MODULE 27 - CHEMICALS IN FOOD

OBJECTIVES

By the end of this session students will be able to-

1. Know about food cycle in nature.
2. Understand food contamination.
3. Sources of chemical contamination in food.
4. Explain harmful effects of Food adulteration.
5. Explain protecting foods from chemical contamination.
6. Effect of chemicals in environment.

SUMMARY

Every bit of food and sip of water we take is important for our health and well-being, right from the time we are newborn baby. Yet, for decades our food and water have been contaminated by powerful and harmful chemicals, now which have been a part of food. And this chemicals and variety of toxic residues in food is continuously increasing as a consequence of industrial development, new agricultural practices, environmental pollution, and climate change.

Now the question is “what is the future of the food industry in India and other nations of the world?” Are we seeing just the beginning of a new age in food, with an ever-increasing number and variety of synthetic or altered food that we can hardly imagine today? Or are public concerns about health issues and possible risks to the environment going to create sufficient concern to make governmental agencies to rein in the kind of changes that researchers can make in food and that food companies can offer to the public.

TRANSCRIPTION

MAN AND NATURE

Man is an integral part of the nature. In fact man is one of the best creations of the nature and the almighty, specially with respect to its body structure, intelligence and creativity. Although he is the creation of nature but he has created a number of wonderful things and ideas which can be used to make this world a best place of the universe. Being the natural creation man derives all its basic necessities from nature whether it is food, clothes or shelter. If man approaches to enjoy the natural resources following the rules and procedures of nature, no doubt, there will not be even a single problem either for man or for nature. But the present scenario is different. Today it can be easily observed that the desire of fulfilling the greed is dominating the desire of fulfilling the need. As a result man has adopted a number of malpractices to make more profit. Many a times these malpractices are adopted deliberately but sometimes they are used because of ignorance. The contamination and adulteration are such practices.

FOOD CYCLE IN NATURE

Nature is composed of a variety of ecosystems. They are forest ecosystem, grassland ecosystem, water ecosystem and so on. Although these ecosystems have their own identity but they are interdependent. Ecosystems maintain themselves by cycling energy and nutrients obtained from external sources. At the first tropic level, primary producers like plants, algae, and some bacteria use solar energy to produce organic plant materials through photosynthesis. With the help of food only plants and animals take essential nutrients, such as carbohydrates, fats, proteins, vitamins, and minerals. The food is ingested and assimilated by the organism in an effort to produce energy, maintain life, or stimulate growth. As food passes through the digestive system, it is digested and absorbed. The process of oxidation of absorbed nutrients releases energy. Food is not only the source of energy only but it is also the source of all those nutrients which are required to build, maintain and repair the body. Food also supplies some more nutrients like vitamins and minerals which are essential for resistance, power and safety of man from the diseases. Thus food is essential for the growth and development of the body, energy generation, catalyzing the biochemical reactions and developing the immunity of body. This is possible only if the food is full of nutrients and devoid of impurities and harmful substances.

FOOD CONTAMINATION

Food contamination refers to the presence of harmful substances specially chemicals and microorganisms and non edible items in the food which can cause illness or improper functioning of body systems of the consumers. Food contamination by chemicals is an important public health hazard. This contamination may occur through environmental pollution of the air, water and soil. Toxic metals, PCBs and dioxins, or the intentional use of various chemicals, such as pesticides, animal drugs and other agrochemicals have serious consequences on human health. Food additives and contaminants used during food manufacture and processing also adversely affect the human health. As opposed to chemical contamination of foods, the microbial contamination can be found under food borne illness.

Food is the measure source for our nutrition to get the energy and food contamination mixed our food edible and also cause illness. There are many sources for food contamination including biological, physical and chemical. Biological food contamination is usually because of bacteria and other organisms in oar edible food and chemical contamination of food is because of presence of agrochemicals, heavy metals and other harmful pollutants

and physical contamination of food is caused by present of physical material including hair, plastics while processing also, packaging material also.

SOURCES OF CHEMICAL CONTAMINATION

There are a number of sources for food contamination. These are fertilizers and Pesticides, Per chlorate, Food Preservation, Artificial colors, Fats and sweeteners, Genetic modification, Food adulteration etc.

Fertilizers & Pesticides

Fertilizers and pesticides both have definite pros and cons associated with their use. Both types of chemicals tend to increase yields, and thus make a significant increase in food production, particularly in countries where food is the biggest problem. On the other hand, both can cause water pollution when erosion carries the chemicals along with eroded soils after each rainfall. There is also concern by some authorities that pesticides pose a risk for smaller organisms such as fish like bioaccumulation of pesticides in their bodies. When these smaller organisms are eaten by larger organisms, residues of pesticides get biomagnified, thus crossing hazarder's levels when we consume such organisms.
The downside of fertilizers is that some portion inevitably washes into waterways along with eroded sediments. This runoff occurs nationwide, and the nitrogenous fertilizers find their ways into rivers, lakes and the ocean
where they cause eutrophication and kill aquatic life. Eutrophication is a process whereby nitrogen feeds an algal bloom, but when the short-lived algae die, decomposing bacteria consume most of the available oxygen, hence suffocating aquatic life. Additionally, the use of artificial fertilizers in place of animal or "green" manure cover crops plowed into the soil eventually can deplete soils with organic matter, making them lose their ability to hold water and more subject to erosion.

In the agricultural field pesticides are used to control pest attack from insects and DDT is the measure pesticides we used in our agricultural field, but DDT causes cancer also and the excesses use of pesticides in agriculture field that because of being the lipophilic DDT gets into our food and enter our
body and it is carcinogen also. There are research report also which review the fact that the DDT causes cancer and another pesticide the organochlorine pesticide,
organochlorine pesticide used in the agricultural field they cause very harmful effects in our body. And food contamination due to agrochemical in the measure concern and India is the only country were DDT is still being manufactured and being used in the agricultural practices. There are reports after the green revolution particularly in Punjab, there is one train from abohar to jodhpur and that train is called cancer train because many cancer patient from Punjab to bakanae and that shows the harmful effects of excessive use of pesticides and food contamination and
because of that more cases of cancer emerging in our society.

The effect of pesticides on humans has not yet been completely understood. Most people are exposed to a certain level of pesticides. Farmers who experience routine exposure to pesticides have exhibited neurological symptoms such as headache and hand tremors. Children, in particular, may be more susceptible to negative effects of pesticide exposure. Pesticide runoff can have devastating effects on non target

organisms as well. For example, roundup, an extremely common herbicide used in agriculture, is highly toxic to fishes and amphibians. The National Coalition for Pesticide-Free Lawns says, "Of 30 commonly used lawn pesticides, 19 are linked with cancer or carcinogenicity, 13 are linked with birth defects, 21 with reproductive effects, 26 with liver or kidney damage, 15 with neurotoxicity, and 11 with disruption of the endocrine system."Some of these pesticides are *Aluminium Phosphide, DDT, Lindane, Methyl Bromide, Methyl Parathion, Sodium Cyanide, Methoxy Ethyl Mercuric Chloride Monocrotophos, Endosulfan, Fenitrothion, Diazinon, Fenthion, Dazome.*

Per chlorate

Per chlorate gets into the environment due to a series of human activities. Military operations, rocket research, firework displays and other activities implying explosive materials are per chlorate. Many industries using per chlorate salts as well as natural formation in arid climates. Thus food pollution by per chlorate is a serious problem that has yet to be defined in other areas of the world. Per chlorate may cause metabolism disruption by affecting the normal function of thyroid.

Food Preservation

We all know food preservatives are harmful. But we still ignore the **harmful effects of food preservatives** and happily opt for preserved and processed foods like canned fruits, vegetables, sea foods, meats, packed juices, aerated drinks etc. The list is endless. Manufacturers use preservatives such as nitrites and sulfites in processed foods to inhibit growth of microorganisms. These preservatives increase our health risk. Nitrites are common preservatives used in processed meats and fishes to prevent bacterial growth. When we consume such foods, our body converts nitrites to carcinogenic substances called nitrosamines.

Artificial Colors

Artificial food coloring ingredients contain plenty of chemicals. Many are derived from highly toxic sources and can cause many different diseases, disorders, and mutations in humans. A trivial amount of food coloring in a piece of a candy we eat may have harmful effects on us.

Artificial Colors aren’t just in junk food or sodas. Some salmon farms actually add red food dye to make them appear more appetizing. When looking for fish a customer always wants the freshest they can buy. A pink or red salmon is much more appealing to eat than one that’s gray or just darker. There have been petitions to ban these chemicals and dyes, but most of them still remain in the market. It will really take some more researches and widespread awareness to ban these chemicals from making their way into our food.

Fats and Sweeteners

Industrially produced fats and sweeteners, common in processed foods, are bad for our health. Manufacturers use trans fats which increase our risk of coronary artery disease in breads, cookies, margarine and microwave popcorn. High-fructose corn syrup, a sweetener used in soft drinks, salad dressings and desserts, can increase our risk of obesity.

Genetic Modification

Scientists have been and are currently introducing genetic material into organisms to alter, create and affect changes in living plants and animals. Scientists are developing specific, desirable traits that might never evolve naturally. This is extremely dangerous. Collectively called recombinant DNA technology, this practice changes the core genetic make-up of organisms. This genetic manipulation gives scientists the ability to create any trait that they wish, or suppress natural traits they don't want.

This genetically modified food like DDT, when it was first considered as a boom to agricultural genetically modified seeds are also being considered as boom to our agricultural production, but a comprehended research and investigation are necessary to confirm the effect of genetically modified
food, like BT Cotton, BT Brinjal and such reports are there where the genetically modified foods and agricultural products they are not being considered very sustainable in terms of ecology and in our environmental concern. They are having some harmful effects also and that's why there are agitations world over.

There are several reasons behind this unnatural genetic manipulation and their effects. However, we have some questions in this regard which are unanswered. Its usually not clear which consumables have been genetically manipulated. We don't know the long term health effects of these genetically modified foods. Agro-chemical companies and the government are planning to charge farmers free to grow their genetically modified crops, thereby negatively affecting the economy and the environment.

FOOD ADULTERATION

Adulteration in food is normally present in its most crude forms. Prohibited substances are added. In India normally the adulteration in food is done either of financial gain or due to carelessness and lack of proper hygienic conditions of processing, storing, transportation and marketing. The ultimate result is that the consumer is cheated and often become a victim of diseases.
Commonly argemone seeds and oil have been found in mustard seeds and oil. Foreign leaves or exhausted leaves have been mixed with tea leaves which are being used by the consumers. Rancid oil is mixed with oils. In food grains and pulses the adulteration by mixing sand, marbles chips, stones etc. have been reported by the consumers. Cadmium has been reported to be mixed in fruits and soft drinks etc. Food chemicals may have been placed on the food for positive reasons, but they can have negative effects on human health also. Thousands of man- made chemicals are being added to

human food supply in these days. Even infants are not spared from being exposed to food chemicals every day. Naturally, the human body is not supposed to be exposed to large amounts of chemicals either through their surrounding environment or through their food intake. Continuous exposure to harmful food chemicals may lead to serious health problems and various other side effects. There are several side affects that are resulted from the constant exposure of chemicals mixed in food. Some of these side affects are extremely harmful and they cause disorder in Nervous system, Breast and other types of cancer , Reproductive damage, Headache, Body Tingling Sensation, Hyperactivity, Immunological or Allergic Reactions and so on.

PROTECTING FOOD FROM CHEMICAL CONTAMINATION

The Food Safety and Standards Authority of India (FSSAI) has been established under Food Safety and Standards Act, 2006 which consolidates various acts & orders that have handled food related issues in various Ministries and Departments. FSSAI has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food consumption. The Act also aims to establish a single reference point for all matters relating to food safety and standards, by moving from multi-level, multi-departmental control to a single line of command.

Advice to Consumers

- Select fruits and vegetables without spots or necrosis (lesions) and any other abnormality.
- Wash fruits and vegetables thoroughly with water before cooking and eating.
- Peeling of fruits before consumption and vegetables before cooking will reduce exposure to pesticide.
- Do not buy and consume cut fruits from open market.
- Throw away fruits and vegetables infected by mould or fungus.
- Do not wash fruits and vegetables with detergents as they may get absorbed inside.
- Ensure the quality of fruits and vegetables by sending them to voluntary testing laboratories.
- Wash your hands with soap and potable water, use clean utensil and clean cutting board with stainless steel knives.

EFFECT OF CHEMICALS IN ENVIRONMENT

Environmental contaminants are chemicals that are present in the environment in which the food is grown, harvested, transported, stored, packaged and consumed. The physical contents of the food with its environment results in its contamination.

Over the past century humans have introduced a large number of chemical substances into the environment. Some are the wastes from industrial and agricultural processes. Some have been designed as structural materials and others have been designed to perform various functions such as healing the sick or killing pests and weeds. Obviously, some of the chemicals are useful but many are toxic. They harm the environment and our health. W e need to manage the risks better by using those chemicals, which are safe.

Chemicals enter air as emissions and water as effluents. Industrial and motor vehicle emissions of nitrogen and sulphur oxides cause acid rain, which damage fishes and other aquatic organisms in rivers and lakes and affect the ability of soil to support plants. Carbon dioxide causes the greenhouse effect and climate change. Chlorofluorocarbons (CFCs) cause the destruction of ozone in the stratosphere and create the possibility of serious environmental damage from ultraviolet radiation. Chemical fertilizers and nutrients run-off from farms and gardens cause the buildup of toxic algae in rivers, making them uninhabitable to aquatic organisms and unpleasant for humans. Some toxic chemicals find their way from landfill waste sites into our groundwater, rivers and oceans and influence genetic changes that compromise the ability of life to reproduce and survive.

The impact of human activities on the environment is complex and affects a chain of interconnecting ecosystems. The extinction of species all along the chain may mean the loss of useful genetic material, life saving cancer drugs and so on.

Conclusion

At one time, many centuries ago, most peoples' diets were very simple. They ate the food they grew themselves or that were available from nearby farms and dairies. The most complicated problems they faced often involved the development of methods to preserve food for those seasons of the year when it was not immediately available.

That way of life persisted well into the 20th century. The rise of modern chemistry during the century's early decades made possible a new and dramatically different way of looking at food. Food scientists developed methods for transforming natural food, not only to make them last longer, but also to make them more interesting and appealing to eat.

Now the question is “what is the future of the food industry in India and other nations of the world?” Are we seeing just the beginning of a new age in food, with an ever-increasing number and variety of synthetic or altered food that we can hardly imagine today? Or are public concerns about health issues and possible risks to the environment going to create sufficient concern to make governmental agencies to rein in the kind of changes that researchers can make in food and that food companies can offer to the public.

No doubt today we are concerned with these questions. Without finding the solutions to these questions it is not possible to dream of safer and healthier food as well as a protective environment.

GLOSSARY

1. **Biological contamination :** Biological contamination is any matter of plant or animal nature, which when added to food matter makes it unfit to eat. The most common type of biological contamination is human hair but other types include animal hair, bits of insects, rodent or fly droppings and toadstools.

2. **Micro-organism :** Organism not visible to the unaided eye, for example bacteria, viruses and some fungi and parasites.

3. **Chemical contamination:** Chemical contamination is when food fit for human consumption is made unfit for human consumption by the addition or migration of harmful chemicals into the food.

4. **Adulterating :** To make impure by adding extraneous, improper, or inferior ingredients.

5. **Eco-System :** An ecological community together with its environment, functioning as a unit.

6. **Fertilizer :** Any of a large number of natural and synthetic materials, including manure and nitrogen, phosphorus, and potassium compounds, spread on or worked into soil to increase its capacity to support plant growth.

7. **Pesticide :** A chemical used to kill pests, especially insects.

8. **Toxic Metals :** Toxic metals are metals that form poisonous soluble compounds and have biological role.

9. **PCBs:** A printed circuit board, or PCB, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate.

10. **Per chlorate :** Per chlorates are the salts derived from per chloric acid ($HClO_4$). Per chlorates are often produced by natural processes but can also be produced artificially.

FAQs

1. What is food contamination?

Ans. Food contamination is the addition of something which makes the food inedible or can cause illness when consumed.

2. How chemicals are present in food?

Ans. All foods, living matter and, indeed, our bodies themselves are made up of chemicals. Many of the chemicals found in food occur naturally and include nutrients such as carbohydrates, protein, fat, fibre and a host of other elements and compounds.

3. Are the pesticides harmful?

Ans. All pesticides have some level of toxicity, just as every substance does. Even the least-toxic products can cause health problems if someone is exposed to it. The risk of health problems depends not only on how toxic the ingredients are, but also on the amount of exposure to the product.

4. Are Bio-fertilizers safer for the environment?

Ans. Yes, Bio-fertilizers are organic and organic based fertilizers are non-toxic, bio-degrable and eco-friendly.

5. What is food adulteration?

Ans. The adulteration of food means the addition of something that isn't food into a food product, in order to be able to get more products to sell at less cost.

6. What is genetic modification of food?

Ans. Genetically modified foods are food derived from genetically modified organisms. Genetically modified organisms have had specific changes introduced into their DNA by genetic engineering techniques. These techniques are much more precise than mutagenesis (mutation breeding) where an organism is exposed to radiation or chemicals to create a non-specific but stable change.

7. What is artificial color in food and their importance?

Ans. Artificial food coloring ingredients contain plenty of chemicals. Many are derived from highly toxic sources and can cause many different diseases, disorders, and mutations in humans. Food coloring, or color additive, is any dye, pigment or substance that imparts color when it is added to food or drink.

8. How we can protect our food from contamination?
   Ans. With the help of following precautions we consumers, protect our food:

- Select fruits and vegetables without spots or necrosis (lesions) and any other abnormality.
- Wash fruits and vegetables thoroughly with water before cooking and eating.
- Peeling of fruits before consumption and vegetables before cooking will reduce exposure to pesticide.
- Do not buy and consume cut fruits from open market.
- Throw away fruits and vegetables infected by mould or fungus.
- Do not wash fruits and vegetables with detergents as they may get absorbed inside.
- Ensure the quality of fruits and vegetables by sending them to voluntary testing laboratories.
- Wash your hands with soap and potable water, use clean utensil and clean cutting board with stainless steel knives.

9. What is environmental contamination?
   Ans. Environmental contaminants are chemicals that are present in the environment in which the food is grown, harvested, transported, stored, packaged and consumed. The physical contents of the food with its environment result in its contamination.

10. What steps are taken by our government to protect the food contamination?

Ans. The Food Safety and Standards Authority of India (FSSAI) has been established under Food Safety and Standards Act, 2006 which consolidates various acts & orders that have handled food related issues in various Ministries and Departments. FSSAI has been created for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food consumption. The Act also aims to establish a single reference point for all matters relating to food safety and standards, by moving from multi-level, multi-departmental control to a single line of command.

11. What are those diseases we face while intake by different sources or using pesticides?
    Ans. Of 30 commonly used lawn pesticides, 19 are linked with cancer or carcinogenicity, 13 are linked with birth defects, 21 with reproductive effects, 26 with liver or kidney damage, 15 with neurotoxicity, and 11 with disruption of the endocrine system.

12. Are natural (botanical) products safer than other products?
    Ans. Natural (botanical) products, like plant oils, are sometimes low in toxicity; however, this is not always the case. Some plant extracts are just as toxic as or even more toxic than similar synthetic pesticides. Always handle pesticide products with care.