FOOD SAFETY WITH SPECIAL REFERENCE TO PUBLIC HEALTH

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Summary

In parallel with such important things as an air for breathing and water for drinking, food is one of the most important factors in the life support systems. It is known that a human-being can not survive a few minutes without breathing the air, several days without drinking the water, and slightly longer, however not very long, i.e. 25-30 days without a food. At the same time, the food products can be infected with pathogenic microorganisms, or contain toxic chemicals and radionuclides.

The most dangerous are the agents of zoonoses, i.e. diseases, which are common for humans and animals (anthrax, tuberculosis, brucellosis) as well as toxic microorganisms, such as Salmonella, Clostridium, Streptococcus and Staphyloccocus causing the food-borne diseases. Through meat and meat products humans can be infected by trichinelliasis, taeniidosis, onchocerciasis, and diphyllobothriasis. Food products can be contaminated by heavy metals (mercury, cadmium, lead), dioxins, polychlorinated biphenyls, mycotoxins, phytotoxins, radionuclides in quantities exceeding admissible levels.

To provide safety of the food products a complex of measures has been developed to prevent any contamination of them with dangerous biological, chemical and radioactive contaminants, and ways and methods for utilization of contaminated products have been proposed.

1. Introduction

It is known that food products can be contaminated by the pathogenic fungi, worm larvae, the toxic substances of anthropogenic and natural origin, radionuclides, resulting in food-borne infections and intoxications in humans. Meat and fish can be contaminated by Salmonella, enteropathogenic types of E. coli, larvae of parasitic worms, mycotoxins,

pesticides residues, heavy metals and radionuclides.

Milk, obtained from the cows with mastitis, may contain staphylococci and streptococci causing food-borne diseases; in cereals, affected by mold, the mycotoxins are detected sometimes; canned meat and vegetables can be contaminated by Clostridium botulinum toxins. The vegetables may contain increased levels of nitrates, pesticide and heavy metal residues. Moreover, they can be contaminated by the viruses causing human hepatitis A, Salmonella, pathogenic aerobic bacteria.

The foods of plant and animal origin, contaminated by the pathogenic microorganisms and toxic chemical substances, were demonstrated to be very dangerous for human health, therefore, they must be decontaminated and detoxicated.

2. Occurrence of the Food-borne Diseases

All these diseases can be broadly divided into four main groups. These are: (1) the diseases of microbial origin (including infections common for man and animals, e.g. anthrax, tuberculosis, brucellosis, tularemia, leptospirosis, etc.), human diseases only (e.g. cholera, infection hepatitis), salmonellosis, food-borne diseases; (2) parasitic diseases (trichinelliasis, taeniidosis, diphyllobothriasis); (3) chemical contaminant poisoning of the natural and anthropogenic origin in case of contamination of the food products with these agents (e.g. toxic elements, pesticides, dioxins, polychlorinated biphenyls, mycotoxins); (4) diseases due to the contamination of food products with radionuclides (137-cesium, 90-strontium, etc.).

The food-borne diseases, arising due to endotoxin-producing bacteria, were considered to be the most important among the diseases of microbial origin. These bacteria are Salmonella, enteropathogenic serotypes of E.coli, Proteus, Clostridium, etc. The bacteria, which can be potentially pathogenic agents, are Staphylococcus and Streptococcus.

As to the occurrence of the food-borne salmonellosis, meat and meat products from the farm animals, affected with salmonellosis, continue to be a high risk food, especially the commercially prepared food (force-meat, sausage-meat, galantine, headcheese, meat and liver pate, etc.).

Destruction of animal muscular tissues, occurring during the process of mincing meat, and the produced meat juice contribute to a dissemination and subsequent multiplication of Salmonella. Waterfowl can be Salmonella-carriers and, therefore, their meat and eggs can give rise to food-borne salmonellosis.

The food-borne salmonellosis can be also caused by finished products contaminated by Salmonella due to contaminated processing equipment, flies, rodents, etc. Moreover, the sources of infection can be often Salmonella-carriers, who deal with cooking of food.

The outbreaks of food-borne diseases of the Salmonella etiology are characterized by similar features (traits): they do emergently arise, have a mass character and simultaneously affect persons who take (ingest) the same food, they are limited in the territorial distribution and have no epidemiological “tail”. The disease can involve the

gastrointestinal tract (gastrointestinal infection), or have typhoid-, cholera-, flu-**like** manifestations or septic form. Incubation period averages usually 12-24 hours, but it may be longer (36-48 hours).

Enteropathogenic serotypes of E.coli were recognized to play certain role in the occurrence of food-borne diseases. In the past, this role was neglected in many countries because E.coli was considered as a persistent intestinal inhabitant in humans and animals. At present, both E.coli and Proteus are recognized (appreciated) to be the etiological factors of food-borne diseases resulting from massive contamination of food products with these bacteria.

In a case of colibacillosis in a human, the incubation period can be 8-24 hours. The clinical characteristics are pain in a region of abdomen, nausea, and diarrhea. Body temperature is normal and its rise up to 38-39°C is rare. A complete recovery occurs after 1-3 days.

In addition, the food-borne diseases can be caused by the ubiquitous environmental bacteria, viz Clostridium (Cl. Perfringers) and B. cereus. These are the several serotypes of Cl. Perfringers, however, the serotype which (most) commonly predominate as disease-causing agent in humans is Cl. Perfringers A., belonging to saprophytes.

Usually, the disease arises as a result of consuming the meat contaminated by the large number of the microorganisms and is characterized by pain in abdomen, nausea (rarely), and in some cases, vomiting and fever. The duration of the disease is often no more than 24 hours. The mass outbreaks of the disease with clinical manifestation (presentation) of intoxication tend to involve first of all children and the elderly or persons with certain underlying diseases.

B. cereus belongs to a group of aerobic spore-forming bacteria, which commonly predominate in the environment (in soil, air, water), in meat, by-products, ready-to-eat meat foods, vegetable food products. B. cereus contamination of the food products occurs by the exogenous route and does not produce any changes in their organoleptic properties.

B. cereus infections arise mainly due to foods of vegetable and animal origin contaminated with a large amount of the microorganisms. Incubation period is 3-24 hours. They are characterized by gastroenteritis (colic pain in abdomen, nausea, diarrhea) in the absence of fever or with a slight fever. The duration of the disease is up to 72-144 hours.

In recent times, a lot of information appeared relating to the food-borne diseases, caused by bacteria of Yersinia, Campylobacter, Pseudomonas, Citrobacter genera. These bacteria inhabit the human and animal intestines and can come from there into the environment including the food products (meat, milk, fish), where they can multiply intensively. The clinical presentations are fever, sickness, headache, nausea, vomiting, and diarrhea. In many cases, duration of the disease is 5-6 days, and this ends by recovering.

The food-borne infections can also arise due to the food products contaminated by Staphylococcus and Streptococcus. These microorganisms are widely disseminated in the environment and commonly inhabit respiratory tract, human and animal intestine. Some of them possess the pathogenic and toxin-forming properties producing ecotoxins, which, in

turn, promote occurrence of food-borne disease. Most cases of Staphylococcus infection occur due to Staphylococcus contaminated confectionery, cakes, milk, dairy produce (cream, sour cream, cheese, cream cheese, etc.). The cows and sheep with mastitis have been reported to be the main source of Staphylococcus and Streptococcus infections. The persons affected with pustular dermal diseases (integument and hands) can also be responsible for exogenic contamination by this group of organisms.

The disease is characterized by fast development, short incubation period, and acute gastroenteritis (nausea, vomiting, quick and liquid stools). In some cases, fever, collapse of cardiac activity, cramps, nasolabial and extremities cyanoses can be observed. The complete recovery occurs in 1-3 days.

Among diseases of the parasitic nature in humans, caused by (due to) the products of animal origin, trichinelliasis, taeniidosis (infestation with Taenia), onchocerciasis and diphyllobothriasis are known to be the dangerous diseases. For trichinelliasis in man to occur it is usually necessary to ingest Trichinella, contaminated with raw meat and insufficiently cooked meat product (to begin with pork products). Trichinella contamination is also likely to occur by ingestion of wild-boar's meat and bear's flesh.

Invasion in humans is characterized by a prevalence of allergic signs, e.g. muscle pain, edemata of eyelids and face, dermal eruption, hyper-eosinophilia (up to 50-60 and even 90%), followed by the serious complications at 3-5 weeks, viz, myocarditis, pneumonia, pareses, paralyses, neurological disorders.

A consumption of meat from the cattle with cysticerosis caused by bovine larval cestodes (Taeniarinchus saginatus) can result in the possible development of the helminty in human intestines. As a rule, it occurs due to raw or insufficiently cooked meat food (dishes), e.g. “stroganina”, “shashlyk”, “basturma”, beefsteaks. In digestive tract of a humans Cysticercus unscrews their scolex by gastric juice action. This is followed by attaching to the upper part of small intestine with the suckers and developing the parasite, which can grow up to 10 m in 2-3 months.

Pork can also be a cause of Taenia solium in humans. These cestode parasitizes exist in human intestine growing up to 3 m as well as the solitary tapeworm larvae, invasive for eyes and brain.

Diphyllobothrium latum infection can occur in humans as a result of eating (ingesting) fish.

The products of vegetable and animal origin can be the dangerous source of poisoning in humans with chemicals and pollutants from the environment as a result of using pesticides and chemical fertilizers in agriculture and in the control of disease vectors, of exposure to the contaminants from industrial effluents.

As present, the toxic elements, such as mercury, cadmium, lead, dioxins, polychlorinated biphenyls (PCB) are attracting increasing attention as factors of sanitary-toxicological importance.

Mercury is known to be the most dangerous contaminant of the environment and food products. The main sources of mercury contamination are chlorine, sodium hydroxide - producing plants, etc. Contamination of marine and river life by industrial effluents containing mercury creates the danger of poisoning in humans.

The cases of such poisoning in thousands of people took place (were observed) in Japan in 1953-1981; the disease was produced in people who ate fish and seafood rendered toxic by the presence of methylmercury from Minamata gulf where mercury contaminated effluents of a pulp and paper mill were poured out. This poisoning was named as Minamata disease. In 1972, the same outbreak of mercury poisoning was reported in Iraq.

Mercury is widespread element in the environment. The natural background levels of mercury in soil, fresh river water, grain, meat, fish are known to be 0.1-2 mg/kg, 0.1 mkg/1, 0.02 mg/kg up to 0.05 and 0.2-0.4 mg/kg, respectively.

However, the food products, which were produced (manufactured) or obtained in the problem regions, demonstrated 10-fold increasing mercury levels. Thus, mercury concentration in muscular tissue of pike fished in a river, contaminated with effluents of a pulp and paper mill was detected to be 20 mg/kg.

The permissible levels of mercury in mg/kg of a raw product were established in Russia to be 0.03 (meat), 0.005 (milk), 0.3 (fresh-water unpredatory fish), 0.6 (fresh-water predatory fish), 0.5 (marine fish), and 1.0 (tuna, sword-fish and white sturgeon).

Of the second sanitary-toxicological importance is cadmium. This heavy metal can also contaminate the environment and the food products. The sources of cadmium contamination are enterprises on zinc ore output and processing, electrolytic alkaline accumulator shops; automotive industry, paint, antiseptic mills, etc. Cadmium is persistent concomitant of lead and its antagonist. According to the hygienic classification, adopted in Russia, it belongs to the first class danger contaminant.

This element is reported in soil, plant, animal tissue. Its background levels were detected to be 0.01-0.7 mg/kg, 0.1-1.3 mg/kg, 0.16-0.24 mg/kg in soil, plants, meat, respectively. In 10-km zone around a zinc melting mill, the cadmium levels were found to be 4.9-21.6 mg/kg, 1.4-2.3 mg/kg, 1.0-2.3 mg/kg in wheat grains, beef, pork, respectively, whereas the maximum permissible level (MPL), established in Russia for meat, is to be 0.05 mg/kg.

Lead and its combinations have the great sanitary-toxicological importance, though (whereas) acute toxicity of the element to the warm-blood animals was found to be rather low. However, the prolonged exposure of humans to rather low doses of lead resulted in affects to the nervous system and haemo-producing (blood-producing) organ functions.

After ingesting lead contaminated food products the element tends to accumulate in bone tissues affecting bone marrow functions. The experiments, conducted in Russia, have demonstrated that 3-months of feeding of lead to the calves at 100 mg/kg dose resulted in element levels of 12.7-26.0, 1.9, 0.03 mg/kg in bones, liver, muscular tissue, respectively, whereas the maximum permissible level is to be 0.5

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Biographical Sketch

Professor German Aleksandrovich Talanov was born in May, 1925 in v. Troitskoye, Yaroslavsky oblast (region), Russia, and he graduated from the Moscow Veterinary Academy in 1953. First veterinary surgeon (up to 1961), then researcher, he became a chief of toxicology and feed hygiene laboratory at the All-Russian Research Institute for Veterinary Sanitation, Hygiene and Ecology until present time. Prof. Talanov moved successfully into the field of toxicology, veterinary hygiene, and ecology and achieved great national and international prestige. His contributions included new developments in veterinary medicine, writing and numerous publications (more than 160) and his books, such as " Veterinary problems on environment protection", "Feed hygiene. Handbook", "Veterinary toxicology. Manual for HEIs".