# Homeopathic Perspective of Sulphur Biochemistry

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*Sulphur* has a dominant position in homoeopathic materia medica, and is probably one of the the most prescribed drugs in homeopathic practice. *Sulphur* has been symbolically entitled as the '*king of antisorics'* by our great masters. It is well proven, and it represents the richest symptomatology in our whole materia medica. Some homeopaths as a routine manner administer a dose of sulphur in high potency at the termination of treatment for acute diseases, and also at the beginning of treatment for chronic diseases. There is also a wide-spread practice of administering a dose of sulphur in high potency when other 'seemingly well indicated' remedies fail, so as to arouse reaction. There is also a saying that the frequency of prescibing sulphur and practitioner's knowledge of materia medica have an inversely proportional relationship, which means, the less the doctor knows his materia medica, the more he is compelled to use sulphur frequently in his practice. Even though one may basically differ regarding the acceptability of such concepts and practices, they ultimately indicate the paramount importance accorded to sulphur in homoeopathy.

As part of a logical continuation of the scientific interpretation of 'Similia Similibus Curentur' and 'Potentization' discussed in my article *"Dialectical Homoeopathy'*, I think it would be appropriate to delve into a deeper analysis of the diverse roles sulphur plays in various biological processes in the organism. It may necessarily lead to the study of the various molecular blocks and biochemical deviations underlying the vast symptomatology of suphur. Such an analysis may also show the way for similar scientific studies about other important drugs of homoeopathic materia medica, which will especially be relevant when we try to present homoeopathy as a higher branch of modern molecular medicine.

In my opinion, we have to undertake a huge reasearch project to study the symptomatology of all important drugs of our materia medica, in such a way that we can identify their individual symptom complexes in relation with the structure and configuration of the active groups of various constituent molecules of the drug substances. As in the case of every state of pathology, no drug symptom can be produced in an organism without a corresponding chain of molecular processes underlying it, initiated by the interaction of some or other drug molecules with some or other biological molecules. From a scientific point of view, drug symptoms should be interpreted and utilized as minute biological indicators of corresponding molecular blocks and biochemic deviations brought about in the organism by the action of drug molecules. We should begin learning materia medica from this scientific perspective, at least in future.

To begin with, let us take up the study of *sulphur*. For this, we have to collect and analyze all the available information regarding the diverse biochemical processes in the organism in which sulphur has a role to play. Obviously, such a study includes not only the study of various natural biological molecules in the organism, but also various exogenic and endogenic pathogenic molecules containing sulphur, and the nature and type of molecular inhibitions caused by them.

According to Samuel Hahnemann, the *'miasm'* of *'psora'* is the main cause of chronic diseases. As per his interpretation, '*psora'* is 'suppressed *itch',* which means, the chronic constitutional susceptibility to diseases, resulting from the suppression of *'itch'* appearing on the surface of the skin. Homeopathic theory of '*chronic diseases'* is built up on this fundamental concept of *'psora'*. He describes *'psora'* as a hiding 'multi-headed hydra', which expresses its presence in the organism in the form of multitudes of chronic ailments with periodical acute exacerbations, persisting until death. Potentized sulphur is supposed to be a an antidote of this chronic miasm of *'psora'*, and hence the saying *" sulphur is the king of anti-psorics"*.

It is interesting to observe at this point that toxins released by bacteria found in lesions of 'itch', are complex chemical molecules of protein nature, containing *'sulphide'* radicals in their active groups. The presence of sulphur-containing amino acid *'cysteine'* in the bacterial proteins is responsible for this factor. During infection, bacterial toxins bind to various biological molecules in the organism using this *'sulphide'* group as the ligand. Antibodies are formed in the organism by a process of *'molecular*

*imprinting'* of certain class of protein molecules called *globulins*, with these bacterial toxins. Obviously, the antibodies are molecular imprints of these bacterial toxins, and contain three-dimensional complementary configurations of this *'sulphide'* group on them. These molecular imprints can immunize the organism against further infections, by acting as neutralizing agents towards the bacterial molecules, and hence the name *'antibodies'*. At the same time, these anti-bodies or molecular imprints can create unwanted molecular blocks in diverse biochemic channels in the organism, by binding themselves to various sulphide-containing bio-molecules, due to their configurational affinity towards sulphide groups. These molecular blocks and biochemical inhibitions arising therefrom are the real cause of chronic diseases that *Hahnemann* attributes to *'miasm of 'psora'*. We already know that the antibodies produced against bacterial skin infections or *'itch'* may attack heart, kidney, brain, and other vital organs causing different types of diseases. *Streptococcal* and *staphylococcal* antibodies formed against acute throat and teeth infections may attack synovial membranes of joints, endocardial linings, and valvular structures of heart. During drug proving, *sulphur* also binds to the same molecular targets as the bacterial toxins, and produces similar molecular deviations and similar symptoms. The similarity between certain symptom groups produced by these bacterial infections and the homeopathic provings of sulphur correlates with this observation. Potentized sulphur, being molecular imprints of sulphur molecules in alcohol-water medium, can act in the same way as *'itch'* antibodies. Here we get the scientific explanation for the observation of Hahnemann that potentised *sulphur* is the most important antipsoric medicine, *'The King of Antipsorics'*. During drug proving, ionized sulphur may also compete with sulphide radicals of various biological protein molecules, thereby preventing their normal biochemical interactions. It is already known that the amino acid called *'cysteine'*, containing *'sulphide'* groups, play an important role in almost all molecular interactions in the organism, especially involving protein molecules of enzymatic functions. This may be the reason for the appearance of so many symptom groups, involving almost every biochemical channels of the body, in the homoeopathic proving of sulphur. Potentized sulphur, being molecular imprints with three-dimensional complementary configuration of sulphur, can neutralize the sulphide groups of bacterial toxins, by binding to them. More over, molecular imprints of sulphur can compete with the bacterial antibodies, in their interactions with biological molecules, and act as a most powerful 'anti psoric' drug. As crude drugs also, *sulphur* exhibits an anti

bacterial and antifungal action, by the competitive relationship of sulphur ions with sulphide groups of such proeins.

A few words about the homeopathic nosodes such as '*psorinum*', '*tuberculinum*', '*streptococcin',* etc. will be relevant here. These nosodes in the potentized form contain molecular imprints of antibodies themselves, formed in the organism against bacterial toxins. Hence, these potentized nosodes will be more useful in treating the chronic miasmatic effects of itch and other bacterial infections, whereas potentized suphur will be appropriate to deal with the direct bacterial infections and bacterial toxins themselves. Hahnnemann also has observed that potentized *'psorinum'* is more appropriate antipsoric in the treatment of chronic diseases, where as potentized *'sulphur'* will be ideal for acute complaints of *'psora'*.

## Sulphur in Biological System

*Sulphur* is an essential element for the existence of life. It is an indispensable part of various aminoacids, proteins, enzymes and co–enzymes. *Sulphur* is a constituent of many important bio-molecules such as *cysteine, methionine, coenzyme-A, iron-sulphur clusters, biotin, lipoic acid, molybdopterin, ERNA, thio-nucleiosides, and thiamine*. These molecules are participants in various vital biochemic processes including the synthesis of *proteins*.

*Sulphur* is also very important in the metabolism of pathogenic organisms such as virus, fungi and bacteria, and as such, play in major role in causing various ailments in human organism. We know, bacteria belonging to *mycobacterium* group are responsible for disease such as *tuberculosis* and *leprosy*. Studies regarding metabolism of these *mycobacteria* have greately enhanced our understanding about the role of *sulphur* in the molecular mechanism of such diseases. Many studies have already taken place regarding *sulphur*-containing molecules discharged by bacteria belonging to *'treponema denticola'* group. This bacteria are widely seen associated with teeth and gum diseases of human beings. Several toxic molecules let out by *fungi* contain *sulphur*. All these facts make it very clear to us why *sulphur* adorns such a prominent place in homeopathy. We should understand how such chemical molecules produce diseases in men and how medicines act against them.

*Sulphur* is an indispensable constituent in the biochemical processes of plant kingdom also. The sulphur-containing phyto-chemical molecules synthesized by plants, such as *glutathione, sulpholipids, alliins, glucosinolates and phytochelates* enable them to defend themselves against insects and over come environmental stress. We use these phytochemicals as powerful therapeutic agents also.

*Sulphur* acts as the bridging ligand of the important enzyme which controls the use of oxygen in the living cells, known as *cytochrome C-oxidase*. This indicates the crucial role of *sulphur* in the very existence of life itself. Certain bacteria maintain their life itself by depending on *sulphur* compounds. It is the *hydrogen sulphide* excreted by such bacteria inhabiting our body which imparts the offensive odour to our sweat and excretions. The peculiar smell produced when organic materials get degenerated is also due to the presence of *sulphur* in them.

*Sulphur* is contained in various defence molecules synthesized by bacteria. All the antibiotics synthesized by bacteria such as *pencillins, cephlosporins, monobactams* and their synthetic derivatives contain *sulphur*.

There is a lot of *sulphur* contained in the horns, nails, hair, skin and other appendages of animals. Their charecteristic hardness is due to the strong *'disulphide'* bonds formed between their protein molecules.

*'Sulfhydryl(thiol)'* groups containing *sulphur* play a very important role in the biochemical processes of all living organisms. *Thioredoxins* containing *'thiol'* groups are indispensable in the synthesis of various biological molecules.

*'Thiol'* contained in *coenzyme-A* participate in the oxidiation activities of *pyruvate-fatty acid* which is the integral part of the energy metabolism in the cells. *Thiol* groups of *glutathione* and *mycothiol* protect the cells by deactivating dangerous oxidants. *Sulphur* is also a factor in the structure of many messenger molecules also.

*Sulphur* ions are comparatively much larger than similar ions. More over, their peculiar electron distribution and ability for easy polarization make them powerful *nuceleophiles*. It is because of tese peculiarities that *Sulphur* has attained so much importance in the biochemical processes.

## Proteins and Sulphur

Among the twenty *amino acids* essential for the synthesis of proteins, only *cysteine* and *methionone* contain *sulphur*. Only if we get a correct understanding about these two amino acids including their structure and the role they play in organic processes, will we be able to explain the biological importance of the *suplhur*.

| **Methionine** | **Cysteine** |
|---|---|
| $H_3C\text{-}S\text{-}(CH_2)_2\text{-}CH\text{-}COOH$ | $HS\text{-}CH_2\text{-}CH\text{-}COOH$ |
| $NH^2$ | $NH_2$ |

The amino acid *'cysteine'* has to be particularly subjected to our study. Its *'R'* group is an *'HS'*, containing *sulphur*. A peculiarity of *'HS'* is that they can form mutual *disulphide bonds*. Such groups are called *'thiol'* groups or *'sulphydryl'* groups.

*'HS'* or *'thiol'* is the functional group of the amino acid called '*cysteine'*. This *thiol* group has great importance in various bio-chemical processes. If *'cysteine'* residues contained in different protein molecules or in different parts of the same molecule happens to come into contact with each other, the *HS* groups in them interact with each other by oxidization process and become *'cystine'* through *disulphide bonding(S-S).* This process plays a very important role in the formation of the highly complex three-dimensional tertiary structure of protein molecules. Multi-unit proteins are also formed by this way.

These '*disulphide bonds'* are crucial in the structure of several antibodies. *Antibodies* bind to the antigens by *'thiol'* groups contained in the *cysteine* residues at their active sites. *Thiol* groups of *cysteine* residues contained in the active sites of enzymes help substrates to remain bound with enzymes and enable the smooth conduct of biochemical transformations. *Cysteine* residues at the active sites of enzymes belonging to the group of '*cysteine proteases'* may be cited as examples. The importance of *'HS'* groups of the amino acid *'cysteine'* in various enzymatic interactions has to be clearly understood.

The phenomenon of curling found in hair is due to *disulphide bonds* formed between *cystenie* residues. The chemicals used for curling and

straightening of hair work by the oxidization-antioxidation processes of *cysteine* residues contained in the hair.

The *HS* groups contained in the *cysteine* residues are capable of reacting with the ions of heavy metals ( *Pb, Hg, Ag).* Such reactions will make proteins inactive by effecting deformities in their three dimensional structure. This is the molecular mechanism behind heavy metal poisoning. *Sulphur* ions are capable of weakening the reactive power of metal ions by binding themselves on them. This happens in the case of *metaloenzymes* where metal ions function as *co–factors*. *Thiol* groups in *cysteine* are easily subjected to oxidization. Their reactive efficiency is tremendously enhanced when ionized. Because of this peculiarity, *'thiol'* groups become participants in many biochemical processes.

*Insulin* is rendered inactive in certain circumtances due to the presence of *cysteine*. It is possible for *cysteine* to inactivate the three *disulphide bonds* contained in *insulin* molecules by deoxidizing and changing their structure, In the conditions of *hypoglycema* where in the sugar content of blood is alarmingly reduced, *cysteine* is employed as a drug to make insulin inactive. Apart from *cysteine , thiamine and vitamin C* are also used for this purpose. Here it is evident why health supplements containing *cysteine* should not be given to diabetic patients. It is to be specially mentioned that foreign molecules containing *sulphur* are capable of intervening in the biochemical processes connected with *insulin*.

The *disulphide bonds* formed between *cysteine* residues are responsible for the phenomenon of cross linking between protein molecules. This type of cross linking has great importance in placing molecules like *insulin* un impaired at their appointed positions.

*Glutathione* which is formed through the combination of amino acids like *cysteine, glycine and glutamic acid* is an important antioxidant in the body. *Thiol* groups and *sulphur* which is a part of it play an important role in the synthesis and functioning of *glutathione.*

*Dissulphide bonds* play an import role in the *post-translational* modifications of proteins. It is through *disulphide bonds* between *cysteine* residues that the peculiarl three dimensional shapes and foldings of proteins molecules working in extracellular medium are shaped. In case such bonds

are not formed protein molecules become deformed and incapable of performing their biochemical functions.

The metal ions such as *zinc, iron, copper, nickel* etc which function as *co-factors* of several enzyme systems actually connect with appropriate enzymes through *thiol* groups contained in their *cysteine* residues. Example are: zinc in *alcohol dehydrogenase*, iorn in *cytochrome P450*, nickel in *[NiFe]-hydrogenases* and copper in *blue-copper proteins*.

It is with the help of enzymes known as *protein disulphide isomerases* that the *S-S disulphide bonds* in proteins are formed. It is possible for various chemical molecules containing *sulphur* to bind themselves competitively on these enzymes and inhibit their functions. It can be legitimately considered that many symptoms observed in homoeopathic proving of *sulphur* and *sulphur-containing drugs* indicate these molecular inhibitions.

*Cysteine* residue is contained in the active sites of many enzymes. *Sulphur(thiol)* groups contained in the enzymes play a crucial role in enzymatic interactions. *Antibodies* also interacts with other molecules through their *thiol* groups. Molecular mechanism of immune disorders also should be understood in this perspective.

*Cystathionine gamma-lyase* and *cystathionine beta-synthase*, are two important enzymes involved in the synthesis of *cysteine. Sulphur* ions and *sulphur-containing drugs* may be capable of inhibiting these enzymes through competitive molecular blocks.

*Thiol* groups are contained in the molecules of various *phytochemicals*. Various viral, bacterial and fungal toxins also contain *thiols.* Such chemicals can interfere in the molecular interactions of proteins in the organism resulting in multitudes of pathological conditions. Symptomatology of homeopathic provings of those drugs should be subjected to a re-reading with this scientific perspective.

Different types of active groups containing *sulphur, like Sulfonyl, Sulfo Sulfinyl, Sulfhydry(Thiol) Thiocynate and Disulphide* are capable of interveining in biochemical processes.

**Antibodies:**

*Immunoglobulins* or *antibodies* represent a very important class of proteins, playing crucial roles in the biological system. They are found in blood, lymph and other body fluids. These antibodies are part of immune system of the organism. These antibodies are synthesized in plasma cells known as *lymphocytes.* Antibodies are molecules belonging to *globulin* proteins. Mainly there are five type of *immunoglobulins*. *Antigens* are bound to antibodies using their active groups known as *epitopes*. The site of binding on antibodies are known as *peritopes.*

The molecular components of an *immunoglobin* are four *polypeptide* chains bound by *disulphide bonds*. These *disulphide bonds* are formed by *thiol* groups of the *cysteine* residues contained in them. It is in the presence of an enzymes known as *protein disulphide isomerase PDI* that the formation and breaking of these bonds take place. Moreover, this enzyme participate in many ways in the *antigen-antibody* process. Involvement of this enzyme is necessary in binding antigens with the molecules of major *histocompatability complex(MHC1)* which is very important in the defence system of the organism.

*Sulphur* ions and foreign molecules containing sulphur are capable of competitively binding on *disulphide isomerase(PDI)* and make them inactive. This is the molecular mechanism of medicinal materials containing sulphur adversely affecting the immunity.

*Peritomes* of antibodies are subjected to *molecular imprinting* with *epitome* groups of antigens. The antibodies thus imprinted have special affinity to the concerned antigens, due to the complementary configurations created by imprinting. It is because of this special complemetary affinity that antibodies are able to recognize exact antigens. It has been proved that these antibodies maintain affinity not only with imprinted antigen epitoms but also with other molecules having similarity in shape with them. Because of this, the antibodies misunderstand the molecules essential for the body as antigens and create different types of *molecular blocks* by binding on them. This phenomenon gives the chance for different type immune related diseases. A detailed discussion of this matter has already been made else where in the same article where miasm is discussed. The potentised homoeo preparations have proved to be capable of cradicating such conditions of illness.

Many bacterial viral toxins act as *antigens*. The groups of symptoms appearing in many diseases due to such bacterial infections exhibit similarity with homoeopathic provings of *sulphur.* The reason for this is evident. We used to treat effectively such conditions of illness using high potency sulphur on the basis of *Similia Similibus Curentur*.

**Biotin:**

*Biotin* is a vitamin containing *sulphur*. *Biotin* is the *co–factor* which makes active several important enzymes like, *Acetyl-CoA carboxylase, Pyruvate carboxylase, Methylcrotonyl-CoA carboxylase, Propionyl-CoA carboxylase*. Many foreign molecules containing *sulphur* groups compete with *biotin* in interacting with the above mentioned enzymes and this subject them to *competetive inhibitions*. Certain bacterial and viral toxins also function in the same manner. As a result a condition equivilant to the absence of *biotin* is created and condition of illness similar to that is produced. This will adversely affect the natural growth of cells, and the metabolism of *lipids and amino acids*. Falling of hair, falling of eyebrow, greying, disinterest in food, *eczema*, *dermatils, drying of skin, increase in blood sugar, numbness of hands and legs, many types of bacterial infections, fungus infections, mental problems and deterioration of immunity* etc. result.

**Ubiqiutination :**

*Ubiquitins* are regulatory protein molecules containing *lysine* residues playing a very important role in various biochemical processes. By binding themselves on different types of protein molecules *ubiqiutins* ensure the configurational stability of proteins, and empower them to do their stipulated chemical functions. *Ubiqiutin polypeptides* also act as *markers* of protein molecules, preparing them for their calabolism. *Ubiquitin-activating enzyme E1, ubiquitin-conjugating enzyme E2, ubiquitin-protein ligases E3* etc are the enzymes associated with ubiquitin interactions.

The first stage of this process known as *ubiqiutination* is performed with the help of *cysteine* residues positioned at the active sites of the *ubiqiutine-activating enzyme E1*. Molecules containing active groups of *sulphur* are capable of competitively binding on these enzymes and making them inactive. This phenomenon underlies many types of disease we face today.

*Ubiqiutination* is crucial in many organic processes like *antigen processing, apoptosis, biogenesis of organelles, cell cycle and division, DNA transcription and repair, differentiation and development, immune response and inflammation, neural and muscular degeneration, morphogenesis of neural networks, modulation of cell surface receptors, ion channels and the secretory pathway, response to stress and extracellular modulators, ribosome biogenesis, viral infections* etc. The plentifulness of diseases conditions likely to be caused by obstructions to the above mentioned organic processes is very evident. All these factors are to be taken in to account when we make a study of the homeopathic symptomatology of *Sulphur.*

**Tyrosine Sulfation:**

*Tyrosine sulfation* is the process in which *sulfate* groups are added to *tyrosine* residues of proteins synthesized in the cells. This chemical process take place in *golgi apparatus*. In this process, *sulphate* ions are extracted from *Adenosine 3'-phosphate 5'-phosphosulfate (PAPS*) and added to *tyrosine* residues of proteins, with the help of an enzyme known as *Tyrosylprotein sulfotransferase (TPST*). Exogenous *sulfate ions* are capable of creating molecular blocks in these enzymes, through competitive relationship. *Tyrosine sulfation* is essential for the molecular interaction of proteins. Many proteins such as *adhesion molecules, G-protein-coupled receptors, coagulation factors, serine protease inhibitors, extracellular matrix proteins, and hormones* are subjected to *tyrosine sulfation.*

The studies dealing with the chemical process known as *tyrosine sulfation* and its partipant enzyme systems are even now incomplete. The influence they exert in the processes like the growth of hair, regulating body weight and reproduction is almost fully uncovered. By this time it has been made very clear that the sulfation of protein is an important area of biochemical activities. We have to constantly follow the scientific researchs taking place in this area positioning ourselves in the perspective of Homoeopathy. It will be very interesting to learn the crucial role the *sulphate* ions play in the organic system.

**Glucosinolates :**

*Glucosinolates* are a class of chemical molecules containing *sulphur* and *nitrogen*, found naturally in plants,. They are used as medicinal drugs and

natural pesticides. *Glucosinolates* are abundant in mustard, radish, horse radish, maca, cress, cabbage, brussels sprouts, kohlrabi, kale, cauliflower, broccoli, turnip, swede(rutabaga) and rapeseed.

*Sinigrin (allylglucosinolate or 2-propenylglucosinlate*) is a *glucosinolate* found in plants like broccoli belonging to the *brassica* family. It has been proved that *sinigrin* is capable of preventing the multiplication of cancer cells. *Sinalbin,* another *glucosinolate* found in mustard also belong to the same group. These are converted to *allyl isothiocyanate* by the action of certain enzymes.

It has been observed that the organo-sulphur compound *sulforaphane* , contained in certain plants can be used as curative agent against *helicobacter pylori* bacteria, the causative agent of gastric ulcers. *Sulforaphane* is also found to be useful as external application to protect skin from ultra violet rays.

*Thiocyanate* ions containing *sulphur* inhibit the production of *thyroide* hormones like *thyroxine and triiodothyronine*. This is because they are capable of producing molecular blocks by competing *with iodine.* The *thioglycoside* such as *alliin* contained in garlic are chemically *sulfoxides.* This function both as antioxidant and *hydroxyl radical scavenger*, because of the presence *sulphur* ions in them. It has been proved in the laboratory tests that the functional ability of *phagocytes* in blood is increased in the presence of *alliin.*

*Lenthionine* is the organo-sulphur compound contained in certain types of fungi. These *sulphur* -containing molecules prevent the clotting of blood. Certain organo-sulphur compounds contained in grlic also function in the same manner. These molecules inhibits the enzymes called *C-S lyase.*

**Thiamine :**

*Thiamine* is included in the group of B-complex vitamins. It is a chemical compound containing *sulphur. Thiamine diphosphate (ThDP),* which is the active form of thiamine works as a co–enzyme in various enzymes systems which regulate catabolic processes of amino acids and sugars. *Thiamine* is synthesized in bacteria, fungi and plants. *Thiamine* required by animals has to be obtained through food. In its absence may cause the disease called

*beriberi,* affecting the nervous system and circulatory system. General *debility, emaciation and mental disorders* are also observed.

*Thiamine (C12H17N4OS)* is a vitamin soluble in water. S*ulfites* are capable of inhbiting *thiamine*. *Thiaminase enzymes* contained shell fishes and certain other fishes, *Hydroxyphenols* such as *Caffeic acid*, *Chlorogenic acid, Tannic acid* foud in plants also make *thiamine* inactive. *Glycocides* like *quercetin and rutin* also deactivate *thiamine* in the same manner.

Enzymes like *phosphatase, pyrophosphatase, thiamine pyrophosphokinase, Na+-dependent ATPase* also adversely affect the availability of *Thiamine*.

Following are the biochemically active forms of thiamine: *thiamine monophosphate(ThMP), thiamine diphosphate(ThDP), thiamine triphosphate (ThTP), adenosine thiamine triphosphate (AthTP), adenosine thiamine diphosphate (AthDP)*. Thiamine in the form of *Thiamine diphosphate (ThDp)* act as co–factors for enzymes such as *pyruvate dehydrogenase, 2-oxoglutarate dehydrogenase , branched-chain α-keto acid dehydrogenase, 2-hydroxyphytanoyl-CoA lyase and transketolase,* which play major roles in carbohydrate metabolism.

The enzyme named *transketolase,* which requires *thiamine* as co-factor, participates in the synthesis of sugars such as *deoxyribose, ribose and NADPH. Pyruvate dehydrogenase(PDH), and 2-oxoglutarate dehydrogenase(OGDH),* both having thiamine as co-factors, are participants in synthesis of *ATP*. These enzymes are also important in *citric acid cycle,* and synthesis of *myelin* and *acetylcholine.*

The deficiency of t*hiamine* cause a disease called *peripheral neuropathy*. This adversely affects sensory, motor and reflex activities in the limbs. Mental problems, emaciation and cardiac dysfuntions also are very serious problems in children. Excessive consumption of alcohol may result in deficiency of *thiamine.* The symptoms of serious thiamine deficiency are found in *HIV-AIDS* patients. Understanding the molecular mechanism of symptoms of thiamine deficiency exhibiting in *HIV* infection may help in developing an effective homoeopathic treatment protocol for such diseases.

*Werenicke's encephlopathy* is a rare disease caused by the severe deficiency of thiamine. Its symptoms are decrease in the motility of eyes,

unsteadiness, and mental disorders. *Koresakott psychosis* is a more aggravated form of the same disease.

Genetic disorders such as *thiamine responsive megaloblastic anemia, Leigh disease (subacute necrotizing encephalomyelopathy, opsoclonic cerebellopathy (a paraneoplastic syndrome), Nigerian seasonal ataxia etc.* are associated with thiamine deficiencies. *Sulphur* ions are capable of creating molecular blocks in the enzymes involved in thiamine metabolism. Compounds containing sulphur or sulphites are directly capable of rendering thiamine molecules inactive.

**Iron – Sulphur Proteins:**

These are the proteins containing *iron–sulphur clusters*. Enzymes such as *NADH dehydrogenase, hydrogenases, coenzyme Q- Cytochrome C reductase, succinate-coenzyme Q reductase, nitrogenase and metalloproteins such as ferredoxins* are exmples. The sulphur necessary for making of *lipoic acid* and *biotin* is made available from iron–sulphur clusters. They play their vital roles in the oxidization and antioxidization processes in *mitochondria*. Their presence is essential in *oxidative phosphorylation* processes as well. *Nitric oxide* is capable of rendering iron–sulphur proteins inactive.

The active group of iron-sulphur proteins are *cysteine* residues containing *'thiol'* group. It is specially noteworthy that *sulphur* ions and exogenous molecules containing sulphur groups are capable of competitive intervention in biochemical processes related to iron-sulphur proteins.

**Sulphite Oxidase:**

*Sulphite oxidase* is an important *metalo-enzyme* found in the *mitocondria* of animals. This enzyme is very crucial in the process of *ATP synthesis. Molybdopterin* molecules containing *molybdinum* acts as co–factors for this enzyme. This co–factor is bound to the *sulphur* of cysteine residues in the enzyme molecule.

Exogenic sulphur ions, suphur-containing drugs and bacterial-viral molecules are capable of competitively binding on the *molybdopterin* molecules, thereby preventing them from connecting with the enzyme molecules. In the absence of the appropriate co-factor, the enzyme is unable

to execute its biochemic functions, leading to a condition of pathology amounting to absence of s*ulphite oxydase*. Neurological disorders, mental retardation, physical deformities and brain disorders are the result. It might even result in death. In some cases, absence of this enzyme may happen due to defects in genetic expression also. Any how, we have to bear in mind the role of sulphur in *sulphite oxidase* metabolism, while engaging in a scientific study of sulphur symptomatology,

**Lipoic Acid:**

*Co-factors* are indispensible components of several important enzyme systems. *Lipoic acid* function as such a *co–factor*. It is an *organo-sulphur compound* containing sulphur in its active group, which is a disulpide. These exist in the cells in the form of *dihydrolipoic acid*. Often it is not found in the organism in independent form, but as part of various enzyme comlplexes like *pyruvate dehydrogenase complex, glycine cleavage gomplexes* etc .

*Lipoic acid* is a food antioxidant as well. It is capable of reviving *glutathione, vitamin C and vitamin E*. It functions as a good molecular scavenger due to the presence of disulphide groups in it.

It has been already proved that sulphur ions and various drug molecules containing sulphur are capable of inhibiting certain enzyme systems associated with lipoic acid synthesis, thereby negatively affecting the availabilty of lipoic acid in the organism. This point has to be especially considered in our scientific study of symptomatology of sulphur. More over, sulphur ions and sulphur-containing drugs may compete with *lipoic acid* in binding with their molecular targets, including the enzyme systems. Obiously, some of the symptoms of sulphur proving may be representing the pathologic conditions arising from such *lipoic acid* deficiency.

**Dapsone:**

*Leprosy* is a disease caused by the bacteria known as *mycobacterium leprae. Dapsone (diamino-diphenyl sulfone)* is widely used for the treatment of leprosy. *Dapsone* interferes in the biochemical processes through its active groups containing *sulphur(sulfone)*. Antibiotics belonging to *sulfonamide* group also work through the same mechanism. *Dapsone* effects its therapeutic properties against *leprosy* by interfering in the synthesis of *dihydrofolic acid* which is essential for the metabolism of these bacteria.

Apart from *leprosy, dapsone* is found effective in many disease like *pemphigoids, dermatitis herpetiformis, linear immunoglobulinA dermatosis, lichen planus, acne* etc. *Sulphone* group of d*apsone* compete with sulphur-containing proteins of infectious agents in binding with native biological molecules, thereby exhibiting their terapeutic effects. It is interesting to note that we can see many groups of symptoms of above said diseases in the homeopathic symptomatology of sulphur. It has been also found that *dapsone* can be used in the treatment of diseases like *pneumocystic pneumonia (PCP), idiopathic thrombocytopenic purpura, and toxoplasmosis*. *Daspone* has been indicated as an antidote for some kinds spider poisons also. *Dapsone* has been effectively used as external application in some non- bacterial skin diseases also.

It has also been observed that the use of *dapsone* results in many types of side effects such as *hemolysis, hemolytic anemia, methemoglobinemia, agranulocytosis, aplastic anaemia, cholestatic jaundice, toxic hepatitis, nausea, headache, skin rashes, eosinophilia, insomnia, psychosis, peripheral neuropathy* etc. It has been proved that *dapsone* is capable of interfering in the enzyme system known as *cytochrome P450*. Since *dapsone* is a drug containing *sulphur in* its active group, these observations are relevant in the study of biological roles of *sulphur.*

## Further studies required

*Sulphur* plays many more important roles in biological processes than those already discussed above. Here we have considered some prominent examples only. Homoeopathic provings and symptomatology of *sulphur* have to be subjected to a thorough re-reading in the light of latest available knowledge regarding the diverse biochemical processes sulphur participates in the living organism. Such a scientific re-reading might help us identify the exact molecular errors underlying each group of complex subjective and objective symptoms attributed to the homeopathic provings of *sulphur.*

Various sulphur-containing drugs of plant, mineral or animal origin, bacterial and viral products, and new generation sulphur-containing synthetic drug molecules also have to be subjected to in-depth study of their chemical structure, biochemical involvement and symptomatology. Such a scientific study may enable us to understand how constitutions of sulphur get evolved in idividuals, as a cumulative result of genetic factors, environment

and life style, including food, drinks, bacterial or viral diseases and usage of medicinal substances. A comparative study of symptomatology of sulphur with other drugs containing sulphur like *natrum sulph, hepar sulph, kali sulph, ars sulph, aethiops, cadmium sulph, calc sulph, carboneam sulph, chininum sulph, ferrum sulph, hydrast sulph, mag sulph, manganum sulph, merc suph, sulph Iod, scid sulph and zinc sulph, petroleum* etc., will be much interesting and useful. All the similar symptom groups found in the symptomatologies of all these substances can be attributed to the suphur content in these drugs.

We have already seen that various viral and bacterial toxins contain sulphur. *Suplhur* is present in most of the food articles we consume. The same is the case with the drugs used by different medical systems in the treatment of diseases. *Sulphur* ions, sulphur-containing drugs and sulphur-containing bacterial and viral toxins can compete with the *thiol* groups of various protein molecules in our body such as enzymes and antibodies, in binding with their legitimate molecular targets, resulting in unwanted molecular blocks and pathologic conditions. All these factors may contribute in building up constitutional states of sulphur in a large percentage of population, by creating diverse types of biochemic deviations in their organism. This indicates the real depth and gravity of the *'miasm'* which Hannemaan called *'psora'* in the whole human race. This study clearly shows how much important is the use of potentized sulphur as a constitutional medication for the protection of our health and vitality.

Homeopathy, based on the principle of *'Similia Similibus Curentur'* uses potentized drugs, containing molecular imprints or *'hydrosomes'* of drug molecules. Obviously, *sulphur,* which plays versatile roles in normal physiology and various states of pathology, will be the most important drug in potentized form in homeopathic therapeutics. As such, the title *'the king of antipsorics'* is not at all an exaggerated statement as far as *sulphur* is concerned.

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