Course on Industrial Biotechnology
By Professor Debabrata Das
Department of Biotechnology
Indian Institute of Technology, Kharagpur
Lecture 31
Module 7
Wine Industry

Welcome back to my course Industrial Biotechnology, today I want to share with you a very interesting fermentation process that is the wine industry which is largely in operation throughout the world.

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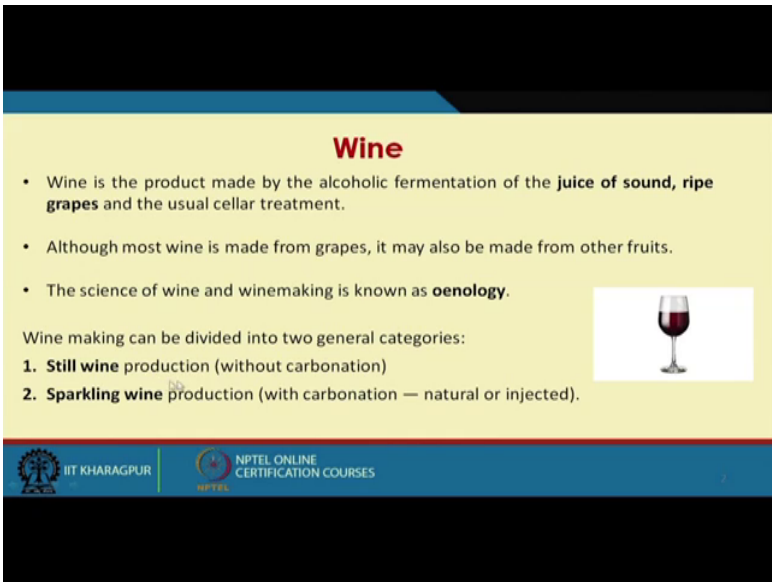

Now wine as you know it is produced from the fruit juice, wine is the product by the alcoholic fermentation of juice of sound and ripe grape and the usual cellar treatment, what do you mean by sound and ripe grape?

Sound grape means the texture of the grape should be hard it is not soft, and what is ripe? If it is ripe then and only then the sugar content or you know in the grape juice will be high. If it is on ripe then then the sugar content will be very would be less. So it is desirable that your grapes should be ripe. Sound and ripe if it is sound we can assume that microbial contamination in the grape will be very less but if it is it is soft there is the possibility of more microbial contamination in the system.

So usually we preferred sound and ripe grapes for the wine fermentation process and that is followed by cellar treatment, cellar treatment underground tank where we keep the this fermented material for longer period of time not only for clarification of wine but also I told

you in the last class that during the beer making industry that during the maturation process, the alcohol the acid and alcohol they form the ester because up to just after the alcoholic fermentation what happens that lot of organic acid that present in the fermentation brawl that give some kind of harsh flavour.

So it is mandatory that it is to be passed through some kind of maturation process, the cellar is the underground tank we can store the material for longer period of time. Now almost all the most wine is made up of grapes but it may also be made from other fruits as for example apple juice. A from apple juice we can also we can produce wine, the science of wine and wine making is known as oenology.

This is the how terminology comes now if you look at the type of wine that is available one is still wine another is sparkling wine, what is the still wine? Still wine means that you know it does not have any carbon-di-oxide when in case of sparkling wine there is a carbon-di-oxide so there is able to doing some carbon-di-oxide so this is the basic difference.

So still wine production without carbonation and sparkling wine with carbonation both natural and injected. This you can do either two way you can allow the fermentation to continue so that carbon-di-oxide can organism will produce carbon-di-oxide there itself or we injected carbon-di-oxide from outside.

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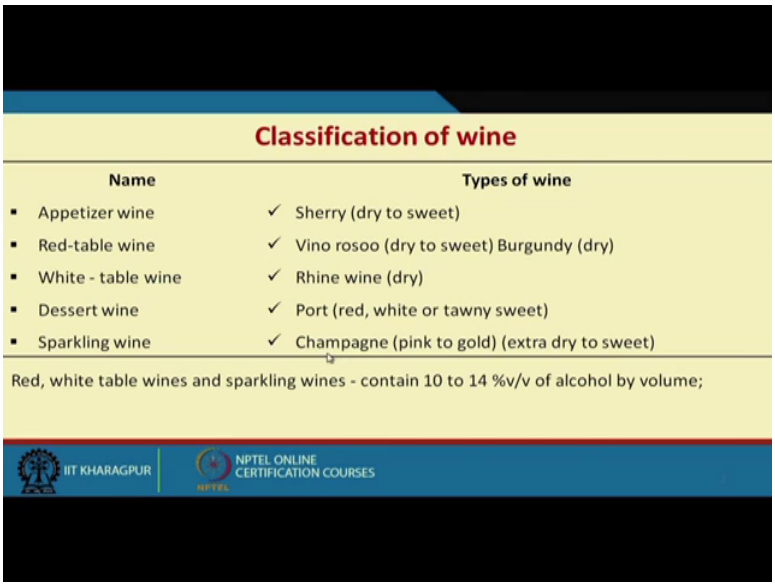

Now if you look at the classification we can have some different types of wines, we have appetizer wine, typical name is sherry dry to sweet what is the dry wine? Dry wine means that wine does not have any kind of sugar because sweetness we know will be as low as

possible because if you taste the wine there should not be any kind of sweetness that is called dry wine and then the red tables wine is vino rosoo that the dry to sweet and burgundy this is dry. And white table wine is rhine wine, it is dry. Dessert wine is example is a port with the red and white to tawny but this is sweet in taste and sparkling wine we know that this is quite throughout the world is very common that we have champagne. Champagne is a name of a place which is located just 140 kilometres from the Paris. So you might be knowing that that you know France is very famous for wine making and two particular wine is worldwide largely used that is white wine and red wine that is considered as the table, table wine because western country they usually serve during lunch and dinner this wine.

Now that champagne seems the name of the place is champagne that is why because champagne now not necessarily the sparkling wine is only can only produce from the place of champagne, some other places also produces sparkling wine then we market it back as a sparkling wine not as a champagne, champagne when it is champagne it is it is the name of the place where it is produced but if you if you the name is sparkling wine that is it is produced other than the champagne other places but it is of similar taste.

Then red and white wine and sparkling wine contains about 10 to 14 per cent alcohol by volumes and appetizer and dessert wine contains about 20 per cent volume by volume of alcohol. So this is the alcohol concentration is quite high as compared to beer.

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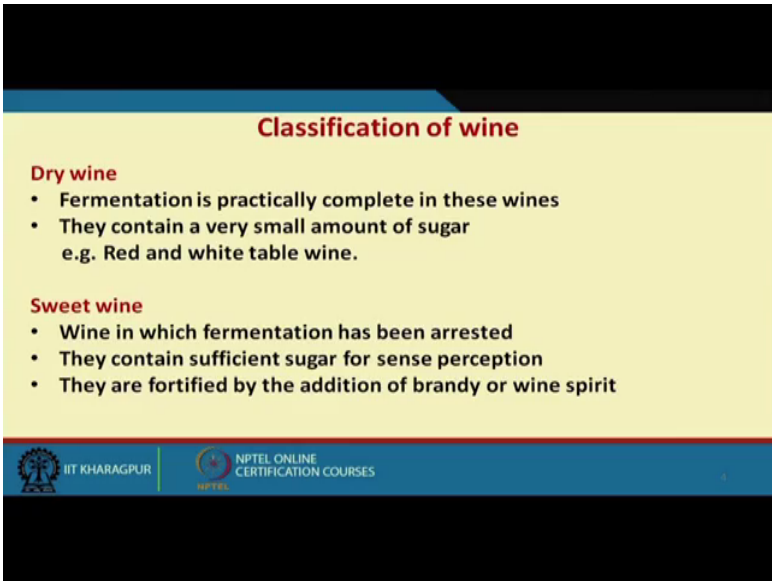

Now the broadly it can be classified as the dry wine I told you dry wine that fermentation practically complete this in this wine.

The fermentation complete in the sense I told you that very small amount of sugar present in the in the wine because it is if you taste the wine there should not be any sweet perception. So it is that is called it is it is that is that is the this why we call it dry wine. And examples are red and white wine this is example of dry wine then we have the example of the sweet wine sweet wine wine in which the fermentation has been arrested. So if the fermentation is arrested then what will happen some sugar un-fermentable sugar that remain in the in the fermentation in the wine then it is sweet in taste.

Or you know purposefully we add some sweetening or some other material to it to make it sweet because you know this content sufficient sugar per cent perception and they are fortified by the addition of brandy or you know that wine spirit.

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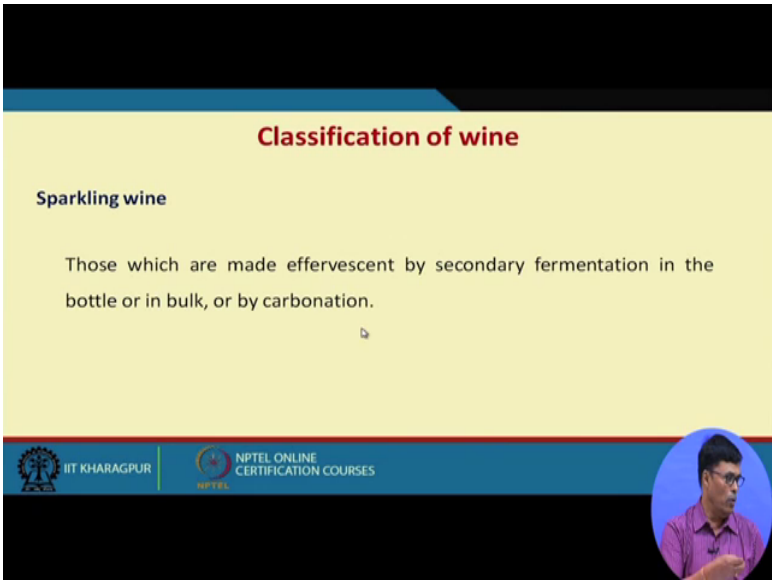

Now sparkling wine those which are made effervescent by secondary fermentation in the bottle or in bulk or carbonations that is exactly I pointed out that not only you do the carbonation by secondary fermentation also when cell respired it produced carbon-di-oxide that that that effervescent wine come from that also.

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Now typical wine has different colour almost clear that green-yellow, platinum-yellow, pale-yellow, pale-gold, deep gold, pale-sulmon so you know different colour of wine that is available throughout the world and examples of this wines are given here.

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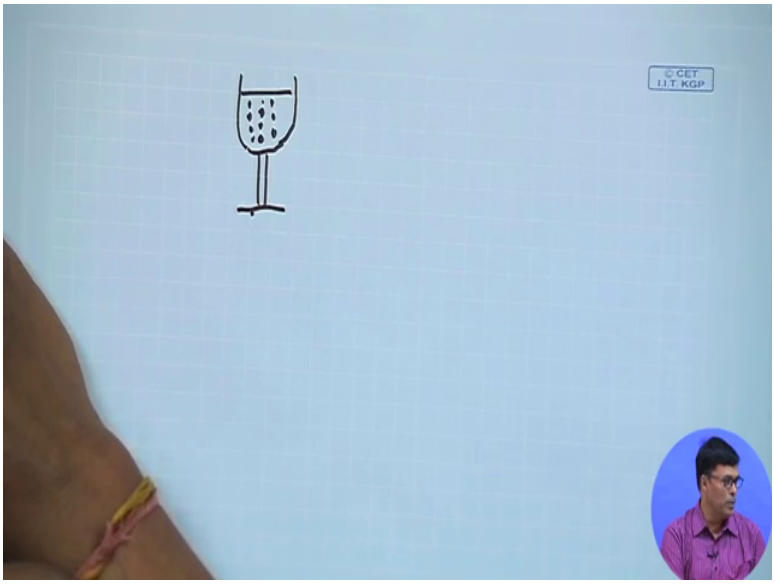

Now I was talking about sparkling wine. You can see if you if you see it here so it is like this. The sparkling wine that so you have that you know carbon-di-oxide the bubbles of carbon-di-oxide bubbles of carbon-di-oxide that will be there.

That is that is exactly what is happening here this is carbon-di-oxide bubbling is there this is called sparkling wine but here there is no carbon-di-oxide that is why it is called as still wine, if you look at here that here it does not contain any kind of carbon-di-oxide that is the sample is prepared from a special variety of grape and black variety pinot noir and the white chardonnay that is the cap of the bottle so the sample it is written like this.

And the grapes are like this now as per grape is concerned I like to point out that in our country this grape easily that is kind of scuppered because it is supporting material is required for the plant to grow this grow this grape plants then then the grapes are hanging from this but here in the western country particularly if you look at I shall show you some other slide that it is just like a tree and normal tree and where these grapes are produced. This is the different types the type you know it is scuppered but this is normal tree the plantation that we have.

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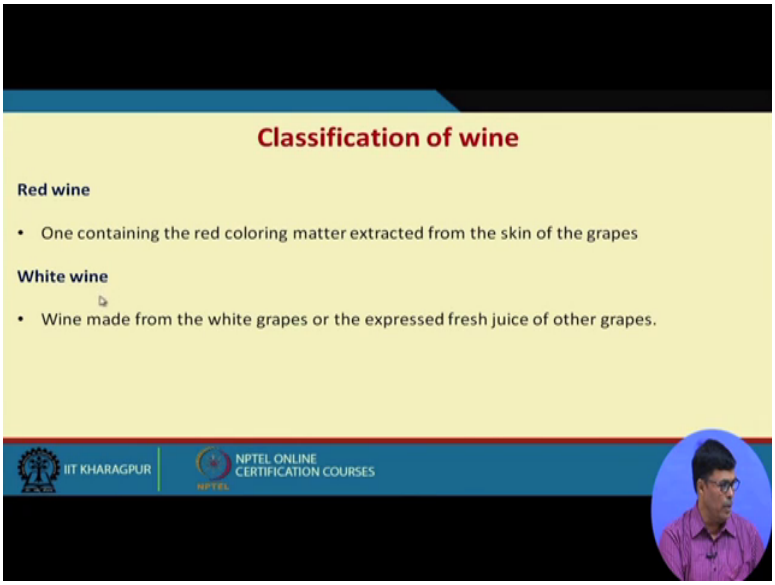

Now red wine, the one contain the red colour matter extracted from the skin of the grapes, grapes has you know we have two types of grapes only the green grapes one is black grapes so you know that red colour it comes from the skin of the grapes and then then white wine, the wine made from the white grapes or maybe little bit green grape that we have expressed the fresh juice of other grapes.

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The steps now if you look at the steps of wine making first we crushing and stemming the grapes, crushing means we have to crush so that you know you take out the juices from that and stemming that you know stemming means stems that is to be separated from the grapes and then treated with sulphur dioxide or pasteurization usually we do the sulphide treatment

potassium we know potassium metabisulfite is a very good preservative that is used for the preserve for the treatment of this wine or we can pass through the pasteurization process.

We know the pasteurization process means the process through all the germ is filtered in presence of chemicals we can kill the germs in by heating we can kill the germs this is two way it can be done. Now it is the this is the fermentation this pass through the fermentation process and this is basically different as compared to other fermentation process the reason is that it is occurred in two different stages one is called primary fermentation another is secondary fermentation.

Now primary fermentation inoculated with a starter containing pure culture of yeast in the aerobic condition aerobic means it is the micro aerobic we are not doing any kind of much variation we use we know the yeast under aerobic condition it multiplies and secondary fermentation after short period of wine is drawn off and placed in a storage for further fermentation and this is done in complete anaerobic condition.

So this is partially aerobic condition we allow the little bit yeast to grow as simultaneously it produced alcohol to some extent but in the secondary fermentation process totally anaerobic condition we produce our desire alcohol main alcohol fermentation take place in the secondary process. Now after this is followed by racking, racking is kind of separation of solid from the liquid or clarification of wine storing for aging and clarified and packed.

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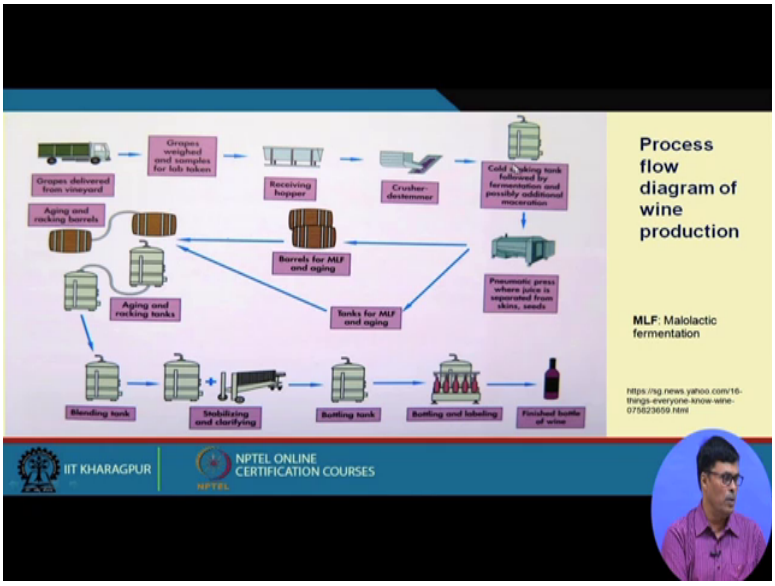

So this is the subsequent operations that we have now if you look at the process flow diagram it is it is look like this we take the grapes from the garden from the field then we wait this

grapes wetted and samples are taken to the lab and then we receive in the hopper and then crusher and destemming that we stem we separated out and here we I shall show you how the segregation of the stemming is done manually and then it put is to the to the tank followed by fermentation cold cold soaking tank followed by fermentation and possibly addition of measuration that you know that we carry out this fermentation like this here and this is the primary fermentation take place then then we pneumatic press where the because this fermentation process I told you it is partially the aerobic fermentation process due to the aerobic fermentation process it produces lot of carbon-di-oxide.

And this carbon-di-oxide that you know juice contains lot of seeds skin and stems so they attach to this and they float at the top of the fermenter so you can you can this is called pomace that you can separate it out. Pneumatic press the juice separated from the skin and seed and then we take it in the in the barrels or in the tanks for carrying out the malolactic fermentation process where the malic acid because malic acid is one of the important ingredients present in the grape juice that also called that is convertive lactic acid.

The malic acid this is the harsh flavour for lactic acid do not have harsh paper in besides that lactic acid has some property out preservation it can use as the preservatives. Then we passes through the aging process I told you the importance of aging and rack rocking process for the clarification of wine then we blend in the tanks as per our requirements and we clarify it here we filter the suspended material through passing through the filtration after that we can here also like I told in case of beer we have two type of you know marketing.

We have short time market we have long time market in the short time market we this we can use little bit of preservative and send it in the market and but in case of long time market we pass through the pasteurization process then we do the bottling .

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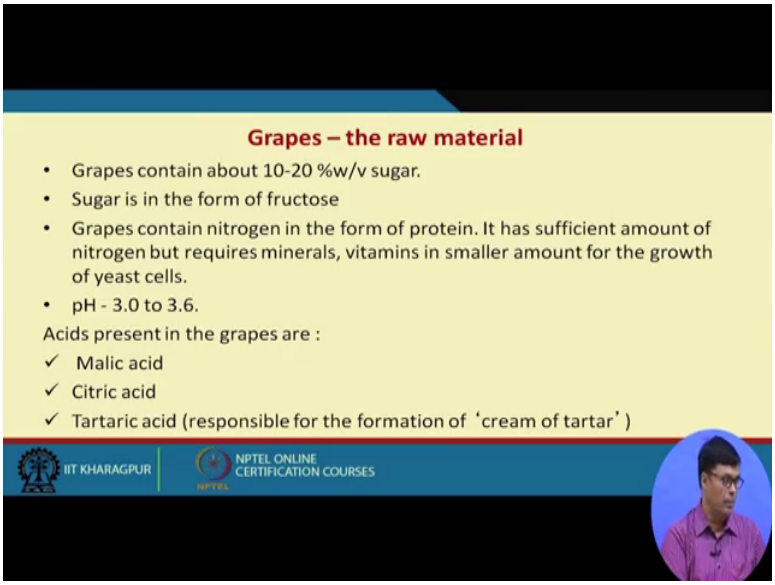

The raw materials that is used the grapes I told you which contains about 10 to 20 per cent weight by volume and sugar in the form of fructose I told you that fructose is 10 times sweeter than sugar that then glucose.

Grapes contain nitrogen in the form of protein and is sufficient for the growth of the organism because this is the anaerobic fermentation process we require very less amount of nitrogen for the growth of organism and but it requires some minerals and vitamin in small amount for the growth of the yeast cells. The pH is usually 3 to 3.6 and typical acid that present one malic acid, citric acid and tartaric acid.

Now tartaric acid responsible for the formation of cream of tartar, cream of tartar means I shall discuss later on, this is called by tartaric acid this is this tartaric acid when the alcohol concentration is high in the fermentation media then it forms the lees lees means kind of you know that white layer formation take place so that that is due to the white tartar formation that we call cream of tartar.

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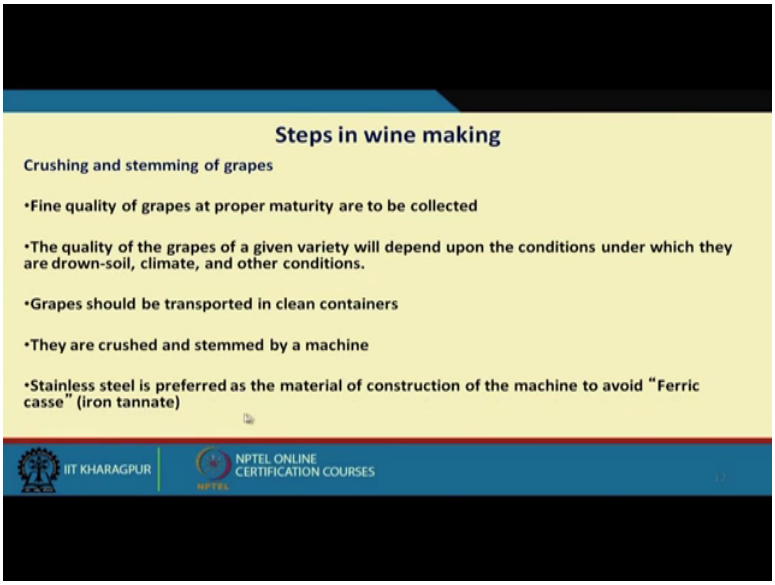

Now then that you know crushing and stemming of grapes the fine quality of grapes at proper maturity are to be collected I told you the grape should be sound and ripe and the quality of the grapes of a given variety will depend on the condition under which they are drown, soil, climate and other condition that is important and grapes should be transported in clean containers and they are crushed and stemmed by a machine.

And stainless steel is prepared as the material of construction for the machine to avoid the ferric casse. Now let me let me tell you here what is what do you mean by ferric casse, ferric casse is nothing but it is the iron tannate because the iron tanning, tanic acid present in the fruit juice in the grape juice and if you cross by using some kind of iron materials then if iron by chance come in contact with tanning it produce some kind of cloudy because that is why we sometime we see the haziness of the fruit juice due to the formation of iron tannat this is called ferric acid.

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Now this is exactly that I was telling that this is the normal tree that you can see is not scuppered because just this is a tree where the this grapes are hanging you can see it. This looks like this, this is called sound and this might be ripe you know that this is like this and this is the you know the kind of, the collection system that mechanically this grape can be collected and it stored and stored in the some kind of that you know volume here.

So you can manually you can do the manually you can do the mechanical. Mechanically if you do they have a collecting tank here so they can collect and manually also you can collect and put it in the storage tank right here, then after that you know you collected when you mechanically collect you unload it in the in kind of hopper and then the hopper you have to segregate that you know whatever the stems and other things that is present there you have to manually you have to take it out.

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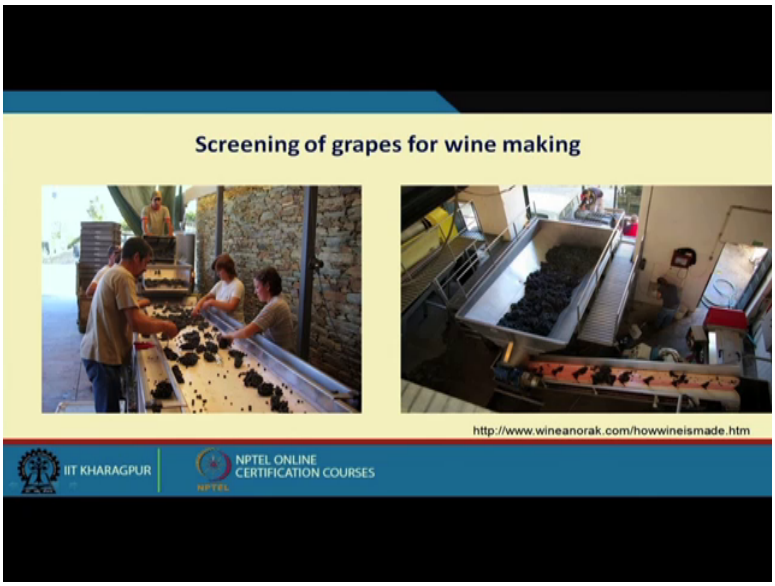

And then then we have we take further care precaution we measure just to ensure the quality of grape that is coming into the process is perfect and ultimately go to the crusher like this and you take out the juices and you crush this material and fresh this juice comes out like this.

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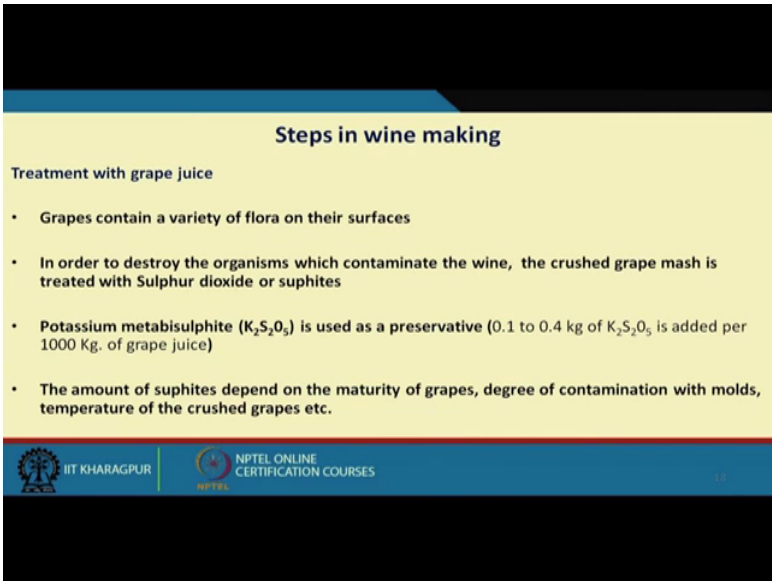

So now treatment with the grape juice grape contains a variety of flora on their surfaces in order to destroy the organism which contaminate the wine the crushed grape mash is treated with sulphur dioxide or sulphides.

I have given the typical example mostly I told you potassium metabisulphite mostly used as a food preservative and 0.1 to 0.4 kg of potassium metabisulphite is added per 1000 kg of grape juice this is required. The amount sulphite depends on the maturity of the grape I mentioned that if the maturity if it is over matured there is the possibility of mold grape more contaminants so we know you require more potassium metabisulphite, degree of contamination of the molds temperature of the crushed grapes etcetera because the fruits usually (())(21:05) low temperature.

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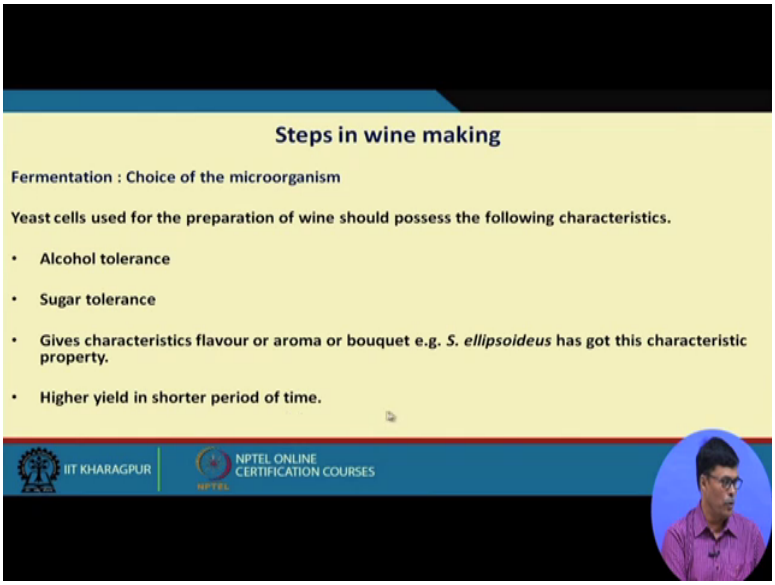

Then fermentation the choice of organism the yeast used the preparation of the wine possess the should possess the following characteristics. Alcohol tolerance, I mentioned during the alcohol fermentation process that here the concentration of alcohol is about 10 to 20 per cent. So 10 per cent alcohol production we require minimum 20 per cent of sugar and 20 per cent alcohol production minimum we require 40 per cent of sugar, so it should have the super tolerance as the alcohol tolerance characteristics. Give the characteristic flavour or aroma or bouquet and typical the yeast that is used for the wine making industry what is called sacramise ellipsoideus. This is the yeast cell that is used in this fermentation process and higher yield in shorter period of time that is another characteristic of the organism.

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Now if you I told you that that wine fermentation usually carried out in two stages, the grape juice contains high amount of sugar so no sugar is required and if the sugar content is less then we add some kind of syrup in it. The oak wood container is used which does not import undesirable colour to the wine and for the preparation of the red wine, red wood containers is used sometimes I mentioned there is a red coloured wine the colour usually come from the from the skin of the grapes. Sometimes the red wood also container also contribute some colour to the wine. Now the capacity of the container is about 50 50,000 gallons 50,000 you know one gallon is approximately equal to 3.78 litres.

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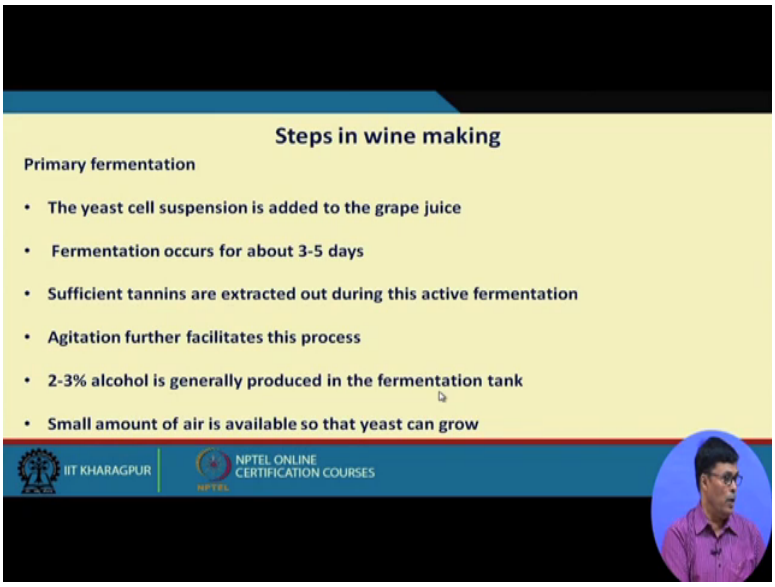

Now let me talk about little bit on primary fermentation process and the primary fermentation process, the yeast cell suspension is added to the grape juice and then fermentation occurs for 3 to 5 days. Sufficient tannins are extracted out during the active fermentation. Agitation further facilitates this process, 2 to 3 per cent alcohol is generally produced in this fermentation tank and small amount of air is available so the yeast can grow.

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So this is the primary fermentation process, secondary fermentation process the partially fermented juice is transferred to the secondary fermentation tank. Fermentation occurs about 7 to 11 days the tank should be completely filled with fermentation broth so you can have the perfect anaerobic conditions then there should not be no way to increase the number of yeast cells in the secondary because you know that we know that during the anaerobic fermentation the growth of organism will be very low, so yeast growth will be negligible and optimum temperature is 21 to 24 degree centigrade and temperature controlled by cooling coil.

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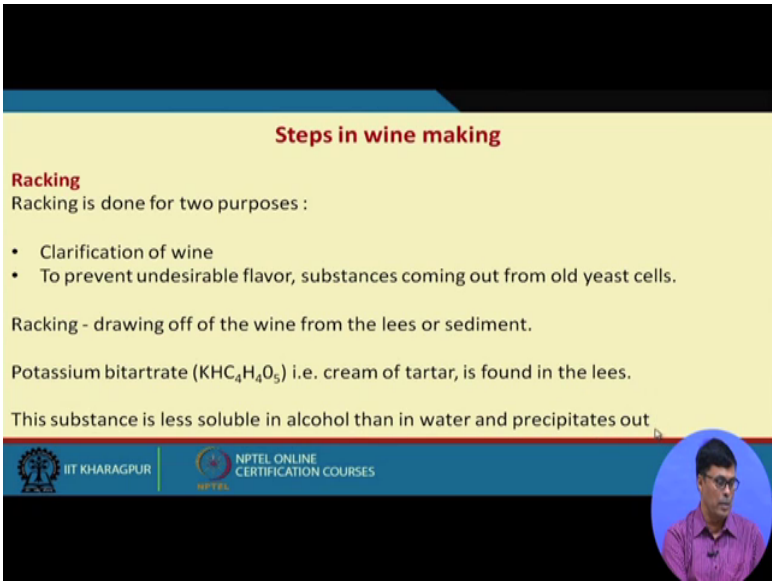

I was talking about the one important step for wine making industry is the racking, racking is done for dual purpose one is for clarification of wine to prevent the undesirable flavour and substances coming out from the old yeast cells. Now racking drawing off the wine from the from the lees or sediment, I told you that that potassium potassium bitartrate that that produce actually that cream of tartrate this forms a lees. Lees kind of white layers that formation is there so racking during racking process we separate the lees and other sediment that is that is we separated out.

This substance is less soluble in alcohol then in water and precipitate out, so at the beginning that potassium bitartrate will not give any kind of problem with the fruit juice but as soon as the alcohol production increases then yeast started producing some kind of lees at the surface then that is to be that precipitate has to be taken it out.

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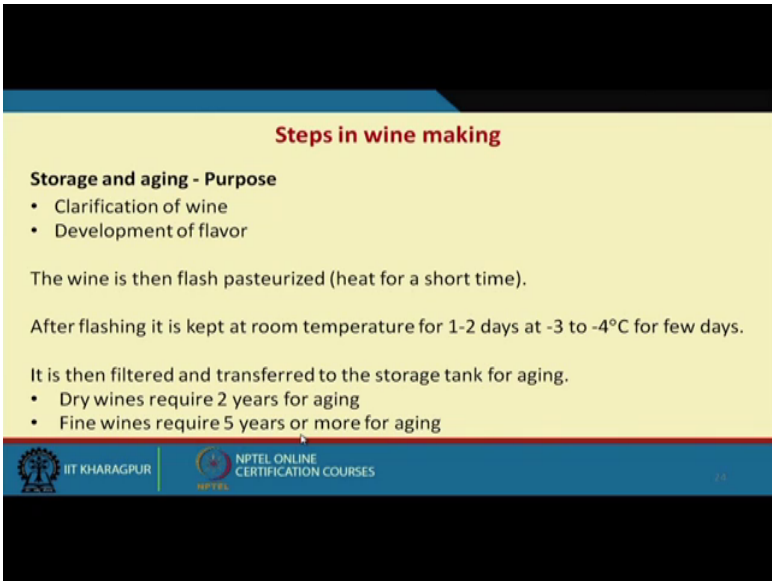

Now the during aging as per wine is concerned that the ageing is very important. The clarification of wine and development of flavour because you know aging I told you when you keep the fermented liquid for longer period of time in the celler then whatever suspended material is there that will settle down.

And not only that it gives the opportunity to that you know that alcohol and acid they combine together and form esters and we know the esters are responsible for development of different flavours, so this is very important. Now wine is then then flash pasteurized heat for a short time I mentioned previously the st-st technique largely used in the biochemical industry for the pasteurization process because the reason is that at lower temperature we find it is more it is more detrimental to the quality of the it affects the quality of the media with respect to vitamin and amino acid that that is will be destruction will take place but if we increase the higher temperature that will be more effective to for killing the organism.

So if we use the high temperature short time so you expose the material for shorter period of time for that lots of vitamin and lots of amino acid in the system will be minimum that is why it is use the flash pasteurization process after flashing it kept at the room temperature for 1 to 2 days at minus 3 to minus 4 degree centigrade to few day and here I want to point out that we have two wines we have we call dry wine this is required two day for aging and fine wine it requires 5 years for aging.

We know that wine if you keep it for longer period of time it would be more costly, the more more if you keep it for longer period of more acid and alcohol they form the esters so the

hastiness of the wine will be totally removed and in exchange of that some good flavour good smell fine taste will develop that is why it is very costly.

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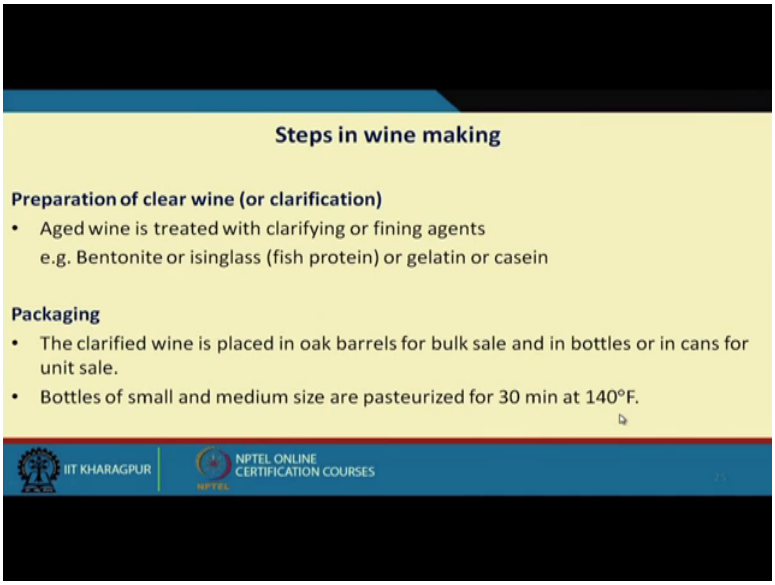

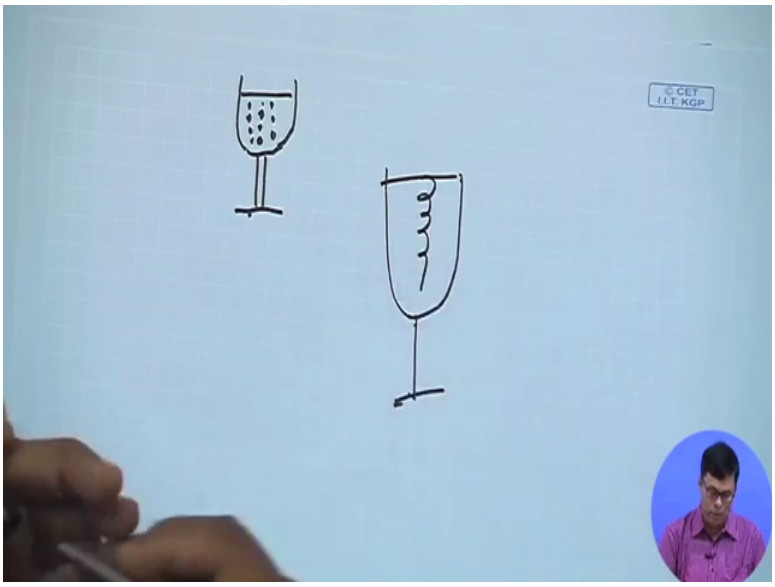

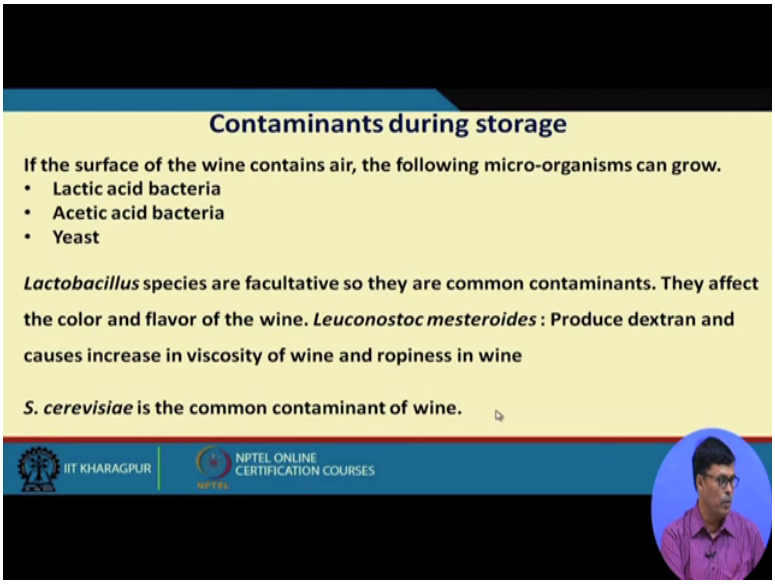

Now the preparation of clear wine or clarification aged wine is treated for clarifying the clarifying or fining agent I told you previously also some times the fine particles are removed by using some kind of filtered aid.

Filter aid means some kind of bigger particle we add so that finer particle adds up on the surface of the bigger particle and bigger particle will be easy to separate it out. So examples are bentonite, isinglass that is kind of fish protein and gelatin and casein that is used. Now packaging the clarified one is placed in the oak barrel for bulk sale in bottles or in can for unit sales.

Bottles of small and medium size are pasteurized for 30 minutes 140 degree Fahrenheit. The contamination there several contamination problem that we have we have lactic acid bacteria contamination problem then we have acetic acid bacteria contamination problem and yeast contamination problem that we have in the in this fermentaion process. The one typical contamination that I have to point out here that is the presence of leuconostoc mesteroides and this leuconostoc mesteroides produces dextran and this causes the ropiness of the wine, here I want to point out that ropiness means rope formation this will be it form rope like this that you know that rope formation will take place like this.

So inside this beard you will be having this kind of rope formation this is undesirable and this is due to the presence of this leuconostoc drive. The (())(29:40)cerevisiae is the common contaminants in this wine because cerevisiae (())(29:47) as and cerevisiae cereviasiae they require same media, same for their growth and metabolism and that is why and this is

available largely in the atmosphere that is that is the common contaminants. Thank you very much.