Dairy and Food Process & Products Technology
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Lecture - 10
Emerging Technology

So, we now go to another topic that is on this Emerging Technology, right. So, we go to this emerging technology, which we said in the last class because of the time constant we could not cover it, but today, we shall cover it. And again emerging technology, it is definitely those which are coming up or which might or might not have taken your commercial aspect or commercial application. But they have the possibility and they have the enough for reasoning; why should they be brought into this I mean into commercialization that is also there.

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So, let us look into that. So, emerging technology; what are the drivers opportunity means why should we number 1 is the product quality and safety. So, products quality and safety is well maintained or well added to consume; it can produce consumer convenience. As well if the total cost of the system is also comparable or it could be brought down. So, then the emerging technology can come up, otherwise, if you have a conventional technology and if that is not so bad compared to the new technology, why

people should come for what; unless it encompasses all this three factors; that is the quality and safety and your convenience of the consumers as well the cross criteria.

So, if all these three are adhere to; then emerging technology can come up. Now, if we look at then; what are the technological advancements in that? Emerging technologies: packaging process, packaging material and value added features all these are coming up also along with the technologies. That packaging industry as really gone up very high and packaging materials also, many people are working on packaging different packaging materials and today or tomorrow, some new and new materials are coming up and that may help.

This is called augmentation of the technology, if there be any emerging technology coming up, then this packaging industry packaging material can definitely put up big thumb into that.

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Now, let us look into that to do that; what could be the challenges which new technology or emerging technology may face with, right, number one that they may be disruptive in the supply chain because normally, what the supply chain is ongoing when you are introducing a new technology. So, that could hamper the supply chain mechanism. So, that could be a challenge. So, as early as it could be recovered; that will be the, that will be good for both the producer as well as the consumer.

Then infrastructure; that could be also a major challenging threat to the new technologies because infrastructure the more it is developed better for the entire technology as well for the consumer; asset flexibility over cost of capital. So, asset flexibility or cost of capital means if you have whatever assets because whenever you are making an industry, definitely, you will have those instruments, equipments, those will be an asset and also land, area, buildings, etcetera; they become the asset.

But how much cost you have to incur as capital; that also will have some challenge on the new technology to come up because the this asset come this cost that should be also very look creative, otherwise, new people new entrepreneur will think twice or may not come forward and last of all the safety regulations, right.

So, if the safety regulations are well maintained, right, then definitely that will be helpful for the new technology to come up. So, what could be recommendations for the new technology to come up for general people who are directly or indirectly associated that is you the people should strategically co operate, , cooperate they should develops skill people.

So, the new technology the people who are doing for a long time with one type of technology indigenous or conventional or any technology which is ongoing if that has to be replaced so, that skill of the people who are working that should be also brought high otherwise it is very difficult for the new technology to come up, then consumer education this is also required.

In most of the cases consumer means who is consuming right anybody who is consuming can be said as a consumer. Now that you just think of a nation like ours where you as an educated engineer or technologist what do you understand and what some common man who does not have that much background or that much knowledge about the product about the implications about the plus and minus of the new technology.

So, unless they are educated, it is not only the packaging by which you can impress on them, but it is also the education of the people that must be looked into and you must be able to convince people with the new technology, right.

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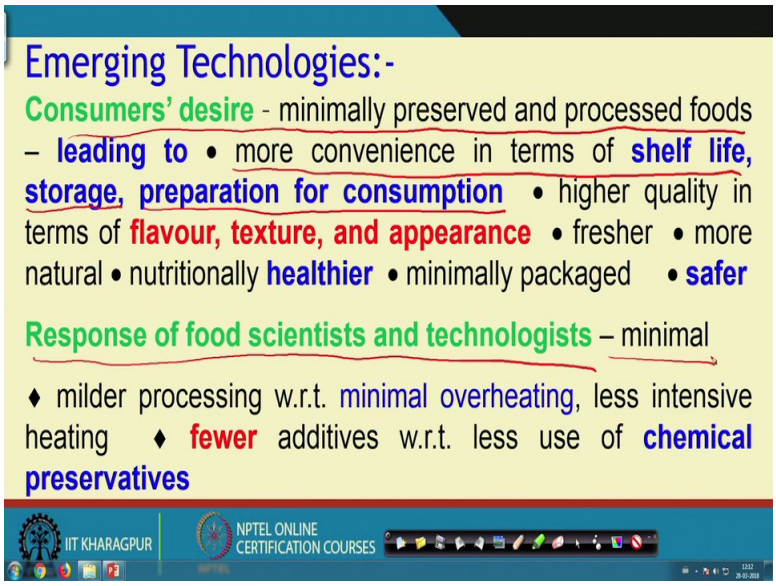

Then let us look into that; what are the emerging technologies, since, it will take if we make the slide in the vertical it will take lot of space. So, to minimize that I have made it like this, you see consumer; what they desire; there is from the consumer point of view; minimally preserved and processed food that is what they want. Then this should lead to more convenience in terms of shelf life, then in terms of storage, in terms of preparation for consumption.

So, this convenience both in terms of shelf life storage or in terms of preparation for consumption; that consumer wants that we should be the most convenient. Then higher quality in terms of flavor, texture, appearance that is also consumers demand, it should be more fresher with the new technology, more natural and naturally healthier, right in a or nutritionally healthier, it should be nutritionally also healthier as well minimally packaged.

Finally, it should be safer that is the point which consumers want that all these aspects if taken care of, then introduction of new technology perhaps they will have minimum resistance and they will be cooperative right. So, retailer then you look into not before going into the producer let us look into that scientists and technologists, what they say. Scientist and technologists says that with minimal changes, we can make milder processing with respect to minimal overheating, less intensive heating and fewer additives with respect to less use of a chemical preservatives that can be brought into. So,

as a technologist or as a scientist, they look into that we can minimally over heat or we can heat less so, that heat sensitive materials; they are not damaged and we can add few chemically preserved pre chemical preservatives so that consumers which they wanted that could be minimized, right.

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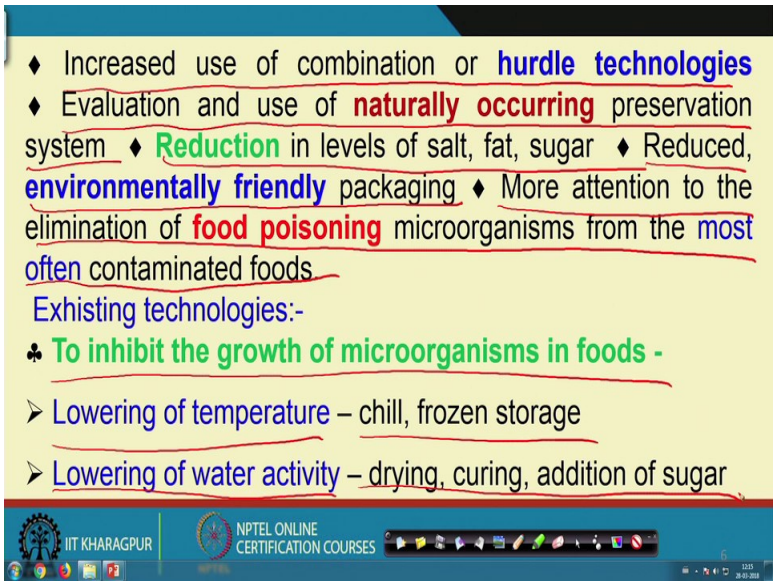

Then it comes to the level of and along with that increased use of combination of hurdle technologies, right combination of hurdle technologies, they say that yes we can do this that combination of hurdle increased use of combination of hurdle technologies that can be done by the scientists what they say. Then evaluation and use of naturally occurring preservation system that can be introduced, reduction in levels of salt, fat, sugar that can be done, reduced environmentally friendly packaging, right; reduced or packaging reduced or environmentally friendly packaging can be introduced and more attention can be given to the elimination of food poisoning microorganisms from the most often contaminated foods.

In many parts of the world even in the developed countries where things are much developed, but even there this problem of getting contaminated or infection is rapid or I do not say it is epidemic, but when it occurs, then it be also may become epidemic depending on the product and then the manufactures withdraw those or withdraws those kind of products from the market. So, that further damage can be controlled, right.

So, scientists and technologists says that this can be taken care of with the new technologies, right. Then what are the existing technologies we have to inhibit the growth of the microorganisms in food, we have lowering of temperature by chilling freezing and storing at low temperature, by lowering the water activity which we have by drying, curing, addition of sugar all these we have by lowering of technologies.

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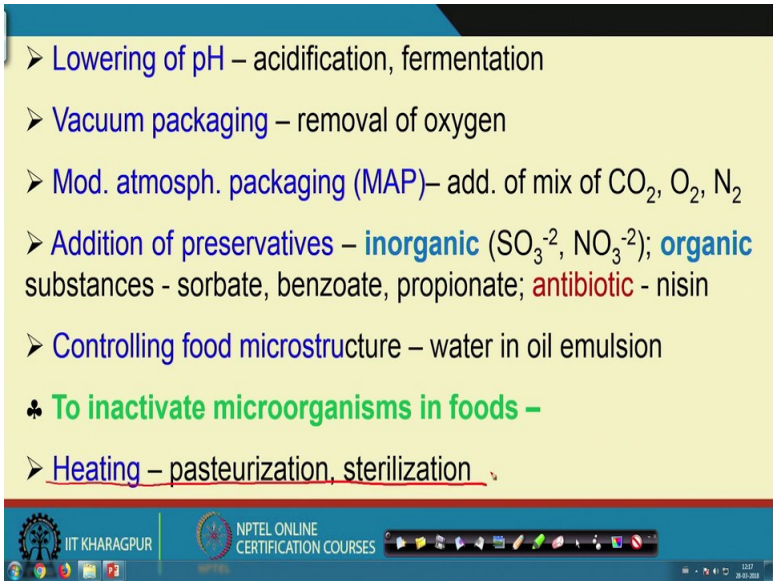

Then by lowering of pH by acidification, right which we have that is either by acidification or by fermentation we can lower the pH by increasing the vacuum technology that is by removing the oxygen from the packaged material. So, in by that vacuum technology or vacuum packaging is also there.

We also have nowadays modified atmosphere packaging or map where addition of maximum of carbon dioxide, oxygen or nitrogen, this adjustment can be done not only addition, but also adjustment of the concentration of carbon dioxide, oxygen and nitrogen that can be adjusted. Then addition of preservatives that is also there inorganic like sulphite, nitrite; these are there; organics substances like sorbate, benzoate, propionate these also there.

And some antibiotics like nisin that are also there, right and there are also controlling food micro structure. By controlling food microstructure like that oil water emulsion, oil water or water oil immersion, right. So, depending on whether your oil is in the primary phase or main phase or continuous phase or oil is in continues phase and water is in the

dispersed phase depending on that this is also there right. To inactivate in organisms in foods what we do, we heat to inactivate we heat thereby we do pasteurize, for example, heating which we normally come across is by pasteurization, sterilization or pasteurization sterilization drying we have already see drying is another, but this is with respect to liquid food normally, this is pasteurized and sterilized right and we also.

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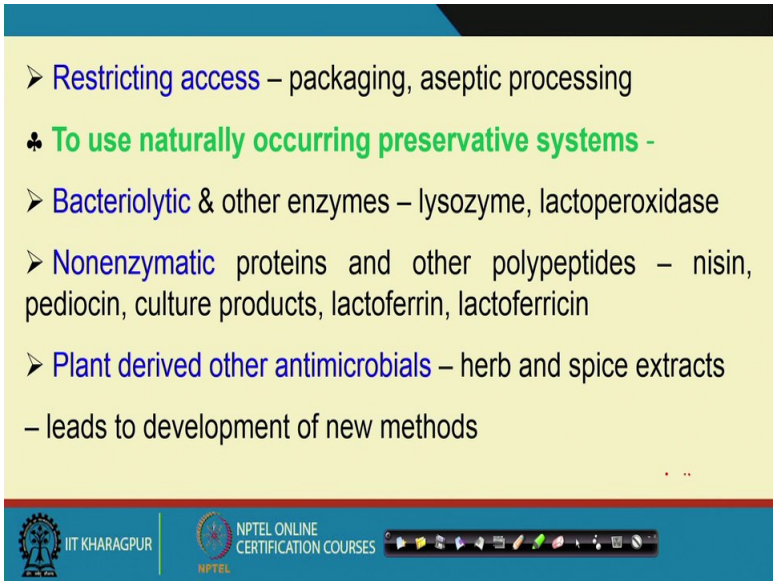

So, we also restricting access of the organisms, we can that is by packaging or aseptic processing processing and aseptic packaging, right. To use naturally occurring preservative systems what is ongoing is bacteriolytic; obviously, from the term bacteriolytic, it appears that if the bacteria is which can be kept aside that is it can be killed or bacteriostatic which can be which can be killed or which can be removed and other enzymes for example, iysozyme or lysozyme, then lactoperoxidase; these enzymes do act on them.

Some non enzymatic proteins and other poly peptides for example, nisin, then pediocin, then culture products then some, lactoferricin, all these are non enzymatic preservatives which are used, plant derivative or plant derived other anti microbes which we use our herbs and spices that is extracts that leads to the development of new and new method.

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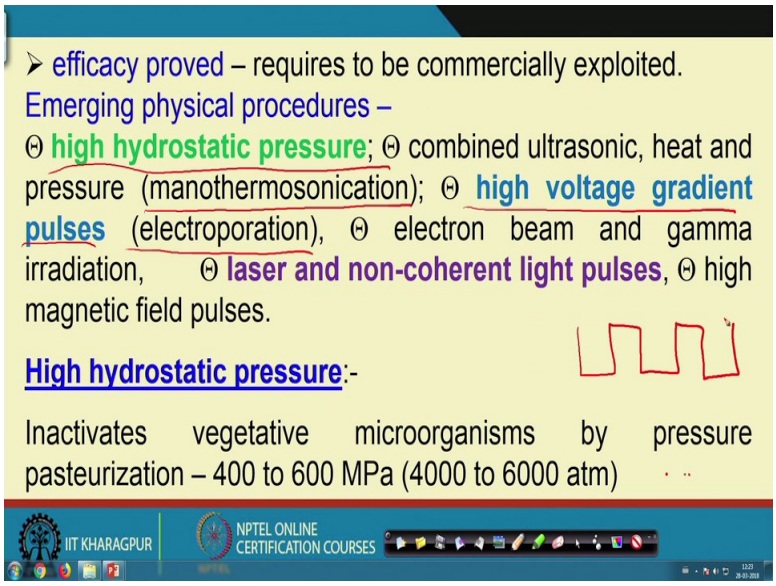

Right; now the efficacy of these methods of course that can be judged or assessed by the required commercial exploitation, how it can be proved that; what is the efficacy means how much it is fruitful to the product or with the system that has to be exploited commercially right. Now emerging physical technologies which I have which are coming up is by high pressure technology right or normally sorry we call it to be hpp; high pressure technology.

So, that high pressure technology or hpp that can be miraculous, but again as I said right in the beginning that everything you have to keep in mind, it is not only the technology itself with this, this is the learning process that is why you are bringing, but when you are considering to implement it, definitely, we will keep all whichever we have already told in mine to decide on when the technology should be adopted or not, right.

So, high pressure technology is one such which has which is coming up I do not say which has come up which is coming up where combination of ultrasonic heat and pressure all these are utilized right; either hpp itself or in combination with ultrasonic or ultrasonic method and heat and pressure all these three could be used and that is termed as manothermosonication; that is termed as manothermosonication where combination of this three ultrasonic, heat and pressure all these three variables are used then high voltage gradient pulse that is called electroporation. this technique is called electroporation where high voltage gradient in terms of pulse; pulse of course, means as you know. So,

this we called pulse, right, this kind of input we call it to be pulse. Then laser and non coherent light pulses, right, where we could use that laser or light pulses for the inactivation or may be as the new technology.

Then high magnetic field pulses again that can be used where magnetic field can be used in the very high form and that can also bring to our new technology ok. Now if you look into simply different from that high pressure. Now how much high pressure, it is high to the tune of that inactivates vegetative organisms by the pressure, right in pasteurization, it is around 400 to 600 Mega Pascal, you see Mega Pascal around 4000 to 6000 atmosphere; atmospheric pressure is 1 atmosphere, right and it you make it 5-6 atmosphere, then only, it becomes the booming kind of thing, 4000 to 6000, right, this is of course, not the pressure which gas pressure, we think of, this is normally hydro static pressure right. So, in that definitely such huge pressure can be built up.

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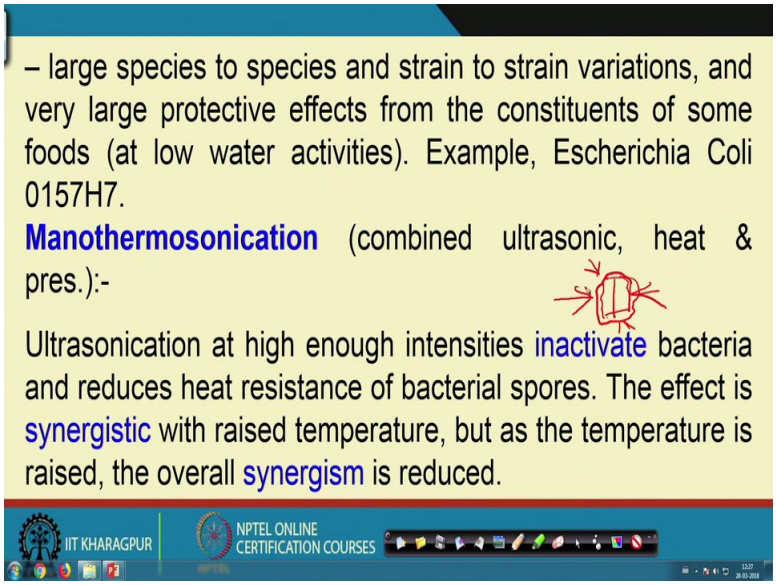

Now, why should we will what it does? It does large species to species and strain to strain variation and very large productive effects from the constituents of sum of the foods at low water activities, for example, Escherichia Coli that can be where this high pressure technology can be used. So, definitely how much pressure; how much you should apply we have given a range of 4000 to 6000 atmosphere, right. So, at that high pressure it varies from species to species or strain to strain how much pressure should be applied, right, example given or we are putting that Escherichia Coli this number can be

one such right, then manothermosonication where it is a combination of ultrasonic facility, heat and pressure, right.

Now, what is the advantage of all these three ultrasonication at high enough intensities inactivate bacteria and reduces heat resistance of the bacterial spores. I hope we understand spores; bacterial spores means if this is a bacteria say rod shaped bacteria. So when it is forming a spore then it forms another coating around it round around it another coating.

So, this is very resistant to the cause given to it, right, it becomes very resistant. So, those which are in a high spore performers, they are more inactive they are more resistant and it is difficult to inactivate those. So, there these ultrasonication helps to inactivate these bacterial spores right. The effect of synergistic effect synergistic means, it is both together, right synergism that is and this b both are acting together and jointly the effect is being available.

So, that is why it is being called that synergistic the effect is synergistic with raised temperature as well the temperature if it is raised then overall; of course, if the temperature is high very high, then overall synergism is reduced; the reason being high temperature, then comes into picture and the damage is done by the high temperature. So, that is why it is a combination of all this three together right.

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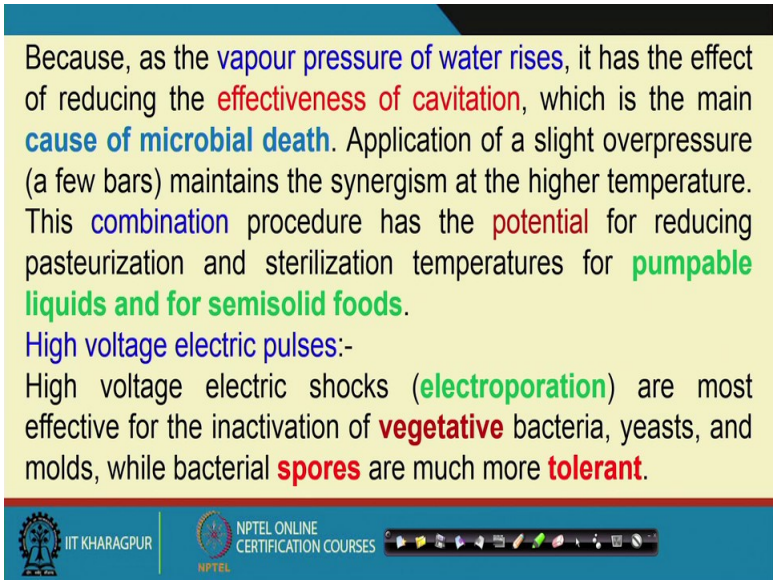

Now, why the synergism is done as you said because as the vapour pressure of water rises, it has the effect of reducing the effectiveness of cavitation which is the main cause of the microbial death right. Vapour pressure, why it will raise because you are increasing the temperature.

So, in vapour pressure is a function of temperature. So, the moment you are increasing the temperature that will also raise the vapour pressure and if vapour pressure is raise then deactivation due to cavitation is reduced and cavitation formation of causing the cavitation is one of the primary reason why the organisms are destroyed.

So, application of slight overpressure, if you maybe if you bars or maintains the synergism at the higher temperature, thus combination. So, if you increase the temperature, then simultaneously you also increase the pressure. So, that the vapour pressure difference that does not become significant and that cavitation problem does not arise, right.

So, it has the potential for reducing the pasteurization and sterilization temperature for pumpable liquids and for semisolid foods, pumpable liquid; that means it has flow ability. Now is the viscosity becomes very high, if the material becomes very high viscous, then pumpability will reduce.

So, it has to be it is applicant can be applied to those where, we have high pumpability of the liquid or of the fluid or of the food right or if it is semi solid so that the pumpability is there, then this technique that is application or in combination of synergistic effect of ultrasonic as well temperature and pressure these in combination can be made effective.

This is a technique which is coming up right, I do not say it has come up, but since we are discussing with the trends of the recently developed technologies so, this is one of them. So, the other too or others we will discuss in the next class because our time here is perhaps limited.

Thank you.