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1. Analysis of Nanotechnology Potential for the Treatment and Diagnosis of COVID-19: Review

Saurav Gosh
Department of Biotechnology, Kalinga University, Atal Nagar, Raipur, Chhattisgarh.

Dilendra Chandraker
Department of Biotechnology, Kalinga University, Atal Nagar, Raipur, Chhattisgarh.

Abline Tirkey
Department of Biotechnology, Kalinga University, Atal Nagar, Raipur, Chhattisgarh.

Neha Khan
Department of Biotechnology, Kalinga University, Atal Nagar, Raipur, Chhattisgarh.

ABSTRACT

As we know that today world is facing a huge crisis, due to current COVID-19 epidemic (virulent disease), only vaccines medicines are not much enough to fight it. Different efficient method should be developing to fight the pandemic. As the whole world is battle ling with extensive measures but this is not enough. But due to nanotechnologies which has the ability to bind with the COVID-19 virus structure, due to comparable same sizes. To detect the presence of corona virus in our body, PCR, RDT and SEROLOGIC test is used, but due to the various nanotechnologies it has given better results than the formers. Different types of vaccines and drugs have been formulated with nanoparticles for the proper medication of the coronavirus so that detection and medication can be done in good way. There are different advantages and disadvantages of the nanotechnology because every experiment is having its pros and cons. But to the sudden rise of the epidemic the use of the nanotechnology has become very important and studious as all over the world the research regarding the use of the nanotechnology has began and scientists are continuously observing that.

KEYWORDS: *Covid-19, Diagnosis, RT-PCR, Nanotechnology, Nanomaterial Drugs and Vaccination.*

Introduction:

Due to the current situation of COVID-19 19 pandemic, and the level of damages it has caused such as death rate is rising, (SARS), (MERS), it is the need of the hour to end this pandemic to its roots [1]. The most important thing is the economy of the world has records its lowest economic rate i.e. approx. 4.4%, earlier it was 5.8%. As the world is doing its best to tackle it, different countries like china, Russia, India America, Germany has developed vaccines like COVAXIN, COVISHEILD and REMDESIVIR, these vaccines have shown good efficacy against other diseases such as malaria, aids other than virus, but these are not enough. But with the coming up of nanotechnologies it has shown better results and great efficacy [2]. Previously in 2020 as the COVID-19 was begin to expand, at that time different immunological biosensors were developed but that did not have accuracy more than 60%, but over the time different changes have been made to make the accuracy more than 60% or equal to 80%. It has been seen that due to small sizes of nanoparticles and the virus these nasopharyngeal (NP) promote NP-COV interaction and could give better immune response by inactivating pathogenic activity [3]. Due to nano formulations the body has better controlled immune response. Back in 2020 nanotechnologies was formulated but now different methods have been developed such as-

1. Rapid test for COVID-19 that could be done at large scale.
2. To prevent the replication of corona virus by using nanotech to block cellular receptor present in cellular level.
3. To provide nanomaterial based vaccine.
4. To provide good immunity by using nano formulations.

So due to the advancement of the nanotechnology it helps in the early detection of the diseases due to which the medication can be done in a proper way. See the fig. no.1 [1].

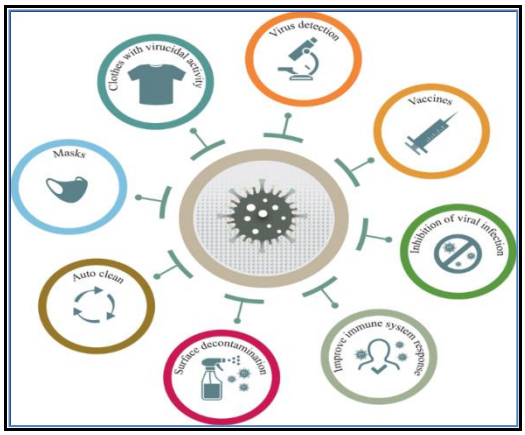

Fig. 1. Showing the Methods to Avoid COVID-19

Due to the rise of COVID- 19 scientists relates to other disease such as SARS (severe acute respiratory diseases), FCOV9 (feline coronavirus), PEDV (porcine epidemic diarrhea virus)

which uses similar nanotechnologies procedure for cure. So the coronavirus and the other diseases mentioned above are related to each other's [1]. See fig no.2 [2]

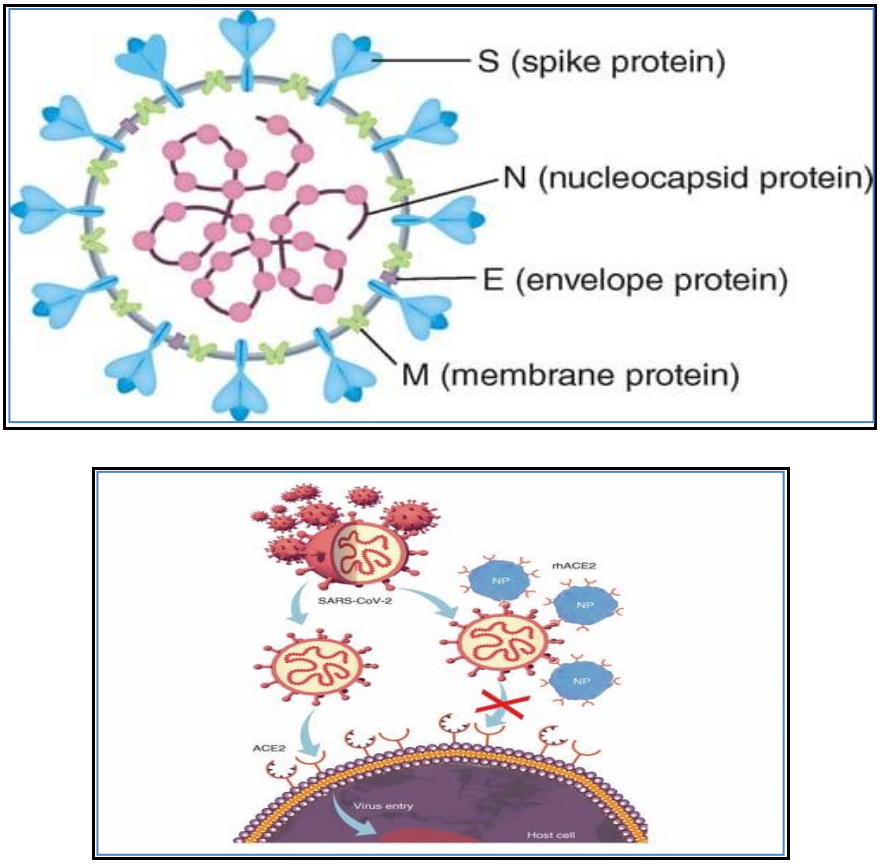

Fig. 2. The Interaction between Nanoparticle Virus and Body Surface Receptors.

Important facts about nanotechnology against coronavirus with their treatments and prevention:

Coronavirus is a type of virus which belongs to the family of CORONAVIRIDAE which was identified as SARS COV-2 in 2019 and had caused respiratory illness called COVID-19 [2]. Through many researches scientists have declared that it is an airborne diseases which spread through droplets, sneezing etc. [1]. The incubation period of corona virus is approximately 14 days. The first cases of COVID- 19 were reported on December 2019 Wuhan fish market in china [2]. Now few of the symptoms of COVID- 19 include cough, fever, sore throat, muscle ache, diarrhea, headache etc [3]. Before coming of nanotechnologies the detection of coronavirus was done by RT-PCR, ELISA, and CHEST X-RAYS [2]. But now due to nanotechnology rapid accurate and sensitive diagnosis has been done. NANOVACCINES deliver the vaccine and antiviral agents into body [4]. the development of biosensors in 2020, lead the scientists to conclusions that due to same size of nanomaterial and the virus, it is able to bind it and inhibit the ACE -2 receptor and help to destroy the virus. It also helps in gene modifications and interactions between analyte

and sensor (allows fast detection of virus). Metals which are generally used are silver, copper and titanium oxide [5]. Generally, nanoparticles size ranges from 100nm which may be less. The special property of nanoparticles is it helps to increase solubility of drugs and target cells quickly [1].

The manufacturing of these NP are done in such a way that it is made porous and hollow so that it can bind to specific cells. The gold nanoparticles can act to increase the immune response of our body quickly. See the figure no. 3 [2].

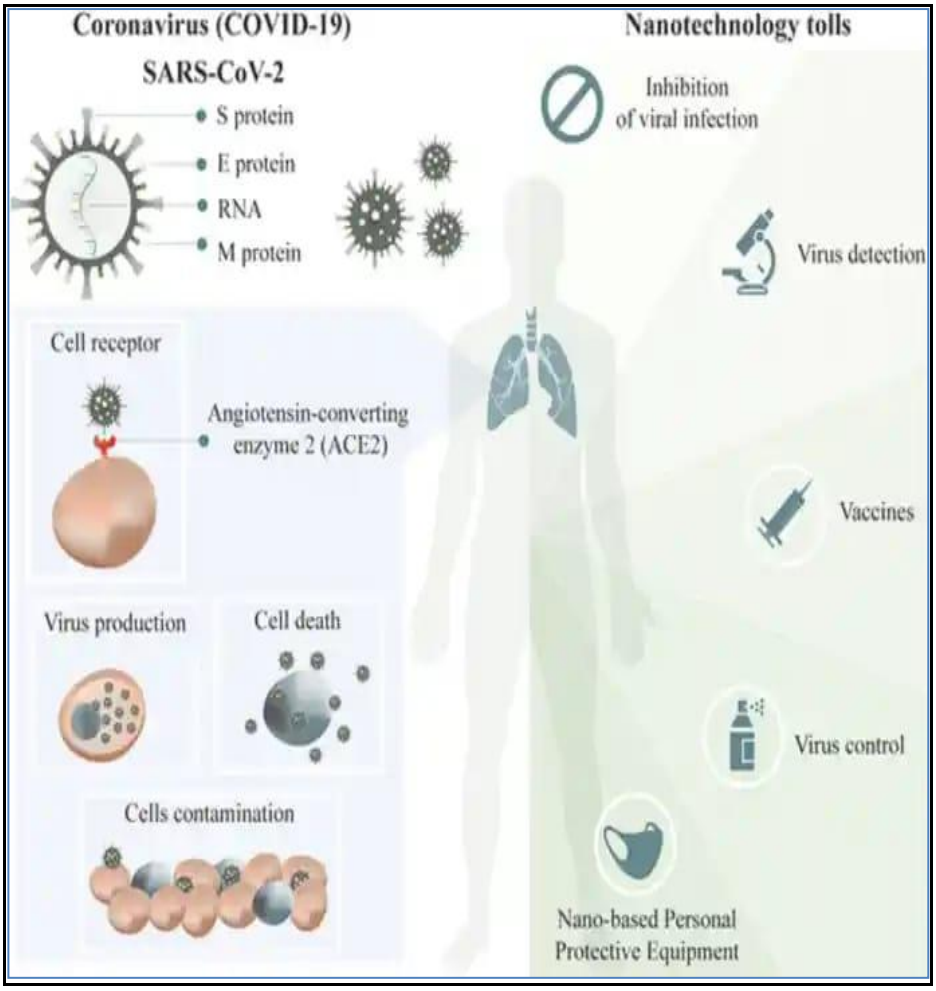

Fig. 3. Some of Comparisons between uses of the Nanotech to Fight against COVID-19

Different types of nanoparticles used in diagnosis/ treatment of covid-19:

As the nanoparticles are generally small in size i.e. 100 nm, different type materials are being used like organic, inorganic, metals [3]. Generally metals are used because they are good conductors [4]. Gold nanoparticles increases the immune response, silver

nanoparticles shows antiviral activity, which is helpful for treating COVID-19 [5]. In 2020 the manufacturing of quantum dots was started but by starting of 2021 quantum dots have been the excellent type of nanoparticles which are used for detection of virus, i.e. they have high sensing property and detecting abilities [1]. Like for example of organic nanoparticle are CYCLODEXTRIN nanoparticle which have a water loving core i.e. hydrophilic, they are used in biochemical industries due to low toxicity [2].

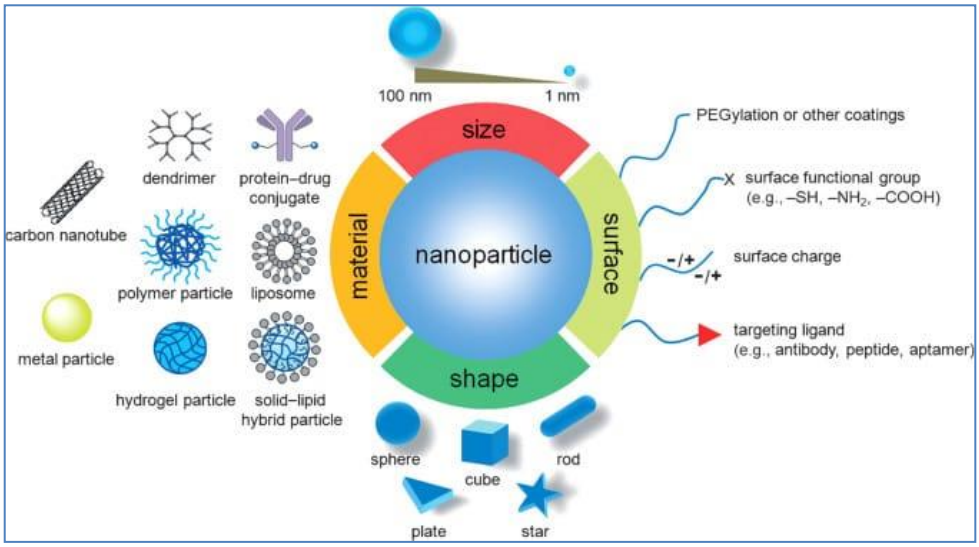

Fig. 4. Showing different Materials Synthesize for the Making of Nanoparticle.

The special feature nanoparticle that enable its interactions with virus:

As the size of the nanoparticle is generally small similar to corona virus so, it has capacity to bind with the virus proteins and can inhibit virus replication [2]. As the COVID-19 19 virus is airborne disease that could transmit by coughing, sneezing, so what happens is that the spike protein with the RBD receptor in the virus attach with ACE (angiotensin) receptor in cell surface of body and converts into ACE2 which causes the virus to replicate. See the fig no. 4 [3].

Nanotechnologies that help in the prevention and treatments of coronavirus:

As we know that coronavirus spread through the droplets, coughing sneezing of one person to another so it sometimes becomes difficult to properly medicate our self [3]. Since it has been declared airborne diseases by World Health Organization (WHO) [4]. Due to the advancement of the Nanotechnologies of there are ways were we are able to counter the coronavirus, as vaccines medicine are not enough so scientists have developed different techniques some of them are as follows [5].

1. Use of Graphene Masks:

As we know that normal masks are made of normal wool cotton quality material, the material that is used is not of fine qualities [1]. The virus cannot be trapped due to low

efficacy of the masks. So Nanotechnologies have been used to make a masks PVDF nanofibres filter masks the special quality of the masks is that it is purely made of fine graphene which is electrostatically charged so which help in interaction between virus so able to trap [2]. Due to high temperature during summer the temp of the masks can go up to 80 degree so it sterile also no needed for frequent wash. The interaction between the virus and the masks helps in trapping the deadly airborne diseases [3].

Same are the surgical graphene masks which helps in trapping of the virus and generally they are super hydrophobic also, in this masks also the temp can go up to 80 degree make it sterile. The cost of the masks is generally around 15k as it manufactured in foreign countries. See the fig no5 [4].

Fig. 5. The Graphene Masks.

2. Zirconium and magnetic nanoparticles-

In this method generally the antibodies formed from COVID-19 are used where there is zirconium nanoparticles are used which are also called quantum dots due to small size [1]. So there is magnetic nanoparticle AU is also used which help in the interaction [2]. So what happens is that a GFP (green fluorescent protein) is used as fluorescents dye which help in the interaction between zirconium and AU, so due to which a complex formation occur which help in detection of the virus [3]. Now it goes through the magnetic separation where peaks are shown in the picometer, due to passage of the fluorescents the peaks are shown color wise. It is approximately 420 nm [4].

3. Reverse transcriptase nanoparticle PCR-

In this method generally the coronavirus samples are taken from the infected patients which are single stranded RNA [1]. So as we got the single stranded RNA we will perform the process of the reverse transcriptase, so a complimentary CDNA is formed which is double stranded now we will perform the NANO -PCR, PCR is the DNA amplification with help of nanoparticle it becomes the NANO-PCR. Now when we do the electrophoresis coronavirus bands are formed in the chamber due to presence of nanoparticle the complex has formed and the bands can be seen [2]. So due to the advancement of NANO-PCR the early detection the virus can be possible. See the fig no. 6 [4].

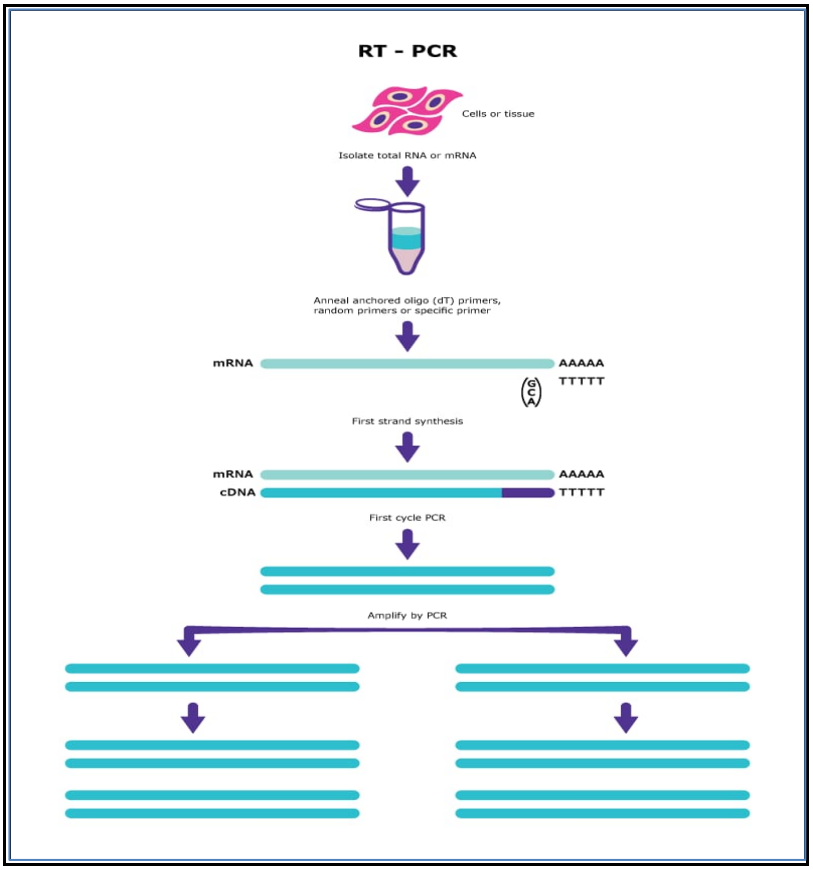

Fig. 6. The NANO-RT-PCR Technology.

4. Graphene Nanoparticle Biosensor:

As we know that graphene is the most common nanoparticle that is used in the recent developments so a biosensor is analytic device which is used detection of chemical compounds in the biological systems. So a biosensor consists of carbon or graphene Electrodes are graphene electrode which are used are nanoparticles so it's a combination of AU-NP [3]. Now due to the spike protein associated with the virus is put on the phosphate associated saline which is detected through the peak current in the meter [4]. Sometimes in place of the electrodes transistors are also used [5].

5. Nanotraps:

This also one of the most important used of Nanotechnologies. In this method in this the combination of nanoparticle AU-GOLD is used which are one of the most usable elements in the field of nanotechnology [1]. What we do is we take a small concentration of the COV virus in small amount i.e. approx. 0.22pm, now what happen is when push virus concentration into the surrounding of nano traps that are made of AU and GOLD helps to capture the COV improving their stability and detection over a long period of time. Early detection of the virus is possible [2]. See the fig. no. 7.

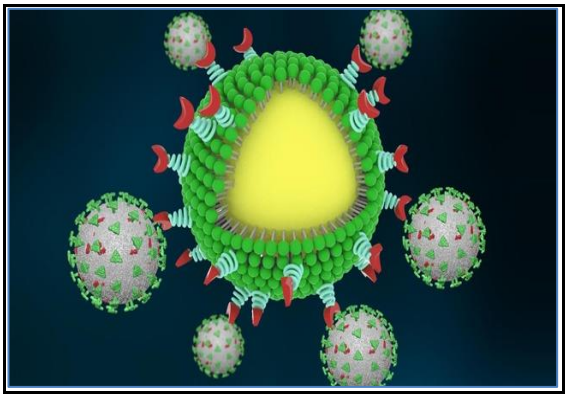

Fig. 7. The Use of Nanotraps as a Nanoparticle.

A vaccine which has the presence of the nanomaterials helps to test against COV infection:

It is observed that the drugs, medicines and vaccines that we are using for the detection of the CORONA VIRUS is not formulated with nanomaterials which has shown lesser efficacy towards the medication process [3]. So through nanotechnology we have formulated vaccines that are formulated with nanomaterials have shown a greater efficacy towards the medication of corona virus. The vaccines that are used in the nanotechnology are formulated with Gold, Chitosin, Plga and PEI or Protein. As we know that COV has spike protein at their surface expressing their genetic material so we use the inactivated form of the antigen with formulated nanotechnology vaccines [4]. The size of the nanotechnology formulated vaccines that we are using the size ranges from 12nm to 600nm [5]. One of the properties of nanomaterials is the charge as they are having a positive charge due to the coating material and shape of the nanomaterials is also spherical due to coating material [1]. When a dry run was performed at the lab of the formulated nanomaterials vaccines there is a production of cytokines macrophages and lymphocytes [2]. So the results were drawn from the experiment that there is the restoration of the respiratory activity which is due to trigger of a reaction of the nanomaterial formulated vaccines against the virus. So the efficacy tested was much greater than the vaccines that we are using with formulated nanomaterials [3]. See the fig no7. [4].

Nanomaterial Drugs:

The drugs that we are using for the infection against the corona virus have show efficacy but the one that are using with formulated nanomaterials have shown a greater interaction among the virus and the cells [4]. Mainly the experiment was carried out in-vitro condition and the results were studied in the IN-VIVO condition [5]. The first drug combination that we use diphylin and polymer which has size of 40nm, which helps in no endosomal acidification and second is AG- nanoparticle which is bounded by the graphene sheets, which helps to prevent COV- cell membrane interaction and third is AG2S nanoparticle which inhibits viral growth [1]. AG2S- nanoparticle which help on the production of IFN stimulatory chemicals inflammatory cytokines. AG2- nanoparticle which helps in apoptotic cell death of the virus [2].

Nanoparticle vaccines against the Coronavirus- [1, 2, 3, 4, 5].

The first combination results in the AU-NP antigen interactions due to which in formation peritoneal macrophages and splenic lynoids which are antibody against virus and second is the polymer and COV antigen which helps In IgG and IgA antibodies formation and lymphocyte proliferation and Third is Polymer and COV-DNA that formation of IgG AND IgA against COV through DC cell activation. Polymer and COV- antigen which works as same as production of the IgG and IgA antibodies and lymphocyte proliferation, and AG2S-nanoparticles which are used in the form of nanoclusters, inhibit viral budding, no growth of virus. AG2S nanoparticles which are formulate using nanowires of 60nm in size which helps in the productions of anti-stimulatory, chemicals and cytokines. See the fig no. 8.

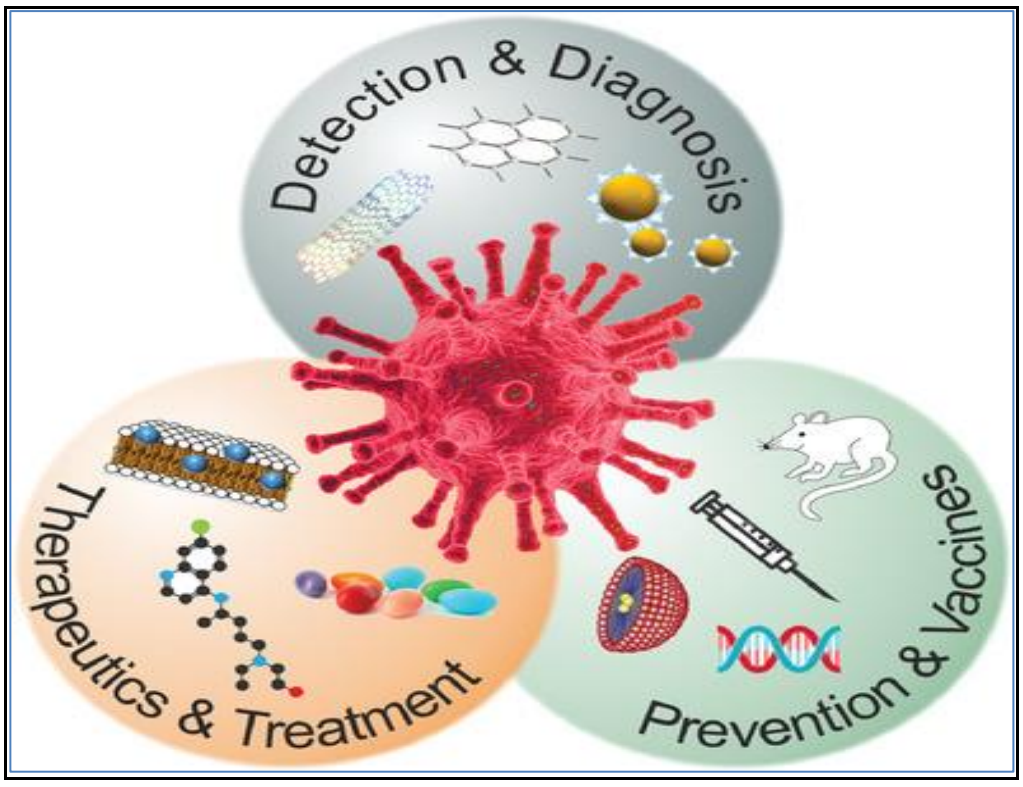

Fig. 8. The use of Nanotech in Vaccines and Drugs, Detection and Diagnosis of the Diseases.

Advantages of using Nanoformulated and DRUGS: [2, 3, 4, 5].

- It helps in strengthening safety and good efficacy against the virus.
- It helps in enhancing inhibitory activity against COV.
- It helps the Antivirals to reach against the desired target.
- It enables administration of poorly soluble active service substance.
- It enhances antibody-immune response against COV.
- The nanoparticle can replace the vaccines adjuvant. See the fig no. 9.

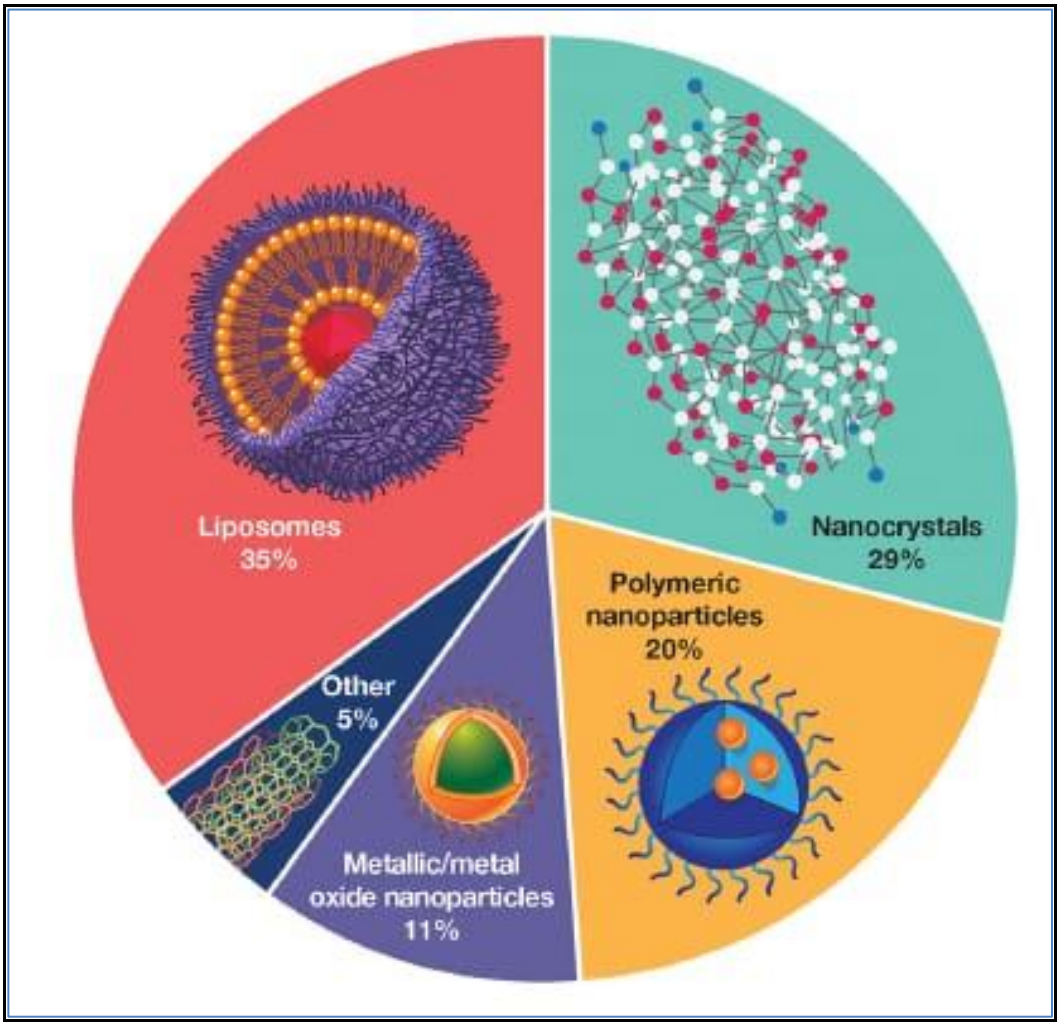

Fig. 9. The Composition of the Nanoparticles.

Advantages of using Nanomaterial against Coronavirus: [1, 2, 3, 4, 5].

1. The nano formulated materials have a good yielding solubility features.
2. AS for coronavirus it is been perfect use because it has the ability to bind the surface receptor ACE and inhibit its interactions with the virus.
3. Due to small sizes of the nanomaterials they are less time consuming and giving better efficacy than other drugs.
4. Nanoparticles gave us a wide variety of combination of products for the interaction with the virus.
5. They also offer high surface area for the conductions of different materials.
6. Due to small size they are able to interact with the cell and organelles at deeper levels.
7. They also have the feature of different magnetic and optical properties.
8. The last and the important is due to small size of the nanoparticles they are easy for sterilization with small nm filters about 0.19-0.20 nm. See the fig no.10.

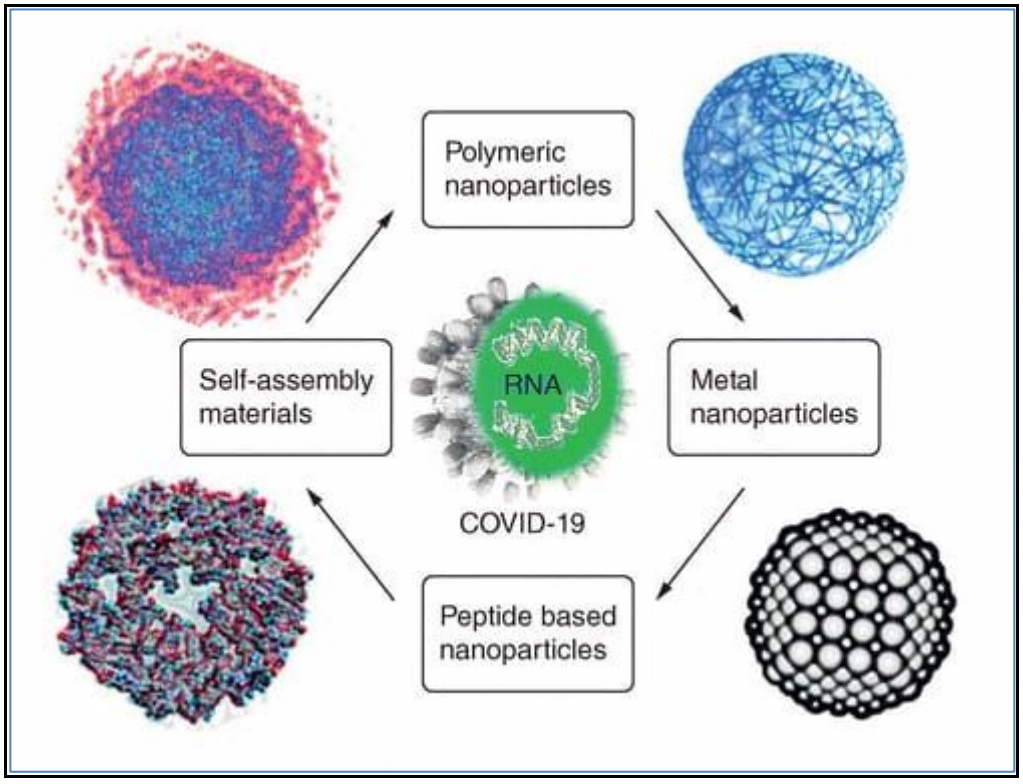

Fig. 10. The Functioning of the Nanoparticles.

Result and Discussion:

In the above review analysis of the use of the nanoparticles a technology which has the potential for treatment and diagnosis of coronavirus there is a vast variety of technologies that are being used for the early detection of the coronavirus which is one of the most important steps towards diseases diagnosis.

This paper is regarding the use of nanotechnology that has the potential to fight against the deadly virus and its analysis with the help different technologies and methods. Scientists Nesli Sozer and Joseph of Illnois have founded the early detection of the coronavirus with the help of finding the mode of the action of virus into the human body due to which they are able to track how it's infecting the cells of the body. Later Eduard Alpandery of The American Chemical Society founded the different nanotechnologies that are made to for the early detection of the virus and its control.

He founded the technologies like NANOTRAPS that helps in the detection of the virus and the PCR machine that useful in the function of the early detection of the virus. Later on Vuk Uskokovic and Dongki Yang formulated the use of the nanomaterial drugs that is used in the prevention of the virus because the vaccine that we are taking is not considering the essential substances that helps in the control of the virus but due to the coming of the Nanopartice Formulated Drugs we are able to detect the virus and helps the early detection of the virus and helps the COVID-19 patients helps to recover faster and reduce the spread of the infection. This how the scientists involved and Nanotechnology become the tool for the detection of the virus.

As the cost is lower and funds required also less helps the this field to grow faster and as different scientists also come to this conclusion about the use of the Nanotechnologies become of the methods with lower costs for the detection of the virus and its prevention.

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