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A Review on: Nano Biotechnology the Novel Drugs Delivery System

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ABSTRACT:

Nanobiotechnology is a recently coined term describing the junction of the two existing but isolated worlds of engineering and molecular biology. It is a combination of three words: "nano" tiny, "bio" is living things, and "technology"is about tools. It refers to the ability to create and manipulatebiological and biochemical materials, devices, and systems at atomic and molecular levels. Thus, it is an integration of physical sciences, molecularengineering, biology, chemistry, and biotechnology, and holds considerable promise of advances in pharmaceuticals and health care. Consequently it applies the tools and processes of nanofabrication to build devices for studying biosystems. In this review we discussed the role of nanobiotechnology in molecular diagnosis, drugdiscovery, and development of nanomedicine and personalized medicine.

Key words: Nanobiotechnology, Nanoparticles, Nanomedicine, Nanotechnology, Drug discovery.

HISTORY OF NANOBIOTICS:

The platform for nanotechnology is believed by many workers in the field of nanotechnology to have been laid by Richard Feynman, a physicist at California Institute of Technology, in an after-dinner speech in 1959 titled, "There is plenty of room at the bottom", at the American Physical Society's Winter Meeting of the West2,4, 6-30. Feynman is known to have explored the possibility of manipulating materials at the scale of individual atoms and molecules, imagining the whole of the Encyclopaedia Britannica written on the head of a pin and foreseeing the increasing ability to examine and control matter at the nanoscale26. Feynman is stated to have noted that the capabilities of atom byatom assembly and nanoengineering could lead to new materials and pathways similar to the biological system. He presented a technological vision of miniaturization of materials, manipulating and controllingthings on a small scale called "Nanotechnology". He visualized a technology using a toolbox of nature to build nano-object, atom by atom, and molecule by molecule30. The words 'nanoscale, nanoengineering, nanotechnology and nano-object in the references above have become the modern concept of Feynman's speech. In his speech, Feynman used words such as small scale, small things and miniaturization31. Junk and Riess32, discussing the historical background of Feynman's speech, the state of the art in 1959 and Feynman motivation, considered the attribution of nanotechnology to Feynman as misleading and asserted that Feynman only wished to construct microbiological machines and tools which would assist scientists in mimickingmicrobiological materials.

Feynman in his speech offered two prizes, one for miniaturizing the printed page of a book and another for fabrication of a micromotor of predefined size. About two and half months after the speech, McLellan, in his spare time, built the motor and presented it to Feynman32. Junk and Riess, based on the above, perceived that Feynman was not aware of the actual state of contemporary technology as neither new tools nor new techniques were required for one of his prizes32 His motivation they stated, wasbased on discussion with one of his friends, Phillip Morrison. The authors concluded by saying "Feynman neither entered an entirely new field, nor did he use his own mentalimages, nor was he adequately informed about the contemporary state of the art in engineering technologies. Instead he presented some fascinating ideas in order to promote the advancement of certain areas of science and development."

It can therefore be concluded that Feynman's interest was in the writing, storage and retrieving (reading) ofinformation by miniaturization and his descriptions such as 4/10,000,
1/16 of an inch and 1/64 of an inch cube are of the microscale and not nanoscale.Cortie15 stated that miniaturization was a point that Feynman emphasized in his speech, which implied that it was not his idea. He stated that since 1800, after the pioneering studies of John Dalton, there had been intense study of the behaviour of individual atoms and molecules and theirmacroscopic aggregation. Despite the hype around nanotechnology in recent years, it is not a new technology. The colour effect of butterfly wings was copied by the Romans about 1600 years ago.

The glass cup known as Lycurgus cup in the British Museum, due to nanoparticles of gold and silver, looks jade green in natural light and an impressive red colour when a bright light shines through it 23. In the manufacture of car tyres, carbon nanoparticles are included while the red and yellow colours seen at sunsets are due to nanoparticles in the atmosphere32. Indian craftsmen and artisans used nanotechnology to make weapons and long lasting cave paintings about 2000 years ago while studies found existence of carbon nanoparticles on the famous sword of Tipu Sultan (ancient ruler of the Kingdom of Mysore, India) and Ajanta paintings.

The first observation and size measurements of nanoparticles were carried out using anultramicroscope by Richard Zsigmondy in 190234,35. The term nanotechnology was first used in 1974 by Norio Taniguchi, a researcher at the University of Tokyo who used it to refer to the ability to engineer materials at nanoscale4,26. In the 1980s, two inventions which enabled the imaging of individual atoms or molecules as well as their manipulation led to significant progress in the field of nanotechnology4,15,27. Gerd Binnig invented scanning tunnelling microscopy (STM) while Henrich Rohrer invented atomic force microscopy. In 1985, Fullerene C60 was discovered by Kroto's and Smalley's research teams.

Afterwards, in 1986, Eric Drexler began to promote and popularize nanotechnology through speeches and books – "Engines of creation: the coming era of nanotechnology"4. In 1991, Saumio Iijima discovered carbon nanotubes and by 2000, the United States government launched the National Nanotechnology Initiative (NNI – a Federal visionary research and development programme for nanotechnology-based investments through the coordination of 16 various US departments and independent agencies) and these paved way for the progress in research and development in the field of nanotechnology.

INTRODUCTION:

Nanotechnology is a novel scientific approach that involves materials and equipments capable of manipulating physical as well as chemical properties of a substance at molecular levels. On the other hand, biotechnology uses the knowledge and techniques of biology to manipulate molecular, genetic and cellular processes to develop products and services and is used in diverse fields from medicine to agriculture. Nanobiotechnology is considered to be the unique fusion of biotechnology and nanotechnology by which classical micro-technology can be merged to a molecular biological approach in real.Throughthis methodology, atomic or molecular grademachines can be made by mimicking or incorporatingbiological systems, or by building tiny tools to study ormodulate diverse properties of a biological system onmolecular basis.

Nanobiotechnology may, therefore, easemany avenues of life sciences by integrating cutting-edgeapplications of information technology & nanotechnologyinto contemporary biological issues. This technologyhas potential to remove obvious boundaries betweenbiology, physics and chemistry to some extent, and shapeup our current ideas and understanding. For this reason,many new challenges and directions may also arise ineducation, research & diagnostics in parallel by the extensiveuse of nanobiotechnology with the passage of time.

The purpose of this essay is to demonstrate the potential impact of nanobiotics, a new form of genetically engineered tailor-made drug which is destined to surpass antibiotics as the wonder drug of the future, on the people of Hong Kong in the near future. Antibiotics have already played an important part in improving the health of people in Hong Kong and will continue to do so but there are also possible problems emerging from the overuse of antibiotics which may have a serious impact on Hong Kong people. Nanobiotics may be the answer to those problems. This essay will begin with a brief review of the science behind nanobiotics and then show how they have the potential to improve the future lives of Hong Kong people. Recently, several reviews on human and/or environmental effects of silver nanoparticles and other silver compounds have been published.This introduction aims at highlighting the most important information to be found in these reviews. In the subsequent sections of the scientific rationale more recent insights and a more detailed overview is given on the most relevant topics mentioned. Silver and silver products have been known for thousands of years for their prestige and effect in hygiene.With the expansion of the photographic industry, the use of silver increased significantly in the 20th century, but with the development of electronic photography the use of silver decreased considerably. However, photographic use of silver still represents 8% of the worldwide silver use, whereas biocidal silver represents only a very small fraction of worldwise silver use (less than 1%). Nowadays silver is increasingly used in a wide range of applications. For example, insanitation of drinking water, cooling towers, recreational waters, textiles, plastics,sunscreens and other cosmetics, food and dietary supplements, antimicrobial surfacesand medical applications. Moreover, because of their unique properties, silver nanoparticles are also used in electronics, optics, biosensing and catalysis.

Cancer remains one of the most complex diseases affecting humans and, despite the impressive advances that have been made in molecular and cell biology, how cancer cells progress through carcinogenesis and acquire their metastatic ability is still widely debated.

The idea that cancer might be attributed to inherent changes within the organism's own genome did not arise until after the discovery that retroviruses could transform host cells and often they contain variants of cellular genes which are necessary for oncogenic transformation. Consequently, for perhaps nearly twenty years, the field of oncology was synonymous with virology and a major focus was on identifying these proto-oncogenes or genes that could be turned into cancer-causing genes.Today, cancer is recognized as a highly heterogeneous disease and over 100 distinct types have been described with various tumor subtypes found within specific organs. It is now also recognized that genetic and phenol typical variability primarily determines the self-progressive growth, invasiveness, and metastatic potential of neoplastic disease and its response or resistance to therapy. It seems that this multi-level complexity of cancer explains the clinical diversity of histologically similar neoplasias.

Recent advances in other disciplines have uncovered that in addition to virus infection, disregulation of many normal cellular processes such as gene regulation, cell cycle control, DNA repair and replication, checkpoint signaling, differentiation, and apoptosis, etc. can lead to cancer. The mechanisms of transformation can be complex with multiple pathways affected. For example, genetic changes in the p53 gene resulting in loss of heterozygosity are known to affect the pattern of gene activation and repression, dampen cell cycle checkpoints, and incapacitate the induction of apoptosis. In addition to multiple pathways being compromised in tumor cells, tumors can arise in a cell- or tissue-specific manner. For instance, mutations in the breast cancer susceptibility gene, are associated with approximately half of the inherited forms of breast and ovarian cancer, but they do not predispose carriers to most other forms of cancer even though the gene is ubiquitously expressed and is involved in the fundamental processes of transcriptional regulation and DNA repair. While some times there are common mutations frequently associated with many cancers, the majority of cancers arise from a diverse array of malfunctions that result in a tumor that is unique to that patient.

The complexity of cancer combined with an avalanche of basic science research uncovering the plethora of pathways that feed into cellular growth control reveals many potential therapeutic targets. As such, there is a critical need for cancer biologists with a broad knowledge of the mechanisms of tumorigenesis to team up with clinical oncologists to address just how this information can be utilized to advance clinical therapies.

The mainstay of cancer treatment has been the same for nearly 40 years and consists of surgical resection, radiation, and/or chemotherapy. This approach involves physically removing as much of the tumor bulk as possible then subjecting the entire body to agents that kill cells by non-selectively damaging the DNA of both cycling tumor and healthy cells. These therapies have limited effectiveness, high cytotoxicity, and untoward side effects. Additionally, the nature of the disease is such that unless all tumor cells are destroyed the cancer will eventually return, often in a form more aggressive and more refractory to treatment. There is a distinct paucity of effective therapies for cancers such as pancreatic and ovarian, which have relatively lower survival rates compared with other types of cancers and where most patients present with advanced stages of the disease at the time of diagnosis. Thus, there is a critical need for not only specific, effective therapies without side effects, but also mechanisms for early detection to ensure that therapies have the best opportunity to be timely and effective.

REVIEW OF LITERATURE:

1. **JITENDRA KAWADKAR et.al.(2011):**Nanobiotechnology is a recently coined term describing the junction of the two existing but isolated worlds of engineering and molecular biology. Itis a combination of three words: “nano” tiny, “bio” is living things, and “technology” is about tools. It refers to the ability to create and manipulate biological and biochemical materials, devices, and systems at atomic and molecular levels. Thus, it is an integration of physical sciences, molecular engineering, biology, chemistry, and biotechnology, and holds considerable promise of advances in pharmaceuticals and health care. Nanomaterials are at the leading edge of the rapidly developing field of nanotechnology. Their unique size-dependent properties make these materials superior, crucial in many areas of human activity, and above all a tiny tool to learn about living things. Consequently it applies the tools and processes of nanofabrication to build devices for studying biosystems. In this review we discussed the role of nanobiotechnology in molecular diagnosis, drug discovery, and development of nanomedicine and personalized medicine.

2. **TOMAS GLASPY et.al.(2010):** Nanotechnology is an emerging science that takes advantage of the novel properties ofmatter at the nanometer scale, and it carries with it promises of advances across a broad spectrum of applications, including electronics, pharmaceuticals, and industrial products. However, products utilizing nanotechnology may also present unique problems to human and environmental health, precisely because they do not behave in the body or environment in the manner expected from conventional materials. As the field of nanotechnology expands and becomes widely integrated across many applications, human exposure to nanomaterials will become more likely. The human health effects of such exposure remains largely unknown, though studies have linked nanoparticle exposure with a variety of impacts, ranging from inflammation to carcinogenicity. With the safety of nanomaterials still in question, this paper examines methods for preventing unwanted exposure through regulation, the likely biological responses that will follow exposure, and the safety considerations that must inform the initial stages of engineering new nanomaterials.

3.M. S. DEODHAR et.al.(2014):

Pharmaceutical nanotechnology is evolved as a powerful tool for pharmaceutical chemist and formulation scientists. It has given a new direction to pharmaceutical and drug discovery research. Nanofluid technology which deals with nanofluids has provided an ultimate engineering solution for heat transfer application and automotive application in different industries. Nanofluids are engineered colloidal suspensions of nanoparticles in a base fluid. The nanoparticles used in nanofluids are typically made up of metals, oxides, carbides or carbon nanotubes. Common base fluids include water, ethylene glycol and oil. Preparation of nanofluids may be done by one step, two step method, chemical approach or laser ablation. The stability of nanofluids can be enhanced by different means such as addition surfactants, surface modification technique, pH control and ultrasonic agitation. Nanofluids are well known for their applications in engineering field, many researchers have also reported their use for different biological, medical and biomedical applications.

4. OV SALATAet.al.(2004): Nanomaterials are at the leading edge of the rapidly developing field of nanotechnology. Theirunique size-dependent properties make these materials superior and indispensable in many areas of human activity. This brief review tries to summarise the most recent developments in the field of applied nanomaterials, in particular their application in biology and medicine, and discusses their commercialisation prospects.

5. SIVANAND S PENNADAM et.al.(2004): The exploitation of nature's machinery at length scales below the dimensions of a cell is an excitingchallenge for biologists, chemists and physicists, while advances in our understanding of these biological motifs are now providing an opportunity to develop real single molecule devices for technological applications. Single molecule studies are already well advanced and biological molecular motors are being used to guide the design of nano-scale machines. However, controlling the specific functions of these devices in biological systems under changing conditions is difficult. In this review we describe the principles underlying the development of a molecular motor with numerous potential applications in nanotechnology and the use of specific synthetic polymers as prototypic molecular switches for control of the motor function. The molecular motor is a derivative of a TypeI Restriction-Modification (R-M) enzyme and the synthetic polymer is drawn from the class of materials that exhibit a temperature-dependent phase transition.

CLASSIFICATION OF NANOMATERIAL:

Nanomaterials can be classified dimension wise into following categories.

TABLE NO.1: CLASSIFICATION OF NANOMATERIAL

SR NO.	CLASS	EXAMPLES
1	Dimension < 100nm	Nanorods, nanowires etc.
2	Dimensions < 100nm	Tubes, fibers, platelets, etc.
3	Zero or 3 dimensions < 100nm	Particles, quantum dots, hollow Spheres, etc.

On the basis of phase composition, nanomaterials in different phases can be classified as, Single phase solids include crystalline, amorphous particles and layers, etc. Multi phase solids include matrix composites, coated particles, etc.
Multi phase systems include colloids, aero gels, Ferro fluids, etc.

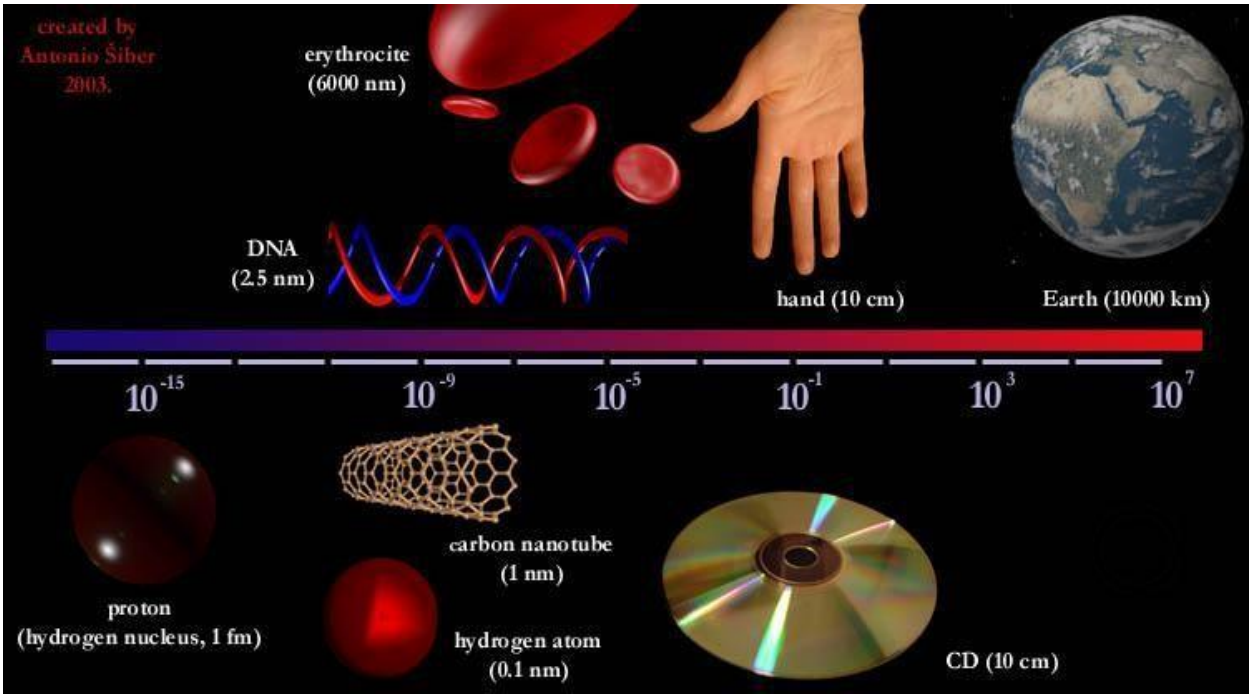

Fig no.1:A bird view of a nanometer.

NANOSCIENCE AND PHYSICS:

Physics is the mother of natural sciences. In principle, physics can be used to explain everything that goes on at the nano scale. There is active physics research going on in nanomechanics, quantum computation, quantum teleportation, artificial atoms etc. At nanometer scale physics is different. Properties not seen on a macroscopic scale now become important- such as quantum mechanical and thermodynamic properties. Rather than workinwith bulk materials, one works with individual atoms and molecules. By learning about an individual molecule"s properties, we can put them together in very well-defined ways to produce new materials with new and amazing characteristics.

SOME PHYSICAL PROPERTIES OF NANOMATERIAL:

Materials reduced to nano scale can suddenly show very different properties compared to what they exhibit on a macro scale, enabling unique applications. For instance:
Copper which is an opaque substance become transparent.

Platinum which is an inert material become catalyst.

Aluminum which is a stable material turns combustible.

Silicon insulators become conductors.

Gold which is solid, inert and yellow on room temperature at micro scale becomes liquid and red in color at nano scale on room temperature. It also gets unusual catalytic properties not seen at macro scale. Figure shows dependence of melting point on the particle size.

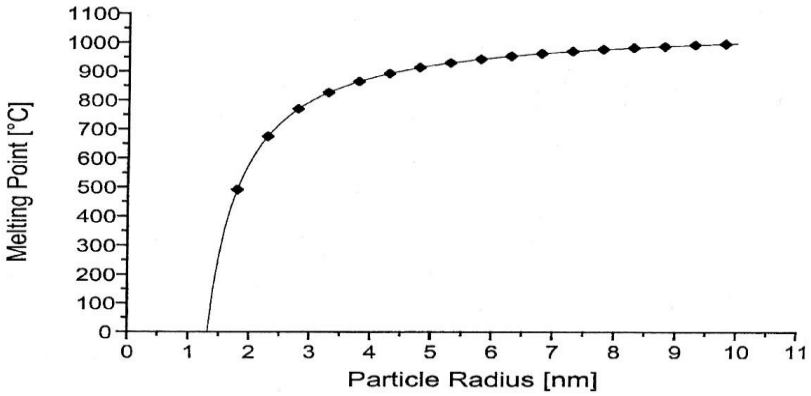

Fig.no.2: Dependence of melting point of gold on particles size.

APPLICATION OF NANO BIOTECHNOLOGY:

The potential applications of Nano Biotechnology in different fields are the following: Electronics

- Health and Medicine
- Transportation
- Energy and Environment
- Space exploration

Nanotechnology in Electronics

Nanotechnology has already reached the electronics industry with features in microprocessors now less than 100 nanometres (nm) in size. Smaller sizes allow faster processing times and also more processing power to be packed into a given area. However, these advances are really only a continuation of existing microelectronics, and will reach their limit sometime around the end of the next decade when it will be both physically impossible to “write” or “etch” smaller features in silicon, and also because at extremely small sizes (less than 20 nm) silicon becomes electrically “leaky” causing short circuits. Some of the areas under development include:

- Improving display screens on electronics devices. This involves reducing power consumption while decreasing the weight and thickness of the screens. This can be achieved using carbon nanotubes (CNT). They can be used as field emitters with extremely high efficiency for field emission displays (FED).

- Increasing the density of memory chips. Researchers are developing a type of memory chip with a projected density of one terabyte of memory per square inch or greater. Integrated nanosensors are used for collecting, processing and communicating massive amounts of data with minimal size, weight, and power consumption

- Reducing the size of transistors used in integrated circuits. One researcher believes it may be possible to "put the power of all of today's present computers in the palm of your hand". Processors with declining energy use and cost per gate, thus increasing efficiency of computer by 106.

- Allowing the refrigeration without the need of refrigeration fluids. This can be done if nanoparticles with large magnetic moments and adequate coericivity can be obtained then the magnetocaloric effect may allow refrigeration on a practical scale.

Nanotechnology in Health and Medicine

Mankind is still fighting against a high number of serious and complex illnesses like cancer, cardiovascular diseases, multiple sclerosis, Alzheimer‟s and Parkinson‟s disease, and diabetes as well as different kinds of serious inflammatory or infectious diseases (e.g. HIV). Nanotechnology has also its applications in field of health and medicine called nanomedicine. The approaches to nanomedicine range from the medical use of nanomaterials, to nanoelectronic biosensors, and even possible future applications of molecular nanotechnology [6]. The medical area of nanoscience application is one of the most potentially valuable, with many projected benefits to humanity.

- Nanomedicine has the potential to enable early detection and prevention, and to essentially improve diagnosis, treatment and follow-up of diseases.
- Biological tests measuring the presence or activity of selected substances become quicker, more sensitive and more flexible when certain nano scale particles are put to work as tags and labels.
- Nanodevices can make gene sequencing more efficient. Gold nanoparticles tagged with short segments of DNA can be used for detection of genetic sequence in a sample.

- Nanotechnology can help to reproduce or to repair damaged tissue. This so called tissue engineering makes use of artificially stimulated cell. It might replace today"s conventional treatments, e.g. transplantation of organs or artificial implants.

Carbon nanotubes have recently become promising functional materials for the development of advanced biosensors with novel features. These sensors are being used for astrobiology to study origins of life. The technology is also being used to develop sensors for cancer diagnostics. CNT, though inert, can be functionalized at the tip with a probe molecule. Their study uses AFM as an experimental platform.

i. Probe molecule to serve as signature of leukemia cells identified ii. Current flow due to hybridization will be through CNT electrode to an IC chip.
iii. Prototype biosensors catheter development

Nanotechnology, Energy and Environment :

Nanotechnology is fundamental over the next 50 years to providing sufficient energy for a growing world and to protecting the environment in which we live. There is an energy/environmental storm gathering and we must pay attention. . Under all practical solutions nanotechnology will play a critical role in any successful outcome. The most advanced nanotechnology projects related to energy are: storage, conversion, manufacturing improvements by reducing materials and process rates, energy saving e.g. by better thermal insulation and enhanced renewable energy sources.

- Nanotechnology is having on renewal energies, from solar technology, to nanocatalysis, fuel cells and hydrogen technology. Thus using nanotechnology more clean and less expensive ways for energy production have been found.
- Carbon nanotube fuel cells are being used to store hydrogen. These are the environmentally friendly form of energy. Researchers are trying to increase effectiveness of carbon nanotube at storing hydrogen. This has the potential to power cars.
- Research on photovoltaic is being done to make them cheap, light weight and more efficient.
- Nanotechnology can contribute to the further reduction of combustion engine pollutants by nanoporous filters, which can clean the exhaust mechanically, by catalytic converters based on nanoscale noble metal particles or by catalytic coatings on cylinder walls and catalytic nanoparticles as additive for fuels.
- Nanotechnology can help in developing new environmental safe and green technologies that can minimize the formation of undesirable byproducts or effluents.
- Solid state lightening can reduce total electricity consumption by 10% and cut carbon emission by the equivalent of 28 million tons/year.
- A reduction of energy consumption can be reached by better insulation systems, by the use of more efficient lighting or combustion systems, and by use of lighter and stronger materials in the transportation sector. Currently used light bulbs only convert approximately 5% of the electrical energy into light. Nanotechnological approaches like LEDs (Light-emitting diodes) or QCAs (Quantum Caged Atoms) could lead to a strong reduction of energy consumption for illumination.

Nanotechnology in Space Exploration :

Most of today's rocket engines rely on chemical propulsion. Real rocket scientists though are actively researching new forms of space propulsion systems. One heavily researched area is electric propulsion (EP) that includes field emission electric propulsion (FEEP), colloid thrusters and other versions of field emission thrusters (FETs). EP systems significantly reduce the required propellant mass compared to conventional chemical rockets, allowing increasing the payload capacity or decrease the launch mass. A new EP concept proposes to utilize electrostatically charged and accelerated nanoparticles as propellant. Millions of micron-sized nanoparticle thrusters would fit on one square centimeter, allowing the fabrication of highly scaleable thruster arrays.

The greatest challenges in the space craft are

1. performance
2. reliability and safety
3. cost

Nanotechnology can improve the situation. Some specific benefits nanotechnology can bring are:

- Nanotechnology can make the structure of space planes much lighter thus can greatly improve their viability.
- Nanotechnology can improve the performance of laser sails. Using nanotechnology sails with 20 nm thickness can be constructed making them light and more durable.
- Performance can also be increased using solar powered ion engines with nanotechnology.
- Using a combination of AI and nanorobotics, computer controlled manufacturing systems will reduce the time and cost of developing new technologies.
- Making exterior of crafts using nanosensors and nanorobots will increase mission rates at lower cost.

VARIOUS APPROACHS OF NANOBIOTICS:

In recent year, the nanonization of herbal medicines hasattracted much attention; some of them areillustrated. Nanoparticles and nanoemulsions are colloidal systems with particles varying in size from 10 nm to1000 nm .Nanoparticle systems with mean particle size well above the100 nm standard have also been reported in literature, includingnanonized curcuminoids, paclitaxel and praziquantel whichhave a mean particle size of 450, 147.7, and even higher than 200nm, respectively. In addition, nanoparticles could also be definedas being submicronic (b1 lm) colloidal systems. The nanospheres have a matrix type structure in which theactive ingredient is dispersed throughout (the particles), whereasthe nanocapsules have a polymeric membrane

and an activeingredient core. Nanonization possesses many advantages, such asincreasing compound solubility, reducing medicinal doses, andimproving the absorbency of herbal medicines compared with therespective crude drugs preparations.

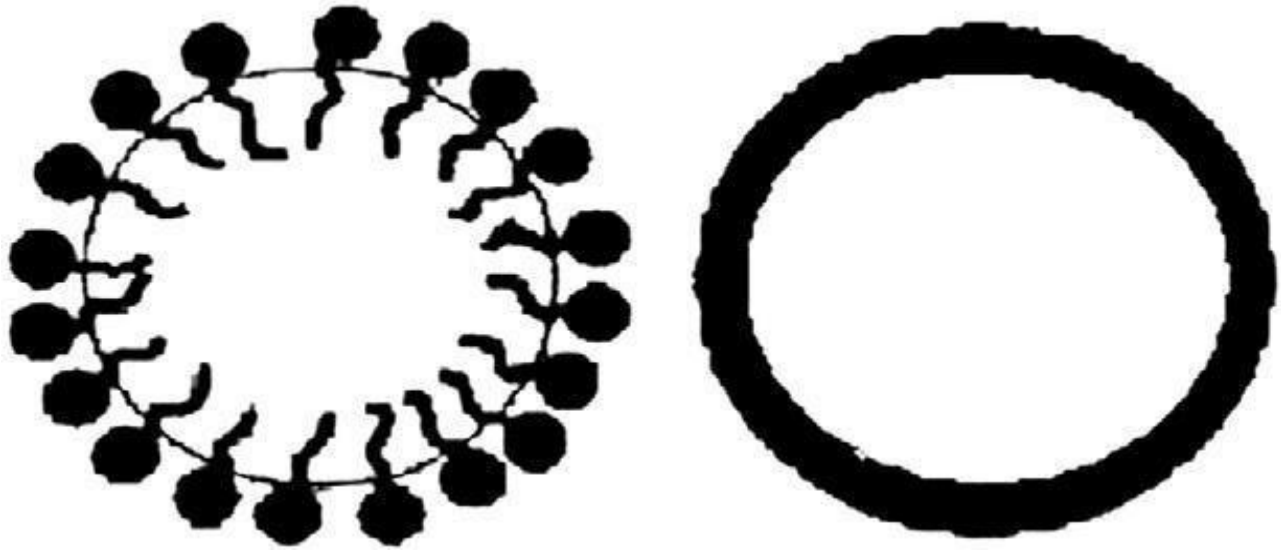

Fig.no.4: Cross section of(A)Nanoemulsion. (B)Bipolymeric nanoparticle.

1. Nanotechnology approaches to enhance the bioavailability of Curcumin:

Today curcumin has been widely acknowledged globallyas a "wonder drug of the future" because of its great potentialabilities to prevent and treat a wide spectrum of incurable andchronic diseases. In addition, it has been proved to be remarkablysafe in animal studies and in phase I clinical trials even at highdoses. However, the major problem limiting theexploitation of its potentially valuable therapeutic effects is its lowbioavailability. In practice, only very low or undetectable levels of curcumin can be achieved in blood byoral administration of curcumin. The low bioavailability ofcurcumin has been attributed to its very low aqueous solubility,tendency to degrade in the gastroinenstinal tract in thephysiological environment, high rate of metabolism, and rapidsystemic elimination. The low bioavailability of curcumin has sofar limited its medical use. It has been suggested that a person isrequired to consume large doses (about 12-20g/day) of curcumin inorder to achieve its therapeutic effects on the human body. That means one has to swallow 24 to 40curcumin capsules of 500mg each. These doses are considered tobe too high, and therefore, not feasible to be incorporated inclinical trials due to unbearable after-taste to the palate, possibilityof giving rise to nauseatic feeling and perceived toxicity issues.

Therefore, to achieve the maximum response of this potentiallyuseful chemopreventive agent, a number of approaches such as theuse of adjuvants like piperine, synthetic analogues, chelating ofcurcumin with metals, combination with other dietary agents etc.have been investigated. Nanotechnology-based novel strategies arebeing aggressively explored worldwide to enhance curcumin'sbioavailability and reduce perceived toxicity as they offer severalother additional benefits such as improved cellular uptake,enhanced dissolution rates, excellent blood stability, controlledrelease functions, multifunctional design, enhancement in itspharmacological activities (e.g. antioxidant and antihepatomaactivities) etc. A 2010 article on polymer nanoparticleencapsulatedcurcumin has been ranked as oneof the top ten most accessed articles (48029 accesses) for all timeby the Journal of Nanobiotechnology. This clearly demonstratesthe emerging importance of this field (nanotechnology-based drugdelivery of curcumin based systems). In this pioneering work,researchers from Johns Hopkins University School of Medicineand the University of Delhi have jointly developed a polymernanoparticle-encapsulated form of curcumin, "nanocurcumin",which can be readily dispersed in aqueous media. In this process,they have coated ordinary hydrophobic curcumin particles withhydrophilic polymer (N-isopropylacrylamide with N-vinyl-2-pyrrolidonne and poly(ethylene glycol) monoacryalate)nanoparticles. This nanocurcumin is soluble in water and can bereadily absorbed into the bloodstream. It has already been tested invitro on pancreatic cancer cells and it was shown to have equal orbetter effects than free curcumin on the human cancer cells, suchas inhibition of NF-kB and downregulation of IL-6. Nanocurcuminwas also given to mice, and did not show any evidence ofundesirable effects. In addition to polymer-encapsulated curcumin,other nanobased drug delivery systems being employed forcurcumin include curcumin nanocrystals, curcumin nanoparticles,nanoemuls nanoliposome-encapsulated curcumin, curcumin-loadedpolymeric micelles, cyclodextrin/curcumin selfassembly, curcuminnanosuspension, solid-lipid nanoparticles etc.

2. Nanotechnology approaches to enhance the bioavailability of berberine HCL:

Berberine hydrochloride is a conventional component in Chinese medicine, and is characterized by a diversity of pharmacological effects. However, due to its hydrophobicproperties, along with poor stability and bioavailability, the application of berberine hydrochloride was hampered for a long time. In recent years, the pharmaceutical preparation of berberine hydrochloride has improved to achieve good prospects for clinical application, especially for novel nanoparticulate delivery systems. Moreover, anticancer activity and novel mechanisms have been explored, the chance of regulating glucose and lipid metabolism in cancer cells showing more potential than ever. Therefore, it is expected that appropriate pharmaceutical procedures could be applied tothe enormous potential for anticancer efficacy, to give some new insights into anticancer drug preparation in Chinese medicine.

3.Nanotechnology approaches to enhance the oralbioavailability of colchicines:

The effect of eugenol on intestinal absorption ofcolchicine in an oral administrative nanoemulsion formulation wasalso demonstrated in vivo. The colchicine nanoemulsion wasprepared with isopropyl myristate ,eugenol, Tween80, ethanol andwater, and eugenol was used as an oil phase in the

formulation ;anaverage particle size of this nanoemulsion was 41.2 ± 7.2 nm. Thepermeation of colchicine in the nanoemulsion across the intestinalmembrane was significantly different from that of the controlgroup (0.2 mM colchicine).Finally, coadministration of eugenolincolchicine nanoemulsion to enhance the colchicines bioavailability was investigated by an oral administration method.After oral administration of colchicine (8 mg/kg) in the form ofeitherthe nanoemulsion or in free colchicine solution, the relativebioavailability of nanoemulsion and eugenol–nanoemulsion wereenhanced by about 1.6- and 2.1-fold, respectively, compared withfree colchicine solution. The procedure indicated that the intestinalabsorption of colchicines was enhanced significantly by eugenol inthe tested nanoemulsion.

4. Nanotechnology approaches to enhance the bioavailability of Artemisinin:

Evaporative precipitation of nanosuspension (EPN) wasused to fabricate nanoparticles of a poorly water-solubleantimalarial drug, artemisinin (ART), with the aim of enhancing itsdissolution rate. We investigated the nanoparticle fabrication ofART via a full factorial experimental design considering theJournal of Current Pharmaceutical Research 2011; 8 (1): 1-7effects of drug concentration and solvent to antisolvent ratio on thephysical, morphological and dissolution properties of ART.Characterization of the original ART powder and EPN preparedART nanoparticles was carried out by scanning electronmicroscopy, differential scanning calorimetry (DSC), X-raydiffraction (XRD) and dissolution tester. DSC and XRD studiessuggested that the crystallinity of EPN prepared ART nanoparticlesdecreased with increasing drug concentration and ratio of solventto antisolvent. The particle diameters of EPN prepared ARTnanoparticles were found to be 100–360 nm. The dissolution ofEPN prepared ART nanoparticles markedly increased as comparedto the original ART powder.Artemisinin regarded as one of the most promisinganticancer drugs can bind to DNA with a binding constant of 1.04× 104 M−1. The electrochemical experiments indicated that forlonger incubation time periods, the reduction peak current ofartemisinin on carbon nanotube modified electrode increases.Therefore, the uptake of drug molecules from a solution into CNTswill be achieved automatically by adsorption of 88.7% ofartemisinin onto carbon nanotubes surface without alteration indrug properties.

5. Nanotechnology approaches to enhance the bioavailability of genistein: Genistein has been shown to possess anticancer activities in different experimentalsystems, yet the same effects could not be translated in the clinical setting due to its poorbioavailability. Newer formulations of genistein such as diindolylmethane (BDIM) fromBioreseponse Inc. has shown some enhanced bioavailability (Azmi et al., 2008). Researcher have tried various nano approaches including incorporation of genistein into topical nanoemulsion formulations composed of egg lecithin, medium chain triglycerides (MCT) or octyldodecanol (ODD) and water by spontaneous emulsification. Poli and group have designed numerous flavonoid nano formulations over the last few years. They have extensively reviewed their studies in a seminal article where they have shown that incorporation into lipidic or polymer-based nanoparticles appears to markedly help the oral delivery of flavonoids, as these particles can protect the drug from degradation in the gastrointestinal tract and, by virtue of their unique absorption mechanism through the lymphatic system, also fromfirst-pass metabolism in the liver.

6. Nanotechnology approaches to enhance the bioavailability of resveratrol: Resveratrol (3,5,4'-trihydroxy-trans-stilbene) is a phytoalexin produced naturally by several plants when under attack by pathogens such as bacteria or fungi. Resveratrol and its effects is currently a topic of numerous animal and human studies. In mouse and rat experiments, anti-cancer 35 anti-inflammatory, blood-sugar-lowering and other beneficial cardiovascular effects of resveratrol have been reported. However, most of these results have yet to be replicated in humans. As with other natural chemopreventive agents, resveratrol also has a very short half life and is rapidly glucoronated and sulfonated, aiding its rapid turnover and excretion. Therefore, researchers focused on ways to enhance the bioavailability of resveratrol by different approaches and nano based studies were among the major driving force in this area. The earliest reported nano formulation of resveratrol comes from a study by Yao et al., where they prepared resveratrol chitosan nanoparticles with free amine groups on the surface so as to conjugate ligands, which will actively target to special tissues or organs.

ADVANTAGES OF NANOBIOTICS:

The pathophysiological conditions and anatomicalchanges of diseased or inflamed tissues can potentiallytrigger a great deal of scopes for the developmentof various targeted nanotechnological products. This developmentis like to be advantageous in the followingways

1. Drug targeting can be achieved by taking advantageof the distinct pathophysiological features of diseased tissues.
2. Various nanoproducts can beaccumulated at higher concentrations than normal drugs.
3. increased vascular permeability coupled with animpaired lymphatic drainage in tumors improve theeffect of the nanosystems in the tumors or inflamed tissues through better transmission and retention.
4. Nanosystems have capacity of selective localization in inflammed tissues.
5. Nanoparticles can be effectivelyused to deliver/transport relevant drugs to the brainovercoming the presence of blood–brain barrier.
6. Drug loading onto nanoparticles modifiescell and tissue distribution and leads to a more selectivedelivery of biologically active compounds to enhance drug efficacy and reduces drug toxicity .

NANOBIOTICS AND MEDICINE:

Nanotechnology is the study and use of structures between 1 nanometer [nm] to 100 nanometers in size. This is probably the simplest and generally agreed upon definition of nanotechnology. According to National Nanotechnology Initiative , nanotechnology is broadly defined as the science and engineering involved in the design, synthesis, characterization, and application of materials and devices with at least one of the dimensions in the nanoscale. Presently nanotechnology is being increasingly used in nearly every aspect of life, medicine, clothing, cosmetics, sports, energy, electronics, aero-space, military & security, food, water, air to name a few. In the United States, 2013 Federal Budget provides $1.8 billion for the National Nanotechnology Initiative [NNI], reflecting steady growth in the NNI investment. Although difficult to measure accurately, estimates from 2008 show

the governments of the European Union [EU] and Japan invested approximately $1.7 billion and $950 million, respectively, in nanotechnology research and development.

The governments of China, Korea, and Taiwan invested approximately $430 million, $310 million, and $110 million, respectively.While the evolvement of nanotechnology has the potential to take several decades, and the early developers are likely to be sizeable institutions with great wealth that can produce considerable advancement efforts, in the long term nanotechnology is going to affect a large variety of people. There will definitely be many other future implications and practical applications of nanotechnology as more and more possibilities and opportunities will keep on continuously coming to light as the branch develops further.

1.ROLE OF NANOBIOTICS:

Nanomedicine deals with the concept of manipulation and assembly of the matter at the nanoscale for applications at the clinical level of medical sciences. In a broad sense, nanomedicine is the application of nanoscale technologies to the practice of medicine. This enables the miniaturization of many current devices, resulting in faster operation or integration of several operations. Furthermore, at this scale, manmade structures match typical sizes of natural functional units in living organisms. This allows them to interact with the biology of living organisms at the smallest structural level.

Nanomedicine has been an important part of nanotechnology from the very beginning, and since nanotechnology began as avisionary enterprise, nanomedicine started by applying mainly nano-mechanical concepts to the body. The 2004 presentation of the cancer nanotechnology initiative in the United States revolves around the goal of "eliminating death and suffering from cancer by 2015". The 2006 European Technology Platform on

Nanomedicine is more subtle than this. It speaks of a "revolution in molecular imaging in the foreseeable future, leading to the detection of a single molecule or a single cell in a complex biological environment". Nanomedicine, in other words, is disease centered, trying to do better and on a molecular level what physiology, pathology, and the various other specialized medical sciences have been doing so far.Summarizes some to the main advantages of nanomedicine over conventional medicine:

- Improved pharmaco-kinetic & pharmaco-dynamic profile of drugs
- Low toxicity & fewer adverse effects of drugs
- Targeted delivery of therapeutic agents
- Combining of multiple therapeutic agents in a single nano-scale entity Combining of diagnostic & therapeutic agents in a single nano-scale entity.
- More precise, less time and labour consuming.

2.PREVENTIVE MEDICINE:

New diagnostic tests making use of nanotechnology to quantify disease-related biomarkers could offer an earlier and more personalized risk assessment before symptoms show up. In general, these analyses must be cost-effective, sensitive, and reliable. The test itself should inflict only minimal discomfort to the patient. Supported by such an analysis and bioinformatics, health professionals could advise patients with an increased risk to take up a personalized prevention program. People with an increased risk for a certain disease could benefit from regular personalized check-ups to monitor changes in the pattern of their biomarkers. Nanotechnology could improve in vitro diagnostic tests by providing more sensitive detection technologies or by providing better nano-labels that can be detected with high sensitivity once they bind to disease-specific molecules present in the sample.

Nanotechnology could also improve the ease-of-use of in vitro diagnostic tests done by untrained users or even by patients at home. For examplea relatively painless minimally invasive sampling technique would greatly improve patient comfort.Diseases with no secretion of biomarkers into blood or urine will require imaging procedures of highspecificity for their early detection. One well-known example used already is x-ray mammography for theearly detection of breast cancer. Novel targeted imaging agents, precisely homing in on diseased cells,promise a much higher sensitivity than today's imaging procedures making possible the detection ofcancer at an even earlier stage.

3. DIAGNOSIS:

If a medical check-up had found an indication or a hint of symptoms for a disease, it is important that"false positives" are excluded by applying more specific diagnostic procedures. These can be morelaborious and expensive as they are applied to a smaller number of patients. In this case, molecularimaging, which makes use of specific targeted agents, plays a crucial role for localization and staging of adisease, or – equally important – for ascertaining the health of a patient. Here, nanotechnology could helpto design a plethora of very specific imaging agents over the next few years. Miniaturized imagingsystems will make it possible to perform image-based diagnostics everywhere and not only in researchcenters. Automatic methods will give diagnostic results without an onsite expert. Conceptually a novel method, combining biochemical techniques with advanced imaging and spectroscopy provide insight to the behavior of single diseased cell and its microenvironment for the individual patient.

This could lead to personalized treatment and medication tailored to the specific needs of a patient. Often, the differences between healthy and diseased or pre-disease states are very small, and the ability to detect single molecules or small changes in the behavior of a cell is required for diagnosis. Nanotechnology capable of measuring single binding events or interactions is a great asset for diagnostics. Nanotechnology hence may enhance disease diagnosis by improving sensitivity, selectivity, decreasing time to diagnosis, and the availability of highly accurate testing equipment.

4.THERAPY:

In many cases, therapy is not restricted to medication only but requires more severe therapeutic action such as surgery or radiation treatment. Planning of therapeutic interventions is based on imaging, or may be performed under image guidance. Here, nanotechnology can lead to a miniaturization of devices that enable minimally invasive procedures and new ways of treatment. The possibilities range from minimally invasive

catheter based interventions to implantable devices. Targeted delivery systems and nanotechnology-assisted regenerative medicine will play a central role in future therapy. Targeted delivery agents allows localized therapy which targets only the diseased cells, thereby increasing efficacy while reducing unwanted side effects.

Pleuripotent stem cells and bioactive signaling factors will be essential components of smart, multi-functional implants which can react according to the changes in surrounding microenvironment. Imaging and biochemical assay techniques will be used to monitor drug release or to follow the therapy progress. This therapeutic logic will lead to the development of novel, disease modifying treatments that will not only significantly increase quality of life but also dramatically reduce societal and economic costs related to the management of permanent disabilities.

CANCER CLINICAL THERAPY:

Cancer remains one of the most complex diseases affecting humans and, despite the impressive advances that have been made in molecular and cell biology, how cancer cells progress through carcinogenesis and acquire their metastatic ability is still widely debated.

The idea that cancer might be attributed to inherent changes within the organism's own genome did not arise until after the discovery that retroviruses could transform host cells and often they contain variants of cellular genes which are necessary for oncogenic transformation. Consequently, for perhaps nearly twenty years, the field of oncology was synonymous with virology and a major focus was on identifying these proto-oncogenes or genes that could be turned into cancer-causing genes.

Today, cancer is recognized as a highly heterogeneous disease and over 100 distinct types have been described with various tumor subtypes found within specific organs. It is now also recognized that genetic and phenotypical variability primarily determines the self-progressive growth, invasiveness, and metastatic potential of neoplastic disease and its response or resistance to therapy. It seems that this multi-level complexity of cancer explains the clinical diversity of histologically similar neoplasias.

Recent advances in other disciplines have uncovered that in addition to virus infection, disregulation of many normal cellular processes such as gene regulation, cell cycle control, DNA repair and replication, checkpoint signaling, differentiation, and apoptosis, etc. can lead to cancer. The mechanisms of transformation can be complex with multiple pathways affected. For example, genetic changes in the p53 gene resulting in loss of heterozygosity are known to affect the pattern of gene activation and repression, dampen cell cycle checkpoints, and incapacitate the induction of apoptosis. In addition to multiple pathways being compromised in tumor cells, tumors can arise in a cell- or tissue-specific manner.For instance, mutations in the breast cancer susceptibility gene, are associated with approximately half of the inherited forms of breast and ovarian cancer, but they do not predispose carriers to most other forms of cancer even though the gene is ubiquitously expressed and is involved in the fundamental processes of transcriptional regulation and DNA repair.While some times there are common mutations frequently associated with many cancers, the majority of cancers arise from a diverse array of malfunctions that result in a tumor that is unique to that patient. The complexity of cancer combined with an avalanche of basic science research uncovering the plethora of pathways that feed into cellular growth control reveals many potential therapeutic targets.

GENETICS OF CANCER:

Before we delve fully into the main issue of this report which deals with applications ofnanotechnology in cancer prevention, detection and treatment, we must address theunderlying causes and the genetic mechanisms involved in cancer. In here we present anover-simplified version of what is known on the genetics of cancer for the sake ofbrevity.The word cancer was first applied to the disease by Hippocrates (460–370 B.C.), theGreek philosopher, who used the words carcinosand carcinomato refer to nonulcerforming and ulcer forming tumours. The words refer to a crab, probably due to theexternal appearance of cancerous tumours, which have branch-like projections thatresemble the claws of a crab.In non-cancerous tissues growth is limited in the sense that cell reproduction istightly controlled. After a certain number of cells have developed, feedback control(contact inhibition) limits cell division, allowing for tissue repair but not expansion.

Cancer or neoplasm, on the other hand, involves tissues composed of cells that divideand/or grow abnormally.Cancer is a genetically rooted disease that involves the simultaneous occurrence oftwo general categories of cellular malfunctions. The precise number of genetic changesrequired for these malfunctions remains unresolved for any cancer, but for adult cancersit is generally believed to range from 5 to 15. Whatwe present here is a brief introduction to the subject.The first category causes the replication of a cell to become permanently enabled dueto a natural or carcinogen-induced genetic mutation, chromosome translocation or geneamplification (genetic instability). The second category is also due to genetic mutations,and causes the apoptosis complex, also known as the suicide complex, to becomepermanently disabled. As stated, both of these problems must occur in thesame cell, at the same time, in order to cause cancer. Under normal circumstances, thecells carefully control their divisions using apoptosis complex activated by the p53.tumour suppressor protein. There are other mechanisms triggering the apoptosiscomplex, including receptor mediated death, which is dependant to chemical messengers,especially tumour necrosis factors. But, when bothof these mechanisms malfunction, the body has no other option. As the uncontrolled celldivision continues, a cluster of fairly unspecialised cells committed to dividing developsand becomes larger and larger. In addition, the cluster of cells releases chemicals topromote abnormal capillary growthinto the tumour. This kind of a cell cluster is knownas a malignant tumour, and can severely damage the surrounding tissue as it sucks upessential nutrients and displaces healthy cells. Eventually, when the tumour grows largeenough, some of the tumour cells can find their way into the bloodstream, formingtumours in other parts of the body. This latter phenomenon is known as metastasis.It effectively multiplies the cancer as well as its effects, and eventually will prove fatal tothe patient.

If we zoom in further on the genetic processes of the cell, we see that the DNA (deoxyribonucleic acid) molecule is involved in nearly all of them. The same DNA is contained inside just about every cell of a particular patient, with the only possible differences being the random mutations mentioned above. DNA, which is the genetic blueprint of the structure and function of every cell, is made up of a sequence of nucleotide bases that

collectively code for the production of a myriad of proteins. Some of these macromolecules serve as catalysts in various biochemical reactions that occur within the cell. Others travel to the membrane and imbed themselves there in order to serve as transport channels for various molecules that need to travel into and out of the cell. Still others serve to decode the DNA strand in order to produce other proteins, or to copy the DNA molecule itself during cell division. Out of all these proteins, the ones that are of interest to cancer research are those responsible for reactions that occur during apoptosis, and those that are active during cell division. Each of these groups of proteins is coded for by a gene complex, which is a group of genes, controlled by a genetic switchknown as an operon. There are different kinds of operons, but ingeneral, the presence or absence of a certain substance within the cell causes a repressorprotein to bind to the operator region of the complex, preventing the transcription of thegenes that are found downstream in the sequence.In the scenario where we have uncontrolled cell division, a mutation occurs in theoperator region of the cell division operon, thus making it impossible for the repressor tobind, or in the regulator region, which is the genetic sequence that codes for the repressorprotein itself. If one, the other, or both of these mutations occur, the proteins responsiblefor division are produced continuously, and the cell continuously divides.

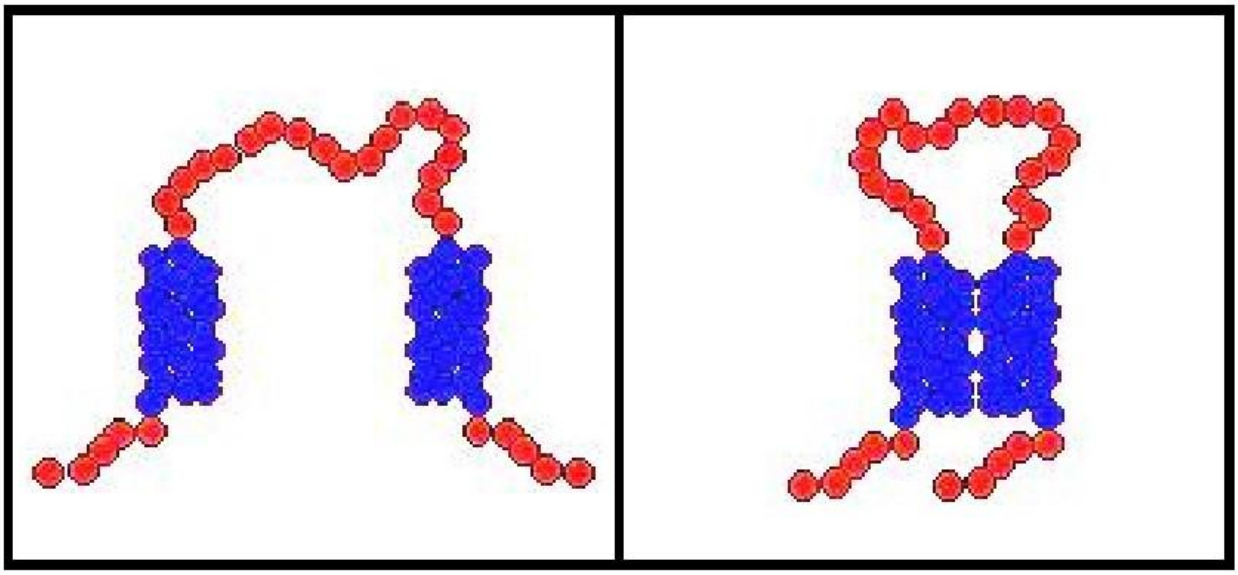

Figure no.6: The shape of a protein is certain complex biochemical reactions.

NANOTECHNOLOGY PREVENTIVE APPROACH:

In general, the best way to eliminate a problem is to eliminate the cause. In cancer, the problem can be perceived differently at various stages of the disease. Most apparently, if genetic mutations are the underlying cause, then we must counteract the causes of the mutations. Unfortunately, genetic mutations are caused by artificial or natural carcinogens only some of the time. At other times, they may occur spontaneously during DNA replication and cell division. With present science and technology there is very little we can do to prevent this from happening. However, in all other cases, eliminating the carcinogens is indeed a highly effective way of cancer prevention. But most patients do not recognise the problem until it has actually occurred, which makes preventive medicine a rarely utilised, although a highly effective form of cancer prevention. Even so, is there a way to eliminate cancer through nanotechnology before it starts? Although there is little current research on preventive treatments using nanotechnology, they are indeed possible.

After a careful review of the most advanced disease-time nanoscale treatment methods, one can easily see why the proposed nanotechnology alternatives to current preventive treatments have so strongly attracted the attention of the scientific and medical communities in recent years. In fact, nanotechnology-based treatments are no more challenging to devise than the currently used disease-time treatment methods. Nonetheless, it requires time and monetary investments to develop such treatment methods in short time. To demonstrate the viability of the nanotechnology-based treatments, let us consider melanoma for example. Melanoma, a form of skin cancer, is caused primarily by ultraviolet radiation from the Sun. The current method of preventive treatment against bombardment with this kind of harmful radiation involves suspending a substance that either absorbs or scatters ultraviolet radiation in a thick emulsion.

We use this emulsion, called sunscreen, to coat our skin prior to prolonged exposure to sunlight. Some of the problems with this method are that this emulsion can be easily rubbed off and can loose its effectiveness over time, thus needing to be reapplied periodically. An even bigger problem is that we leave openings in the sunscreen coating during sunscreen application due to macro-scale and micro-scale imperfections in our skin. This allows the Ultra Violet (UV) radiation to permeate through the dead layer of skin, spreading out to a wider area due to slit diffraction and causing more widespread damage. All of these problems take away from the overall effectiveness of this preventive method.

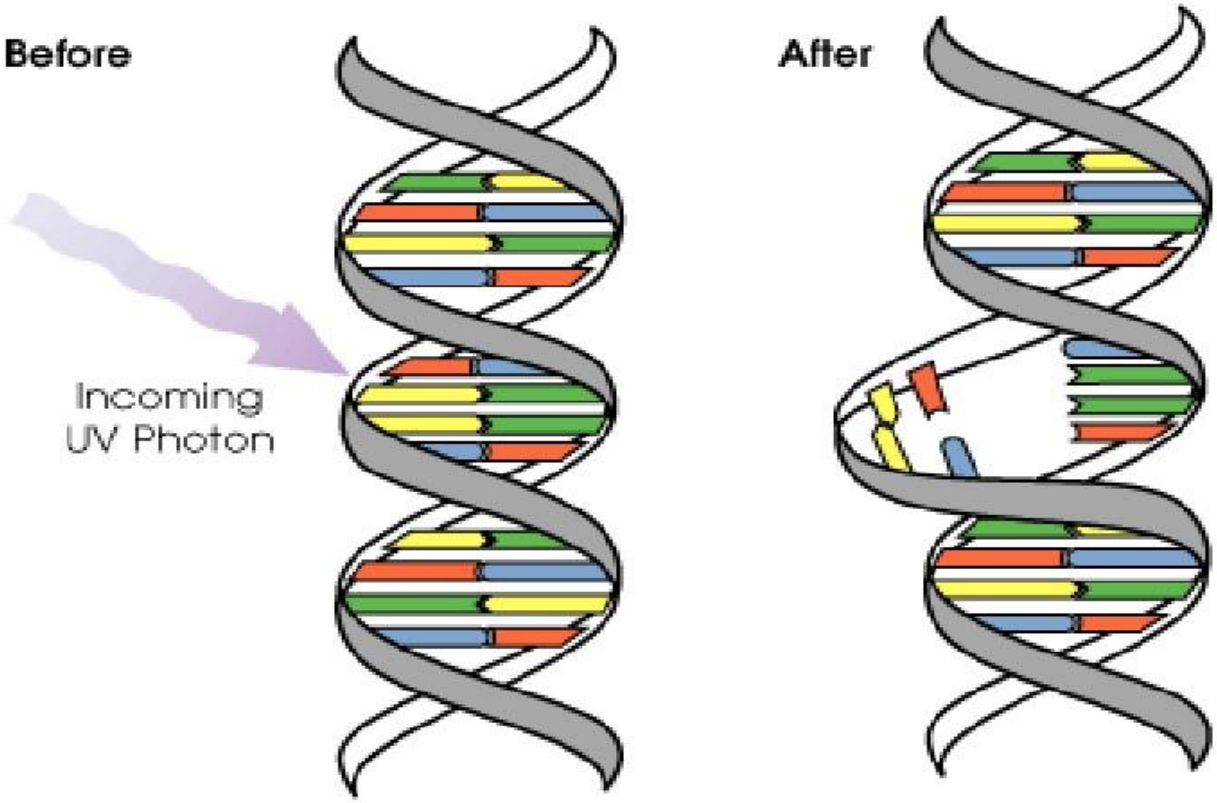

Figure no.7: UV radiation is one of the most prominent causes of DNA damage.

DETECTION AND DIAGNOSIS THROUGH NANOTECHNOLOGY:

Another important issue to be addressed is cancer diagnosis through nanotechnology. In order to provide early and thus more effective cancer treatment, early detection of the disease is crucial. Two approaches to cancer detection may be envisioned and they include

- In vitro (laboratory-based) diagnostics
- In vivo diagnostics.

Although in vivo detection is still a challenge, in vitro detection studies have recently produced some impressive breakthroughs.

- In vitro (laboratory-based) diagnostics

Laboratory-based (in vitro) nanotechnology methods are based on the concept of computer chips. For example, with the use of some recent discoveries in nanoarrays, we can now detect multiple biomolecular markers at very low concentrations in various biological fluids. There are currently two equally effective nanoarray methods. The first method involves nanowires connected to a high-sensitivity electronic ammeter. Each nanowire is designed to be a good binding site for a specific biomolecule. The biofluid under study is passed through a channel where it is allowed to come into direct contact with the wire array. The conductance of the wires changes as the molecules bind, and detection is made possible by measuring the conductance in real time. The second method involves a nanoarray of Atomic Force Microscope (AFM) cantilevers which are equipped with antibodies specific to selected molecules. The array is submerged in a biofluid where the molecules that are present are allowed to bind to the antibodies. As they bind, they cause the levers to deflect, and the deflection is measured by a combination of a highly focused laser beam and sensitive photodetectors, with a technique similar to that used in AFM. Both methods can yield data that are highly accurate, even with concentrations in the range of parts per million.

- In vivo diagnostics.

Some promising in vivo techniques are currently under development. One method is to use nanoarrays similar to those described above. However, due to conditions that are much more adverse in a living patient, significantly higher concentrations of the desired molecules are necessary for accurate detection. Another method is to implant biosensors directly into the patient and to have them relay gathered information to an external data collector. The major problem with these methods that still remains unresolved is biofouling, or the nonspecific adoption of serum proteins to the sensors. Since serum proteins are present in healthy as well as malignant environments, the accuracy of the measurements can be greatly impaired. This problem has been in the way of effective in vivo detection for quite some time. Ferrari suggests more novel measuring methods must be developed that are dependent on other physical properties, and from which the biofouling signal can be decoupled using appropriate mathematical algorithms.

CONCLUSION:

Prevention, diagnosis and treatment of cancer have always been a formidable medical challenge. In fact, cancer has long been considered an incurable disease and it is grouped with Hepatitis C and AIDS. Throughout the bulk of human history, cancer tended to be fatal in those who were unfortunate to develop it. Cancer will continue to be a big problem since it is a disease related mostly to age. As our population average age increases due to medical advances cancer will be a major disease of the aging. Over the past 150 years, many innovative and groundbreaking techniques have been developed in order to treat cancer. These techniques range from brute surgical removal to X-ray irradiation to system wide flooding with anticancer agents. However, each of these approaches has its own series of undesirable side effects that are both dangerous and damaging to the overall health of the patient. On thecontrary, very recent breakthroughs in nanotechnology have managed to change all that.Now at last there is hope for a cure that is effective and can be made it safe.Although there is still plenty of work to be done, some very promising newnanotechnology treatment methods are in the works. Nanotechnology treatments can beused in both the preemptive and in the disease-time approaches to dealing with cancer.

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