Dairy and Food Process & Products Technology
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Lecture - 11
Emerging Technology (Contd.)

So, Emerging Technology in continuation, in the last class we could not finish because obviously, as and when the new and new things are coming up we are also getting stuck into that to explain more and more right. Now in continuation of the previous class, let us look into that this is under dairy and food process and the products technology and this is the 11th lecture right and we are talking about the emerging technology right.

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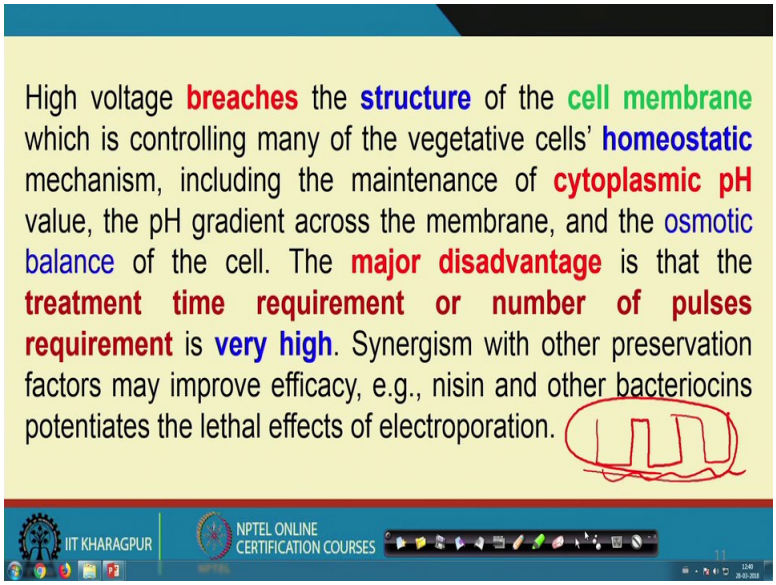

So, if you look into this then we see that the previous one was like this that high voltage electric pulse right.

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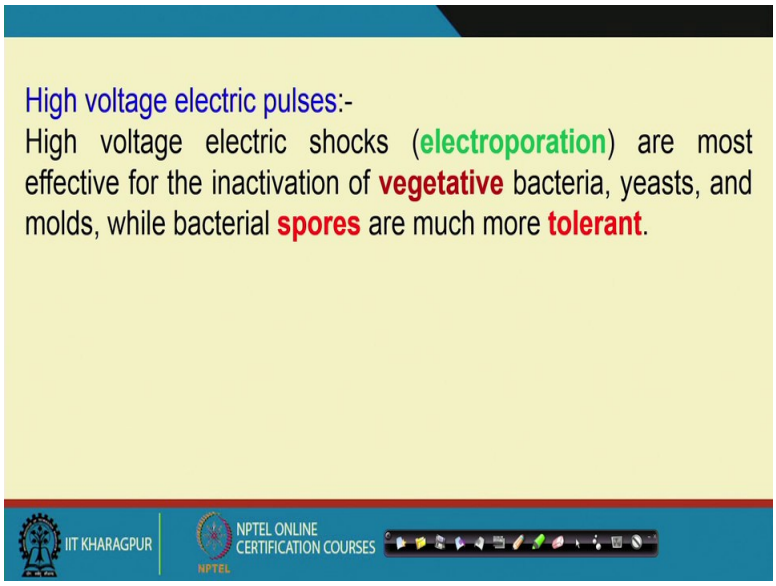

If we remember that, we talked about in the previous class ultrasonication, then heat and pressure; all this three together in combination we had said as one of the technology emerging technologies which is coming up right. Then we say that high voltage electric pulse which we said in the previous class. Now let us also explain a little so that we understand what the process is high voltage electric shocks right and that is called Electroporation is given to in activate the vegetative bacterial cells vegetative.

Now the previous class you also said one more thing, that was the spore former right. So, those vegetative cells which become more resistant, then they form spore former. It is not that all organisms can do the spores; there are very selective organisms, which can do which can form the spores and they become the resistant to right.

So, in this method of electric pulse giving the high voltage shock and that spoils the vegetative bacteria or vegetative cells as well as yeast and mold. Vegetative means which and grow under given favorable condition rapidly right; normal growth. So, in that case they are called vegetative cells right while bacterial spores are much more tolerant. So, for spore former which you have seen in the previous one there they even the spore formers who are were affected, but in this the spore formers are not.

So, because they are tolerant to the high the voltage shock or high voltage pulse given right, then what it does? A high voltage breaches the structure. So, breaches means if some we understand by the term breach English term, that is that you are dividing or you

are breaking something; so, right. So, it is breaking the structure of the cell membrane, which is controlling many of the vegetative cells homeostatic mechanism; homeostatic means the condition was where it can grow easily.

So, that homeostatic condition is being broken and the, and maintenance of the cytoplasm, that is also cytoplasmic pH that is also getting hampered. So, these pH gradient across the membrane and the osmotic balance of the cell all these are being hampered by the electrostatics electro so, that by the electric pulse which is applied. So, the breach that is the structural break of this cell mem membrane that occurs and because of that the vegetative cells are not able to grow right because that is also effecting the homeostatic mechanism of this cell as well the cytoplasmic pH and pH gradient across the membrane and osmotic balance all these are getting affected right.

The major disadvantage is in this process is that the treatment time requirement or number of pulse requirement is very high right so, that is the primary. That treatment time as well as the number of pulses you remember we are shown earlier that pulses means we said like this. So, this is an electric wave pulse. If that is, this cycles of pulses if they are very high right then that becomes one disadvantage right as well as the time because the more the pulses number required more will be the time required.

So, that is the basic disadvantage and synergism with other preservative factors may improve efficacy. So; that means, simultaneously if we can apply some chemicals along with this, then we can get synergistic effect along with this high shock or high voltage right. For example, which at nisin and other bacteriocins, that is potential that potentiates the lethal effects of the, you have the electroporation right.

So, this potential can be improved, if we take the help of simultaneously some other along with this. So, again it is a combination. So, high intensity high light pulses which were also we said.

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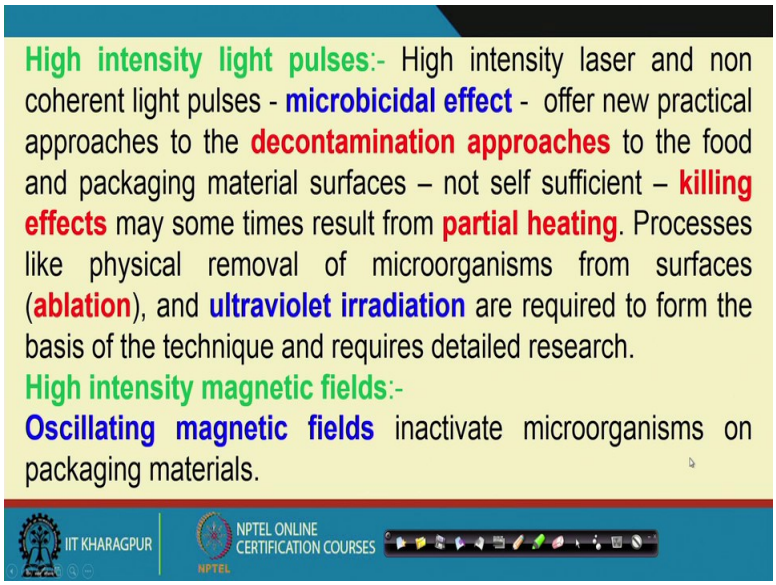

So, in that high intensity laser and non cohesive and non coherent light pulses are used in to deactivate or as this can act as a microcidal effect; that means, it is killing the microorganism right. Of often new practical approaches to the decontamination approaches to the food and packaging material services this offers new a practical approach this high intensity pulse, to do decontaminate the surface of the of the food. So, these killing effect not self sufficient, but killing effects may sometimes result from the partial heating, because of the light which is being given. So, that may increase the law time increase the temperature because that may have some partial killing effect.

So, process like physical removal of microorganism from surface that is ablation and ultraviolet irradiation are required to form the basis of the technique and this request detail result. So, it is still under infant or not an infant under researcher program, but this also as one thing that in many of the cases where handling of the food products become difficult right.

So, during handling they may incorporate some contamination and this in contamination on the surface that can be easily minimized by this high light pulses right; high intensity light pulses. So, that is a very good thing, which can come up right. Then high intensity magnetic fields. So, if you also incorporate high intensity magnetic fields like oscillating magnetic fields right. So, where this oscillation in activate microorganisms on the packaging material. So, you have already taken a pack the material.

Now, you want to minimize the or remove the organisms or kill the organism. So, this high intensity magnetic field or oscillating magnetic field can come up as one of the risk square of your system right.

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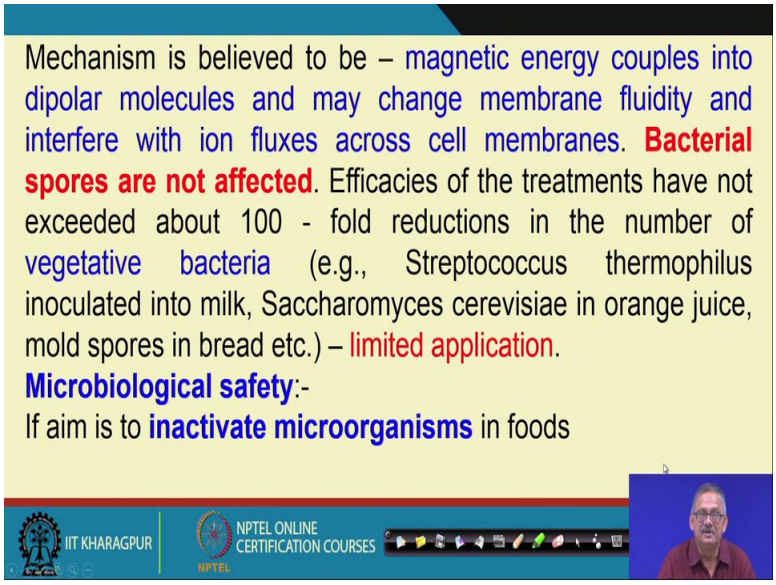

Then the mechanism is believed to be that that magnetic energy couples into dipolar molecules and may change membrane fluidity and interfere with the fluxes across the cell membrane right. Bacterial spores are not affected in all the cases, whatever we have discussed till now you see, the spore formers because spore are very what should I say it is very resistant tolerant resistant tolerant to normal conditions by which the vegetative cells are destroyed easily.

So, here also that mechanism is more fruitful for the vegetative cells, but may not be so for the spore formers. And these efficacies of the treatment have not exceeded about 100 fold reductions in the number of vegetative bacteria right. Subsequently you will see that in the death cycle right there are there are many such thing which you come up death cycle where it is termed in terms of how many number of lock cycles it is being reduced whether it is 12D, 6D, 10D, 8D that dictates that what is the number of cycles reduction, that is originally the number of organisms present could be 10 to the power 12.

Now after your reduction if you do 12 d then it should come to 1 right. So, in that case it is like that. So, that this microbial that that limited applications are because of that, it is spore formation not in activated and not more than 100 fold that is 100 times, that is 10

to the power 2 it is not getting destroyed. So, examples are streptococcus thermophilus inoculated into milk, saccharomyces cervisiae in orange juices or mold spores in bread if they are looked into under this kind of thing.Then it is in not more than 10 to the power 2 or 100 spores the reductions are being managed to obtain.

Then we come to the microbiological safety, if aim is to inactivate microorganisms in foods; if that is the aim to inactivate the microorganisms in food, then there must be some basis for judging it right and the efficacy required to delivery is sufficiently microbiologically safe product.

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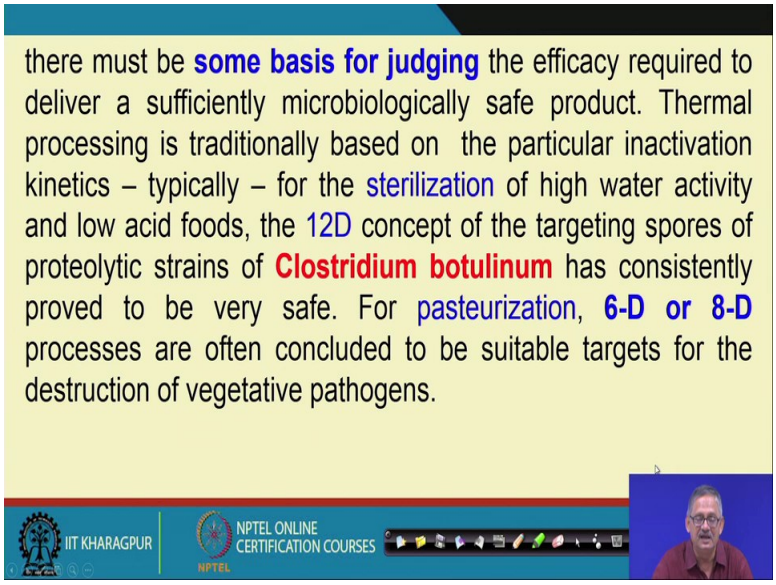

So, that you can depend that yes this process has efficacy and has been proved its efficacy and its can be applicable microorganisms in terms of microorganism or microbiologically it is safe right. So, how normally thermal processing is traditionally based on the particular inactivation kinetics and they are typically it is said, just before I was referring to that for the sterilization of the high water activity and low as it foods, it is said that 12D concept the targeting spores of proteolytic strains, of clostridium botulinum. Clostridium botulinum is one organism which is considered to be highly spore forming and very heat resistant. So, if that is it destroyed, then it can be said that yes the food material is away from the, or it safe for the microbial point of view.

Similarly, pasteurization in that, it could be 6D or 8D concept that may be applied. Now this D concept perhaps this is also not within our this course curricular. So, we may not

be able to go into detail because that is the death kinetics of the organisms. So, if everything has to be told in the class, then till the course will not be covered. So, I advice you that you please also look into the death kinetics of the food material of the micro organisms right where this D value, z value, d is f value these will come up and you can easily pickup what is being said that what is 12D or 6D right. So, these conclude that that suitable that are often this the process 6D or 8D processes are often concluded to be suitable targets for the destruction one of the pathogenic organisms because pathogens are not that much heat resistant or that much resistant.

So, in that case when pathogens are getting destroyed, then we can say that the product is microbiology or pathogenically it is safe to consume right. So, that 6 D, 8 D, 12 D this concepts are comings. So, you please also consult that death microbiology of the material. I hope we have finished little early in this, but, but here then we can say that new technology, which or emerging there are many more emerging technologies are there. So, it is not that all the time we can utilize them or all the time we can bring them into as we said one two cases, we have said that it is still under the lab scale, lot of some more researches are required and also the destruction of or elimination of the organisms are not to the extent as it is required.

So, in that case more and more thorough investigation has to be done and then only we can say yes that is done right, but since we have some more time then let us also look into that what are the difficulties in introducing the new or this technology, which we are coming in which we are calling to be emerging right. This is emerging means they are coming right they are coming, but they have not come up.

So, we have to keep in mind not only the microbial contamination, yes microbiology or microbial contamination is one major because either it spoils the food material or it is it is making the consumer affected with the maybe pathogen or some other organisms. So, if that is removed yes, a little we are assured of the safety of consuming the food. But the primary concern is the efficacy of the new technology, which you are bringing in.

So, new technology when you are bringing in, that time definitely you should not be only considering the microbiological status. But also others like the other day we are said the quality, that overall quality aspect right both in terms if it mean if it happens that to do that microbiologically yes like high pressure right.

So, when you are giving high pressure technology, that time you also have to keep in mind that it is not only the organisms, which you are considering, but also the appearance, the color the shape, the size, the texture, then this if it is viscous material the viscosity or if it is not then viscosity should not be increased all these aspects. If the viscosity become increased again that the word we will used pumpable or not right. If it is low viscous then pump required that the cost on pump or the energy on pump requirement will be less. So, its more acceptable, but if the process changes the viscosity.

So, that it becomes highly viscous from whatever it was then definitely the manufacturer will be implementing this new technology will think no may not be that this technology at the moment can be implemented right. So, to consider a new technology lot many other aspects, other than microbiology is required to be kept in mind right. And in that case we should be very much we should be, it is you should be very much judging the process judging the technology in terms of its efficacy right.

So, efficacy of course, in terms of organisms, but also in all other quality aspects that we have to keep in mind and also the process cost, which is very fundamental because high pressure technology to create that high pressure you have to have system and this is normally hydrostatic pressure and in that case high pressure development will be a major obstacle for the implementation right.

So, if your instrumental cost is very high to bring that instrument maybe several lakhs or crores rupees you have to incur, then the, that cost will come on to the product. So, the product which was otherwise we conventional mechanism, which was available maybe say for comparison 10 rupees piece or a pouch it was available. If that pouch now under high pressure if it is to be costing around 50, 60, 100 rupees; obviously, the consumer that they will take it otherwise and they would keep their mind and face from the new best technology right.

So, when we are approaching when we are adhering to the new and newly developed technologies, then we should also consider the cost primarily. Because technologically it may be very good, but the cost wise if that is not comparative, if that is not at per with the already available, then the purpose is defeated right.

This we should keep in mind and we should also look into the quality aspects. All put together it is not when you are judging technique or technology, that times it is not a

single parameter on which we will decide. Technologically it is it may be proved that yes the purpose may be served right for which the technology has come up yes it is serving the purpose, but it is again with respect to both microbial or non microbial status, but again the price also.

Then again it becomes that if the price is also comparable, but the implementation that may need lot of perennial others like it may be it may not be friendly to the ecology or a environment. So, in that case keeping everything then the developed technology because of the non environmental friendly may not be acceptable and may not get the light.

So, that people will accept or implement it. So, when new technologies we are concerning, we are definitely considering the effect, we are definitely considering the effect on micro organism, we are also considering the quality aspect of the material as well that if there any nutritional if there any nutritional disorder nutritional destruction of the process make by which you are killing organism by which you are doing.

So, nutritional quality that went down then; obviously, you will not be able to sustained with the new technology. So, nutritional balance, nutritional quality should also not get hampered with the technology, you are bringing into. I am not against high pressure it is not the that I am not saying that high pressure technology is bad or the other one high electrostatic field or high magnetic field whatever we have discussed or combination we have also seen that technologically combination system may be applied right.

Combinations scheme may be thought of in such a way that all put together synergism may occur. But again that this is not one aspect, but other aspects of the contribution towards the maintenance of the nutritional value, towards the cost incurred or it also can be that the initial cost. The initial cost may be very high, but operating cost is very low right for example, that air conditioning right.

If the air conditioning is made with the conventional air refrigeration system, then the operating cost becomes very small. So, there the initial cost could be high, but since the operating cost is very high very low, then people will go for it. But if someone is bringing something where the operated initial cost is very low, but operating cost is very high, then that becomes headache to the implementer.

So, we he or they we will think that why should this operating curve because operating cost initial cost you may get people or who are the entrepreneur, they are they may gets bank support or support from other agencies. But the same may not be true with when the operating cost is high, because operating cost has to come from the manufacturer or processor. So, they will think twice right.

So, I am not saying one factor, this is that only that initial investment or operating cost while you are considering you have to consider all in totality, such that you can say yes our system is full proved and proof from all the sides. So, emerging technology is which will come up, they have to compete from all corners with the all this already existing systems ok.

So, let us stop it today here time is over. So be again that, please look into the thermal death kinetics of the microwave microbes from some other sources ok.

Thank you.