sanitation in public places by wearing surgical masks and gloves. Using alcohol based hand sanitizers whenever touching surfaces. With the advent of pandemic many countries have undergone lockdowns with the closing of schools, cinema halls, colleges, and other public places. Many countries like South Korea and New Zealand have successfully reduced the spread of the virus by practicing social distancing and rapid testing programs.

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