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Antigen and antibody for Coronavirus RNA Vaccination Development

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Abstract

Coronavirus and its strains are associated to the subfamily of Orthocoronavirinae. It is associated with the family of Coronaviridae and order of Nidovirales and realm in Ribavirin. These are enveloped viruses with positive single stranded RNA genome and nucleocapsid of helical symmetry. The size of genome for coronaviruses varies from 27 to 34 kilobases.

Mutation of Coronavirus may or may not be recognized by the immune system on subsequent infection; and once it hijacks host of the cell, replication of virus becomes faster. As a result immune system will be unable to recognize the strains of these infections; infections caused by coronavirus like Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) have inclined to be very severe and can cause significant mortality. In this paper discusses about antigen and antibody for development of vaccines for coronavirus and its strains so that some of the B cells become memory B cells which recognizes future exposure to the disease.

Keywords: Coronavirus; Ribonucleic acid; Protein; Antigen; Antibody; Vaccination; Immunization; Middle East Respiratory Syndrome, Severe Acute Respiratory Syndrome

Abbreviations: RNA: Ribonucleic Acid; MERS: Middle East Respiratory Syndrome; SARS: Severe Acute Respiratory Syndrome

Introduction

Coronavirus was discovered in the year 1960's. It infected in chicken and two human patients with common cold. There are family of corona virus which is as lethal as Severe Acute Respiratory Syndrome (SARS). Most of these involves respiratory tract infections [1]. There are many human coronaviruses to exist. Few them are human coronavirus 229E (HCoV-229E), HCoV-OC43 which is related coronavirus (SARA-Cov). The genome structure of coronavirus has unique features that includes N-terminal fragment within spike protein [2]. A new strain of corona virus which was discovered in December 2019 named as COVID 19 (Figures 1-5).

Antigen and Antibody

Antigen is the element that can induce in an immune response. It is usually proteins, it can also be polysaccharides, lipids or nucleic acids. Its origin can be within the body or externally. Its specific binding site is Epitope [3] (Figures 6-10). Example: Antibodies are proteins that recognize and bind antigens. Its molecular type are proteins. Its origin is within the body. Its specific binding site is Paratope [3].

Example: Vaccines contain antigens which stimulates the B lymphocytes of the immune system to respond by generating plasma cells which discharges disease related antibodies that is called primary response. Some of the B cells become memory B cells, which recognizes future exposure to the disease.

Thus resulting in faster and more concentrated production of antibodies, which effectively work to remove the disease by binding to the antigens that is called secondary response [3] (Figures 10-15).

Antigens For Coronavirus

Because of high cases of fatality and deficiency of therapeutic and prophylactic procedures against these novel viruses; there is a need of immediate and new countermeasures for research and development [4]. Human Coronavirus 229E Nucleoprotein is a recombinant protein containing 359 amino acids derived from the nucleocapsid sequence, with a C-terminal 6xHis tag [4]. Human Coronavirus NL63 Nucleoprotein is a recombinant protein containing the nucleocapsid C-terminal region (130 amino acids), cloned and expressed in *E. coli*, and purified by affinity chromatography (nickel column) [4]. MERS Coronavirus Spike Glycoprotein (S1), His-tag is a recombinant protein containing a peptide from amino acids 56 to 295 of MERS-CoV Spike protein S1, cloned and expressed in *E. coli* [4]. Recombinant Middle Eastern Respiratory Syndrome (MERS) coronavirus (CoV) Spike 1 protein (S1), manufactured in HEK293 cells with C-terminal mouse Fc-tag [4]. The protein contains a C-terminal 15 amino acid glycine-serine linker followed by a mouse IgG2a Fc-tag. The Fc-tag has an approximate apparent molecular weight of 25kDa [4] (Figures 15-20).

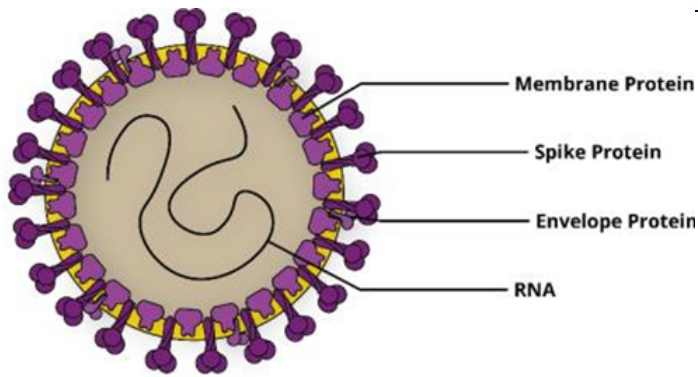


Figure 1: Internal structure of coronavirus [4].



Figure 2: Example of Antigen [3].



Figure 3: Example of Antibody [3].

SARS Coronavirus Envelope Protein is a recombinant antigen which contains the N-terminus (1-76 amino acids) of the Envelope protein immunodominant regions. It is manufactured in *E. coli* [4]. SARS Coronavirus Membrane Protein (Matrix) is a recombinant protein (also known as E1 glycoprotein or Matrix), and comprises aa 182-216 immunodominant regions. It is manufactured in *E. coli* [4]. SARS Coronavirus Nucleoprotein (C-Term) is a recombinant protein (also known as the nucleocapsid core antigen) comprising amino acids 340-390 immunodominant regions. It is manufactured in *E. coli* [4]. SARS Coronavirus Nucleoprotein (aa 1-422) is a recombinant nucleocapsid antigen manufactured in *E. coli* with greater than 95% purity. For use in Western blot, ELISA and other immunoassays [4]. SARS Coronavirus Nucleoprotein (N-Term, Mid) is a recombinant protein (also known as the nucleocapsid core antigen) comprising the N-term fused to an immunodominant region from the middle of the protein (aa 1-49, 192-220). It is manufactured in *E. coli* [4] (Figures 21-25).

Antibodies For Coronavirus

Mouse anti MERS-CoV Spike S1 (clone 3871) is a monoclonal antibody that is specific for the S1 domain of the spike protein of the MERS coronavirus. This antibody does not cross-react with the SARS Coronavirus and is suitable for use in ELISA and IFA [4]. Mouse anti MERS-CoV Spike S1 (clone 3872) is a monoclonal

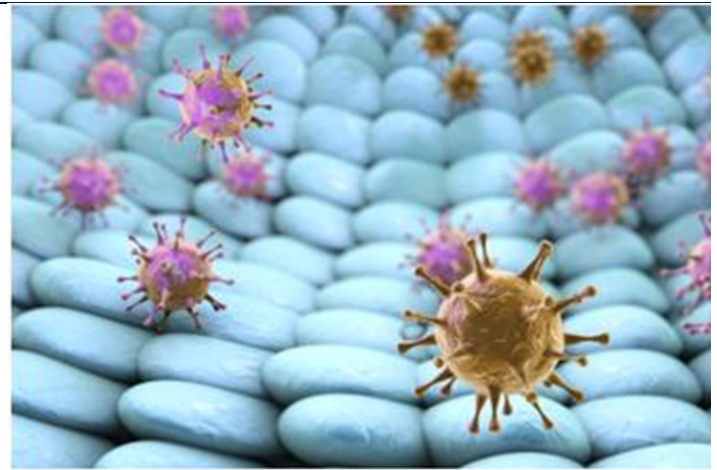


Figure 4: Human Coronavirus 229E Nucleoprotein (*E. coli*).

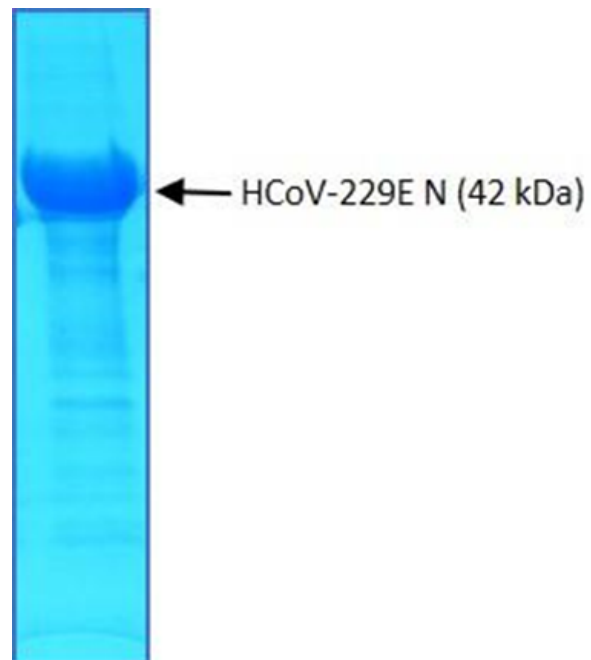


Figure 5: Coomassie-stained SDS-PAGE showing purified recombinant HCoV-229E nucleoprotein (N) [4].

antibody that is specific for the S1 domain of the spike protein of the MERS coronavirus. This antibody does not cross-react with the SARS Coronavirus and is suitable for use in ELISA and IFA [4]. Mouse anti MERS-CoV Spike S1 (clone 3873) is a monoclonal antibody that is specific for the S1 domain of the spike protein of the MERS coronavirus. This antibody does not cross-react with the SARS Coronavirus and is suitable for use in ELISA and IFA [4]. Mouse anti SARS-CoV Membrane antibody (2H2C4) is a monoclonal antibody that is specific for human coronavirus and reacts with the SARS-CoV membrane glycoprotein (also known as E1 or Matrix glycoprotein). Antibody is suitable for use in Western blot and ELISA [4] (Figures 26-30).

Mouse monoclonal antibody specific for SARS Coronavirus nucleoprotein. Antibody is also reactive with the NP of SARS-CoV-2 (COVID-19) by ELISA [4]. Mouse monoclonal antibody specific for SARS Coronavirus nucleoprotein. Antibody is also

reactive with the NP of SARS-CoV-2 (COVID-19) by ELISA [4]. Mouse anti SARS Coronavirus nucleoprotein antibody is specific for the nucleocapsid protein of Severe Acute Respiratory Syndrome (SARS) Coronavirus (SARS-CoV) and also recognizes the NP of SARS-CoV-2 (COVID-19) by ELISA. SARS-CoV-2, previously known as the 2019 Novel Coronavirus (2019-nCoV), causes the pandemic COVID-19 disease [4]. Mouse anti SARS Coronavirus nucleoprotein antibody is specific for the nucleocapsid protein of Severe Acute Respiratory Syndrome (SARS) Coronavirus (SARS-CoV) and also recognizes the NP of SARS-CoV-2 (COVID-19) by ELISA. SARS-CoV-2, previously known as the 2019 Novel Coronavirus (2019-nCoV), causes the pandemic COVID-19 disease [4] (Figures 31&32).

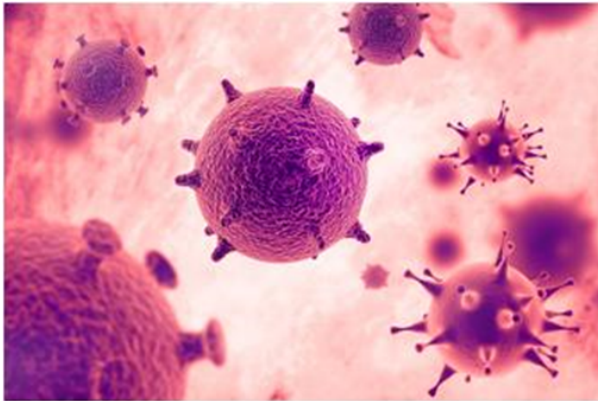


Figure 6: Human Coronavirus NL63 Nucleoprotein (*E. coli*).

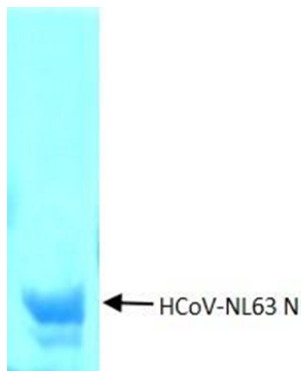


Figure 7: Coomassie-stained SDS-PAGE showing purified recombinant HCoV-229E nucleoprotein (N) [4].

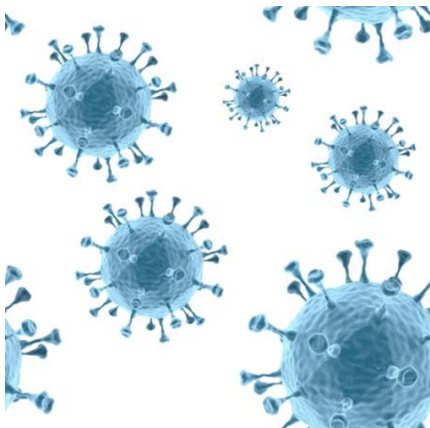


Figure 8: MERS Coronavirus Spike Glycoprotein (S1), His-Tag (*E. coli*).

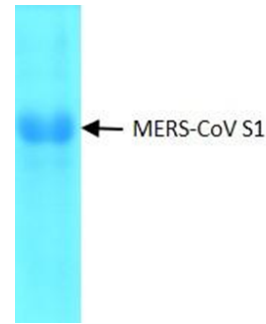


Figure 9: Coomassie-stained SDS-PAGE showing purified recombinant MERS-CoV Spike (S1) protein [4].

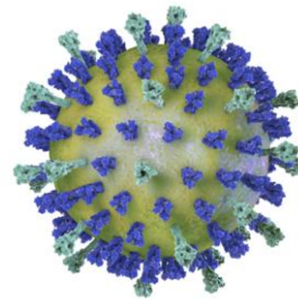


Figure 10: MERS Coronavirus Spike Glycoprotein (S1), Mouse Fc-Tag (HEK293).

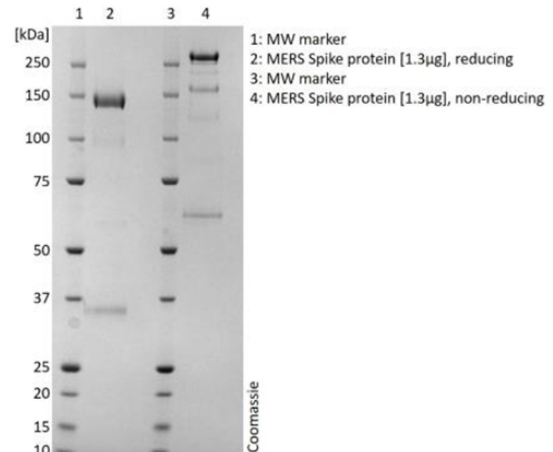


Figure 11: Recombinant MERS-CoV S1, corresponding to amino acids 18-725 of the MERS-CoV Spike protein.



Figure 12: SARS Coronavirus Envelope Protein (*E. coli*).

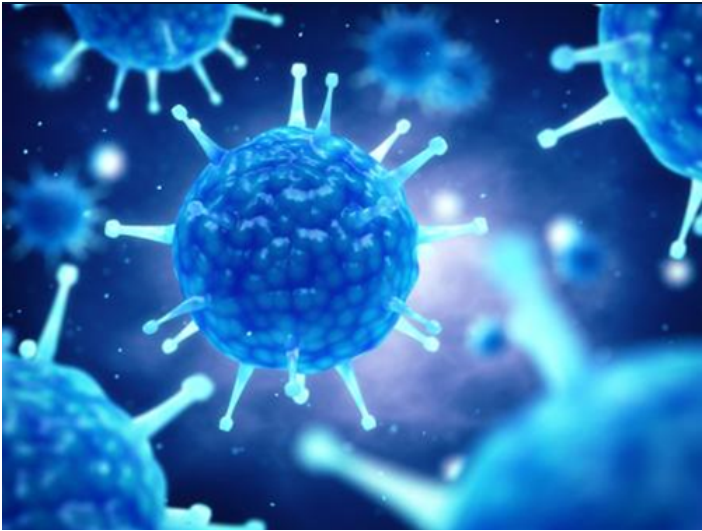


Figure 13: SARS Coronavirus Membrane Protein (Matrix) (*E. coli*).

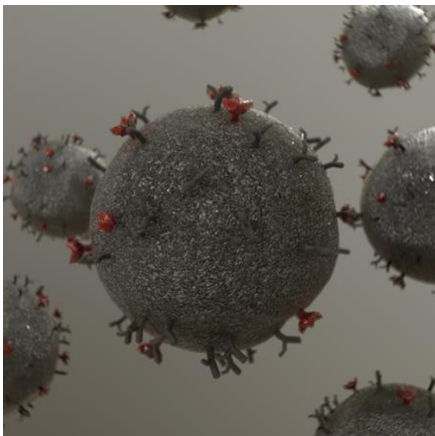


Figure 14: SARS Coronavirus Nucleoprotein (C-Term) (*E. coli*).

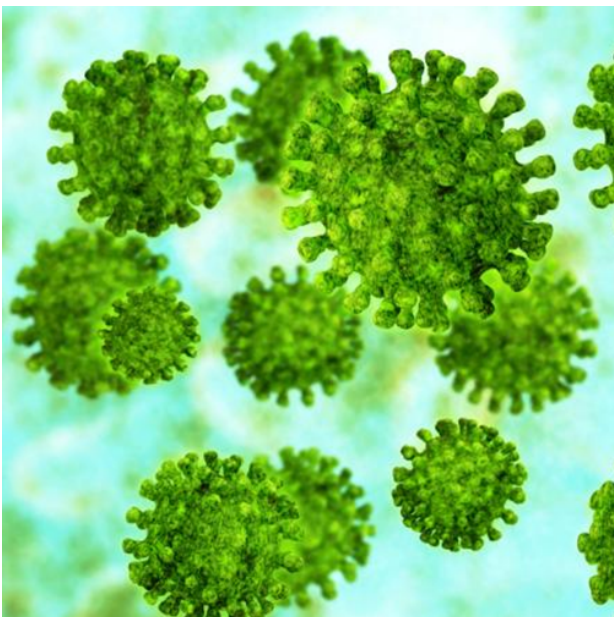


Figure 15: SARS Coronavirus Nucleoprotein (Full Length) (*E. coli*).



Figure 16: SARS Coronavirus Nucleoprotein (N-Term, Mid) (*E. coli*).



Figure 17: Mouse Anti MERS Coronavirus Spike (S1) Antibody (3871).

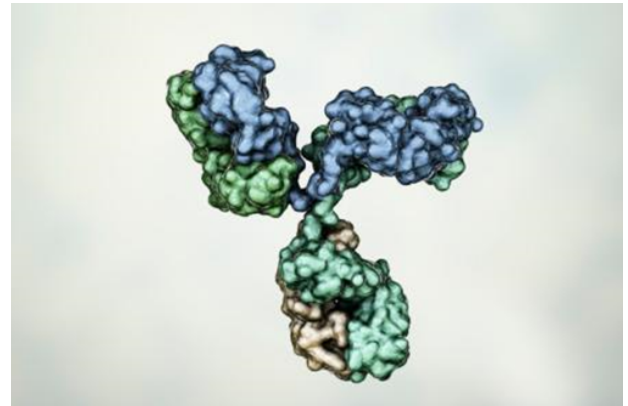


Figure 18: Mouse Anti MERS Coronavirus Spike (S1) Antibody (3872).

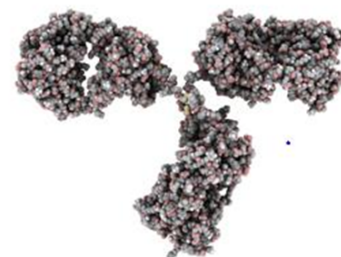


Figure 19: Mouse Anti MERS Coronavirus Spike (S1) Antibody (3873).

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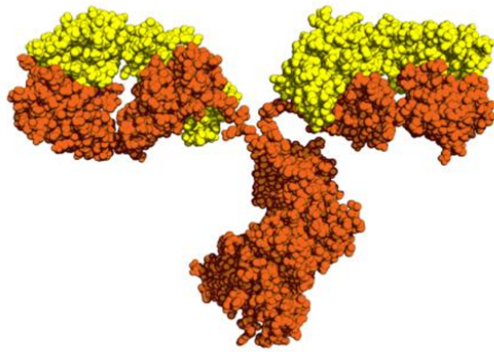


Figure 20: Mouse Anti SARS Coronavirus Membrane Antibody (2H2C4).

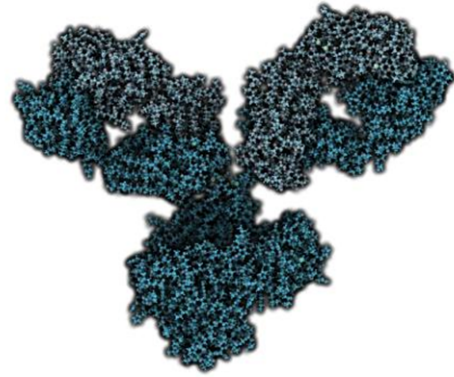


Figure 24: Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3861).



Figure 21: Detection of recombinant SARS-CoV membrane protein using MAB12394 [4].

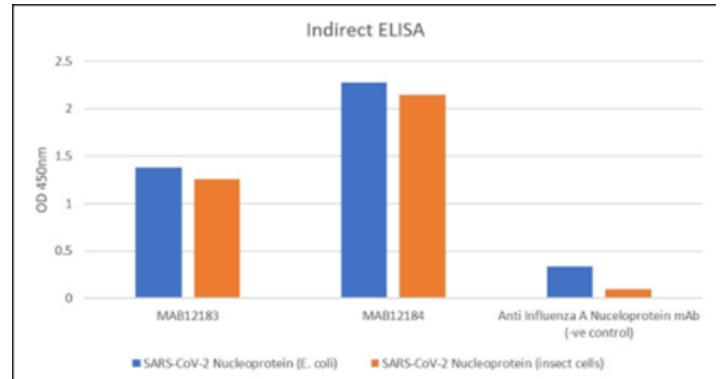


Figure 25: Showing MAB12183 and MAB12184 vs. two different recombinant SARS-CoV-2 (COVID-19) nucleoproteins [4].



Figure 22: Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3851).

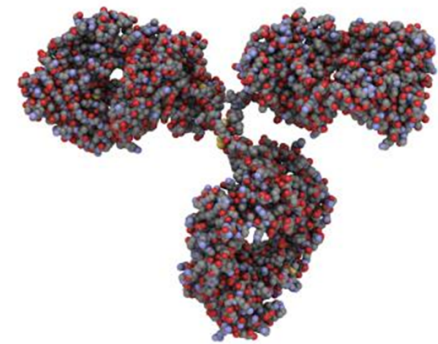


Figure 26: Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3862).

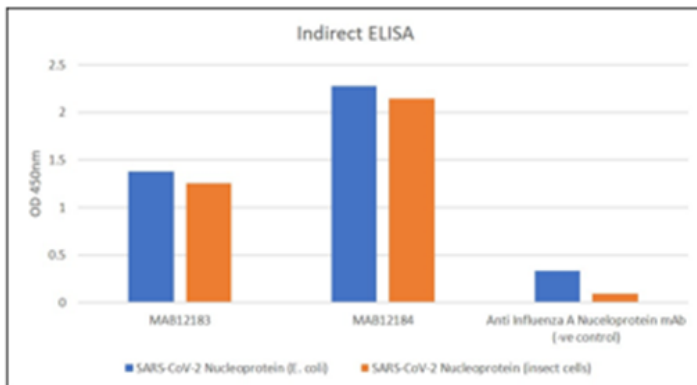


Figure 23: Showing MAB12183 and MAB12184 vs. two different recombinant SARS-CoV-2 (COVID-19) nucleoproteins [4].

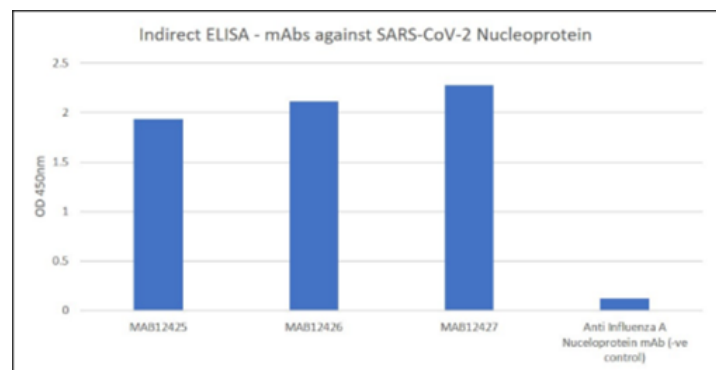


Figure 27: mAbs vs. recombinant SARS-CoV-2 (COVID-19) nucleoprotein [4].

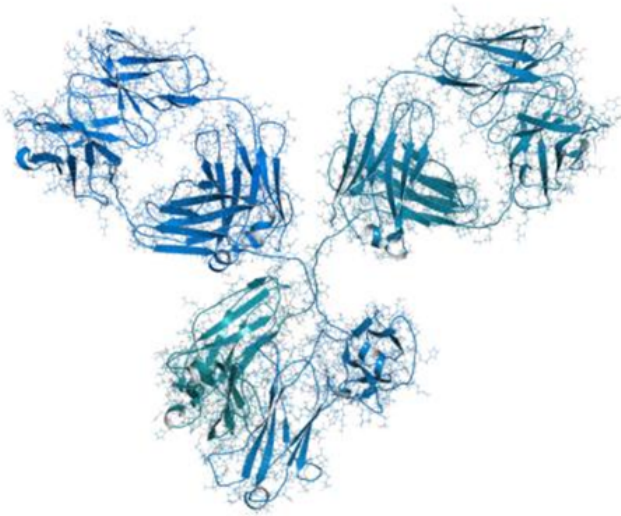


Figure 28: Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3863).

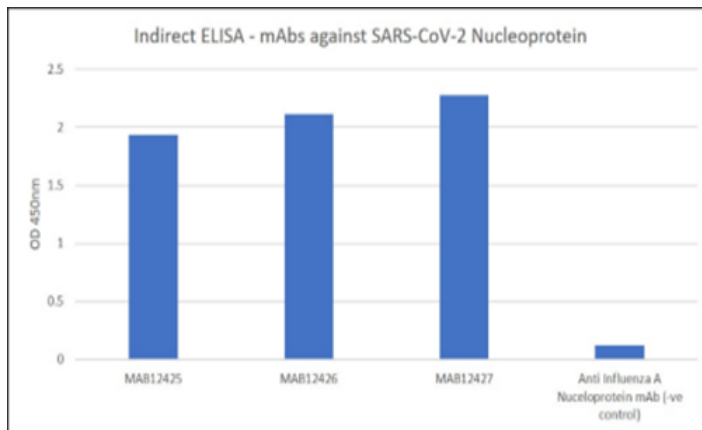


Figure 29: mAbs vs. recombinant SARS-CoV-2 (COVID-19) nucleoprotein.

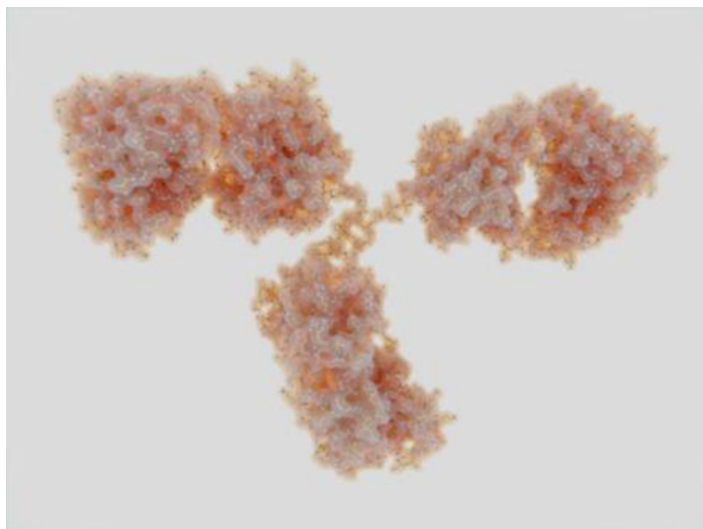


Figure 30: Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3864).

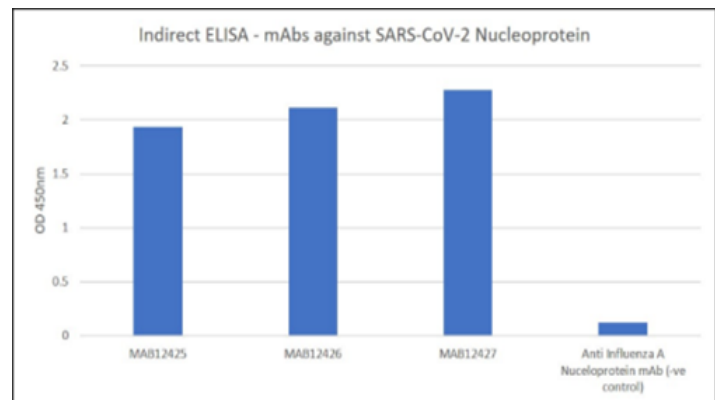


Figure 31: mAbs vs. recombinant SARS-CoV-2 (COVID-19) nucleoprotein [4]



Figure 32: Image shows the vaccination for Covid-19. Image Credit: Marc-Antoine De La Vega [5].

Mouse anti SARS Coronavirus nucleoprotein antibody is specific for the nucleocapsid protein of Severe Acute Respiratory Syndrome (SARS) Coronavirus (SARS-CoV) and also recognizes the NP of SARS-CoV-2 (COVID-19) by ELISA. SARS-CoV-2, previously known as the 2019 Novel Coronavirus (2019-nCoV), causes the pandemic COVID-19 disease [4].

Vaccination For Covid-19

RNA vaccines are novel vaccination which is composed of ribonucleic acid (RNA). It is enveloped within a vector of lipid nanoparticles. As normal vaccines, RNA vaccines are intended to induce the production of antibodies which binds potential pathogens. This can be accomplished when the RNA from vaccine is delivered into cells in the body which produce proteins that are similar to proteins of pathogen. These proteins are used by the body immune system to produce antibodies against the pathogen, causing future protection from the pathogen. [5,6].

Conflicts of Interest

There are no conflict of interest as per Author's point of view.

Author Notes

Based on the Antigen and Antibody; RNA vaccination for coronavirus can be developed.

Conclusion

Below are few points to be noted for development of vaccines for coronavirus:

Antigens:

1. Human Coronavirus 229E Nucleoprotein (*E. coli*)
2. Human Coronavirus NL63 Nucleoprotein (*E. coli*)
3. MERS Coronavirus Spike Glycoprotein (S1), His-Tag (*E. coli*)
4. MERS Coronavirus Spike Glycoprotein (S1), Mouse Fc-Tag (HEK293)
5. SARS Coronavirus Envelope Protein (*E. coli*)
6. SARS Coronavirus Membrane Protein (Matrix) (*E. coli*)
7. SARS Coronavirus Nucleoprotein (C-Term) (*E. coli*)
8. SARS Coronavirus Nucleoprotein (Full Length) (*E. coli*)
9. SARS Coronavirus Nucleoprotein (N-Term, Mid) (*E. coli*)

Antibody:

10. Mouse Anti MERS Coronavirus Spike (S1) Antibody (3871)
11. Mouse Anti MERS Coronavirus Spike (S1) Antibody (3872)
12. Mouse Anti MERS Coronavirus Spike (S1) Antibody (3873)

13. Mouse Anti SARS Coronavirus Membrane Antibody (2H2C4)
14. Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3851)
15. Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3861)
16. Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3862)
17. Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3863)
18. Mouse Anti SARS Coronavirus Nucleoprotein Antibody (3864)

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