European Journal of Biology and Medical Science Research

Vol.9, No.2, pp.1-71, 2021

Print ISSN: ISSN 2053-406X, Online ISSN: ISSN 2053-4078

THE POTENTIAL HINDRANCE OF SARS-COV2 SPIKE PROTEINS, PRIONS MISFOLDED PROTEINS AND OTHER INFECTED PROTEINEOUS MOLECULE INCORPORATING TOXIC GENOMES OF PATHOGENIC MICROBES FROM GAINING ACCESS INTO THE HUMAN BODY CELLS. THROUGH THE USE OF A NEW BIOMIMETIC NANOPARTICLE COATED CELL MEMBRANE

Amen Ugochukwu Ikeh, Abdulhakeem Babatunde Sobodun, Sonaya Oluwadamilola Emmanuella

ABSTRACT: *This research study paper advocates for a new bio-mimetic nano coated cell membrane, to help in fighting infections and other related diseases in the human body system. As pathogenic microbes, (bacteria, fungi, viruses etc.) have carefully studied and mastered how to trick and evade body immune defense protein and antibodies in the human body system, by generating special protein organelles or manipulating protein molecules to delude the human immune system in other to gain access into the human body cells. Every living organism is composed of four basic components, namely (DNA or RNA or both, proteins, Cells and Cell membrane). This paper reviews these four basic components in their respective sub headings. Also, this article advocates for the use of nanoparticles to create the new cell membrane. The reasons for suggesting nanoparticles is because nanomaterials are dynamic, easily manipulated, and have proofed to be a very effective tool in modern medicine. The research focused more on viruses, as it is the most implicated amongst microbes. The human existence is undergoing significant challenges because of the outcome of the SARS-CoV-2 outbreak. Therefore, this research work gives a brief detailed study of the infectious process of coronavirus, and how it uses its spike proteins to bind and infect the human cells. Special attention should be given to the conceptual frame work of this research paper as it holds the potential key on how to hinder viruses especially SARS-COV2. The conceptual framework of this research argues and explains why we need to introduce a new bio-mimetic cell membrane, the limitations of the normal cell membrane in the body, and how this new cell membrane will overcome these shortcomings or limitations and provide a more robust working efficiency, the functions and working mechanism of the new cell membrane, which is impenetrable to viruses and other pathogenic microbes. The theoretical framework of this article is composed of two different theories. The first reviews the cytokine storm theory and the second reviews the fluid mosaic model and the functions of cell membrane in the body. The Related empirical Research study reviews the existing work related with the use of nanoparticles in fighting the SARS-CoV-2 CORONAVIRUS, in addition x-raying the progress in creation of new cells and cell membrane by modern research scientist. Finally,*

the article highlights potential research recommendations and research for further research study points.

KEY WORDS: microbes, prion, bio-mimetic, pathogen, viruses, Cells, cell membrane, uracil, thymine, DNA, RNA, Proteins, nanoparticles, semi-permeable

INTRODUCTION

Microorganisms often referred to as microbes are microscopic, unicellular, Multi- Cellular or cell clusters. Microscopic organisms are abundant and are beneficial to Life. It is needful to point out that some can cause serious harm when they penetrate the cells of their host (Man, animals and plants). Examples of microorganism categorization are bacteria, archea, protozoa, algae and viruses. Every living organism on earth has four common basic characteristic components which they all share in common, be it plant or animal. These are;

1. DNA or RNA or Both
2. Cells
3. Cell membrane or sometimes called plasma membrane
4. Amino acid and protein.

These four common basic common basic components are further reviewed under their respective subheadings.

Viruses are tiny organisms with a simple and static structure. They have no metabolic system of their own. They depend on the machinery of their host cell for replication. Some viruses infect prokaryotic cells while others infect eukaryotic cells. Some viruses destroy cells, producing disease; others persist in infected cells either in a latent or persistent state; and others may cause cellular malignant transformation.

VIRAL STRUCTURE

Viruses are composed of a nucleic acid genome (DNA or RNA) and a protein coat. Many viruses contain an external membrane called an envelope.

The protein coat, or capsid, of an individual virion (fully assembled virus or virus particle) contains multiple copies of one or more types of proteins. These proteins assemble, forming

structural units called capsomeres. The nucleic acid plus the capsid shell of a virus particle is often called nucleocapsid.

The simplest viruses are those devoid of envelope with single-stranded DNA or RNA

Enveloped viruses contain an external membrane surrounding the nucleocapsid. The viral envelope is derived from host cell membranes (nuclear, Golgi apparatus, endoplasmic reticulum or plasma membrane). As such, it is composed by a lipid bilayer, with virus-encoded proteins inserted on it. Some viruses, such as bacteriophages, have complex protein tails necessary for attachment and/or penetration of viral DNA into susceptible host cells.

Five Basic Structural Forms

Based upon basic morphology, as stated above, there are five different basic structural forms of viruses. These forms are listed below with examples:

1. Naked icosahedral - adenoviruses and picornaviruses.
2. Naked helical - tobacco mosaic virus; no known human or animal viruses have this structure.
3. Enveloped icosahedral - togaviruses and flaviviruses.
4. Enveloped helical - rhabdoviruses and paramyxoviruses.
5. Complex - bacteriophages and poxviruses.

HOW VIRUS CAUSE DISEASES:

Replication of the virus depends on the host cell chemical machinery. The steps may differ slightly depending on the type of host cell that the virus is attacking. Viruses lie around our environment all of the time just waiting for a host cell to come along. They can enter us through the eyes, nose, mouth or breaks in the skin. Once inside they find a host cell to infect. For example the cold and flu virus will attack the cells that line the respiratory or digestive tract.

- HIV, which causes AIDS, attacks T-cells (CD4 Cells) of the immune system.
- Ebola attacks the Macrophages and dendritic immune cells; Small pox attaches itself to Macrophages (endothelial cells) in the liver, spleen, lymph nodes and bones.
- Measles attacks the macrophages and dendritic immune cells,
- COVID-19 attacks ACE2 cell receptor (ACE2pathway) angiotensin converting enzymes 2 are cell receptors that line cells of lungs, the kidney, the liver, the alveoli lining and part of the brain cells.

Viruses are small, nonliving parasites, which cannot replicate outside of the host cell. A virus consists of genetic information -- either DNA or RNA -- coated by a protein. A virus injects its genetic information into a host cell and then takes control of the cell's machinery. This process enables the virus to make copies of its DNA or RNA and make the viral proteins inside the host cell. A virus can quickly make multiple copies of itself in one cell, release these copies to infect new host cells and make even more copies. In this way, a virus can replicate very quickly inside a host.

Regardless of the host cell, viruses follow the same basic principle or steps to relocate:

- A virus particle attacks to a host cell.
- The particles release its genetic instruction into the host cell.
- The injected genetic materials recruit the host cells enzyme.
- The enzyme makes parts for more new virus particles.
- The new particles assemble the part into new viruses.
- The new particles break free from the host cell and spread into other healthy cells, repeating the same process.

What happens after a virus infects a cell?

Once a virus enters the body, it needs to get inside of a cell before it can create new copies of itself and spread. The proteins on the capsule or envelope determine which types of cells the virus can enter. For example, some viruses can only enter cells in the respiratory tract while other can only enter cells in the gastrointestinal tract. Tropism is the ability of a virus to attach and enter only certain types of cells.

- Attachment: Once the virus gets into the body and finds its target cell, it attaches itself to the surface of the cell using the specialized proteins found on the capsule or envelope. The viral proteins stick to another type of protein on the outside surface of the cell called a receptor. The types of cells that make a receptor determine the tropism of a virus.
- Entry: After the virus sticks to the receptor on the surface of the cell, it is brought inside the body of the cell and is released from the receptor.
- Replication: Once inside the cell, the virus uses the machinery of the cell (the proteins normally found inside the cell) to create new viral genetic material and specialized viral proteins. A virus must be inside a cell to make new genetic material or proteins.
- Assembly: It then makes new viral particles out of the genetic material and proteins made during the replication step. A cell infected by a single virus can produce thousands of new viral particles.

- Release: Once it assembles the new viral particles, the viruses need to leave the cell so they can infect other cells. Some viruses leave the cell by causing the cell to explode. This kills the cell while releasing all the virus particles at the same time. Viruses that require an envelope attach to the wall of the cell (the membrane) and take part of the wall with them as they leave the cell. This process is called budding. Some viruses can remain in a cell for months or even years before producing new virus and leaving the cell.

All viruses have some protein on the outside coat or envelope that "feels" or "recognizes" the proper host cells. The protein attaches the virus to the membrane of the host cell. Some envelope viruses can dissolve right through the cell membrane of the host because both the virus envelope and cell membrane are made of lipids. The viruses that do not enter the cell inject their contents (genetic instructions enzymes) into the host cell. The viruses that dissolve into a cell release their contents once inside the host. In either case, the result is the same.(1-3)

A quick review of DNA and RNA

RNA (ribonucleic acid) is a polymer made of ribonucleotides, compound molecules made of three parts, or smaller molecules: a nitrogenous base (adenine, uracil, cytosine or guanine), a ribose sugar and a phosphate group.

DNA (deoxyribonucleic acid) is similar, but instead of uracil it has thymine, and instead of a ribose sugar is has a deoxyribose, so that it is made of deoxyribonucleotides. Another difference is that DNA is a double chain twisted helicoidally, where two nitrogenous bases (each from one chain) are connected. Adenine is always connected to thymine and cytosine always to guanine, so that one chain always depends on the other.

Currently, it's highly accepted that RNA was the first nucleic acid to exist, and that DNA developed from it, so the changes in the sugar and one of the nitrogenous bases must have some advantage.(8-10)

To understand that, let's look at the structure of the uracil:

Uracil

The only difference between it and thymine is a methyl group

Thymine

In fact, thymine is also called 5-methyluracil. But let's go to the explanation:

While nucleotides are synthesized, the nucleotide-monophosphates (NMPs), i.e., the set nitrogenous base + sugar + phosphate is dehydroxylated, creating 2'-deoxy-nucleotide-monophosphate (dNMPs), i.e., GMP, AMP, CMP and UMP (for guanine, adenine, cytosine and uracil) are changed to dGMP, dAMP, dCMP and dUMP.

This modification by dehydroxylation has been shown to make the phosphodiester bonds (the bonds of phosphates on the sugar) less susceptible to hydrolysis and damage by UV radiation. It assures that DNA molecule will not be broken easily as an RNA molecule, which is very useful since DNA carries all the information to build up the organism. After the dehydroxylation of the nucleotide-monophosphates, the next step, catalyzed by folic acid, adds a methyl group to the uracil to form a thymine, so turning dUMP into dTMP.

There are many explanations for that:

1. Despite uracil's tendency to pair with adenine, it can also pair with any other base, including itself. By adding a methyl group (which is hydrophobic) and turning it into thymine, its position is reorganized in the double-helix, not allowing those wrong pairings to happen.
2. Cytosine can deaminate to produce uracil. The problem is that, if uracil were a component of DNA, the repair systems could not distinguish original uracil from uracil originated by deamination of cytosine. So using thymine instead makes it way easier and more stable, as any uracil inside DNA must come from a cytosine and so a new cytosine can replace it.

Cytosine

This didn't develop for that purpose. Evolution cannot predict what happens. Probably during the earliest times of life, eventually an error changed uracil for thymine and it was found to be more stable to carry information, since such a molecule wouldn't be destroyed so easily and thus would pass its "layout" to the next generation.(8)

DNA Viruses

As their name implies, DNA viruses use DNA as their genetic material. Some common examples of DNA viruses are parvovirus, papillomavirus, and herpesvirus. DNA viruses can affect both

humans and animals and can range from causing benign symptoms to posing a very serious health risk.

DNA viruses enter a host cell, usually when the membrane of the virus fuses with the cell's membrane. The contents of the virus enter the cell, travel to the nucleus and take over the cell's biochemical machinery for DNA replication and transcription into RNA. The RNA controls the formation of proteins needed by the virus to coat the viral DNA. The viral DNA coat is known as a capsid. The capsids accumulate inside the cell until the cell reaches capacity and bursts open, releasing the newly formed viruses to infect new host cells.

RNA Viruses

RNA viruses, also known as retroviruses, have RNA as their genetic material. Some examples of retroviruses are hepatitis viruses and HIV. When these viruses enter a host cell, they must first convert their RNA into DNA. This process, called reverse transcription, enables the virus to inject its genetic material into the host cell and use the host's biochemical machinery, similar to a DNA virus. A retrovirus is a particular virus that uses RNA (ribonucleic acid) as its genetic material, and this is the key element of the retrovirus definition. Retroviruses do not kill the host cell at first because they can insert their genome into the host genome. This process is called reverse transcription and catalyzed by the viral protein reverse transcriptase. Often, retroviruses use an enzyme, called integrase, to insert the retroviral DNA into the genome of the host cell. The ability of retroviruses to integrate this DNA into the host cell's DNA increases the chances of causing cancer or other diseases. For example, if the insertion of the retroviral DNA into the middle of one of the host cell's genes, that gene may no longer be functional, leading to disease.(10)

MUTATIONS IN VIRUSES

Most organisms' genomes are based on DNA. Some viruses such as those that cause the flu and HIV, however, have RNA-based genomes instead. Viral RNA genomes are much more mutation-prone than those based on DNA. This distinction is important because RNA-based viruses have repeatedly developed resistance to drugs.

Mutation rates in RNA viruses are important because these viruses cause a terrible toll in terms of human death and disease. Viruses that cause the flu and HIV are with RNA-based genomes. The high mutation rate means that they can rapidly develop resistance to new drugs. Any population of these viruses is genetically diverse. This makes it very difficult for scientists to develop vaccines for the flu, for example. Because the influenza virus genome is diverse,

scientists must often combine vaccines for several viral strains. And, because the flu virus genome changes constantly, vaccines effective during one flu season might be ineffective the next. The higher mutation rates in RNA viruses ensure that they develop more rapidly and could develop resistance to drugs more readily than DNA-based viruses. It is estimated that average mutation rates in RNA viruses to be about 100 times higher than those for DNA viruses. This rate is especially high because RNA viruses lack the sophisticated DNA repair mechanisms found in human and other animal cells. The enzyme that occurs in RNA viruses and take part in copying viral genomes is a key reason for this difference. These enzymes lack the built-in capabilities to recognize DNA damage, that enzymes in most organisms have.(9)

Uracil and Thymine (key factors for mutations)

Another interesting difference between RNA and DNA mutations involves the bases thymine, cytosine and uracil, typically represented as T, C and U in the DNA code. DNA uses thymine, while RNA uses uracil instead. Cytosine can sometimes spontaneously change to uracil. In DNA, this error will be detected because DNA doesn't contain uracil; the cell has enzymes that can recognize and fix the substitution. In RNA, however, this kind of error cannot be detected because RNA ordinarily contains both cytosine and uracil bases. So, some mutations are less likely to be recognized and repaired in RNA viruses, and the mutation rate increases. (10)

Why DNA Is the Most Favorable Molecule for Genetic Material & How RNA Compares to It in This Respect

With the exception of certain viruses, DNA rather than RNA carries the hereditary genetic code in all biological life on Earth. DNA is both more resilient and more easily repaired than RNA. As a result, DNA serves as a more stable carrier of the genetic information that is essential to survival and reproduction.(36)

DNA Is More Stable

Both DNA and RNA contain the sugar ribose, which is essentially a ring of carbon atoms surrounded by oxygen and hydrogen. But whereas RNA contains a complete ribose sugar, DNA contains a ribose sugar that has lost one oxygen and one hydrogen atom. This minor difference explains the different names assigned to RNA and DNA – ribonucleic acid versus deoxyribonucleic acid. The extra oxygen and hydrogen atoms in RNA leave it prone to hydrolysis, a chemical reaction that effectively breaks the RNA molecule in half. Under normal cellular conditions, RNA undergoes hydrolysis almost 100 times faster than DNA, which makes DNA a more stable molecule.(44)

DNA Is More Easily Repaired

In both DNA and RNA, the base cytosine frequently undergoes a spontaneous chemical reaction known as "deamination." The result of deamination is that cytosine changes into uracil, another nucleic acid base. In RNA, which contains both uracil and cytosine bases, natural uracil bases and uracil bases that resulted from deamination of cytosine are indistinguishable. Therefore, the cell cannot "know" whether uracil should be there or not, making it impossible to repair cytosine deamination in RNA. DNA, however, contains thymine instead of uracil. The cell identifies all uracil bases in DNA as having been the result of cytosine deamination and can repair the DNA molecule.(44)

DNA's Genetic Information Is Better Protected

The double-stranded nature of DNA, as opposed to the single-stranded nature of RNA, further contributes to the favorability of DNA as the genetic material. The double-helix structure of DNA places bases inside the structure, protecting the genetic information from chemical mutagens -- that is, from chemicals that react with the bases, potentially changing the genetic information. In single-stranded RNA, on the other hand, the bases are exposed and more vulnerable to reaction and degradation.(44)

Double Strands Allow Double-Checking

When DNA is replicated, the new double-stranded DNA molecule contains one parent strand -- which serves as the template for replication -- and one daughter strand of newly synthesized DNA. If there is a base mismatch across the strands, as often happens after replication, the cell can identify the correct base pair from the parent DNA strand and repair it accordingly. For example, if at one nucleotide position the parent strand contains a thymine and the daughter strand a cytosine, the cell "knows" to fix the mismatch by following the instructions in the parent strand. The cell will therefore replace the daughter strand's cytosine with an adenosine. Since RNA is single-stranded, it cannot be repaired in this way. (44)

Definition of cell and Cell Structure

Cells are the basic units of life capable of carrying out all the processes of life. They are the building blocks of all organisms. Some living organisms called unicellular organisms comprise only one cell, while the multicellular organism comprises many cells. In both unicellular and multicellular organisms, the cells are separated from each other and surroundings by a barrier called plasma membrane or cell membrane.

There are many types, sizes, and shapes of cells in the body. For descriptive purposes, the concept of a "generalized cell" is introduced. It includes features from all cell types.

A cell comprises three parts: the cell membrane, the nucleus, and, between the two, the cytoplasm. Within the cytoplasm are intricate arrangements of fine fibers and hundreds or even thousands of miniscule but distinct structures called organelles.

Cell membrane

Every cell in the human body is enclosed by a cell membrane, sometimes referred to as plasma membrane. The cell membrane separates the material outside the cell, (extracellular), from the material inside the cell, (intracellular). It maintains the integrity of a cell and controls passage of materials into and out of the cell. All materials within a cell must have access to the cell membrane (the cell's boundary) for the needed exchange.

All cells have a cell membrane around them. The cell membrane is a thin layer that encloses the cell's contents and separates the cell from its environment.

Many substances have to pass in and out of a cell in order for it to function. The cell membrane controls the substances allowed to enter and leave the cell. We say the cell membrane is selectively permeable. The organelles are also enclosed by membranes.

If something is 'permeable', then it means that substances, such as gases and liquids, can pass through it freely.

The cell membrane is a double layer of phospholipid molecules. Proteins in the cell membrane provide structural support, form channels for passage of materials, act as receptor sites, function as carrier molecules, and provide identification markers.(5)

Nucleus and Nucleolus

The nucleus, formed by a nuclear membrane around a fluid nucleoplasm, is the control center of the cell. Threads of chromatin in the nucleus contain deoxyribonucleic acid (DNA), the genetic material of the cell. The nucleolus is a dense region of ribonucleic acid (RNA) in the nucleus and is the site of ribosome formation. The nucleus determines how the cell will function, and the basic structure of that cell.

Cytoplasm

The cytoplasm is the gel-like fluid inside the cell. It is the medium for chemical reaction. It provides a platform upon which other organelles can operate within the cell. All the functions for cell expansion, growth and replication are carried out in the cytoplasm of a cell. Within the cytoplasm, materials move by diffusion, a physical process that can work only for short distances.

Cytoplasmic organelles

Cytoplasmic organelles are "little organs" that are within the cytoplasm of the cell. Each type of organelle has a definite structure and a specific role in the cell's function. Examples of cytoplasmic organelles are mitochondrion, ribosomes, endoplasmic reticulum, golgi apparatus, and lysosomes.

Cell membrane definition

The cell membrane, also known as the plasma membrane, is a double layer of lipids and proteins that surrounds a cell. It separates the cytoplasm (the contents of the cell) from the external environment. It is a feature of all cells, both prokaryotic and eukaryotic. Cell membrane, also called the plasma membrane, is a physical barrier between a cell and the surrounding environment. It is the outermost part of the cell in animals. However, in plants, bacteria, and fungi, it is surrounded by a thick cell wall. It does not allow everything that is within the cell to leave it unless allowed by the plasma membrane. Similarly, nothing can enter the cell unless it is permeable through the cell membrane.

The cell membrane provides a barrier around the cell, separating its internal components from the extracellular environment. It is composed of a phospholipid bilayer, with hydrophobic internal lipid "tails" and hydrophilic external phosphate "heads." Various membrane proteins are scattered throughout the bilayer, both inserted within it and attached to it peripherally. The cell membrane is selectively permeable, allowing only a few materials to diffuse through its lipid bilayer. All materials that cross the membrane do so using passive (non-energy-requiring) or active (energy-requiring) transport processes. During passive transport, materials move by simple diffusion or by facilitated diffusion through the membrane, down their concentration gradient. Water passes through the membrane in a diffusion process called osmosis. During active transport, energy is expended to assist material movement across the membrane in a direction against their concentration gradient. Active transport may take place with the help of protein pumps or through the use of vesicles.(5)

Structure of the Cell Membrane

Phospholipid Bilayer

The cell membrane is made up of a phospholipid bilayer. Phospholipids are lipid molecules made up of a phosphate group head and two fatty acid tails. Importantly, the properties of phospholipid molecules allow them to spontaneously form a double-layered membrane.

The phosphate group head of a phospholipid is hydrophilic, whereas the phospholipid tail is hydrophobic. This means that the phosphate group is attracted to water, whereas the tail is repelled by water.

When in water or an aqueous solution (including inside the body) the hydrophobic heads of phospholipids will orient themselves to be on the inside, as far away from the water. In contrast, the hydrophilic heads will be on the outside, making contact with the water. The result is that it forms a double layer of phospholipids, with the hydrophobic heads clustering together in the center, and the hydrophilic tails forming the outside of the structure. The technical term for this double layer of phospholipids that forms the cell membrane is a phospholipid bilayer.

Membrane-Associated Factors

Besides the phospholipid bilayer, the cell membrane also contains lipid molecules, particularly glycolipids and sterols. One important sterol is cholesterol, which regulates the fluidity of the cell membrane in animal cells. When there is less cholesterol, membranes become more fluid, but also more permeable to molecules. The amount of cholesterol in the membrane helps maintain its permeability so that the right amount of molecules can enter the cell at a time.

The cell membrane also contains many proteins. Proteins make up about half of the cell membrane. Many of these proteins are trans-membrane proteins, which are embedded in the membrane but stick out on both sides (i.e., they span across the entire lipid bilayer). Some of these proteins are receptors, which bind to signal molecules. Others are ion channels, which are the only means of allowing ions into or out of the cell. Scientists use the fluid mosaic model to describe the structure of the cell membrane. The cell membrane has a fluid consistency because of being made up in large part of phospholipids, and because of this, proteins move freely across its surface. The multitude of different proteins and lipids in the cell membrane give it the look of a mosaic.(5)

Protein and protein synthesis

The wide world of proteins, with its impressive assortment of shapes, bestows cells with capabilities that allow for life to exist and allow for its diversity (e.g., the differences between eye, skin, lung or heart cells, and the differences between species). Perhaps for this reason, the word "protein" is from the Greek word "protas," meaning "of primary importance." (4)

Protein Synthesis

During the 1950s and 1960s, it became apparent that DNA is essential in the synthesis of proteins. Among many functions, proteins can serve as enzymes and as structural materials in cells. Many specialized proteins function in cellular activities. For example, in humans, the hormone insulin and the muscle cell filaments are composed of protein. The hair, skin, and nails of humans are composed of proteins, as are all the hundreds of thousands of enzymes in the body.

The amino acid linkage is key to a protein molecule. The sequence of amino acids in a protein is a type of code that specifies the protein and distinguishes one protein from another. A genetic code in the DNA determines this amino acid code. The genetic code consists of the sequence of nitrogenous bases in the DNA. How the nitrogenous base code is translated to an amino acid sequence in a protein is the basis for protein synthesis. For protein synthesis to occur, several essential materials must be present, such as a supply of the 20 amino acids, which comprise most proteins. Another essential component is series of enzymes that will function in the process. DNA and another form of nucleic acid called ribonucleic acid (RNA) are essential.

RNA is the nucleic acid that carries instructions from the nuclear DNA into the cytoplasm, where protein is synthesized. RNA is like DNA, with two exceptions. First, the carbohydrate in RNA is ribose rather than deoxyribose, and second, RNA nucleotides contain the pyrimidine uracil rather than thymine.

Types of RNA

In the synthesis of protein, three types of RNA function. The first type is called ribosomal RNA (rRNA). This form of RNA is used to manufacture ribosomes. Ribosomes are ultramicroscopic particles of rRNA and protein. They are the places (the chemical "workbenches") where amino acids are linked to one another to synthesize proteins. Ribosomes are found in large numbers along the membranes of the endoplasmic reticulum and in the cell's cytoplasm.

A second important type of RNA is transfer RNA (tRNA). Transfer RNA exists in the cell cytoplasm and carries amino acids to the ribosomes for protein synthesis. When protein synthesis is taking place, enzymes link tRNA molecules to amino acids highly specifically. For example, tRNA molecule X will link only to amino acid X; tRNA molecule Y will link only to amino acid Y.

The third form of RNA is messenger RNA (mRNA). In the nucleus, messenger RNA is constructed from DNA's code of base pairs and carries the code into the cytoplasm or to the rough endoplasmic reticulum where protein synthesis takes place. Messenger RNA is synthesized in the nucleus using the DNA molecules. During the synthesis, the genetic information is transferred from the DNA molecule to the mRNA molecule. In this way, a genetic code can synthesize a protein in a distant location. RNA polymerase, an enzyme, accomplishes mRNA, tRNA, and rRNA synthesis.

Transcription

Transcription is one of the first processes in the mechanism of protein synthesis. In transcription, a complementary strand of mRNA is synthesized according to the nitrogenous base code of DNA. To begin, the enzyme RNA polymerase binds to an area of one of the DNA molecules in the double helix. (During transcription, only one DNA strand serves as a template for RNA synthesis. The other DNA strand remains dormant.) The enzyme moves along the DNA strand and "reads" the nucleotides one by one. Similar to the process of DNA replication, the new nucleic acid strand elongates in a 5'-3' direction. The enzyme selects complementary bases from nucleotides and positions them in an mRNA molecule according to the principle of complementary base pairing. The chain of mRNA lengthens until a "stop" message is received.

The nucleotides of the DNA strands are read in groups of three. Each group is a codon. Thus, a codon may be CGA, or TTA, or GCT, or any other combination of the four bases, depending on the codon's complementary sequence in the DNA strand. Each codon will later serve as a "code word" for an amino acid. First, however, the codons are transcribed to the mRNA molecule. Thus, the mRNA molecule comprises nothing more than a series of codons received from the genetic message in the DNA.

After the "stop" codon is reached, the synthesis of the mRNA ends. The mRNA molecule leaves the DNA molecule, and the DNA molecule rewinds to form a double helix. Meanwhile, the mRNA molecule passes through a pore in the nucleus and proceeds into the cellular cytoplasm, where it moves toward the ribosomes located in the cytoplasm or on the rough endoplasmic reticulum.(13)

Translation

The genetic code is transferred to an amino acid sequence in a protein through the translation process, which begins with the mRNA molecule at the ribosome. While the mRNA was being synthesized, tRNA molecules were uniting with their specific amino acids according to the activity of specific enzymes. The tRNA molecules then began transporting their amino acids to the ribosomes to meet the mRNA molecule.

After it arrives at the ribosomes, the mRNA molecule exposes its bases in sets of three, the codons. Each codon has a complementary codon called an anticodon on a tRNA molecule. When the codon of the mRNA molecule complements the anticodon on the tRNA molecule, the latter places the particular amino acid in that position. Then the next codon of the mRNA is exposed, and the complementary anticodon of a tRNA molecule matches with it. The amino acid carried by the second tRNA molecule is positioned next to the first amino acid, and the two are linked. The tRNA molecules release their amino acids and return to the cytoplasm to link up with new molecules of amino acid.

When it's time for the next amino acid to be positioned in the growing protein, a new codon on the mRNA molecule is exposed, and the complementary three-base anticodon of a tRNA molecule positions itself opposite the codon. This brings another amino acid into position, and that amino acid links to the previous amino acids. The ribosome moves farther down the mRNA molecule and exposes another codon, which attracts another tRNA molecule with its anticodon.

One by one, amino acids are added to the growing chain until the ribosome has moved down to the end of the mRNA molecule. Because of the specificity of tRNA molecules for their individual amino acids, and because of the base pairing between codons and anticodons, the sequence of codons on the mRNA molecule determines the sequence of amino acids in the protein being constructed. And because the codon sequence of the mRNA complements the codon sequence of the DNA, the DNA molecule ultimately directs the amino acid sequencing in proteins. The primary "start" codon on an mRNA molecule is AUG, which codes for the amino acid methionine. Therefore, each mRNA transcript begins with the AUG codon, and the resulting polypeptide begins with methionine.

After the protein synthesis has been completely, it is removed from the ribosome for further processing and to perform its function. For example, the protein may be stored in the Golgi apparatus before being released by the cell or it may be stored in the lysosome as a digestive enzyme. Also, a protein may be used in the cell as a structural component, or it may be released as a hormone, such as insulin. After synthesis, the mRNA molecule breaks up and the

nucleotides return to the nucleus. The tRNA molecules return to the cytoplasm to unite with other molecules of amino acids, and the ribosome awaits the arrival of a new mRNA molecule.(13)

Functions of Proteins

- Oxygen Transport

Each of us has tens of thousands of proteins, which serve a variety of functions, and each protein has a unique three-dimensional structure that specifies its function. For example, hemoglobin is a protein found in red blood cells, which plays a key role in oxygen transport; it has 4 subunits of two distinct types (2 alpha and 2 beta subunits).

- Sickle Cell Anemia

People with sickle cell disease have abnormal hemoglobin, called hemoglobin S (instead of normal hemoglobin A). Hemoglobin S differs from hemoglobin A in that the amino acid valine is found at position number 6 in the beta chain instead of the amino acid glutamate. Unlike glutamate, the side chain of valine is very non-polar and creates a sticky patch on the outside of each of the beta chains. There is a complementary sticky patch elsewhere on the hemoglobin, but it is masked as long as the hemoglobin molecules are bound to oxygen. However, if large numbers of hemoglobin molecules become deoxygenated, the sticky sites created by the abnormal valines begin to bind to the complementary sticky site on other hemoglobin molecules. This forms long aggregates of hemoglobin that distort the red blood cell and give it a characteristic sickle shape. This causes red cells to aggregate and impairs their ability to circulate through small blood vessels (arterioles and capillaries), and it also makes them fragile, shortening their life span and leading to anemia.

Acute exacerbations referred to as “sickle cell crises” are triggered by deoxygenation of hemoglobin, for example, after rigorous exercise or infections. Sickling can be very extensive and result in inadequate blood flow to organs with severe pain and complications such as stroke, kidney damage and breathing problems.

- Proteins as Enzymes

Some proteins function as enzymes, i.e., proteins that catalyze specific biochemical reactions. Enzymes facilitate biochemical reactions and speed them up enormously, making them as much as a million times faster. There are thousands of enzymes, and each type facilitates a specific

biochemical reaction. A given enzyme only acts on specific reactant molecules (substrates) to produce a specific end product or products.

The three-dimensional shape of an enzyme will include a very specific binding site that the substrate will fit into very precisely, in much the same way that a key fits a specific lock. The substrate is bound the enzyme cleaves the substrate and the products are released.

- Antibodies are Proteins

Antibodies are defensive proteins that have binding sites whose three-dimensional structure allows them to identify and bind to very specific foreign molecules. By binding to foreign proteins they can help neutralize them and tag them, facilitating their engulfment and removal by defensive cells.

- Structural Proteins

There are also structural proteins, which are frequently long and fibrous, such as silk, keratin in hair, and collagen in tendons and ligaments.

- Contractile Proteins

There are contractile proteins, such as actin and myosin, which provide movement in muscles and movement within single cells.

- Signal Proteins

There are signal proteins, such as the hormone insulin, which comprises two polypeptide chains linked together with disulfide (two sulfur) bridges. The insulin receptor (a recognition protein) is embedded in the cell membranes of muscle, fat cells, and certain types of other cells. Its function is to facilitate their uptake of glucose from the blood stream through special glucose transport proteins that are normally present inside the cell in an inactive form. For example, in muscle cells, the glucose transporter is called “GLUT4”. When the insulin molecule binds to the alpha subunits of the receptor, it triggers a chain reaction within the cytosol (the interior of the cell) that activates GLUT4 and causes it to be translocated and inserted into the cell membrane.

- Transportation across the Cell Membrane

Except for simple diffusion, proteins are also essential for moving polarized or charged molecules and large molecules across cell membranes.

Simple Diffusion

Small molecules like oxygen and carbon dioxide can diffuse across the lipid bilayer of the cell membrane. The direction of movement depends on the concentration gradient. Substances with higher concentration inside the cell (e.g., CO2) will diffuse out of the cell toward the side with lower concentration. Substances in higher concentration outside the cell (e.g., O2) will diffuse to the inside of the cell, i.e., down the concentration gradient.

However, many other molecules cannot cross cell membranes by simple diffusion and require specialized mechanisms for movement across membranes. A variety of transport proteins, frequently aggregates of protein subunits, provide a way of transporting charged molecules and large molecules through one of two mechanisms:

Facilitated Transport

Polar molecules and charged ions cannot cross the lipid bilayer; their transit relies on special transport channels created by proteins embedded in the cell membrane. Facilitated transport is passive in that it does not require expenditure of cellular energy, and as with simple diffusion, movement of the molecules is down a concentration gradient from high concentration to low concentration. There are specific proteins for each substance transported by this mechanism, and transit can be regulated by the cell. Molecules like glucose and amino acids are transported this way. They will bind to their carrier/transport protein, and binding triggers a change in the shape of the carrier which moves the molecule across the membrane. Once the molecule is released, the carrier returns to its original shape (conformation).

Active Transport

Active transport also relies on trans-membrane transport proteins, but this process can transport substances against a concentration gradient, meaning that even if the concentration of, say potassium ions, is higher inside the cell than outside, more potassium can be transported into the cell. This is because cellular energy (ATP) is expended.

Proteins play an integral role in the function of a cell. Many are embedded in the cell's membranes or span the entire lipid bilayer where they play an important role in recognition, signaling, and transport. (11)

PRIONS

A prion is a protein that can cause disease in animals and humans by triggering normally healthy proteins in the brain to fold abnormally.

Prion mode of action is very different to bacteria and viruses as they are proteins, devoid of any genetic material. Once a misfolded prion enters a healthy person by eating infected food, it converts correctly folded proteins into the disease-associated form.

A protein's function depends on its shape, and when protein formation goes wrong, the resulting misshapen proteins cause problems that range from bad, when proteins neglect their important work, to ugly, when they form a sticky, clumpy residue inside of cells. Current research suggests that the world of proteins is far from pristine. Protein formation is an error-prone process, and mistakes along the way have been linked to several human diseases. (19)

PrPC characteristics. ("cellular prion protein" or PrPC)

- The normal protein is called PrPC (for cellular)
- It is a glycoprotein normally anchored to the surface of cells.
- It has its secondary structure dominated by alpha helices (probably 3 of them)
- It is easily soluble
- It is digested easily by proteases
- It is encoded by a genetic designated (in humans) PRNP located on our chromosome 20.

PrPSc characteristics ("scrapie prion protein" or PrPSc)

- The abnormal, disease-producing protein is called PrPSc (for scrapie)
- It has the same amino acid sequence as the normal protein;Their primary structures are identical but, its secondary structure is dominated by beta conformation
- It is insoluble in all but the strongest solvents
- It is highly resistant to digestion by proteases (19)

When PrPSc comes in contact with PrPC, it converts the PrPC into more of itself (even in the test-tube). These molecules bind to each other, forming aggregates.

It is not yet clear if these aggregates are themselves the cause of the cell damage or are a side effect of the underlying disease process. There are 20,000 to over 100,000 unique types of proteins within a typical human cell. Why so many? Proteins are the workhorses of the cell. Each

expertly performs a specific task. Some are structural, lending stiffness and rigidity to muscle cells or long thin neurons, for example. Others bind to specific molecules and shuttle them to new locations, and still others catalyze reactions that allow cells to divide and grow. This wealth of diversity and specificity in function is made possible by a simple property of proteins: they fold.(19)

Why does protein folding sometimes fail?

Folding allows a protein to adopt a functional shape, but it is a complex process that sometimes fails. Protein folding can go wrong for three major reasons:

1. A person might possess a mutation that changes an amino acid in the protein chain, making it difficult for a particular protein to find its preferred fold or "native" state. This is the case for inherited mutations, for example, those leading to cystic fibrosis or sickle cell anemia. These mutations are in the DNA sequence or "gene" that encodes one particular protein. Therefore, these types of inherited mutations affect only that protein and its related function.
2. Protein folding failure can be viewed as an ongoing and more general process that affects many proteins. When proteins are formed, the machine that reads the directions from DNA to create the long chains of amino acids can make mistakes. Scientists estimate that this machine, the ribosome, makes mistakes in 1 in every 7 proteins! These mistakes can make the resulting proteins less likely to fold properly.
3. Even if an amino acid chain has no mutations or mistakes, it may still not reach its preferred folded shape simply because proteins do not fold correctly 100% of the time. Protein folding becomes even more difficult if the conditions in the cell, like acidity and temperature, change from those to which the organism is accustomed. (18)

Stable and Unstable Proteins

When native folded proteins are synthesized in a healthy cell, usually everything is right and well. However, our genome also codes for proteins that, as mentioned before, are inherently unstable because they have the property of folding in alternative minimal-energy states. Only very few of these alternative structures are functional to the cell; the overwhelming majority are useless or even toxic. The functional or native conformation of non-membrane-bound proteins is typically water soluble. Chaperones will help unstable proteins fold correctly, although some proteins misfold anyway. Misfolded proteins (also called toxic conformations) are typically insoluble, and they form long linear or fibrillar aggregates known as amyloid deposits. But how can a protein change so radically by folding differently, if the sequence of amino acids is the same? The answer is in the way the amino acids interact.

A failure in protein folding causes several known diseases, and scientists hypothesize that many more diseases may be related to folding problems. There are two distinct problems that occur in cells when their proteins do not fold properly.

One type of problem, called "loss of function," results when not enough of a particular protein folds properly, causing a shortage of "specialized workers" needed to do a specific job. For example, imagine that a properly folded protein is perfectly shaped to bind a toxin and break it into less toxic byproducts. Without enough of the properly folded protein available, the toxin will build up to damaging levels. As another example, a protein may metabolize sugar so that the cell can use it for energy. The cell will grow slowly because of lack of energy if not enough of the protein is present in its functional state. The reason the cell gets dysfunctional, in these cases, is because of a lack of one specific, properly folded, functional protein. Cystic fibrosis, Tay-Sachs disease, Marfan syndrome, and some forms of cancer are examples of diseases that result when one type of protein cannot perform its job. Who knew that one type of protein among tens of thousands could be so important?

One misfolded protein stands out among the rest to deserve special attention. The "prion" protein in Creutzfeldt-Jakob disease is an example of a misfolded protein gone rogue. This protein is not only irreversibly misfolded, but it converts other functional proteins into its twisted state.

By the 1960s, some scientists had suspected that the agent of scrapie was not a virus at all but actually a protein. However, there was an enormous problem; this directly went against everything we understood about cells, the central dogma of molecular biology. In simple terms, it states that information moves from DNA to RNA to form proteins and doesn't go in the opposite direction. Proteins can't give instructions, so how could one be a pathogen?

However, after many failed experiments designed to inactivate the illness—conducted by such scientists as T. Alper, J. S. Griffith, and I. H. Patterson—a protein was one of the few options left. Then, in 1967, Griffith officially proposed a protein caused the scrapie and even suggested mechanisms. Soon the nature of the infectious agent became clear. The "scrapie agent," as it is called, was a protein [Prusiner 1982]. Unlike bacteria and viruses, it has no DNA or RNA. This was a new thing in all of biology; finally, in 1982 Stanley Prusiner coined the term 'prion', stating that the illness was caused only by proteins. The specific protein involved was referred to as the PrP (Prion Protein). Prusiner's research earned him a Nobel Prize in 1997.

So first there was the "scrapie agent", and then this was shown to be an infectious protein which Prusiner dubbed a "prion". Then when Prusiner discovered the protein of which prions were made, he called it "prion protein" (PrP for short) [Prusiner 1983]. Next it turned out that PrP was

a protein that everyone have, even people who aren't sick, have in their bodies, and that there's a gene in your DNA, on chromosome 20, that contains instructions telling each cell how to make PrP [Oesch 1985]. This gene was eventually called the PRNP (prion protein) gene.

If everyone has prion protein, then why do most people never get sick with a prion disease? It turns out that PrP normally exists in a healthy state called "cellular prion protein" or PrPC. But it's capable of misfolding into a "scrapie prion protein" or PrPSc. One particle of PrPSc can cause other PrPC to convert into PrPSc.

When Stanley Prusiner coined the term prion, there weren't many known prion diseases – just kuru, scrapie, and Creutzfeldt-Jakob disease, all of which turned out to be caused by the same protein, PrP. We now know that several other diseases – mad cow or bovine spongiform encephalopathy in cows, chronic wasting disease in deer, and fatal familial insomnia and Gerstmann-Straussler-Scheinker syndrome (just call it GSS!) in humans are all prion diseases, also caused by PrP.

Such diseases are called transmissible spongiform encephalopathies (TSEs) and, in these diseases, the brain degenerates in such a way that gaps form in the tissue. They cause your brain to become Swiss cheese or, as the name suggests, like a sponge in appearance. The results are severe and, unfortunately, always fatal. (18)

Proteins that fold improperly may also affect the health of the cell, regardless of the function of the protein. When proteins cannot fold into their functional state, the resulting misfolded proteins can be contorted into shapes unfavorable to the crowded cellular environment. Most proteins possess sticky, "water-hating" amino acids that they bury deep inside their core. Misfolded proteins wear these inner parts on the outside, like a chocolate-covered candy that has been crushed to reveal a gooey caramel center. These misfolded proteins often stick together, forming clumps called "aggregates." Scientists hypothesize that the accumulation of misfolded proteins plays a role in several neurological diseases, including Alzheimer's, Parkinson's, Huntington's, and Lou Gehrig's (ALS) disease, but scientists are still working to discover exactly how these misfolded, sticky molecules inflict their damage on cells.

So how does a misfolded protein do all of that damage? Scientists still don't really know the mechanism. However, a simplified way to look at it is that prions are highly charismatic proteins, able to 'convince' other proteins that their flawed structure is the right structure. The protein associated with most TSEs is called PrPC (for common), which is common in cell membranes in the normal configuration. It becomes a prion when it changes to PrPSC (for scrapie) which is the misfolded, infectious form of the protein.

Once consumed the PrPSC passes through the wall of the intestine by an unclear mechanism. Even more impressively, from there it enters the central nervous system, apparently moving from nerve to nerve until it enters the brain itself. Upon encountering PrPC on a cell surface, it induces structural changes to occur, encouraging folding of the protein until it resembles the PrPSC form. Now satisfied that its work is done, the prion moves on to the next PrPC, showing itself off and spreading the good word about its bad conformation.

Before long it has gained a crowd following that is also going forth to share this new shape with others. The newly converted PrPSC like to group together, forming aggregate communities throughout the brain. These aggregates form amyloid fibrils, insoluble clusters of protein which accumulate to form plaques (a process also associated with Alzheimer's). And thus the spongiform structure occurs, with gaps being left behind by this accumulation. Worse still, this form of the protein is resistant to proteases, enzymes which break down proteins.

Symptoms of these illnesses include poor coordination, confusion, memory loss, hallucinations. Sometimes, patients will experience dementia, psychoses and persistent insomnia. There are few ways to avoid such rare diseases, but the best you can do is ensure that your food comes from safe sources—also, try not to eat any suspicious brains.(20)

How do our cells protect themselves from misfolded proteins?

Recent research shows that protein misfolding happens frequently inside of cells. Fortunately, cells are accustomed to coping with this problem and have several systems in place to refold or destroy aberrant protein formations.

Chaperones are one such system. Appropriately named, they accompany proteins through the folding process, improving a protein's chances of folding properly and even allowing some misfolded proteins the opportunity to refold. Interestingly, chaperones are proteins themselves! There are many types of chaperones. Some cater specifically to helping one type of protein fold, while others act. Some chaperones are shaped like large hollow chambers and provide proteins with a safe space, isolated from other molecules, in which to fold. The Production of several chaperones is boosted when a cell encounters high temperatures or other conditions, making protein folding more difficult, thus earning these chaperones the alias, "heat shock proteins."

Another line of cell defense against misfolded proteins is called the proteasome. If misfolded proteins linger in the cell, they will be targeted for destruction by this machine, which chews up proteins and spits them out as small fragments of amino acids. The proteasome is like a recycling center, allowing the cell to reuse amino acids to make more proteins. The proteasome itself is not

one protein but many acting together. Proteins frequently interact to form larger structures with important cellular functions. For example, the tail of a human sperm is a structure composed of many types of proteins that work together to form a complex rotary engine that propels the sperm forward.(18-20)

Some Functional Limitation encountered by chaperones and proteases

Chaperones can rescue misfolded proteins by breaking up aggregates and assisting in the refolding process. Proteins that cannot be rescued by refolding can be delivered to the proteasome by chaperones to be recycled. One class of 'misfolded' proteins, prions, appears to evade detection by this machinery and persist in a misfolded state. In fact, the prions usurp the refolding machinery and employ chaperones to propagate the prion state.

These aggregates form amyloid fibrils, insoluble clusters of protein which accumulate to form plaques (a process also associated with Alzheimer's). And thus the spongiform structure occurs, with gaps being left behind by this accumulation. Worse still, this form of the protein is resistant to proteases, enzymes which break down proteins.(18-20)

THE CORONAVIRUS USES A PROTEIN CALLED "SPIKE" PROTEIN AS A BINDING MECHANISM

Researchers worldwide are racing to develop potential vaccines and drugs to fight the new coronavirus, called SARS-CoV-2. Now, a group of researchers has figured out the molecular structure of a key protein that the coronavirus uses to invade human cells, potentially opening the door to the development of a vaccine, according to new findings.

Previous research revealed that coronaviruses invade cells through so-called "spike" proteins, but those proteins take on different shapes in different coronaviruses. Figuring out the shape of the spike protein in SARS-CoV-2 is the key to figuring out how to target the virus, said Jason McLellan, senior author of the study and an associate professor of molecular biosciences at the University of Texas at Austin. Though the coronavirus uses many proteins to replicate and invade cells, the spike protein is the major surface protein that it uses to bind to a receptor — another protein that acts like a doorway into a human cell. After the spike protein binds to the human cell receptor, the viral membrane fuses with the human cell membrane, allowing the genome of the virus to enter human cells and begin infection. So "if you can prevent attachment and fusion, you will prevent entry,"(6)

The (SARS-CoV-2) Coronavirus process of infecting the human body cells that produce Ace2 protein. The virus that causes COVID-19 is spreading around the world. At least six other types of coronavirus infect humans, with some causing the common cold and two causing outbreaks: SARS and MERS.

Covered With Spikes

The coronavirus is named after the crown-like spikes that protrude from its surface. The virus is enveloped in a bubble of oily lipid molecules, which fall apart on contact with soap.

Entering a Vulnerable Cell The virus enters the body through the nose, mouth or eyes, then attaches to cells in the airway that produce a protein called ACE2. The virus is believed to have originated in bats, where it may have attached to a similar protein.

Releasing Viral RNA

The virus infects the cell by fusing its oily membrane with the membrane of the cell. Once inside, the coronavirus releases a snippet of genetic material called RNA.

Hijacking the Cell

The virus's genome is less than 30,000 genetic "letters" long. (Ours is over 3 billion.) The infected cell reads the RNA and begins making proteins that will keep the immune system at bay and help assemble new copies of the virus.

Making Viral Proteins

As the infection progresses, the machinery of the cell churns out new spikes and other proteins that will form more copies of the coronavirus.

Assembly New Copies : New copies of the virus are assembled and carried to the outer edges of the cell.

Spreading the Infection

Each infected cell can release millions of copies of the virus before the cell finally breaks down and dies. The viruses may infect nearby cells, or end up in droplets that escape the lungs.

Immune Response

Most COVID-19 infections cause a fever as the immune system fights to clear the virus. In severe cases, the immune system can overreact and start attacking lung cells. The lungs become obstructed with fluid and dying cells, making it difficult to breathe. A small percentage of infections can lead to acute respiratory distress syndrome, and possibly death.

Leaving the Body

Coughing and sneezing can expel virus-laden droplets onto nearby people and surfaces, where the virus can remain infectious for several hours to several days. The C.D.C.(center for disease and control) recommends that people diagnosed with COVID-19 wear masks to reduce the release of viruses. Health care workers and others who care for infected people should wear masks, too.(21)

CONCEPTUAL FRAMEWORK

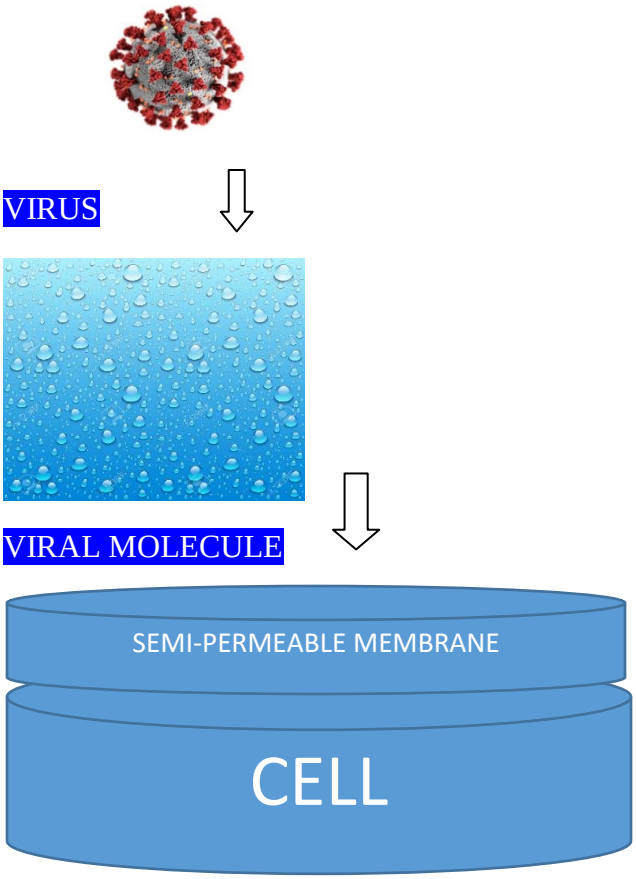

FIGURE1: DIAGRAM OF SEMI-PERMEABLE CELL MEMBRANE

Note: it should be subjected to clinical test evaluation in order to ascertain its efficacy and effectiveness against Covid-19 Virus.

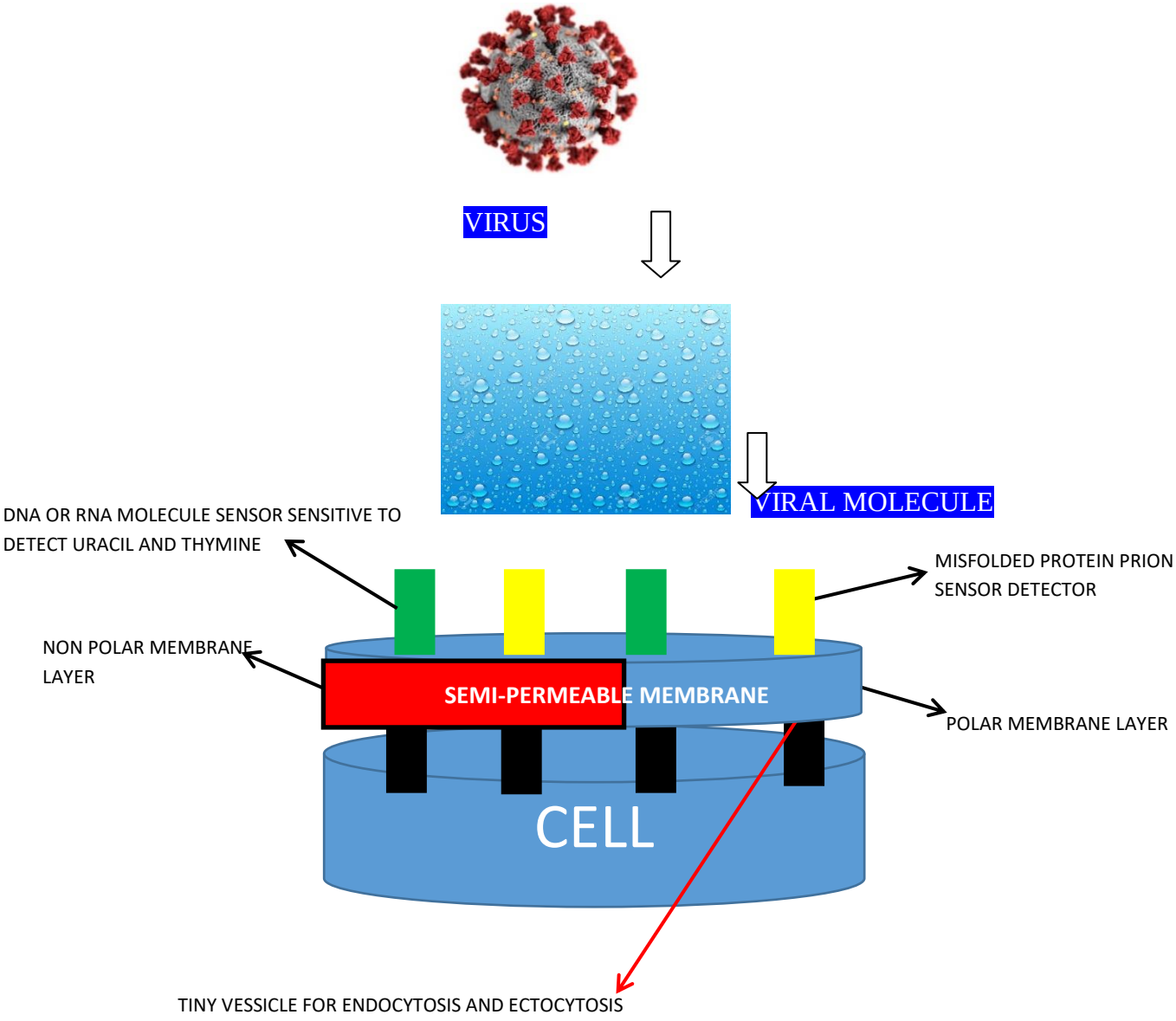

FIGURE2: DIAGRAM OF CLOAKED BIOMIMETIC SEMI-PERMEABLE NANOPARTICLE COATED CELL MEMBRANE WITH SENSITIVE SENSORS TO DETECT TOXIC PROTEINS

Note: it should be subjected to clinical test evaluation in order to ascertain its efficacy and effectiveness against Covid-19 Virus.

Every living organism is characterized of having a cell, and consequently a cell membrane. Similarly every living organism is composed of DNA or RNA or both, as highlighted from the review of cells, cell membrane, DNA and RNA in this article. It is important to emphasize that every living organisms has a protection for its nucleic composition, it could be in the form of a nuclear membrane or cell membrane (the cell membrane comprising mostly protein, very few organisms cell membrane are made of glycoprotein or lipid membrane),(29,30,31)

Evidently in humans viruses, bacteria, and other harmful pathogenic microbes try to wear down the cell membrane, which is one of the most important line of defence against viruses, preventing their entry into the cell, viruses do this by chemical action through insertion of their toxic molecular protein, which can wear down the cell membrane, by either binding or fusion of their capsid protein to cell receptors or they physically wear down the cell membrane. It is therefore imminent and paramount for a new cell membrane to be introduced to the human body, as viruses, bacteria and other pathogenic microbes have carefully mastered and studied how to break through the protective cell membrane of humans. This new bio-mimetic nano coated cell membrane should be made of a different material impenetrable to viruses and other pathogenic microbes, whenever they try to insert their toxic molecular protein, bind or by physical action. It is a fact that proteins are the major constituent for variations between structural components of different species and of the same species. In humans, protein makes the difference in body structure of hairs, skin etc, Even the defensive antibodies in humans are all composed of proteins. This article lays more emphasis on viruses, and especially the coronavirus as a case study. As earlier reviewed all viruses have a capsid or protective coating made of proteins. we can therefore hypothesize that all pathogenic microbes use protein either as a defensive mechanism to evade the immune system or as a weapon to attack the cell membrane and immune system. Having been able to narrow the three most important factors that viruses and other pathogenic microbes use, and these factors also share a common relationship with the human body system. What are the three factors?

These are DNA or RNA nucleus, protein and cell membrane. Therefore, the new bio-mimetic nano coated cell membrane should have multiple bio-sensors that could be able to detect DNA, or RNA viral genome infected protein, misfolded protein, which applies to prions. How does this cell membrane differentiate between DNA and RNA? Simple, the presence of thymine shows it's a DNA nucleotide, while the presence of uracil shows that it is RNA nucleotides. A Semi permeable membrane that could screen and proof read protein molecules to check and detect for

the base nucleotide molecule uracil for RNA and thymine for DNA, in addition, also proof screen protein molecules against prion (misfolded) protein molecules that have deformed structural arrangement.

Prion misfolded proteins have very distinguishable characteristics from normal native structural proteins; prion proteins are insoluble, while native proteins are soluble. Once any of the aforementioned abnormally is detected in the protein molecule it is not allowed to cross the nanoparticle semi-permeable membrane. The semi permeable membrane only proof read and proof screen protein molecules, since it's the pathway for both DNA and RNA viruses to hide and incorporate their viral genome into it. Proteins are the major underlying factor for structural variations in all organism, the human antibodies are all composed of protein molecule. The semi permeable membrane made of nanoparticle should have multiple bio-sensors to detect misfolded protein, DNA or RNA infected substances, since DNA and RNA activities are usually restricted within the cell membrane, so any external DNA or RNA molecule outside of the cell membrane is tagged as a foreign pathogen and may not get access into the cell membrane. Potentially, how does the introduction of a new cell membrane made of a different material helps to inhibit or possibly stops the actions of the coronavirus and other harmful viruses, and microbe?

The coronavirus moves through the ace2 cell receptor pathway; it breaks the cell membrane receptor lining where ace2 cell receptor, responsible for Ace 2 protein (manufacture) is present.

Firstly, Introduction of a new cell membrane made of entirely a different material and composition from the normal cell membrane will stop the coronavirus from binding directly to the ace2 cell membrane matrix, as the new bio-mimetic nano coated cell membrane will serve as a protective shield to the inner normal cell membrane. The bio-mimetic nano material to be used should be inorganic nano -materials, as organic nano-materials have deleterious and toxic effect to the human body. These inorganic nanomaterial should have anti-microbial properties. Eg silver or any other better nano inorganic materials, (29,30,31)

That the defences of the body's immune system destroy synthetic nanoparticles is a major barrier to the use of nanotechnology in medicine. Systemically administered nanoparticles are captured and removed from the body within few minutes.(27)

However, by 'cloaking' the nanoparticles with cell membranes, for instance by disguising nanoparticles as red blood cells, they often can survive for hours unharmed.

This has led to the development of a new class of biomimetic nanoparticles that combines the advantages of both natural and artificial nanomaterials. These cell membrane-coated

nanoparticles are characterized by a synthetic nanoparticulate core cloaked by a layer of natural cell membrane.(27)

Cell membrane coating is a platform technology that presents a facile top-down method for designing nanocarriers with surfaces that directly replicate the highly complex functionalities necessary for effective bio-interfacing.(27)

Cell membrane-coated nanoparticles inherently mimic the properties of the source cells from which their membrane is derived, bestowing a wide range of functions such as long circulation and disease-relevant targeting.(27)

Secondly, since the new cell membrane is made of nanoparticles, it will stop the mechanism of viruses from fusing or diffusing their lipid membrane into the cell membrane.

Thirdly, if the virus tries to inject it viral genome into a protein molecule, it will be detected by the bio-sensors incorporated or in-built in the new nanoparticle (semi permeable) that screens protein molecule for DNA, or RNA incorporated proteins, or misfolded proteins (prion) as its DNA or RNA nucleotides compound will be detected and barred from entering through the New cell membrane.(29,30,31)

Simple basic functions, which this new bio-mimetic nano cell membrane can perform, are: Passive transpor**t**, endocytosis and exocytosis, phagocytosis, allowance of polar solvent and non-polar solvent

Passive transport: by allowing oxygen, carbon dioxide and other gases to pass through it membrane pores freely.

Endocytosis: by creating tiny vesicles that elongates from the new nano cell membrane to the normal cell membrane, helping to allow bulk movement of nutrients. In addition, misfolded proteins (prions) and DNA or RNA genome incorporated proteins prevented are marked, for engulfing by special layer, which trap oxygen and uses it to oxidize the protein molecule, there by dis-balancing their structural molecular arrangement.

Exocytosis: by creating tiny vesicles that elongates from the new nano cell membrane to the normal cell membrane, that specially uptake waste materials from the surface of the Cell membrane. Allowing blood to pass through it, and transport the waste materials through the bloodstream, where they are all carried to the respective body organs that are characterized with further processing waste matter.

Phagocytosis: by creating special vesicles where toxic infected protein are phagocytes through the emission of ions harmful to viruses.

Allowance for polar and nonpolar solvent: the cell membrane should be divided into two component halves. The first half of the divide allows only polar solvent and the second half of the divide allowing non-polar solvents.

An example of a polar substance is water, an example of non- polar substance is lipid or sometimes referred as fatty acid.

This article just uses the coronavirus as a case study, to exemplify how it can restrict the action of viruses and other harmful microscopic pathogenic organisms from gaining entry into the human body cells. If we can restrict the toxic protein infected by viruses e.g. SARS-CoV-2 and prions from entering cells through proof reading and proof screening mechanism of this new bio-mimetic nanoparticle coated Cell membrane, then the coronavirus will be powerless since it can't bind or fuse with the new nano cell membrane. Also, its protein constituent is destroyed by engulfing through a special portion created on the bio-mimetic nano cell membrane to destroy all marked protein. For if we can keep pathogenic microbes (which include bacteria, archaea, fungi, algae, protozoa, and viruses inclusive), from entering the cells, then they won't be able to cause harm and diseases in humans. There by rendering them latent. In other words, the normal cell membrane should be coated with this new bio-mimetic nano cell membrane, to act as protective shield to the normal cell membrane and organs in the human body system. As highlighted in the beginning of this research article. All viruses have some protein on the outside coat or envelope that feels or recognizes the proper host cells. The protein attaches the virus to the membrane of the host cell. Some envelope viruses can dissolve right through the cell membrane of the host because both the virus envelope and cell membrane are made of lipids. Those viruses that do not enter the cell must inject their contents (genetic instructions enzymes) into the host cell. Those viruses that dissolve into a cell release their contents once inside the host. In either case, the result is the same.(29,30,31)

For example

The cold and flu virus will attack the cells that line the respiratory or digestive tract.

HIV, which causes AIDS attacks T-cells (CD4 Cells) of the immune system.

Ebola attacks the Macrophages and dendritic immune cells;

Small pox attaches itself to Macrophages (endothelial cells) in the liver, spleen, lymph nodes and bones.

Measles attacks the macrophages and dendritic immune cells,

COVID-19 attacks ACE2 cell receptor (ACE2pathway) angiotensin converting enzymes 2, are cell receptors that line cells of lungs, the kidney, the liver, the alveoli lining and part of the brain cells.(1-3)

THEORETICAL FRAMEWORK

CYTOKINE STORM THEORY

Diseases such as COVID-19 and influenza can be fatal because of an overreaction of the body's immune system called a cytokine storm. Cytokines are small proteins released by many cells in the body, including those of the immune system where they coordinate the body's response against infection and trigger inflammation. The name cytokine is derived from the Greek words for cyto (cell) and kinos (movement).

Sometimes the body's response to infection can go into overdrive. For example, when SARS-CoV-2–the virus behind the COVID-19 pandemic–enters the lungs, it triggers an immune response, attracting immune cells to the region to attack the virus, resulting in localized inflammation. But in some patients, excessive or uncontrolled levels of cytokines are released, which then activate more immune cells, resulting in hyper inflammation. This can seriously harm or even kill the patient. Cytokine storms are a common complication not only of COVID-19 and flu but of other respiratory diseases caused by coronaviruses such as SARS and MERS. They are also associated with non-infectious diseases such as multiple sclerosis and pancreatitis. The phenomenon became more widely known after the 2005 outbreak of the avian H5N1 influenza virus, also known as bird flu, when the high fatality rate was linked to an out-of-control cytokine response. Cytokine storms might explain why some people have a severe reaction to coronaviruses while others only experience mild symptoms. They could also be the reason younger people are less affected, as their immune systems are less developed and so produce lower levels of inflammation-driving cytokines.(6,7)

Fluid Mosaic Model theory

The currently accepted model for the structure of the plasma membrane, called the fluid mosaic model, was first proposed in 1972. This model has evolved, but it still provides a good basic description of the structure and behaviour of membranes in many cells.

According to the fluid mosaic model, the plasma membrane is a mosaic of components primarily, phospholipids, cholesterol, and proteins that move freely and fluidly in the membrane's plane. Interestingly enough, this fluidity means that if you insert a very fine needle into a cell, the membrane will simply part to flow around the needle; once the needle is removed, the membrane will flow back together seamlessly.

The principal components of the plasma membrane are lipids (phospholipids and cholesterol), proteins, and carbohydrate groups that are attached to some lipids and proteins.

The structure of the cell membrane is described by the fluid mosaic model, a universally accepted model of the plasma membrane. According to this model, the cell membrane is considered as a liquid having two surfaces. It is composed of a lipid bilayer with proteins embedded in it. Let us study the detailed composition of this lipid bilayer and other substances found in the cell membrane.(16)

Lipid Bilayer

The lipid bilayer is made up of two layers of phospholipids that are amphipathic compounds. Recall that a phospholipid molecule has a polar head and two nonpolar tails. The phospholipid molecules are arranged into two layers form a lipid bilayer. They are organized in such a way that the tails of the molecules in two layers face each other, while their heads are directed opposite. The heads are in contact with the water in the cytoplasm and in the extracellular fluid. Certain hydrophobic interactions develop among the tails of phospholipids, forming a spherical hydrophobic barrier around the cell. As a result, water and other dissolved substances in the cytoplasm or the extracellular fluid cannot enter or leave the cell. However, lipid-soluble compounds can easily cross this lipid bilayer. It is also impermeable to polar and charged compounds.

Other lipids

Besides the phospholipids, two other types of lipids are also present in the cell membrane. These are cholesterol and glycolipids. The percentage of these lipids in the cell membrane varies from cell to cell.

Cholesterol

It is abundantly present in the cell membranes of animal cells. Cholesterol molecules are present in the spaces among the hydrophobic tails of phospholipids in the lipid bilayer.

The function of cholesterol is to regulate the fluidity of the cell membrane. According to the fluid mosaic model, the cell membrane is just like a fluid in which the individual components can move freely. Cholesterol molecules in the lipid bilayer check this mobility. The role of cholesterol is temperature dependent. At high temperatures, it decreases the mobility of phospholipid molecules while at a lower temperature; it promotes their mobility.

Glycolipids

The amount of glycolipids also varies from cell to cell. They are mostly seen in the membranes of nerve cells. The hydrophobic chains of such lipids have an even number of fatty acids. The fatty acid chains are buried inside the lipid bilayer, while the carbohydrate component is present either on the cellular or extracellular face of the membrane.

The glycolipids serve to stabilize the cell membrane. They are also responsible for cell-to-cell interactions. Some glycolipids in the membrane also serve as cell surface receptors. The blood antigens are also glycolipids in nature, present on the cell membrane of red blood cells. The carbohydrate part of glycolipid is antigenic.

Proteins

protein-molecules

Proteins are the second-largest component of cell membranes. They make around 50% of the total cell membrane. They can be divided into three types;

Integral proteins, Lipid anchored proteins, Peripheral proteins.

Integral Proteins

These are the integral components of the cell membrane. Integral proteins are those that span throughout the width of the cell membrane. Therefore, they are also called **trans-membrane proteins.**

A trans-membrane protein has the following structures;

A hydrophilic domain present on the cytosolic side of the membrane. This domain interacts with the molecules present in the cytoplasm of the cells.

A hydrophobic domain that spans the width of the lipid bilayer. It anchors the protein in the cell membrane.

Another hydrophilic domain present on the extracellular side of the membrane. It interacts with the molecules in the surrounding environment of the cell.

Examples of integral proteins are transport channel proteins like glucose transporter, potassium channels, etc.

Anchored Proteins

Such proteins are not in contact with the cell membrane. They are attached to a lipid residue that is inserted into the lipid bilayer of the cell membrane. The protein is present either in the cytoplasm or in the extracellular fluid.

Examples of anchored proteins include alkaline phosphatase enzyme on the extracellular surface and G-proteins coupled to receptors on the cytoplasmic side of the membrane.

Peripheral Proteins

These are the proteins that are present only on one side of the cell membrane. They are present in association with the integral proteins or with the peripheral parts of the lipid bilayer.

These are the temporary proteins and lose their association with the cell membrane as soon as they have performed their function. Examples of such proteins include hormones attached to receptor proteins, etc.

Carbohydrates

Carbohydrates are also present in the cell membranes. However, they are always present in conjugation with lipids or proteins. They are involved in cell-to-cell recognition and other inter-cellular interactions.

Glycocalyx is formed by glycoproteins and glycolipids around some eukaryotic and prokaryotic cells. It is responsible for cell-to-cell adhesions. It is mostly seen with the epithelial cells and bacterial cells.

Membrane Polarity

An important concept that must be understood in cell membranes is membrane polarity. It means that the charges on the two sides of the cell membrane are not equal.

In a resting cell, the cytoplasm has more negative charges as compared to the extracellular fluid. It is because of the presence of organic anions in the cytoplasm. Also, potassium ions keep diffusing outside the cell down the concentration gradient. This further makes the cytoplasm negative as compared to the extracellular fluid.

Extracellular fluid is rich in cations, the major cations being the sodium ions. Because of this difference of charges on both sides, the cell membrane is never neutral. Rather, it shows electrical polarity. The cytoplasmic side carries a negative charge while the extracellular side carries a positive charge regarding each other.

Functions of cell membrane

In this section, we will discuss the several functions performed by cell membrane concerning a cell.

Cell membrane acts as Barrier

This is the most important function performed by the cell membrane. It acts as a barrier that controls the movements of substances across the cell. It is a selectively permeable membrane that allows only limited substances to pass through it.

Different substances can cross the cell membrane via one of the following processes.

Passive Diffusion

It is the movement of substances down their concentration gradient without using energy or any carrier protein. Cell membrane allows simple diffusion of only lipid-soluble substances. The hydrophobic compounds like steroid hormones can easily cross the cell membranes via simple diffusion. Besides, gases like CO2 and O2 can also freely diffuse across the cell membranes.

However, polar substances like water and charged compounds cannot diffuse through the cell membranes. They need some channel proteins to cross them.

Facilitated Diffusion

This diffusion is facilitated by some channel proteins. It is the process by which substances move down the concentration gradient by passing through a channel protein. Polar and charged compounds use specialized trans-membrane proteins called channel proteins to cross the cell membranes. Examples of such protein channels are potassium channels that allow the diffusion of potassium ions, and aquaporin that allow the diffusion of water molecules across the membranes. Nutrients such as sugars and amino acids also enter or leave the cell via specialized transport channels.

Active Transport

It is the movements of substances against the concentration gradient using energy in the form of ATP. It takes place via specialized trans-membrane proteins that have an integral ATPase activity so they can breakdown the ATP and use the energy that is released.

Cell membrane is necessary for Cell Signalling

Cell signalling is the process by which various metabolic processes taking place in the cell are controlled and regulated to maintain homeostasis. It is necessary for the overall coordination of the body.

Cells respond to the signals when a ligand binds to the cell surface receptors. These receptors are mostly proteins present in the cell membrane. This is true for many signalling molecules except the steroid hormones that are lipid soluble.

Cell membrane anchors the Cytoskeleton

The cytoskeletal framework of the cell is necessary for the maintenance of its shape and structure. It provides structural and mechanical support to the cell. Cytoskeleton is anchored to the cell membrane via linker proteins, such as integrin. The microfilaments and other components of the cytoskeleton are kept anchored to the cell membrane via these anchoring proteins.

The anchoring of the cytoskeleton is necessary for its function. If the framework is not anchored, it cannot provide mechanical support to the cell.

Cell membrane is involved in Cell to Cell recognition

This function is performed by glycolipids and glycoproteins present on the outer surface of cell membranes. Cells belonging to the same tissue have a particular arrangement of glycolipid and glycoproteins on the membrane that partner cells can recognize but not by the cells of the other tissues.

Endocytosis and Exocytosis

These are the methods of transporting bulk substances across the cell membranes. In endocytoses, the membrane of the cell extends around the large substance to form an endocytic vesicle. Endocytosis includes phagocytosis (cell eating) and pinocytosis (cell drinking). During these processes, the cell membrane forms a depression surrounding the particle it is engulfing. It then "pinches off" to form a small sphere of membrane called a vesicle that contains the molecule and transports it to wherever it will be used in the cell. Large molecules can be taken into the cell through the process of endocytosis. The vesicle is later taken in by the cell as it breaks from the cell membrane.

During exocytosis, the preformed vesicles fuse the cytoplasmic surface of the cell membrane. The vesicle becomes a part of the membrane while the substance is dumped into the extracellular fluid. The vesicles form in the cytoplasm and move to the surface of the cell membrane. Here, they merge with the membrane and release their contents to the outside of the cell. Exocytosis removes the cells waste products, which are the parts of molecules that are not used by the cell, including old organelles.(16)

POTENTIAL LIMITATIONS OF THE HUMAN CELL MEMBRANE

1. Inability to proof screen and detect protein molecules incorporating viral genomes of viruses and other toxic pathogenic microbes.
2. Inability to proof screen, detect and hinder harmful, insoluble and misfolded proteins (prions) from entering the human body cells.
3. Inability to stop the fusion and binding activities of viruses and other toxic pathogenic microbes.
4. Inability to proof screen food substrate and detect toxic misfolded proteins.
5. Inability to detect and hinder external DNA or RNA from entering the cell membrane, since the activities of DNA and RNA are confined internally within cells and cell membrane. (29,30,31)

RELATED EMPIRICAL STUDIES

EVIDENCE OF NANOTECHNOLOGY AGAINST SARS-CoV-2

Scientists have developed a new tool that mimics how the virus that causes COVID-19 infects a cell, potentially speeding the search for treatments against the disease. The tool is a fluorescent nanoparticle probe that uses the spike protein on the virus surface to bind to cells and trigger the process that pulls the virus into cells. The probe could be used to rapidly gauge how drugs and compounds might block the virus from infecting cells.(26)

A team of scientists from the National Center for Advancing Translational Sciences (NCATS) and Naval Research Laboratory (NRL) in Washington, D.C., has developed a new tool that mimics how SARS-CoV-2 -- the virus that causes COVID-19 -- infects a cell, information that might speed the search for treatments against the disease.

The tool is a fluorescent nanoparticle probe that uses the spike protein on the surface of SARS-CoV-2 to bind to cells and trigger the process that pulls the virus into the cell. The probe could be used in tests to rapidly gauge the ability of biologics, drugs and compounds to block the actual virus from infecting human cells. The researchers' findings appeared online Aug. 26 in ACS Nano.

"Our goal is to create a screening system to find compounds that block SARS-CoV-2 from binding to cells and infecting them," explained Kirill Gorshkov, Ph.D., a translational scientist at NCATS and a co-corresponding author of the study.

However, using the actual virus in such screening studies would be difficult and require special facilities. Instead, Gorshkov and Eunkeu Oh, Ph.D., a research biophysicist at NRL and co-corresponding author of the study, and their colleagues wanted to use nanoparticles to mimic the viral function of binding to and invading the host human cell.

The NCATS and NRL researchers collaborated to design and test the probe, combining their complementary skill sets to deliver results far sooner than separate research efforts would have. The NRL team, led by Mason Wolak, Ph.D., an expert in optical nanomaterials, put the initial collaboration together.

“We at NRL are experts in nanoparticles, and the NCATS researchers are experts in drug screening using cellular systems,” explained Oh. “So, it was the perfect match.”

To create the probe, NRL scientists built a fluorescent nanoparticle called a quantum dot, fashioned from cadmium and selenium. At around 10 nanometers in size, these spherical nanoparticles are 3,000 times smaller than the width of a human hair.

The NCATS-NRL research team then studded the quantum dots’ surfaces with a section of the SARS-CoV-2 spike protein that binds to the angiotensin-converting enzyme 2 (ACE2) receptor on human cells. The union of the spike protein with ACE2 is the first step in the pathway to viral infection.

The glow from the quantum dots allows scientists to track the dots’ behavior under a microscope. “Because they’re such bright fluorescent objects, the quantum dots give us a powerful system to track viral attachment and effects on the cell in actual time,” explained Gorshkov.

The investigators tracked how the quantum dot probes interacted with human cells that have ACE2 on their surfaces. They watched the nanoparticle probes attach to ACE2, which combined with the probes and pulled them into the cells. The quantum dot probes did the same in a lung cell line commonly used in coronavirus assays. Safety data showed that the probes were not toxic to the test cells at the concentrations and exposure times used in the study.

The quantum dots followed the SARS-CoV-2 pathway into cells, but the research team found the probes also mimicked the virus in the presence of antibodies. Antibodies are proteins made by the immune system that can neutralize viruses such as SARS-CoV-2. The antibodies proved to potent inhibitors of the quantum dot probes, preventing them from binding to ACE2 and entering human cells.

That antibody response means the quantum dot probes could help researchers rapidly test the ability of potential therapeutic agents to block the virus from entering and infecting cells. Assays using the probes also could determine the concentrations at which potential treatments may safely and block infection.

“Using the quantum dots, we could create tests to use in drug screening and drug repurposing, using libraries of compounds that have activity but that also are approved by the U.S. Food and Drug Administration,” Gorshkov said. “Such assays could rapidly identify promising, safe treatments for COVID-19.”

ACE2 may not be the only receptor SARS-CoV-2 targets, and the quantum dot probe’s flexible design will allow researchers to swap in spikes that bind to other receptors. With the probe, researchers also could test how mutations in the spike change the way the virus behaves -- and how well treatments work -- by adding the mutated spikes to the quantum dots. Beyond SARS-CoV-2, researchers could revise the nanoparticle probe to mimic other viruses and reveal their pathways to infection. The quantum dot probes also could be useful when testing potential therapies for other diseases, Gorshkov said. The quantum dots also might deliver drugs directly to cells, narrowing treatment to specific cell types, organs or cancers.(26)

SILVER NANOPARTICLES USED AGAINST SARS-COV2

Do silver nanoparticles help against corona viruses?

In principle, that is true. The antibacterial effect of silver nanoparticles is known. This is the reason it is used as a coating for implants or in wound dressings. The effect is based on the release of silver ions, i.e. small, electrically charged particulate matter. Silver nanoparticles have especially good properties, as they have a large surface from which these ions can be released. Scientific studies show that besides the antibacterial effect, these ions act as antiviral agents. Laboratory tests have shown that they are effective against certain types of corona virus family. Scientists are currently investigating whether this applies to the originator of the disease COVID-19 and are looking into the use of surface coatings with silver nanoparticles in hospitals and public places.(24)

GOLD NANOPARTICLES USED IN DETECTION OF SARS-COV2

Using gold nanoparticles to detect COVID-19 (23)

An article published May 29, 2020 By Nancy Crotti, reveals the implementation of gold nanoparticles in detecting covid-19.

A nasal swab containing a test sample is mixed with a simple lab test that contains a liquid mixed with gold nanoparticles attached to a molecule that binds to the novel coronavirus. If the virus is present, the gold nanoparticles turns the solution a deep blue color (bottom of the tube). If it is not present, the solution keeps its original purple color.

Scientists from the University of Maryland School of Medicine have developed an experimental diagnostic test for COVID-19 that they say can visually detect the virus in 10 minutes.

It uses a simple assay containing plasmonic gold nanoparticles to detect a color change when the virus is present. The test does not require the use of advanced laboratory techniques, such as those commonly used to amplify DNA for analysis. The authors published their work last week in the American Chemical Society's nanotechnology journal ACS Nano.

"Based on our preliminary results, we believe this promising new test may detect RNA material from the virus as early as the first day of infection," said study leader Dipanjan Pan, a professor of diagnostic radiology and nuclear medicine and pediatrics at the university, in a news release. "Additional studies are needed, however, to confirm whether this is indeed the case."

RNA is extracted from a nasal swab or saliva sample using a simple process that takes about 10 minutes, according to the researchers. The test uses a highly specific molecule attached to the gold nanoparticles to detect a particular protein that is part of the genetic sequence unique to the novel coronavirus. When the biosensor binds to the virus's gene sequence, the gold nanoparticles respond by turning the liquid reagent from purple to blue, they explained.

"The accuracy of any COVID-19 test is based on being able to reliably detect any virus. This means it does not give a false negative result if the virus is present or a false positive result if the virus is not present," Pan said. "Many of the diagnostic tests currently on the market cannot detect the virus until several days after infection. For this reason, they have a significant rate of false-negative results."

Pan has created a company called VitruVian Bio to develop the test for commercial application. He plans to have a pre-submission meeting with the FDA within the next month to discuss requirements for getting an emergency use authorization (EUA) for the test.

Although more clinical studies are warranted, this test could be far less expensive to produce and process than a standard COVID-19 lab test, according to the university. It does not require laboratory equipment or trained personnel to run the test and analyse the results. If this new test meets FDA expectations, it could potentially be used in daycare centers, nursing homes, college campuses, and workplaces as a surveillance technique to monitor any resurgence of infections, the researchers said. (23)

COPPER NANOPARTICLES

Copper Nanoparticles take on COVID-19(22)

While researchers the world over are searching for a cure or vaccine for COVID-19, nanotechnology specialists have used nanoparticles of copper in fabrics to kill the coronavirus on contact.

However, using copper as an anti-viral raw material is not at all new. The cleansing power of metals has been utilised to sterilise all manner of objects for thousands of years. It is one reason many medical instruments and tools were often made out of silver.

It is an understanding that has inspired the breakthrough that could help stop today's pandemic. Today, nanotechnology developments mean that only minute particles of metal need to be deployed before their virus-killing properties come into effect. By using copper nanoparticles, each measuring less than 100 nm wide (0.0001 mm), the metal can be sprayed onto fabric, even face masks, providing an added defence against coronavirus.

"We wondered how we could use our existing technology to turn something used in ancient times, like copper, into protection against COVID-19," explains Professor Mangilal Agarwal, a director of the Integrated Nanosystems Development Institute at Indiana University who led the research. "Any virus sitting on the surface that comes in contact with copper will be killed because of the antiviral properties."

Knowing this, the nanotech team began work developing a reusable face mask that trapped airborne virus particles and de-activate them with copper nanoparticles contained within the fabric.

As the nanotechnology industry journal Nanowerk reports, "The technology initially developed to make composite materials cheaper, lighter and stronger using nanomaterials could be used to coat household masks with a layer of fabric protection inlaid with copper nanoparticles that disable virus particles as they reach the surface. The public could wear a reusable mask that offers the same superior level of protection as masks worn by healthcare providers, such as N95 masks."

"These masks have copper oxide applied at the nano level and would offer ultimate protection against virus risks like COVID-19," Agarwal said. "Some cloth masks allow the small airborne particles to pass through, but with our technology, it would be close to 100% proof that you have the capability incorporated in the mask to deactivate the virus and improve filter performance."

Not only does the nanotechnology mask function well, they are also practical for large-scale production. As Agarwal notes, "To make any fabric into a mask or filter, we have to provide the nanostructure, and we can put that nanostructure on a roll-to-roll printing machine with the fibres at nanoscale. We are using electrospinning, using the electric field to spray the nanofibers onto the fabric."

The team has now placed a patent on the process and are looking to secure investors with whom to commercialise the nanoproduct, possibly with government procurement help via America's Defence Protection Act.

Agarwal's co-researcher and business partner, associate professor Hamid Dalir, also notes how the process can apply anti-viral and antibacterial copper nanoparticles to countless other products. "Our technology is good for masks and filters because we are not changing the manufacturing process," he says. "We just get the rolls of the mask and filter, manufacture and enhance it with copper-coated fabric and then use it as it would be used conventionally."

One potential alternative is using the nanoparticle fabric in High-Efficiency Particulate Air (HEPA) filters found in heating and air conditioning units. This would allow the nanoparticles to deactivate viruses that are circulating through the ventilation systems found in offices, shopping centres, public buildings, and even hospitals and care homes.

Applications such as this truly enable nanotechnology to play a key role in keeping people healthy. While the current focus is on using the nanoparticle fabric in masks to combat the spread of coronavirus, the product's effectiveness against a wide variety of pathogens makes it a preventative measure against thousands of infectious diseases anywhere a fabric filter can be applied.

While nanoparticles may be small; they have a huge role to play in 21st century healthcare.(22)

CELL MEMBRANE NANOTECHNOLOGY

Cell membrane coating as a platform nanotechnology for medicine.

Nanoparticles can deliver different drugs to specific cell types, for example, chemotherapy to cancer cells. But for all the benefits they offer and to get to where they need to deliver the needed drug, nanoparticles must outsmart the body's defences so they don't recognize them as intruders.

That the defences of the body's immune system destroy synthetic nanoparticles is a major barrier to the use of nanotechnology in medicine. Systemically administered nanoparticles are captured and removed from the body within few minutes.

However, by 'cloaking' the nanoparticles with cell membranes, for instance by disguising nanoparticles as red blood cells, they often can survive for hours unharmed.

This has led to the development of a new class of biomimetic nanoparticles that combines the advantages of both natural and artificial nanomaterials. These cell membrane-coated nanoparticles are characterized by a synthetic nanoparticulate core cloaked by a layer of natural cell membrane.

Cell membrane coating is a platform technology that presents a facile top-down method for designing nanocarriers with surfaces that directly replicate the highly complex functionalities necessary for effective bio-interfacing.

Cell membrane-coated nanoparticles inherently mimic the properties of the source cells from which their membrane is derived, bestowing a wide range of functions such as long circulation and disease-relevant targeting.

In a review in Advanced Materials ("Cell Membrane Coating Nanotechnology"), scientists from the University of California San Diego provide a comprehensive overview of this new technology, from its initial development to the current state of the art.

In their article, the authors place specific emphasis on the different membrane coatings currently used, along with their special features. They cover these coatings' advantages for specific applications in depth, including some applications that uniquely benefit from the presence of biological membranes. (27)

Cell membrane-coated nanoparticles

Cell membrane-coated nanoparticles. A variety of cell types have been used as sources of membranes to coat over nanoparticles. Each cell membrane type can use unique properties to provide functionalities to nanoparticulate cores, the material of which can be varied depending on the desired application.

Cell membranes are composed of a mixture of lipids, proteins, and carbohydrates. Lipids are responsible for the bilayer structure and fluidity of the membrane, while also playing a role in signalling. Proteins, either transmembrane or membrane-anchored, and carbohydrates provide the interfacing functionalities of the membrane.

The cell membrane coating technology was first reported in 2011 (PNAS, "Erythrocyte membrane-camouflaged polymeric nanoparticles as a biomimetic delivery platform"), in which researchers directly leveraged entire cell membranes as a material for nanoparticle coating.

By transferring the outermost layer of a cell directly onto the surface of a nanoparticle, the complexity of the membrane, with all of its lipids, proteins, and carbohydrates, can be faithfully preserved, enabling the resultant membrane-coated nanoparticle to take on many of the properties exhibited by the source cell. These biomimetic nanoparticles combine the advantages of both natural and artificial nanomaterials and are poised to find a wide use for applications such as drug delivery, detoxification, immune modulation, biodetection, imaging and photoactivatable therapy.

Red blood cell membrane-coated nanoparticles

This concept was first shown using red blood cells (RBCs) as the source of membrane material (Nature, "Nanoparticle biointerfacing by platelet membrane cloaking"). RBCs, which are responsible for oxygen delivery within the body, have a lifespan of up to four months in humans. The ability of these cells to circulate for extended periods of time is a highly desirable property for nanoparticle drug delivery.

The RBC-coated nanoparticle became the first cell membrane-coated system reported, and it is currently the well-studied in the field. The rapid expansion of this platform is partially because of the ease of cell collection and lack of intracellular organelles, which makes membrane collection simple and scalable for efficient manufacturing.

In addition, RBC-coated nanoparticles have the clearest path toward translation, as blood transfusions are common, and there is the potential to use type-matched RBCs as membrane sources to maximize biocompatibility for wide clinical use.

Platelet membrane-coated nanoparticles

With the success of RBC-coated nanoparticles, other types of blood cells with unique functionalities have also been investigated as membrane sources. One important cell type that has been explored is platelets, which are nuclear fragments from megakaryocytes.

The major function of platelets is maintaining hemostasis, as they are naturally recruited to sites of vascular injury to trigger a cascade that leads to clot formation, starting the healing process. Platelets have various other functions and have been implicated in the pathogenesis of a variety of diseases, ranging from cancer and atherosclerosis to bacterial infections.

Like the immunomodulatory markers on RBCs, these disease-relevant platelet functions are largely a consequence of their surface marker expression, which can be transferred onto nanoparticles via membrane coatings.

White blood cell membrane-coated nanoparticles

Membrane derived from white blood cells (WBCs), the last major category of blood cells, has also recently been used for nanoparticle coating. Leukocytes help to carry out immune functions and comprise many subsets, including macrophages, dendritic cells, B cells, T cells, neutrophils, and others. Compared with RBCs or platelets, WBCs are nucleated and have more complex intracellular components, which cause more complicated workflows for obtaining their membranes.

However, WBCs have unique properties that enable site-specific targeting, especially to tumors or vascular abnormalities, and thus their membrane can carry exceptional utility that makes their use worthwhile.

Cancer cell membrane-coated nanoparticles

Moving beyond cells originating solely from the blood, another major source of membrane can be malignant cells. Aberrant cells have many attributes that make them well-suited for use with the cell membrane coating technology. Because of their robustness, it is easy to culture them in vitro and get their membrane material.

There are also unique properties exhibited by cancer cells, such as the ability to self-target, which can be leveraged for cancer drug delivery and imaging purposes, and antigenic display, which can be taken advantage of for immune modulation.

Stem cell membrane-coated nanoparticles

Stem cells are another class of cells that have been leveraged to make membrane coatings. The cells themselves have been widely explored for various therapeutic purposes, especially in the field of regenerative medicine. They are relatively easy to work with, as techniques for their large-scale culture are widely reported. Stem cells display many special properties, including tumortropism, which researchers have taken advantage of to deliver therapeutic payloads. Likewise, coating the membrane of stem cells onto nanoparticles has enabled the fabrication of nanocarriers with similar targeting functionality. Besides these major groups of membrane-coatings, researchers also are exploring and working on other types of membrane-coatings: endothelial cells, beta cells, bacterial cells, and hybrid cell membranes.

"The utility of the cell membrane coating approach will undoubtedly expand as time progresses," the authors conclude. "Ultimately, as this emerging biomimetic nanotechnology matures, attempts will be made in earnest to translate such platforms to the clinic where they are primed to make a positive impact on human health." (27)

NANOTECHNOLOGY AS EFFECTIVE ANTIVIRAL THERAPY

Antiviral Nanotherapeutics and Nanomedicine

Several nanomedicines have already been approved, or are currently undergoing the approval process, to be used to treat viral infections. Some potential nanotherapeutics under development is discussed below.(25)

Human Immunodeficiency Virus (HIV):

The treatment is based on the usage of drugs that target the various stages in the life cycle of the virus. The current antiretroviral (ARV) armamentarium includes protease inhibitors, nucleoside/nucleotide reverse transcriptase inhibitors, non-nucleoside inhibitors, entry/fusion inhibitors, and integrase inhibitors.

Modern drug design involves the incorporation of the ARV drug with nanosystems, which decrease the dosage requirements and toxicity. This method of drug delivery improves the safety and efficacy profiles of the drug.

Hepatitis B Virus (HBV):

HBV is responsible for the inflammation and cirrhosis of the liver and can also cause liver cancer. This virus accounts for over 700,000 deaths per year.

Current anti-HBV nano-therapy includes the use of pegylated IFN, lamivudine, adefovir, interferon (IFN)-α, etc.

Hepatitis C Virus (HCV):

The major complication of HCV includes liver cirrhosis and liver cancer. Significant HCV inhibition was reported using nanozymes. These nanozymes are extremely stable against enzymatic degradation and possess very low levels of toxicity.

INFLUENZA:

Influenza is an immensely contagious respiratory disease. The genomic sequence of the influenza virus is capable of rapid mutations, thereby giving rise to several novel strains. Nanotrap particles are thermo-responsive hydrogels.

These particles possess the property of entrapping viral RNA and viral proteins that cause the disease. This is a very novel technology that can be utilized in the treatment of influenza.

Another method to treat influenza involves the use of liposomes and oseltamivir incorporated silver nanoparticles as drug delivery agents.

Herpes Simplex Virus (HSV):

HSV causes oral and facial lesions, encephalitis, genital infections, etc. In the treatment of HSV, promising results have been observed (including a reduction in the periodicity of drug administration) by the use of nanoparticles loaded with acyclovir.

Human Papillomavirus (HPV):

HPV primarily infects epithelial cells. HPV could cause common warts, cervical neoplasia, or cancer. Nano-based drugs incorporate siRNA to treat HPV16 and HPV18.

These nanoparticle-based drugs express their antiviral potential through the E7 gene.

Human Parainfluenza Virus (HPIV):

This virus primarily infects human epithelial cells. The respiratory tract of infants and children are the primary targets of the disease caused by HPIV. Silver nanoparticles have recently been found to be effective against HPIV.

Ebola Virus Disease (EVD):

This virus is extremely deadly. It causes a highly infectious disease in humans and other primates. Treatment of EVD involves the usage of liposomes containing siRNA. Clinical trials have shown mixed results.

The drug did not show any effective results in patients in advanced stages of the disease. However, in milder cases, the drug showed promising results.

Nanovaccines

Nanovaccinology follows both preventive and remedial approaches.

Advantages of Nanovaccines:

Nanovaccines are superior to conventional vaccines in several ways. Conventional vaccines may require multiple administrations, be unstable, or may have weak immunogenicity. Nanovaccines help overcome such shortcomings.

Nanovaccines need not be transported in cold chambers as they can be lyophilized. The shelf life of nanovaccines is also significantly greater than conventional vaccines.

Given the small size of nanovaccines (similar to bacteria and viruses), it is readily identified by the human immune system.

Examples of Nanovaccines:

Hepatitis A Virus (HAV) is mostly associated with food-borne infections. A lipid-based nanosystem is effectively used to prevent HAV.

A similar liposomal based vaccine is used for the prevention of Hepatitis B. Also, a virosomal adjuvant-based vaccine is administered to prevent Influenza.

The effectiveness of antiviral drugs could be enhanced with nanomedicine formulations. Nanoparticles associated with antiviral drugs and vaccines allow controlled release kinetics, enhanced bioavailability, and minimizes side effects.(25)

Nano-Biomimetics

The term "biomimetics" originates from the Greek words "bios" (life) and "mimesis" (to imitate), yet its definition is not as simple as just those two words. More specifically, biomimetics is a creative form of technology that uses or imitates nature to improve human lives.

Biomimetics, also known as bionics, biognosis, or biomimicry, is the use and implementation of concepts and principles from nature to creating new materials, devices, and systems. This adaptation of methods and systems found in nature into synthetic constructs is desirable because evolutionary pressure typically forces natural systems to become highly optimized and efficient. Nature provides a database of several solutions that already work and thus serve as models of inspiration for synthetic paradigms.

Biomimetics has its origins back in the times when the Wright brothers modeled their planes on the structure of bird wings; when Joseph Paxton used the design of a lily pad to structure the Crystal Palace and when Leonardo da Vinci was working on his flying machines and ships. However, the field was only given its official name and definition by Jack Steele of the U.S. Force in the 1960's.

Biomimmicry only recently begun to reach is full potential since the invention of Velcro, the biomimetic-equivalent of hooks in natural burrs created by George de Mestral in 1948. Since then, many facets have evolved and can be broadly categorized under two main topics:

· Mimicking mechanisms found in nature

e.g. water-proof glue developed with parallel mechanisms found in the study of adhesives produced by mollusks.

· Utilizing or incorporating nature itself into novel devices

e.g. new strong but light materials have come from studying the structure of bone, Velcro.(34)

Confluence of Nanotechnology and Biomimetics

Most of the applications developed in the past have been created on the macromolecular level. Only recently has Biomimetics begun to approach the micro and sub-micro molecular level of matter. At the turn of the century, however, the interests of scientists and researchers have shifted towards thinking of matter at the atomic level hence the field Nanotechnology.

What is Nanotechnology?

It is the ability to manipulate atoms at the atomic level ranging from one to several nanometers to understand, create and use material structures, devices, and systems with fundamentally new properties and functions resulting from their small structure.

All biological systems have their most basic properties and functions defined at the nanoscale from their first level of organization. The overall aim of nanotechnology in biological systems then is to hierarchically assemble molecules into objects and vice versa, using bonds that require low energy consumption. Nanotechnology provides tools and platforms for the investigation and transformation of biological systems, and biology serves as the source of inspiration for creating new devices and systems integrated from the nanoscale under the two facets already outlined above.

It is important to note that biological models cannot be emulated exactly as they operate on a much smaller time-scale than usually necessary in industry and also require water while industrial processes work in various other media.(34)

Biomimetics in biomedical engineering

With designs originating from organisms, biomimetics has facilitated and improved human life through many convenient products. In the future, biomimetics will have a greater impact through the combination of medicine, science, and biomedical engineering to treat diseases, physical disabilities, and wounds. Regenerative medicine and tissue engineering are particularly promising fields. Principles and functions of biomimetics that can be applied in biomedical engineering are derived from many sources, including how a lizard regenerates its tail and a buckhorn regenerates its horns every year, the adhesive, phlegmatic, and regenerative properties of a spider web, and leukocyte adhesion/migration in inflammation.

An example would be a biocompatible medical bandage that can be made compatible with human tissue and integrated with ubiquitous health care (U-health) system to get real-time

reports on the granular status of recovery or disease. A biocompatible, short-lived medical bandage or tape can be used to detect signals, allowing us to monitor heart attacks or myocardial infarction that cannot be monitored or detected using current medical devices. Such a bandage would also be compatible with our skin and result in fewer side effects and less irritation despite better attachment. Such function is derived from the foot hair of the gecko, as mentioned previously.(33)

Next-generation biomimetics combines biology with other technology in solving problems. In particular, nanotechnology is becoming a key discipline that will be utilized to help understand the material and its structures along with accelerating the development of the secondary structure of proteins. Protein-functionalized nanoparticles, peptide-functionalized gold nanoparticles, and carbohydrate-functionalized nanoparticles are areas of nanotechnology that are finding biomimetic applications. Furthermore, biomimetic approaches may open up promising new fields. Various hybrid composites inspired by the nature have been fabricated and used as a template that can regulate biological processes in tissue engineering. Structural biomaterials such as bones or nacres are hierarchically constructed and organized. To elucidate the structural complexity of these biomaterials, studies have demonstrated the development of morphological structures of inorganic-organic hybrid materials to mimic biological and structural formations like sponge spicule formation or the nacre (brick-and-mortar) structure of mollusks.

Multifunctional fibrous scaffolds have been developed as native tissue architecture, which has a high potential for bone regeneration. One group recently tested nanofibers as a scaffold made of poly D, L-lactide-co-trimethylene carbonate (PLMC). The biomimicking attributes of poly D, L-lactide-co-trimethylene carbonate nanofibers showed enhanced efficacies and efficiencies as scaffold materials for tissue repair and regeneration.

The integration of biomimetics in biomedical engineering is advancing technology in many ways. Painless syringe needles developed by Kansai University (Osaka, Japan) is one example of biomimetics meeting bioengineering to develop a new material to improve medical operations. This group modeled the structure of mosquito mouthparts that can extract blood from the host animal with the least amount of nerve irritation. Such needles are used to help diabetics or during surgery to help patients overcome fear of needles. They use biodegradable polymer, polylactic micro silicones the needles safer and more practical than traditional micro silicon needles. Such needles can be inserted at particular angles with a certain sensitivity to result in painless insertion. Painless needles are a great example of a significant contribution to the advancement of biomimetics and biomedical engineering.

Due to the heterogeneous nature of the cellular microenvironments, biomimetic analytical platforms conveying complex environments in vivo models have been studied to probe the characteristics of cells and their microenvironments. By engineering the microenvironments (ie, microwells), researchers mimicked the cell-to-cell interactions in lymph nodes or other tissues where two types of cells dynamically communicate upon immunological cues. As the biomimetic microenvironments become more elaborated and sophisticated, researchers preparing biomimetic cellular environments will be enlightened and find solutions to the enigmatic relationships between cells and their adjacent microenvironment. (33)

Reference to biological models inspiring engineers to develop new materials and technologies is based on the assumption that nature, in many billion years of evolution, has created optimal living structures that are far more effective and endurable than any man-made structures. For example, the study of the "lotus effect", i.e. the property of lotus leaves to resist wetting and dirt due to their micro- and nanostructured surface has led to the development of waterproof paints and textiles. Polymer nanofibres whose strength is comparable to that of steel were inspired by an example from biology, namely the cobweb whose threads can withstand three times greater strain than steel wire with equal diameter. Burdock fruit became a prototype for the synthetic adhesive material Velcro, the basis of widely used hook-and-loop fasteners.

Many biomolecules are capable of self-assembly in regular structures. For example, under polymerization conditions, the contractile protein actin forms filaments 7 nm thick, and tubulin forms microtubes 25 nm in diameter. Using this self-assembling mechanism and the biostructures as matrices, nanoconductors and nanotubes can be created through the deposition of metal monolayers onto biopolymers. Complementarity that underlies the double-stranded DNA assembly is used in the development of new DNA-based nanomaterials.

Knowing the structure and functions of biological molecules, we can synthesize hybrid molecules, including peptides, lipids, and organic polymers, and develop biomimetic nanofibres, bioinorganic composites, and nanoporous coatings for tissue engineering.

Biomimetic nanoparticles are under active development. For example, ferritin, a protein that transports and stores iron in an organism, forms nanocavities with an inner diameter of 8 nm. Magnetic nanoparticles of iron oxide and cobalt oxide with a mean size of 6 nm can be encapsulated in these nanocavities. Other approaches employ "growing" nanoparticles of specific sizes inside bacteria or the biomass of plants (oats, wheat or alfalfa). Metal salts are added to these biological objects, and after biocatalytic reduction to metals, they form nanoparticles. Methods of growing metallic nanoparticles in plants by adding metal salts to the irrigation water have been described. Nanoparticles are formed in the stems and other parts of

plants and can be extracted. Proteins involved in reducing reactions define the size of the formed nanoparticles. In some cases, peptide sequences responsible for catalysis have been identified, which allowed them to be used as ring peptides for the in vitro development of nanoparticles. Nanoparticles can also be created using viral shells (capsids). Viral capsid proteins are assembled to form regular-shaped three-dimensional structures with a hollow space inside where the virus genome is packed. High regularity calibrated metallic nanoparticles and nanocomposites can be assembled both inside a capsid and on its surface. Biomimetic synthesis of nanoparticles has certain advantages; for example, it is carried out under milder conditions compared to the physical and chemical production of nanoparticles. In the large-scale production of nanoparticles, this feature makes it possible to minimize adverse environmental effects.(35)

NANOTECHNOLOGY IN MEDICINE

Nanotechnology is enabling technology that deals with nano-meter sized objects. It is expected that nanotechnology will be developed at several levels: materials, devices, and systems. The nanomaterials level is the most advanced at present, both in scientific knowledge and in commercial applications. A decade ago, nanoparticles were studied because of their size-dependent physical and chemical properties. Now they have entered a commercial exploration period.

Living organisms are built of cells that are typically 10 μm across. However, the cell parts are much smaller and are in the sub-micron size domain. Even smaller are the proteins with a typical size of just 5 nm, which is comparable with the dimensions of the smallest artificial nanoparticles. This simple size comparison shows using nanoparticles as tiny probes that would allow us to spy at the cellular machinery without introducing too much interference. Understanding of biological processes on the nanoscale level is a powerful driving force behind development of nanotechnology.

Out of plethora of size-dependant physical properties available to someone who is interested in the practical side of nanomaterials, optical and magnetic effects are the most used for biological applications.

The aim of this review is firstly to give a reader a historic perspective of nanomaterial application to biology and medicine, secondly to try to overview the most recent developments in this field, and finally to discuss the hard road to commercialisation. Hybrid bionanomaterials can also build novel electronic, optoelectronics and memory devices.

As mentioned above, that nanoparticles exist in the same size domain as proteins makes nanomaterials suitable for bio tagging or labelling. However, size is just one of many characteristics of nanoparticles that it is rarely sufficient if one is to use nanoparticles as biological tags. To interact with a biological target, a biological or molecular coating or layer acting as a bioinorganic interface should be attached to the nanoparticle. Examples of biological coatings may include antibodies, biopolymers like collagen, or monolayers of small molecules that make the nanoparticles biocompatible. In addition, as optical detection techniques are widespread in biological research, nanoparticles should either fluoresce or change their optical properties.

Nano-particle usually forms the core of nano-biomaterial. It can be used as a convenient surface for molecular assembly, and may be composed of inorganic or polymeric materials. It can also be in the form of nano-vesicle surrounded by a membrane or a layer. The shape is more often spherical but cylindrical, plate-like, and other shapes are possible. The size and size distribution might be important sometimes, for example, if penetration through a pore structure of a cellular membrane is required. The size and size distribution are becoming extremely critical when quantum-sized effects are used to control material properties. A tight control of the average particle size and a narrow distribution of sizes allow creating very efficient fluorescent probes that emit narrow light in a very wide range of wavelengths. This helps with creating biomarkers with many and well distinguished colours. The core itself might have several layers and be multifunctional. For example, combining magnetic and luminescent layers one can both detect and manipulate the particles.

The core particle is often protected by several monolayers of inert material, for example silica. Organic molecules that are adsorbed or chemisorbed on the surface of the particle are also used for this purpose. The same layer might act as a biocompatible material. However, more often an additional layer of linker molecules is required to proceed with further fictionalisation. This linear linker molecule has reactive groups at both ends. One group is aimed at attaching the linker to the nanoparticle surface and the other is used to bind various moieties like bio-compatibles (dextran), antibodies, fluorophores etc., depending on the function required by the application.(28)

Classification of nanoparticles

Nanoparticles can be broadly grouped into two: namely organic and inorganic nanoparticles. Organic nanoparticles may include carbon nanoparticles (fullerenes) while some of the inorganic nanoparticles may include magnetic nanoparticles, noble metal nanoparticles (like gold and silver) and semiconductor nanoparticles (like titanium dioxide and zinc oxide).(32)

There is a growing interest in inorganic nanoparticles as they provide superior material properties with functional versatility. Due to their size features and advantages over available chemical imaging drugs agents and drugs, inorganic nanoparticles have been examined as potential tools for medical imaging as well as for treating diseases. (32)

Recent developments

Tissue engineering

Natural bone surface is quite often contains features that are about 100 nm across. If the surface of an artificial bone implant were left smooth, the body would try to reject it. Because of that smooth surface is likely to cause production of a fibrous tissue covering the surface of the implant. This layer reduces the bone-implant contact, which may cause loosening of the implant and further inflammation. It was demonstrated that by creating nano-sized features on the surface of the hip or knee prosthesis, one could reduce the chances of rejection and to stimulate the production of osteoblasts. The osteoblasts are the cells responsible for the growth of the bone matrix and are found on the advancing surface of the developing bone.

The effect was demonstrated with polymeric, ceramic and, more recently, metal materials. Over 90% of the human bone cells from suspension adhered to the nanostructured metal surface, but only 50% in the control sample. This finding would allow to design a more durable and longer lasting hip or knee replacements and to reduce the chances of the implant getting loose.

Titanium is a well-known bone repairing material widely used in orthopaedics and dentistry. It has a high fracture resistance, ductility and weight to strength ratio. Unfortunately, it suffers from the lack of bioactivity, as it does not support cell adhesion and growth well. Apatite coatings are known to be bioactive and to bond to the bone. Hence, several techniques were used in the past to produce an apatite coating on titanium. Those coatings suffer from thickness non-uniformity, poor adhesion and low mechanical strength. In addition, a stable porous structure is required to support the nutrients transport through the cell growth.

It was shown that using a biomimetic approach – a slow growth of nanostructured apatite film from the simulated body fluid resulted in the formation of a strongly adherent, uniform nanoporous layer. The layer was found to be built of 60 nm crystallites and possess a stable nanoporous structure and bioactivity.

A real bone is a nanocomposite material, composed of hydroxyapatite crystallites in the organic matrix which is mainly composed of collagen. Thanks to that, the bone is mechanically tough

and plastic, so it can recover from mechanical damage. The actual nanoscale mechanism leading to this useful combination of properties is still debated.

An artificial hybrid material was prepared from 15–18 nm ceramic nanoparticles and poly (methyl methacrylate) copolymer. Using tribology approach, a viscoelastic behaviour (healing) of the human teeth was demonstrated. An investigated hybrid material, deposited as a coating on the tooth surface, improved scratch resistance and possessed a healing behaviour similar to that of the tooth.

Cancer therapy

Photodynamic cancer therapy is based on the destruction of the cancer cells by laser generated atomic oxygen, which is cytotoxic. A greater quantity of a special dye that is used to generate the atomic oxygen is taken in by the cancer cells when compared with a healthy tissue. Hence, only the cancer cells are destroyed then exposed to a laser radiation. Unfortunately, the remaining dye molecules migrate to the skin and the eyes and make the patient very sensitive to the daylight exposure. This effect can last for up to six weeks.

To avoid this side effect, the hydrophobic version of the dye molecule was enclosed inside a porous nanoparticle. The dye stayed trapped inside the Ormosil nanoparticle and did not spread to the other parts of the body. Its oxygen generating ability has not been affected and the pore size of about 1 nm freely allowed for the oxygen to diffuse out.

Multicolour optical coding for biological assays

The ever-increasing research in proteomics and genomic generates escalating number of sequence data and requires development of high throughput screening technologies. Realistically, various array technologies that are currently used in parallel analysis are likely to reach saturation when several array elements exceed several millions. A three-dimensional approach, based on optical “bar coding” of polymer particles in solution, is limited only by the number of unique tags one can reliably produce and detect. Single quantum dots of compound semiconductors were successfully used as a replacement of organic dyes in various bio-tagging applications. This idea has been taken one step further by combining differently sized and hence having different fluorescent colours quantum dots, and combining them in polymeric microbeads [29]. A precise control of quantum dot ratios has been achieved. The selection of nanoparticles used in those experiments had 6 different colours as well as 10 intensities. It is enough to encode over 1 million combinations. The uniformity and reproducibility of beads was high, letting for the bead identification accuracies of 99.99%.

Manipulation of cells and biomolecules

Functionalized magnetic nanoparticles have found many applications, including cell separation and probing; these and other applications are discussed in a recent review. Most of the magnetic particles studied so far are spherical, which somewhat limits the possibilities to make these nanoparticles multifunctional. Alternative cylindrically shaped nanoparticles can be created by employing metal electrodeposition into nanoporous alumina template. Depending on the properties of the template, nanocylinder radius can be selected in the range of 5 to 500 nm while their length can be as big as 60 μm. By sequentially depositing various thicknesses of different metals, the structure and the magnetic properties of individual cylinders can be tuned widely.

As surface chemistry for functionalization of metal surfaces is well developed, different ligands can be selectively attached to different segments. For example, porphyrins with thiol or carboxyl linkers were simultaneously attached to the gold or nickel segments, respectively. Thus, it is possible to produce magnetic nanowires with spatially segregated fluorescent parts. In addition, because of the large aspect ratios, the residual magnetisation of these nanowires can be high. Hence, weaker magnetic field can be used to drive them. It has been shown that a self-assembly of magnetic nanowires in suspension can be controlled by weak external magnetic fields. This might allow controlling cell assembly in different shapes and forms. Moreover, an external magnetic field can be combined with a lithographically defined magnetic pattern ("magnetic trapping").

Protein detection

Proteins are the important part of the cell's language, machinery and structure, and understanding their functionalities is extremely important for further progress in human wellbeing. Gold nanoparticles are widely used in immunohistochemistry to identify protein-protein interaction. However, the multiple simultaneous detection capabilities of this technique are fairly limited. Surface-enhanced Raman scattering spectroscopy is a well-established technique for detection and identification of single dye molecules. By combining both methods in a single nanoparticle probe, one can drastically improve the multiplexing capabilities of protein probes. The group of Prof. Mirkin has designed a sophisticated multifunctional probe that is built around a 13 nm gold nanoparticle. The nanoparticles are coated with hydrophilic oligonucleotides containing a Raman dye at one end and terminally capped with a small molecule recognition element (e.g. biotin). Moreover, this molecule is catalytically active and will be coated with silver in the solution of Ag (I) and hydroquinone. After the probe is attached to a small molecule or an antigen it is designed to detect, the substrate is exposed to silver and hydroquinone solution. A silver-plating is happening close to the Raman dye, which allows for

dye signature detection with a standard Raman microscope. Apart from being able to recognise small molecules, this probe can be modified to contain antibodies on the surface to recognise proteins. When tested in the protein array format against both small molecules and proteins, the probe has shown no cross-reactivity.

Commercial exploration

Most of the companies are developing pharmaceutical applications, mainly for drug delivery. Several companies exploit quantum size effects in semiconductor nanocrystals for tagging biomolecules, or use bio-conjugated gold nanoparticles for labelling various cellular parts. Several companies are applying nano-ceramic materials to tissue engineering and orthopaedics.

Most major and established pharmaceutical companies have internal research programs on drug delivery are on formulations or dispersions containing components down to nano sizes. Colloidal silver is widely used in anti-microbial formulations and dressings. The high reactivity of titania nanoparticles, either on their own or then illuminated with UV light, is also used for bactericidal purposes in filters. Enhanced catalytic properties of surfaces of nano-ceramics or those of noble metals like platinum are used to destruct dangerous toxins and other hazardous organic materials.

Future directions

As it stands now, most commercial nanoparticle applications in medicine are geared towards drug delivery. In biosciences, nanoparticles are replacing organic dyes in the applications that require high photo-stability and high multiplexing capabilities. There are some developments in directing and remotely controlling the functions of nano-probes, for example driving magnetic nanoparticles to the tumour and then making them either to release the drug load or just heating them to destroy the surrounding tissue. The major trend in further development of nanomaterials is to make them multifunctional and controllable by external signals or by local environment, thus turning them into nano-devices. (28)

KNOWN METHODS OF FIGHTING VIRAL DISEASES MEDICALLY AND THEIR LIMITATIONS

Antibiotics, Anti-viral medications, Immunization and vaccines, Monoclonal, Serology

- **Antibiotics:** Antibiotics are known to be effective on bacteria, but they are not effective on viruses.
- **Anti-viral medications:** Anti-viral medications mostly focus on symptom relief of viral infections and do not fight against it. For example, cold medicine helps to ease the pain and congestion associated with the cold, but it does not act directly on the cold virus. Anti-viral medications do not kill viruses they trap it, within 48 hours of early detection and sometimes due to the fact that some viruses change form or mutate, especially RNA viruses, it becomes less effective on the virus. Anti-viral drugs can equally damage the host cell where the virus lives. Another challenge with anti-viral drugs or medication is that a particular drug used to fight a particular virus may not be effective in fighting a new virus. A very promising anti-viral drug strategy is using non-functional analogues or inauthentic copies of the basic building blocks of (RNA) genome. The presence of these analogues in the viral genome blocks the viral polymerase. Meaning the virus cannot make another copy of its (RNA), Acyclovir, Ribavirin and Azidothymidine (AZT) are examples of these anti-viral drugs. Unfortunately, the coronavirus is tricky because it proofreads the authenticity of its (RNA) genome. It identifies the analogues as being inauthentic and removes them. This stops certain anti-viral drugs like ribavirin from being effective. Fortunately, the corona virus proofreading powers do not block a similar anti-viral medication called remdesivir. So remdesivir potently halts corona virus replication and represents a promising drug option for COVID-19 patients.

- **Vaccines/Immunization:** This works by pre-injecting the body so it knows how to produce the right antibodies as soon as the virus reproduces. Also, viruses reproduce fast and may change form and mutate so vaccines used earlier on may not be effective again and may require an upgraded form to be effective. Also, vaccines are immune system boosters, that activate the white blood immune system to produce antibodies to fight off a viral infection, but sometimes even with vaccines a person's immune system may not be responsive enough quickly to produce the needed antibodies required to fight off a viral infection. Such factors that make it impossible for a person's immune system to respond quickly include age, heredity characteristics, etc. Vaccines have caused side effects which are very harmful to the individual after administration. Some examples include brain damage (encephalitis) from smallpox vaccine, sometimes vaccination does not kill the virus, as the virus may resist and even become more virulent, a good example is with chicken pox transforming into shingles.

- **Monoclonals:** Antibodies are naturally produced by the immune system. However, scientists can produce antibodies in the lab that mimic the action of the immune system. These man-made (synthetic) antibodies act against proteins that attack normal tissues in people with auto-immune disorders. Man-made antibodies are produced by introducing human genes that produce antibodies into mice or another suitable mammal. The mice then are vaccinated with the antigen that scientists want to produce antibodies against. This causes the immune cells of the mice to produce the desired human antibody. The term monoclonal antibody means that the man-made antibody is synthesized from cloned immune cells, and the identical monoclonal antibody produced binds to one type of antigen. Polyclonal antibodies are synthesized from different immune cells, and the antibodies produced bind to multiple antigens. Minor changes in antigen epitope structure affect the function of monoclonal.
- **Serology:** Blood serum is the clear liquid that remains after blood clots. Serum in a body is a component of plasma, as blood plasma is composed of a combination of both serum and coagulants. However, when separated from those coagulants through the use of a centrifuge, serum can conduct several medical tests, and it can also be used to develop antiserum – used to help transfer resistance to disease from one body to another. A major disadvantage of serum is that they are scattered shot and they are not specific.(1-3)

POTENTIAL MEDICAL BENEFITS OF A NEW BIOMIMETIC NANOPARTICLE COATED CELL MEMBRANE

- Introduction of new semi permeable membrane to only proof read and proof screen protein molecules, allowing only those that are healthy and discarding toxic protein molecules. Since it's the pathway for both DNA and RNA viruses to hide and incorporate their viral genome into it. Proteins are the major underlying factor for structural variations in all organism, the human antibodies are all composed of protein molecule. The semi permeable membrane made of nanoparticle should have multiple bio-sensors to detect misfolded protein, DNA or RNA infected substances, since DNA and RNA activities are usually restricted within the cell membrane, so any external DNA or RNA molecule outside of the cell membrane is tagged as a foreign pathogen and may not get access into the cell membrane.on, making it impenetrable to breakdown by action of viruses or their molecular insertion into cells. This helps to curtail their disguise mechanism and render them latent.
- The semi - permeable membrane proof reading actions are not limited to viruses alone, as it aids to block other harmful microbes (bacteria, fungi etc.) that will want to gain entry into the cell.

- It also serves as pre-regulator to cells, thus assisting in the healthy functions of localized cells. Inclusively, assist against autoimmune diseases, by regulating the amount of flow of cytokine hormones into body tissues and organs.
- Creating a new cell membrane will prove to be more cost effective and friendly in the Long run, when compared to the cost of creating vaccines every time there is a viral outbreak or microbic pathogenic pandemic.
- The new nanoparticle semi-permeable cell membrane will hinder the fusion and binding activities viruses and other toxic pathogenic microbes. (29,30,31)

Limitations of the study.

The under-listed are the limitations affecting this research study

- This is a hypothesized study (theoretical analysis), and real practical laboratory experimentation has not been carried out as the time of publishing this article.
- Inadequate access to laboratory facilities and equipment also hindered the outcome of the practical implementation of this research study by the researchers.
- Having no empirical data to test run the effectiveness of the study, due to the fact that this is an innovative hypothesized blueprint manual for the use of a new cell membrane and no known trial have been recorded both in animals and humans to prove the effectiveness of this technique medically.
- The researchers had setbacks with funds required to enable them to carry out the research work. (The researchers did not receive any form of funding in terms of grants or study scholarship) (29,30,31)

SUMMARY

All microbes ranging from bacteria, fungi viruses etc. Immediately they enter the human body, they face the challenge of crossing or entering through the human cell membrane, with the sole aim of avoiding to alert or trigger the body immune system from recognizing their entry into the human body cells. Where they can have the comfortable environment to multiply into colonies by hijacking the cells. Viruses most especially have successfully mastered how to beat the human body immune system. They either infuse their viral genomic material into the cell membrane, or they fuse their lipid or protein membrane to bind to cell membrane receptors. Hiv virus for example goes as far as even fighting to Wear down and prevent the CD4 cells that are responsible for secreting body immune defensive protein against invading pathogens. After successfully disengaging the CD4 cells, then they have the leeway to enter and cause harm to the cells of the body.

The SARS-CoV-2 (coronavirus) uses its spike protein to fuse with the ace2 cell receptor membrane lining, present along the lungs, the kidney, the liver, the alveoli linings, and parts of the brain cells. Every living organism have four common characteristic relationship, they are composed of DNA or RNA or both cells, proteins and Cell membrane. Proteins have been identified to make structural variations among organisms of the same species and different species. Even the antibodies in humans are composed of proteins. Viruses use this protein as weapons to trick and wear down the cell membrane and cells of the body. It is now very imminent for a new Cell membrane composed of a different material impenetrable to viral attack. It also a known fact that every living organism is composed of either DNA or RNA and sometimes contains both. The normal cell membrane of the human body system allows food substrate and other nutrients to pass through it. Although it also performs selective absorption, of materials it allows to gain entry into the cell, but this selective absorption operation according to us is quite limited, as it cannot proof screen protein molecules if they are embedded with viral genome or stop the binding of proteinous membrane covering viruses from binding to cell receptors on its surface. Because of this limitation in function, that is why this research paper study is advocating for introducing a new bio-mimetic nano coated cell membrane capable of performing both the functions of the Cell membrane, and even overcoming the limitations highlighted for the former. Having the ability to detect viral infected protein, and not allowing this infected protein from gaining entry into the cell, also not providing binding receptors for viruses to attach or fuse their lipid or proteineous membrane. The new membrane should be made of nanoparticles armed with multiple sensors to detect DNA or RNA infected protein and

misfolded structural protein (prions). It's of the belief of the Researchers that if a new nano cell membrane is created capable of performing the aforementioned qualities. Then humanity would have been able to defeat not only the SARS-CoV-2 (coronavirus) but also other pathogenic microbes that cause different diseases. (29,30,31)

CONCLUSION

The human existence has been faced with serious challenges, as a result of the coronavirus pandemic, most importantly social and economical challenges. This research paper therefore outlines the theoretical blue print model of hindering the activities of viruses from penetrating into the human cells, either through binding or fusion mechanism. It advocates for the construction of a new bio-mimetic nano cell membrane, which is impenetrable to viral genome or toxic prion misfolded proteins. As our normal cell membrane is limited in function. The new bio-mimetic nano cell membrane is constructed in such a way that it overcomes the limitations of the normal cell membrane. This new bio-mimetic nano cell membrane is very robust in function, As it application is to permanently hinder the activities of viruses and other pathogenic microbes from entering and causing harm to the human body cells. As earlier highlighted biocompatibility of the material to be used in creating this new bio-mimetic nano cell membrane should be greatly factored and considered. The material should be made from better enhanced inorganic nanomaterial, with powerful anti-microbial properties. Eg silver or any other better inorganic nanomaterial or combination. The functions of this new bio-mimetic nano cell membrane, have been precisely elaborated in the conceptual frame work section of this article. The author's thereby encourage scientist, medical practioners, governmental organisations, to see how they can collaborate and collectively help to combat the SARS-COV2 coronavirus through the introduction of this new bio-mimetic nano cell membrane. The author's are very hopeful that having a new cell membrane will assist greatly against covid-19 pandemic.(29,30,31)

RECOMMENDATIONS

- Proper cognizance of toxicity factors should be taken keenly and carefully into consideration, when selecting the nanoparticles to be used in creating the new bio-mimetic nano cell membrane and its interactions with the human body system.
- Before trial of this bio-mimetic nano cell membrane on human subject. Extensive experiment should be carried out on lower specie organisms, rats, monkey, etc. To test for toxicity related factors that may arise, because of the nano material used in creating this cell membrane.
- The New bio-mimetic nano cell membrane should allow enzymes and other molecules to flow in and out of the cell membrane. It only inhibits protein infected with genomes of viruses and other pathogenic microbes, or misfolded insoluble prion Proteins.
- Bio-compatibilty of the nanoparticles with human body system, should be greatly considered.(29,30,31)

- **Research for Further study**
  - The new bio-mimetic nano cell membrane should have two equal divisions that allow polar and non-polar solvents separately.
  - The bio-mimetic nano cell membrane should be able to signal cells, once it detects that a cell is not emitting the right signal, it auto starts cell death by chemical, electrical or electromagnetic signaling emission. By so doing inhibits proliferation and contamination with other cells. There by preventing diseases such as cancer, viral proliferation infection and prion cell proliferation.
  - The bio-mimetic nano cell membrane can send either electrical or magnetic or chemical signals to detect unstable proteins and mark them for destruction by the proteases.
  - Nano materials to be used should be inorganic materials, as organic nanomaterials have deleterious and toxic effect to the human body. These inorganic nanomaterial should have anti-microbial properties. Eg silver or any other better nano inorganic materials, (29,30,31)

REFERENCES

Ugochukwu, A., Sonaya, O., & Sobodun, A. (2020). A Possible Cure Therapy for Covid-19 Virus and Other Types of Viral Diseases. Using Autologous Stem Cell Trapping Mechanism. Journal Of Bioanalysis & Biomedicine, 12(4). doi: 10.37421/jbabms.2020.12.228

Sobodun, A . (2020). A Possible Cure Therapy for Covid-19 Virus and Other Types of Viral Diseases. Using Autologous Stem Cell Trapping Mechanism. Journal Of Bioanalysis & Biomedicine, 12(4). doi: 10.37421/jbabms.2020.12.228

Sonaya, O. (2020). A Possible Cure Therapy for Covid-19 Virus and Other Types of Viral Diseases. Using Autologous Stem Cell Trapping Mechanism. Journal Of Bioanalysis & Biomedicine, 12(4). doi: 10.37421/jbabms.2020.12.228

Reynaud, E. (2010). "Protein misfolding and Degenerative Diseases". Nature Education3 (9):28. Retrieved May 02 2021 fromhttps://www.nature.com/scitable/topicpage/protein-misfolding-and-degenerative-diseases-14434929/

A- Level Biology (2015) Cell Membranes | Function, Structure, Model, Facts & Notes. Retrieved 1 May 2021, from https://alevelbiology.co.uk/notes/cell-membranes/

Yasemin Saplakoglu (2020) Coronavirus 'spike' protein just mapped, leading way to vaccine. .Retrieved May 02 2021, from https://www.livescience.com/coronavirus-spike-protein-structure.html

University of California - Davis. (2020). Genomic analysis reveals many animal species may be vulnerable to SARS-CoV-2 infection. *ScienceDaily*. Retrieved April 30, 2021 from www.sciencedaily.com/releases/2020/08/200821161423.htm

Piter, Kehoma (2012) "Why does DNA use thymine instead of uracil as RNA Does"? Retrieved 02 May 2021, from https://earthlingnature.wordpress.com/2012/09/29/why-thymine-instead-of-uracil/

Jonsson, J., Sandberg, M., & Wold, S. (1996). The evolutionary transition from uracil to thymine balances the genetic code. Journal Of Chemometrics, 10(2), 163-170. doi: 10.1002/(sici)1099-128x(199603)10:2<163::aid-cem415>3.0.co;2-s

Brennan, John. (2017). RNA Mutation Vs. DNA Mutation. sciencing.com. Retrieved May 02 2021, from https://sciencing.com/rna-mutation-vs-dna-mutation-3260.html

Wayne W.(2016) Functions of Protein Basic Cell Biology Bosten University Wayne W. Lamorte MD, PHD & MPH. March 22, 2016.

Biologydictionary.net Editors. (2017). Cell Membrane. Retrieved May 02 2021, from https://biologydictionary.net/cell-membrane/

ATDbio LTD. (2020). Transcription, Translation and Replication. Retrieved 1 May 2021, from https://www.atdbio.com/content/14/Transcription-Translation-and-Replication

Mandal, Ananya. (2019). What are Nanoparticles?. News-Medical. Retrieved on May 01, 2021 from https://www.news-medical.net/life-sciences/What-are-Nanoparticles.aspx.

Leslie, M. (2018). Biologists create the most lifelike artificial cells yet. Retrieved 1 May2021, from https://www.sciencemag.org/news/2018/11/biologists-create-most-lifelike-artificial-cells-yet

SEER Training Modules(2020) "Cell Structure." U. S. National Institutes of Health, National Cancer Institute. September 18, 2020 <*https://training.seer.cancer.gov/*>.

Imperial College London. (2019). Artificial cells that can sense and respond to their environment. *ScienceDaily*. Retrieved May 1, 2021 from www.sciencedaily.com/releases/2019/07/190729181640.htm

Gordon, Z. (2018). What are prions -- the confusing protein. Retrieved 1 May 2021, from https://www.zmescience.com/medicine/prions-the-charismatic-proteins/

Admin Prion alliance (2013). ":What are prions?. Retrieved 1 May 2021, from http://www.prionalliance.org/2013/11/26/what-are-prions/

Geiler, K. (2010). Protein Folding: The Good, the Bad, and the Ugly - Science in the News. Retrieved 1 May 2021, from https://sitn.hms.harvard.edu/flash/2010/issue65/

Corum, J., & Zimmer, C. (2020). How Coronavirus Hijacks Your Cells. Retrieved 1 May 2021, from https://www.nytimes.com/interactive/2020/03/11/science/how-coronavirus-hijacks-your-cells.html.

Hilton, S. (2020). Copper Nanoparticles take on COVID-19. Retrieved 1 May 2021, from https://blog.agchemigroup.eu/copper-nanoparticles-take-on-covid-19/

Crotti, N. (2021). Using gold nanoparticles to detect COVID-19 | Medical Design and Outsourcing. Retrieved 1 May 2021, from https://www.medicaldesignandoutsourcing.com/using-gold-nanoparticles-to-detect-covid-19/

Wissens platform nanomaterialien. (2020). Do Silver Nanoparticles help against covid 19"

Bose, Priyom. (2020). Application of Nanotechnology in the Treatment of Viral Infections. News-Medical. Retrieved on May 01, 2021 from https://www.news-medical.net/health/Application-of-Nanotechnology-in-the-Treatment-of-Viral-Infections.aspx.

NIH/National Center for Advancing Translational Sciences (NCATS). (2020). Nanoparticle SARS-CoV-2 model may speed drug discovery for COVID-19. *ScienceDaily*. Retrieved May 1, 2021 from www.sciencedaily.com/releases/2020/09/200921170448.htm

Berger, M. (2018). Cell membrane coating as a platform nanotechnology for medicine. Retrieved 1 May 2021, from https://www.nanowerk.com/spotlight/spotid=50496.php

Salata, O (2004). Applications of nanoparticles in biology and medicine. J Nanobiotechnol 2, 3. https://doi.org/10.1186/1477-3155-2-3

Ugochukwu A.I (2020) Unpublished Research Manuscript " The potential hindrance of SARS-COV2 Coronavirus Spike Proteins, Prions misfolded protein and other infected proteineous molecule incorporating toxic genomes of pathogenicmicrobes from gaining access into the human body cells. Through the introduction of a new artificial semi-permeable nanoparticule cell membrane".(2020)

Sobodun A.B. (2020) Unpublished Research Manuscript " The potential hindrance of SARS-COV2 Coronavirus Spike Proteins, Prions misfolded protein and other infected proteineous molecule incorporating toxic genomes of pathogenicmicrobes from gaining access into the human body cells. Through the introduction of a new artificial semi-permeable nanoparticule cell membrane".(2020)

Sonaya O.E. (2020) Unpublished Research Manuscript " The potential hindrance of SARS-COV2 Coronavirus Spike Proteins, Prions misfolded protein and other infected proteineous molecule incorporating toxic genomes of pathogenicmicrobes from gaining access into the human body cells. Through the introduction of a new artificial semi-permeable nanoparticule cell membrane".(2020)

Prathna T.C., Lazar Mathew, N. Chandrasekaran, Ashok M. Raichur and Amitava Mukherjee (2010). Biomimetic Synthesis of Nanoparticles: Science, Technology & Applicability, Biomimetics Learning from Nature, Amitava Mukherjee, IntechOpen, DOI: 10.5772/8776. Available from: https://www.intechopen.com/books/biomimetics-learning-from-nature/biomimetic-synthesis-of-nanoparticles-science-technology-amp-applicability

Hwang J, Jeong Y, Park J.M, Lee K.H, Hong J.W, Choi J.(2015) Biomimetics: forecasting the future of science, engineering, and medicine. Int J Nanomedicine. 2015;10(1):5701-5713 https://doi.org/10.2147/IJN.S83642

Roco, Mihail C, kosoruff, Alex, Hooper, Rowan et al.(2003) "Nanobiomimetics" RetrievedMay022021https://web.stanford.edu/group/mota/education/Physics%2087N%20Final%20Projects/Group%20Gamma/#:~:text=Nano%2DBiomimetics,new%20materials%2C%20devices%20and%20systems.

Roco, Mihail C.(2003) "Nanotechnology: convergence of modern biology with medicine." Current Opinion in Biotechnology 2003: 337-346.

Kosorukoff, Alex.(2004) "Bionics." Wikipedia. 31 Aug. 2004. 30 Nov. 2005 Retrieved May 02 2021, from http://en.wikipedia.org.

Center for Biomimetics(2004). 15 Nov. 2004. Universitiy of Reading. 2 Dec. 2005 Retrieved May 02 2021, from http://rdg.ac.uk.

Hooper, Rowan.(2004) "Ideas Stolen from Right Nature." Wired News 9 Nov. 2004. 2 Dec. 2005 Retrieved May 02 2021, from http://www.wired.com.

Quinion, Michael.(1997) "Turns of Phrase: Biomimetics." World Wide Words. 22 Nov. 1997. Retrieved May 02 2021, from http://www.worldwidewords.org.

Sarikaya, Mehmet(2003). "Moleucular biomimetics: nanotechnology through biology."Nature Materials Sept. 2003.

Shirinsky Vladimir P. Glossary of nanotechnology and related term. Retrieved May 02 2021, from https://eng.thesaurus.rusnano.com/wiki/article579

Ma P. X. (2008) Biomimetic Materials for Tissue Engineering // Adv. Drug Deliv. Rev. 2008. V. 60. P. 184–198. Retrieved May 02 2021, from https://eng.thesaurus.rusnano.com/wiki/article579

Kumar, C.S. (2009). Nanostructured Oxides (Nanomaterials for Life Sciences (VCH)) - PDF Free Download. Retrieved 1 May 2021, from https://epdf.pub/nanostructured-oxides-nanomaterials-for-life-sciences-vch.html

Michael Graw (2018) "Why DNA Is the Most Favorable Molecule for Genetic Material & How RNA Compares to It in This Respect" Updated March 13, 2018 Retrieved May 02 2021, from https://sciencing.com/dna-favorable- molecule-genetic-material-rna-compares-respect-17806.html

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

Authors' Contributions List

The underlisted names contributed equally to this work

Engr. Matthew Amen Ikeh, High Chief. Raphael Obiduba, Dr. Ben Olusola, Dr. Sunny Oshodi, Dr. Toba Babarinsa, Ikeh Majesters Nnamdi, Eno Thompson Nse, Oluwadamilare Lukman Tijani, Alaki Clifford, Opeyemi Olanite Ismail, Dr. Oluigbo Caleb, Nnaemeka E. Miracle, Udoka Nwabunike, Udo Benedicta, Izuchukwu Modestus Ifeanyi, Chukwunonso Mordi, Adeleke Joshua Owolabi , Esther Tosin, Michael Nkordeh, Odu Paul, Ogundipe Benjamin, Gift Wuche, Ifeoma Chijioke Chiwendu, Bright Nwogu, Dr. Joe Ersinghaus, Kazeem Adebola Ibrahim, Folu John, Mrs.John Abosede, High Chief Ralphael Obiduba. Joan. C. Ananaba, Biodun Muibi, Uzoma Okolocha, Michael Onyeaghala, Francisco Olatunde Yemaren, Dasho Abraham Yunana, Philip Bassey, Cyril Angioha, Sodiq Adewale, Okeke Tochukwu Emmanuel, Ekuma Chukwunonyerem, Mrs. Maria Ogunkelu

Funding

The authors did not receive any form of funding in terms of grants, or sponsorship.

ACKNOWLEDGEMENT

Firstly, we want to acknowledge and appreciate God Almighty who divinely inspired us with this idea, and also giving us the strength to accomplish this research work, positively contributing our own quota to the advancement, upliftment and betterment of humanity all to the honor and glory of God. Secondly, our sincere appreciation and acknowledgement goes to the underlisted names, as they all collectively supported and worked to see to the manifestation of this research opinion paper.

Engr.Matthew Amen Ikeh, High Chief. Raphael Obiduba, Dr. Ben Olusola, Dr. Sunny Oshodi, Gift Wuche, Esther Tosin, Chiwendu Ifeoma Chijioke, Oluwadamilare Lukman Tijani, Ikeh Majesters Nnamdi, Alaki Clifford Msuega, Mordi chukwunonso, Udoka Nwabunike, Udo Benedicta, Ogundipe Benjamin, Michael Nkordeh, Kazeem Adebola Ibrahim, Adeleke Joshua Owolabi, Odu Paul, Olanite Opeyemi Ismail, Izuchukwu Modestus Ifeanyi, Bright Nwogu, Awoneye Temitope, Eno Thompson Nse, Dr.Toba Babarinsa, Dr. Oluigbo Caleb, Nnaemeka

Miracle, Dr. Joe Ersinghaus, Joan .C. Ananaba, Folu john, Mrs. John Abosede, Prof. Greg Simire, Mrs. Margaret ovonlen, Chief.Vitals Ibe, Mr. Nnaji Chimezie, Biodun Muibi, Uzoma Okolocha, Biodun Adelua, Nnaemeka Onyeaghala, Dr. Udoh Christopher Timothy, Francisco Olatunde Yemaren, Dasho Abraham Yunana, Philip Bassey, Cyril Angioha, Sodiq Adewale, Okeke Tochukwu Emmanuel, Ekuma Chukwunonyerem, Mrs. Maria Ogunkelu.