Dairy and Food Process & Products Technology

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Lecture - 50
New Technologies in Dairy Industries

So, in this Dairy and Food Process and Products Technology class this is lecture number 50. We will discuss some of the technologies which are used in dairy industries of course, this is not only in dairy industry, but also in processing industries; they are used.

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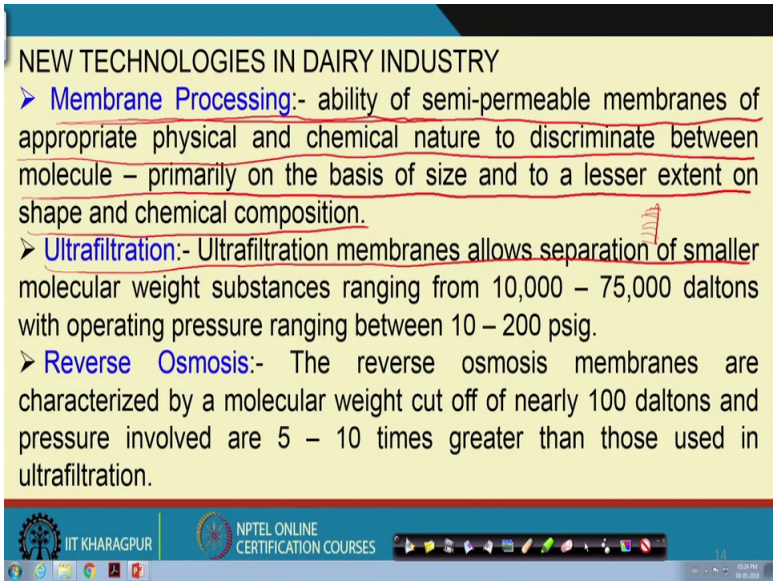

And this new technologies are coming up very much in not only again in dairy liquid food but, obviously in liquid food it is more important, but in solid also some of them are utilized. But for example, membrane you have to have with liquid food only right; membrane processing and membrane separation by which nowadays you get in every house this water filter you get that is true membrane technologies.

And in our institute we have our collogues they have made this membrane to the level that bacterial filtration is also possible and not only that in many cases people are using for removing the contaminates like arsenic which is very poisonous.

So, this is a very useful technology that membrane technology that is being used. So, that is let us start with that time is not very high we are coming very closer to the end. So,

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1that regularly as we are explaining more and more time is also being consumed, but yes 2it is a try and time frame plus and cannot be extended beyond the 60 lectures.

3So, we have to finish some more a very important things maybe some products will also 4discuss right. May be like to very two important one, one is your what you get cheese 5and another one ice cream. This two products also we can discuss maybe and then we 6may have sometime to discuss about the general that control/modified atmosphere 7storage or packaging that also we can and maybe for this kind of liquid food some your 8packaging that can also be discussed will try and see as much we can cover up ok.

9So, is the membrane process where this is ability of semi permeable membrane of 10appropriate physical and chemical nature to discriminate between molecule primarily on 11the basis of this size to a lesser extent on shape and chemical composition. What 12membrane technology is done, say this is one we have a membrane right.

13So, it will have very fine pores very very fine pores; the finer the pore size the filtration 14efficiency or rather in terms of quality filtration efficiency is so high even to the tune of 15bacteria who is who are maybe less than microns. So, they are can be separated, they can 16we remove there also used for separation of this. So, this membrane technology it is a 17semi permeable membrane; semi-permeable means it will permit only one right and rest 18of the things will not be allowed to pass on right. So, that is what is primarily this 19membrane technology.

20Then ultrafiltration in many of the collages this ultrafiltration is also available right.

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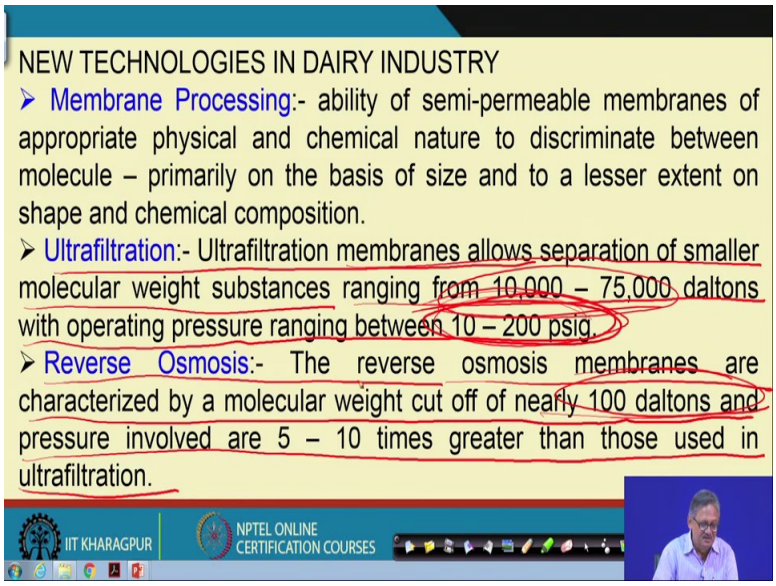

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3And this is also a membrane that allows separation of smaller molecular weight 4substances ranging from 10000 to 75000 daltons Molecular weight right that molecular 5substances can be removed with opening operating pressures ranging between 10 to 200 6psig right. This ultrafiltration can be utilized for separating around 10000 to 75000 7daltons this molecular mass; whose that is the mass that is a material or impurity which 8you want to remove and that ranges between 10000 to 75000 dalton molecular size or 9weight right.

10Then by reverse osmosis right, osmosis is as I said that household this filter things they 11are available with reverse osmosis right. RO and this RO filters are available very much 12popular nowadays; whose where this membranes are characterized by molecular weight 13cutoff of nearly 100 daltons. It was 10000 to 75000 here it is nearly 100 daltons and the 14pressure involved is around 5 to 10 times greater than those in the ultrafiltration, here it 15was 10 to 200 psi. So, it will be 5 to 10 time so, around 50 to 2000 psi it is pressure is 16applied for reverse osmosis.

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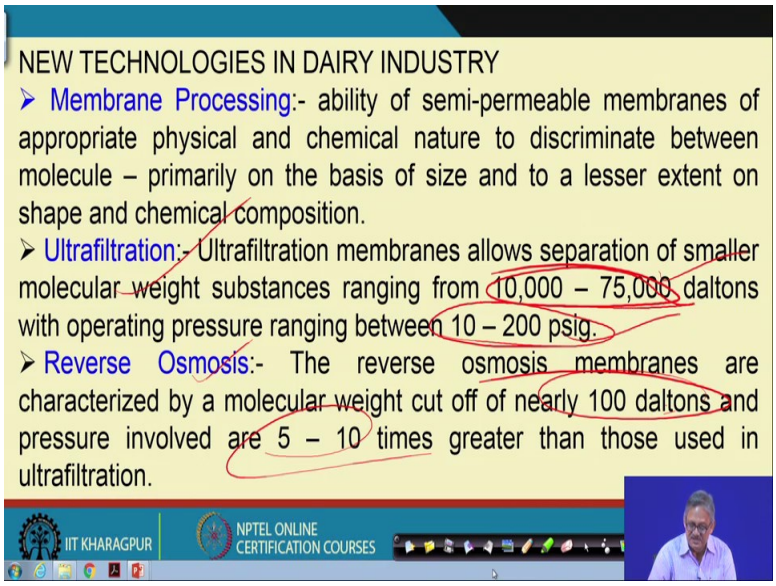

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3So, this data are very important for you. So, that 10 to 75000, 10000 to 75000, 10 to 200 4psi this is the size where the molecular weight of substances which are removed and this 5pressure is around 10 to 200 psi. Whereas, here it is around 100 in reverse osmosis it is 6around 100 and 5 to 10 times greater than the pressure of the ultrafiltration.

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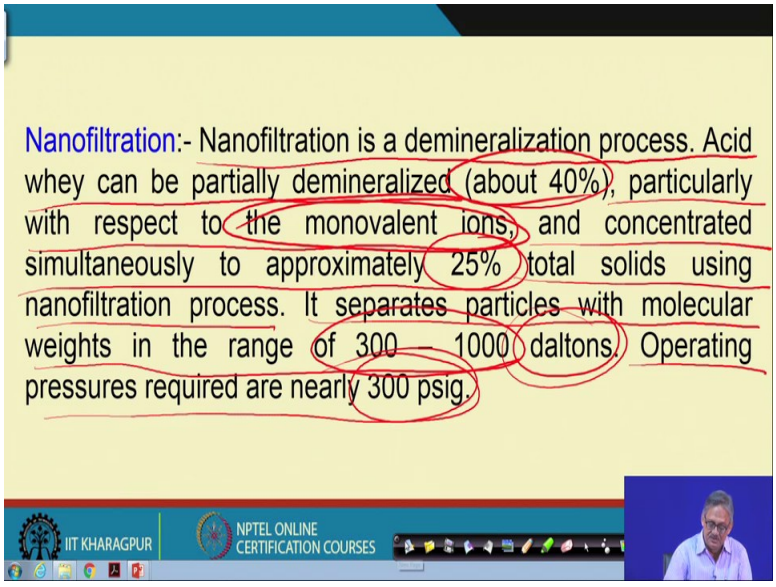

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9Then you see nanofiltration, this nano word now it is utilized in many many cases. Since, 10it has come let me I just cannot hold myself whenever new thing comes at least make it 11little open to you. So, that understanding in a bigger sense maybe easier; nano filtration

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1nano size is 10. So, these nano is utilize nowadays in many cases right in even in 2packaging industries also, this nanoparticles they are trying to mix up with the film. So, 3that the strength of the film becomes more as well the all properties because it is not only 4one many properties also can also be not only affected, but also be improved towards 5your requirement.

6So, this nano technology is coming up here also nano filtration that is you want to filter 7very very fine one. So, nanofiltration is a demineralization process. Acid whey can be 8partially demineralized about 40% particularly way with respect to the movement of the 9ions or this monovalent ions. Monovalent ions are also separated and concentrated 10simultaneously to approximately around 25% total solids using the nanofiltration 11process.

12It separates particles with molecular weights in the range of 300 to 1000 daltons. So, this 13300 to 1000 daltons with nanofiltration it can be separated and operating pressure 14requires nearly around 300 psig. So, high pressure you need for this nanofiltration and 15the particles which you were separating is around 300 to 1000 daltons right. So, this is 16another technique by which you can separate.

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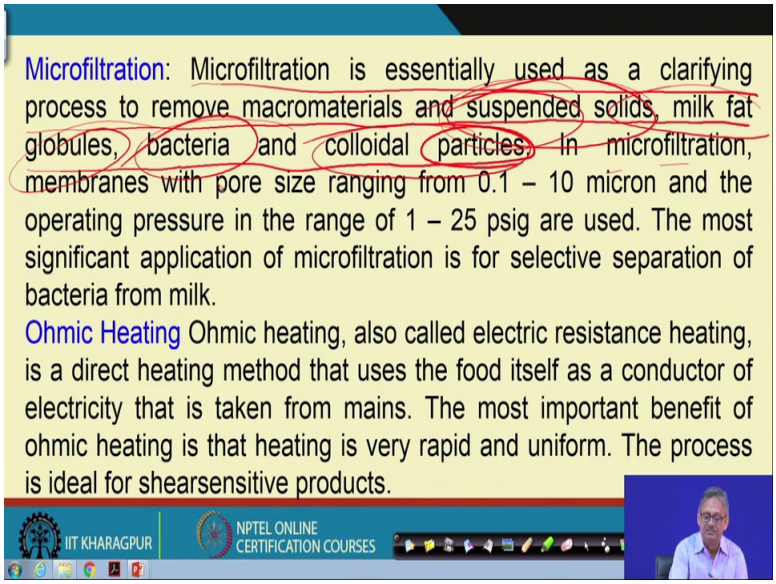

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19Then microfiltration right; so, from nano we are coming to micro, micro is bigger than 20nano much bigger right. So, microfiltration is another technique by which you can of 21course, from the word itself it goes that the size will be much bigger than the nano.

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1So, in that microfiltration is essentially used as a clarifying process to remove 2macromaterials and suspended solids, milk fat globules, bacteria and colloidal particles. 3These are all with respect to nano/macro right though micro, but with respect to nano 4they are macro molecules. For example, we said suspended solids, we said milk fat, we 5said milk fat globules, we said bacteria or we said colloidal particles; all of them can be 6removed by the microfiltration.

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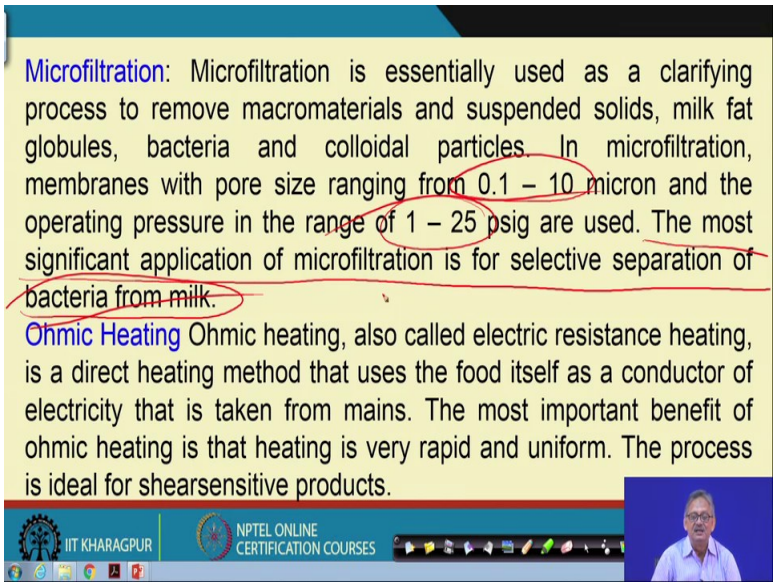

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9Then in microfiltration membranes with pore size ranging between 0.1 to 10µm 0.1 to 1010µm, the pore size of the pore size again as we said if this is a filtered medium. So, 11these are the pore sizes through which it may pass right. So, between 0.1 to 10 micron 12size and the pressure operating pressure ranges between 1 to 25 psig right is used.

13The most significant application of the microfiltration is to separate the bacteria from 14milk, that is one vital that bacteria with microfiltration if that can be removed from milk 15then that high temperature which affects the quality of milk cannot be required or is 16minimum can be minimized right. So, this is another technique by which you can remove 17the even the bacteria from the milk.

18They are come to some other techniques like ohmic heating right.

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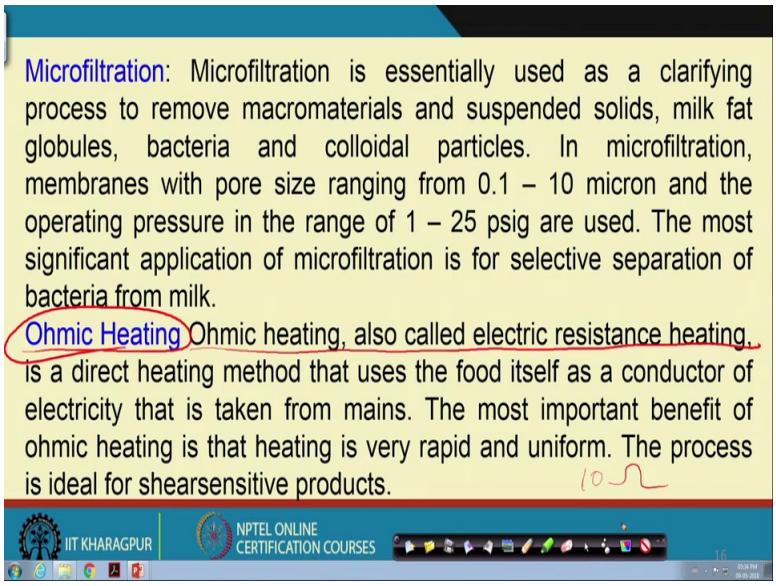

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3So, we have had the ohms law. So, from there we know rather why it should not say we 4have heard we know ohms law, from there this ohmic heating has come up. This is what 5is also called the electric resistance heating. So, depending on because we know that the 6resistances of the electrical conductors are expressed in terms of its ohm. This has so, 7much ohm 10 ohm, 14 ohm, 15 ohm or 20 like that depending on the on the product, 8depending around the material this we say as the resistance of that.

9So, resistance of the material there is a primary or electrical resistance of the primary 10mechanism by which this ohmic heating is bring kept introduced right.

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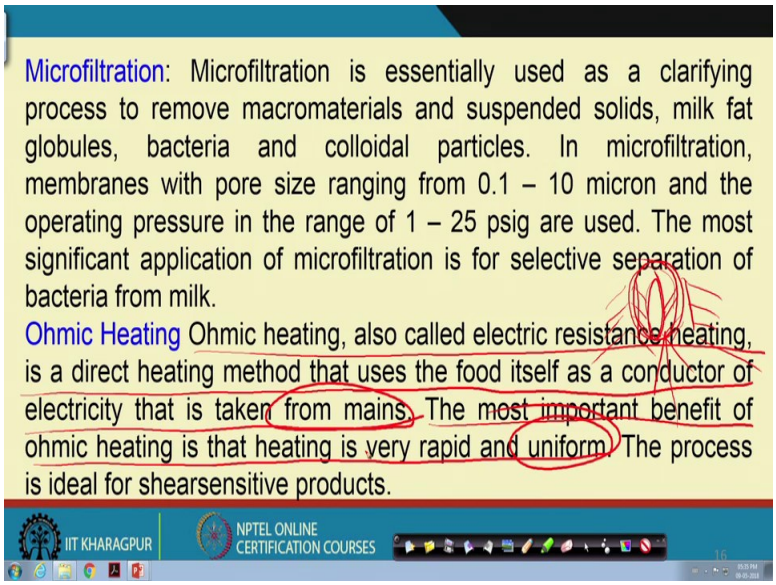

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3So, ohmic heating also called electric resistance heating, is a direct heating method that 4uses food itself as a conductor of electricity that is taken from the mains. The most 5important benefit of ohmic heating is that heating is very rapid and uniform that is 6another thing right. Say you have pipe like this and through which milk is going and this 7is side is being heated by steam, this side is heated by steam right.

8So, it is all like that the milk which are towards the pipe side they will be heated more 9than the interior.So, the non uniform heating may arise. Whereas, in this case this heating 10is very very uniform because you are using the food product as your resistance material, 11you are passing the electricity through that and that is causing the product to be heated 12up.

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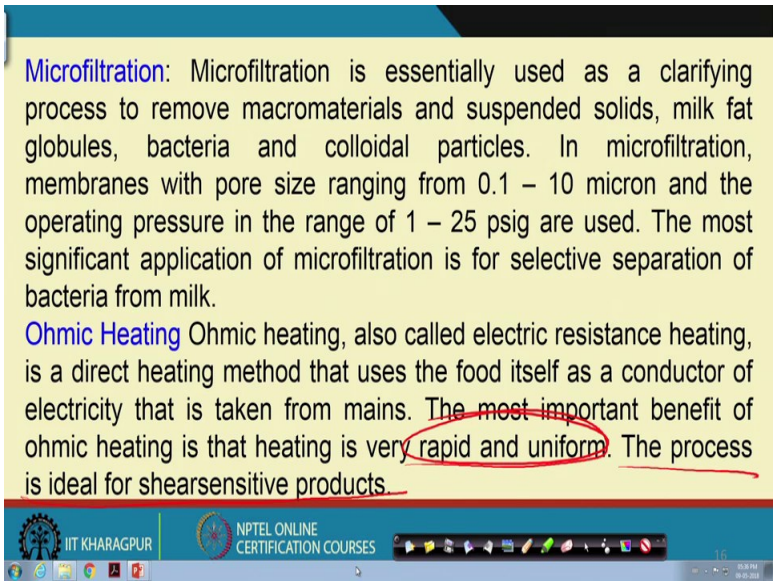

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3So, uniform heating is being made right and rapid and inform meeting is being made that 4is the primary key of the success of this you need. The process is ideal for shear sensitive 5products right. So, those which are which are shear sensitive those products can be very 6effectively very heated by this ohmic heating method.

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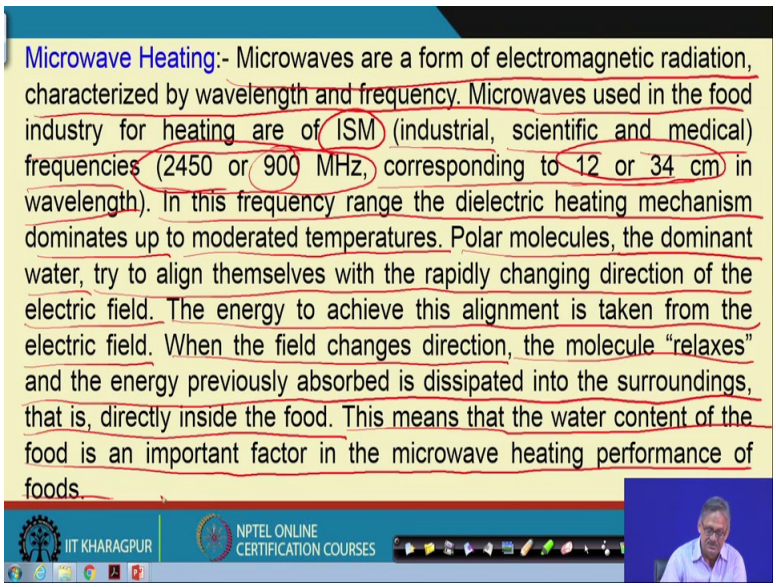

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9Then microwave heating, in many cases in nowadays microwave have has become one 10of the household commodity by which you utilized now and then. In my most of the 11houses I am not saying in terms of villages, villages may not be is this aspirated into that

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level; But definitely in the biggest cities or in metros this is very very useful nowadays and people are using.

So, in that microbe heating what for primarily is being done this is what. So, microwaves are being passed and then depending on the polarity and there the polarity of the material which bring heated is primary. So, that is why non-polar systems are not being heated or not being used right, but it has to be a polar where like a water right. So, that becomes heated up and then that because of its movement it gets heated up and raises the temperature and does the performance right.

So microwave, are form of electromagnetic radiation characterized by the wavelength and frequency. Microwaves used in the food industry for heating are ISM that is industrial, scientific and medical frequencies which are around 2450 to or 900 mega hertz right, corresponding to 12 or 34 centimeter in wave length, 12 or 34 centimeter in wave length

In this frequency range the dielectric heating mechanism dominates up to moderated temperatures. Polar molecules, the dominant water try to align themselves with the rapidly changing direction of the electric field. The energy to achieve this alignment is taken from the electric field. When the field changes direction the molecule “relaxes” and energy previously observed is dissipated into the surroundings, that is directly, inside the food.

This means that the water content of the food is an important factor in the microwave heating performance of the foods right. So, depending on that is why any dry product where moisture is not there, you cannot heat through microwave because that water that acts as the heating medium right. So, the polarity of the water that makes the heating. So, unless you have been moisture then you cannot heat. So, this is one which has to be kept in mind.

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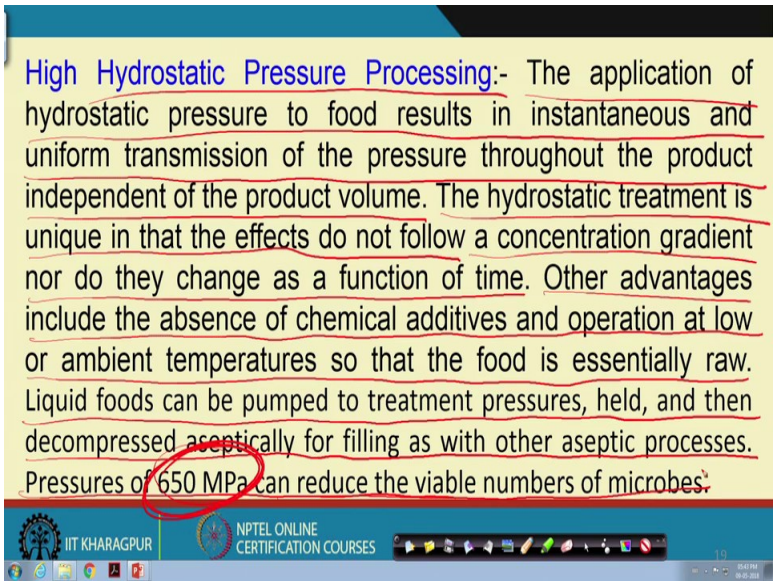

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3So, after the microwave heating; there are high hydrostatic pressure processing or HPP. 4Again HPP, since it has come up high pressure processing; high hydrostatic pressure 5processing or HPP which we come across, let me also tell about this that though, 6throughout the world this technology people are trying; high pressure technology I am 7not against it, but only the thing that it is very difficult to commercialize it because the 8primary is not in terms of quality or in terms of the process.

9It is primarily the price which is the drawback of the system and may not be feasible for 10commercialization right. But of course, we must know the process that is why I have 11brought it into this that high pressure technology or hydrostatic pressure processing is 12that the application of hydrostatic pressure for food results in instantaneous and uniform 13transmission of the pressure throughout the product independent of the product volume; 14irrespective of the volume or it is irrespective of the size right.

15So, it is hydrostatic pressure which is in affecting the food material like this is generally 16used for inactivation of the microorganisms right and without the heat treatment. So, it is 17the pressure treatment which you are making. So, it is not the heat which is coming 18across for which the quality is not getting affected right.

19The hydrostatic treatment is unique in the effects do not follow a concentration gradient 20nor do they change as function of time. Other advantages include that the substance of 21chemical additives and operation at low or ambient temperature so, that food is

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1essentially raw. Liquid foods can be pumped to treatment pressures held and then 2decompressed aseptically for filling as with other aseptic processes. Pressures of 650 3megapascals 650 megapascals can reduce the viable numbers of microbes right.

4So, primarily this is for deactivation of the microorganisms and you see the pressure 5range is around 650Mpa right 650Mpa, We know one atmosphere is 101.321kPa right. 6So, that is so, many times then the atmospheric pressure.

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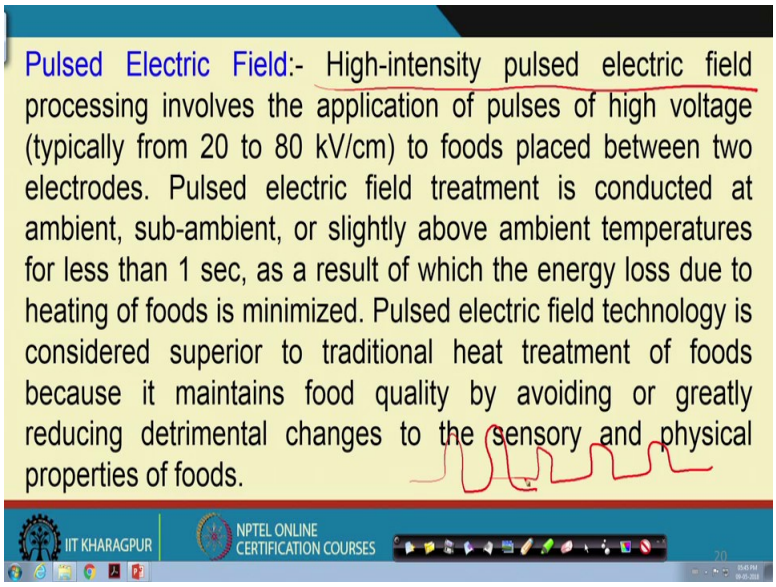

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9Then pulsed electric field another very new one which is coming up; High-intensity 10pulsed electric pulse, pulse means whenever you are giving little then stop, a little then 11stop like this is called pulse. This way it goes right like our body pulse you will not get a 12continuous right it gives pick and then this and the pick and then this right. So, like that it 13is so, that why it is called pulse. So, pulse electric field is like this.

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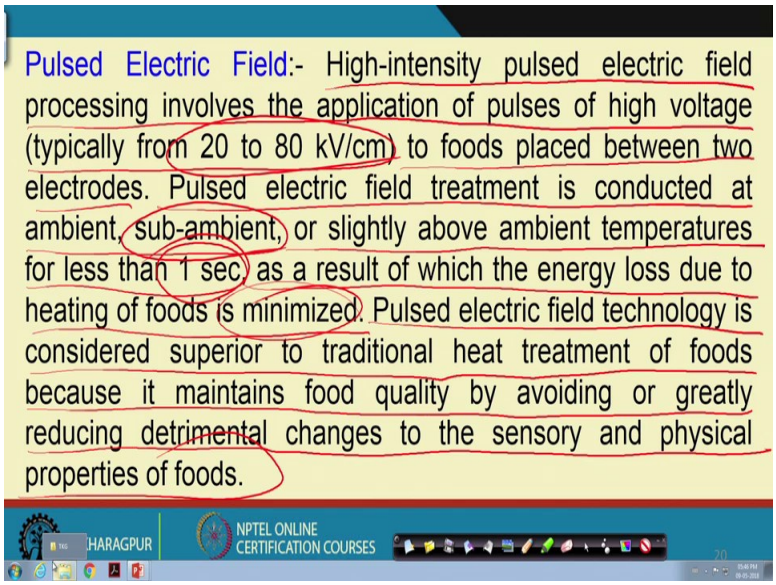

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3High-intensity pulse electric field processing in bulks the application of pulse of high 4voltage typically from 20 to 80 kvol/cm, 20 to 80 kvol/cm to foods placed between two 5electrodes. Pulsed electric field treatment is conducted at ambient or sub ambient, or 6significantly above ambient temperatures for less than 1 second, it is very short time; as a 7result of which the energy loss due to heating up foods is minimized.

8Pulsed electric field technology is considered superior to traditional heat treatment of 9foods because it maintains food quality by avoiding or greatly reducing detrimental 10changes to the sensory and physical properties of food that is another one which is very 11very important right.

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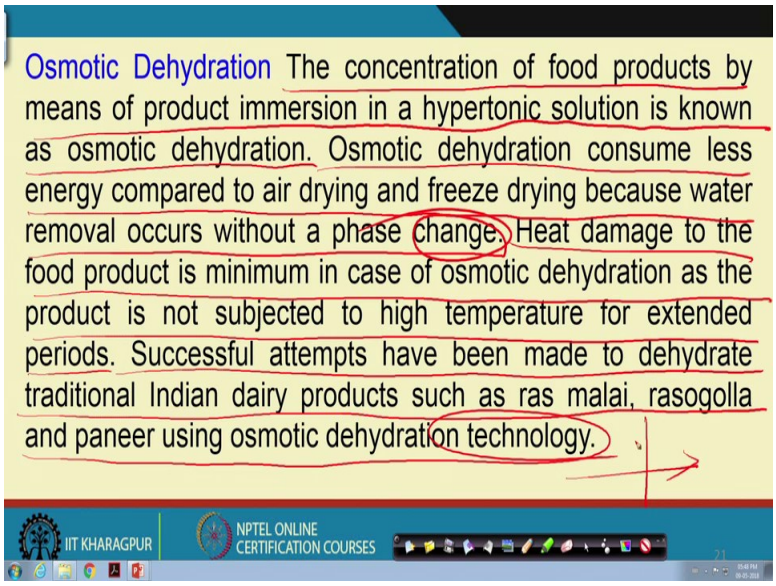

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3Then osmotic dehydration right of course, we know osmosis right. Osmosis is also again 4a semi permeable membrane technology right and this is due to the concentration 5difference one is high concentrated, another is less concentrated depending on that the 6movement of the liquid is from one side to the other side. So, that technology is being 7used here right.

8So, osmotic dehydration and in many cases this concentration this is dehydration that is 9you are removing moisture from the food material you are removing moisture. So, many 10cases this is done right and in that what we can say is that the concentration of food 11products by means of product immersion in a hypertonic solution is known as osmatic 12dehydration. And osmatic dehydration consume less energy compare to air drying and 13freeze drying because water removal occurs without a phase change. There is no phase 14change because you have a membrane and this water is moving from one side to the 15other side right.

16So, heat damage to the food product is minimum in case of osmotic dehydration as the 17product is not subjected to high temperature for extended periods. Successful attempts 18have been made to dehydrate traditional Indian dairy products such as malai, rasogolla 19and paneer using osmotic dehydration technology right. So, osmotic process is a very 20very helpful and useful process for renewal or concentrating the food products right.

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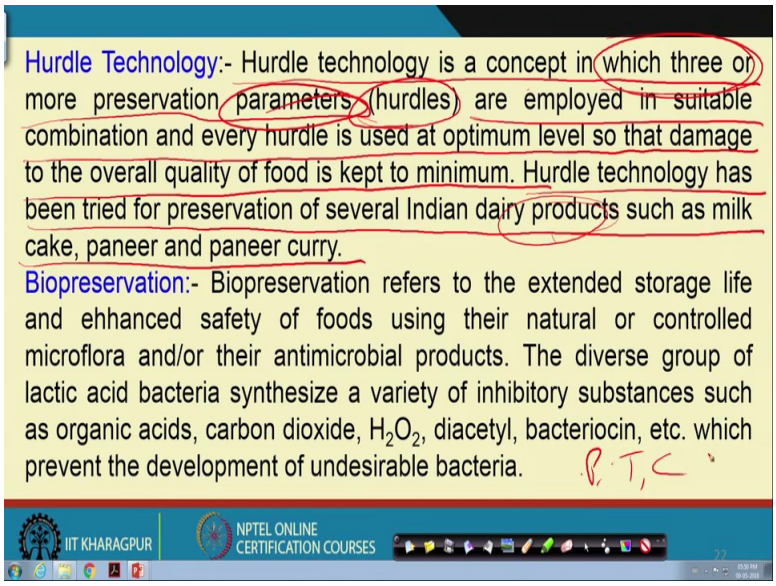

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3Then hurdle technology, this hurdle technology is of course, another one that is where 4the combination. Hurdle technology is the concept in which three or more preservation 5parameters that is hurdles are employed in suitable combination and every hurdle is used 6to at optimum level so, that damage to the overall quality of food is kept minimum. 7Hurdle technology has been tried for preservation of several Indian dairy products such 8as milk cake paneer and paneer curry right. So, these hurdle technology more than three 9or three parameters then the hurdles are employed right. Maybe pressure, temperature 10and some other maybe concentration like that so, it is a combination technology.

11It is a combination technology where more than one parameters are controlled. So, that 12type of thing where combination technologies are where temperature high is not possible. 13So, use a little pressure, use some concentration difference. So, all these put together you 14are crossing the hurdle so, by that you are processing. This is a very good concept 15because if you see like walking through narrow space if you see that this road is not 16good. So, you can use a little for that and change to another so like that. So, it is 17combination where according to your requirement, according to your for the usability 18you are utilizing it right.

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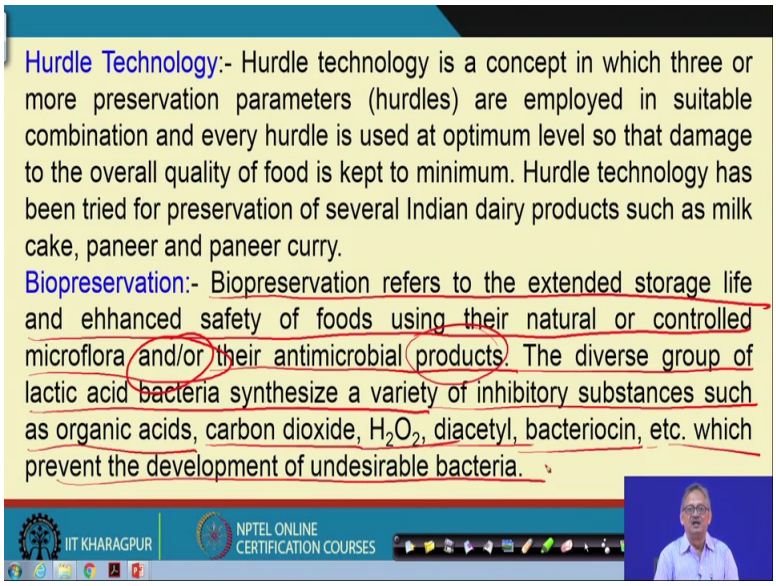

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3Then the last one is biopreservation, by which you are already done in many cases. The 4biopreservation refers to the extended storage life and enhanced safety of foods using 5their natural or controlled microflora and or their antimicrobial products; The diverse 6group of lactic acid bacteria synthesis a variety of inhibitory substances such as organic 7acids, carbon dioxide, hydrogen peroxide, diacetyl, bacteriocin, etcetera. So, by the 8organisms you are you are creating many many substances one or in many combination 9which are acting against the organisms; for example, the word which you said hydrogen 10peroxide. Hydrogen peroxide is very anti-microbial right, so which prevent the 11development of undesirable bacteria.

12So, these are some of the techniques which recently have come up and they are not only 13used in dairy, but also are used in many other food products right. So, with this let us 14complete today.

15Thank you.

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