Course on Industrial Biotechnology
Professor Debabrata Das
Department of Biotechnology
Indian Institute of Technology Kharagpur
Lecture 45
Module 9
Fodder Yeast Production

Welcome back to my course Industrial Biotechnology now today I am going to talk about this fodder yeast production and fodder yeast means the yeast that is used as a animal feed and in the last class I I talk about this Bakers yeast fermentation process Bakers yeast is usually considered as a food yeast and food yeast is usually we we also term as the nutritional yeast because it is it contains about the 50 percent of protein and also it contains vitamin B and other essential minerals which is which is required for our as a nutrient.

And I I told you that two type of Bakers yeast that is marketed one is active dry yeast and it is compressed yeast and also I talk about this what are the different parameters that influence the Bakers yeast fermentation process and what should be the characteristics of the Bakers yeast one important characteristics you have mentioned that that the yeast should be well disperse in the water because if it is not well disperse this causes some problem in the bread making industries and also I told that that this Bakers yeast also can be one thing I forget to mention this can be also be used for the production of yeast extract.

This extract when you treat with with chloroform under anaerobic condition we keep it at high temperature maybe 40 to 50 degree centigrade then soluble that is yeast cell yeast cell will bust and soluble material present inside the yeast cell that will comes out and that we can use as a yeast extract. Now today I want to discuss the the fodder yeast production and food yeast basically this is produced by using another kind of yeast what it call torula utilis.

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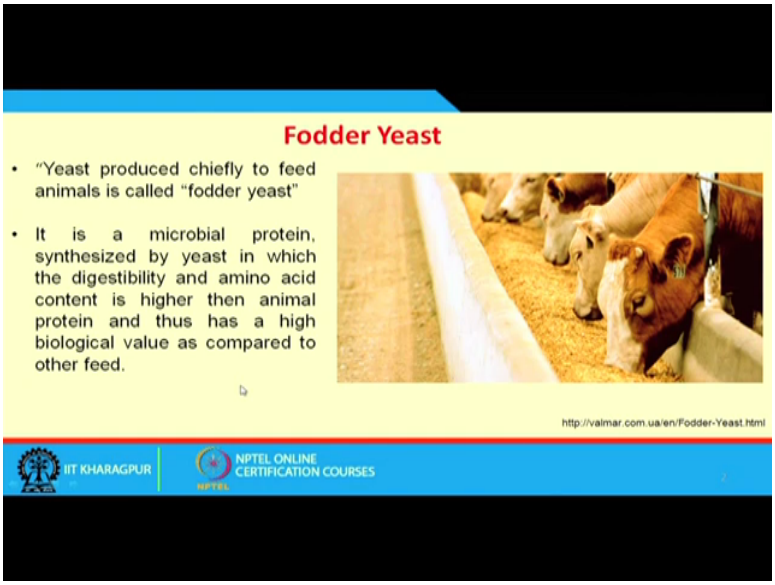

Now the yeast is produced cheaply to feed animal is called fodder yeast this is this has the good nutritional value and when I was talking about the single cell protein I told you that more advantage of single cell protein is that your cell mass grow very fast as compared to any other biomass that plan biomass, so naturally that that it is always always desirable that we use the microbial protein as our food but this is not used in practice the reason is that most of the microbial protein contents lot of nucleic acid and this nucleic acid causes some kind of kidney stone and gout.

So so if you want to use this as a human food then we shall have to we have to we have to take the nucleic acid out from this single cell protein then it can be used as human food, so here the candidate is mostly used it has a good amount of nucleic acid so it is not used actually for human food, it is used for animal food and and this usually produced from the waste product from the industry because particularly sulphate sulphite waste liquor from the Balken paper industry.

Now here if you see that it is a microbial protein synthesis by yeast in which the digestibility and amino acid contents is higher than the animal protein and thus has the high biological value as compared to other feed, so this is one of the very important aspects why it consider as a as the animal food.

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Now the manufacture of fodder yeast is of interest to those desired to convert waste or surplus or low cost carbohydrate material into products of value for feeding cattle, hogs and other farm animals. The utilization of waste sulphite liquor from pulp and paper industry for fodder yeast production as for example results in extension of animal food at the same time aids in the elimination of stream of pollutants because this sulphate waste liquor if you throw it to the atmosphere this causes the environmental pollution problem this is another issue that we have that is to be seriously considered.

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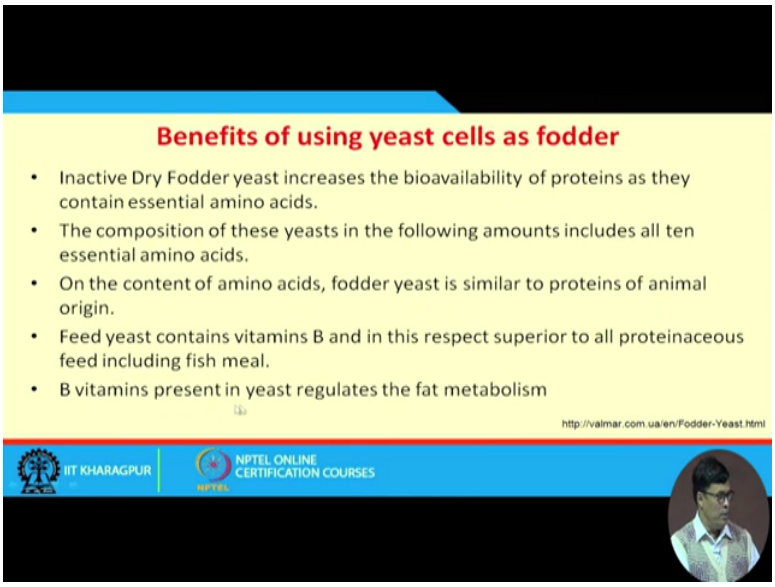

Now benefits of using yeast as a fodder is as inactive dry fodder yeast increases the bioavailability of protein as they contain essential amino acids. The composition of this yeast

in the following amounts includes the ten essential amino acid. We know very well that what is the purpose of essential amino acid, essential amino acids are those amino acids which are not produce our our body as per as per desired amount. So that is why we shall have to supply those amino acids for our for our growth and metabolism so that is very much important

On the content that amino acid the fodder yeast is similar to proteins of animal source in the animal origin we have all the amino acids more or less balanced and feed yeast contains the vitamin B and this respect superior to all proteinaceous feed including the fish meal. The B vitamin present in the yeast regulate the fat metabolism this is this we have.

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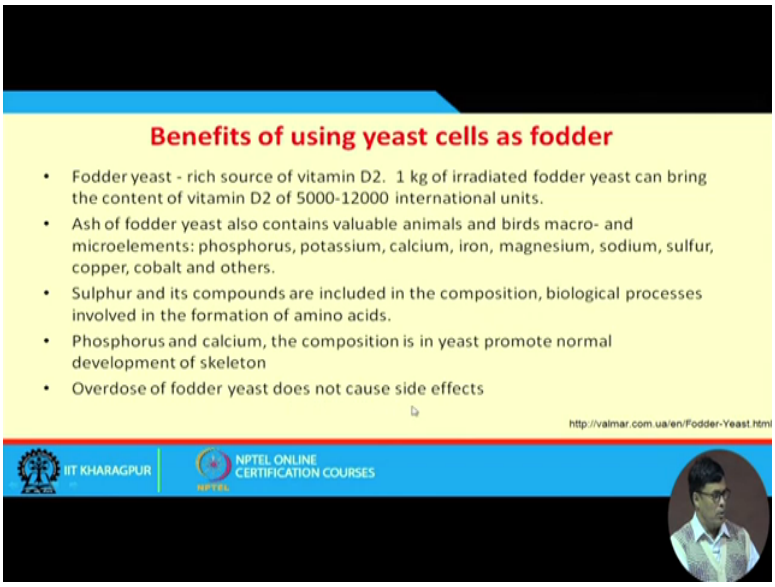

The fodder yeast rich in vitamin D2 the 1 kg irradiated fodder yeast can bring the contents of vitamin D of 500 to (12) 5000 to 12000 international unit

Ash of fodder yeast also contains valuable animals and birds micro and macro elements such as phosphorus, potassium, calcium, iron, magnesium, sodium, sulphur, copper, cobalt and others. Sulphur and its compounds are included in the composition and biological process involve in the formation of amino acids the phosphorus and calcium the composition is the yeast promote this normal development of skeleton. Overdose of fodder yeast does not cause any kind of side effect.

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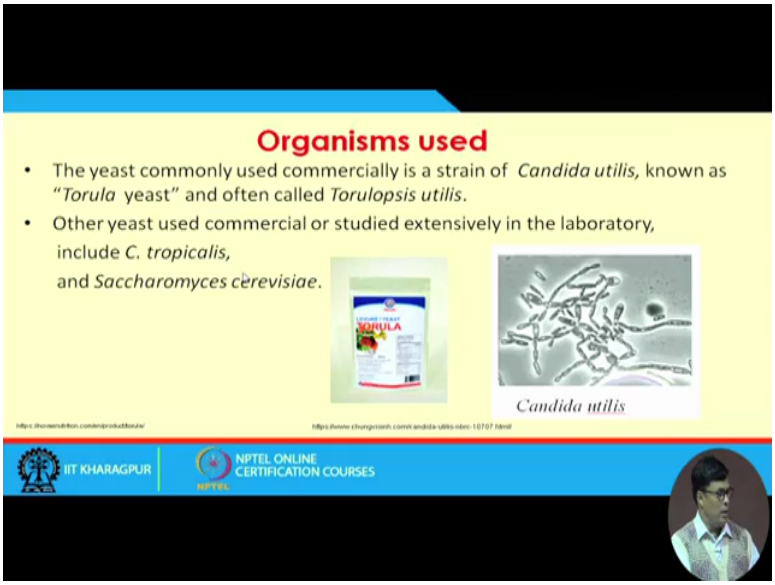

Now yeast commonly used commercially is a strain of candida utilis I told you just now which also known as Torula utilis the torula utilis and candida utilis is basically same and often called as Torulopsis Utilis. The other yeast used commercially or studied extensively also in the lab this is candida tropicalis and saccharomyces carevisiae.

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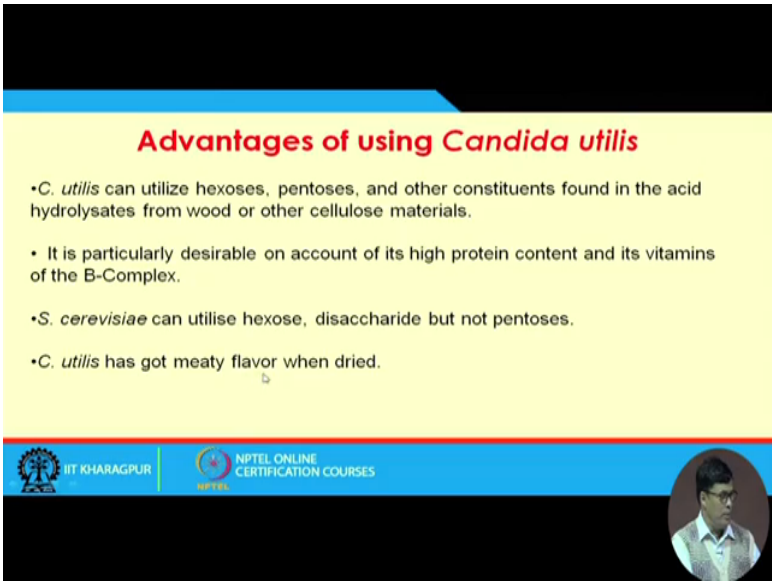

Now advantages of using candida utilis is that candida utilis can utilise the hexoses and pentose sugar because if you look at this Bakers yeast fermentation process your Bakers yeast saccharomyces carevisiae can only use the hexoses sugar they cannot use the pentose sugar now when we use any kind of that you know plant material it contains also not only contains cellulose material but also contains hemicellulose

Hemicellulose is a cellulose is basically the polymer of hexoses but if you look at the hemicellulose this is a polymer of both pentoses and hexoses, so naturally that and in case of pulp and paper industry we do some kind of acid treatment or alkali treatment and during this process some of the hemicellulose that solubilize so there is every possibility of presence of pentose and hexose sugar.

So if you that is why we we find that waste sulphite liquor that is a good raw materials for the fodder yeast production particularly for the utilization of candida utilis. Now the candida utilis can utilise hexoses and pentoses and other constituents found in the acid hydrolysates from the wood and other cellulose material as we know that paper pulp, pulp and paper industry they use the wood paper material particularly bamboos for the production of paper that it is particularly desirable on account of it high protein contents and is vitamin B complex saccharomyces carevisiae can use the hexoses I told you, disaccharide but not the pentoses. But it it also can saccharomyces carevisiae it has the inverted enzyme is due to the presence of inverted enzyme. Sucrose is degraded to glucose and fructose.

Candida utilis has got the meaty flavour this is when dried this is one one one very important aspect that we have when you drive a candida utilis is give the meaty flavour kind of flavour that is developed when you dried it.

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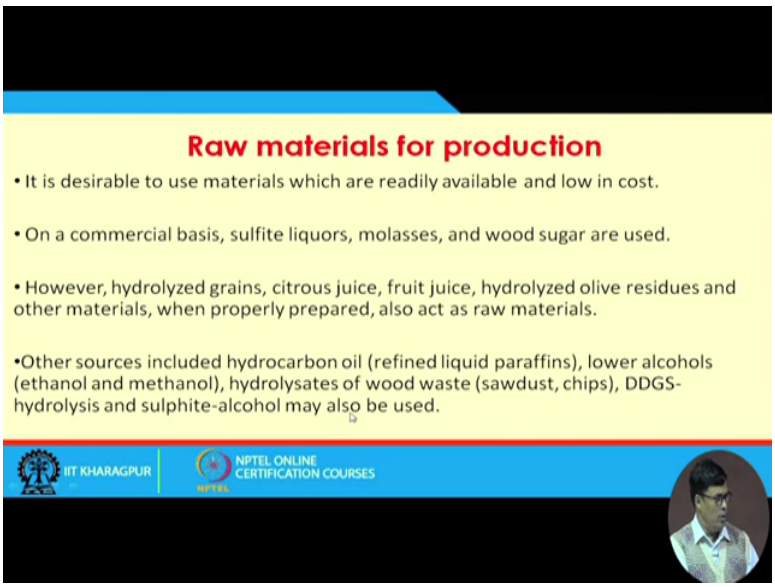

Now raw material for production it is desirable to use the raw material which are readily available but low yield cost because since we are using this as a fodder yeast the raw materials should be low in cost otherwise cost of production will be very high on on a

commercial basis sulphite liquor molasses wood sugar are used. However hydrolysed grain citrus food or food juice hydrolyse olive residue and other materials when properly prepared also acts as raw materials.

So this are the different materials can be considered for the production of fodder yeast, other resources like hydro carbon soil, refined liquid paraffins, low alcohols like ethanol and methanol hydrolysates of wood waste like sawdust and chips and distiller dry grain solids, distillers dry grain solid or solubles they are hydrolysis and sulphite alcohol also be used.

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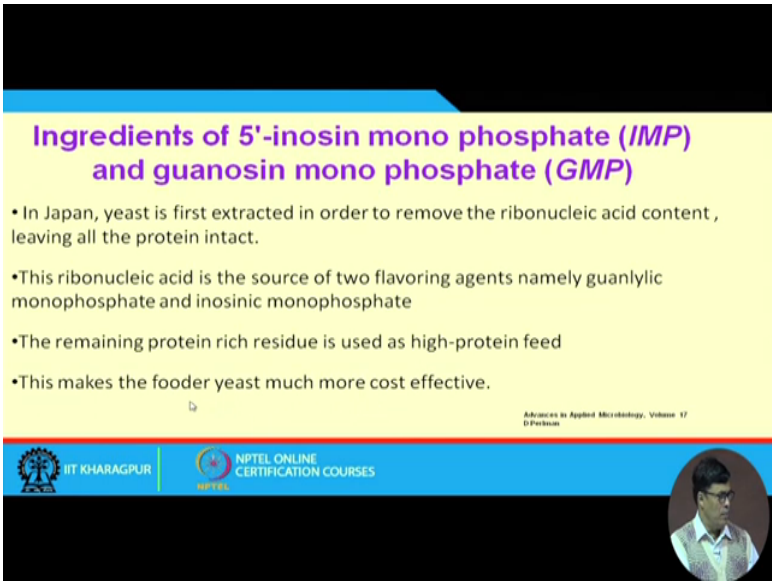

Now ingredients for 5 inositol inosin mono phosphate or the guanosin mono phosphate IMP and the in Japan yeast is the first extracted in order to remove ribonucleic acid content and leaving all protein intact. This ribonucleic acid is the source of two flavouring agent namely that guanlayer, guanlytic, monophosphate and inosinic the monophosphate. The remaining protein rich reside is used as a high protein feed, this makes the fodder yeast much more cost effective.

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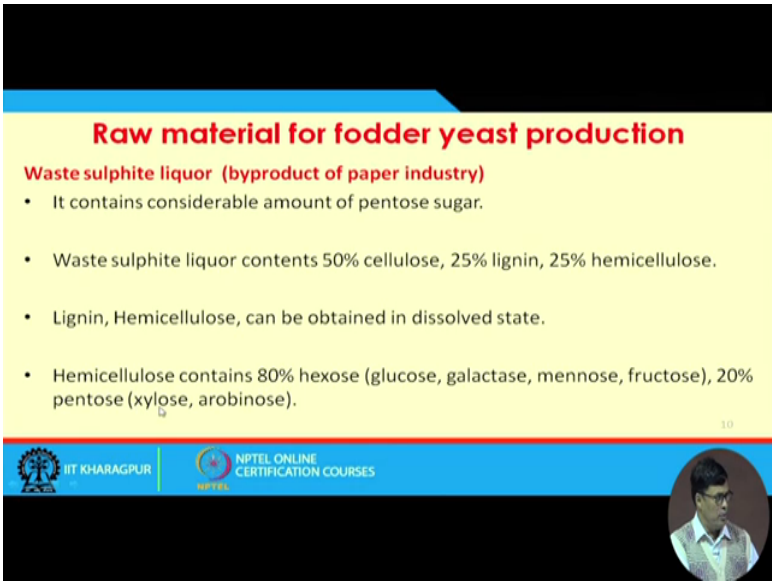

Now raw materials for the for the fodder yeast production I told you this is the waste sulphite liquor is likely used which is the byproduct of the paper pulp and the paper industry. It contains considerable amount of pentose sugar and waste sulphite liquor contains 50 percent cellulose, 25 percent lignin and 25 percent of hemicellulose. Legnin and hemicellulose can be obtained by dissolver in dissolved state. The hemicellulose contains about the 80 percent of hexoses like glucose, galactase, mennose, fructose and 20 percent pentose like xylose and arabinose.

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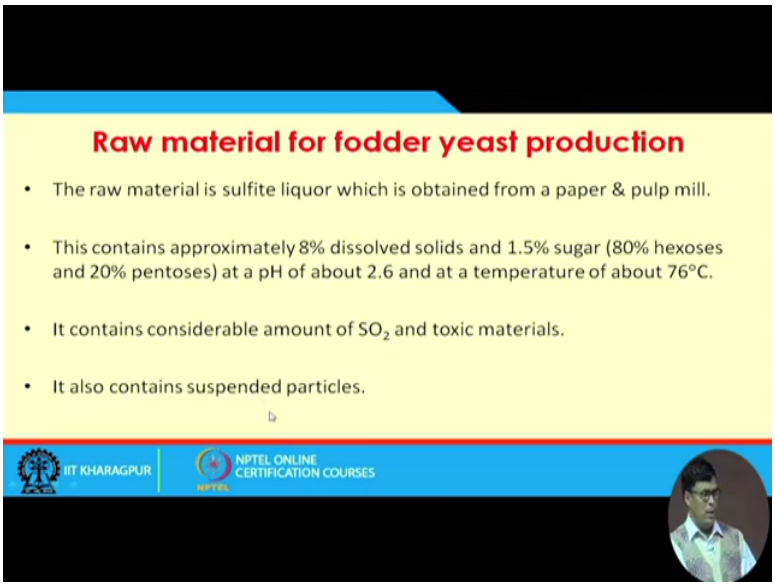

Now raw materials in the sulphite liquor which obtained from pulp paper industry this this contains 8 percent dissolved solids, 1.5 percent sugar I told you that 80 percent hexoses and

20 percent pentose pH is 2.6 at temperature is 76 degree centigrade, it contains considerable amount of sulphur dioxide and and toxic material also it contains the suspended particles.

So as you know that sulphur di oxide is a strong oxidising agent and since it contains the sulphur dioxide your yeast when we look let in the media they will not grow properly. So if you want to grow yeast cells you have to remove that sulphur dioxide from the waste sulphur liquor I shall explain you the process there is the steam, steaming process through which we can remove the sulphur dioxide then we can condense back this sulphur dioxide and we can have liquid liquor that is totally free from sulphur dioxide.

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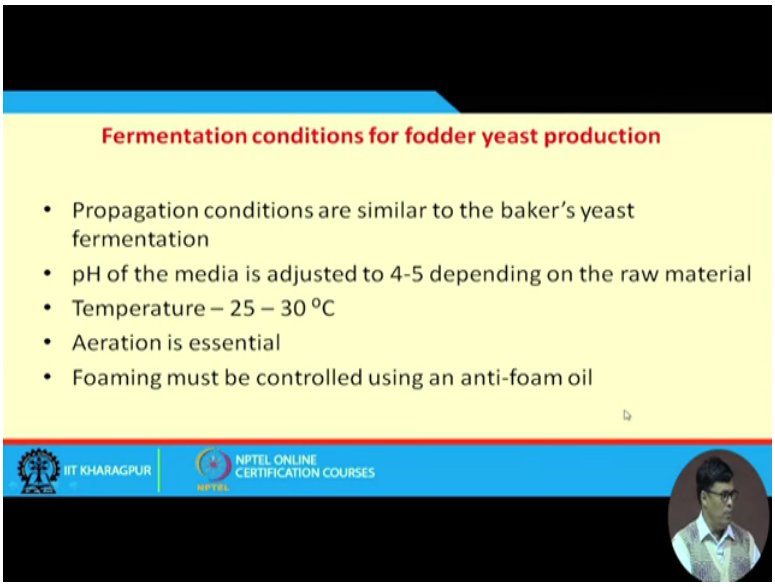

The propagation conditions are similar to Bakers yeast fermentation process pH of the media is about 4 to 5 depending on the raw materials, temperature is 25 to 30 degree centigrade. Aeration is essential this is also aerobic fermentation process foaming must be controlled with the help of antifoam oil, so this is the fermentation conditions we required for fodder yeast fermentation process.

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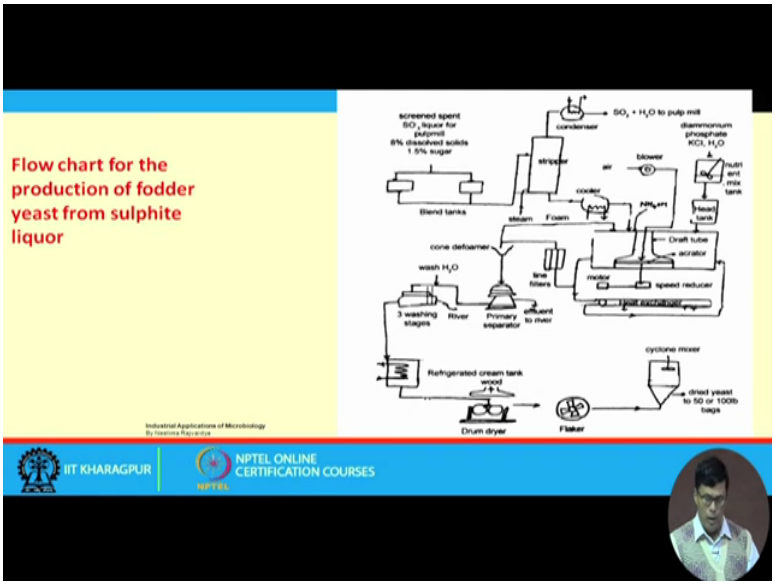

This is kind of kind of that food chart that we have how how the waste sulphite liquor can be used for the for the for the fodder yeast production. So here we can have the blended tank here than we we I shall I shall explain this stripper the stripper we pass the the steam so there we heat the material when we heat the material sulphur dioxide goes out and and and and sulphur dioxide and water make the sulphurous acid then when you cool this liquid and does not contain much of sulphur dioxide and then we add some kind of nutrients to it and take it in the fermenters and after that it produces that you know cell mass then we we pass it through the primary separator then washing stage then then print tank, drum drive for drying purpose and the flakers and finally cyclone mixer we get the dry yeast cells.

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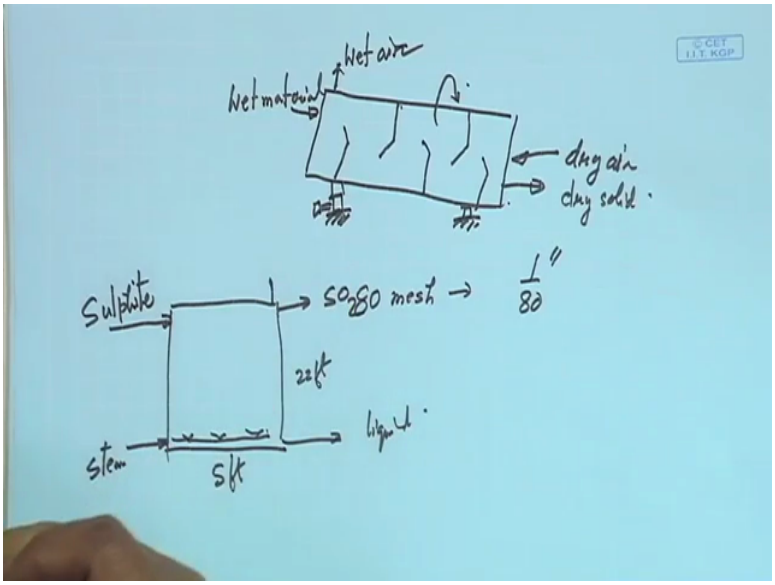

Now that this is the drum drier I already explained how drum drier functions it inclined at certain angle and it rotates at very low rpm I can explain this like this suppose you you can put the material here and I I told you it will be like this, your material should be not be free falling it should be some kind of addition is there so this is rotates this rotates like this and this is here we have some kind of gear arrangement we have here we have motor with the help of this is, this is grounded with this and here some kind of supporting materials we have this also kind of grounding so it is rotates.

So here we pass the dry air the when here you have wet material or wet biomass the when it goes like this your material comes in contact with the dry air and dry air will be going like this here this is we have wet air will get some kind of wet layer outside so it goes in process when your material comes here it will be dry solid, this is how it functions largely used by the industries I I explain this process during when I explain this citric acid fermentation process.

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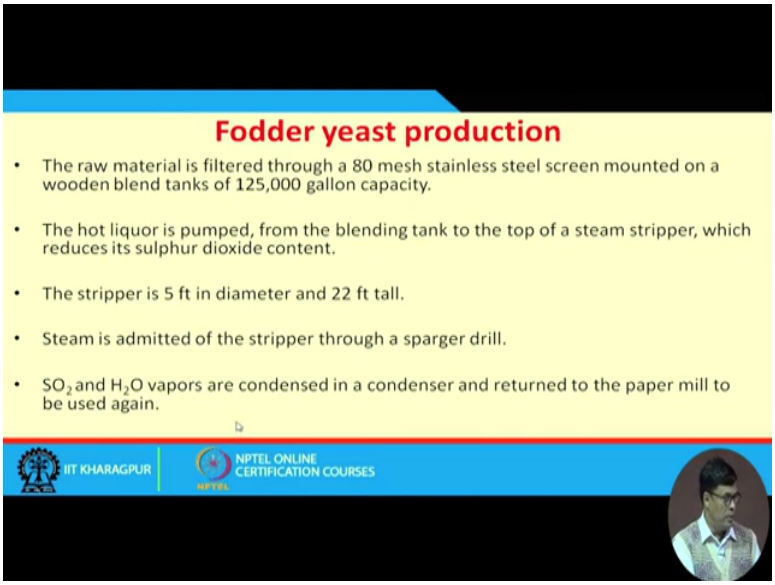

Now fodder yeast the raw materials is filtered through the 80 mesh stainless steel screen mounted on a wooden blend tank 1,25,000 gallon capacity I I already discussed what you mean by 80 mesh 80 means that means the pore size is approximately 1 by 80 inch this the this is the pore size of the mess that you know that shaving mess is about that 1 by 80 approximately not exactly.

The hot liquid is pumped from the building tank to the top of the steam stripper, which reduces the sulphur dioxide content I explained that how it is done. The stripper is 5 feet

diameter and 20 feet tall, so it is it is it is very simple that we can have this is like this we can we can pass steam, steam we can pass and here you have the liquid that sulphite

So here we will get the sulphite dioxide and here we get the liquid this is like this so the stripper this is diameter is 5 feet and this is 5 feet and tall is 22 feet so this is like this this is how it is used and steam is admitted the stripper through the sparger so you have you have sparger here through the ring we can we can have the sparger the equally distributed through this and and sulphur dioxide water vapour are condense in the condenser and written to the paper mill for use it is again recycled back to the paper mill for reusing purpose, the recycling is there.

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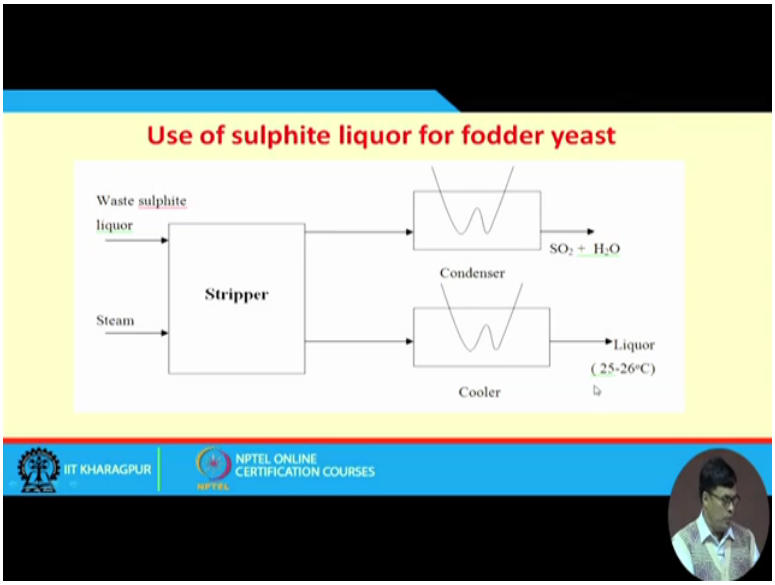

So here it can be explained here it is it is waste sulphite liquor is coming here steam is coming here this is a stripper then vapour of sulphur dioxide and water it condense here so you get the sulphurous acid because both are the coolers. The here also cooling this and there also hot liquid also cooling and this liquor is good for the fermentation process we reduce the temperature to 25 to 25 to 26 degree centigrade.

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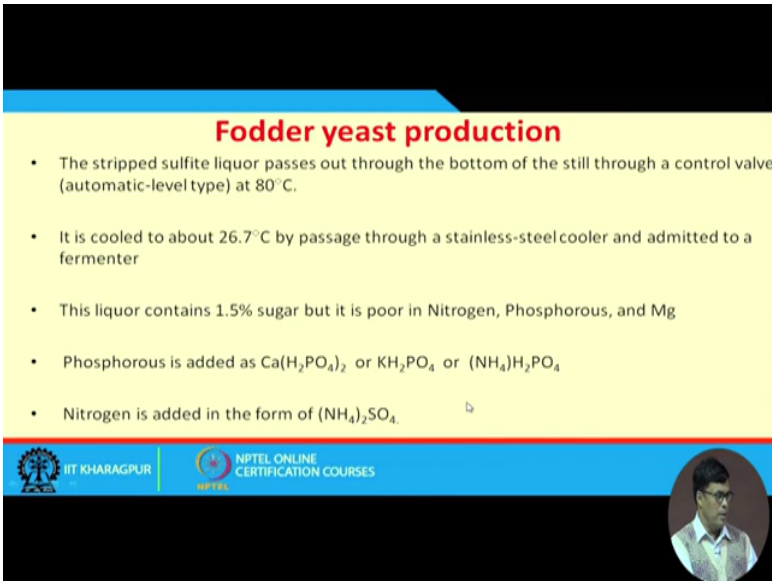

Now now the stripes sulphite liquor passes through the bottom of the steel through the control valve automatic level type at 80 degree centigrade, it is cooled to about 26.7 degree centigrade by passage through a stainless steel cooler admitted to the fermenter and then the liquor contains 1.5 percent sugar but it is poor in it has the poor nitrogen phosphorous and magnesium contents.

The phosphorous is added in the form of calcium dihydrogen phosphate this is something you can correct it Ca is to see this is ok Ca is to PO4 and this is or this is calcium dihydrogen phosphate or this is potassium dihydrogen phosphate, ammonium dihydrogen phosphate, nitrogen is added in the form of ammonium sulphite and I told you, you can remember this ammonium sulphate purposefully added in case of Bakers yeast fermentation process to keep the pH of the media acidic because here also in case of fodder yeast fermentation process we require the pH 4 to 5.

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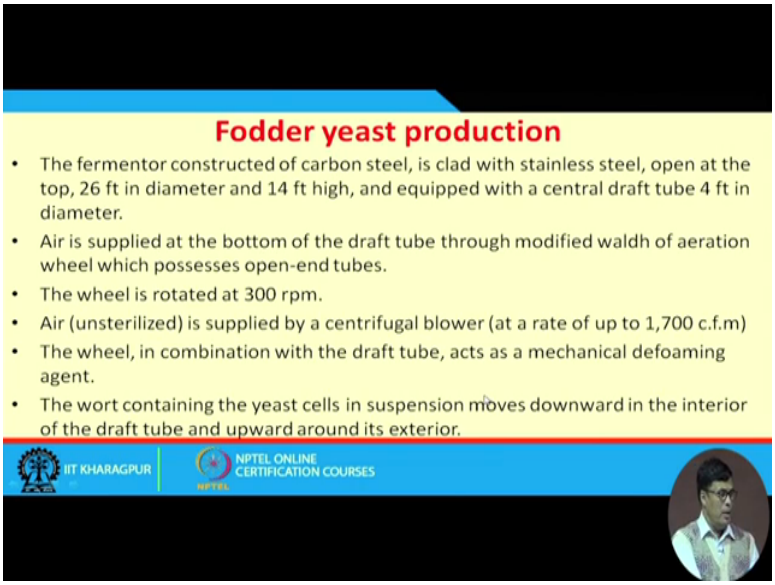

Now fodder yeast production, the fermenter constructed in carbon steel is clad with stainless steel, stainless steel open at top and 26 feet diameter and 14 feet high equipped with a central draft tube 4 feet in diameter. Air is supplied in the bottom of the draft tube through the modified waldh of aeration wheel which possess open end tubes.

Now wheel rotated as 300 rpm this air is supplied by the centrifugal blower at the rate of that 1700 cubic feet cfm, cfm is the cubic feet per minute that the wheel is in combination with draft tube acts as a mechanical defoaming agent. The wort containing the yeast cells suspension moves downward in the interior of the draft tube and upward around the exterior, this is the typical feature of the fodder yeast fermentation process that we have.

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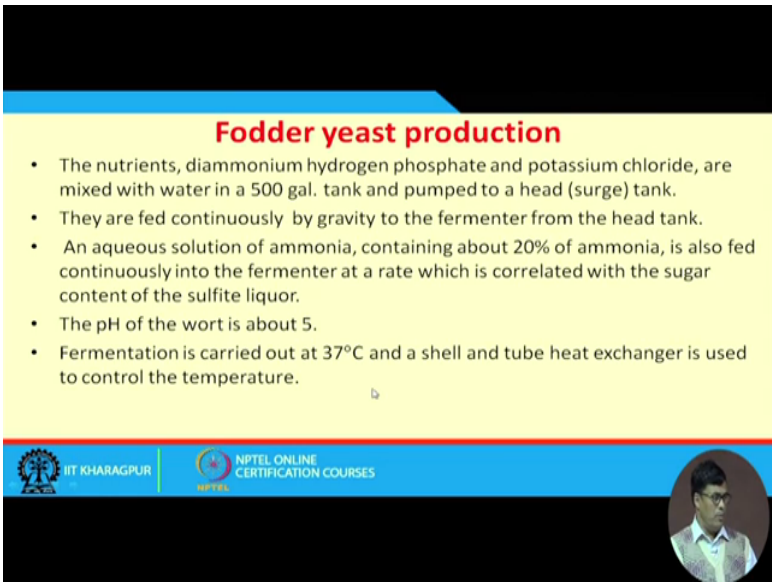

The nutrients that is disodium hydrogen phosphate, potassium iodide are mixed with the water in 500 gallons tank and pumped the head that is surge tank because search tank is located in the in the higher level and they are fed continuously by gravity to the fermenter from the head tank.

The aqueous solution of ammonia containing about 20 percent ammonia is also fed continuously into the fermenter at a rate which is correlated with the sugar content content of the sulphite liquor, the pH of the wort is about about 5 and fermentation is carried out at 37 degree centigrade a shell and tube heat exchanger is used to control the temperature this is we require some kind of heat exchanger to control the temperature of the liquid.

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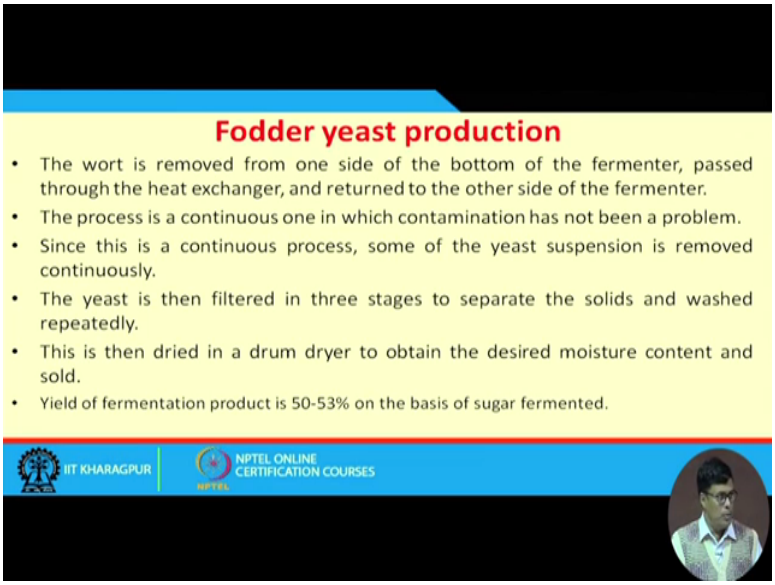

Now wort is removed from the one side of the bottom of the fermenter and pass through the heat exchanger and return to the other side of the fermenter. The process is continuous one in which the contamination has not been a problem since this is a continuous process some of the yeast suspension is removed continuously and yeast is then filtered in three stages to separate the solid and wash separately wash repeatedly.

And this is then dried in the drum drier to obtain the desired moisture content and and then it is sold. The yeast the yield of fermentation product is about 50 to 53 percent on the basis of sugar fermented.

So this is more or less this is all about this that yeast fermentation process and what I what I tried to mean here that that that the torula utilis is used as a fodder yeast and it has a typical characteristics because it can it can degrade not only the hexoses sugar but also it can degrade

the pentose sugar and this contains some kind of nucleic acid that is why it is recommended that as a as a fodder.

And fodder means animal system they can easily utilise this nucleic acid containing of that biomass very easily so this can be use as a good fodder and and since it is a it is a animal animal feed that is we we use some kind of waste material for the production of this fodder yeast and we find that sulphite waste liquor that is produced from the pulp and paper industry that is found to be the best raw material for this fermentation process because pulp and paper industry that usually we use the bamboos as a raw materials or some kind of (())(25:44) material is a raw materials what the production of paper because paper is nothing but it is pure cellulosic material and this is undergoes some kind of digestion process.

So that ling and removal that take place when we remove the linin then we remove the linin then then then then then it takes out some kind of hemicellulose present in the in the in the bamboos that also comes out and this hemicellulose I already pointed out it comprises of 80 percent of hexoses and hexoses sugar and 20 percent of pentose sugar. So this that is why we find is the very good material but when we try to use this material we find that we use in the pulp and paper industry we use the sulphur dioxide as the oxidising agent because this bleached the paper because you know when we see our paper it should be perfectly white and the bleaching is done with the help of sulphur dioxide

So sulphur dioxide contains in the sulphide waste liquor is quite significant amount so this is to be removed before we use for the this that fodder yeast fermentation process and this can be removed by steam stripping technique in a steam stripping technique what we do we we pass the stream and to heat the liquid but about 80 degree centigrade or more than that so that vapour of sulphur dioxide and water it goes out from the top and the and the and the liquid which is coming out from the bottom is running contents sulphur dioxide and it can be we.

Then we supplement this with some nitrogen and phosphorous source we we already pointed out that for the growth of microorganisms we require nitrogen source we require carbon source we require minerals and vitamin, so then when those materials you have to put desire amount so that your growth of the organism that can take place to the desired extent and this is another thing I told you this is like vapours Bakers yeast fermentation process this is also aerobic fermentation process. So you have to do kind of aeration for this process.

So one speciality of the fodder yeast is that when we dry this fodder yeast it gives a meaty flavour what is the that is the typical feature typical characteristics we have as per fodder is concerned. So so we cover both the Bakers yeast fermentation, Bakers yeast is, fodder yeast is a kind of animal food for the for the can be used so so this is greatly used in day to day life, thank you very much.