## IMPACT OF FLOW OF FLUIDS IN FOOD PROCESSING AND PRESERVATION

## Lecture01

## LECTURE 01: INTRODUCTION TO FOOD PROCESS ENGINEERING

Good morning, my dear students and friends, who are very aged or moderately aged or from industries. So, I wish you all, happy Dasara, happy Diwali. and maybe after few months, new year will come, so happy new year. Today, we shall discuss about the new course. Already, you have undergone through my different courses, but this one is Impact of flow of fluids in food processing and preservation.

So, it is primarily, flow of fluids, right. This is not in particular, applicable to food, because flow of fluids is applicable to any branch of engineering. I do not think, in computer science, it is so much, unless some people are very much working with the hardware. Software, obviously not required.

Similarly, maybe in electronics it is less, but even in electrical, civil, mechanical, Agricultural engineering, food engineering this is very much applicable, right, but the basic is flow of fluid, but in our case it is applicable to the food processing and preservation. So, whatever I say, they will be common to any branch of engineering. But, we will definitely highlight for the food processing and preservation also, right. So, that is why, the first lecture, we are giving, the title of the lecture is, Introduction to Food Process or Food Processing, right.

So, that means, we need to know something on food processing. Right? Then, it comes, what is food? Right? So, obviously, we know that, food is that, which we consume every day.

This is the only thing which scientists or engineers could not manage to overcome the need of food. I am now aged obviously. I remember, when we were students, my senior professors obviously who are no more, so they used to tell that it is the food engineers or engineers or agricultural engineers' duty to make someday that whatever we do, that is primarily for food.

Whatever you do, you earn, you do everything primarily for fulfillment of your body requirements, right? So, anything, which we consume through our mouth, can be said as food. And this is the one of the three basic requirements of mankind that you know. One is food, another is clothing and third one is the some place to stay.

So, these are the three, but out of the three, the fundamental one is the food, because you can live even without any living place. You can live, even without any clothes or clothings, but you cannot live without any food. So, what I was referring to that our teachers used to tell that if someday, it comes like that, you take one spoon of fat, one spoon of protein, one spoon of carbohydrate and one spoon of all others, then the whole day requirement is over. If that could be achieved, then obviously, so much struggle of human being may not be there.

But, we just cannot predict today. Some or other day, it may happen. You may come over, you may definitely bring something new, which may help mankind. If this is one of the basic requirements of human being, then it is also regarded as the source of power. That, I am talking with you, that, you are listening, that, you are working or playing,

you need some energy. So, this food can be regarded as a source of power, Right? Then, what it does? Definitely, it helps human being.

Not only human being, any living, any living unit, Right? Everybody needs food. Whether it is micro or macro, it does not matter. Any living entity requires food.

Micro needs micro level. Macro needs macro level. I do not know, in ancient time, when there were the huge animals, very very big, their requirements were also, may be, very very high, even much more than what we consume, right? So, it is the source of the basic nutrients and it provides energy, which is required for all activities, as we said, that is growth. You imagine that, in your house, if there are very infant or kids, so their size is very small. They are growing.

You were also one of them couple of years or couple of decades back. So, for your today's what you are, you needed growth, right and people like us who are becoming aged, we also lose every now and then many tissues or it gets damaged.

So, it is to be repaired and that is done by the food and definitely by reproduction and sustenance of the living units.

Whatever it be, it can be mankind, it can be animal, it can be anything, right? So, everybody needs that nutrition, nutrients, right? So, then it comes, what are these nutrients? Right? And its availability.

Its availability is that, it is related directly to the production and to the strength of population. Obviously, you have heard and you know because nowadays, our Google Baba or whatever, being in your hand, you have the mobile or any other means of investigation, so that you have come to know that there are many places where it is dearth of food. And there is, there are many places, where it is more than required and rather surplus or excess and are being spoiled.

So, that is why, it is directly proportional, availability is to the production as well as to the strength of the population. The more population, more food is required. The less population, the less food is required. But the reality is not so.

Maybe, as you know, that reality is that where population is less, food production may be very more, very, very high. Where population is more, Food production may not be sufficient to cater all the people. Then it is not equitably distributed. As I said that in some places of world it may be dearth of food and in some places it is in excess.

So, whatever, that means, it is not equitably distributed everywhere. Then it is under nourished people and people with exotic food both are prevailing, Right? I should not say, typically, some area, because we are not biased, but it is true that in some places, people are undernourished and in some places there are many many exotic foods which may not be required to that extent, Right?

So, this disparity is there. But, whatever be the situation, we have to definitely accept the reality. Then, as we said that, how the energy is coming? Energy is coming from the nutrients available from the food. What are these?

There are six types of nutrients. One is called carbohydrate. One is called fat, another is protein, then minerals, vitamins and water. Though, in a common sense, in a common understanding, we do not give water that much importance, Right?

It is plenty available all over the world. So, as of now, we do not know what will be after couple of decades. That is not yet known. But, the predictions are not so favorable. However, the requirement of water is also there.

Because, your body, this your whole body, is depending on person to person, may be around plus minus 60 percent water and plus minus 40 percent is the rest of the other materials. So, and in many many animals which we consume Or otherwise, this varies between 60 to 80 percent, generally. But, this is for animal, for other foods like vegetables or leafy vegetables.

So, they may contain even more than 95 percent of water, but still they are solid. So, these six basic nutrients are the backbone of the requirement of energy or supply of energy. Energy is supplied from these six basic nutrients, right.? Then, how much energy they are giving? So, nutrient content in some different types of foods are like this, that, if it is a food like milk of 100 grams, then it contains water around 87 to 88 %,

carbohydrate, around 4.5 to 4.9 or this is representative. It is not exact, because, milk, if you go through dairy, then you will see that it varies from animals to animals, from mammalians to mammalians of different ingredients. So, this is a representative number. Fat, milk contains around 3.3 to 3.8. As I said just now, in many dairy industries or many mammals do give milk having even 15, 16 percent, 17 percent of fat.

Just, since it has come, and this is sharing of information, that those who stay at high altitude out of you many may be staying at high altitudes. High means, I mean, really high, maybe around 6000, 7000 feet above the sea level. There, you have seen that, many animals are, nature is such a beautiful thing. We do consider nature as God or whatever you call, right? So, nature is such, its creation is so beautiful that to protect those animals which are at very high altitude,

it is given some kind of insulation in the body. And, since they are young, newly born or maybe rearing, so they need high energy to combat the low temperature at high altitude. So, there, the fat content of the milk is much much higher than that available at the sea level. That is why, I said that it is a tentative and representative number. Protein is around 3.5 grams per 100 gram in milk. And, vitamin, minerals all put together, it is around say 0.1 gram per 100 grams. This is in milk. Vis-a-vis another food, milk is a natural food, and bread, which is manufactured, right?

It is having roughly, say around 40 grams per 100 grams of bread, water content is 40 grams. Carbohydrate content may be around 50 grams per 100 gram because bread is basically a high carbohydrate product. Fat, very low around 2 grams at the most. Protein, that is also low at around 1 gram per 100 grams,

and vitamins and minerals that also contains around 1 gram per 100 grams. So, this indicates that depending on the source as just in the previous slides, we said the energy, they come from the different nutrients and we said, the nutrients are carbohydrate, fat, protein, vitamins, minerals and water, right? So, all put together, they are giving you the total energy. Now, how much energy you are given?

Before going into that, there, this food may be of different origins, one could be from plant origin and another could be from animal origin, right? So, if it is from plant origin then, Cereals like rice, wheat, corn, this could be under the umbrella of cereals or legumes. There are many types of legumes for example, one of them is soybean. Nuts, again different types of nuts are available all over the world.

It could be of high fat, it could be cashew nut, it could be high protein, it could be almonds or high carbohydrate like chestnuts etc. There could be root tubers, roots and tubers like carrot, beet, radish or potato they come under this umbrella of roots and tubers. Many vegetables are available, for example cabbage, onion, cauliflower etc, etc, and another very important source is fruit, right? Hundreds of different fruits are available all over the world depending on place to place, could be banana, orange, apple, etc.

Or, if it is from the other source, that is animal origin, then it could be meat. Meat now, all over the world, many types of meats are available. Example, maybe beef, pork, lamb, etc. It could be from fish. Many people, all over the world, do survive on fish also. Typically, people who are in the coastal area, right?

They are, may be bound to make habit of consuming fish, because, that is the primary product they do have. So, that fish could be fatty fish or lean fish or maybe different crustaceans right, shrimp then prawns etc, etc. Then the other category

could be poultry. That could be chicken or duck or turkey or many such variety. So, we have come to know the sources, right?

Food and its sources. Now, energy available from the different nutrients and from some of the foods are like this. That, we, though, in all engineering, we follow SI units, right? Obviously, kilo calorie is not in SI unit. Then, you may ask question, then why are you giving this in kilo calorie? because, that is not in SI?

In SI unit, it is joules, right? but, the numbers which we are giving you is that the carbohydrate, it contains 4 kilo calorie per gram. Now, if it is 4 kilo calorie per gram that means, 1 gram of carbohydrate gives you 4 kilo calorie energy. If you convert it into joule, then it will become a number and some decimals.

So, that becomes not easy to remember, there is a chance of making mistakes that is why, though it is not in SI, but commonly, it is said, all over the world, that nutrients from the different or rather, energy available from the different nutrients, like carbohydrate, fat, or protein, they are said in terms of kilo calorie per gram. Carbohydrate gives 4 kilo calorie per gram, fat gives 9 kilo calorie per gram and protein gives 4 kilo calorie per gram. Obviously, water or vitamins and minerals, they in terms of energy, they do not have these numbers, but then you may say how they will be also treated as the source of energy? Because, our body is such a unique system made by nature.

Whatever you consume, right? Suppose, you are consuming only fat, right? Though, it will not be out of place to mention that, you are respiring. You are listening to me.

I am talking to you. Both of us are respiring, Right? For respiration, what we need? Oxygen.

Right? But, if it is there only, oxygen, will we be able to respire? May not be so because this oxygen helps these food materials which you are consuming to be converted into the energy available from that and there are many biochemical processes that go on in the body, right? And we are definitely, we are definitely getting those food materials converted with the help of these minerals, these vitamins and with the help of water. So, they are part of the utilization, right?

So, that is why you see, this carbohydrate, gives 4 kilocalories per gram energy, fat gives 9 kilo calories per gram and protein gives 4 kilo calories per gram. Now,

if we look at in a food material that energy available from 100 gram of the sum of the foods are like this. If you consume 100 gram of milk, somewhere it is around 65 kilo calorie per 100 grams" energy we may avail or we may get. Bread, again it is around 230 kilo calorie per 100 grams if we consume. Butter, now, if you remember earlier we had given you the contents of milk and bread, not the butter.

Obviously, we know that butter is made of fat. Butter is a fat, right? It is around 83% plus minus 83% fat and some quantity of water and a little salt. Because, in our country, what we consume butter, like Amul and many others, Amul is very much famous. So, it contains some salt also.

But, in other countries, it may not have any salt. Unsalted butter is also available, Right? So, there, both salted and unsalted are available. But you see, the energy from butter, you are getting 740 kilo calories per 100 grams,

compared to milk 65 per 100 gram, bread 230 per 100 gram, even egg 150 kilo calorie per 100 gram. That means, again coming back to the composition, that depending on what it is made of, the food what it is made of, how much carbohydrate, how much fat, how much protein, how much other vitamins, minerals are there? Again, as I am saying, vitamin, minerals or water, they help in utilizing these nutrients by the body by different biochemical path, that is beyond the scope of this subject, right.

So, we cannot go whatever is coming in between we will explain then the course will never be over, right never be completed. So, wherever we are requiring we are definitely trying to give you some input. So, that It does not become Greek to you, Greek I mean that which is not understandable ok. Then what we said that depending on the composition like milk it contains some fat, some protein, some carbohydrate, bread it also contains high quantity of carbohydrate, low quantity of fat and protein,

butter very very high quantity of fat, egg moderately fat protein right, a little carbohydrate right? So, all put together is giving this type of energy when we are consuming, right? And this energy is giving us enough impetus, to work to think to even when you are sleeping that time also some energy is required, right? So, from the food, we are getting different energies and from different types of foods we are getting different types of energy requirement, right?

This is for food scientist and technologist what they are supposed to do as I said that in our childhood we heard from our senior teachers what is expected from you, right. Then, we come to another, obviously, now the time may be very short, but instead of going into it because this is a new thing which is coming in. Let me highlight the previous one that the energy which we are getting from the different food material right. Again and again I am emphasizing that the vitamins, minerals and water they are not taking part in giving energy directly, but they are part of the whole so that the energy is obtained from the food material, Right?

In the morning breakfast, maybe you had lot of bread, a little sugar, little milk or maybe good quantity of butter, egg, etc. So, that is why nowadays people do say that your food must be such that it is made of all the required energy materials, right, that required energy materials is carbohydrate, fat, protein along with minerals and vitamins with water also, right? And the primary thing which we should say that not only 100 grams, because, it may not be that all the time you are consuming one thing 100 gram, another thing maybe 200 gram because your total consumption is also limited.

It cannot be, I mean a very very emphatic number. But, when you are consuming, you see that you are consuming a balanced diet. Balanced diet means your diet should have sufficient quantity of protein, quantity of fat, quantum of carbohydrate. But, now-a-days, many senior peoples, they are all over the world, they are maybe having some problem with diabetes or sugar content. So, those people who are suffering from that,

so, for them again that consumption of carbohydrate may be a limiting factor right? So, their choice of food should be accordingly different. As I said that leafy vegetables, they do have very high quantum of water, but very low quantity of the other material. So, in that case, you must be you must be consuming a balanced diet for you suitable

for obtaining different energy level, ok. So, with this we complete this first class as the prelim of the course that is flow of fluids ok. Thank you.