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Highlights of Biomolecules as Spark of Life

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Abstract— *Biomolecules are the constructing molecules of all the living organisms and are vital for the structure and proper functioning of all the living cells. Major Biomolecules that are synthesized in the body are carbohydrates, proteins, lipids and nucleic acids. The carbohydrates provide energy and regulate metabolism. Nucleic acids are the stores of the genetic information and transmit the inherent characters from the parents to the offspring's and synthesize proteins. Proteins and lipids regulate the cellular functioning and various metabolic activities. Protein is essential for muscle growth and health whereas lipids stores fats in our body for survival. Minor molecules such as vitamins and minerals are essential for growth and development. They aid strong immune and good health, is required in adequate amounts to fulfill the basic functioning of the body. These biomolecules are involved in cell proliferation, tissue development, repair, and regulate immune health as well as metabolic activity of the body. They are recognized as spark of life as without these biomolecules, life could not exist. The present article represents the basics of the major and minor biomolecules that are the stars of life to regulate the metabolism of the living world.*

Keywords— *Biomolecules, macromolecules, micronutrients.*

I. Introduction

Biomolecule is a biological molecule produced by the living organisms that are essential to carry out the various biological processes such as cell growth, development, differentiation and morphogenesis. The biomolecules are the organic compounds commonly made up of carbon, hydrogen and oxygen. The major biomolecules are carbohydrates, proteins, lipids and nucleic acids which are also known as macronutrients. The macronutrients are required in large quantities to carry out various metabolic activities besides the basic functioning of growth promotion and development (Trembo et al; 2002, Gonzalez et al; 2018). These biomolecules play a major role in physiological and metabolic processes such as respiration, lipid metabolism, storage of genetic information etc. Micronutrients are required in small varying quantities to carry out the physiological functions required in the health maintenance. Micronutrients basically include vitamins and minerals which are the building blocks of the good health. Vitamins and minerals can be obtained from the balanced diet that fulfills the adequate requirement of these micronutrients if consumed systematically. Improper diet can cause micronutrient malnutrition which may affect the physiological functioning leading to poor health and weakness. The detailed study of these major biomolecules such as macronutrients and micronutrients is well documented in the article below.

1.1 Macronutrients (major biomolecules)

1.1.1. Carbohydrates

Carbohydrates are derives from a Greek work saccharide which means sugar. The carbohydrates are sugar containing biomolecules which works best reservoir of energy storage (Gonzalez et al.; 2018). The carbohydrates are present in most of the fruits and vegetables as well as grains, legumes etc. They form the vital part of the backbone of the nucleic acids such as deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). The two major categories of the carbohydrates are simple and complex carbohydrates (Cummings et al.; 2007, Englyst et al.; 2007) Figure 1. The simpler is composed of single or two monomeric units of sugars with basic molecular structures composed of monosaccharide and disaccharide. The most common examples of simple sugars are glucose, fructose, sucrose and lactose. The complex sugars are composed of multiple units of sugars bonded together and compose of heavy molecular structure such as polysaccharides (Zeng et al.; 2019). Homo and heteropolysaacharides are two categories of the complex polysaccharides. The examples are starch and cellulose etc. The complex carbs are broken down into simpler one's to release and store energy to carry out the metabolic activities and day to day functioning by the living organisms (Navarro et al.; 2019).

Monosaccharide means mono (single) and saccharide meaning sugar. It is a simple carbohydrate composed of single unit of sugar. They serve as the building block of carbohydrates. They are polyhydroxy aldehydes or ketones composed of hydroxyl group and carbonyl group. They are colorless, water soluble crystalline solids. The disaccharides are formed by two monosaccharides that are joined by the glycosidic bonds. Monosaccharides can form complex carbohydrates. When more than ten monosaccharides combine together by glycosidic bonds, then polysaccharides are formed (Cummings et al.; 2007). The glucose, galactose and fructose are the common monosaccharides made up of single unit sugar. Monosaccharides play a vitol role in metabolism by providing energy to the living organisms. Glucose is an aldose sugar comprises of aldehyde group and is a hexose. It exhibits mutarotation and is a reducing sugar. The most basic monosaccharide glucose is broken down in cellular respiration by the process known as glycolysis. Furthermore, it enters into the kreb's cycle and later on oxidative phosphorylation to release energy in the form of adenosine triphosphate (ATP) (Gonzalez et al.; 2018 and Cummings et al.; 2007). When the energy is not needed then the glucose is stored with other monosaccharides in the form of glycogen. The glucose can be combined as many monosaccharide units to form polysaccharides such as cellulose, starch etc. The other monosaccharide fructose, a fruit sugar can form disaccharide sucrose. The sucrose is formed from glucose and fructose

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combined together by glycosidic bond. Fructose is a simple ketose sugar known as six carbon polyhydroxy ketone and derived from sugarcane or sugarbeet. The fructose is used in the food and beverage industry because of its low cost and sweetness property (Cummings et al.; 2007, Englyst et al.; 2007). Another monosaccharide galactose which is a aldohexose when combined with glucose forms a disaccharide lactose. Many of the dairy products such as sugar beets are composed of galactose. Galactose is a non-essential biomolecule or a nutrient is synthesized in the body by glucose as when required. Galactose combines with lipids/proteins to form glycolipids/glycoproteins. It is composed of antioxidant and anti-inflammatory properties as well good for digestive system too.

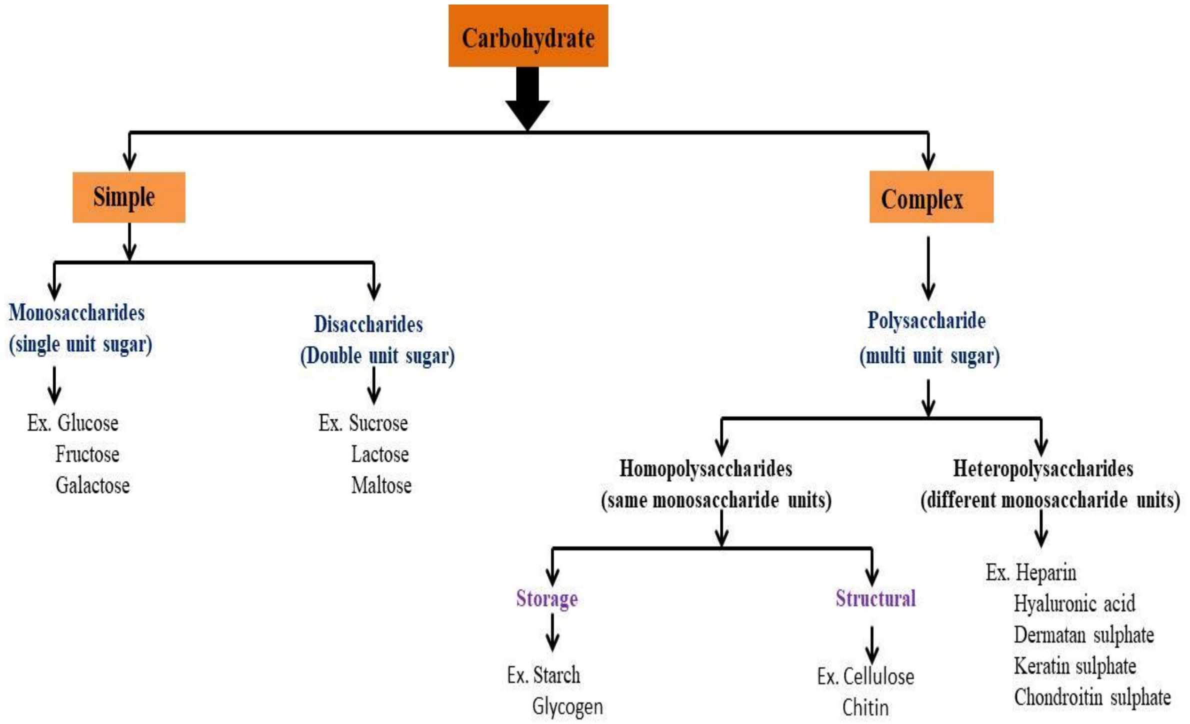

Figure 1. The figure shows the classification of carbohydrates.

The disaccharide is another simpler sugar made up of two units of monosaccharides and are maltose, sucrose and lactose. Maltose is a malt sugar formed from two monosaccharide units of glucose by glycosidic bond. Maltose is a reducing sugar and is less sweet. It is not used much in the food and beverages because of its less sweetness property. It is found in the barley malt syrup. Maltose is used in the brewing industry and baking as well (Cummings et al.; 2007, Englyst et al.; 2007). The yeast in the fermentation easily metabolizes maltose as compared to other sugars. The maltose is also used as flavoring and aroma as well in the food of infants. Sucrose commonly known as cane sugar or table sugar is formed from fructose and glucose. Sucrose is produced commercially in large quantities from sugarcane and sugarbeet. It is used in the food industry in most of the soft drinks and beverages. It is also used in the production of jams, jellies and as food preservation. It is used in baking to provide a brown color and as an intermediate for emulsifying agents. The other unique property is to act as an antioxidant as well. It is also used for the carriage of carbon in plants. Lactose is another disaccharide made up of glucose and galactose subunits and is used in the food industry (Cummings et al.; 2007, Englyst et al.; 2007). It is white water soluble, mild sweet in taste. Lactose is one of the major components of the milk and it is also known as milk sugar. Lactase is the enzyme which helps the human body to digest lactose. Lactose is used in the pharmaceutical industry as a drug binder and filler in most of the medicines.

The complex polysaccharides are composed of multiple monosaccharide units and are categorized into two subtypes homo and hetero polysaccharides. The polysaccharides are involved in the cellular communication. Homopolysaccharides composed of same type of the monosaccharide units. Furthermore, homopolysaccharides are divided into storage and structural polysaccharides. The storage polysaccharides store the food for the metabolic functions in the living organisms. The basic examples are starch and glycogen. Starch is stored in plants and is a polymer of glucose and is composed of amylose and amylopectin (Navarro et al; 2019, Brown et al.; 2004). Amylose is composed of few linear chains of the glucose molecule while amylopectin is a branched chain of several thousand glucose molecule. Amylose is present about 20% while amylopectin about 80% which combined to form starch. The starch is composed of alpha 1,4 glycosidic bonds. During photosynthesis, starch is produced from excess glucose by the green leaves of the plant. Starch is widely used in the food and textile industries (Brown et al.; 2004). Glycogen another storage homopolysaccharide more branched is composed of alpha 1, 4 linkage linked with alpha 1, 6 glycosidic linkage. It serves as storage in animal cells. It is stored in the liver and muscles and works as an energy reservoir. Upon hydrolysis, forms glucose for energy production as per the energy need by the living organism. Structural homopolysaccharides are cellulose and chitin which forms the structural part of the plant and animals. The plant cell wall is composed of cellulose as the major component. Cellulose is made up of glucose units by β linkages and produces paper, wood in many industries (Cummings et al; 2007). Among these paper and cotton are purely made up of cellulose. Chitin is a structural component of many animals and fungi. It provides strength and structure to them. Chitin is a fiber forming polymer made up of N acetyl glucosamine formed by β 1,4 covalent bonds. Chitin is related to chitosan and is used in food and pharmaceutical industry (Cummings et al; 2007).

Hetero-polysaccharides or mucopolysaccharide are made up of different monosaccharide units and are responsible for structural functional roles in the living organism (Gonzalez et al; 2019, Zeng et al.; 2019). Heparin, hyaluronic acid, dermatan sulphate, keratin sulphate and chondroitin sulphate are the major mucopolysaccharides. Heparin is a linear hetero-polysaccharide composed of α1-iduronic acid, β-d-glucuronic acid and α-d- glucosamine repeat units. Heparin acts as an anticoagulant prevents the formation of clots within the blood. It has close structural and functional similarity to heparan sulphate. Heparin is highly sulphated form of heparan sulphate.

Keratan sulphate another heteropolysaccharide is linear composed of N-acetyl glucosamine-galactose. It is mainly found in cartilage, bones, cornea, nails, and hairs and play a vital role in structural support and strength. It acts as a cushion to absorb mechanical shocks. It also used as molecular marker tool for the diagnosis of cartilage damage (Gonzalez et al.; 2019, Zeng et al.; 2019). Keratan sulphate is the key component of the corneal stroma and regulates the architecture of the tissues with collagen to govern the fibril size and spatial arrangement. Dermatan sulphate is another heteropolysaccharide found in skin, vessels, heart. Lungs and play a role in coagulation, cardiovascular diseases, wound repair, response to infection etc. It accumulates abnormally in mucopolysaccharidosis disorders.

Hyaluronic acid is non sulphated glycosaminoglycan found in neural, connective and epithelial tissues. It acts as the cushion and lubricator in the joints and the other tissues. The amount of hyaluronic acid decreases with an age elevation so it is used in the medication of various diseases. It is used in the treatment of the eye cataract, osteoarthritis, mouth sores, dry eyes etc. Chondroitin sulphate is another polysaccharide residing in the extracellular matrix. It works in adhesion with other growth factors in the cell proliferation, central nervous system development (Gonzalez et al; 2019, Zeng et al.; 2019). It is also found in cartilage around joints and it is also produced commercially. It protects the cartilage by retaining the water. It also helps to slow down the activities of the enzymes and proteins that breakdown the collagen in the joints. It acts as a lubricator and provides mechanical strength to the bones and cartilage. These polysaccharides play a role in structural support and strength in the body.

1.1.2. Amino acids and Protein

Amino acids are the organic molecules composed of basic amine group, acidic carboxyl group, and carbon, hydrogen along with a specific R group which is a functional group or side chain unique in all the amino acids. The amino acids are further classified on the basis of the chemical structure of the R group. The proteins are made up of amino acids. The sequence of the amino acid in the protein is determined by the information found in the cell genetic code (Calder et al.; 2004, Kimball et al. 2006). The genetic code is the nucleotide base sequence in the nucleic acids (DNA and RNA) that code for the amino acids. This not only determines the order of the amino acids in the protein but also the structure and function of the protein (Calder et al.; 2004). Amino acids is composed of the zwitter ionic property which means net charge is zero as amino acids have both positive and negative charge so it is neutral. They are amphoteric in nature act as both acid and base. All amino acids are of levorotatory (L) conformation except glycine as it does not have asymmetric carbon atom, not optically active neither dextrorotatory (D) nor levorotatory (L) (Akram et al.; 2011, Rose et al.; 2019, Rose et al.; 1957).

Amino acids are classified on various aspects Figure 2a. On the basis of functional R groups, amino acids are classified into five major groups such as polar uncharged R groups, non-polar aliphatic R groups, aromatic R group, positively charged R group and negatively charged R groups (Arany et al.; 2018). The polar uncharged amino acids are neutral that means neither basic nor acidic in nature. The polar uncharged amino acids are cysteine, glutamine, serine, asparagine, proline and threonine. The non-polar aliphatic amino acids compose of aliphatic side chains as their functional group and are non-polar hydrophobic in nature. The non-polar aliphatic amino acids are valine, isoleucine, methionine, alanine, leucine and glycine. The aromatic amino acids contain aromatic ring in their structure. The aromatic amino acids are tyrosine, tryptophan and phenylalanine. Among these, tyrosine is polar in nature. The positively charged amino acids are polar basic amino acids such as arginine, lysine and histidine. The negatively charged amino acids are polar acidic amino acids. The examples of negatively charged amino acids are glutamate and aspartate.

On the basis of the nutritional classification, amino acids are of three types essential, semi-essential and non-essential (Hou et al.; 2015, Hou et al.; 2018). The essential amino acids are very necessary for the growth and development of the body to carry out the necessary metabolic functions (Rose et al; 2019, Li et al.; 2007). These amino acids are not synthesized by the body but they are necessarily required in the diet as they regulate metabolism. Such essential amino acids are threonine, phenylalanine, leucine, valine, tryptophan, methionine and isoleucine. The semi-essential amino acids are also involved in the regulation of growth and development. They also regulate metabolism but not synthesized in adequate amount in the body to meet the growth promotion and metabolic regulation (Li et al; 2007). These semi-essential amino acids are histidine and arginine. Last comes the non-

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essential amino acids that are not required essentially but are synthesized in the body. These non-essential amino acids are glutamine, cysteine, glycine, serine, proline, alanine, asparagine and tyrosine.

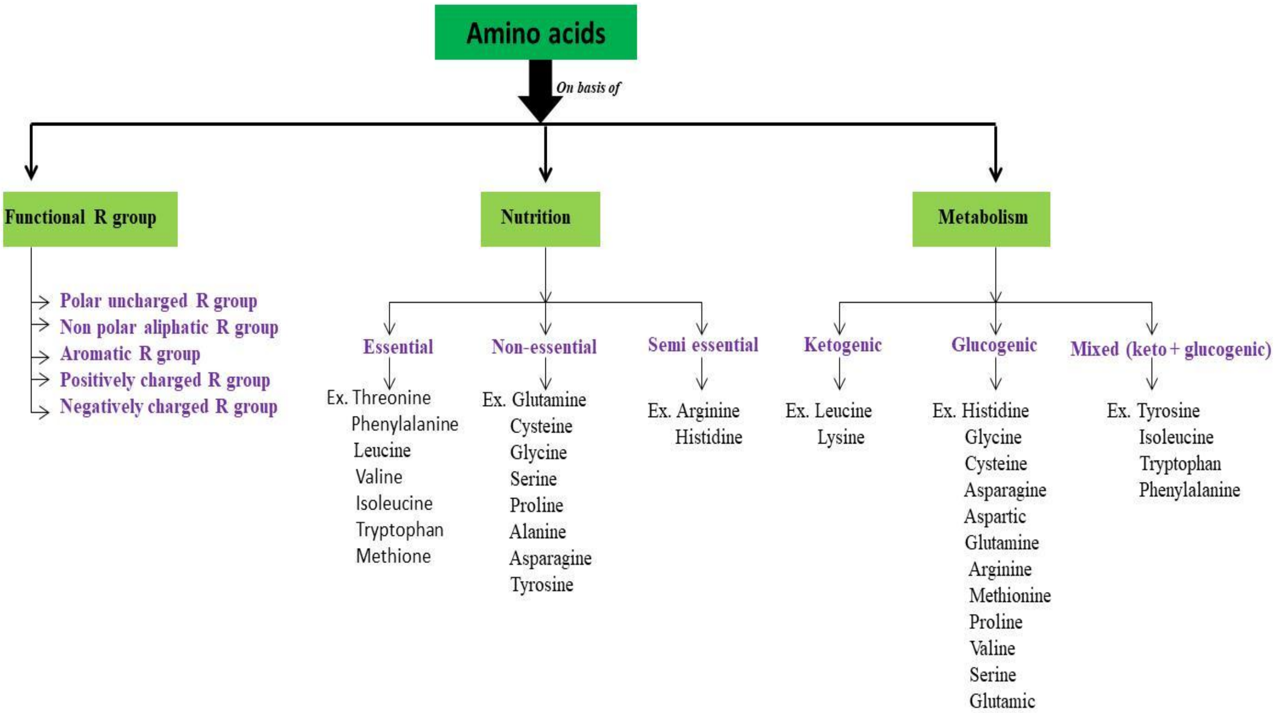

Figure 2a. The figure depicts the classification of amino acids on the basis of functional group, nutrition and metabolism

Furthermore, amino acids are also classified on the basis of metabolism. They are classified into three group's ketogenic, glucogenic and mixed ketogenic glucogenic amino acids. The ketogenic amino acids as the name suggests give ketone bodies such as leucine and lysine. The glucogenic amino acids give glucose on their degradation and examples are histidine, glycine, cysteine, asparagine, aspartic, glutamine, arginine, methionine, proline, valine, serine and glutamic. The gluco and ketogenic amino acids forms both glucose and ketones on their metabolism and are phenylalanine, tyrosine, isoleucine and tryptophan. This way the amino acids are being classified on the basis of functional, metabolic and nutritional categories.

Amino acids are the building blocks or base of the proteins, hormones and neurotransmitters (Li et al.; 2007). Proteins serve as the base of the muscles, bones, cartilage, blood and skin. The proteins help to regulate most of the body functions and regulate various organs. They are involved in the growth and development provides structural support, tensile strength to bones, muscles, and act as a chemical messenger to carry out neural transmission (Pasiakos et al.; 2014 and Pasiakos et al.; 2015). Proteins are also involved in the cell signaling and locomotion. On the basis of structure proteins are classified into three group's globular, fibrous and intermediate proteins (Ouzounis et al.; 2003, Swindells et al.; 1998, Fu et al.; 2000) Figure 2b. The globular proteins are most abundant and are spherical in structure (Travaglini-Allocatelli et al.; 2009). They carry out the specific biological functions in the body. They are soluble in water and regulate the functioning of various organs. The common globular proteins are insulin, haemoglobin, myoglobin etc. Insulin regulates the blood sugar levels allows the cells to absorb glucose from the blood (Tremblay et al; 2007). Insulin is produced by the pancreas. Haemoglobin transports oxygen from the capillaries in the lungs to rest of the tissues of the body. It is the main protein in red blood cells to carry out the oxygen from lungs to other parts of the body. Myoglobin is a protein in the muscles binds oxygen and acts as an oxygen reservoir during physical stress. Fibrous proteins are less soluble in water and provide structural support and strength by forming connective tissues, muscles fibers (Squire et al.; 2017, Yigit et al.; 2016). They provide shape and strength to the tissues. The common fibrous proteins are keratin, collagen, fibrin, and elastin. Collagen is the main protein of the connective tissues, provides strength and support to them. Keratin is the protein mainly found in the hairs (Astbury et al.; 1930). It makes the hair soft, straight and strong. Fibrin is another fibrous protein responsible for the blood clotting. Elastin is a protein present in extracellular matrix, maintains shape of the connective tissue and retains the elasticity of the tissue. The third type is intermediate filament proteins that are the cellular phosphoproteins. They are regulated by the post translational modifications such as phosphorylation, glycosylation etc. Vimentin is an intermediate protein found in the mesenchymal cells.

On the basis of the composition, proteins are classified into three groups simple, conjugated and derived proteins (Ouzounis et al.; 2003) Figure 2b. The simple proteins are the proteins which upon hydrolysis yield amino acid and small compounds of carbohydrates. The examples are globulins,

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albumins, histones, glutelins and protamines etc. The conjugated proteins are the proteins that conjugate either with lipids, carbohydrates and nucleic acids to form glycoproteins, phosphoproteins and nucleoproteins. The derived proteins are obtained from either simple or conjugated proteins such as peptides or denatured proteins.

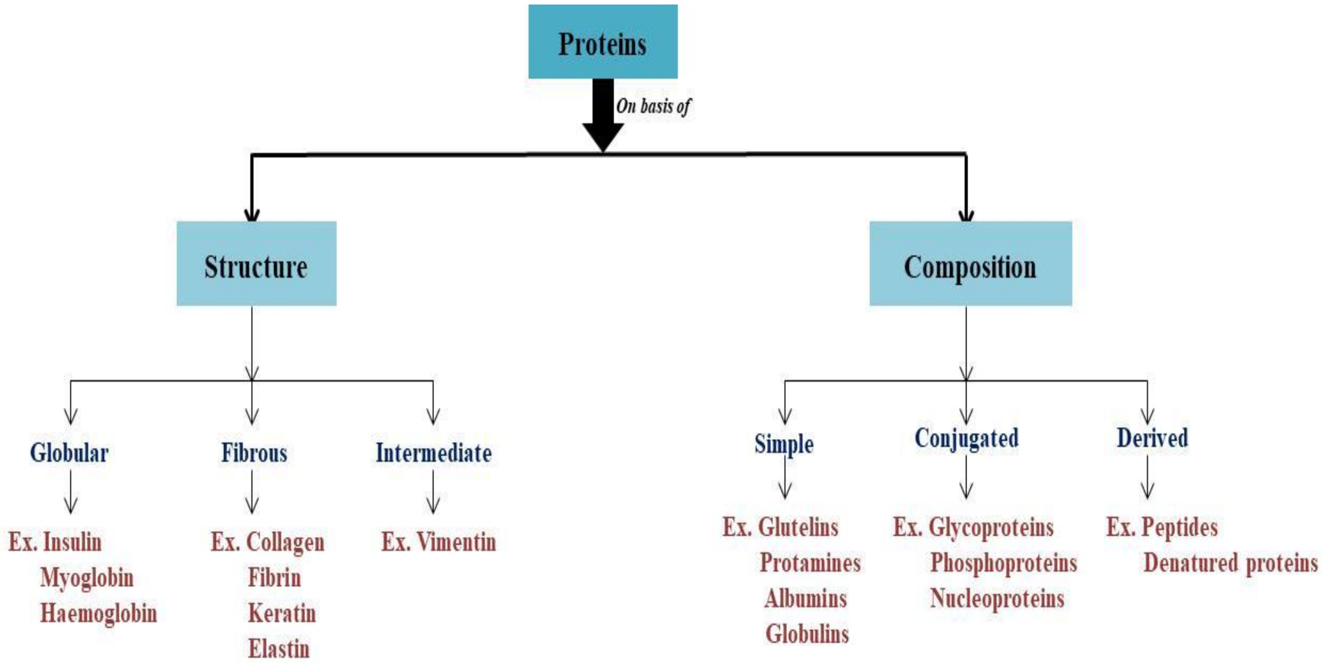

Figure 2b. The figure represents the classification of proteins on the basis of structure and composition

Talking about the structure of the proteins, there are of four types primary, secondary, tertiary and quaternary (Kabsch et al.; 1983, Huang et al.; 2010). The primary structure of protein is the amino acid sequence in a polypeptide chain bonded together by the peptide bonds. The polypeptide chain is composed of two ends amino terminus (N terminus) and carboxyl terminus (C terminus). The DNA of the gene that encodes the protein determines the sequence of the protein. The amino acid sequence determines the overall structure of the protein. If anyone amino acid is changed, it affects the entire structure of the protein. The secondary structure of the protein is composed of alpha (α)-helix and beta (β)-pleated sheets which are bonded by the hydrogen bonds between the peptide groups which are formed in the main chain. The α-helix secondary structure of protein is a coiled spring like structure bonded by hydrogen bonds in a long polypeptide chain. The β-pleated sheet is folded or pleated like structure by hydrogen bonds in a polypeptide chain. The strands of the β-pleated sheet can be parallel in the same direction or antiparallel pointing in the opposite direction (Kabsch et al.; 1983, Huang et al.; 2010).

The tertiary structure of protein reveals the three dimensional structure of the protein. The tertiary structure of the protein is solely dependent on the functional R group interaction in the amino acid. The tertiary structure is bonded by several interactions such as hydrophobic, ionic, disulphide as well as hydrogen bonds. The shaping and folding of the protein is contributed by the hydrophobic bonds. The R group of the amino acids can be hydrophilic or hydrophobic in nature. The hydrogen bonds stabilize the shape and structure maintained by the hydrophobic bonds in the polypeptide chain of amino acids. The ionic bonds are established between positively and negatively R groups of the amino acids due to the folding of the protein. Finally, a disulphide bond is also formed between the R groups of the cysteine residues of the amino acids in a polypeptide chain. In this way, tertiary structure of the protein is formed. When the protein is made up of multiple polypeptide chain, it gives rise to the quaternary structure of the protein. Hemoglobin is a protein with quaternary structure. It is an iron containing protein found in the blood binds to the oxygen molecule and composed of two alpha and two beta subunits. This way protein is arranged in the four structures.

1.1.3. Nucleic acids

Nucleic acids are the larger biomolecules that carry the genetic information of the cell through the protein synthesis where they determine the inherited characteristics of the cell. There are two types of the nucleic acid Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). Nucleic acids are present in the nucleus and cytoplasm of the cell. They are composed of the nucleotides which are composed of three components nitrogenous base, 5carbon sugar and a phosphate. The nitrogenous base is composed of purine or pyrimidine bases. The purine bases are adenine guanine and the pyrimidine bases are cytosine, thymine and uracil. The polynucleotide chain is formed when the nucleotides are bound together by the covalent bonds between the phosphate group and the sugar molecule. There are few differences in the structure of DNA and RNA (Travers et al; 2015, Watson et al.; 1953). In the DNA the nitrogenous bases are adenine, guanine, cytosine and

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thymine where in the RNA uracil is present in place of thymine and rest of the three bases are same. The sugar molecule in the DNA is 5 carbon deoxyribose sugar whereas in the RNA is ribose sugar that is a pentose sugar. There are three different types of the DNA i.e. A-DNA, B-DNA and Z-DNA. The A-DNA is the right handed double helix and is formed during dehydration and protects the DNA during extreme conditions of desiccation. The B-DNA is a right handed helix and the most common form in which DNA exists. The Z-DNA is the left handed helix and forms a zig zag pattern (Travers et al.; 2015, Watson et al.; 1953).

There is a central dogma in the world of molecular biology where three processes occurs replication, transcription and translation. Replication is the process in which DNA is formed from the DNA means replica multiple copies of the DNA formed in the cell by the enzyme DNA polymerase. The DNA is further transcribed in to the RNA by the process of the transcription. The enzyme involved in the transcription is known as RNA polymerase. Furthermore, RNA is converted to protein where the genetic information is coded in the protein. Finally the genetic information is passed from the DNA to RNA then to the proteins. Thus the RNA is essential for the synthesis of the proteins. The RNA exists in the single stranded form and do not occur in the double stranded form as of DNA because the bases of the RNA forms complementary base pairs with the other bases on the same RNA strand forming various shapes. There are four types of the RNA that are ribosomal RNA, transfer RNA, messenger RNA and micro RNA (Brimacombe et al.; 1985, Saarbach et al.; 2019). The ribosomal RNA is responsible for the protein synthesis and is found in the cytoplasm where the ribosomes are located. The transfer RNA is important for the messenger RNA translation into the protein synthesis as it transfers the amino acids to the ribosomes. The messenger RNA is translated to proteins as they are the RNA copy of the DNA produced during DNA transcription. It carries the genetic information from the nucleus to the cytoplasm of the cell. The micro RNA is involved in the regulation of the gene expression and is the small RNA.

1.1.4. Lipids

Lipids are the organic compunds synthesized in the liver and are soluble in the non-polar solvents. The lipase enzyme breakdown the lipids into the glycerol and the fatty acids in the liver. The metabolism of lipids and carbohydrate glucose occurs together and converted to lipids. The lipoproteins are formed when the protein is conjugated with the carbohydrates which in turn transport lipids into the bloodstream. Lipids are the structural component of the cell membrane, stores energy and are involved in the cell signaling. Lipids are also known as fats as they are composed of the molecules of the fatty acids and their derivatives. Lipids are categorized into three type's simple, complex and derived lipids (Fahy et al.; 2011, Fahy et al.; 2005) Figure 3.

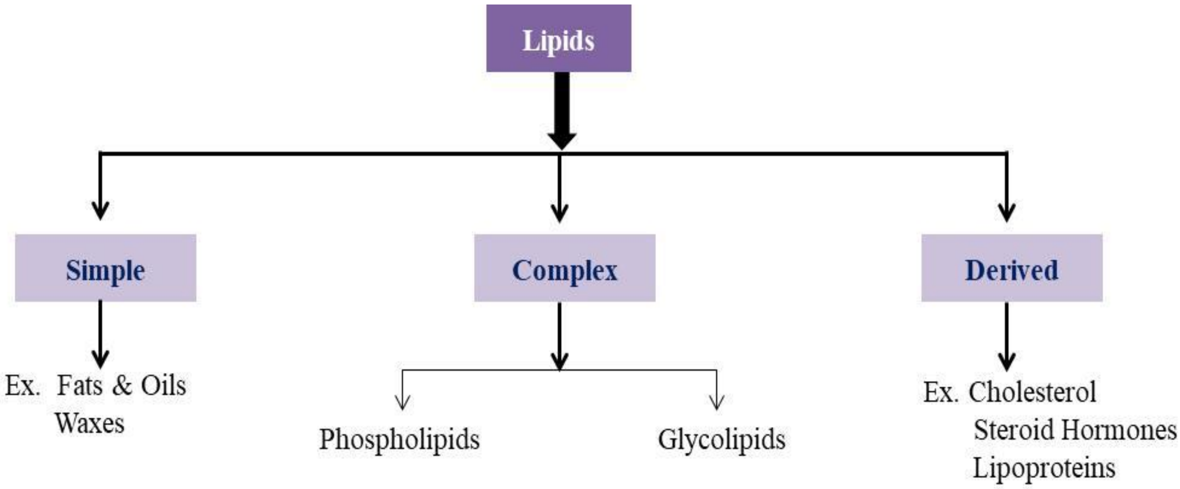

Figure 3. The figure illustrates the lipid classification

The simple lipids are fatty acid esters of the alcohol. They are composed of alcohol and fatty acids only. They are composed of fats, oils and waxes. The fats and oils are known as triacylglycerols as they are esters of the fatty acid and glycerol (Coleman et al.; 2004). Waxes are the made up of fatty acids and monohydric alcohol. The complex lipids are the esters of fatty acids with alcohol and other molecules. They are of two type's glycolipids and phospholipids (Bach et al; 2003, Burdge et al.; 2015, Merrill et al; 2002). Glycolipids also known as glycosphingolipids composed of fatty acid, carbohydrate and a sphingosine. Glycosphingolipids are of two type's neutral glycosphingolipids and negatively charged glycosphingolipids. The neutral glycosphingolipids are neutral having no charge while the negatively charged glycospingolipids possess negative charge such as gangliosides. The sialic acid is found in the gangliosides which possess a sulphate group. Gangliosides are involved in the cell signaling as they are found in the cell membrane of the central nervous system. Phospholipids are composed of a phosphoric acid residue along with fatty acid and alcohol. Phospholipids composed of a hydrophilic head group that is a phosphate group and fatty acid which is a hydrophobic tail joined by the glycerol moiety. Phospholipids maintain the cell membrane permeability and composition and control the

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activity of the enzymes within the cell (Bach et al.; 2003). It forms the phospholipid bilayer of the plasma membrane and allows certain solutes to pass through it.

The products derived on the hydrolysis of the simple and complex lipids are the derived lipids such as glycerol, fatty acid, steroid hormones, cholesterol, fat soluble vitamins etc. The lipids combine with proteins and form lipoproteins which transport cholesterol (Burdge et al.; 2015). It mainly transports fat molecules in blood plasma, water and extracellular fluids. The different types of lipoprotein are high density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL), intermediate density lipoprotein (IDL) and chylomicrons. The HDL cholesterol refers to the good cholesterol as it reduced the risk of the cardiovascular disease such as heart attacks. LDL cholesterol is bad cholesterol as it is involved in the atherosclerosis, auto oxidized and blocks the arteries and increases the risk of the heart attacks. VLDL in the bloodstream is converted to LDL and IDL (Burdge et al.; 2015). Chylomicrons are the ultra-low density lipoproteins and more prone to cause heart attacks.

1.2. Micronutrients

1.2.1. Vitamins and minerals

Vitamins are the organic compounds required in the minor quantities to boost the immune system and maintaining good health. They are not synthesized by the body or produced in very minor amount so they are required in adequate quantity in order to maintain proper health (Huskisson et al.; 2007, Bender et al.; 2003). Dietary sources provide sufficient amount of vitamins when consumed in adequate amount. Hence, it is recommended to take balanced diet in order to avoid nutritional malnutrition. There are two classes of vitamins that are water soluble and fat soluble Figure 4. The water soluble vitamins are soluble in water such as vitamin B complex and vitamin C (Bender et al.; 2003). The vitamin B complex includes several vitamins as mentioned forward. Vitamin B1 (thiamine) breakdown the nutrients to produce energy. They are found in cauliflower, potatoes, eggs, brown rice. The deficiency of vitamin B1 causes beriberi. The vitamin B2 (riboflavin) is involved in cell metabolism and energy production. They are found in bananas, milk, yogurt, and cottage. The deficiency causes mouth sores, fissures, dry lips. The vitamin B3 (niacin) metabolize food to release energy and found in chicken, tomatoes, eggs, beef and leafy vegetables. The deficiency causes pellagra. The vitamin B5 (pantothenic acid) found in broccoli, yogurt and grains. The deficiency causes paresthesia. The vitamin B6 (pyridoxine) is found in nuts, chickpeas and beef. It is responsible for the formation of red blood cells and deficiency causes anemia. The vitamin B7 (biotin) is found in egg yolk, spinach (Bender et al.; 2003). It forms the keratin protein that is necessary for hair, skin and nails. The vitamin B9 (folic acid) is found in sunflower seeds and legumes. It makes DNA and RNA. Its inadequate quantity can affect fetus's nervous system. The vitamin B12 (cyanocobalamin) is responsible for healthy nervous system and found in eggs, meat, and milk. The vitamin C is found in citrus fruits like orange, lemon. It strengthens bones, forms collagen, wound healing, tooth formation. Its deficiency causes scurvy (Bender et al; 2003).

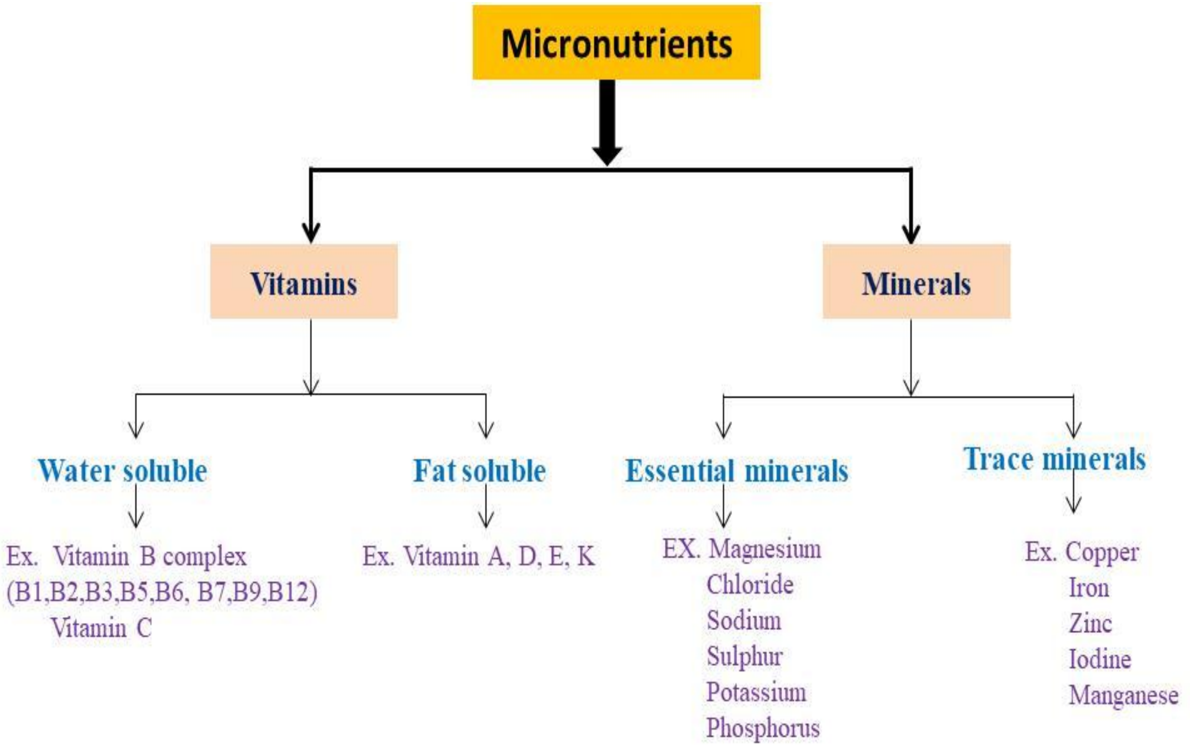

Figure 4. The figure represents that the micronutrients are categorized into vitamins and minerals

The fat soluble vitamins are vitamin A, D, E and K (Reddy et al.; 2020). The vitamin A (retinol and beta carotene) is essential for the eye vision. The deficiency causes night blindness and keratomalacia (Semba et al; 1998, Underwood et al.; 1996). The sources are cod liver oil, carrots, butter, milk and vegetables. The vitamin D (cholecalciferol) is necessary for bone strength and strongness (Jones et al.; 1998). Its major source is ultraviolet rays B from sun. The vitamin E (tocopherol) is an antioxidant and anti-inflammatory and found in dry fruits such as almonds, nuts, kiwis and eggs (Meydani et al.; 1997). The vitamin K (phylloquinone) is necessary for blood clotting and is found in green leafy vegetables (Villines et al.; 2005).

Minerals are also very important for the growth and development (Huskisson et al.; 2007). The most essential minerals are magnesium, chloride, sodium, phosphorus, calcium, sulfur and potassium Figure 4. The sodium, chloride and magnesium balance fluid and regulate blood pressure. The calcium and phosphorus are required for strong bone, teeth and cell membrane structure maintenance. The potassium is involved in nerve transmission. There are few trace minerals that are required in small quantity and are also important for regulation of the body functions such as zinc, iron, copper, manganese, iodine etc. Figure 4. The iron provides oxygen to muscles and zinc regulates immune function. The copper involved in the connective tissue formation and iodine regulates thyroid function. The magnesium is involved in biomolecules metabolism.

II. CONCLUSION

Biomolecules are the macro and micro molecules that are star molecules to control the metabolism of a living organism. They are essential to regulate the biological functions and maintain the health of a living being. The major biomolecules such as carbohydrates, lipids, proteins and nucleic acids are synthesized by the body and regulate the metabolic functioning while the micro molecules such as vitamins and minerals not synthesized by the body but still required in adequate amount to maintain the good health and immunity. They solely regulate biological activities and act as a baseline of various metabolic reactions. There would be no life without these biomolecules as they are involve in the sustenance of life by regulating growth, development, cellular and metabolic signaling. They also help in regulating the health by strengthening the immune system of the living beings.

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