Thermal Operations in Food Process Engineering: Theory and Applications
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Lecture - 02
Fundamentals of Food Processing and Preservation (Contd.)

Good morning. So, you have seen that in the previous class, we have started with Fundamentals of Food so, that a little Food Processing and Preservation is also being said, because that is required for the understanding of the subsequent things 'right'. So, we had said if you recall that what are the different sources 'right'. So now, from that sources, what are the other things we get?

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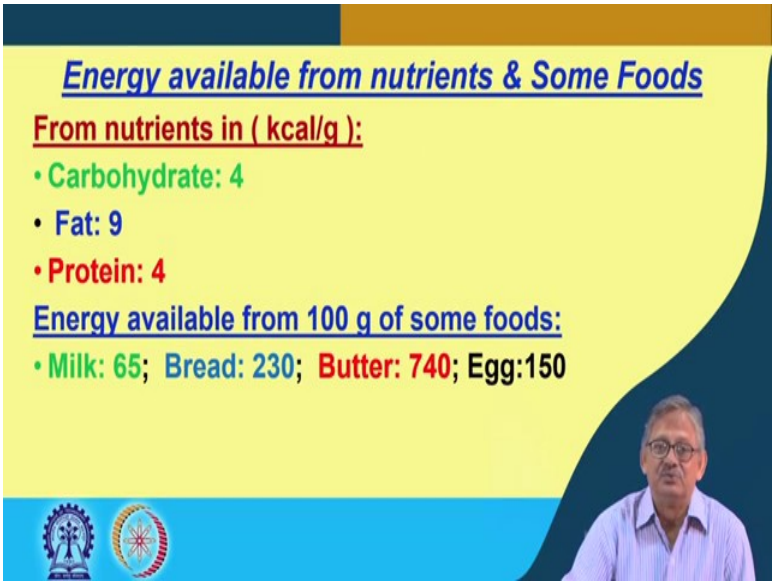

Let us see energy available from nutrients and some foods, which are obtained from the food as energy. So, we can say that the nutrients in terms of kilo calorie per gram. Now per gram kilo calorie you will say that kilo calorie is not a SI unit 'right', but still why we are saying it in non SI unit, because the numbers are so, unique and whole number had it been in SI, then it would have been a decimal or some fraction. So, may not be easy to remember for that is up remembering, we all not only here all over the world, we give this example in kilo calorie or non SI units, 'right'.

So, carbohydrate has 4 kilo calorie per gram whereas, fat has 9 kilo calorie per gram see 4 and 9 more than double per gram. So, if you take 1 gram of fat you get 9 kilo calorie

whereas, if you take 1 gram of carbohydrate, you get only 4 kilocalories. So, the energy content in fat is very-very high, and then protein it also is at the tune of 4 kilo calorie per gram. So, energy in terms of carbohydrate and protein they are at per whereas, fat is more than double, 'right'.

So, that is why the fatty-mid food materials, they give more energy per unit gram, 'right'. Now, energy available from 100 gram of the edible version of some foods, why again and again I am saying edible; yes milk is edible 100 percent, 'right', but other things are not all time all parts are edible. Like example given say fruit, when you are taking a fruit say banana.

Banana though it may be say 100 gram as such with its peel, but without the peel it may not be 100 gram much lower than that, that and that peel is not edible you do not take those peel. So, that is why we are I am referring to more and more that edible portion. So, 100 gram of the edible portion of food, generally what we get from that in terms of energy as milk gives around 65 kilocalories, bread 230 kilocalories, butter 740 kilocalories, and egg around 150 kilocalories, 'right'.

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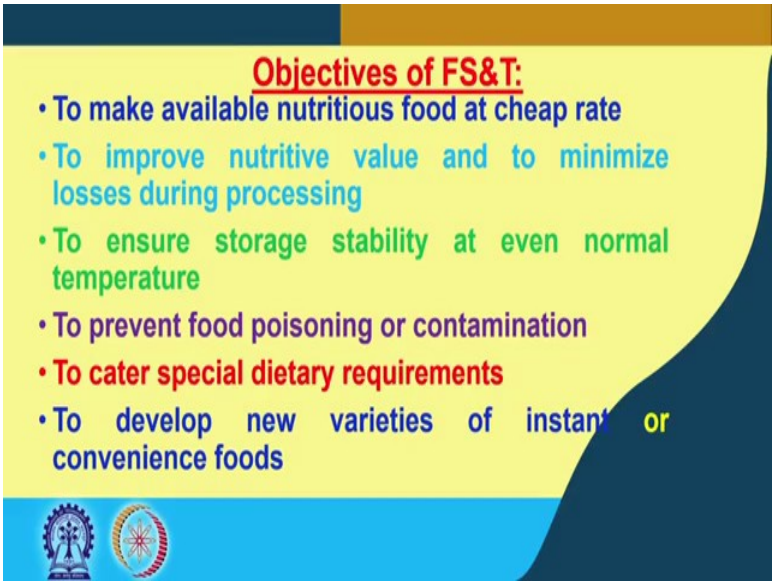

So, these tell that how the total nutrients we get from different sources, 'right'. Now, as a food technologies ultimately which you will be food technologist or scientist or engineer all over the world or any process engineer; what is expected from you that to make the

available nutrients from the food at a cheaper rate, then to improve the nutritive value and to minimize the losses during processing.

These are not our part at this moment, but just highlighting that to ensure storage stability at even normal temperature to prevent food processing or food poisoning or contaminations, and to cater special dietary requirements, then to develop new varieties of instant or convenience food, 'right' instant or convenient food. So, that is also there.

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Now, let us have some terminologies definition, 'right'. Because, unless we know them, it will not be possible for you to understand perishable foods, 'right', what is that? Why you call it to perishable? I hope by that term perishable we understand that it is getting rotten, 'right', it is getting spoiled, that type of food by definition we can say. So, these deteriorates quickly after harvest for example, fruits and vegetables, they are harvested or soon after slaughter. Plant origins are harvested, animal origins are not harvested they are called slaughtering, 'right' or catching after slaughter or catch fresh meat, poultry, fish etcetera.

So, these are that deteriorates quickly after harvest or slaughter or catch are known as perishable, 'right'. So, it is true that if you if you if you if you take a it is a mango this is the season of mango. When mango is being harvested, if you are not taking care within couple of days the thing gets rotten and you have to throw it out, 'right'. Similarly, fish when it is caught if you are not taking care of it maybe after several hours, it may go

wrong particularly in summer season like this in winter it may not be so, vulnerable, but trained someone definitely, ‘right’.

So, then semi perishable food, there are many foods which are under this category, because the nature the best friend or the best enemy whatever you call is the nature. Nature is such where it gives some protection to everything for it is survivability, ‘right’. So, where these contains natural inhibitors to spoilage? For example, egg and root vegetables both do have egg, it has a it has a coating over it, ‘right’.

So, nature has begun away because from the egg if it is hatched, then it may bring the young animal. So, that is why it is given by the nature that protection of this shell. So, that the in internal things are easily protected, ‘right’. However, when you take egg that time; obviously, you are not hatching it and you are not allowing it to make it to the young animal so, but you are getting the benefit of the natural support, ‘right’. Again and again as scientist we believe most at least, I do not know whether all or not that nature is the best friend and nature is the best enemy.

So, whatever best nature can do, if you are taking it in that way it will be your friend, if you are taking in the other way it may not be your friend or we may become your enemy they are all depends; however. So, egg and root vegetables are a natural example or have received some type of mild preservation treatment which creates greater tolerances to the environmental conditions and abuses during handling and distribution.

For example, pasteurization or smoking or pickling, these are some example pasteurization is that which you get, when you are getting the milk from the from the market, you will see that nowadays in earlier days it was maybe in bottles and other things, but nowadays you all are in mostly in pouches. And, those pouches of milk, if they are not pasteurized I am not going in detail, because this is not that part if it is not pasteurized, but it is also a thermal if it is not pasteurized, then the milk will get deteriorated not only that pasteurization what it does it kills the pathogenic organisms, ‘right’.

So, at least if the milk is not spoiled, but if somebody consumes the non pasteurized milk may get some or other kind of sickness due to if it is not pasteurized if the or I if the organisms responsible for any disease causing is there. So, that is why pasteurization is run and that is the thermal.

So, this protects the material. The purpose is that it is semi perishable because you have given some free treatment or some treatment such that it can survive or it can sustain for a longer period, 'right'.

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Then shelf stable foods, 'right'; there are many foods which are called shelf stable. Shelf stable means without any requirement of anything it is as such I give you the best example, I do not know at your age of course, you are around now 20 plus minus.

So, this aging may not be, but if you ask your parents that during their time or during your grandparents time the there was some convention household convention that, people is to buy from the market when it is available in good condition, or cheap whatever we or good quality all depending on these factors, they used to buy lot many or lot or much quantity of rice and keep under at the at home at some places, 'right'. Why, because they have seen that this rice, which they are purchased from the market and in bulk quantity is self stable, it does not need to have a refrigerator or some other component, where it can be stored, 'right'.

So, it is already in some baggage or in some container. So, that is good enough to keep it for a long period maybe 6 months 1 year maybe in many cases earlier the privilege to have this kind of food for over a period of 6 months to 1 year, 'right'. So, that is what these are non perishable at room temperature. For example, cereal grains and nuts or

received reservation treatment for example, canning ‘right’. Another thing canning is also a part of thermal, ‘right’.

So, where you are you are heating the food material at home you have you see that mummy or some elders are using pressure cookers, ‘right’. So, what you are doing during that pressure cooker you are increasing the pressure, because it has a lid and that lid is capable of holding that pressure and when the pressure comes to 14.7 psig, ‘right’, PG for gauge, ‘right’ one atmospheric pressure gauge, then this material is boiled at very high temperature around 121 degree centigrade corresponding to that pressure, ‘right’. So, and the material becomes cooked at much earlier time and maybe uniformly or very good I mean boiling is done.

Now, canning is such operation where materials like that like your canned nowadays available canned your food materials, ‘right’, we will say pineapple canned pineapple, ‘right’. So, these are of available now a days and this canning is done under pressure and high treatment. But, this is also once you canned then that is stable for a long period, maybe couple of months to couple of years depending on how you are processing, what you were processing canning is one example. So, these are called self stable foods, ‘right’ or process to reduce moisture content. You will see that most of the dried food material; dried food material example we give say potato chips, ‘right’. It is fried and dried both, ‘right’, it is fried or dried.

Nowadays again some more new things have come up where it is not fried also, but the moisture content is brought down to such a level, because maybe in continuation of these course or preamble, we will come to that and touch upon that, because your moisture when it is present it is capable of spoiling the material at an early date or early stage, compared to that where the moisture content is much lower, ‘right’. This will come perhaps in subsequent classes little and because the first week we have dedicated for this preamble understanding what why reasoning for the thermal processes, ‘right’.

So, this is that. So, canning is one example we have given which is very good example of thermal treatment and drying is also another very good example of thermal processing, where you are drying up (Refer Time: 17:55) required primarily heat treatment. And, you are removing the must have purposes, you are removing the moisture if the moisture

content becomes lower, then some number will give you this number we will do not want to discuss now.

So, then it becomes either stable or that is why it is called shelf stable, ‘right’. So, shelf stable food materials are those which are non perishable at room temperature we example given cereal grains, nuts etcetera or received certain preservation technical methods and treatment whatever it be, and example could be candying or canned material. And it might have also undergone processing to reduce the moisture content, ‘right’ for example, the dried material, ‘right’.

Then, the definition of dry storage, now this is one where we say that storage at 20 degree centigrade and 50 percent R.H again you see R.H maybe not in ok. Since, it has come let me also tell, because the more you learn the more you know better for you R.H is Relative Humidity, like in this room where we are sitting I am sitting and you all are sitting. This room contains say relative humidity of around say 55 or 60 percent, ‘right’. What does it mean? It means that the air relative humidity is a part of air water this relation, ‘right’.

So, this means that in this room if it is 60 percent water relative humidity. So, it may contain another 40 to make it saturation, ‘right’. Once, it become saturated then the extra will condense out and will separate, ‘right’. So, that is water holding capacity relative humidity can be in other words said that the water holding capacity, ‘right’. So, it is 50 percent R.H and 20 degree centigrade is one of the storing method or condition for 20 degree centigrade as dry storage, ‘right’.

Then, some other like cool storage cool storage is definitely, where the temperature will be lower than 20 degree centigrade and there it is stored below at 12 degree centigrade, ‘right’.

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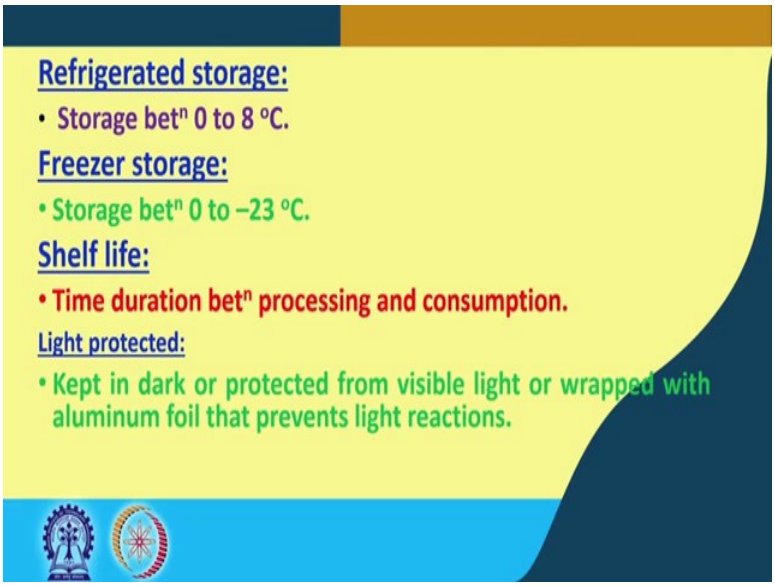

Another example is refrigerated storage. Refrigerated storage is the storage between 0 to 8 degree centigrade, that is called refrigerated storage now the earlier we have said that your food material, 'right'.

So, there the major crop is that potato, 'right'. And, potato is available throughout the year in our country at least, 'right'. And, this is being why potato is stored around plus minus 2 degree centigrade, 'right'. So, that comes under this refrigerated storage between 0 to 8 degree centigrade, then freezer storage. Freezer storage is; obviously, where it is at or below minus 23 degree centigrade or 0 to minus 20 degree centigrade.

So, lower than this is called sub-zero, 'right', it is called sub-zero storage and above 0 you know that was 0 to 8. So, 0 to 8 there is no phase change, 'right', 0 to 8 degree there is no phase change in potato the moisture content in the potato is not getting any phase change whereas, the material which is less than 0 degree centigrade is undergoing the phase change of the water content in it and that water is becoming ice, 'right'.

The best example is ice cream; 'right', ice cream is stored at or below minus 18 degree centigrade, 'right', where over there is no normally yes because by the definition there is some un-freezable water and that un-freezable water is known as bound water this is there, but minus 18 or below is the temperature, where the frozen materials are being stored, 'right'. So, these are called freezer storage. Then shelf life this is the time duration between processing and consumption.

So, you are processing now consuming at this time, this time duration is known as the shelf life SHELF, 'right'. It is not s e l f, s h e l f shelf life. So, the time duration between processing and consumption is known as the shelf life, 'right'. Then, light protected yes there are some food materials which are also kept in some colored containers. So, that light cannot make any disturbance to that, ok.

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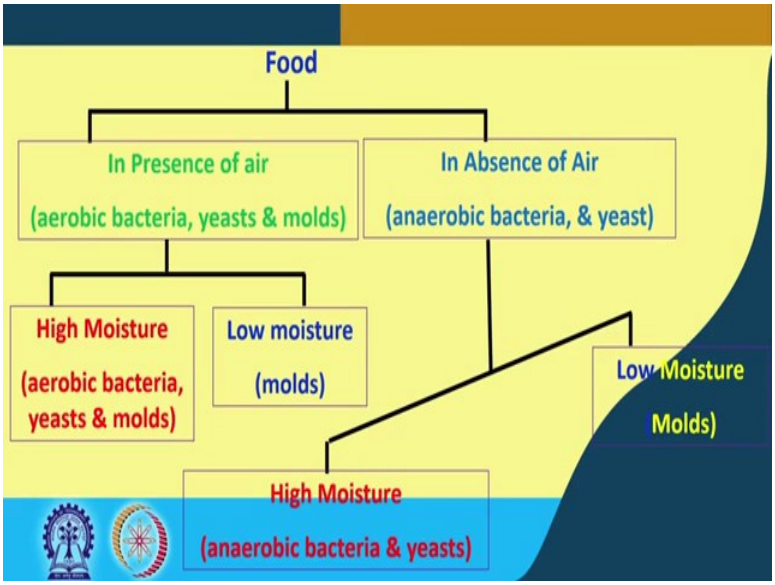

Then, we come to the whole thing that food for storage in presence of air, 'right' and these are called aerobic bacteria yeast or mold, 'right', food how they are getting spoiled is or how it can be stored also. If it is impedance of air then aerobic bacteria, aerobic yeast or aerobic mold can act on it, 'right'.

So, the other part comes in presence of or in absence of air, 'right'. So, where also anaerobic bacteria and anaerobic yeast can grow, 'right' anaerobic bacteria and anaerobic yeast can grow. Then, in the category of aerobic bacteria yeast and mold, then it also comes to high moisture, where all if it is under high moisture, all aerobic bacteria yeast and mold can grow and spoil whereas, the other one if it is low moisture, then only mold can grow, 'right', where if it is under low moisture only mold can grow.

So, high moisture all three that is aerobic bacteria yeast and mold can grow, but if it is low moisture then mold only can grow. Then it comes to that low moisture to the level; obviously, where mold also can grow. If, it is below that then none of them can grow, but if it is in absence of air, then again if it is under high moisture, then anaerobic bacteria or

yeast can grow, ‘right’. And if it is not high moisture, but very low moisture then none; obviously, here we have written molds, but it should not be let it be rectified, that if it is low moisture then none can grow not even molds, ‘right’ none can grow.

So, then it comes that food if it is under aerobic condition, this mold and bacteria can grow, if it is anaerobic then anaerobic bacteria or anaerobic yeast can grow, if it is under high moisture as well as air then all 3 aerobic bacteria yeast mold can grow, but if it is under low moisture, then only mold can grow right under air aerobic condition. But, if it is not aerobic, but it is in absence of air, then under high moisture, then it can be that anaerobic bacteria and yeast can grow and if it is under low moisture nothing can grow, ‘right’.

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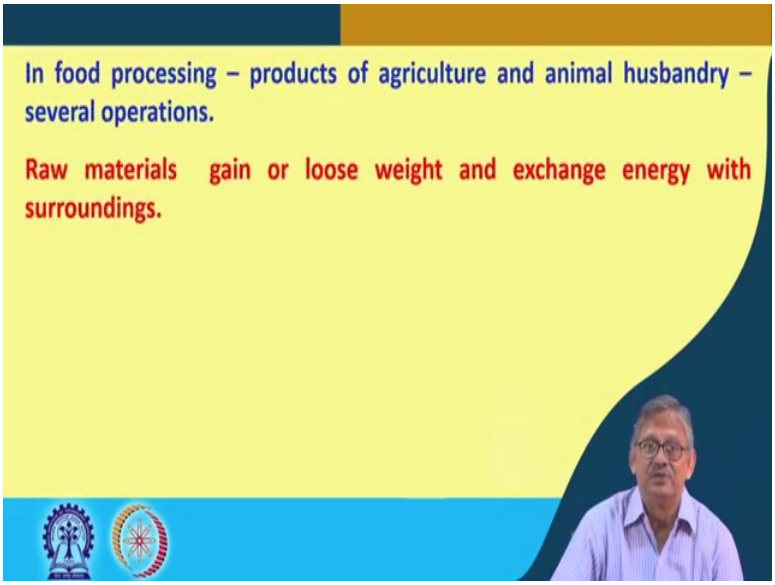

I hope we have come to the end of the time. So, let me thank you and in subsequent classes we will also try to give some more highlights on the basic of the food material why, what it is, ‘right’ why it they need the thermal operations, why it they are required. So, that is why it is required to understand, ok.

Thank you.