Bioinorganic Chemistry
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Lecture - 39
Non-metals in Biology - III

Good morning, so today we will in the third phase of the Non Metal in the Biology system.

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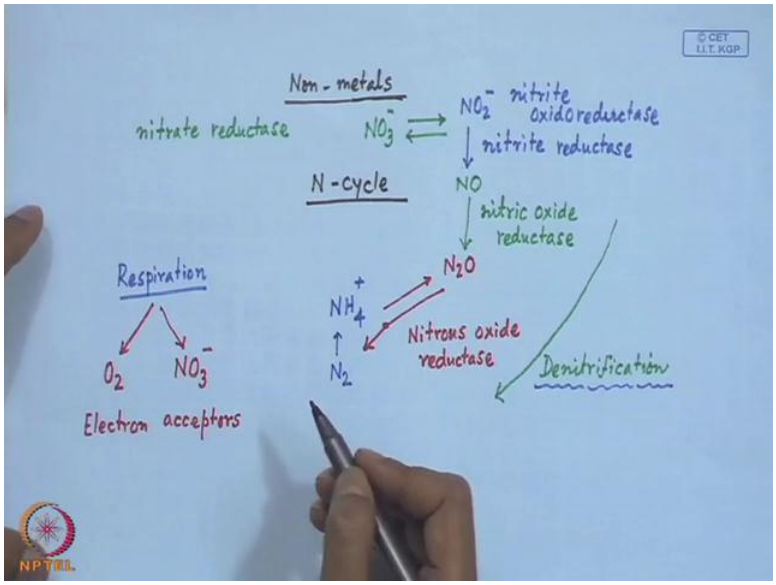

So, while talking about the corresponding nitrogen cycle, we have seen that several important reactions, which are mainly controlling the corresponding fixation of this nitrogen molecule, which is a very interesting molecule indeed. So, if we can have N 2 molecule in our hand, which can be fixed as ammonia and depending upon the condition of the medium; that means, if it is slightly acidic in nature. We should able to trap this nitrogen has the ammonium ion.

And in this particular case when ammonium ion from the nitrogen is forming, it can also give rise at the same time to the most important nitrogen bearing greenhouse gas which is nitrous oxide. So, this N2O can be formed over there or in the reverse way; that means the N2O can be degraded to nitrogen itself. So, when N2O the nitrous oxide is getting degraded to dinitrogen. The enzyme system which is involved there are the nitrous oxide reductase.

So, nitrous oxide reductase can play some important role to convert this and which is very important. Because if we consider that nitrous oxide is the most important greenhouse gas which do contribute in terms of the corresponding NOx the nitrogen oxides. And the challenge is there everywhere from the technology to the corresponding science related to the reaction of degradation.

That means, the taking of the nitrogen and oxygen bond to dinitrogen molecule and the oxygen molecule itself, is very important and this N2O can also be formed from the reduction of the nitric oxide molecule. So, this can also be formed through the reduction, so hence this is forming the corresponding reduction of N2O to N2. So, here the corresponding enzyme system, which is present is therefore, the nitric oxide reductase.

So, nitric oxide reductase we can have in our hand and from these basically what we can get, which is basically get it from the nitrite ion. So, nitrite ion when giving us the nitric oxide molecule again the enzyme system is here is nitrite reductase, so NO2 minus NO and N2O. So, all these basically belong to the part of this nitrogen cycle and this particular thing; that means, this NO2 minus and the corresponding nitrate ion they are basically and equilibrium inter converting system.

And this basically goes for the corresponding transformation of NO2 minus to NO3 minus or NO3 minus to NO2 minus. And when we consider that it is involving the corresponding reduction of NO3 minus to NO2 minus we get that the involved material in terms of this enzymatic reaction is the nitrate reductase. So, nitrate reductase will be operating on the nitrate ions NO3 minus and can be converted to the NO2 minus and when NO2 minus is going back to NO3 minus.

So, we will be working on NO2 minus nitrite oxido reductase will be there, nitrite oxido reductase will be there. So, the all these states basically are involving through the corresponding enzymatic systems starting from the nitrate reductase nitrite oxido reductase, nitrite reductase, from here also is when we are reducing nitrite to nitric oxide then nitric oxide reductase and nitrous oxide reductase also. So, all these steps basically; that means, one we get the corresponding fixation has the corresponding ammonium ion or the ammonia.

But, in all these cases; that means, the conversation of NO3 minus to NO2 minus to NON2 and all, these basically we consider has a typical denitrification reaction. So, this

denitrification reaction is basically important, so if we can in our system the typical accumulation of the nitrite anions, we can simply go for the corresponding observation of the formation of the corresponding nitrogen gas. So, we get this through the corresponding denitrification reaction.

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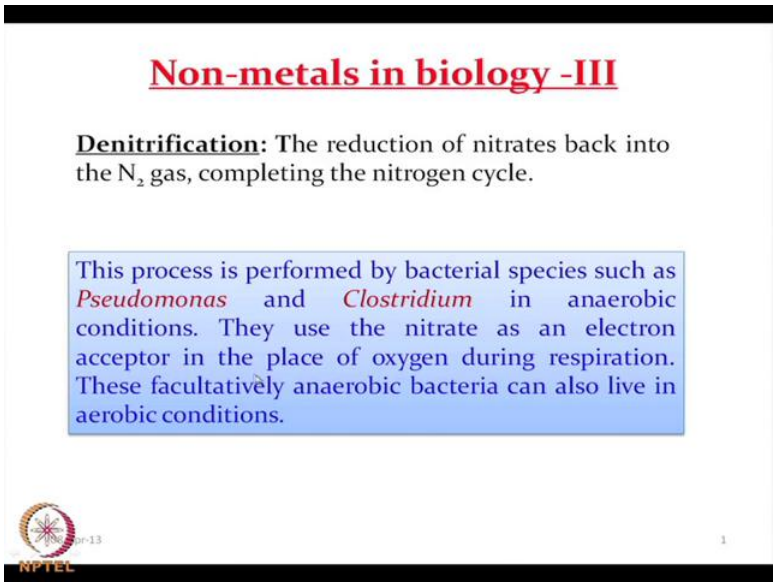

So, how this denitrification reaction can take place in the 3 rd phase of this non metals in biology class. We will see that the typical denitrification reaction is nothing but it is the reduction reaction which is operating on nitrates back into the nitrogen gas completing the nitrogen cycle. So, whatever we are just talking about during the fixation of this N 2 to ammonia and ammonium ion and there inter conversation; that means, their conversation to N2O, NO, NO2, NO3.

And when we are getting back; that means, we are coming down from these nitrogen in the pentavalent state in nitrite ion to typically to di nitrogen gas which is in the 0 oxidation state. We consider that this is a very important step of these always nitrogen cycles. So, this basically fulfills our thing; that means, we are can go from the corresponding nitrate iron to di nitrogen gas through a process, contributing to the nitrogen cycle has the corresponding denitrification reaction.

So, this basically can be performed by several bacterial forms pseudomonas and clostridium are the types of this bacterial species and typically in an anaerobic conditions; since these are all reduction reactions. So, reduction reactions does not take

the help of the oxygen. So, in absence of the di oxygen molecule in absence of oxygen environment, we can go for this typical reaction. And the electron acceptor because the nitrite ion the NO3 minus where the nitrogen is present in the pentavalent state.

So, the particular nitrogen can be very much electron greedy it can take off the electron for it is reduction reaction, and this can function as electron acceptor in the place of oxygen during respiration, where some type of respiration. So, in the respiration, which can be of two types, one is aerobic respiration and another is anaerobic respiration. So, when we have the aerobic respiration, we basically take this O2, this O2 has the electron acceptor.

And in case of other cases, where an aerobic condition is prevalent, we get the nitrate and other nitrite and all other things has the corresponding electron acceptors. So, these are the typical electron acceptors for the respiration, in case of aerobic condition and in case of anaerobic condition. So, means we are talking in terms of the corresponding bacterial process. So, the faculty for these thing the facultatively anaerobic bacteria which is very intelligent though, can also live in aerobic conditions also. Because, the electron what they are demanding, what they are accepting is taken up by the nitrate anion and the most oxidized form of the nitrogen and it can also survive. Therefore, in also these aerobic conditions; that means, where oxygen if it is present will not interfere with the corresponding reaction of all these bacterial species.

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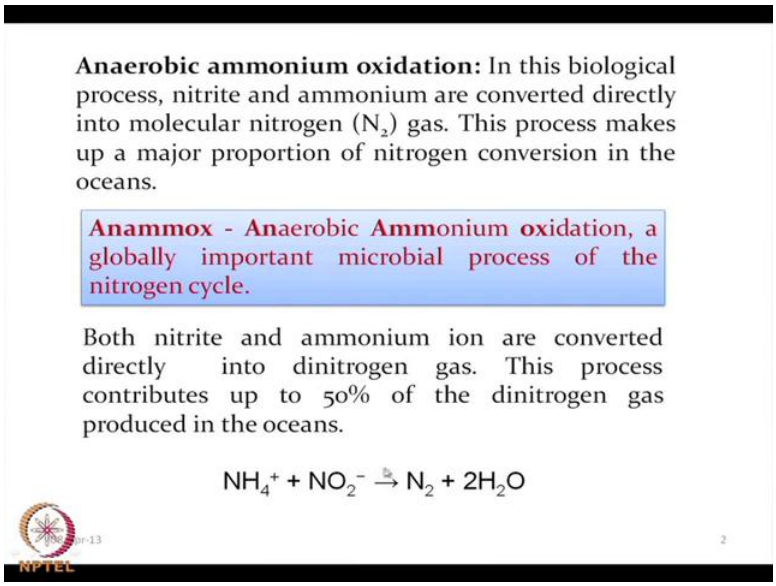

So, this particular case if we just, consider this anaerobic ammonium ion oxidation which is a very important reactions, so will be considering the oxidation of ammonium ion.

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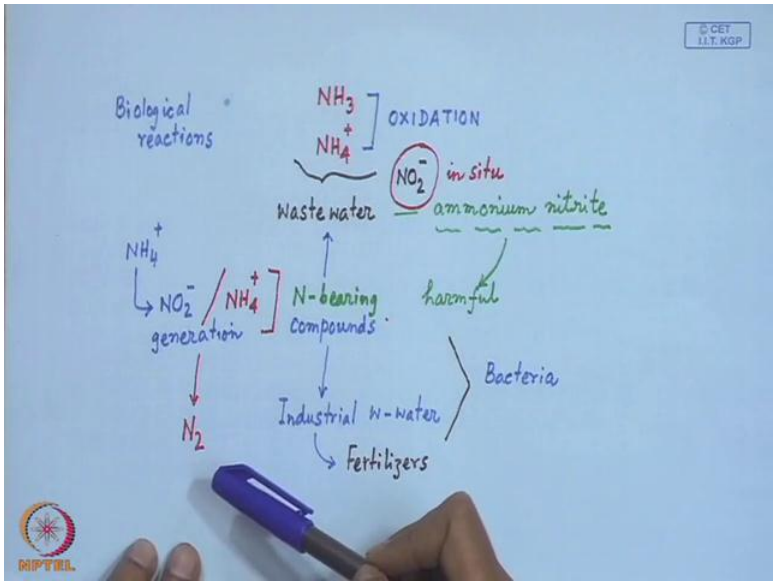

So, if we have ammonia or NH4 plus is the corresponding ionic form, and if we just consider there oxidation. So, how we can go for the corresponding oxidation of these two species and this is also a typical biological reaction. So, bio chemical things we should follow. So, for that the biological reactions we should follow and these reactions are therefore, important when a particular biological reaction, which is operating on ammonium iron; and we do not have any oxygen present over there.

Therefore, it is the anaerobic condition which is responsible for the oxidation of ammonia. So, nitrite has well has ammonium ion are converted directly to molecular nitrogen; that means, the nitrogen gas can be produced through the reaction of nitrite and ammonium ion. So, the nitrite ion the nitrogen in nitrite ion is getting reduced and nitrogen in the ammonium ion is getting oxidized that is why we call it has a corresponding reaction responsible for the oxidization of ammonia or ammonium ion.

So, it is basically a major proportion of nitrogen conversion in the ocean. So, in the ocean we get large amount of nitrogen present in the ocean environment. And if the corresponding nitrite and ammonium ion can react to produce the dinitrogen gas, where this source for this nitrogen is both the nitrite ion and the ammonium ion. Then we can

think of the nitrogen gas whatever available is due to the oxidation of ammonia and ammonium ion.

So, if we consider that a condition where in anaerobic condition ammonium ion is getting oxidation. So, is a abbreviated form is known as anammox, so ion is the anaerobic for ion from the anaerobic reaction amm a from the ammonium ion and oxidization. Ox is the so anammox is a globally important microbial process of the nitrogen cycle. So, bacteria can take part now bacteria can interfere for the corresponding nitrogen balance corresponding nitrogen cycle and amount of nitrogen bearing element.

That means, whether we have the nitrate ion or nitrite ion or ammonium ion into the system, that can be control through the interference of the microbes and they do take part in the corresponding nitrogen cycle. So, the typical reaction is a very simple reaction, where ammonium ion is reacting with the nitrite ion forming dinitrogen and water molecule. Is a very simple and straight cut reaction, but not that we always get this reaction in the laboratory and in the environment, in the natural process we get this particular conversion.

So, both these two ions the anion and the cation, the nitrite and the ammonium they are directly utilized for the generation of nitrogen gas. And it basically contributes about 50 percent of the nitrogen gas produced in the ocean. So, oceanic environment is also responsible for the production of nitrogen gas in the environment. So, whatever species we have in the ocean, water that can be utilized and the bacteria present in the ocean environment.

They are responsible for the corresponding degradation of both the ammonium ion as well as a nitrite ion for the useful production of dinitrogen gas, which can no longer be trapped in the water molecule of the ocean. So, they basically leave the ocean water system and can contribute to the corresponding interaction of this nitrogen gas in the environment.

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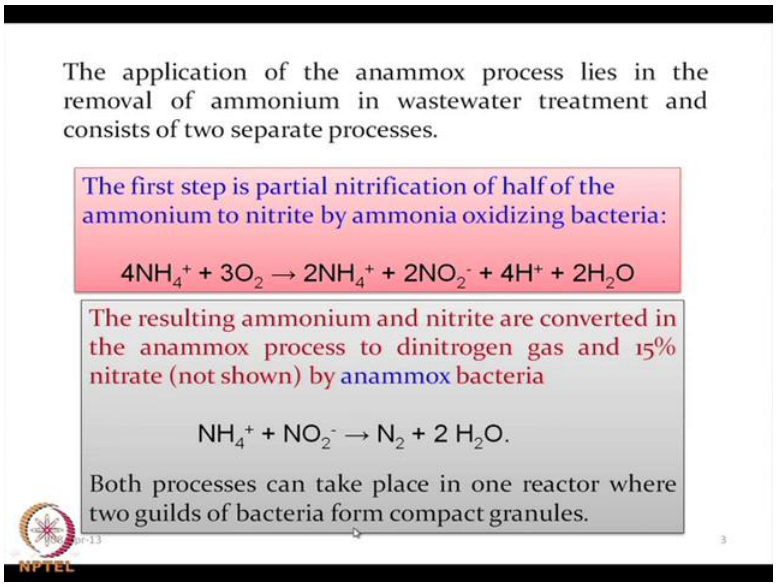

So, how we apply is a very simple and very useful reaction of this anammox process, if we want to remove the ammonium ion the wastewater treatment. So, how we can have, so we get basically something, if we have both these two; that means, the ammonia has well has the ammonium iron, in industrially fluent in the corresponding city water level; that means, the corresponding wastewater. So, if this is present in wastewater, which is getting polluted due to the presence of a high level of high amount of this nitrogen bearing inputs.

So, in the wastewater if we have ammonium ion has well as the corresponding nitrite ion. So, if we have the ammonium nitrite basically. So, what the salt which is present in the wastewater is the ammonium nitrite. So, the presence of ammonium nitrite is therefore, is a typical concern; because high level of these ammonium nitrite as not good these are a harmful for our health. So, they can have some severe health effect.

So, these basically harmful to the living organism and they can contribute to some other important reactions, which are mainly control by the presence of the ammonium ion has well has the nitrite iron. So, if we can take the typical anaerobic ammonium ion oxidation and if we just consider one such reaction. That means where ammonium ion is taking care of, so in the first step a typical reaction, what we can have is the partial nitrification of half of the ammonium ion to nitrite by ammonia oxidizing bacteria.

So, this is a bacterial reaction and bacteria is present over there and in that particular case the ammonium iron is simply oxidized by the dioxygen molecule, but this oxygen is coming from some aerobic condition. So, is a not a typical anaerobic condition is present, so in the first step where we are utilizing the dioxygen molecule. So, utilization of this dioxygen molecule for the corresponding degradation of this ammonium ion to nitrite ion can be considered like this.

So, half of the ammonium ion; that means, two of this NH4 plus is converted to of that corresponding NO2 minus and 2 remains as corresponding ammonium ion and some protons is also forming H plus ion is forming together with some water molecule. And in the second step, so if we have the corresponding these two species; that means, in solution we have both ammonium ion as well as the nitrite ion. So, this is the corresponding anammox reaction, which is not required any oxygen.

So, is in typical anaerobic condition, so in typical anaerobic condition when half of the ammonium ion has generated nitrite ion; so the presence of nitrite ion is important. So, the generation of these NO2 minus NO2 minus generation from where, from the ammonium the ammonium ion is therefore, important. So, once it is a pres form we already have the ammonium ion the system, so this what, is we are talking about this are generated. So, within the reaction medium; that means, in C 2 we are generating some amount of nitrite ion.

And that nitrite ion, when react with that ammonium ion can go for the typical degradation with the production of only nitrogen gas. So, these two; that means, the ammonium and the nitrite ion are converted by this process through nitrogen gas and 15 percent of the nitrate ion also. So, this reaction is not only for the direct conversation of both ammonium iron and the nitrite ion to nitrogen molecule the nitrogen gas, but at the same time some amount of side reaction can take place.

So, as bi product of this reaction, we get some amount of nitrite ion also through this particular reaction. So, what bacteria can do for us we can take these bacteria in some closed vessels since some reaction vessel what we call has a reactor where two guilds of bacteria form compact granules. So, if the granulated bacteria's are there bacteria's attract within the granules and those granules are expose to the solution bearing the ammonium ion and the nitrite ion.

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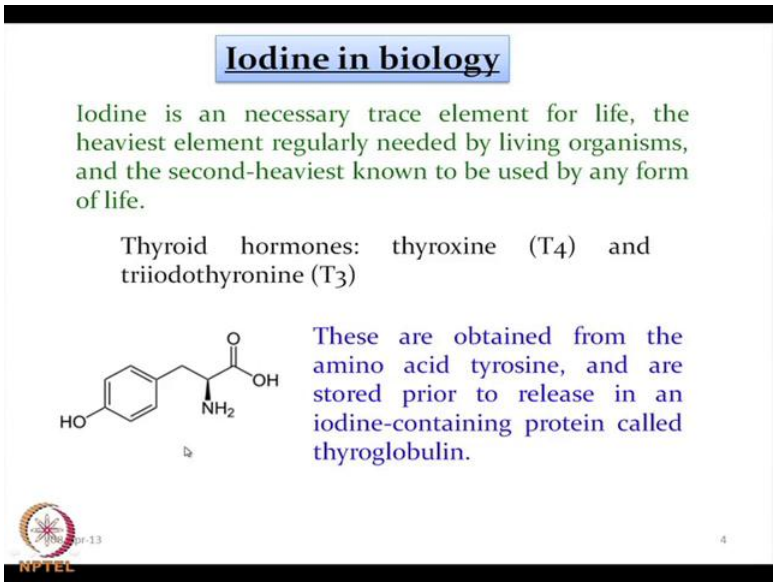

So, this basically can go for the corresponding elimination of both these two. So, if the wastewater, the storage water or the drainage water from the municipality, where we have, so all the nitrogen bearing materials. Because they are coming from all the nitrogen bearing molecules like the fertilizer the proteins the amine acids all nitrogen bearing compounds.

So, if we have several of these nitrogen bearing compounds in our hand and they are basically also present in the wastewater, there are several nitrogen bearing compounds also present in industrial wastewater. So, industrial wastewater several of these nitrogen bearing compounds are present, particularly if the industry is based on some fertilizer production industry, if they are dealing with some fertilizers, manufacturing of some fertilizers.

So, they definitely will have some this all this nitrogen bearing compounds where the nitrogen level the nitrogen concentration is very high and the wastewater should be treated. So, these anammox treatment, so this particular treatment; that means, the bacterial treatment. So, both these; that means, simple ground water contamination can be avoided, if we can go for the corresponding treatment by using some bacteria only.

So, bacteria is therefore, very much helpful for us to relieve these all nitrogen containing contaminations all the nitrogen bearing element to that dinitrogen gas and this dinitrogen gas can be remove to the environment. So, from this; that means, after this nitrogen cycle

we can now considered another very important non metal, which is playing some important role. That means, they are playing some very good contribution towards some important biological reactions, which is the iodine that, we all know.

Now a days, that iodine supplement, what we are getting as the corresponding salt the common salt, the table salt as the corresponding sodium chlorite, because iodine can give rise to some important reactions in our health for our good health also. So, it is a very necessary trace element for our life for the human being also and it is definitely a heavier element and is known for the heaviest element regularly needed by living organisms.

And is therefore, a second heaviest element, because already we have discussed while we are talking in terms of the corresponding enzymes bearing molybdenum and tungsten. So, tungsten was the heaviest one and after tungsten, we have the corresponding elemental composition for all these biological important molecule is due to the iodine. So, in terms of the corresponding atomic weight, we consider it is the second heaviest element, which can have some contribution towards some biological reaction and which can be used by any form of life. So, human being is also important and also dependent on the corresponding iodine concentration. So, how iodine can do iodine can be useful for our health that we can see, so these are the two thyroid hormones.

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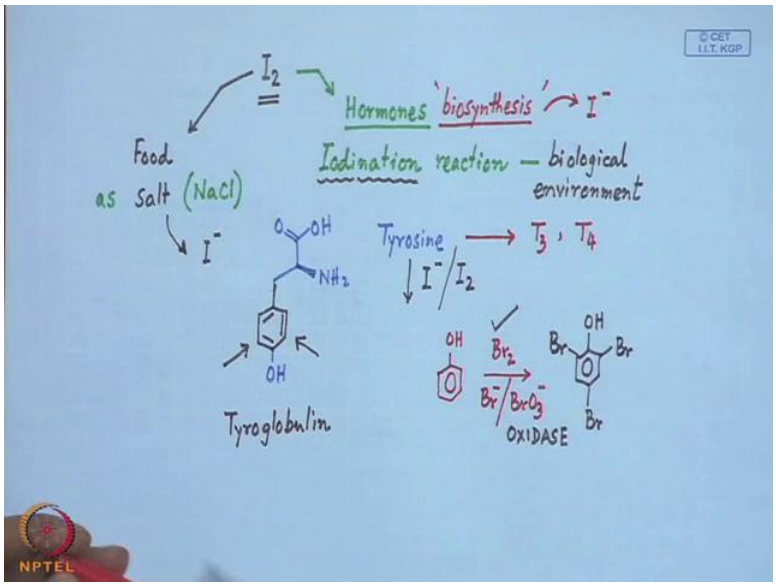

So, iodine deficiency is basically led us to some diseased condition. So, if we have this I 2 the iodine and we basically get this particular in our food material as the corresponding

salt intake, if we are not getting sufficient amount of iodine from the other food material. So, as salt along with our sodium chloride intake we get the corresponding iodine intake also. So, these iodine is utilized for the production of hormones basically. So, while we are talking about the corresponding vanadium dependent enzymes.

So, vanadium chloroperoxidasae we have seen, that we can go for the insertion of the c l; that means, the chlorine atom or the bromine atom to some organic substrate or organic molecule, by the corresponding chlorination and bromination reaction. Similarly, if we know that all these hormones are bearing some iodine fragment within the molecule. That means, the basic important reaction for the generation of these hormones should be iodination.

So, iodination reaction we can talk about, so how in a very mild and very soft condition the biological environment. So, biological environment, how they can go for some important iodination reaction, when we have the corresponding iodine bearing salt; where we have iodine as present as the corresponding iodide ion like chloride, like bromide we have the iodide ion. So, this iodide can go for the generation of two such hormones and it is the thyroid gland.

This particular thyroid gland is controlling everything. So, two such hormones we can have one is known as thyroxine and is also labeled as T4 and another is known as triiodothyronine, this is also thyroxine. This particular thyroxine is also known as tetraiodothyronine, so when we have the corresponding organic molecule has a derivate bearing four iodine atoms we call it as a corresponding tetra or T 4. And when it is the tri one triiodo derivate; that means, we have three iodine atoms within the molecule we call it as a triiodothyronine.

So, we must have some substrate, where four iodine atom should keep be incorporated within the molecule. And in another case three such iodine atoms can incorporated within the molecule, and they play some important role related to our thyroid hormones. So, the molecule which we get is a typical amino acid and which is our tyrosine. So, tyrosine molecule we can have, so is plenty in amount in our body also the amino acid tyrosine is everywhere in our system, in different proteins and polypeptide chains also.

So, if can generate some amount tyrosine from there different food materials also can supply tyrosine. So, there are several tyrosine bearing food materials also there. So, we

have regular intake of these tyrosine molecules in our system and these amino acids they are iodinated. So, they are basically stored to released in an iodine containing protein called thyroglobulin. So, some iron containing protein we can have, which is related to the thyroid gland, that is why it is named as thyroglobulin.

So, if we have this particular amino acid as their typical backbone or the substrate. So, like our vanadium bearing enzymes, what we have seen which are responsible for the corresponding conversion of the molecule from it is non chloro or non bromo derivate to it is corresponding chloro derivate to that of our bromo derivate. Similarly, we have the corresponding tyrosine residue. So, the tyrosine residue what we have in our hand which the basically the amino acid a very simple amino acid bearing the phenol unit.

And this particular one, this part is basically the corresponding amino acid part, so like that of our tyrosine molecule. So, is the amino and you can have and we have the carboxyl end. Therefore, it is basically a para substituted phenol unit. So, para substitute phenol unit is the pendent unit to that of our drisine molecule which is our tyrosine amino acid. So, if we have the tyrosine molecule in our hand and this tyrosine molecule can react or interact with that of our iodide ion or the free iodine molecule.

Further reaction the reaction is our typical iodination reaction. So, how we can have the corresponding iodination reaction; that means, if can have the simple phenol unit, We know that this is a very simple and straight cut reaction; that means, phenol can be brominated by the use of simple or elemental bromine or bromide, bromide mixture; that means, if we add the bromide ion as well as the bromide ion, so this basically these two; that means, a bromide, bromide mixture.

This bromide is nothing but the corresponding oxidizing agent this is the oxidase. So, bromate can function as a typical oxidase for the production of these bear two molecule. And this basically responsible for the corresponding substitution of these three positions with respect to the phenol OH function. So, we get straight away from there the molecule like tribromophenol. So, this tribromophenol can very easily we make with the addition of bromine to the phenol molecule.

Similarly, if we can have the tyrosine and if are looking for some typical or the corresponding iodination reaction, which is present in the protein part. That means the protein thyroglobulin is there and that thyroglobulin can handle this iodine to be inserted.

So, these are the two ortho positions similar to that of our tribromophenol, which can be iodinated with respect to the phenol OH. So, this is the simple possibility where the generation of the typical hormone can take place, whether the simple iodination reaction can convert the tyrosine.

Whether we get the simple tyrosine as we get the tyrosine and whether the tyrosine how the tyrosine is responsible for the generation of these two important molecules the triiodothyronine. And the tetratriiodothyronine; that means, the T 3 and T 4 molecule. So, what is that particular reaction because we always know that depending upon this corresponding deficiency in iodine that why we take all the time the regular salt the table salt what we take in our food as which should be supplemented by the corresponding iodine.

So, the iodine availability should be there which can be utilized for the tyrosine iodination for the production and the generation of the hormone. So, this hormone biosynthesis is therefore, important, so this biosynthesis is dependent. So, this hormone biosynthesis is that the formation T 3 and T 4 is basically dependent on the corresponding concentration of I minus or the I 2 molecule. So, this particular thing; that means, the iodine containing protein thyroglobulin, which is basically stored the corresponding iodinated form of this tyrosine molecule.

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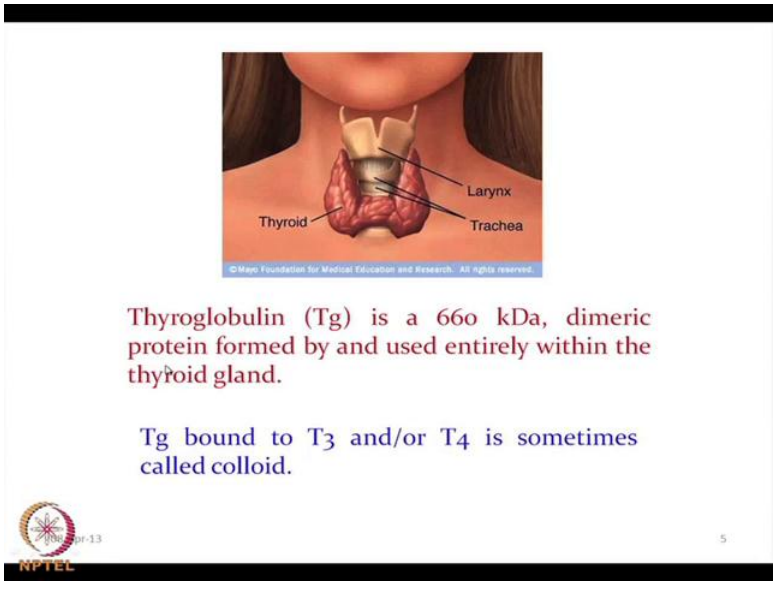

So, this is some example of this thyroid gland and is basically is corresponding larynx and trachea we have. So, this is our lack larynx there's the vocal organ where we use utilized it for speaking our thing; that means, and we have the trachea. And this entire part is surrounded by the very big thyroid gland. And thyroid gland is you can have which is responsible for the production of these all these important molecules has there corresponding hormones.

So, the T g is we have the thyroglobulin is basically a very big protein molecule is a having a molecular weight of 660 kilo dalton. So, this 660 kilo dalton bearing dimeric protein; that means, it has two parts basically, which is formed by and used entirely within the thyroid gland. So, thyroid gland is responsible for the use of this thyroglobulin protein molecule and thyroglobulin molecule is responsible for handling these molecules like this T 3 and T 4 molecules.

So, when we have this thyroglobulin, thyroglobulin is bound to T 3 and T 4, T 3 or T 4 and when in the bound condition they are known as the corresponding colloid form. So, in thyroid the gland we have, so, the human begin also we have this particular thyroid gland and this thyroid within this thyroid gland, we have the corresponding protein molecule which is the T g. So, thyroglobulin and that thyroglobulin is responsible for binding that T 3 and T 4. So, therefore, we can see how this T 3 and T 4 molecules are formed from tyrosine molecule itself. And they are going they are basically and bound to the corresponding thyroglobulin molecule.

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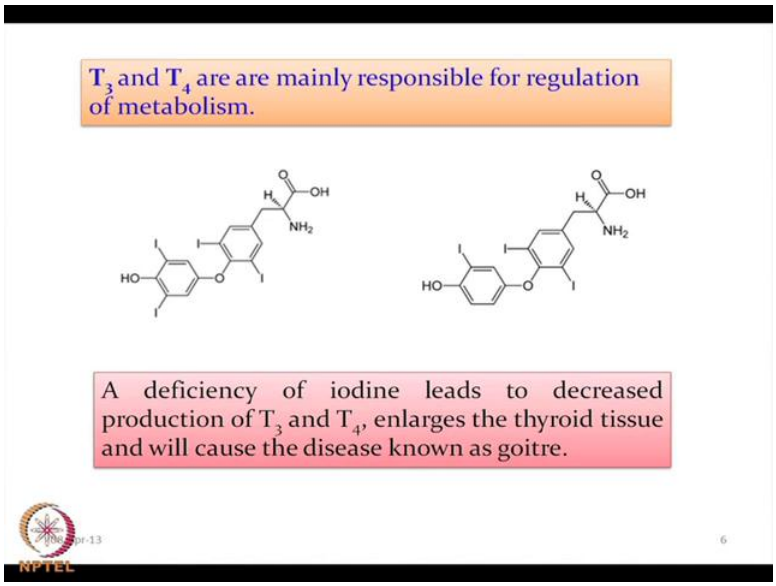

So, these T 3 and T 4 are very important molecule. So, why they have serve has this T 3 and T 4 molecule why they are, so important. So, these T 3 and T 4 are responsible for one, very important reaction in our body is responsible for controlling the metabolism is a very important reaction in our body.

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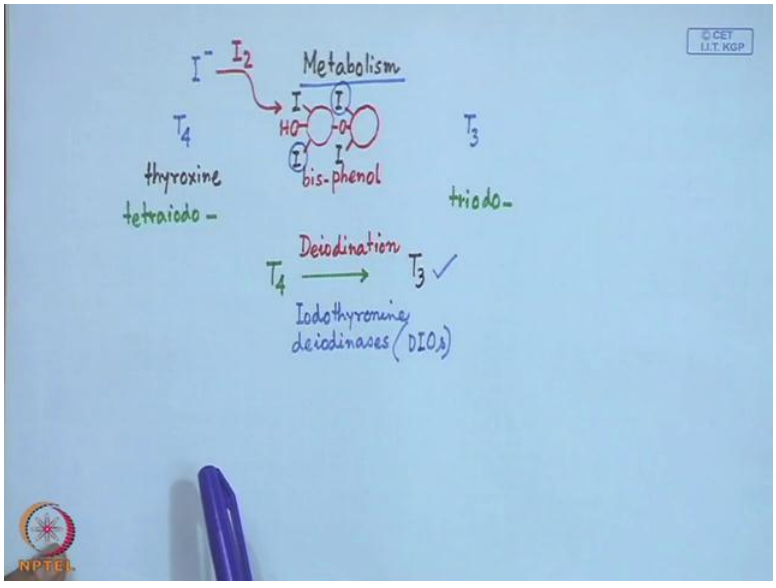

So, if we can have the corresponding sufficient amount of this T 3 and T 4 molecule we can have good metabolic rate and we can have useful metabolism reactions for the food material the respiration everything. So, basically we see that metabolism is also

therefore, dependent on the non metal component; that means, the iodide ion. So, iodide ion dependent metabolism reaction is there, because this (Refer Slide Time: 40:54) both these two molecules these two hormones T 3 and T 4 can control our body metabolism reactions.

So, this is not entirely the corresponding iodinated form of the tyrosine though this is the tyrosine part, but is basically a bisphenol molecule. So, the bisphenol molecule is there, so from the tyrosine we basically get a bis phenol type of molecule having two phenyl rings. So, for getting a system like T 4 and getting a system like T 3 through iodination reaction. So, whatever reaction we have in our hand is utilizing these I minus or I 2 in C 2 generated I 2 through some oxidation reaction.

So, these iodination reactions, so this particular iodination reaction can take place if we can have one benzene ring and this particular benzene ring can have two ortho positions. So, T 3 and T 4 can only be possible if we have two such benzene rings, which can give rise to four ortho positions with respect to the corresponding O H groups available. And if this is attached to the second molecule, we get a corresponding bis phenol molecule.

So, we have a bis phenol unit and this bis phenol unit is utilized for iodination, so when all four positions are responsible for iodination reaction, we get a T 4 molecule. And when only three positions are occupied for iodine where your getting we get the corresponding T 3. So, this is the corresponding T 4 molecule we have, where 4 of these positions two ortho of this O H group and two of ortho to this (( )) molecule of this bis phenol unit, we have the T 4 molecule in our hand.

Similarly, when we have this first of these; that means, which is directly attached to the amino acid fragment at the para position are both are occupied both the two positions the positions 2 and 6. Basically are occupied by iodine group and the second phenol unit having one iodine unit group to one of the ortho position, we get the corresponding T 3 molecule. So, we will see that how these two molecules can basically take part in the corresponding, important metabolic pathways for our system or our body.

So, if we have some deficiency of iodine; that means the deficiency of iodide ion as we are consume in our body. So, if we have less amount of this iodine in our system. So, less amount of iodination can take place though this bis phenol type of molecule can form. But the iodination reaction cannot take place, but the effective hormone the real

hormone what is being formed over there is basically the corresponding molecule having this iodine derivatives.

So, any kind of deficiency of iodine basically needs to decreased production of T 3 and T 4; if the concentration of iodine or iodide ion which is required for the regular production T 3 and T 4 is sufficient. Then only the required amount of T 3 and T 4 can be formed in our body. Otherwise, we will have some less amount of T 3 and T 4 in our system; that means, we are having some deficiency of iodine as well as deficiency of T 3 and T 4 molecules.

And the diseased condition for that; that means, if we have a deficiency of T 3 and T 4, we will see that, we are having goiter that this goiter is nothing but we have the thyroid gland and that thyroid gland will be enlarged. Because if it is swells of if it has a bigger volume if the thyroid gland size is increased it will try to absorb more and more is basically fighting for more amount of iodine absorption.

So, if the iodine absorption is less, there is deficiency the iodine is not getting to the system and the less amount of iodine can be considered as the corresponding enlarge thyroid gland. Because thyroid gland will next try to enlarge itself and try to increase it is surface area and through that surface area it will try to accumulate more and more iodine to the system. So, will be having a diseased condition, which is known as goiter is well known from our childhood days, from our school days we all know how the goiter is there. But now, we come to know that it is the deficiency of the inorganic ion; that means, the iodide ion or the non metal element iodine which is responsible for this condition.

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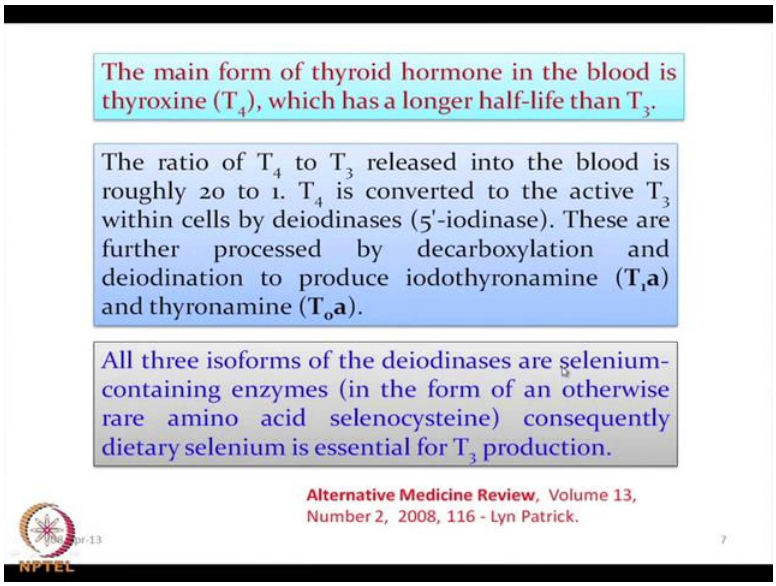

So, if we have in our system the main, form what is forming over there is the thyroid hormone in the blood is the T 4 which is known as the thyroxine or tetraiodothyronine. So, this T 4 when is forming in our system we call it as a thyroxine. So, this thyroxine is nothing but the corresponding tetra iodide derivative and this is the corresponding tri iodo derivative, but these two compounds have some difference in terms of it is corresponding life time.

So, the T 4 has a longer life half life than T 3. So, whenever T 3 is forming in our system it is degrading very quickly it as less half time compared to our T 4, so T 4 is the most stable compound. So, T 4 will stay in the blood for longer period of time, but the two ratios; that means, the formation T 4 and T 3 what is forming over there and released into the blood is roughly 20 to 1. So, more and more T 4 can be formed in our body and in the blood stream the concentration of T 4 would always be the higher; that means, it is always 20 times higher.

Basically it is 20 times higher than the T 3, which is available in the bloods stream. But another very interesting reaction is the corresponding involvement of some enzyme. So, which can be responsible for a typical catalytic reaction which is nothing but, the removal of the iodine atom from the phenyl ring attached to the bis phenol unit, which is known has deiodinases; that means, which is responsible for deiodination reaction. So,

deiodinases, which is taking the 5 prime iodinase reaction; that means, it is taking out that particular I group from the T 4.

So, the reaction what is forming over there, which is operating, so these deiodinases, so, deiodinases. So, idothyronine deiodinases, so we call them as idothyronine deiodinases. So, we have the thyronine moleculem which are iodized. So, idothyronine deiodinases that abbreviated as the DIO de iodinases. So, these basically catalyze the corresponding reaction, which is known as de iodination reaction we have seen.

So, far that the introduction of this iodine atom to the phenyl rings attached to ortho position of the OH or O group is known as iodination reaction. So, this will be our de iodination reaction. So, through this de iodination reaction what will basically get we can be able to convert the T 4 molecule to T 3 molecule; and which is very interesting to know that we have, this four iodine positions and we are taking out this iodine atom from these rings.

So, we can have the possibilities that I can be removed from this ring or I can be removed from that particular ring. So, the removal of I from one particular ring which is leading us to the generation of T 3 is the most acceptable reaction for this particular pathway; that means, the de iodination path for the conversion T 4 to T 3 is therefore very important. So, when de iodinases are operating there these particular molecules are further process by decarboxylation and de iodination to produce iodothyronamine and thyronamine molecule.

So, decarboxylation can take place also; that means, CO2 group can remove from the molecule and only some benzyl ammine type of derivate can be present over there from T 4 and T 3. So, there are three forms iso forms basically of deiodinases. So, this deiodinases deiodinases molecules are some enzymes and we just introduce the first time that the selenium atom. The selenium is there which is important in the biological reactions.

So, like that what we are seeing today the reaction of iodine in biology. So, what will be taking in our next class as the corresponding involvement of these selenium groups the selenium containing enzymes. So, now, today we will see that this selenium bearing enzyme is also important; that means, these are very much inter related; that means, the corresponding reactions involving iodine or iodide ion. Or the reaction involving the

selenium atom they are inter related, because the deiodination reaction can be controlled by some enzyme, which is bearing the typical selenium atom.

So, in the form of otherwise rare amino acid selenocysteine. So, when the cysteine is there and selecysteine sulfur bearing selenium atom we get the corresponding amino acid has selenocysteine. And that selenocysteine is present in this particular enzyme and therefore, like that of our iodine in our food material in our diet we should have also selenium which is essential for the production of T 3. So, now, at this particular point we should be able to tell you that why selenium is important, why selenium as well as iodine is important for the treatment of goiter. Because, the less amount of T 4 will lead to less amount of T 3 production, because for this deiodination reaction we will see that T 4 is directly converting to T 3, And that particular T 3 is responsible for our metabolic reactions. So, whatever thing we can have; that means, what we just basically go for the corresponding de iodination reaction.

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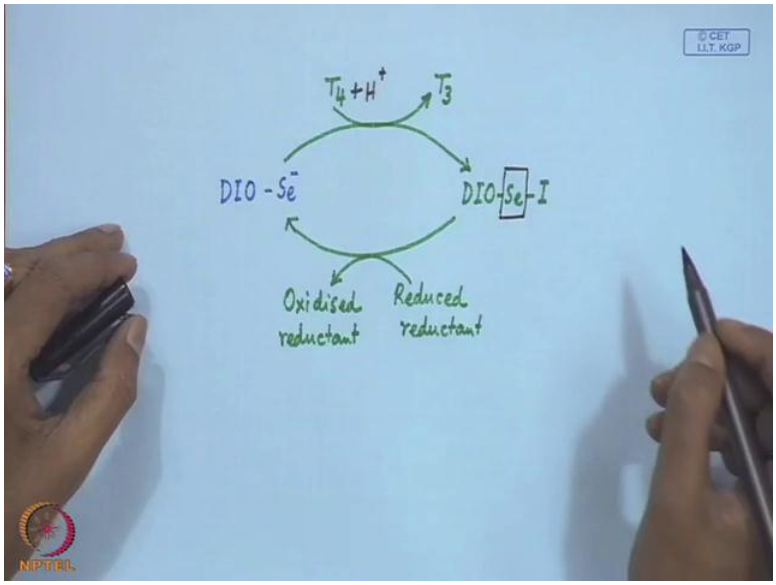

So, basically if we have the enzyme, which is the deiodinases, so de iodinase now we see that it will have the selenocysteine amino acid. So, this particular selenocysteine amino acid is therefore, there and this basically is responsible for the conversion of the corresponding T 4. So, we can have the T 4, which can be converted to T 3. So, for the production of T 3, we should have selenium bearing this protein peptide chain and this

particular is responsible for the corresponding removal of this one of the I group from T 4.

So, that basically giving us DIO selenium and this selenium is basically taking up this iodine. And this cycle can be closed since it is a typical catalytic cycle for that, where we use some reductant to convert this particular oxidized form of this deiodinases to the reduced form of this. So, we have the reduced reductant, which can be converted to it is oxidized form as oxidized reductant. So, that basically gives us some idea that how selenium is playing some important role for the generation of this selenium iodide bound, which is very important. So, next day we will consider this particular element that mean the selenium towards the corresponding metabolic pathways, because the iodine is important for the generation of this T 3 and T 4. This basically when taking part one proton also is generating the corresponding T 3, how selenium is important for the generation of T 3 molecule.

Thank you very much.