

UNIT 5

Food safety and Ethics: Food Hazards, Food Additives, Food Allergens Drugs, Hormones, and Antibiotics in Animals.

Factors That Contribute to Foodborne Illness, Consumer Lifestyles and Demand, Food Production and Economics,

History of Food Safety, The Role of Food Preservation in Food Safety.

Ethics: Clinical ethics, Health Policy, Research ethics, ethics on Animals.

Biosafety and Bioethics.

Food Additives, Food Allergens Drugs, Hormones, and Antibiotics in Animals.

Agriculture uses antibiotics to help reduce death rates among livestock, but the amount is very low and tightly regulated. No current evidence suggests that antibiotics in meat and animal foods directly harms humans.

Antibiotic use in food-producing animals

Antibiotics are drugs used to treat bacterial infections. They work by killing or stopping the growth of harmful bacteria.

Since the 1940s, antibiotics have been given to farm animals such as cows, pigs, and chickens in order to treat infections or prevent an illness from spreading.

Low doses of antibiotics are also added to animal feed to promote growth. This means a greater production of meat or milk in shorter periods of time .

These low doses may also reduce animal death rates and improve reproduction.

Foods may also be contaminated by drugs (such as antibiotics and growth hormone) that are given to animals. Levels that have not caused illness or other problems in people are considered safe. However, determining whether a small amount of a contaminant has caused a problem is very difficult.

Antibiotics in Animals:

Antibiotics are naturally-occurring, semi-synthetic and synthetic compounds with antimicrobial activity that can be administered orally, parenterally or topically and are used in human and veterinary medicine to treat and prevent disease, and for growth promotion in food animals.

Huge quantities of antibiotics are used annually in livestock farming operations throughout the world, but the eventual fate of their residues and their potential damage to environmental health generally remains unknown. Moreover, antibiotics are also used to improve performance in growth and feed efficiency, to synchronize or control the reproductive cycle and breeding performance also often lead to harmful residual effects. Nonetheless, their misuse has led to an increase in diseases in humans and domestic animals worldwide.

The use of antibiotics in animals can have direct and indirect effects on human health. The direct effects are those that can be causally linked to contact with antibiotic-resistant bacteria from food animals, and indirect effects are those that result from contact with resistant organisms that have been spread to various components of the ecosystem (e.g., water and soil) as a result of antibiotic use in food animals.

The concern over antibiotic residues in food of animal origin occurs in two situations; one which produces potential threat to direct toxicity in human, second is whether the low levels of antibiotic exposure would result in alteration of microflora, cause disease and the possible development of resistant strains which cause failure of antibiotic therapy. This review explains the effects of antibiotic residues in food animals as a critical and important issue to be considered.

The use of antibiotics in food animals

Antibiotics as growth promoters

The mechanism of action of antibiotics as growth promoters is related to interactions between the antibiotics and the gut microbiota. The low doses of antibiotics are sometimes added to cattle, poultry and swine feed to increase their body size. Example includes Sulphonamides which is used as growth promoter in poultry.

Antibiotics as therapy, and prophylaxis

The use of antibiotics in specific conditions is justified because the role of microbial agents is mainly to kill or destroy the rapidly invading cells. These invading microorganisms sometimes damage the cells of the animals and reduce their growth performance. These antibiotics may either be administered to prevent disease or during an infection.

Antibiotic residues

Antibiotic residues are metabolites found in trace amounts in any edible portion of the animal product after the administration of the antibiotics. The antibiotic residues in food animal in excess of the acceptable maximum residue limit may contribute to the development of antibiotic resistances in animals or humans.

Health impacts

Antibiotics used in food animals can cause health hazards due to their secretion in edible animal tissues in trace amounts. Some drugs have the potential to produce toxic reactions in consumers directly while some other is able to produce allergic or hypersensitivity reactions. For example, β -lactam antibiotics can cause cutaneous eruptions, dermatitis, gastro-intestinal symptoms and anaphylaxis at very low doses. Such drugs include the penicillin and cephalosporin groups of antibiotics. These direct effects may include the induction of resistance in normal flora of the human gastrointestinal tract due to the consumption of antibiotic-containing meat products causing an outbreak of resistant diarrheal disease. Moreover, increased risk of resistant colonization or infection in humans due to their exposure to farm animals treated with antibiotics.

The Indirect and long term hazards include microbiological effects, carcinogenicity, reproductive effects and teratogenicity. Microbiological effects are one of the major health hazards in human beings. The Resistant bacteria from animal waste used as fertilizer may cause contamination of water supply and alterations in human flora.

The risk factors that contribute to foodborne illness

These are the top five risk factors contributing to foodborne illness:

- Food from unsafe sources
- Inadequate cooking
- Improper hot/cold holding temperatures
- Contaminated equipment
- Poor personal hygiene

Contributing factors are preventable causes of outbreaks.

- Contributing factors are the practices and factors that lead to outbreaks. In an outbreak, contributing factors are the "how" and root causes are the "why."
- Identifying contributing factors in foodborne illness outbreaks can help stop them and prevent them in the future.

Contributing factors fall into 3 types.

1. **Contamination**

Pathogens and other hazards get into food.

For example, a sick food worker handles food with their bare hands.

2. **Proliferation**

Pathogens already in food grow.

For example, food held at the wrong temperature for a long time can allow harmful bacteria to grow.

3. **Survival**

Pathogens survive a process to kill or reduce them.

For example, food is not cooked long enough or to a hot enough temperature.

The most common contributing factors for outbreaks in restaurants come from sick food workers and food preparation practices.

Sick food workers can contaminate ready-to-eat food when they come into work while experiencing symptoms, such as vomiting or diarrhea. Food workers who are infectious can contaminate food:

- with bare hands
- while wearing gloves
- in other ways, such as letting food touch a contaminated cutting board or utensil

Improper food preparation practices are another common contributing factor for restaurant outbreaks. Not cooking food to a hot enough temperature and other improper food preparation practices can lead to pathogens growing.

Major foodborne illnesses and causes

Foodborne illnesses are usually infectious or toxic in nature and caused by bacteria, viruses, parasites or chemical substances entering the body through contaminated food. Chemical contamination can lead to acute poisoning or long-term diseases, such as cancer. Many foodborne diseases may lead to long-lasting disability and death. Some examples of food hazards are listed below.

Bacteria

- *Salmonella*, *Campylobacter* and enterohaemorrhagic *Escherichia coli* are some of the most common foodborne pathogens that affect millions of people annually, sometimes with severe and fatal outcomes. Symptoms can be fever, headache, nausea, vomiting, abdominal pain and diarrhoea. Foods involved in outbreaks of salmonellosis include eggs, poultry and other products of animal origin. Foodborne cases with *Campylobacter* are mainly caused by raw milk, raw or undercooked poultry and drinking water. Enterohaemorrhagic *Escherichia coli* is associated with unpasteurized milk, undercooked meat and contaminated fresh fruits and vegetables.
- *Listeria* infections can lead to miscarriage in pregnant women or death of newborn babies. Although disease occurrence is relatively low, *Listeria*'s severe and sometimes fatal health consequences, particularly among infants, children and the elderly, count them among the most serious foodborne infections. *Listeria* is found in unpasteurised dairy products and various ready-to-eat foods and can grow at refrigeration temperatures.
- *Vibrio cholerae* can infect people through contaminated water or food. Symptoms may include abdominal pain, vomiting and profuse watery diarrhoea, which quickly lead to severe dehydration and possibly death. Rice, vegetables, millet gruel and various types of seafood have been implicated in cholera outbreaks.

Antimicrobials, such as antibiotics, are essential to treat infections caused by bacteria, including foodborne pathogens. However, their overuse and misuse in veterinary and human medicine has been linked to the emergence and spread of resistant bacteria, rendering the treatment of infectious diseases ineffective in animals and humans.

Viruses

Some viruses can be transmitted by food consumption. Norovirus is a common cause of foodborne infections that is characterized by nausea, explosive vomiting, watery diarrhoea and abdominal pain. Hepatitis A virus can also be transmitted by food and can cause long-lasting liver disease and spreads typically through raw or undercooked seafood or contaminated raw produce.

Parasites

Some parasites, such as fish-borne trematodes, are only transmitted through food. Others, for example tapeworms like *Echinococcus* spp, or *Taenia* spp, may infect people through food or direct contact with animals. Other parasites, such as *Ascaris*, *Cryptosporidium*, *Entamoeba histolytica* or *Giardia*, enter the food chain via water or soil and can contaminate fresh produce.

Prions

Prions, infectious agents composed of protein, are unique in that they are associated with specific forms of neurodegenerative disease. Bovine spongiform encephalopathy (BSE, or so-called mad cow disease) is a prion disease in cattle, associated with the variant Creutzfeldt-Jakob disease (vCJD) in humans. Consuming meat products containing specified risk material, such as brain tissue, is the most likely route of transmission of the prion agent to humans.

Chemicals

Of most concern for health are naturally occurring toxins and environmental pollutants.

- **Naturally occurring toxins** include mycotoxins, marine biotoxins, cyanogenic glycosides and toxins occurring in poisonous mushrooms. Staple foods like corn or cereals can contain high levels of mycotoxins, such as aflatoxin and ochratoxin, produced by mould on grain. A long-term exposure can affect the immune system and normal development, or cause cancer.
- **Persistent organic pollutants (POPs)** are compounds that accumulate in the environment and human body. Known examples are dioxins and polychlorinated biphenyls (PCBs), which are unwanted by-products of industrial processes and waste incineration. They are found worldwide in the environment and accumulate in

animal food chains. Dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and cause cancer.

- **Heavy metals** such as lead, cadmium and mercury cause neurological and kidney damage. Contamination by heavy metal in food occurs mainly through pollution of water and soil.
- **Other chemical hazards** in food can include radioactive nucleotides that can be discharged into the environment from industries and from civil or military nuclear operations, food allergens, residues of drugs and other contaminants incorporated in the food during the process.

The advancement in technology is likely to tame several life forms present on earth. Microorganisms are posing a big challenge due to difficulties encountered to control the diseases caused by them. Working with deadly disease-causing microorganisms for their characterization, diagnostics or therapeutics and vaccine development purposes are posing increasingly potential biosafety problems for laboratory workers. Thus, an appropriate biosafe working environment may protect workers from laboratory-induced infections.

Biotechnology has the ability to solve the upcoming problems of the world's increasing population. However, there is often reluctance among the public to accept and support biotechnological products in medicine, industry, or agriculture. There are many safety and ethical issues raised for GM crops and human cloning. Raising transgenic animals and plants has fueled ethical concerns, and the scientists have faced a lot of resistance where genetically modified crop plants or reproductive cloning research of human beings is involved. Thus, biosafety and bioethics are continuously being expanded to combine the rationale of ever-increasing scientific knowledge in biotechnology that is often in conflict with the long-standing social and moral value system of our society.

CONSUMERS LIFE STYLE AND DEMAND FOR FOOD

Consumers want to eat healthily, but the price is an obstacle. The pandemic has put health at the forefront and changed our relationship with food. Consumers want to eat healthier, and this has been the most significant lifestyle change in recent years, followed by working out more often.

In consumer marketing, lifestyle is considered a psychological variable known to influence the buyer decision process for consumers. Lifestyle can be broadly defined as the way a person lives. In sociology, a lifestyle typically reflects an individual's attitudes, values, or world view.

Consumer behaviour can be defined as 'those activities directly involved in obtaining, consuming and disposing of products and services, including the decision processes that precede and follow these actions'

Understanding consumer behaviour

Consumer behaviour can be defined as 'those activities directly involved in obtaining, consuming and disposing of products and services, including the decision processes that precede and follow these actions' (Engel et al., 1995). There are environmental influences affecting this behaviour such as ethnicity and culture, social group, regional preferences, as well as food availability and household technology. There are also differences among individuals, not only their age and sex, their education, their standard of living, but also their physiological and psychological make-up. Individuals have their own food choice, which to a greater or lesser extent overrides preferences defined by culture or religion. In the last 30 years, multidisciplinary social science research has increased knowledge of food consumer behaviour and food choice.

Consumer behaviour occurs in sequential stages and at each stage there is a use of knowledge to make decisions. General consumer behaviour has six action stages as shown in Fig. 5.1 (Engel et al., 1995).

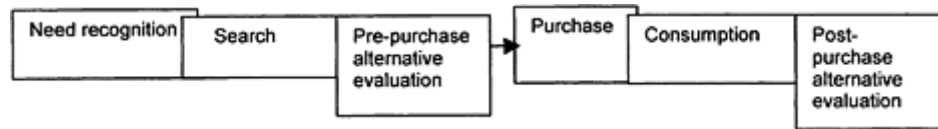


Fig. 5.1 General consumer behaviour in buying and consumption (Source: After Engel et al., 1995).

1. Exposure to information, communication, the product.
2. Attention given to the information.
3. Comprehension of the information, as it is analysed against the knowledge and the attitudes stored in the memory.
4. Acceptance or rejection of the incoming information.
5. Retention of the new information in the memory as knowledge.

When buying food, the consumer usually wants to keep the decision process as simple and quick as possible. Food is consumed two or three times a day, and may be bought every day, so the consumer does not want to spend a great deal of time in buying and today even in consuming food. It is only the special occasion, the special meal or the special food that is given detailed analysis. But it is important for the food designer to recognise that there is detailed and critical thought at certain points of time. Consumers receive a great deal of information on food through the media and advertising as well as by word-of-mouth; gradually and often imperceptibly this information changes their knowledge base and therefore their food behaviour. If there is a great deal of information on saturated fats in the diet, they will consider and may gradually change to low-fat foods. Sometimes their behaviour is changed by a jolt; this could be a food poisoning scare, or it could be food poisoning affecting them directly.

These can cause long-term changes in food behaviour, for example reduced meat-eating triggered by reports of BSE ('mad cow disease'), and complete rejection of shellfish caused by a bout of shellfish-related food poisoning.

In the past ten years, food brands in basic food areas have had very similar features and competed mainly on price, so that they have degenerated into commodity products - no brand being distinctive. Also there has been a proliferation of products with very little difference between them - for example in the small New Zealand market, there are about 157 breakfast cereals under the national and retailer brands. Can the consumers differentiate adequately between these, even if they read a consumer magazine? No wonder they choose the easy way out and buy on price, choosing the specials; or keep on buying their familiar product. Foods can be bought on impulse to relieve food boredom or as a treat. A new snack or a new takeaway can be bought to see if it lives up to its promotion; if it satisfies the consumer it can become a regular food.

The food designer needs to be aware, in the target market, of the general consumer behaviour towards foods and eating, and how this is slowly changing with time, but also needs to recognise the sudden change. This can be caused by either new information giving an attitude change, or new foods giving the consumers some greater advantage for safety, nutrition, convenience or attractiveness. Companies that have a long-term relationship with their target consumers build up knowledge about the trends in changes of their behaviour, which is invaluable in product development.

Food consumer behaviour can include the growing of the food but usually in the urban environment it concerns obtaining food from the supermarket, restaurant or takeaway. In the future it may be more distant with food being ordered through the Internet. Food companies must realise that although their food behaviour often starts with the selection of food at the retailer, consumers have an interest in how food is produced and they have their concerns about production and processing. Stages in the consumers' buying sequence and the related consumer thought processes are shown in Fig. 5.2.

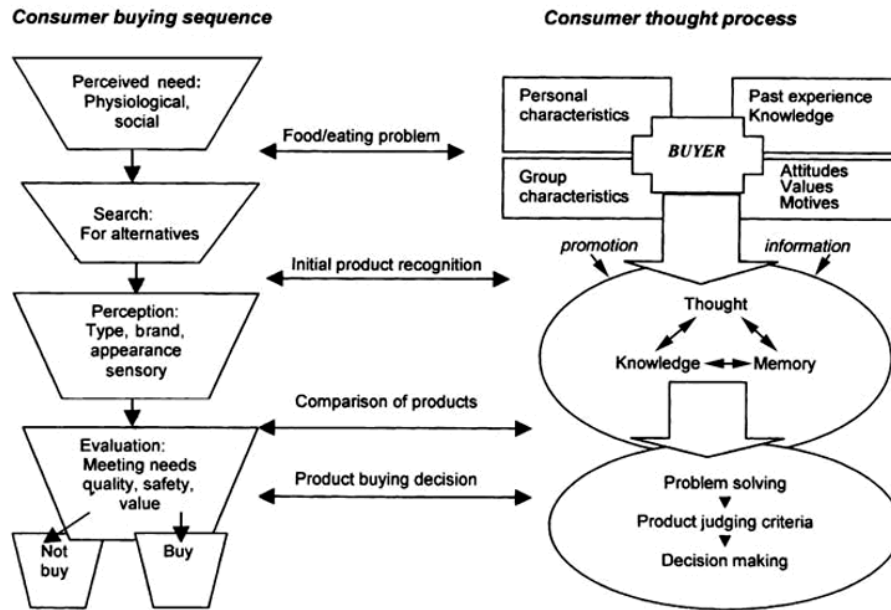


Fig. 5.2 Consumer food purchase patterns.
(- click to enlarge)

Recognition of the stimuli that start the buying sequence, the product judging criteria that are used in comparing products during the buying decision, and the level of consumer involvement with the product throughout the purchase and post-purchase sequence, are important in product design.

FOOD PRODUCTION AND ECONOMICS

The role of food production in shaping a nation's economy is tremendous. It not only provides stable employment opportunities but also fuels local economies. By fostering innovation in the food system, it caters to the rising demand for exports. Additionally, it contributes to making food affordable and meets consumer demand.

Food production, as the name suggests, is all about preparing food, in which raw materials are converted into ready-made food products for human use either in the home or in the food processing industries. Its process comprises scientific approaches. Food production has many sections and it starts with basic things like cleaning, packing, segregating, sorting, preparing, adding ingredients in correct proportions, presenting, etc.

Let us explore food production notes to learn how the food is produced and what are the methods involved in the production of food.

How is Food Produced?

There are large numbers of plant and animal products, which are used for our well-being. They provide us with food, which comes from both plants and animals. These include grains, pulses, spices, honey, nuts, cereals, milk, vegetables, fruits, egg, meat, chicken, etc. The existence of our life is completely depended on plants and animals. Altogether, plant and animal species provide 90% of global energy.

Types of Food Production

Food production is further classified into different types including, cultivation, selection, crop management, harvesting, **crop production**, preserving, baking, pasteurizing, pudding, carving, butchering, fermenting, pickling, drink and candy making, restaurants, etc.

Methods of Food Production

- Chopping or slicing of vegetables.
- Curing food.
- Grinding and marinating.
- Emulsification.
- Food fermentation.
- Fermenting beer at brewing industries.
- Boiling, broiling, frying, grilling, steaming and mixing.
- Pasteurization.
- Fruit juice processing.
- Removing the outer layers either by peeling and skinning.
- Gasification of soft drinks.
- Preserving and packaging of food products by vacuum packs.

The **Food Economy** explores a variety of trends and topics from the broad perspective that their evolution is interdependent with all kinds of counter currents and opposite notions: scarcity goes together with abundance, public and private initiatives co-evolve, slow food is connected with fast food, global brands.

It takes a forward-looking perspective on how different actors in the food system shape the sustainability of food production, distribution, and consumption, as well as on major challenges to efficient and inclusive food systems.

A normal good is a good that experiences an increase in demand due to an increase in a consumer's income. Normal goods have a positive correlation between income and demand. Examples of normal goods include food, clothing, and household appliances.

Food Economics Division (FED)

FED conducts economic research and analysis on policy-relevant issues related to the food sector (food safety, food prices, and markets); consumer behavior related to food choices (food consumption, diet quality, and nutrition); and food and nutrition assistance programs (SNAP, WIC, National School Lunch Program). FED also provides data and statistics on food prices, food expenditures, and the food supply chain.

Food Prices and Markets

FED researchers monitor and estimate indicators of individual, household, and market-level food consumption, prices, and expenditures; food marketing costs; and farm-to-retail price spreads. Research also focuses on food processing and distribution as well as trends and developments in food wholesale and retail markets. Topics include the ability of the sector to meet changing consumer demands, the effect of government interventions to facilitate that response, and the effect of government interventions and changes in the sector on consumer and producer welfare.

Food Safety

FED researchers analyze food safety issues, including consumer benefits from risk reduction, economic impacts of foodborne disease, production and other economic tradeoffs in reducing hazards, impacts of proposed regulations and international harmonization, and consumer responses to food safety events.

Food Security and Food Assistance

FED researchers assess the adequacy and effectiveness of the Department's food and nutrition assistance programs, including SNAP, WIC, and the National School Lunch Program. FED research is particularly focused on household food security, determinants of program participation, outcomes of program participation, and the linkages with the agricultural sector and general economy.

Consumer Behavior, Food Consumption, and Nutrition

FED researchers examine the demographic, social, and economic determinants of food and nutrient consumption; interrelationships between food and nonfood consumption; estimates of food availability and food loss; consumer valuation of quality, safety, and nutrition characteristics; and the role of information in determining food choices and associated health outcomes.
