Cooling Technology: Why and How utilized in Food Processing and allied Industries

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Module No 01

Lecture 04
How to produce Safe Foods

Good morning again. In the previous class we completed with the different definitions perishable, nonperishable, self stable etc. After defining, we come to this point that how to produce safe foods, right. Because, as we are saying that, safe food is the slogan of today or is the word of today, where everybody is looking for or running after safe foods. So, to do that let us come to this point that there are many ways by which safe foods can be prepared. Mainly by thermal processing, thermal processing meaning that we are lowering down the water activity by either drying or freezing and also we can do the same by adding sodium chloride or some molecules for example, as we said sodium chloride.

So, this is one way of producing safe foods. Some others are also there like high pressure. High pressure processing is a new type of technique which has come up, but obviously is very highly costly, right, because you are not creating high pressure through gases. So, there to create high pressure, lot of equipment, instruments are there.

Then, some ultraviolet light, yes, ultraviolet light, but that also has limitation of the range of ultraviolet treatment. May be a ozone treatment, we know all that ozone is such a thing which helps in oxidation, but in many cases it is also helpful to create the food safe. Using some electrical pulses, electrical pulses in the sense we create this type of pulses, right. We create this type of pulses in the electric field, of course, it needs very very high voltage and that is the reason this electrical pulses or high pressure processing or many others which are of today's nature they are not commercially used. So, it will take time because as of today the price of these processed foods are very very high.

So, we are not able to produce them. Now, incorporation of additives which we have done, I had given you some example earlier, that you are making, you are making sauerkraut or some food materials which are handled by application of some salts, right. So, incorporation of additives, they are like that, right. So, these are how you are able to produce some safe foods. Now, another way is that refrigeration and freezing as a

method of preservation that most pathogen growth is stopped at or below minus 5 degree centigrade.

Now again in this regard since pathogen has come out and the temperature has come up let me also inform you that there are three types of bacteria one is called thermophilic another is called mesophilic and third one is called psychrophilic. Philic means loving. Now, thermophilic means that high temperatures loving, high temperature loving organisms. So, they do act around 40, 50, 55 degree centigrade. So, they are thermophilic, some we said as mesophilic meaning that they do act around plus 20 to plus 30 degree centigrade moderate temperature.

Psychrophilic are those which act around minus plus 5 degree centigrade plus minus 5 degree centigrade. That means, if the temperature is around 40, 45, 60 degree centigrade then thermophiles will be active and all the organisms which are thermophiles or depending on many other factors like that, what is the what is the food material for them etc. may definitely detect that the thermophile action. Then this mesophilic, where the temperature range is between 20 to 30 degree centigrade and more in many cases, this is the room temperature of most of the places during most of the time of the year except some period. So, there the mesophiles do grow around 20 to 30, but thermophiles do not, right, like when is 40 to 45 or 50 or 60 degree centigrade that time mesophiles or psychrophiles do not act, when the temperature is 25 plus minus degree, then thermophiles and psychrophiles do not act.

And the third one is plus 5 degree centigrade where psychrophiles, sorry, mesophiles and thermophiles are not acting, but the thing is that in none of the cases the lowering of temperature does not kill the organism. If you want to kill the organism you have to heat them, no other way, heat them or like that that high pressure processing, there it is though costly very costly, but by that technique you can also do the extension of the storage life. Then, it comes that the few pathogens grow slowly under refrigeration conditions also and this is owing to the fact that it follows down spoilage microorganism mechanism, growth, and it follows chemical reactions that can happen to make off flavors, at what temperature do freeze or food freeze. Now, normally we know that food freezes around 0 degree centigrade, but most of the food materials, being having some soluble particles, the freezing point is depressed, freezing point depression takes place, right, and it is lower than 0 degree centigrade, but foods are not pure water. So, they freeze at less than 0 degree centigrade, for example, meats do not start to freeze until they are less than about minus 2.

2 degree centigrade and hard frozen until closer to minus 18 degree centigrade. Now, the moment it comes to minus 18, the word I would like to put before you why minus 18,

why not minus 20 or minus 10 or minus 5, 15, some good number, not such an odd number of 18, any idea any explanation from your side take a minute, I have no problem, but the history says that during old age, very very earlier not earlier centuries, earlier many many centuries, people used to travel from one place to other place with the help of either camel or sheep or maybe horse and they had to carry lot of food materials with them. Now, since they are carrying, maybe some food material or milk in some containers, like where it can be maintained at 0 degree centigrade or rather 0 degree Fahrenheit or it has been found that the products which they were carrying was very good at the temperature of 0 Fahrenheit. So, since the product was very good at 0 Fahrenheit they considered that this is the best possible way of making it at minus 18 degree centigrade. Now, 0 Fahrenheit, if you convert to centigrade, then you will see it is almost minus 17 point some number, some degree centigrade, maybe 17.

6 or 5 like that. So, minus 17.7 or 5 is rounded off to minus 18 and that is why minus 18 has come up, right. So, and this is everywhere that the old history of 0 Fahrenheit, that time there were no centigrade scale and this is why people do say that minus 18 or below is the base temperature of storage, whether frozen food normally frozen food because minus 18 normally no foods are bare. Now, at temperatures less than 0 degree centigrade no organisms can grow.

So, no pathogen can grow, no spoilage organisms can grow, it is the freezer that gets colder that is even less than minus 18 degree centigrade, chemical reactions are even that minus 18, chemical reactions are inhibited even more ok. Eventually chemical reactions will deteriorate the food material because ultimately it is the chemical reactions which control the quality of the food material. Now, this chemical reaction could be pure chemical reactions, like sodium hydroxide plus HCl sodium chloride plus other materials. Similarly, chemical reactions like biochemical path for example, we are taking everyday pickled food materials, pickling is also a part of this chemical controlled mechanism and we then try to keep it in the refrigerator, but most of us know that it is no longer required to keep under refrigerated conditions because it has sufficient quantity of salt. Now what we were referring to was that at minus 18 degree centigrade or below if the food materials are kept then they are stored for a longer period, but if you lower down the food temperature, what I was saying is that, eventually chemical reactions, they will dictate the quality of the food material.

So, it is not all, of course, it is not the microorganisms which will dictate alone, it is also the chemical reactions or biochemical reactions that will also dictate the quality of the food materials, but here we have to keep in mind that lowering the temperature up to minus 18 degree centigrade or 0 Fahrenheit does not mean that you can kill the organism. So, killing is not possible by lowering the temperature even to minus 18

degree centigrade, right. So, it becomes no more that if somebody is believing that freezing can kill any organism but he is away from the truth. The truth is that freezing is not a method of killing bacteria. So, killing bacteria is always required to have thermal processing, high temperature processing which in other words is not possible in any other thing.

Maybe as I said earlier some other different processes like electrical technology or high pressure processing etc. They are yet to come up to the commercial level, but someday it may come up, we have no idea, but what I was highlighting on that, the freezing is not method to kill organisms or microorganisms, right. So, some of the preservation techniques, what we have already come up to us, is that, application of heat during cooking frying bottling or boiling or simply heating prior to consumption, commercial processes, are used for example, blanching, pasteurization, sterilization, dehydration etc. Now, out of this blanching is one of the very very important one, all are important, blanching is done prior to mostly freezing. In non freezing also, blanching can be done because blanching, what it is doing, it is heating around 70 to 95 degree centigrade, or 75 to 95 degree centigrade for 1 to 10 minute depending on the food material and its enzymatic load.

So, enzymes are deactivated mostly in blanching and that is why, nowadays, you get pea round the clock or throughout the year though Pea is a very very sophisticated and weather dependent material. So, there the color of the Pea is maintained typically, if it is blanched around 75 to 95 degree 1 to 10 minute, that depends on what kind of material you are taking. So, it restricts undesirable changes in odor, color, flavor, texture and nutritive values of storage by freezing and removes intracellular gases, minimizes potential for oxidative changes and that reduces microbial food that may be toxic by microbial food leaching rather and is toxic and constituents of such products like it containing nitrates in France and removes pesticides, right. So, I think today's time is over. So, in the next class we shall go through how the taste of the organism through microbes or through this as we said pasteurization is done, right. Thank you.