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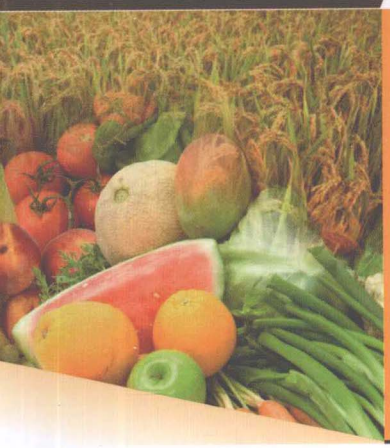

农产品质量与安全专业英语

Special English for Agri-Food Quality & Safety

骆焱平　柳志强　主编
徐汉虹　主审

中国轻工业出版社

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《农产品质量与安全专业英语》

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前　言

“国以民为本，民以食为天，食以安为先”，人们每天消费的食物，大部分来自农产品。农产品质量安全已经成为世界普遍关注的热点问题，英国的“疯牛病”、比利时的“二噁英”、欧洲的“口蹄疫”等，曾一度使整个世界陷入恐慌之中。随着我国温饱问题的解决与加入世界贸易组织，农产品质量与安全问题日益突出。近年来，有关有毒大米、有毒面粉、劣质奶粉、瘦肉精、苏丹红以及蔬菜中农药、激素含量超标的报道屡见不鲜，出口农产品及加工品因农（兽）药残留超标出现被拒收、扣留、退货、索赔、终止合同和停止贸易交往的现象时有发生，严重影响我国农产品的出口。因此，农产品的质量与安全不仅与人民群众的身体健康和生命安全息息相关，也与一国或一地的社会稳定和经济发展关系密切。

农产品质量与安全的含义为：农产品质量符合保障人的健康、安全的要求，即食物应当无毒无害，不能对人体造成任何危害。本书涉及的农产品是指来源于农业的初级产品，即在农业活动中获得的植物、动物、微生物及其产品。

我国农产品质量安全与发达国家相比还有一定差距，了解国际农产品质量与安全发展动态、学习国外先进的管理经验正变得越来越重要和迫切。对于国内学者和广大农产品质量与安全专业师生来说，没有扎实的专业英语知识很难了解和获得来自国外的第一手文献和资料，也无法掌握国际发展动向。因此，农产品质量与安全专业英语的学习显得尤为重要。然而，目前国内没有专门的农产品质量与安全专业英语教材，为此，我们组织编写了《农产品质量与安全专业英语》。

全书共三大部分，20 个单元。第一部分介绍农产品的安全知识，包括农产品安全危害、化学危害、食品添加剂、细菌毒素、转基因食品、风险分析、风险评估、食品安全评估方法、风险交流、WTO 加入与中国粮食安全等十个单元；第二部分介绍农产品的质量情况，包括质量的作用、质量管理、危害分析与关键控制点（HACCP）前提方案与设施、农产品工业卫生、沙门氏菌检测方法和食品链信息等六个单元；第三部分介绍农产品法规，包括农产品管理机构、HACCP 体系、良好操作规范和 ISO 质量体系标准等四个单元。每个单元后面提供一定数量的习题及相关阅读材料，供读者练习、巩固和提高。书后附上专业词汇、缩写及参考答案。

本书出版得到博士科研启动经费和海南大学教育教学研究项目（hdjy1014）的资助。

本书承蒙徐汉虹教授审稿，在此谨表诚挚的谢意。除了编委人员外，在此还要特别感谢海南大学农产品质量与安全专业的本科生，本书是在他们所使用讲义的基础上修改编写而成。由于时间仓促，加之编者的水平有限，难免会出现一些不足之处，恳请同行专家及广大师生批评指正。

编者

2010 年 10 月

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PART I AGRI-FOOD SAFETY

Food safety is the extent to which those requirements relating specifically to characteristics or properties that have the potential to be harmful to health or to cause illness or injury are met.

Food safety is the assurance that food will not cause harm to the consumer when it is prepared and eaten according to its intended use. All requirements relating to the safety characteristics of a food must be met; there must be no unacceptable health risk associated with a food. The assurance that a food will not cause harm, injury, or illness is determined by: (1) whether all harmful substances present in the food have been eliminated, reduced to an established acceptable level, or prevented from exceeding the acceptable level; and (2) the food has been prepared, handled, and stored under controlled and sanitary conditions in conformance with practices prescribed by government regulations. The harmful substances in foods are food safety hazards. The prescribed conditions and practices for preparing, handling, and storing food are considered Good Manufacturing Practices (GMPs).

For decades, the food industry has depended on the use of quality programs based on inspection and testing of food products for hazards, and on GMPs for addressing food safety. Since the late 1980s, there has been widespread use of the HACCP system specifically to achieve food safety; the system addresses food safety primarily on the basis of prevention or elimination of unacceptable hazard levels. The GMPs, which were used to address food safety requirements prior to the use of the HACCP system, have been incorporated into prerequisite programs for the HACCP system. A food company that does not operate with the HACCP system must continue to use the GMPs.

Selected from: Alli, Inteaz. Food quality assurance: principles and practices. Florida: CRC Press LLC, 2004: 31-32.

Unit 1 Agri-Food Safety Hazards

For a known food safety hazard, the extent of the harmful effects of the hazard on the health of the consumer is established by risk analysis and by hazard analysis. Risk analysis is usually conducted by a national food or health regulatory agency and addresses a public health concern regarding a particular food safety hazard associated with a sector of the food industry. A risk analysis is comprised of risk assessment, risk management, and risk communication. A primary objective of risk analysis is to establish a national food safety objective for a hazard in a food. The food safety objective for a hazard is the maximum frequency and concentration of a hazard in a food at the time of consumption that provides the appropriate level of protection from the hazard. The food safety objective can be considered as the maximum acceptable level for the hazard in a food.

At the level of production, processing, handling, or storage, a food company performs hazard analysis as part of the development of an HACCP plan for the food. Hazard analysis is the first of the seven HACCP principles, and is performed to determine the health risk associated with a hazard present in a food when it is produced, processed, handled, or stored, according to an established sequence of steps at a particular location. Once a food safety objective for a hazard has been established by risk analysis, it must be considered during the hazard analysis step of HACCP plan development.

Biological hazards in foods

Pathogenic bacteria

Food-borne pathogenic bacteria are responsible for a large proportion of food poisoning incidents in North America. Therefore, the importance of this group of hazards must be emphasized. More than forty different pathogenic bacteria are known; however, a large proportion of the reported cases of food poisoning can be attributed to the following pathogenic bacteria: *Salmonella* spp., *Eschericha coli 0157*: *H7*, *Lysteria monocytogenes*, *Clostridium perfringens*, *Clostridium botulinum*, *Staphylococcus aureus*, and *Campylobacter jejeuni*. Food poisoning from these organisms occur frequently, with symptoms that include headache, muscle pain, nausea, fatigue, chills or fever, stomach or abdominal pain, vomiting, and diarrhea. Numerous severe and fatal illnesses occur as a result of food poisoning from pathogenic bacteria; infants and the elderly are particularly vulnerable. The foods that are commonly involved in these food poisoning incidents include meat and poultry and their products, seafood and seafood products, egg and egg products, milk and dairy products, fruits and vegetables and their products, low-acid canned foods, and water.

Viruses

Foods can be the medium for transmission of certain viruses. Examples of viruses that are known to be food safety hazards are the hepatitis A and E viruses, the Norwalk group of viruses, and rotavirus.

Parasites

Several human parasites can be transmitted by foods. The most common human parasites include parasitic protozoan species (e. g. , *Entamoeba histolytica*, *Giardia lamblia*, *Cryptosporidium parvum*), and parasitic worms (*Ascaris lumbricoides*, *Taenia solium*, *Trichinella spiralis*).

Chemical hazards in foods

Permitted food additives

Government regulations permit numerous chemical and biochemical substances to be added to foods at specified maximum levels. These substances are intended to impart some improved nutritional effect (e. g. , vitamin fortification) or some specific technical function (e. g. , preservative action, sensory attribute, stabilizing effect, etc.). In addition, the Codex Alimentarius contains specifications of permitted food additives. Although food additives are permitted by government regulations, many can be harmful if they are present in the food at levels above the maximum established, and are therefore, potential chemical hazards. In some instances, a permitted food additive present below the maximum allowable level in a food can be a health hazard for specific segments of the population. For example, sodium bisulfite is a permitted food additive in some foods; however, individuals who are asthmatic could be at risk from foods containing sodium bisulfite. The labels on the containers containing the foods must clearly indicate the presence of the additives for the benefit of individuals who may be at risk from these additives.

Naturally occurring harmful compounds

It is well known that many foods contain as their normal or inherent components naturally occurring substances that can be harmful if they are present in excess of certain levels; examples are oxalate in rhubarb, alkaloids in potatoes, toxins in mushrooms and in shellfish. In the U. S. , the FDCA considers foods containing these naturally occurring substances to be adulterated only if the harmful substance is present in sufficient quantity that is likely to cause illness.

Unavoidable contaminants

Some foods can contain naturally occurring harmful substances that are not normal or inherent components of the foods. These substances are considered unavoidable contaminants in the food and cannot be removed through processing or manufacturing practices; examples are aflatoxins from molds in peanuts and in some cereals. If the normal level of a naturally occurring harmful substance in a food is increased to an unsafe level as a result of mishandling of the food or by any other action, then the harmful substance can be considered as an added harmful substance.

Agricultural residues

Agricultural residues are a group of residual chemical or biochemical substances found in foods and are directly attributable to certain substances that have been approved for use in the production of crops and livestock for food. They include residues of permitted pesticides, herbicides, fungicides, drugs, hormones, and antibiotics. Some of these residues are considered as added harmful substances attributable to human actions and are regulated by governments. In the U. S. , these residues are regulated under several laws including the FDCA. The Codex Alimentarius establishes maximum residual levels (MRL) for various harmful pesticides and veterinary drugs.

Industrial contaminants

Several harmful chemicals that enter the environment as a result of industrial activity have been shown to be present in foods. These substances include heavy metals (lead, mercury, arsenic), organo-chlorinated compounds such as polychlorinated biphenyls (PCBs), are considered as industrial or environmental contaminants.

Chemical residues

In food processing operations, some chemical compounds that are not permitted substances in food are used during certain operations and care must be taken to prevent unintentional contamination. These substances include chemical compounds used for cleaning and sanitizing food contact surfaces of processing, handling, and storage equipment, and for lubricating certain parts of food processing equipment.

Prohibited chemicals

No chemical substance is permitted for use in a food unless it meets all of the requirements that are covered in the applicable food laws and regulations.

Food allergens

Certain foods are known to contain inherent components that cause serious immunological, allergic responses in a relatively small proportion of food consumers. These foods are entirely safe for most consumers who are not sensitive to the allergens. The following foods and some of their products are generally considered to be the most common food allergens: peanuts, soybeans, milk, eggs, fish, crustacea, tree nuts, and wheat. Some other foods (e. g. , sesame seeds) are also known to cause allergenicity occasionally. In addition, sulfites (including bisulfites and metabisulfites) used as ingredients in certain foods can produce nonimmunological allergic reactions in certain sensitive individuals.

Physical hazards in foods

Physical hazards include organic or inorganic substances, commonly referred to as foreign objects, foreign matter, or extraneous materials. Hard and sharp physical hazards are of particular concern. Depending on their size and dimensions, hard and sharp physical hazards can cause injury to the mouth or teeth, or can cause serious injuries if swallowed. In addition, some physical

hazards, depending on their size, shape, and texture, have the potential to cause choking if swallowed. Physical hazards in foods can be particularly harmful to infants.

Certain hard and sharp foreign objects that are natural components of food (e. g., prune, date or olive pits; fish bones, nutshells) are not considered physical hazards since it is expected that the consumer will be aware that these objects are natural components of the foods. However, if the food carries a label stating that the hard and sharp object has been removed (e. g., pitted prunes), the presence of the hard and sharp object in the food represents a hazard, since it is not expected by the consumer.

The common hazards considered as avoidable physical hazards in foods include broken glass, pieces of hard or soft plastic materials, stones, pieces of metal, pieces of wood, and personal articles.

Broken glass

In a food plant, the common potential sources of broken glass include light bulbs, glass containers, and gauges with glass covers. Every effort must be taken to protect or eliminate these sources of broken glass, and to protect food from contamination with this hazard. In addition, many foods are packaged, distributed and sold in glass containers. For these foods, the glass packaging itself can be a source of broken glass.

Plastic

Both hard and soft plastic foreign objects are sometimes found in foods. In some food plants, some utensils and tools used for cleaning of equipment are made from hard plastic material; this type of plastic can become brittle from use over an extended period of time, and pieces can adulterate foods. The common sources of soft plastic foreign objects in food are plastic material used for packaging food and gloves used by employees who handle food.

Metal pieces

The most common sources of metal pieces in a food plant are food processing equipment, metallic cleaning tools, and equipment maintenance activities. In many food plants, magnets are used to eliminate some metals from foods, and metal detectors are used to detect the presence of metals in foods.

Wood pieces

The most common sources of wood pieces in a food plant are wood structures and wood pallets. The presence of these sources should be avoided whenever possible in food processing and production.

Stones

Many plant foods and particularly field crops such as peas and beans can contain small stones that become incorporated with the foods during harvesting. In addition, in food processing plants, a common source of stones is concrete structures, particularly concrete floors.

Personal articles

A variety of personal articles can become foreign objects in foods, resulting from unintentional adulteration by employees during preparation, handling, processing, and packaging. Personal

articles that have been found in foods include jewelry, pens or pencils or their parts, Band-Aids, and ear plugs.

Selected from: Alli, Inteaz. Food quality assurance: principles and practices. Florida: CRC Press LLC, 2004: 34-39.

Words and Expressions

pathogenic [ˌpæθəˈdʒenik] *adj.* 致病的，病原的，发病的
diarrhea [ˌdaiəˈriə] *n.* 痢疾，腹泻
poultry [ˈpəultri] *n.* 家禽
protozoan [ˌprəutəuˈzəuən] *n.* 原生动物
hepatitis [ˌhepəˈtaitis] *n.* [医] 肝炎
rotavirus [ˈrəutəˌvaiərəs] *n.* [微] 轮状病毒
food additive *n.* 食品添加剂
vitamin fortification 维生素强化，维生素增补
specification [ˌspesifiˈkeiʃən] *n.* 说明书，详述，说明
asthmatic [æsˈmætik] *adj.* 哮喘的，患哮喘症
oxalate [ˈɔksəleit] *n.* 草酸盐
rhubarb [ˈruːbaːb] *n.* 大黄，大黄的叶柄
alkaloid [ˌælkəlɔid] *n.* [化] 生物碱，植物碱基
shellfish [ˈʃelfiʃ] *n.* 贝类动物，甲壳类动物
adulterate [əˈdʌltəreit] *vt.* 掺杂；*adj.* 掺假的
aflatoxin [ˌæfləˈtɔksin] *n.* [生化] 黄曲霉毒素
mishandling [ˈmisˈhændliŋ] *n.* 不正确运转，违反运行规程
residue [ˈrezidjuː] *n.* 残余，渣滓，滤渣，残数，剩余物
livestock [ˈlaivstɔk] *n.* 家畜，牲畜
pesticide [ˈpestisaid] *n.* 农药，杀虫剂
herbicide [ˈhəːbisaid] *n.* 除草剂
fungicide [ˈfʌndʒisaid] *n.* 杀真菌剂
antibiotic [ˌæntibaiˈɔtik] *n.* 抗生素，抗菌素
veterinary drug *n.* 兽药
contaminant [kənˈtæminənt] *n.* 致污物，污染物
arsenic [ˈɑːsənik] *n.* [化] 砷，砒霜
lubricate [ˈluːbrikeit] *vt.* 润滑；*v.* 加润滑油
allergen [ˈælədʒən] *n.* [医] 变态反应原，过敏原
immunological *adj.* 免疫学的
sensitive [ˈsensitiv] *adj.* 易受伤害的，敏感的
bisulfite [ˌbaiˈsʌlfait] *n.* 重亚硫酸盐
metabisulfite [ˈmetəbaiˈsʌlfait] *n.* 偏亚硫酸氢盐
choking [ˈtʃəukiŋ] *adj.* 窒息的，憋闷的，透不过气来的
pallet [ˈpælit] *n.* 货盘

Organo-chlorinated compounds 有机氯化合物
Band-Aids 邦迪牌创可贴
Salmonella spp. 沙门氏菌
Eschericha coli 大肠杆菌
Lysteria monocytogenes 单核细胞增生李斯特菌
Clostridium perfringens 产气荚膜梭菌
Clostridium botulinum 肉毒杆菌
Staphylococcus aureu 金黄色葡萄球菌
Campylobacter jejeuni 空肠弯曲菌
Entamoeba histolytica 痢疾内变形虫
Giardia lamblia 肠兰伯氏鞭毛虫
Cryptosporidium parvum 微小隐孢子虫
Ascaris lumbricoides 蛔虫
Taenia solium 猪肉绦虫
Trichinella spiralis 旋毛虫

Notes

[1] risk assessment：风险评估，通过资料包括毒理学数据、污染物残留数据、统计手段、暴露量及相关参数的评估等，对食品中生物、化学或物理因素对人体健康产生的不良后果进行识别、确认和定量，决定某种食品有害物质的风险。

[2] risk management：风险管理，根据风险评估的结果，选择和实施适当的管理措施，尽可能有效地控制食品的风险，从而保障大众的健康。

[3] risk communication：风险交流，在风险评估人员、管理人员、消费者和其他有关团体之间进行的关于风险分析过程、相关风险、风险因素以及风险观察的一个信息、意见互动交流。

[4] HACCP（Hazard Analysis and Critical Control Point）：危害分析和关键控制点。确保食品在消费的生产、加工、制造、准备和食用等过程中的安全，在危害识别、评价和控制方面是一种科学、合理和系统的方法。有七条原则作为体系的实施基础，它们分别是：分析危害、确定关键控制点、制订预防措施、监控、纠正措施、确认、记录。

[5] low-acid canned foods：低酸性罐装食品。

[6] the Norwalk group of viruses：诺沃克类病毒，为发达国家流行性胃肠炎的主要病原，常可引起急性腹泻。

[7] the Codex Alimentarius：食品法典。食品法典由国际食品法典委员会（Codex Alimentarius Commission，CAC）制定，成为全球消费者、食品生产和加工者、各国食品管理机构和国际食品贸易重要的基本参照标准。

[8] FDCA（the Food，Drug and Cosmetic Act）：食品、药品和化妆品法。

[9] hepatitis A：甲型病毒性肝炎，是由甲肝病毒（HAV）引起的一种病毒性肝炎，主要是经粪－口传播途径感染，即由病人的潜伏期或急性期粪便、血液中的甲肝病毒污染水源、食物、用具及生活密切接触经口进入胃肠道而传播。

Exercises

Ⅰ Answer the following questions according to the text.

1. How many hazards are associated with food? Please give two or three examples for each.
2. What is the definition of risk analysis?
3. What is the meaning of agricultural residues? How many agricultural residues do you know?
4. How many factors are referred to as physical hazards in foods? What are they?

Ⅱ Translate the following English phrases into Chinese.

risk analysis　risk assessment　chemical hazard　organo-chlorinated compound
food additive　veterinary drug　physical hazard　maximum residual level
food poison　agricultural residue　HACCP　industrial contaminant

Ⅲ Translate the following Chinese phrases into English.

食品安全　风险管理　公共健康　最大容许水平　食物过敏原　病原菌
管理机构　风险交流　外来杂质　维生素强化剂　生物性危害　低酸性罐装食品

Ⅳ Choose the best answer for each question from the four given choices according to the text

1. Which of the following statements is NOT true about risk analysis?
   A. Risk analysis is usually conducted by a national food or health regulatory agency
   B. A risk analysis is comprised of risk assessment, risk management, and risk communication
   C. Risk analysis is the first of the seven HACCP principles
   D. A primary objective of risk analysis is to establish a national food safety objective for a hazard in a food
2. Which of the following does not belong to biological hazards?
   A. Pathogenic bacteria　B. Additives　C. Viruses　D. Parasites
3. Which of the following group is not included in the naturally occurring harmful compounds?
   A. Oxalate in rhubarb, alkaloids in potatoes
   B. Alkaloids in potatoes, toxins in mushrooms and in shellfish
   C. Oxalate in rhubarb, toxins in mushrooms and in shellfish
   D. Parasitic protozoan species, parasitic worms
4. Some people who are asthmatic could be at risk from foods containing _____.
   A. Alkaloids in potatoes　B. Parasites
   C. *Aflatoxins from molds in peanuts*　D. *Sodium bisulfite*
5. PCBs (polychlorinated biphenyls) are considered as _____.
   A. *Industrial contaminants*　B. *Chemical residues*
   C. Prohibited chemicals　D. Unavoidable contaminants
6. Which of the following statement about food allergens is true?
   A. Certain foods which contain inherent components that cause serious allergic responses in some food consumers should be prohibited in food market
   B. Certain foods which contain inherent components that cause serious allergic responses are not safe for all the consumers
   C. Peanuts, soybeans, milk, eggs, fish, crustacea, tree nuts, and wheat are generally considered to be the most common food allergens
   D. All of the above
7. All of the followings are physical hazards in foods except _____.
   A. Pieces of hard or soft plastic materials, pieces of metal

B. Pits of dates without a label stating that the pits have been removed

C. Pieces of wood, and personal articles

D. Broken glass, stones

V Translate the following short paragraphs into Chinese.

1. Risk analysis is usually conducted by a national food or health regulatory agency and addresses a public health concern regarding a particular food safety hazard associated with a sector of the food industry. A risk analysis is comprised of risk assessment, risk management, and risk communication.

2. Agricultural residues are a group of residual chemical or biochemical substances found in foods and are directly attributable to certain substances that have been approved for use in the production of crops and livestock for food. They include residues of permitted pesticides, herbicides, fungicides, drugs, hormones, and antibiotics.

Reading material

Food Safety and Food Security

Food safety is of public concern and its definition is evolving due to its highly political nature and its global health importance. Food safety is an integrated index of a degree of protection from hazards, of reliability, and of edibility of foods; therefore, safe foods are securely protected, reliably produced, and harmless edible and nutritious products. *Protection* means to secure the food products out of harm's way. *Reliability* implies dependable, trustworthy, and careful actions of the entire food stream, from producers to consumers. *Edibility* describes the nondangerous, harmless, or nontoxic nature of foods as well as their positive health benefits.

Hazards endangering food safety are of chemical, physical, or biological origin. Chemical hazards include pesticides, herbicides, insecticides, and other agrochemicals, and toxic compounds. Explosion, blade-cut, broken glass, stones, and other dangerous obstacles are physical hazards. Pathogens, virus, parasites, insects, rodents, and other unwanted organisms are biological hazards. Most of these hazards may inadvertently compromise the safety level of food products; however, intentional tampering of foods for any political reason and, more seriously, massive and destructive acts of terrorism represent another category. The unintended hazards may break out accidentally despite thorough quality and security assurance programs. However, malicious tampering and acts of bioterrorism are unpredictable, despite vigilant food inspection programs and regulations of oversight agencies, and not only jeopardize the level of public health but also destroy innocent human life and society.

Food security refers to the availability of food and one's access to it. Food security exists when all people at all times have access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Therefore, hunger or starvation is the consequence of a low level of food security. After September 11, 2001, the meaning of food security broadened to encompass reliable access to safe food.

Thus, the common meaning of food security changed to protection of the food system against bioterrorism. Basic approaches to antiterrorism and food safety actions involve (1) multiple lay-

ered defense lines, which are a great example of hurdle technology to enhance the level of newly defined security; (2) a reliable and prompt tracing system of data involved; and (3) precise assessments of risk and benefit. The effectiveness of antiterrorism and food safety programs is balanced with the convenience and quality of public services. In the case of food systems, the more convenient foods, such as ready-to-eat case products or minimally processed foods, are more likely to be contaminated with undesirable hazards than are fully cooked foods, canned foods, or military rations.

Selected from: Heredia, Norma., Wesley, Irene., Garcia, Santos. Microbiologically safe foods. New Jersey: John Wiley & Sons, 2009: 507-508.

Words and Expressions

massive ['mæsiv] *adj.* 厚重的，大块的，魁伟的，结实的
malicious [mə'liʃəs] *adj.* 怀有恶意的，恶毒的
bioterrorism [baiəu'terərizəm] *n.* 生物恐怖活动
vigilant ['vidʒilənt] *adj.* 警惕着的，警醒的
jeopardize ['dʒepədaiz] *vt.* 使处于危险之中，危及
antiterrorism [ˌænti'terərizəm] *n.* 反恐怖主义

Unit 2 Chemical Hazards

Chemicals can occur in the food chain due either to their existence in the environment through unintentional contamination of food, or to their intentional use somewhere along the food production chain. Generally, industrial pollutants are unintentional contaminants of foods, so, even if regulated, may be difficult to control. Agricultural chemicals are deliberately applied to land or crops during production, so their use can be both regulated and controlled. Some toxic chemical compounds can occur naturally in foods and in the environment.

Industrial Pollutants

Heavy metals

Heavy metals which can occur in foods include lead, arsenic, mercury, cadmium, copper, fluorine and selenium.

Lead can occur in animals grazing close to lead-smelting plants or after ingestion of paints or lead-containing substances. Paint on animal housing and fences may contain lead and be licked by farm animals. Animals accumulate lead in the bones, and acute exposure results in high lead levels in the liver and kidney.

Food animal exposure typically occurs via feeds or liquids contaminated with arsenical herbicides, rodenticides or insecticides. Arsenical compounds have been used as antiparasitics in the past, but are now largely obsolete. Accumulation of arsenic occurs in the liver and kidney, when fatty degeneration can be seen. Arsenic also accumulates in the bones of animals.

Cadmium is an increasing problem in farm animal production. Unacceptably high cadmium levels can occur in animals, particularly cattle, after grazing pasture irrigated with aerobically digested sludge. High levels of cadmium are a major concern in fish and shellfish hygiene, since the metal is a major water contaminant. Cadmium accumulates in body tissues and can ultimately cause kidney failure in humans.

Halogenated hydrocarbons

This group of reactive compounds includes polychlorinated biphenyls (PCBs), polychlorinated naphatelenes (PCNs) and dioxins.

Common sources of PCBs and PCNs are electrical machinery, industrial plants, lubricants, paints and some insecticides. These pollutants are extremely stable, and do not break down readily in the environment or in food. PCBs and PCNs accumulate in the liver. Their toxicity primarily relates to teratogenic and carcinogenic effects.

Dioxins have industrial origins similar to PCBs and PCNs. The main source of dioxins is the burning of chlorine-based compounds with hydrocarbons. Two industries which produce or use sig-