From farm to plate, make food safe
Contents

A. Introduction ..................................................................................................... 3
B. Food quality and food safety ........................................................................ 4
C. Buying safe food in the market ..................................................................... 7
D. Preparing food safely at home ..................................................................... 10
  • D1. Food cooking and reheating .............................................................. 10
  • D2. Food preservation and storage ....................................................... 14
E. Food additives and fortification .................................................................. 19
F. Food adulteration and contamination ....................................................... 20
G. Hazards and health risks related to food .................................................. 23
  • G1. Natural toxins present in food ......................................................... 23
  • G2. Dioxins and acrylamides ................................................................. 25
H. Foodborne illness ....................................................................................... 26
I. Glossary ....................................................................................................... 28
Did you know? ................................................................................................ 30
A. Introduction

Food safety is everybody’s concern, and it is difficult to find anyone who has not encountered an unpleasant moment of foodborne illness at least once in the past year. Foodborne illnesses may result from the consumption of food contaminated by microbial pathogens, toxic chemicals or radioactive materials. Food allergy is another emerging problem. While many foodborne diseases may be self-limiting, some can be very serious and even result in death. Ensuring food safety is becoming increasingly important in the context of changing food habits, popularization of mass catering establishments and the globalization of our food supply. As our food supply becomes increasingly globalized, the need to strengthen food safety systems in and between all countries is becoming more and more evident. That is why WHO is promoting efforts to improve food safety, from farm to plate (and everywhere in between) on World Health Day, 7 April 2015. The World Health Day 2015 slogan is: “From farm to plate, make food safe”.

The informal food production and marketing system is still strong in most countries of the South-East Asia Region, which presents challenges for enforcement of food safety regulations. As a result, instances of food adulteration and contamination can occur. Traditionally, societal preferences call for hot and well-cooked food, and even milk is boiled (pasteurized). These habits are partially responsible for preventing foodborne infections. Street food is popular in urban settings in many countries. Hygienic conditions are improving, provided that potable water supply and clean facilities are ensured by municipal authorities. The introduction of bottled drinking water and its popularity in urban areas has contributed to prevent waterborne and diarrhoeal diseases in countries with inconsistent water treatment. Political awareness and consumer education on food safety will help strengthen enforcement of food standards, improve hygienic practices, and prevent foodborne illnesses. The “WHO Five keys to safer food” serve as the basis for educational programmes to train food handlers and educate the consumers. They are especially important in preventing foodborne illness. The Five keys are as follows.

1. Keep food surfaces clean. Wash all utensils, plates, platters, and cutlery as soon as used.
2. Separate raw food from cooked food.
3. Cook food thoroughly, to the appropriate temperature.
4. Keep food at safe temperatures, both for serving and storage.
5. Use safe water and raw materials.
Ensuring food safety starts with production, at the farm level. In this regard, misuse of agro-chemicals, including pesticides, growth hormones and veterinary drugs may have harmful effects on human health. The microbial and chemical risks could be introduced at the farm-level (e.g. using water contaminated by industrial waste or poultry farm waste for irrigation of crops). Good agricultural practices should be applied to reduce microbial and chemical hazards. Organic farming (without the use of pesticides) has been promoted in many countries of the South-East Asia Region, as there is a significant segment of health-conscious people, particularly in urban settings. Although organic products are expensive as compared to commonly available food items, there is a tendency among health-conscious consumers to eat less, but buy organic foods.

Ensuring food safety requires due attention during harvest, transport, processing, storage and finally during food preparation and storage by consumers. Processed, frozen or ready-to-eat food is gaining popularity in recent years due to changing food habits, product diversification, busy lifestyle and mass production practices. In urban settings, there is a growing tendency to buy meat, milk and vegetables on the weekend and store these items in the freezer or refrigerator. Microwave ovens are often used for reheating of food. However, while using a refrigerator and microwave are part of daily life in urban settings, most users and food handlers rarely have a chance to learn how to safely store and reheat food. We have, therefore, developed a collection of questions and answers on food safety, considering this knowledge gap among consumers and food handlers, with a specific focus on concerns of regional importance. These questions and answers include topics such as food adulteration and falsification (food fraud), unhealthy and unsafe food-handling practices in food markets and at home, and food allergies.

B. Food quality and food safety
1. What is food quality?

Quality includes positive and negative attributes that influence a product’s value to the consumer. Positive attributes that demonstrate good quality may be the origin, colour, flavour, texture and processing method of the food, while negative attributes may be visible spoilage, contamination with filth, discoloration, or bad odours or tastes. However not all unsafe foods may demonstrate bad quality, that is, unsafe food may appear to be of good quality, such as tainted meat disguised using bleach or strong spices. This distinction between safety and quality has implications for public policy and influences the nature and content of the food control system most suited to meet predetermined national objectives.
2. **How is food quality evaluated?**

Traditionally, qualities of foods are evaluated by our sensory organs – our eyes, nose or mouth or, more recently, by the use of instruments. Sensory evaluation is commonly practiced by food regulatory authorities which consists of judging the quality of food by a panel of judges. The evaluation deals with measuring, evaluating, analyzing and interpreting the qualities of food as they are perceived by the senses of sight, taste, touch and hearing.

Careful sampling of the food is necessary for sensory evaluation. It is not always possible to detect with sensory methods alone the contamination of food by pesticides, veterinary drug residues and adulteration. Objective evaluation is done which includes chemical, physiochemical, microbial and physical methods of analysis. Chemical methods include the determination of nutritive value of foods before and after cooking, and to detect the products of decomposition and adulterants in foods. The most widely employed objective evaluation is the measurement of physical properties by the use of instruments. Measurements of the appearance and volume of foods are also important.

3. **What is food safety?**

Food safety refers to limiting the presence of those hazards whether chronic or acute, that may make food injurious to the health of the consumer. Food safety is about producing, handling, storing and preparing food in such a way as to prevent infection and contamination in the food production chain, and to help ensure that food quality and wholesomeness are maintained to promote good health.

4. **How safe is organic or locally produced food?**

Organic and locally produced foods may have environmental benefits such as using less pesticides or fertilizers. These foods, like others, can be exposed to harmful bacteria during the growing and harvesting process. It is important for farmers and distributors to use good sanitary practices to minimize food contamination. Consumers should always prepare and cook food properly, no matter where it is from.

5. **How safe is street food?**

Street food vendors are a traditional and indigenous fast food approaching most countries of the South-East Asia Region. Street food vendors provide cheap and enjoyable food to millions of consumers. It is difficult to say how safe street food is as
there are many contributing factors associated with the safety of street food. A 1993 survey of 100 street foods in 100 countries, conducted by WHO, revealed the major health threat facing the public comes from raw and undercooked food, infected food handlers and inadequate hygiene measures in processing and storing such food. Since the majority of street food is cooked well and served hot, there is less chance of food poisoning. The water quality, hygienic conditions and the level of cleanliness—particularly in the summer season—may contribute to episodes of food poisoning. However, improvements in physical infrastructure and hygienic conditions are growing as consumers are also demanding quality food.

6. **What is the Hazard Analysis of Critical Control Point system (HACCP) and how does HACCP work in food production?**

HACCP, or the Hazard Analysis Critical Control Point system, is a process control system that identifies where hazards might occur in the food production process and puts into place stringent actions to prevent the hazards from occurring. By strictly monitoring and controlling each step of the process, there is less chance for hazards to occur. HACCP is an integral part of modern food industry used to identify and control major food risks, such as microbiological, chemical and physical contaminants. Consumers can implement HACCP-like practices in the home by following proper storage, handling, cooking and cleaning procedures. The introduction of preventive approaches such as HACCP, have resulted in industry taking greater responsibility for and control of food safety risks. Such an integrated approach facilitates improved consumer protection, effectively stimulates agriculture and the food processing industry, and promotes domestic and international food trade.

7. **What is a Food Recall and how it is done?**

A food recall is defined as an action taken to remove foods which may pose a safety risk from the sale, distribution or consumption to consumers. In other words, it is the action to remove food from the market at any stage of the food chain, including that possessed by consumers. The term “withdrawal” is used widely in relation to food recall. Food recall is a fundamental tool in the management of risks in response to food safety events and emergencies.

A food recall may be initiated as a result of a report or complaint from a variety of sources – manufacturers, wholesalers, retailers, government agencies and consumers. Recalls are conducted by food businesses to ensure that potentially hazardous or
unsafe foods are not consumed. Microbiological contamination is primary cause of
food recall but it may also be due to chemical or radionuclear contamination of food. It
is mandatory for consumer protection in industrialized countries where food labelling
is compulsory for prepackaged food and commonly practiced by multinational food
industries.

8. How is the food recall system supported internationally?

Foods and the ingredients in food products are increasingly grown, processed and
consumed in different locations around the globe. This globalization poses new
challenges in the conduct of key activities associated with food recalls, such as the
trace-forward and trace-back activities required for a food suspected or confirmed
to be unsafe. The FAO/WHO International Food Safety Authorities Network
(INFOSAN) coordinates communication regarding contaminated food which has been
internationally distributed to allow for food recalls in importing countries. Such alerts
are communicated to national INFOSAN Emergency Contact Points in each country
for their attention and action as required.

C. Buying safe food in the market

9. What precautions should be taken while buying
vegetables and fruits?

Most fresh vegetables and fruits retain their freshness for a short time under ideal
conditions of storage and it is always better to buy vegetables in the morning or
evening hours depending on harvesting pattern. When purchasing, select fresh
vegetables and fruits which are firm, crisp, bright in colour, with no visible bruises or
signs of decay and wilting. Be careful as some fruits and vegetables may be artificially
coloured to give the illusion of freshness and quality. It is advisable to buy vegetables
and fruits which are in season, as the quality is usually high and the price is low.

10. How to recognize fresh fish?

Fresh fish has firm flesh, a stiff body and tight scales. If you press the body, no
indentation should be left. Select fresh fish, which have red gills and bright eyes.
Be sure to purchase fish which have been refrigerated or stored on ice and are not
slippery or slimy to touch.
11. What kinds of chemicals are commonly used as colorants or preservatives in fish and what are the associated health risks?

Carbon monoxide treatment of fish is used where the red colour is an important quality attribute. As a change in colour is used by consumers as a primary assessment of quality, carbon monoxide treatment has the potential to make inferior quality fish appear aesthetically more pleasing to consumers. Therefore, the treatment of fish with carbon monoxide gas is not permitted in Singapore, Canada, the EU and Japan. The use of carbon monoxide to treat fish is undertaken in some Asian countries.

It has been found that formalin solution has been used by some fish handlers for preservation which may give a special smell; the use of formalin to preserve food is illegal because it is a potent poison, and fish preserved with formalin is not fit for consumption.

12. What are food safety issues related to seafood and fish?

Seafood and fish can become contaminated with pathogens such as *Vibrio cholera*, Salmonella, *E. coli*, *Shigella*, *Listeria* due to human activity or poor hygiene and sanitation during food production and processing. There have been outbreaks of foodborne illnesses and infections linked to consumption of contaminated fish and seafood. In addition, Methyl mercury is formed by bacterial action in an aquatic environment from dumping of industrial mercury as well as natural sources of elemental mercury. Testing of fish against methyl mercury is demanded by most importing countries. Certain parasite larvae can be present in fish, which is why most fish should be cooked thoroughly.

13. What is food labelling and why it is important?

Prepackaged food must be properly labelled for legal, technical and administrative reasons. Food labelling is any written, printed or graphic matter that is present on the label, accompanies the food, or is displayed near the food, including that for the purpose of promoting its sale or disposal. Prepackaged food shall not be described or presented on any label or in any labelling in a manner that is false, misleading or deceptive. The following information should appear on the label of prepackaged foods as applicable to the food being labelled which could be different in each country depending on their national food control system and the existing legislation;
• The name of the food
• List of ingredients
• Net contents and drained weight
• Name and address
• Country of origin
• Lot identification
• Date marking and storage instructions
• Instructions for use

Considering the importance of food labelling for international trade, the Codex Alimentarius Commission has made general and commodity standards and recommendations in relation to food labelling. Food labelling is important for protection of consumer interest. Label declaration on packed food is very important for knowing the ingredients and nutritional value, and helps in checking the freshness of the food and “best-before” dates. It provides a clue for ‘food recall’ or ‘food withdrawal’ if situation demands.

14. What is ‘use-by date’ in the food label and why is it important for a consumer?

‘Use-by Date’ (also known as the recommended last consumption date or expiration date) is the end of the estimated period after which the product probably will not have the quality attributes normally expected by the consumers as long as it is maintained under the stated storage conditions. In order words, the expiration date is the date up to which the food maintains its microbiological and physical stability as well as the nutrient content declared on the label. That means it is important to use the food before the expiry date to get the most nutritional value from it and to be relatively sure the contents are safe.

Checking the “best before” and “use-by date” labels on foods is one of the first things consumers should do before buying. It is important in countries of the South-East Asia Region where food safety law enforcement is weak and consumer’s understanding of food safety issues is limited. It is a common practice for supermarkets to reduce prices of food items that will soon reach their “use-by-date” so special attention should be paid before purchasing such items to avoid purchasing food that may not be consumed before the expiration date.
D. Preparing food safely at home

D1. Food cooking and reheating

15. Many people taste raw food during the cooking process? Is it a good habit?

Definitely not. It is a risky behavior.

16. What type of water is suitable for food preparation?

Water is essential in food preparation. It is used to wash food before cooking, it is used to act as a cooking medium, it is used to clean containers of food before and after preparation and it is also used as the most important beverage. Therefore, it is important that all water meant for drinking and cooking purposes should be free from pathogenic bacteria. Water free from pathogenic bacteria and palatable is known as potable water. Water used for making ice must also be potable. The ice may be used to cool foods or added to cold drinks. It is important to ensure that the ice for cold food storage or for drinks be made from potable water.

17. How many times may cooking oil can be reused for frying and what is the health hazard of reuse of cooked oil?

Oil is an often essential part of cooking and it is usually added during the first step of cooking. It is desirable to pour some oil into the pan at the beginning rather than later when the pan is very hot. Though using a fresh batch of oil every time is good, it is not always practical and people may tend to reuse it several times.

The problem with reusing oil is that it can create “free radicals” which can cause ailments in the long run. These free radicals can be carcinogenic i.e. can cause cancer and also atherosclerosis which can lead to increase in bad cholesterol levels, blocking the arteries.

The following measures should be considered to minimize health hazard of reusing oil;

• Sunflower, soybean, mustard and canola oil have a high smoke point i.e. they do not break down at high temperatures and are therefore suitable for frying,
including deep frying (where the food is submerged into the oil). Oils which do not have a high smoke point such as olive oil should only be used for sautéing.

- Make sure the leftover oil from cooking or frying is cooled down and then transferred into an airtight container through a strainer.
- If reused cooking oil is dark in colour or is greasy/sticky than it is time to change the oil.
- Clean the vessel in which cooking is performed between uses.

18. What can be done in the kitchen to reduce dietary intake of pesticides?

It is difficult to for a consumer to determine whether vegetables or fruits contain pesticide residues as often they do not have any noticeable smell, taste or visual defect. The following precautions can be taken to reduce dietary exposure to pesticide residue if agricultural products are sold in common market;

- Thoroughly rinse and scrub fruits and vegetables. Peel them if appropriate.
- Remove outer leaves of leafy vegetables, such as cauliflower, cabbage.
- Trim fat from meat, poultry and fish; discard oils and fats in broths and drippings.
- Throw back the big fish as the little ones have less time to take up and concentrate pesticides and other harmful residues.

19. How to know if meat or fish is properly cooked?

It is important to cook all meat properly to kill the bacteria that can cause foodborne illness. Temperature and cooking times will vary depending on the type of cut of meat and the method of cooking.

All meat should be checked visually to see if it is cooked thoroughly. The following tips should be considered while preparing meat at home;

- Make sure there is no pink meat left. Meat changes colour when it is cooked.
- When you pierce the thickest part of the meat with a fork or skewer, the juices should run clear.
- Cut the meat open with a clean knife to check it is piping hot all the way through – it should be steaming.

  Chicken is well cooked if the meat is white and there is no pink flesh.

  Fish is done when it is opaque and flakes easily with a fork.
A meat thermometer is used in modern kitchen which measures the internal temperature of cooked meat and poultry, or any other dishes, to assure that a safe temperature has been reached and that harmful bacteria have been destroyed.

20. Why should I keep raw food separate from cooked food?

Cross-contamination is the transfer of harmful microorganisms from one item of food to another via a nonfood surface such as human hands, equipment, or utensils. It may also be a direct transfer from a raw to a cooked food item. Contaminated water may be potential source of food contamination.

21. How are microwave ovens used?

Many people have an impression that microwave ovens are used mainly for reheating. However, microwave ovens may be used for reheating, cooking and defrosting.

22. What precautions should be taken while using microwave oven?

Only use cookware that is specially manufactured for use in the microwave oven. Only use products that have been clearly labeled as safe to use in a microwave, whether made from glass or ceramic pottery. Many plastics are not safe in microwaves, where they can melt, form cracks that can cause food leakage, or dissolve, so be extra careful. Most metals, including metal paints on ceramics or glass, are usually not safe either because of the increased risk for sparks and fire.

Cover the dish with a lid or plastic wrap approved for microwave use. Allow enough space between the food and the top of the dish so that plastic wrap does not touch the food. Loosen or vent the lid or wrap to allow steam to vent. The moist heat that is created will help destroy harmful bacteria and ensure uniform cooking. Cooking bags also provide safe even cooking.

Stir, rotate, or turn food upside down (where possible) midway through the microwaving time to even the cooking and eliminate cold spots where harmful bacteria can survive. Even if the microwave oven has a turntable, it is still helpful to stir and turn food top to bottom.

After removing food from the microwave, always allow a standing time of at least 3 minutes. This completes the cooking process.
23. How safe is food when cooked in microwave oven?

Bacteria will be destroyed during microwave cooking just as in other types of ovens, so food is safe cooked in a microwave oven, as long as it is heated to the necessary temperature (generally above 70°C). However the food can cook less evenly than in a conventional oven. In other words, microwave ovens can cook unevenly and leave “cold spots” where harmful bacteria can survive. To promote uniform cooking, arrange food items evenly in a covered dish and add some liquid if needed.

In a microwave oven, the air in the oven is closer to room temperature so the temperature of the food surface is often cooler than food in a conventional oven where the food is heated by hot air.

24. What is the best way to thaw frozen food in a microwave oven?

Remove food from its packaging before defrosting. Do not use foam trays and plastic wraps because they are not heat stable at high temperatures; melting or warping of the trays or wraps from the heat of the food may cause harmful chemicals to leach in. Many microwaves have special settings for defrosting. During microwave defrosting, rotate and turn food upside down periodically (2-3 times during defrosting). Microwaves are absorbed preferentially by water rather than ice, and by the first layer that can absorb the radiation, so turning/stirring the food during the defrosting process improves the evenness of the heat.

Cooking whole, stuffed poultry in a microwave oven is not recommended. Because food in a microwave oven can cook faster on the outside than food on the inside, the stuffing might not have enough time to reach the temperature needed to destroy harmful bacteria.

25. What is “standing time”?

Microwaves cause water, fat, and sugar molecules to vibrate 2.5 million times per second, producing heat. After the oven is off or food is removed from the oven, the molecules continue to generate heat as they come to a standstill. This additional cooking after microwaving stops is called “carryover cooking time,” “resting time,” or “standing time.” It occurs for a longer time in dense foods such as a whole chicken roast than in less-dense foods like breads, small vegetables and fruits. During this time, the temperature of a food can increase several degrees. Additionally, microwave heating is often uneven with focal spots of intense heat may be near areas of cool
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26. What is pasteurization and how long we can keep pasteurized milk?

Pasteurisation is the most popular method of heat treatment. It involves heating milk to high enough temperatures to kill harmful bacteria that can cause illness. Milk is heated to a high temperature and then rapidly cooled so that heat stable and heat labile pathogens are killed. It does not kill all bacteria, some of which, whilst harmless in the quantities present, will cause the milk to spoil after a few days. Therefore, pasteurization alone does not give a safe shelf-stable product without proper storage. Pasteurized milk must be kept in refrigerator but it can be kept for longer period in the freezer chamber.

27. Why milk or juice produced in a tetra pack can be kept without refrigeration?

The milk, fruit juice or cream is pasteurized at a higher temperature (132°C.), but for a shorter time which is known as ultra-high temperature (UHT) food processing. The UHT milk or juice passes through heating and cooling stages in quick succession, then, is immediately put into a sterile Tetra pack shelf-safe carton. The end result is a product that lasts up to six months without refrigeration or preservatives. Tetra pack products are sterile and safe to consume until they’re opened. After opening it should be stored in the refrigerator. These products are labelled as ultra-pasteurized.

D2. Food preservation and storage

28. How long can food be preserved in refrigerator?

There is a general belief that food items can be kept in a freezer for an indefinite period. A refrigerator set to below 5°C will protect most foods – but not forever. Over time, even chilled foods will spoil. The cool temperatures slow down bacterial growth but they don’t stop the growth completely.

It should be noted that some bacteria like listeria can grow well under refrigerator and cross-contamination can occur if raw and cooked food or salads are open and kept together. Eggs, cake and some food items may absorb flavor from other food items.
29. What precautions should be taken to ensure food safety while using refrigerator or freezer?

Refrigerators should be kept clean and dry all the time. The following tips will help to ensure food safety, wholesomeness and quality of food materials;

- Do not overstock your refrigerator. Overfilling will reduce the circulation of cool air and make difficult the proper cooling or chilling of food materials and beverages.
- Don’t open refrigerator/freezer doors more often than necessary, as temperatures rise when the refrigerator doors open. Close doors as soon as possible to save energy and keep safe temperatures.
- Raw meat, poultry, and seafood should be in sealed containers or wrapped securely to prevent raw juices from contaminating other foods.
- A large pot of food like soup or stew should be divided into small portions and put in shallow containers before being refrigerated.
- Cover foods or wrap leafy vegetables with paper to retain moisture and prevent them from picking up odors from other foods.
- Once a week, make it a habit to throw out perishable foods that should no longer be eaten.

Food preservation is designed to prevent spoilage and decay of seasonal and perishable foods by increasing the shelf-life of food thus increasing the supply and availability throughout the year. Technological advancements such as canning, vacuum packing, refrigeration, freezing and tetra packing have increased shelf-life of food.

30. What is food preservation and which are common methods of preservation?

The underlying principle of all preservation techniques, whether carried out in the home or commercially, is to restrict food spoilage so that food can be used safely in a palatable form at a later time. Food preservation should inhibit the growth of harmful microorganisms and arrest the biochemical breakdown of tissues and the transformation of its cell contents. This is achieved by heat, cold, drying, fermentation, radiation and chemicals. The use of ice or snow to preserve foods was known to early man. Fermentation of agricultural produce also was known from early times and it is still practiced for preservation of vegetables such as *kimchi*, *sinki*, *gundruk* and pickles. Other popular domestic methods used for food preservation were smoking, drying and salting. Smoking of meat and fish for preservation and flavouring is an old practice.
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In microbiological terms, there are basically two methods of traditional food preservation;

- Altering environmental conditions in which spoilage microorganisms are unable to grow in the food, e.g. in dehydration, pickling, salting, smoking, freezing etc. Such conditions can be created by removal of water, use of acid, use of oil and spices, use of chemical preservatives and use of low temperatures.

- Removal of microorganisms and enzymes in which most of the microorganisms present in the food are killed and enzymes are inactivated, e.g. in canning, cooking, irradiation, blanching etc. Heating food to high temperatures help preserve them through coagulation of proteins, inactivation of their metabolic enzymes and destruction of microorganisms. High-fat foods do not store well in the frozen state. Oily fish are the most suitable for canning. Canning retains the natural flavor of the fish. Botulinum spores are not always killed by the high heat of the canning process, but the poison that these bacteria make does not occur in acidic conditions. Therefore, canning or pickling of vegetables or meat in airtight containers where possible should contain enough acid to prevent toxin formation. Cans that appear to have swelled or bulged, or unopened jars with pressure pop-up centers that have popped up should not be consumed and should be thrown away.

31. What kind of microbes grow inside refrigerator and how to prevent microbial growth?

Bacteria and fungi may grow inside the refrigerator if dryness and cleanliness are not maintained. Spoilage bacteria are a major concern as they cause foods to deteriorate and develop unpleasant odors, tastes, and textures. Spoilage bacteria can grow at low temperatures and eventually they cause food to develop off or bad tastes and smells, compromising quality and wholesomeness of food. Pathogenic bacteria do not generally affect the taste, smell, or appearance of a food, but there is a chance of cross-contamination if raw and cooked foods are kept together. Some pathogenic bacteria such as *Listeria monocytogenes* thrive at cold temperatures and, if present, will multiply in the refrigerator over time and could cause illness.

32. What should be done in case of a power cut to a refrigerator for a long time?

Keep the door closed as much as possible to maintain internal temperature safe. Food within be safe as long as power is out no more than 4 hours (without opening the
doors). Discard any perishable food (such as meat, poultry, fish, eggs, and leftovers) that has been above 5 °C for over 2 hours. Always discard any items in the refrigerator that have come into contact with raw meat juices.

33. How to get rid of strong food odors inside refrigerator due to food spoilage?

Food odors may develop as a result of food spoilage, which may be associated with power failure, overloading of refrigerator with food items, or poor hygiene. Strong food odors are frequent after power outages. The following action should be taken to get rid of unpleasant, undesirable food odors;

- The refrigerator or freezer must be empty and unplugged when cleaning
- Take out all removable parts and wash with mild soap and water.
- Rinse with water and dry.
- Use vinegar solutions (One cup vinegar per gallon of water) to wash the interior walls of the refrigerator or freezer.
- Fill a large shallow container with vinegar. Set in refrigerator or freezer several hours.
- If odor persists, let set two to three days, changing vinegar every eight hours.

34. How long can we keep canned or packaged foods?

There is no time limit on how long unopened cans will be safe. The usual recommendation for canned foods with low acidity such as vegetables and meats is that they will be good for 2 to 4 years. Acidic canned foods such as fruits, fruit juices and tomatoes will usually still be good quality for 1 to 2 years.

Definitely long storage will change the quality of the food before the safety is affected. Temperatures over 38°C for an extended time will speed loss of quality. Cans that are rusted or badly dented should be thrown away, no matter their age. Cans and jars with bulging sides or tops should also be thrown away; do not eat any of the food as it may be contaminated with botulinum toxin which can be fatal if consumed. Unopened jars or bottles with visible bubbles or discoloration should also be thrown away.

It is always a good idea to rotate canned or packaged foods, and to put dates on packages so that one can know how old the items are.
35. What kinds of plastics are used for food handling and storage and are there any health hazards of using it?

Plastic packaging plays a significant role in the shelf life and ease of storage and cooking for many foods and most are safe to use provided that they are used appropriately. Some kinds of plastics materials which are widely used for handling and storage of food and water are as follows:

1. Polyethylene terephthalate (PET) is used to make soft drink, water, sports drink, ketchup, and salad dressing bottles, and peanut butter, pickle, jelly and jam jars. It is strong, heat resistant and resistant to gases and acidic foods. It can be transparent or opaque. Not known to leach any chemicals that are suspected of causing cancer or disrupting hormones and it can be recycled.

2. High density polyethylene (HDPE) is used to make milk, water, and juice bottles, yogurt and margarine tubs and grocery, trash, and retail bags. High-density polyethylene is stiff and strong but is not heat stable (i.e. it melts at a relatively low temperature). Not known to leach any chemicals that are suspected of causing cancer or disrupting hormones and it can be recycled.

3. Low-density polyethylene (LDPE) is used to make films of various sorts, some bread and frozen food bags and squeezable bottles. Low-density polyethylene is relatively transparent. Many of the films are not heat stable either and may melt to the food if touching.

4. Polypropylene (PP) is more heat resistant, harder, denser and more transparent than polyethylene so is used for heat-resistant microwavable packaging and sauce or salad dressing bottles.

5. Polycarbonate is clear, heat resistant and durable and often used to make refillable water bottles and sterilisable baby bottles, microwave ovenware, eating utensils, plastic coating for metal cans. Tiny amounts of bisphenol A are formed when polycarbonate bottles are washed with harsh detergents or bleach (e.g., sodium hypochlorite). At high levels of exposure, bisphenol A is potentially hazardous because it mimics the female hormone estrogen.

In addition, polystyrene (PS) and polyvinyl chloride (PVC) are also used during food material transportation and handling in supermarkets. Modern food safe plastic bags are plasticizer-free and will not release harmful chemicals into your food while it is being cooked.
36. How can we reduce the migration of chemicals from plastic into food?

All plastic is made from chemicals that have the potential to harm a person’s health. Proper use of plastic packaging lowers chemical migration. Following these simple tips will help to reduce the migration of chemicals from plastic into food:

- Follow manufacturers’ instructions when using household plastics such as cling films and bags.
- Follow recommendations for cleaning products to be used on containers, bottles and lids.
- Use the correct type of plastic for the role, e.g. only use microwave-safe plastics in the microwave.
- Do not let cling film touch the food during microwave cooking as it melts at a low temperature. In many cases, the film should be removed before cooking in a microwave.
- Leave a corner of the dish uncovered to allow the steam to escape. This reduces the risk of the film being blown off and settling on to the food.
- Re-use plastic containers that are food compatible, in the way the original food was presented. For example, you can freeze food in ice-cream containers but don’t heat them in the microwave – they were designed for use on cold food.

E. Food additives and fortification

37. What are food additives and why are they added?

Food additives are substances not normally consumed as a food by itself and are not normally used as a typical ingredient of the food, whether or not it has nutritive value. In many cases, the intentional addition certain additives to food is for a technological purpose (including organoleptic) in the manufacturing process, and may be added during the preparation, treatment, packing, packaging, transport or holding of such food. The term does not include contaminants, or substances added to food for maintaining or improving nutritional qualities, or sodium chloride. Adequate information shall be given about the manner in which the food additive is to be kept and is to be used in food.
38. What is food fortification?

Food fortification has been defined as the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups. Food fortification has the advantage of being able to deliver nutrients to large segments of the population without requiring radical changes in food consumption patterns.

The rapidly changing lifestyles and increasing reliance on more highly processed foods has been used to justify the addition of nutrients to an expanding range of foods in order to ensure nutritional adequacy of the diet. Fortification of food with micronutrients is a valid technology for reducing micronutrient malnutrition as part of a food-based approach when and where existing food supplies and limited access fail to provide adequate levels of the respective nutrients in the diet. Food technology has been developed for fortification of vitamins and micronutrients in cereals and cereal based products, milk and milk products, fats and oils.

39. What are the priority areas for food fortification?

In 2000, the World Health Report, identified iodine, iron, vitamin A and zinc deficiencies as being among the world’s most serious health risk factors. The control of iodine deficiency disorders through salt iodization, for example, has been a major accomplishment in public health nutrition over the last 30 years. The focus of the international community for promotion of food fortification has so far been on the three most prevalent deficiencies: vitamin A, vitamin B complex, iodine and iron.

F. Food adulteration and contamination

40. What is food adulteration?

Food adulteration is an unethical and often criminal malpractice which is unfortunately commonplace in countries of the South-East Asia region. It frequently occurs where informal food production and marketing services are predominant and enforcement of food regulation is weak. Adulteration of food is normally observed in its most crude form, where prohibited substances are either added or used to partly or wholly substitute healthy ingredients or to artificially create the impression of freshness in old food. Normally, intentionally adulterating food is done for financial gain. Among food items, spices, due to their inherent nature--great demand and high price--
become easy substances for gross adulteration. Other forms of adulteration happen due to carelessness and lack in proper hygienic conditions of processing, storage, transportation and marketing. This adulteration ultimately causes the consumer to be either cheated financially or worse as a victim of illness or disease. However, adequate precautions taken by consumers at the time of purchase of such products can allow them to avoid purchasing such adulterated food.

Some examples of food adulteration are as follows;
- Whole spices: Dirt, dust, other seeds
- Chili powder: Brick powder, salt powder or talc, powder
- Ghee/butter: vegetable ghee, animal fat, mashed potato, sweet potato, etc.
- Ice cream and beverages: Saccharin
- Honey: Jaggery, sugar syrup

Some examples of artificial colorants are as follows;
- Sweets: Metanil yellow (a non-permitted coal tar colour)
- Chili powder: Rhodamine B
- Green chili, bitter gourd, green vegetables, green peas: Malachite green
- Turmeric powder: Lead chromate

41. What is food contamination and what may be potential causes of contamination?

Food contaminants are any substances not intentionally added to food, which are present in such food as a result of the production (including operations carried out in crop farming, animal husbandry and aquaculture), manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food or as a result of environmental contamination. Food contamination refers to the presence of harmful chemicals or micro-organisms in food, which can cause several debilitating illnesses if consumed. The unintentional contamination may occur during production, processing, storage and marketing. Edible oil may be contaminated during processing due to leakage of mineral oil in production line.

Food contamination is an even bigger threat in countries of the South-East Asia region due to the lack of produce harvesting norms, food handling standards, and environmental regulations.
42. What is being done to reduce exposure to pesticides?

It is widely known that pesticides / insecticides and herbicides / fungicides are used for pest and weed / spoilage control. These agrochemicals are available over the counter; farmers may use them without proper understanding or supervision. These chemicals can be hazardous, and there is always a chance of contamination of agriculture produce with residues of these chemicals. Considering the possible health hazard of dietary intake of residues of these chemicals, the Joint FAO/WHO Meetings on Pesticide Residues provides independent scientific expert advice on pesticide residues, residual limits and the acceptable maximum dietary intake (ADI) and maximum residual limit (MRL) on the basis of evidence-based information and risk assessment.

43. What are acceptable daily intake (ADI) and maximum residual limit (MRL)?

Acceptable daily intake (ADI) of a chemical is the daily intake which, during an entire lifetime, appears to be without appreciable risk to the health of the consumer on the basis of all the known facts at the time of the evaluation of the chemical by the Joint FAO/WHO Meeting on Pesticide Residues (JMPR). It is expressed in milligrams of the chemical per kilogram of body weight.

Maximum residual limit (MRL) is the maximum concentration of a pesticide residue (expressed as mg/kg), recommended by the Codex Alimentarius Commission to be legally permitted in food commodities and animal feeds. Respective MRLs are intended to be toxicologically acceptable. MRLs which are primarily intended to apply in international trade are derived from estimations made by the JMPR following both:

1. toxicological assessment of the pesticide and its residue
2. review of residue data from supervised trials and supervised uses including those reflecting national food agricultural practices. Data from supervised trials conducted at the highest nationally recommended, authorized, or registered uses are included in the review. In order to accommodate variations in national pest control requirements,

ADI and MRLs are also determined for veterinary drug residues and antimicrobial substances as these chemicals are used for growth promotion and animal disease prevention and control.
G. Hazards and health risks related to food

G1. Natural toxins present in food

44. Are there natural toxins found in food of plant or animal origin? What should be done to get rid of them?

Some foods contain toxins in their raw form that are made less toxic once cooked. Red kidney beans can contain high dose of lectin which is toxic when consumed in raw form. As few as four or five raw beans can cause severe stomach ache, vomiting and diarrhoea. Therefore red beans must be well cooked or boiled briskly in fresh water for at least 10 minutes to destroy toxins. Similarly, the castor bean lectin ricin is notorious for causing deaths of children when consumed in raw state.

Solanine, a glycoalkaloid found in high greatest concentration in budding or green areas of the potato, is acutely toxic to humans. Glycoalkaloids are not destroyed by cooking, so it is important to avoid eating the sprouts and to remove any green or damaged parts before cooking. Cucumber may occasionally contain a group of natural toxins known as cucurbitacins. These toxins give cucumber a bitter taste.

Cabbage and related vegetables contain thioglucosides which may be absorbed in people with low dietary iodine, and may contribute to thyroid enlargement.

Naturally occurring cyanogenic glycosides are found in raw or unprocessed cassava (*Manihot esculenta*), which can cause nerve damage or death if consumed in quantity. To avoid exposure to these toxins, Cassava should be properly prepared before eating. Peel and slice the cassava and then cook it thoroughly, either by baking, boiling or roasting.

Most of natural toxins found in fish are produced by species of naturally occurring marine algae. They accumulate in fish when they feed on the algae or on other fish that have fed on the algae. Ciguatera fish poisoning is characterized by numbness and tingling of the lips and tongue, vomiting, diarrhea and is associated with consumption of toxin-contaminated subtropical and tropical reef fish. Unfortunately these toxins are not destroyed by normal cooking or processing.
45. What kinds of toxin are present in wild mushrooms and what precautions should be taken?

Food poisoning from the consumption of poisonous wild mushrooms has been reported frequently during monsoon season in countries of south and southeast Asia. In some episodes, the whole families lost their life due to consumption of poisonous wild mushrooms. Many toxic mushrooms are quite similar in appearance to their less toxic cousins, so often easy to mistake.

Majority of fatal mushroom poisoning occurs due to ingestion of *Amanita Phalloides* - the ‘death cap’, due to its high content of Amatoxin - a potent cytotoxin. One mushroom contains enough poison to kill an adult. Cooking or peeling does not inactivate the toxin, and all parts are poisonous. Onset of symptoms occurs 6-24 hours or more after ingestion of mushrooms. Fatal poisoning is usually associated with delayed onset of symptoms which are very severe, with toxic effect on liver, kidney and nervous system. For absolute safety avoid any wild mushrooms, unless definitely identified as non-poisonous.

46. What are mycotoxins?

Mycotoxins are a group of naturally occurring chemicals produced by certain moulds or fungi. They can grow on a variety of different crops and foodstuffs including cereals, nuts, spices and dried fruits. Mycotoxins are produced by several fungi in foodstuffs and feed during production, storage, transportation, often under warm and humid conditions.

47. Which mycotoxins are concerns from a food safety point of view?

The mycotoxins of most concern from a food safety perspective include the aflatoxins, ochratoxin A, fumonisins, trichothecenes and zearalenone. The aflatoxins are most commonly found in maize, peanuts and feed as contaminants and it can also be found in the milk of animals that are fed contaminated feed, in the form of aflatoxin M1. Some mycotoxins such as trichothecene remain toxic even after being cooked.

48. How mycotoxins affect human health?

Mycotoxins can cause a variety of adverse health effects in humans. Aflatoxins B1 are genotoxic and carcinogenic, and can cause liver cancer in humans. Other mycotoxins
G2. Dioxins and acrylamides

49. What is dioxin?

Dioxins are a group of chemically-related compounds that are mainly by-products of industrial processes but can also result from natural processes, such as volcanic eruptions and forest fires. Dioxins are found throughout the world in the environment and they accumulate in the food chain, mainly in the fatty tissue of animals and pass to human body through food, mainly meat and dairy products, fish and shellfish. More than 90% of human exposure is through food, mainly meat and dairy products, fish and shellfish. Short-term exposure of humans to high levels of dioxins may result in skin lesions. Dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer.

50. What are the ways to reduce human exposure to dioxin?

Prevention or reduction of human exposure is best done via source-directed measures, i.e. strict control of industrial processes to reduce formation of dioxins. Many national authorities have programmes in place to monitor the food supply. This monitoring has led to early detection of contamination and has often prevented impact on a larger scale.

51. What is acrylamide and how it is produced?

Acrylamide is a chemical which is found in certain foods that have been cooked and processed at high temperatures, and the levels of acrylamide increase with the time of heating. Of the limited range and number of foods analysed to date, acrylamide levels are highest in potato and cereal-based products subjected to heat processing such as frying, grilling or baking. However, the mechanisms of formation of acrylamide in food are poorly understood.

52. Why there is a concern about acrylamides when it is produced naturally during cooking process?

In 2002, Swedish studies revealed that high levels of acrylamide formed during the frying or baking of potato or cereal products. Studies in laboratory animals suggest
acrylamide has a carcinogenic potency in rats that is similar to that of other carcinogens in food, but the intake levels for acrylamide are likely to be higher. A joint FAO/WHO consultation on health implications of acrylamide in foods held in 2002 recognized the presence of acrylamide in food as a major concern in humans, given its ability to induce cancers and heritable mutations in laboratory animals.

53. How to avoid adverse effect of acrylamides?

There are currently no regulatory maximum limits for acrylamide in food. The following principles can be applied to minimize whatever risk exists:

- Food should not be cooked excessively, i.e. for too long or at too high a temperature. However, all food, particularly meat and meat products, should be cooked thoroughly to destroy foodborne pathogens.
- The information available on acrylamide so far reinforces general advice on healthy eating. Bread should be toasted to the lightest colour acceptable.
- People should eat a balanced and varied diet, which includes plenty of fruit and vegetables, and should moderate their consumption of fried and fatty foods.

H. Foodborne illness

54. What is food poisoning?

When certain disease-causing bacteria or pathogens contaminate food, they can cause foodborne illness, often called “food poisoning”. Foods that are contaminated may not look, taste or smell any different from foods that are safe to eat. Salmonella, Campylobacter, Listeria and Escherichia coli (E. coli) are common bacteria causing foodborne illness. Some foodborne illnesses are mild where most people get better within a few days, but illness can sometimes be more severe, even deadly. Bacillus cereus can form heat resistant spores and a heat resistant toxin in cooked rice left at room temperature. Reheating or lightly cooking the food will not destroy this toxin.

55. What are clinical symptoms of foodborne illness?

Most types of foodborne illness cause one or more of the following signs and symptoms:

- Nausea
- Vomiting
- Watery diarrhea
- Abdominal pain and cramps
Fever and/or the presence of blood or mucus in the stool are signs of bacterial infection that may require a medical consultation.

56. What can I do to protect myself from foodborne illness?

Proper food handling can prevent most foodborne illness and diseases. Follow WHO’s five keys to safer food;

1. Keep clean
   - Thoroughly wash raw fruits and vegetables with tap water.
   - Keep clean hands, kitchen and chopping board all the time.

2. Separate raw from cooked
   - Do not mix raw food and ready-to-eat food.
   - Do not mix raw meat, fish and raw vegetables.

3. Cook thoroughly:
   - Thoroughly cook all meat, poultry and seafood, especially shellfish.
   - Reheat all leftovers until they are steaming hot.

4. Keep food at safe temperatures:
   - Refrigerate cooked food within two hours of preparation.
   - Never defrost food at room temperature. Defrost frozen food in the refrigerator, cold water or in the microwave.

5. Use safe water and raw materials.
   - Use safe drinking water for food preparation.
   - Check use-by dates and labels while buying packed food.
I. Glossary

**Additives**: Non-nutritive substance added intentionally to food, generally in small quantities to improve appearance, flavor, texture or storage properties. Amounts used in food are usually regulated by law.

**Adulteration**: The process by which the quality or the nature of a given substance is reduced through (i) the addition of a foreign or an inferior substance, and (ii) the removal of vital element. Adulteration of food may endanger health if the physiological functions of the consumer are affected.

**Antibiotics**: A substance produced by living organisms that inhibits the growth of other organisms, sometimes used as a growth promoter or food preservative in some countries.

**Blanching**: Dipping of fruits or vegetables in boiling water or exposing these to steam for a few minutes to kill enzymatic and biological activity prior to freezing or processing.

**Coliform bacteria**: Group of aerobic bacteria commonly found in feces; their presence indicates lack of sanitation (as in insufficiently treated water for drinking).

**Contaminant**: Any substance not intentionally added to food, which is present in such food as a result of the production (including operations carried out in crop husbandry, animal husbandry and veterinary medicine), manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food or as a result of environmental contamination.

**Fermentation**: Breakdown of compounds without the use of oxygen, e.g. breakdown of sugar by yeast to form alcohol and carbon dioxide.

**Food poisoning**: A general term applied to all stomach and intestinal disturbances due to food contaminated with certain microorganisms or to their toxins.

**Fortification**: Addition of one or more nutrients to a food to make it richer than the unprocessed food, e.g. Vitamin C added to fruit juice.

**Pasteurization**: The process of killing harmful organisms in a food product by heating at controlled temperatures below 100°C, commonly applied to milk.

**Pathogenic**: Capable to producing disease.

**Potable water**: Water which is free from pathogenic bacteria and is palatable.
**Preservative**: Substance added to perishable foods to prevent spoilage by inhibiting growth of microorganisms.

**Smoke point**: The temperature at which the breakdown products of fat become visible as smoke.

**Withholding period**: The time interval after the withdrawal of a drug from the treatment of an animal before the animal or its products can be used for human food.
Did you know?

- Unsafe food containing harmful bacteria, viruses, parasites or chemical substances, causes more than 200 diseases - ranging from diarrhoea to cancers.
- Foodborne and waterborne diarrhoeal diseases kill an estimated 2 million people worldwide annually, including many children.
- A single foodborne bacterium can grow into more than two million bacteria in just seven hours under the right conditions.
- Foodborne pathogen called Listeria can survive and sometimes grow on foods being stored in the refrigerator.
- Hepatitis A virus can cause long-lasting liver disease and spreads typically through raw or undercooked seafood or contaminated raw produce.
- It is estimated that more than 250 million people worldwide suffer food allergies.
- The boiling temperature (smoke point) of cooking oil is above 200 °C.
- The boiling point of water is 100 °C.

More information on safe food handling can be obtained from following websites;

www.who.int/food_safety
www.searo.who.int/entity/foodsafety
http://www.searo.who.int/entity/world_health_day/2015/en/