



Recent Advancement in Biochemistry and Molecular Biology

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ABSTRACT

Background: The researches in the field of Biochemistry influence the agriculture, nutrition, environment as well as health departments. The novel classes of potential drugs for the treatment of various diseases have been developed by the tremendous progress in biochemistry.

Objective: The objective of this review was to assess the recent advancement in the field of biochemistry and molecular biology.

Methods: The pertinent available data was investigated using electronic database sources. Initially, a total of 150 published research articles, reports, and reviews were identified that were further scrutinized. Only 17 researches were reviewed and mentioned here in detail.

Results: Molecular biology developed the causal relationship among the protein and living system but the basic knowledge regarding protein function is more important to clarify this relationship.

Conclusions: The corresponding use of both biochemistry and molecular biology study in the field of biology is increasing our understanding regarding the function of the protein in the living system.

Keywords: Biochemistry; Advancement; Molecular biology; Microfluidic tools; Protein-protein interactions

INTRODUCTION

Recent advancement in the field of biochemistry led to remarkable progress in the field of medical sciences. For the diagnosis and discovery of novel treatment of the various diseases, the medicinally valued molecules are constantly being produced by altering the plants and animals hereditary traits. Even the cloning process also takes advantage of their advancements. Biochemistry also encompasses the

expression of proteins and peptides for the development of vaccine subunits [1]. Conventionally, just *in vitro* experiments were performed to study the enzymes function in the field of biochemistry. These studies play a vital role to understand the biochemical enzyme parameters. In the past, innovations in protein function were created by using the powerful methodologies of biochemistry. Molecular biology emerged in the late 20th century which elaborates the control of the targeted proteins expression in living cells through genetic

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manipulations. As the protein expression was studied in relation to living cells, the relationship between the loss and gain of a particular protein and their phenotypes in the gene became easier to understand by the researchers [2]. It becomes difficult to extrapolate the data from *in vitro* study to the living system in biochemistry. Numerous intracellular factors like protein-protein interactions, modification after the translation of protein and changes in protein position and intracellular environment [3]. Adequate knowledge and considerations are required to understand the function of the protein in the living systems. But this is a challenge in the field of Biochemistry for many reasons. As there are thousands of enzymes and most of the enzymes act silently on the living system, so it becomes difficult to acquire specialty to understand the functioning of the target enzyme [4]. Besides these, a number of other factors like pH as well as redox states also affect the biochemical parameters and are difficult to estimate in living cells. In the recent era, chemical biology also focuses on the understanding of the biological system by using chemical knowledge and techniques. There are numerous chemical techniques that directly monitor the biological systems and some of them will connect and help the field of Biochemistry to understand how enzymes function in the biological system [5]. Here, I discuss some advancement in the field of biochemistry that is recently published.

MATERIALS AND METHODS

Recent research work done in the field of biochemistry and molecular biology was reviewed by two different scholars (SMA and UK) using electronic databases. We studied some of the important research articles published in PubMed and Google scholar. Search terms used for this purpose included biochemistry, latest research articles of biochemistry, advancements in biochemistry, some recent advances in biochemistry of the vast research articles, our review was focused on some of the key topics of biochemistry like toll like receptor, host response, cell signaling, mucus, mucin, mucosal hyperplasia, cholesteatoma, genetics, chinchilla genome, tissue remodeling, and animal model.

Exclusion Criteria

The search for this review included all published literature with the abstract available in english. There were no further selection criteria for exclusion applied.

Study Selection

A total of 147 studies were initially identified and considered potentially relevant of these, 111 studies did not meet the inclusion criteria. Twenty seven studies were evaluated in detail. Nine studies meeting the selection criteria were considered for the current review and analysis.

RESULTS

Recent advances in microfluidic technologies for biochemistry and molecular biology

An incredible development in the field of biochemistry has been done over the last 60 years. Conventional analytical systems have to face the problem of consumption of a large volume of reagents. The chances of errors in conventional systems also increase as the sample is transferred among multiple instruments. Therefore, there is also a need to take innovation in experimental and analytical assay systems with the advancement in the post genomic period along with an increase in biochemical information [6,7]. Recently, several biochemical experiments have been performed using microfluidic techniques. A very small amount of fluid should be processed through the microfluidic system by using a small dimension of channels [8]. It is advantageous to use this system over conventional as it is a faster system, high performance, uses a small volume of fluid and reduces the chance of errors as it does not require to transport between multiple instruments [9,10].

Microfluidic Tools for Genomic Analysis

Over the previous decade, microfluidic techniques have been rapidly developed for the synthesis, sequencing, amplification and translation of DNA. The real focus of this technique is on digital Polymerase Chain Reaction (PCR) and advanced applications in the production of biomolecules.

DNA Sequencing Technologies

In a genomic study, DNA sequencing is an important task. The rapid advancement in DNA sequencing technique has contributed to early detection of the human genome and this will certainly help for many coming years in the field of biochemistry and molecular biology [11-14]. For instance stated a nano liter scale micro fabricated bio processor incorporating three steps of Sanger sequencing. The authors revealed the complete sequencing of Sanger by using only one DNA template. In addition, the same group achieved 100 atomize sensitivity by integrating a gel affinity method for the capture of DNA. However, it is supposed that this method would be cheaper and high performance throughput. Still this method is not fully optimized in terms of performance.

DNA Amplification by Polymerase Chain Reaction

The polymerase chain reaction is an important tool for DNA sequencing that plays an essential role in diagnostic and cloning procedures [15]. A recent development of chip based polymerase chain reaction is the adoption of segmented-flow or droplet based formats that perform millions of amplification processes within a few minutes. The most important of this system is a single copy digital polymerase chain reaction. For instance, continuous flow polymerase chain reaction within PI volume droplets was reported by Florian Hollfelder and co workers [16].

Xanthone's protects lead induced Chronic kidney Disease (CKD) via activating Nrf-2 and modulating NF-kB, MAPK pathway

CKD is a common health issue that affects almost 11-13% of the community throughout the world [17,18]. The major role of the kidneys is to filter and excrete toxic products through the urinary system. In CKD, the normal function of the kidney is compromised and elements like lead (Pb) target and affect the normal functionality of kidneys. Sometimes kidneys do not filter out it and lead to accumulation and result in lead toxicity [19]. This toxicity exerts its action through oxidative stress. So, the lead toxicity is a risk factor for several diseases like diabetes etc [20]. The white juicy fruit of *Garcinia mangostana* L. is xanthenes have anti-inflammatory, antibiotics, antioxidants as well as anti-diabetic properties. Recently, a study was conducted to determine the protective action of the xanthenes against the lead toxicity. In order to complete this study, antioxidant activities were studied by *in vitro* and oxidative and inflammatory parameters were studied by *in vivo* method. These studies were conducted on male mice and lead acetate toxicity was induced in those mice. The protein ligand interaction of the receptor on the target organ was studied by the process of silicon molecular docking. It was observed in the previous study that this compound had antioxidant properties and improved the neurotoxic behavior of the mice. The result of this study discovered that xanthenes treatment improved tissue physiology by reducing the oxidative stress. It was also observed in the study that Xanthenes had the ability of Nrf-2 activation, intracellular Ca²⁺ activation and down regulation of NF-kB, MAPK pathway and resulted to reduce lead induced kidney failure.

Anti-oxidative enzyme SOD2 is important for physiological persistence of corpora lutea in lynxes

The endocrine gland of the ovarian system that formed at the ovulation site by the rupturing follicle is *Corpora lutea* (CL). This gland is involved in the production of progesterone hormone and helps to sustain pregnancies. The life cycle consists of days in rats and weeks in dogs. The steroid hormone produces ROS1. The level of reactive oxygen species in the body increases during the course of the luteal regression phase and antioxidant enzymes can protect the corpora lutea from recession during pregnancy. The various activities within the cells produce superoxide and peroxide radicals. Reactive oxygen species are parts of both signaling as well as pathological processes, so these involve physiological and non-physiological processes. Enzymatic and non-enzymatic components of antioxidant enzymes keep the reactive oxygen species in balance. Super Oxide Dismutase (SOD, type 1 and 2) are the best antioxidant enzymes and transform the superoxide to hydrogen peroxide and then to water. The activities of ten enzymes that had anti-oxidative properties in new and persistent and in domestic cats at different luteal stages of CL were examined in a study. Superoxide dismutase (SOD, type 1 and 2) showed a prominent difference in gene expression in both groups by immunohistochemistry. This difference in the profile of gene

expression of SOD2 was further confirmed by western blot analysis and activity assays. Noticeable gene expression and enzyme activity were observed in SOD2. The elevated superoxide anion detoxified by superoxide dismutase 2. This acted as a signaling molecule and might increase the survival rate of luteal cells.

Regulation of Proteins in Human Skeletal Muscle: The Role of Transcription

The most prevalent diseases in western countries are metabolic syndromes in which type 2 diabetes is more common. Insulin sensitivity increases by regular aerobic exercises and this effect is associated with increased mitochondrial enzyme activities. So it is important to examine the molecular mechanism of skeleton muscle for aerobic training. During exercise, every individual has to face acute stress in the cells that link to several hours of alterations in gene expression. If the stress is continuously exposed to skeleton muscle, this will lead to a change in protein expression and cellular functions. A recent study observed the mRNA level and its role in the regulation of proteins in cells as well as in several tissues. In this study, 7 males were selected and trained for the cycling program. 2 months cycling programs were conducted for this study. The response of proteome and transcriptase against training and exercise were evaluated through RNA sequencing and mass spectrometry. It was found that different functions of proteins regulated differently at the transcriptional phase. For example, extracellular matrix related contents of protein are increased while the contents of mitochondrial proteins do not increase at the transcriptional stage. Protein stability increases with the increase in protein contents of the skeleton muscle. These results increased our knowledge related to the regulation of molecular mechanisms when stress was applied to the skeleton muscles.

Peptides of Major Basic Protein and Eosinophil Cationic Protein Activate Human Mast Cells

The recurrent incident of eosinophilia at localized and systemic sites occurs in parasitic infections, atopic and other inflammatory diseases. The main constituents of granules that are driven from eosinophil's are major basic protein, eosinophil cationic protein, eosinophil derived neurotoxin, and eosinophil peroxidase. It was observed in a study that major basic protein and eosinophil cationic protein concentration increased in patients of eosinophilia as well as asthma. A number of biological changes could be possible through these proteins. Micro vascular permeability can indirectly affect protein action. Eosinophil granules act on mast cells and hyper reactivity actions induced by mast cell degranulation at the chronic inflammation site. Further, it has also examined that eosinophil granules and mast cells had an association with the pathology of allergic disease. On the basis of theoretical fragmentation of major basic proteins and eosinophil cationic protein at the striptease digestion sites, a study was established to determine the effects of these proteins. It was also investigated in the study that could

fragmentation of these proteins induce degranulation of mast cells through MRGPRX2? The spectrum of activities of these peptides in HCMCs co Ca²⁺ mobilization activities in mas related G-protein coupled receptor family member X2 (MRGPRX2) expressing HEK293 cells. HCMCs DE granulated and mobilization of intracellular Ca²⁺ in MRGPRX2-expressing HEK293 cells occurred by two peptides corresponding to MBP residues 99–110 (MBP (99–110) and ECP residues 29–45 (ECP (29–45), respectively. The prostaglandin D2 production was induced along with MBP (99–110) or ECP (29–45) stimulation by HCMCs.

Surface Dielectric Barrier Discharge Plasma: A Suitable Measure against Fungal Plant Pathogens

One of the key restrictions to the agriculture and food industry is the fungal diseases. Fungal diseases reduce the quantity as well as the quality of the products and affect the economy of the world. Synthetic fungicides are powerful tools used against fungal diseases to protect the crop. Tough fungicides are extensively used for the reduction of yield losses by enhancing its production but their uses could contribute to the health and ecological hazards. Hence, new and environmentally safer solutions are implemented to minimize health risks. Therefore, worldwide demand for the growth of the population is also increasing with the increasing number of undernourished individuals in the world. All plant protective measures should be integrated in such a manner that limits the yield losses and protects the plants from field and postharvest diseases. Furthermore, other challenges for growers are toxic substances like mycotoxins, as well as human pathogens such as *Salmonella spp.*, *Listeria monocytogenes*, *Escherichia coli*, and nor viruses. Therefore, there is a requirement of sustainable approaches for the protection of plant and food products. New safer technologies are developed and promoted based on human as well as environmental safety. An innovative favorable solution among those fungicides is low temperature plasma that can be manufactured by using different discharge techniques. Comprehensive multidisciplinary research has been conducted in the field of biology to prove the validity of the application of plasma technologies against numerous pathogens. Recent developments in the field of plasma medicines increase the demand for the application of plasma in the field of agriculture. The use of plasma medicines has also increased for the treatment of pathogen diseases. The use of low temperature pressure on seeds reduces the contamination of microbes and supports the growth of seeds.

Pharmacological Evidence for the use of *Cissus assamica* as a Medicinal Plant in the Management of Pain and Pyrexia

A harmful stimulus induces physical distress within the body is known as pain. Traditionally, different pain killers are used for the relief of pain. A number of plant metabolites produce an anti-nociceptive response and are used as painkillers. Pyrexia is also known as a fever. Different infections, inflammation and diseased conditions are responsible for the fever.

Inflammation is caused by the chemical mediators that are formulated by the infected and injured tissues. Cytokines increase the production of prostaglandin E2 in the brain and activate the hypothalamus to raise the body temperature. Then the feedback mechanism dilutes the blood vessels and induces sweating to reduce the body temperature. Traditional use of medicinal plants for the treatment of fever had fewer side effects. Different medicinal plant extracts had also pharmacologically investigated; still, a number of plants were needed to extract their medicinal properties. It is estimated by World Health Organization (WHO) that approximately 1.5 billion populations diseases are cured by multiple herbal medicines and almost 25% prescribed medicines are made up of plant extracts. It was also estimated that 80% of the developing countries population depend on herbal medicines. As most of the therapeutic agents cause severe side effects, there is a need for efficient management of fever. A recent study explored the bioactive and phytochemical components of a Bangladeshi tribal medicinal plant *Cissus assamica* Vitaceae. Cold extraction was done after collection, washing, dried and powdered of stems, leaves and roots of this plant. The methanol stems were fractionated with four solvents while fractionation of leaves extract was done with two solvents. The anti-nociceptive activity of plant extract was examined by *in vivo* study and antipyretic activity of methanolic extract of only leaves was investigated. The doses of 200 and 400 mg/kg of all the extracts were used in Swiss-albino mice. As compared to standard diclofenac sodium (60.49% inhibition), both doses showed a significant anti-nociceptive response of the methanolic extracts of stems as well as roots and its dichloromethane, chloroform, pet ether fractions. When compared with standard morphine dose, both doses showed a significant anti-nociceptive response of methanolic stem and root extracts. It was also observed that when methanolic extract of leaves was compared with standard exhibited significant antipyretic activity after the administration of 3 doses. So it was concluded in this study that significant pharmacological properties were present in this medicinal plant and further researches are required to explore the actions of different parts of this plant.

Porcine Liver Decomposition Product derived Lysophospholipids Promote Microglial Activation *in vitro*

The burden on the health care department increases by rapid aging and age related diseases. Almost 50 million people are suffering from the decline of normal cognitive function also known as 'dementia' at the age of 60 or above whereas approximately 10 million new cases are diagnosed every year. As dementia is of different types, alzheimer's is the most common type of it. Almost 60-70% of elderly people are suffering from alzheimer's disease. Although mild cognitive impairment relapses to normal or sometimes remains stable, the risk of developing dementia is more in these patients. Currently, clinical trials are being performed to determine the effective treatment of mild cognitive impairment. Till now, no specific treatment is approved for the management of diabetes. Lipids play a vital role in the neuronal function of

the brain. The mammalian cell membranes are made up of glycerophospholipids, sphingolipids, and cholesterol. Neuronal membranes are made up of lipid bilayers plasma membranes. It was reported in previous studies that the cognitive function of elder people may increase by Porcine Liver Decomposition Product (PLDP) produced by protease treatment. But the exact composition of this product is still unclear. A study was conducted for the identification of major phospholipids and effects of phospholipids on *in vitro* activation of microglial cell shape, proliferation and morphology. The study showed that microglial cells involved in the activation of phospholipids and procaine liver decomposition products derived from phospholipids. The enzyme autotoxin mediated the cell morphology by the production of lysophosphatidylcholine. Inhibition of autotoxin enzyme also promotes cell morphology but this effect may be reversed with increased production of this enzyme by lysophosphatidylcholine high level. Further research is required to assess the use of lysophosphatidylcholine in the treatment of cognitive impaired function.

Low Level Electricity Increases the Secretion of Extracellular Vesicles from Cultured Cells

Different types of cells secrete extracellular vesicles also known as exosomes made up of lipid bilayers. The endogenous cargo includes protein and nucleic acids as well as microRNA (miRNA) and mRNA transfer from one cell to another cell through exosomes. Exosomes are also known as bio shuttle in the gene therapy field for the effective supply of biomolecules within the cells. It was previously demonstrated in a study that small interfering RNA (siRNA) were filled into exosomes through the electroporation process and contribute to pathologies of several diseases by acting as a delivery vector. Particularly, in cancer, exosomes derived from cancerous cells are involved in the formation of metastasis and provide an environment to grow cancer. Cancer cell derived exosomes also contain expected cancer antigens that could be used in the treatment of cancer. Therefore, exosomes are also predicted as treating tools for the management of various diseases. Ultracentrifugation processes are generally used to provide a conditioned medium in laboratories for research to obtain exosomes. But there would be the difference in the yield, properties and purity of these exosomes of donor cells. Polymeric precipitation and affinity based purification methods have been stated as the yield and purity increasing methods. Another useful approach is to increase yield of exosomes to develop such methods that increase the secretion of exosomes. Plasma membrane depolarization of neurons, increases of intracellular Ca^{2+} concentrations being triggered in certain cells and involvement of the Rab GTPase family are previously reported a mechanism to increase secretion from exosomes. Thus, a study was conducted to determine the effect of electrical treatment of 0.34 Ma/cm^2 on the secretion of exosomes. It was also investigated the amount of secretion from extravascular in that study. Therefore, B16F1 murine melanoma and 3T3 swiss albino cells as representative cancer and normal cell line respectively were used for this study. In

order to confirm the purity of secretions, the representative exosomes markers were also examined in that study (Figure 1).

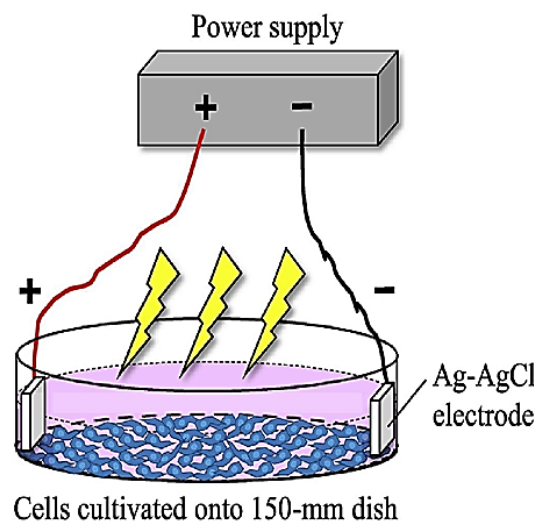


Figure 1: Cells cultivated onto 150 mm dish.

The results of the study demonstrated that the ultracentrifugation process increased the release of extravascular particles without causing any toxicity. Gene expression was not changed by applying electric current and the collected amount of extravascular particles was also increased.

Biochemical Characterization of TRIM72 E3 Ligase and its Interaction with the Insulin Receptor Substrate 1.

In order to maintain the homeostasis of the cells, the protein ubiquitination process plays an important role. Multiple cell processes such as apoptosis, DNA/RNA replication, progression, transcription and autophagy of cell cycle are regulated by protein ubiquitination. Covalent attachment of the ~ 76 amino acid group known as ubiquitin to a target protein *via* an is peptide bond is called Ubiquitination. Three important enzyme systems like ubiquitin activating enzyme (E1), conjugating enzyme (E2) and an ubiquitin ligase (E3) are involved in ubiquitin conjugation process. The enzyme, ubiquitin ligase, plays an important role in recognition of target substrate based on the attachment of ubiquitin chains to lysine residue. Recently, *in vitro* auto ubiquitination assays were performed to determine the activity of TRIM72 E3 ligase. Despite the recent advancement of a study was conducted to characterize TRIM72 oligomer status and different forms of this enzyme family were also determined. A set of 12 conjugating enzymes (E2) were screened and 2 new conjugating enzymes that work along with TRIM72 were recognized. However, the study showed that this enzyme had minimal activity and its activity may be enhanced with additional regulation.

Concentration Dependent Cholesterol-Ester and Wax-Ester Structural Relationships and Meibomian Gland Dysfunction

The elucidation of the compositional and functional relationship of wax ester and cholesterol ester helps us to understand how lipids contribute to natural and pathological processes. Wax ester and cholesterol ester are natural lipids abundantly found in sebaceous glands secretion and meibomian glands secretion. These lipids are also found in the spermaceti of whales and exoskeleton coating of insects. Their structure is demonstrated in [Figure 2](#).

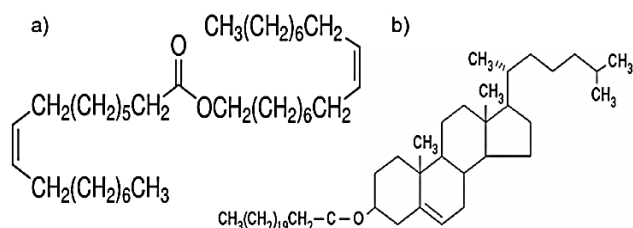


Figure 2: Structure of a) The wax ester oleyl oleate and b) The cholesteryl ester cholesteryl behenate.

In humans, different functions of cholesterol ester have already been studied. Cholesterol ester involved in regulation of free cholesterol in cells and the transportation of cholesterol to specific organs. As a high level of cholesterol is present in the human eye lens and is associated with cataract formation in the eye, therefore, it is important to regulate cholesterol levels in the lens by cholesterol ester. It was discovered in several studies that cholesterol ester level in the human eye increases up to 50% in concentration with age. It was also demonstrated that this is also involved in plaque formation and contributes to atherosclerosis. A recent study was established to investigate the effect of the variable cholesterol ester/wax ester ratio on lipid thermodynamics. For the quantification of cholesterol ester and wax ester in human lenses, infrared spectroscopy method was used in that study. The results of this study showed 36% lower in the ratio of cholesterol ester/wax ester due to dysfunction of the meibomian gland in donors as compared to donors without dry eye.

Mitochondrial Respiration of Complex II is not lower than that of Complex I in Mouse Skeletal Muscle

A large amount of energy is required by skeleton muscles to perform daily activities. Mitochondria play an important role in the production of ATP. Mitochondrial function is suspected to compromise in those tissues that require a large amount of energy and it is an alarming situation that might disturb the normal function of skeleton muscles and as a result whole body function. A study reported the impaired function of mitochondria in skeletal muscle diseases and various diseases like diabetes, heart disorders as well as Chronic Obstructive Disorder (COPD) also associated with mitochondrial dysfunction. Furthermore, it was also demonstrated that age related muscle dysfunction is also associated with impaired mitochondrial dysfunction. Super complexes consist of

complex I, III and IV of super molecules in the electron transport chain that increases the electron transfer efficiency. Complex II is important among other complexes as it involves in the oxidation of succinate to fumarate in mitochondria and reduces ubiquinone to ubiquinol. Furthermore, in a recent study, it was demonstrated that several diseases are associated with a deficiency of complex II. Birch-Machin, et al. also reported a number of diseases associated with deficiency of complex II including neurodegenerative diseases. But it is still unclear how complex II contributes to ATP production by mitochondrial Oxidative Phosphorylation (OXPHOS). Further research is required to confirm this step.

Molecular Dynamics Simulation Study of AG10 and Tafamidis Binding to the Val122Ile Transthyretin Variant

An unusual genetic disorder in which amyloid plaques deposit in the heart is known as familial amyloid cardiomyopathy. These plaques lead to heart failure after intruding into the heart muscle and can also damage other organs of the body. The onset of familial amyloid cardiomyopathy occurs mostly in those people who are above 60 years old and have a history of carpal tunnel syndrome. Treatment of disease includes pacemaker and gene therapies. The study reported that the protein Transthyretin (TTR) involves in plaque formation by aggregation proceeding misfolding of protein produced by the liver and brain. Transthyretin protein transports thyroxine hormone into the blood and the cerebrospinal fluid. Molecular Dynamics (MD) simulation study was conducted to determine the linkage of four ligands to the protein transthyretin. It was studied that familial amyloid cardiomyopathy is due to detachment, incorrect folding and aggregation of altered transthyretin proteins. The drug tafamidis accompanying drug candidate AG10 and its decarboxylase and N-methyl derivatives were used as ligands. The study reported that these ligands bound to 2 halogen binding sites in the receptors. A very little change was observed during molecular dynamics simulation in the conformation of ligand AG10. The ligand AG10 interacts with the protein at two points and this interaction is disrupted with the decarboxylation of this ligand. Similarly, this two point interaction is also destroyed by the addition of a methyl group. This would lead to change in the arrangements of AG10 ligand during molecular dynamics simulations. In conclusion, less hydrogen bonding points to the receptor were observed in ligand tafamidis as compared to ligand AG10 during molecular dynamics simulation study.

Discovery of Entirely New Class of RNA Caps in Bacteria

Dinucleotide polyphosphates are more than 50 years known signaling molecules and present in almost every type of organism. These molecules are also known as "Alarmones" as stress increases their concentration into the cells and have an impact on the functions of the cell but the mechanism of action is still not known. It was observed by Hana Cahova and her colleagues that the structure of these molecules

resembled RNA structure. In fact, they assumed that these molecules were part of the RNA structure (Figure 3).

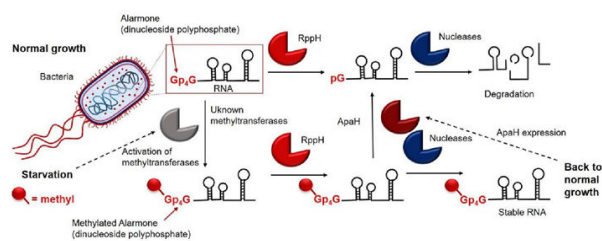


Figure 3: Methyated normal growth.

Certainly, nine new structures were detected as a part of RNA by using mass spectrometry. The chemists perceived the conspicuous resemblance of these molecules with the structure of RNA. It was observed by the researchers that RNA polymerases use alarmones as a building block in the synthesis of RNA. Furthermore, they perceived that 2 types of enzymes degraded the capping of alarmones on RNA. It was also reported that some of these caps molecules had methyl groups and cleavage of RNA can be protected by this methylation. As starvation conditions significantly increase the amount of alarmones capped RNA, degradation of RNA protected by these RNA capped molecules. This is the first work in the field of chemistry to determine the signaling molecule as a part of the RNA molecule.

Amplification and Imaging of MicroRNA as a Biomarker to Detect Tumor Development

The dysregulation in the living cells is indicated as an alteration in the expression of RNA structure. MicroRNA is a type of RNA that is deliberated as a biomarker for the cells that have a potential to cause cancer. A bio imaging process was used by the china scientists for the amplification of MicroRNA in the live cancer cells based on autocatalytic biocircuit activated by synthetic DNA (Figure 4).

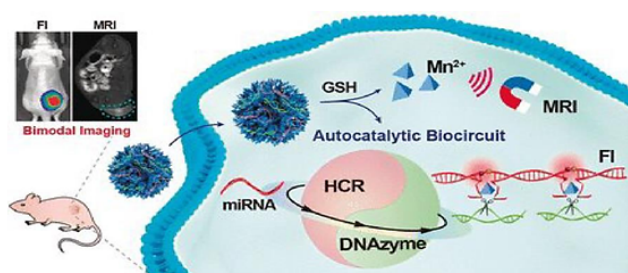


Figure 4: Amplification and imaging of microRNA as a biomarker to detect tumor development.

The long lasting goal in the field of medicines is to diagnose the tumor before it appears in the body. The pattern of RNA expression or metabolic degradation caused by a change in the expression of RNA structure is the most precise biomarker to determine the carcinogenicity in a live cell. Among the different types of RNA, MicroRNA is a noncoding short RNA that stimulates or inhibits the translation of genetic information. As MicroRNA present in a very small amount and signaling entity is required for their visualization in the cells,

so it is difficult to detect it in the live cells. Thus, an appropriate amplification detection mechanism is developed by Wuhan University scientists. Genetic information is transferred by RNA to the cytoplasm from the nucleus where it synthesizes. Wang and his coworkers examined an autocatalytic DNAzyme biocircuit in which the synthetic DNA assembled with MicroRNA. Fluorescence dye analysis was used to detect cancer in a mouse. Bright fluorescence was observed at the site where the tumor was located after the administration of DNA enzyme detection kit. For the delivery of DNA enzyme to the cancerous cells, drugs in the form of nanoparticles, structure as honeycomb, made up of manganese dioxide were used by the scientists. The advantage of composition and structure is that glutathione abundantly present in cancerous cells can readily activate the nanoparticles and autocatalytic DNA enzyme biocircuit is sustained by manganese ions. This bioimaging system would be a powerful technique for the visualization of cancer cells. This is highly auspicious to selectively target different MicroRNA for the investigation of cancer cells.

Researchers Map Structure of key Chromatin Remodelling Complex

The researchers in Northwestern University have mapped a protein complex known as SWI/SNF complex that consists of ATPase Swi2/Snf2p. This complex is important for both expression of genes and repairing of impaired DNA. The understating of this protein complex helps to understand the mechanism of action of cancer (Figure 5).

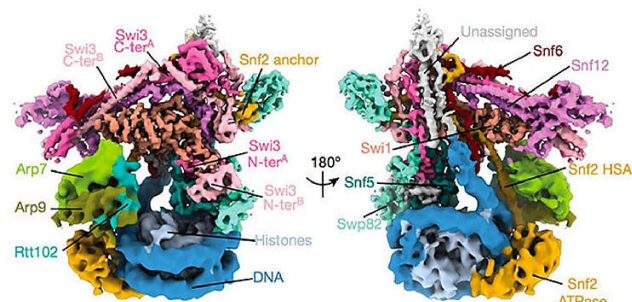


Figure 5: Researchers map structure of key chromatin remodeling complex.

Northwestern's Yuan he reported that more than 20% of human cancer cells have this protein complex. So it is important to understand how SWI/SNF complex regulates the chromatin structure in gene transcription. A study was conducted to reveal the 3D structure of the SWI/SNF complex by using cryogenic electron microscopy (cryo-EM) technique. Electron microscopy is used for the direct image of protein complexes. Then the supercomputing cluster is reconstructed this image into 3D form. This is the first study in which scientists use revolutionary cryogenic electron microscopy technique for the determination of 3D structure that is bound to a nucleosome. This study also helps the researchers to understand the cancer associated mutations in this protein complex and this complex overwhelms the development of cancer in the body.

DISCUSSION

Discovery of New Structure of Important Protein in the Brain

Leucine Transporter (LeuT) is a special type of bacterial protein present in the cell membrane. Brain's neurotransmitter transporters belong to the same family as leucine transporter belongs. Neurotransmitters are released from the nerve cells and reuptake of neurotransmitters occurs after receiving signals from the brain. Some drugs act by increasing the neurotransmitter level through blocking the transport systems like antidepressants act by inhibiting the serotonin neurotransmitter. Transporters are usually derived from bacteria that absorb nutrients from the environment for survival. Transporters play an important role in the regulation of signaling molecules and they balance the work of the whole system of the brain. So the understanding of the functions of these transporter proteins is important in order to discover better drugs. X-ray crystallography is recently used for mapping the mechanism of transporter proteins (Figure 6).

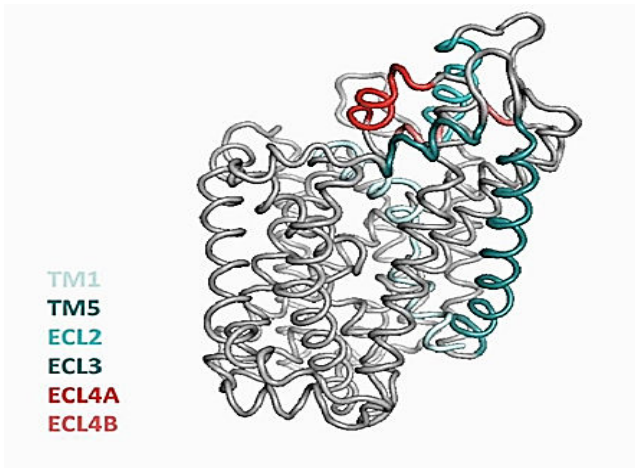


Figure 6: Animation of the four stages of the LeuT transporter put together for a full cycle.

CONCLUSION

The corresponding use of both biochemistry and molecular biology study in the field of biology is increasing our understanding regarding the function of the protein in the living system. If we know how the protein functions in living systems, it will become easy to understand how protein functions could control and alter the living systems.

COMPETING INTERESTS

No significant competing interests were declared among the authors.

AUTHOR CONTRIBUTIONS

SMA planned and designed the study. SMA and UK searched the data. UK and SMA interpret the results and draft the manuscript. UK critically reviews the draft.

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