Dairy and Food Process & Products Technology
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Lecture - 04
Best Way of Storage of Food Materials

Again our course name we should show that this is the Dairy and Food Products Process food process and products technology right. So, in the previous class, I was referring to \ that, refrigerator storage, though we get the definition any temperature between 0 to -23°C.

And after that, I said that why it is in most of the books it is written that refrigerated storage or cold storage or frozen storage is normally at or below -18 °C . Then I raise this question why -18°C . Because -18°C is a odd number, it could have been 15 it could have been 20 or 25°C something like that why typically -18°C right. This was the question which I raised and; obviously, if you look into the history, you will find that this 'SI' is recent times right it is recent times may be couple of decades back 'SI' is come up.

However, before that, many other units' nomenclatures were there and one of them was 'FPS' right and perhaps one of the oldest unit system. Therefore, in that 'FPS' Fahrenheit is the unit for the temperature right. So, things were all measured in Fahrenheit's and the improvement of the society or world has taken up more or less say right from the First World War onwards very rapidly right and before that, we are things were not so much and for movement from one place to other for business or any other purpose. People had to travel long and that travelling normally either with some animal like camel or horse or things like that donkey whatever right.

So, lot of time used to be spent on this travel. And since like today you have so many eateries here and there, those things were not there during that time. So, people use to also take lot of food material along with them. And again sciences come up like that from the use, people who are taking these and they have experienced that if they had travelled through the areas where the temperatures were in that time, in Fahrenheit 0 then they were very good, there was no problem after consuming. Nevertheless, if it was not so, then things were rotten or gone wrong or infected right.

So, people came across, people came to know science to from this that yes 0 Fahrenheit is one temperature, where the material food is maintaining its ability for a long time. It is not getting rotten it is not getting pungent or any other. So, 0 Fahrenheit was considered to be the temperature at which food material can be stored for a longer period.

This is by experience science is developed from there and this 0 Fahrenheit if you convert it into centigrade you will see that it is coming somewhere 17 point something, some decimal as I said somewhere that kilo calorie 9 and 4, it is easy to remember like just like this 0 Fahrenheit how much centigrade is just not possible to say unless you memorize I did not it is 17 point something right.

So, to make it whole number this 18 came up, that 17 point something is not easy to remember. So, let us make it 18. So, that is where this 0 Fahrenheit got converted into centigrade as 0 Fahrenheit equivalent to 18 degree centigrade to be the temperature where food materials can be kept, for a longer period of time right.

That is how -18°C that came up 0 Fahrenheit equivalent to -17 point something degree centigrade, is roughly equal to -18°C whole number -18 °C right. So, -18 or below because some time will come after words, there is a there is a term called Q_{10} or temperature quotient right.

Let me use it now since it has come, let me use it and let me also try to use this system I can write here this is pen.

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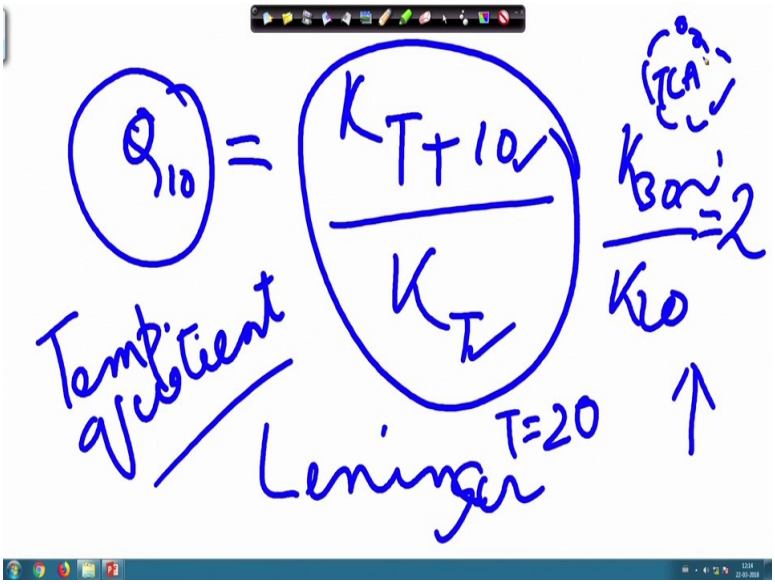

$$Q_{10}=\frac{K_{T+10}}{K_T}$$

So, the above equation is referred as Q_{10} or as temperature quotient right. It is defined as the rate of reaction at any temperature T, this T can be any to that at T plus 10ºC right.

So, Q_{10} will be say if it is 20°C if T is plus 20 °C , then if you will make this plus 20°C . So, K_{30} over K_{20}, this roughly can be said to be equals to 2 right. Therefore, any rate of reaction any reaction be it chemical, be it microbial, be it biochemical or enzymatic, any kind of reaction will follow these simple temperature quotient law. That a temperature at a reaction; at a temperature say 20 degree, if the temperature is raised by 10°C . So, that is 30°C, then the rates of reaction which were at 20°C will now become double at 30°C then that at 20°C right.

Similarly, if we increase from 30°C by 10°C to 40°C then the rates of reaction is doubled from that at 30°C rather it is doubled at 40°C then that at 30°C . So, likewise if we go on increasing so, each 10 °C is making double of the rates of reaction, then that at the previous 10°C right.

So, this is rates of reactions are increasing right all rates of reactions again be it chemical, be it biochemical, be it enzymatic, be it microbial any kind of reactions that will follow this if it is for increase of temperature now if you do the reverse right.

So, from 30-20°C to 30°C it was double roughly right. I am not saying that chemical also will give 2 biochemical also will give 2 enzymatic also will give 2 or microbial also will give 2, there is no such equation that it will be 2, but their numbers are very close to 2. So, roughly that is why I have given this symbol roughly. So, roughly it can be said to be doubled right for understanding. And if the reverse is done that is if the rates temperatures are lowered by 10°C.

So, from 30°C whatever it was, at 20°C it will become half of that that is inverse of 2 that is half right. From 10- 20°C if it is low at by 10°C to 10°C then whatever rates of reactions were at 20°C now it will become half of that at 10°C right.

So, this way if you go on decreasing from 10 to 0, 0 to 10, -10 to -20 like that as we are decreasing then the rates of reactions are also decreasing that is why -18 we said 0 Fahrenheit equivalent to -18, that is the temperature where we assume that the rates of reactions will be minimum and there will be no microbial decay, microbial growth, microbial spoilage or enzymatic spoilage at the most they will be under dormant stage right.

This is the philosophy on which the cooling is entirely dependent on right cooling storage or long term storage under refrigeration, under freezing, under present condition is fundamentally because of this that if you are lowering the temperature by 10°C the rates of reaction is becoming half.

So, each 10°C lowering will make the temperature half of that. I will make the reactions half of that. So, that could be chemical, biochemical; I gave the example that you have taken fat and that fat is converted into glucose by the body. So, that was possible only by some biochemical reactions. One of the good book which book I am not given the names afterwards perhaps I will give, that one of the very good book on biochemical not part of this course is ‘Leninger’ on biochemistry.

You will see lots of cycles are there right from here it started one product then another, then another, then another, then another, then another like that if cycle is being formed right for example, one such cycle is called ‘TCA’ cycle or respiration is also under that similar cycle that is also under cycle right, it comes from that glucose and makes carbon dioxide water and energy and that is under respiration cycle you will get it in Leninger. This is not under this purview of this class, but as a reference I am telling that you go to that book and see, lot many things are given understand biochemical right.

So, these reactions are minimized, as the temperature is lower from any temperature to 10°C less than that temperature. So, depending on what the product; obviously, a product whose cost is 50 paise say or 1 rupee 1 rupee a kg, you will and though if you bring it to -20°C , it may stay for 12 months say for the sake of saying if we assume. Obviously, you will not keep because for making it -20°C , you have to spend money why should unnecessarily one product whose availability if it is high or price is so, low that is one rupee per kg; that means, it is plenty available, that is why it is 1 kg 1 rupee had it been not available so much then its price would have gone up.

So, which one you will keep at which temperature many factors will come forward it is not a single parameter by which, you will judge, you will decide I will do this based on many things and maybe something is consumed so much that within 2 couple of months this is consumed. You do not need to unnecessarily extend for years together. So, why unnecessarily additional a effort will make additional cost you will incur so, that the price becomes high and the requirements are low. So, depending on that market demand supply everything you will decide what to do, when to do, how to do right.

So, this Q_{10} remember this is one very good example or information to keep in mind in terms of any processing and preservation right. So, we come back so, that we tried and now again coming back to that.

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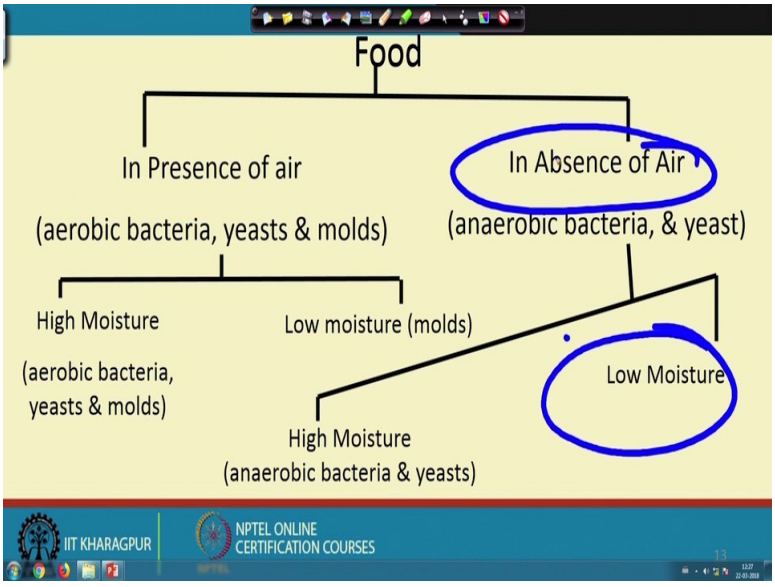

So, we can now say that we can divide in terms this Q_{10} is one such right and we earlier also said that if you remove the moisture, then in that definition of so many perishable, nonperishable, naturally perishable those definitions we have said that, if you are removing moisture to the level where the organisms cannot grow. So, that level will allow you to keep the food material for a longer period right.

So, in this term another scientific term will come up there is called water activity. Normally the moisture level in the food we call that in terms of water activity. By simple definition, it is defined as the ratio of two pressures a one vapour pressure of moisture in the food material at the temperature because pressure is a function of temperature.

So, at a given temperature the vapour pressure of moisture in the food material to that vapour pressure of pure water at that temperature, that is a simple definition of water activity. So, in terms of understanding then we can say that availability of water right water activity in other words say the availability of moisture for the organisms to grow or multiply your act right.

So, water activity in terms of that when we are referred we refer to dry. So, they are again since it is coming up let me also say here. As I said no though it cannot be within a frame wall of this that will courses has to be like that. We are so, many ancillary things do come up which as teacher we think that, if it is also shared with you then that may help you in understanding right. So, like that a water activity came up and the moment water activity came up, then also I should also said that there are microorganisms, there are basically we can divide there are n numbers n variety is everything, but we can divide for food, we can divide them in three parts; one is bacteria and other is mold and third one is yeast.

So, bacteria, yeast, mold these are the three categories of organisms right. In terms of water activity, bacterial growth action everything is around 0.9 or above in terms of water activity. I define water activity again; it is the ratio of vapour pressure of moisture in the food material at a temperature T to that, the vapour pressure of pure water at that temperature T right.

So, if that water activity is 0.9 or above, then bacteria can survive will grow and multiply and do all the actions. If it is less than 0.9 then bacteria goes out it cannot do any activities we cannot survive. Then comes yeast roughly again as I said there is a that that that Q_{10}, 2 wise gave example that is the representative number.

So, this 0.9 is also representative if does not mean all bacterial will be like that there could be some difference right, but by and large so, that is how we generalized. So, point nine will be bacteria if it is less than that, say 0.8 water activity, then why it is becoming then fraction? Because the pure water has higher vapour pressure than that in the food because food it is not only moisture along with that some other things are there. So, it is lowering down the vapour pressure. So, vapour pressure act at a given temperature of the pure of the moisture in food material to that vapour pressure of pure water at that temperature is the water activity.

So, 0.8 is the water activity where yeast can grow 0.8 and above, yeast can grow a multiply and do good thing bad thing whatever activities right. Bacteria also do it is not that all bacteria enemy yeah they can be good, they can be bad depending on where how you are using where how they are acting. So, 0.8 above yeast 0.9 above bacteria, 0.7 above mold right. So, if you bring down the water activity below 0.6, then problem with moisture is out. So, in all dried material this water activity level comes down, in many cases it comes down much more, but this is one factor which place into right.

So, if you look at this tree where how we can keep food material if we look into that, you see we can saying that food if it is in presence of air then all three types of organisms that is aerobic, bacteria, yeast or mold or three can grow in presence of air. So, under that at thigh moisture level it is aerobic, bacteria yeast and mold all three needs moisture high moisture level they can grow.

If it is a low moisture level then bacteria yeast cannot grow only mold can grow right only mold can grow but if it is like that in absence of air, then anaerobic bacteria not aerobic bacteria. Anaerobic bacteria can grow along with that yeast also can grow mold cannot grow because mold needs air as well moisture. If moisture is also less still mold can grow, but air is a must. So, it is aerobic, but anaerobic organisms anaerobic bacteria is also there yeast is also there. So, they can grow at this low in absence of air.

So, anaerobic bacteria and yeast can grow. Again it comes if it is high moisture then both of them anaerobic and yeast can grow and multiply and do a action, but if it is in low moisture, then none of them because we have seen here low moisture only mold can grow in aerobic here also in aerobic none of them yeast mold bacteria, none of them can grow.

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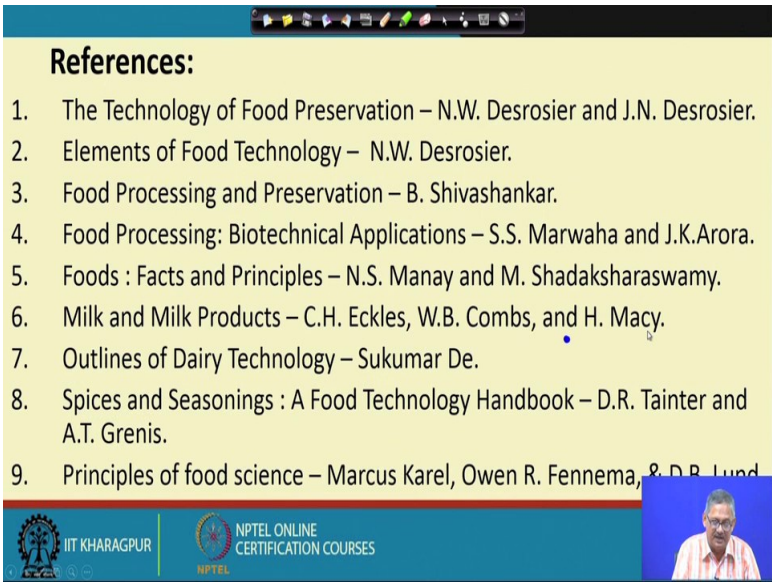

So, ideal situation condition is that we should get we should get ideal condition is that we should get we should get low moisture and in absence of air we should be able to preserve it for long period. But it is ideal situation maybe many food materials do not come under this purview. So, that is why this ideal situation may or may not be suitable for all the food materials, but ideally we can tell that this is the situation for all the food materials can stay for a very very long period right.

So, I told you the other day that I will give you the difference. So, these are the some of the like the technology of food preservation by N.W. Desrosier and J.N. Desrosier elements of food technology by N.M. Desrosier, food processing and preservation by Shivashankar this is a Indian, then food processing biotechnology application by S.S. Marwaha and J.K. Arora. Foods facts and principles by N.S. Manay and M. Shadaksharaswamy and milk and milk products by C.H. Eckles, W.B. Combs and H. Macy.

Outlines of dairy technology by Sukumar De; an another Indian writer. Spices and seasonings a food technology handbook by D.R. Tainter and A.T. Grenis and but I normally follow and like very much that is principles of food science by Marcus Karel, Owen R. Fennema and D.B. Lund. This book is known as the book in the name of Fennema. Fennema only if you go and tell that library and or somebody will bring that typical book only this book only.

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the cases that it is edited books right. So, lot of writers are contributing contributed book, they are not on the basic or basic principles, but these books are on the basic principle Fenneama is one of the best.

Thank you.