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Article Review

Biological Toxins in Foods: Source and Preservation

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ABSTRACT

Biological toxins are hazardous Compounds produced by a wide range of living organisms, including microorganisms, plants, and animals, and they pose a significant threat to the health of humans, animals, and even other plants. By definition, a toxin is a deleterious substance resulting from an organism's metabolic processes, typically highly unstable and especially harmful when introduced into living tissues. These substances are notorious for provoking antibody production due to their pronounced toxicity.

These toxins may originate from the metabolic activities of living organisms or as secondary metabolites from decomposing biological material. Additionally, Certain toxins arise as a Consequence of fermentation processes Conducted by bacteria or fungi, further broadening the scope of potential exposure to hazardous substances.

Food poisoning, otherwise known as foodborne illness, is a prevalent outcome of ingesting Contaminated food. While the majority of Cases resolve without medical intervention, specific populations face heightened risk. Pregnant individuals, adults over the age of 65, those with Compromised immune systems, and young Children are particularly susceptible, with the latter group especially vulnerable to dehydration. Consequently, understanding the sources and risks associated with biological toxins is Crucial for effective public health management and prevention strategies.

INTRODUCTION

Food poisoning, or foodborne illness, occurs when an individual Consumes food Contaminated with harmful agents. This Contamination is frequently the result of inadequate personal hygiene, insufficient Cleaning of storage or food preparation areas, and the use of unclean utensils. Contaminated food is defined as food that Contains harmful organisms, which may include bacteria, fungi, parasites, or viruses. In some Cases, these microorganisms are not directly toxic, but they produce toxic byproducts that Can Cause illness, as noted by the **American College of Medical Toxicology (2013).**

Upon ingesting a toxic substance, the hu-

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man body attempts to eliminate the toxin, typically through mechanisms such as vomiting, diarrhea, or fever. These symptoms represent the body's efforts to restore homeostasis and generally resolve within one to two days.

Regarding Causative agents, foodborne illness Can result from exposure to Chemicals, heavy metals, parasites, fungi, viruses, and bacteria. Of these, bacterial Contamination is the most Common Cause of food poisoning, though fewer than twenty bacterial species are responsible for the majority of Cases. Over 90% of food poisoning Cases annually are attributed to the following bacteria: Staphylococcus aureus, Salmonella, Clostridium perfringens, Campylobacter, Listeria monocytogenes, Vibrio parahaemolyticus, Bacillus Cereus, and entero-pathogenic Escherichia Coli. These pathogens are often present on raw foods. Generally, a significant bacterial load is necessary to induce illness.

As such, food poisoning Can be prevented by
(1) Controlling the initial bacterial Count.
(2) inhibiting bacterial proliferation.
(3) eliminating bacteria through sufficient Cooking.
(4) preventing re-Contamination of prepared foods.

Foodborne illness remains a persistent public health Concern, though it Can be mitigated through proper food handling and hygiene practices. It is estimated that, in the United States, foodborne diarrheal diseases affect between 24 and 81 million individuals annually, resulting in economic losses of $5 to $17 billion due to medical Costs and reduced productivity **(EFSA, 2014).**

Toxins are ubiquitous in nature and Can originate from a range of sources, including bacteria, fungi, and plants. These substances may enter the human body through ingestion (as in the Case of foodborne toxins) or injection (as with animal venoms), and they often disrupt normal physiological processes with potentially severe-and sometimes fatal-Consequences.

Bacterial toxins are particularly notorious for their role in serious diseases such as Cholera, tetanus, and botulism. These toxins are also significant Contributors to life-threatening Conditions like sepsis and necrotizing fasciitis. Tetrodotoxin, for example, is Commonly linked to pufferfish and is produced by associated bacteria. When ingested, tetrodotoxin blocks sodium Channels in nerve Cells, resulting in muscular paralysis that Can prove fatal without prompt intervention.

Fungal toxins, such as aflatoxins, frequently Contaminate Cereal grains and have a well-documented association with Chronic liver disease and hepatocellular Carcinoma.
Animal venoms Comprise Complex mixtures of various toxins, each with the potential to Cause a wide array of effects in humans, depending on the species and the Composition of the venom **(Jenner et al. 2017).**

Types of food poisoning: (Edyta Janik et al. 2019)

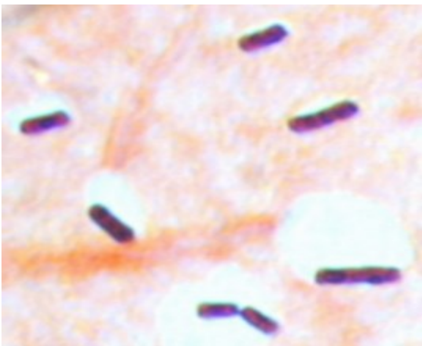
1-Spore-Forming Pathogenic Bacteria in Ready-to-Eat Food

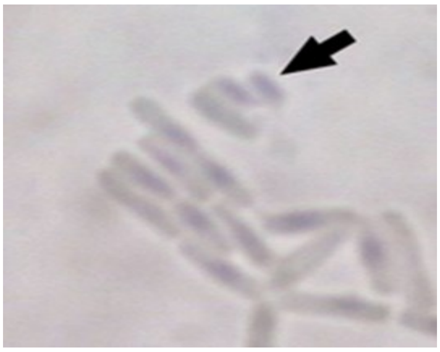
Regarding foodborne illnesses, Certain spore-forming bacteria, such as ***BaCillus Cereus and Clostridium perfringens***, present unique Challenges. These organisms Can exist in both spore and vegetative forms. Their spores are notably heat-resistant, enabling them to survive standard cooking processes. When food is left at room temperature for extended periods after Cooking, these spores Can germinate and proliferate. This underscores the importance of promptly storing Cooked food at temperatures of 4°C or lower to inhibit bacterial growth. Contrary to some beliefs, reheating food thoroughly does not always mitigate the risk if vegetative Cells have already multiplied during improper storage.

In summary, biological toxins and venoms represent significant hazards to human health, necessitating vigilance in food handling and awareness of environmental risks.

Illustration**: Vegetative Cells (left) and spores (right, under the arrow) of Bacillus spp. (Photo: Dr. Samson S.Y. Wong, Department**

of MiCrobiology, University of Hong Kong)





2- Non-Spore-Forming Pathogenic Bacteria in Ready-to-Eat Food – A Common Cause of Food Poisoning in Hong Kong

While spore-forming bacteria present clear challenges in food safety, the leading agents responsible for food poisoning in Hong Kong during 2006 were actually non-spore-forming pathogenic bacteria: *Vibrio parahaemolyticus, Salmonella* species, and *Staphylococcus aureus*. This observation prompts a closer examination of the underlying factors.

The prevalence of foodborne illness appears to be less about whether bacteria form spores and more about specific environmental and handling conditions. *Vibrio parahaemolyticus* is indigenous to marine environments and frequently associated with raw or undercooked seafood, as well as *with* cooked foods that become cross-contaminated. Consumption of raw seafood from unsanitary sources likely contributes to its high incidence. *Salmonella* species are commonly found in meats, poultry, and even fresh produce irrigated with contaminated water. Insufficient cooking and cross-contamination during storage or preparation increase the risk of salmonellosis. *Staphylococcus aureus*, meanwhile, is a normal constituent of human flora; food can become contaminated through poor personal hygiene, direct contact, or respiratory droplets. Inadequate temperature control further facilitates bacterial growth. Overall, improper or unhygienic food handling remains a primary driver of these outbreaks **(Slagboom et al. 2018).**

What is proper temperature for Storage and Cooking for some poisonous bacteria?

Temperature control is central to preventing the proliferation of these pathogenic bacteria. Regardless of their ability to form spores, it is essential to keep potentially hazardous foods outside the “danger zone” of 4°C to 60° C. Most pathogenic bacteria thrive within this temperature range. As indicated in the table on the following page, proper storage and thorough cooking are critical to reducing the risk of foodborne illness.

Pathogenic bacteria	Growth Temperature Range
Listeria monocytogenes	0-45°C (37 °C)
Salmonella spp.	6.5-47 °C (35-37 °C)
Staphylococcus aureus	7-45 °C (37 °C)
Bacillus Cereus (vegetative form)	10-49 °C (30-37 °C)
Clostridium perfringens (vegetative form)	10-52 °C (43-47 °C)
Vibrio parahaemolyticus	12.8-40 °C (37 °C)

***Optimal growth temperatures are shown in brackets Source: Bad Bug Book from the US FDA and Microbial Pathogen & Data Sheets from the New Zealand Food Safety Authority**

Listeria monocytogenes is notably resilient, capable of surviving and even multiplying at refrigeration temperatures (0°C). Fortunately, standard cooking procedures are effective in eradicating this pathogen. The principal concern arises with post-cooking contamination of ready-to-eat foods, as well as extended storage of raw foods that may harbor the bacterium.

Pathogenic bacteria exhibit varying resistances, but, generally, cooking food to an internal temperature of 75°C for a minimum of 30 seconds is sufficient to destroy most harmful bacteria-spore forms being a notable exception due to their heightened resistance.

It is important to recognize that while certain bacterial traits contribute to their pathogenicity, improper or unhygienic food handling by humans remains the leading cause of foodborne illness. Emphasizing proper food handling and hygiene practices is essential in significantly reducing the risk of bacterial food poisoning **(Ken, 2008).**

How can we prevent food born illness caused by bacteria?

Prevention of foodborne illness requires vigilance. Adhering to fundamental principles of safe food handling-including thorough cooking, avoiding cross-contamination between raw and cooked foods, and minimizing storage time of perishable items-serves as the most effective strategy for eliminating the risk of food poisoning. Ultimately, individuals play a crucial role in safeguarding food safety through conscientious practices

Bacterial Reference Table

Bacteria Responsible	Description	Habitat	Types of Foods	Symptoms	Cause	Temperature Sensitivity
Staphylococcus aureus	Produces a heat-stable toxin	Nose and throat of 30 to 50 percent of healthy population; also skin and superficial wounds.	Meat and seafood salads, sandwich spreads and high salt foods.	Nausea, vomiting and diarrhea within 4 to 6 hours. No fever.	Poor personal hygiene and subsequent temperature abuse.	No growth below 40° F. Bacteria are destroyed by normal cooking but toxin is heat-stable.
Salmonella	Produces an intestinal infection	Intestinal tracts of animals and man	High protein foods – meat, poultry, fish and eggs.	Diarrhea nausea, chills, vomiting and fever within 12 to 24 hours.	Contamination of ready-to-eat foods, insufficient cooking and recontamination of cooked foods.	No growth below 40° F. Bacteria are destroyed by normal cooking.
Clostridium perfringens	Produces a spore and prefers low oxygen atmosphere. Live cells must be ingested.	Dust, soil and gastrointestinal tracts of animals and man.	Meat and poultry dishes, sauces and gravies.	Cramps and diarrhea within 12 to 24 hours. No vomiting or fever.	Improper temperature control of hot foods, and recontamination.	No growth below 40 degrees F. Bacteria are killed by normal cooking but a heat-stable spore can survive.
Clostridium botulinum	Produces a spore and requires a low oxygen atmosphere. Produces a heat-sensitive toxin.	Soils, plants, marine sediments and fish.	Home-canned foods.	Blurred vision, respiratory distress and possible DEATH.	Improper methods of home-processing foods.	Type E and Type B can grow at 38° F. Bacteria destroyed by cooking and the toxin is destroyed by boiling for 5 to 10 minutes. Heat-resistant spore can survive.

Bacterial Reference

Bacteria Responsible	Description	Habitat	Types of Foods	Symptoms	Cause	Temperature Sensitivity
Vibrio parahaemolyticus	Requires salt for growth.	Fish and shellfish	Raw and cooked seafood.	Diarrhea, cramps, vomiting, headache and fever within 12 to 24 hours.	Recontamination of cooked foods or eating raw seafood.	No growth below 40° F. Bacteria killed by normal cooking.
Bacillus cereus	Produces a spore and grows in normal oxygen atmosphere.	Soil, dust and spices.	Starchy food.	Mild case of diarrhea and some nausea within 12 to 24 hours.	Improper holding and storage temperatures after cooking.	No growth below 40° F. Bacteria killed by normal cooking, but heat-resistant spore can survive.
Listeria monocytogenes	Survives adverse conditions for long time periods.	Soil, vegetation and water. Can survive for long periods in soil and plant materials.	Milk, soft cheeses, vegetables fertilized with manure.	Mimics meningitis. Immuno-compromised individuals most susceptible.	Contaminated raw products.	Grows at refrigeration (38-40° F) temperatures. May survive minimum pasturization temperatures (161° F for 15 seconds.)
Campylobacter jejuni	Oxygen sensitive, does not grow below 86° F.	Animal reservoirs and foods of animal origin.	Meat, poulty, milk, and mushrooms.	Diarrhea, abdomianl cramps and nausea.	Improper pasteuriztion or cooking. Cross-contamination.	Sensitive to drying or freezing. Survives in milk and water at 39° F for several weeks.
Versinia enterocolitica	Not frequent cause of human infection.	Poultry, beef, swine. Isolated only in human pathogen.	Milk, tofu, and pork.	Diarrhea, abdominal pain, vomiting. Mimics appendicitis.	Improper cooking. Cross-contamination.	Grows at refrigeration temperatures (35-40° F) Sensitive to heat (122° F)
Enteropathogenic E. coli	Can produce toxins that are heat stable and others that are heat-sensitive.	Feces of infected humans.	Meat and cheeses.	Diarrhea, abdominal cramps, no fever.	Inadequate cooking. Recontamination of cooked product.	Organisms can be controlled by heating. Can grow at refrigeration temperatures.

What are the most dangerous poisonous bacteria?

Staphylococcus aureus is a notable pathogen frequently present on human skin, in the respiratory tract, and in superficial wounds. Its relevance to food safety stems from the fact that, when allowed to proliferate in food, S. aureus produces a toxin capable of causing illness. This enterotoxin is notably heat-stable, meaning that while proper cooking destroys the bacteria, the toxin itself may persist and retain its harmful effects. Staphylococcal food poisoning is most often linked to foods prepared by hand—such as potato salad, ham salad, and sandwich spreads—especially when these items are left at room temperature for extended periods, allowing for significant toxin production. To mitigate the risk, adherence to good personal hygiene practices during food preparation and prompt refrigeration of both raw and cooked foods are critical.

Salmonella, another significant bacterial pathogen, is commonly found in the gastrointestinal tracts of both humans and animals. Foods rich in protein-meat, poultry, fish, and eggs-are particularly susceptible to Salmonella contamination. However, virtually any food can become a vector if contaminated and subsequently stored at inappropriate temperatures. Salmonella is inactivated by cooking at temperatures greater than 150°F. The primary contributors to salmonellosis are cross-contamination between raw and cooked foods, and insufficient cooking. Proper sanitation of food-contact surfaces and utensils, combined with refrigeration below 40°F, are essential preventive measures.

Clostridium perfringens, an organism prevalent in soil, dust, and the gastrointestinal tracts of humans and animals, also poses a significant foodborne risk. This bacterium can exist as a heat-resistant spore, which enables it to survive standard cooking temperatures. When foods contaminated with a sufficient quantity of C. perfringens are consumed, the bacteria can produce toxins in the intestinal tract, resulting in illness. Preventive strategies include minimizing the time cooked foods spend at room temperature and ensuring prompt refrigeration.

Vibrio parahaemolyticus

This one's a real ocean dweller—lives on seafood, loves salty water, can't stand the cold or too much heat. If you stash your seafood below 40°F and then cook it good and hot (over 140° F), you'll wipe out all the V. parahaemolyticus hanging around. Trouble starts when folks don't cook their seafood enough, or when raw stuff gets mixed up with already-cooked food, and then it all sits around at the wrong temp. Japan gets hit the hardest, probably because sushi is basically a national treasure. Oh, and there's V. vulnificus too—another ocean bacteria, just as fun. This one's on the rise but, honestly, you can shut it down with proper cooking and keeping things cold. Not rocket science.

Bacillus cereus

Meet B. cereus—it's basically everywhere: dust, dirt, spices. The annoying part? It laughs in the face of normal cooking because it can turn into a heat-resistant spore. Then, you let your rice or potato salad hang out at the wrong temp, and bam, it comes back to life and multiplies like crazy. It's always those starchy foods—rice, pasta, potatoes—that get hit. Spores can chill on raw foods, so even after you cook, you gotta serve them hot or cool them fast. Leave them in the "danger zone" and you're just asking for trouble.

Listeria

Back in the day, Listeria was mostly a farm animal problem. That all changed in the '80s, when outbreaks started popping up in places like Nova Scotia, Massachusetts, California, and Texas—thanks, modern food system! The thing about Listeria? It's tough. Hangs out everywhere, doesn't care about harsh conditions, and—get this—it can actually grow in the fridge. Yeah, you heard me. Pregnant women, the elderly, people with weak immune systems—they're all sitting ducks for this thing. Listeria monocytogenes is the real troublemaker; it causes listeriosis, which can feel like the flu or, weirdly, not much at all. Some folks don't even notice it, but if you're vulnerable, it can be deadly—like, up to 30% fatal for babies or immunocompromised people.

Here's the kicker: cold doesn't stop Listeria. At 39.5°F (aka, your fridge), it can double every day and a half. If you blast it with heat above 170°F, you'll kill it off—but once your food is cooked, any contamination from the environment is a big deal. Since Listeria likes to party in the fridge, keep your food moving—don't let stuff sit forever. Rotate it out, keep things clean, and remember: this bug is sneaky.

In summary, understanding the unique characteristics and modes of transmission of these bacteria is fundamental in developing effective food safety protocols.

Prevention

The foremost strategy for preventing foodborne illness is to recognize that all foods can serve as potential sources of contamination. To minimize risk, it is essential to adhere to established food safety protocols. This includes thorough handwashing, as well as cleaning food preparation surfaces and utensils both before and after handling raw foods to prevent cross-contamination. Refrigerated items should be maintained at temperatures below 40°F, while hot foods should be served promptly or kept above 140°F to inhibit bacterial growth. When storing large quantities of food, dividing them into smaller portions facilitates rapid and safe cooling. It is important to note that the temperature range between 40°F and 140°F is often referred to as the “danger zone,” where bacteria multiply most rapidly.

For those engaged in home canning, it is advisable to consult recognized guidelines from reputable sources, such as the USDA or Cooperative Extension Service. Canned foods must be thoroughly heated before tasting to reduce the risk of foodborne illness. When the safety of a food item is in question, it is prudent to discard it. Special attention should be paid to vulnerable populations, including infants, older adults, pregnant individuals, and those with compromised immune systems, who should avoid consuming raw fish, seafood, and undercooked meat products **(Heshmati, et al. 2021).**

Regarding fungal mycotoxins, these are toxic secondary metabolites produced by specific fungi during the colonization of food and animal feed. Mycotoxins represent a significant global public health concern due to their mutagenic, teratogenic, and carcinogenic properties. Common mycotoxins found in food include aflatoxins and ochratoxins (primarily from Aspergillus species), ochratoxins and patulin (from Penicillium species), as well as fumonisins, deoxynivalenol, and zearalenone (from Fusarium species). These compounds have been implicated in a variety of acute and chronic diseases in both humans and animals. Analytical techniques have been developed and refined for the detection and quantification of mycotoxins in food products, underscoring the importance of ongoing monitoring and food safety research **(Abdolmaleki, 2021).**

Mycotoxins in food aren’t just a minor concern-they’re an ongoing challenge for analysts and producers alike. Over the years, scientists have developed and utilized a variety of analytical methods to quantify and detect these toxins in food commodities **(Ingle et al. 2020).** Addressing contamination isn’t a one-size-fits-all process; mitigation strategies include physical, chemical, and biological approaches, each with their own advantages and limitations.

It’s important to note that a single mold species can produce multiple mycotoxins, meaning that a range of different toxins can end up in food products (**Kamle et al. 2019).** For instance, studies have identified the presence of NIV and DON in cereal-based goods, while ZEN, OTA, and aflatoxins were generally found at lower levels **(Mousavi Khaneghah et al. 2019).**

Environmental factors-such as moisture, temperature, and water activity-play a significant role in fungal growth and mycotoxin production. When these conditions are favorable, fungi can infiltrate the food matrix, posing risks to human health and reducing agricultural profitability **(Rausch, 2021).**

Among the most significant mycotoxins found in foods are aflatoxins (AFs), zearalenone (ZEN), T2/HT2, deoxynivalenol (DON), patulin (PAT), and ochratoxin A (OTA) ***(*Abhay et al. 2023).** Each of these compounds presents unique challenges in terms of detection, mitigation, and public health impact.

Mycotoxins commonly found in food and why they are of concern?

Mycotoxins are a common contaminant in food and represent a significant public health concern. Certain food-borne mycotoxins can have acute effects, causing severe illness shortly after ingestion of contaminated products. Others, however, are more insidious, contributing to long-term health problems such as carcinogenesis and immunosuppression. Among the hundreds of known mycotoxins, approximately a dozen are considered particularly concerning, both for their prevalence and their severe health implications.

Aflatoxins stand out as some of the most toxic mycotoxins and are produced by specific mold species, notably Aspergillus flavus and Aspergillus parasiticus. These fungi thrive in soil, decaying organic matter, and are particularly problematic in stored grains and hay. Crops commonly contaminated by Aspergillus include cereals (e.g., corn, sorghum, wheat, and rice), oilseeds (such as soybean, peanut, sunflower, and cottonseed), spices (including chili peppers, black pepper, coriander, turmeric, and ginger), and a variety of tree nuts (like pistachio, almond, walnut, coconut, and Brazil nut). Importantly, aflatoxins can also enter the human food chain via animal products; for example, aflatoxin M1 can be detected in milk from animals that have consumed contaminated feed **(WHO, 2018).**

The presence of aflatoxins in a broad spectrum of food products presents major challenges for food safety, particularly in tropical and subtropical regions where environmental conditions favor mold growth and toxin production. There is also the risk of these toxins being transferred to animal-derived foods, such as eggs, which further complicates control efforts **(Martin et al. 1998).**

Acute exposure to high levels of aflatoxins can result in aflatoxicosis, a potentially fatal condition primarily characterized by severe liver damage. Beyond acute toxicity, aflatoxins are genotoxic, meaning they can damage DNA and induce cancers in various animal species. Substantial evidence implicates aflatoxins in the development of liver cancer in humans as well. Consequently, aflatoxins are classified as human carcinogens, reflecting the significant risk they pose to public health. **(Yaling et al. 2008).**

Ochratoxin A, a mycotoxin produced by various Aspergillus and Penicillium species, is a widespread contaminant found in numerous food products—cereals, coffee beans, dried fruits, wine, grape juice, spices, and even liquorice. Its prevalence is a global issue, primarily arising during the storage phase of crops. The toxin's most significant toxicological impact is nephrotoxicity, though evidence also suggests potential effects on fetal development and immunological function. While experimental data in animals clearly demonstrate associations with kidney damage and carcinogenicity, the evidence in humans is less definitive; however, renal effects have been observed **(Khaneghah, 2020).**

How can I minimise the risk from mycotoxins?

Mitigating the risk of mycotoxin exposure requires awareness of the fact that molds capable of producing these toxins can infiltrate deeply into food matrices—not simply reside on the surface. Molds are unlikely to proliferate in conditions where foods are thoroughly dried and properly stored, so maintaining optimal storage environments is critical.

Recommendations for reducing mycotoxin risk include:

- Avoiding physical damage to grains during drying and storage, since damaged grains have heightened vulnerability to mold colonization and subsequent toxin production.
- Inspecting whole grains (such as corn, sorghum, wheat, and rice), dried figs, and a variety of nuts (including peanuts, pistachios, almonds, walnuts, coconuts, Brazil nuts, and hazelnuts) for signs of mold, discoloration, or shriveling, and discarding any compromised items.
- Purchasing grains and nuts that are as fresh as possible, as the risk of contamination increases with age.
- Ensuring food is stored in dry, insect-free, and temperature-appropriate conditions.
- Minimizing the duration of storage prior to consumption.
- Maintaining dietary diversity, which not only promotes overall nutritional adequacy, but also reduces the risk of significant exposure to any single contaminated food source.

Through these practices, the likelihood of mycotoxin-related health effects can be significantly reduced.

Chemical toxicity, though distinct from biological toxicity, poses a significant risk to human health. Among its various forms, metal toxicity is particularly noteworthy, partly due to its connection with foodborne illnesses. Cooking utensils, for instance, can serve as unexpected sources of such toxicity.

Metal toxicity, also referred to as metal poisoning, arises when certain metals, in specific forms and doses, exert harmful effects on living organisms. Some metals become toxic by forming soluble compounds, and several have no known biological function; their presence in the body can be detrimental **(Metals**

Primer, 2013).

A relevant example is aluminum cookware. Actions such as washing or scraping aluminum vessels with steel utensils can cause small particles of aluminum to dislodge. These particles may then enter food prepared in these vessels, leading to ingestion. It is estimated that, on average, individuals may ingest approximately 5 to 7 milligrams of aluminum daily through this route.

The risk increases when acidic foods, such as those containing lime or tomatoes, are cooked in aluminum vessels. Acidic substances facilitate the dissolution of aluminum ions into the food, thereby increasing exposure and potential harm.

The human body's capacity to eliminate these metals is limited. Once this threshold is exceeded, metals may gradually accumulate in various tissues, including muscle, kidneys, liver, bones, and even brain cells. Aluminum, in particular, exhibits neurotoxic effects attributed to its action as an oxidative free radical. The accumulation of such metals can ultimately result in slow, chronic poisoning **(Dr. Thombare, 2019).**

Given these risks, awareness of the materials used in cookware and food preparation is essential for minimizing exposure to harmful metals.

Throughout history, there have been accounts, such as those involving the British government, where food served to prisoners was intentionally prepared using aluminum cookware, presumably with the intent to reduce life expectancy. This historical anecdote highlights the awareness of metal toxicity long before modern science provided clear explanations. **(CDCP, 2012).**

When discussing metals and toxicity, lead stands out for its danger—even minimal exposure can have serious health impacts. While "heavy metals" are commonly associated with toxicity, lighter metals like beryllium and lithium can also be harmful under certain circumstances. (**Okereafor et al. 2022).**

Conversely, not all heavy metals are inherently toxic; iron, for instance, is essential for physiological function. The classification of metals as toxic often extends to trace elements, which become hazardous only in excessive amounts **(ACMT, 2013).**

In cases of metal poisoning, chelation therapy is a widely recognized intervention. This medical approach involves administering chelating agents, compounds that bind metal ions and facilitate their excretion from the body. Chelation should be reserved for individuals with confirmed cases of metal toxicity, as recommended by public health authorities **(Brodkin, et al. 2007).**

A defining feature of toxic metals is their tendency to bioaccumulate, both within the human body and throughout the food chain. Chronic exposure is therefore a principal concern. Radioactive heavy metals, such as radium, can mimic essential elements like calcium and become incorporated into bone tissue, leading to long-term health consequences. Similar mechanisms are seen with lead and mercury toxicity.

Environmental exposure to metals is ubiquitous, and trace amounts are often detectable through medical testing. However, detection alone is not sufficient to diagnose poisoning. Testing should be considered primarily when there is a clear history of exposure or clinical symptoms that suggest toxicity. Medical professionals are advised to rely on patient history and physical examination before pursuing further diagnostic testing.

For individuals concerned about possible poisoning, consultation with a healthcare provider is advised. Appropriate diagnosis and management depend on both clinical evaluation and laboratory findings. **(Brodkin, et al. 2007).**

Finally, foodborne illnesses, including those resulting from metal contamination, can affect anyone. While most individuals recover without intervention, vulnerable populations—such as pregnant women, older adults, young children, and those with compromised immune systems-face increased risks, particularly from complications like dehydration. Awareness of food safety practices remains essential for public health.

REFERENCES

Abdolmaleki K, Khedri S, Alizadeh L, Javanmardi F, Oliveira CA, Khaneghah AM. 2021. The mycotoxins in edible oils: An overview of prevalence, concentration, toxicity, detection and decontamination techniques. Trends Food Sci Technol2021,115: 500-511.

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ACMT. 2013. (American College of Medical Toxicology; American Academy of Clinical Toxicology (February 2013), "Five Things Physicians and Patients Should Question", Choosing Wisely: an initiative of the ABIM Foundation, American College of Medical Toxicology and American Academy of Clinical Toxicology, archived from the original on 4 December 2013, retrieved 5 December 2013, which cites and modified mycotoxins in beer.Food Chem2021,(338): 127801.

Antoniego Chrusciela “Montera” 105, 00-, Poland;m.ceremuga@wichir.waw.pl

Brodkin Elizabeth Copes Ray Mattman, Andre Kennedy James Kling Rakel Yassi, Annalee (2007-01-02). "Lead and mercury exposures: interpretation and action". CMAJ. 176 (1): 59–63. doi:10.1503/cmaj.060790. ISSN 0820-3946. PMC 1764574. PMID 17200393.

A Metals Primer" 2013. Dartmouth Toxic Metals Superfund Research Program. 2012-05-30. Archived from the original on 2013-12-30. Retrieved 2013-12-29.

CDCP. 2012. (Centers for Disease Control and Prevention. 2012-05-25) "Announcement: Response to the Advisory Committee on Childhood Lead Poisoning Prevention Report, Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention". Archived from the original on 2017-04-30.

Dr. Thombare's. 2019. Classical Homeopathy Health Blog: Dangerous Effects of Aluminium Utensils on Human body, Aug 10, 2019, Updated: Feb 16, 2021

Edyta Janik 1, Michal Ceremuga 2, Joanna Saluk-Bijak 1 and Michal Bijak 1,* (Biological Toxins as the Potential Tools for Bioterrorism)

EFSA Journal 2014;12(7):3782 Scientific Opinion on the public health risks of table eggs due todeterioration and development of pathogens1, EFSA Panel on Biological Hazards (BIOHAZ)2,3,European Food Safety Authority (EFSA), Parma, Italy.

Heshmati A, Khorshidi M, Khaneghah AM. 2021. The prevalence and risk assessment of aflatoxin in sesame-based products. Ital J Food Sci2021,33(SP1): 92-102.

ure/Forest Sciencehttps://www.who.int/newsroom/factsheets/detail/mycotoxins#:~:text=Key%20facts,under%20warm%20and%20humid%20conditions.

Ingle AP, Gupta I, Jogee P, Rai M. 2020. Role of nanotechnology in the detection of mycotoxins ,a smart approach. In Nanomycotoxicology, (pp. 11-33). Academic Press.

Jenner, R, Undheim, E. 2017. Venom: The Secrets of Nature’s Deadliest Weapon, The Natural History Museum,(UK).

Kamle M, Mahato DK, Devi S, Lee KE, Kang SG, Kumar P: Fumonisins. 2019. impact on agriculture, food, and human health and their management strategies. Toxins.

Ken Chong, 2008: -Food Safety Focus (25th Issue, August 2008) – Food Safety Platform (Biological Hazard in Food – Pathogenic Bacteria (Part II) Reported by Dr. Ken Chong, Scientific Officer, Risk Assessment Section, Centre for Food Safety *Correspondence: michal. Bijak @biol.

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Khaneghah AM, Moosavi MH, Oliveira CA, Vanin F, Sant'Ana AS. 2020. Electron beam irradiation to reduce the mycotoxin and microbial contaminations of cereal-based products: An overview. Food Chem Toxicol2020, 111557.

Martin HM, Bernatdo FM, Martins ML. 1998. Effect of Saccharomyces cerevisiae ATCC97631 on Aflatoxins production, 4th World Cong. Foodborne Infection and Intoxication, pp. 7-12.

Mousavi-Khaneghah A, Fakhri Y, Gahruie HH, Niakousari M, Sant'Ana AS. 2019. Mycotoxins incereal-based products during 24 years (1983–2017): A global systematic review. Trends food Sci. Technol.2019, (91):95-105.

Okereafor, Uchenna; Makhatha, Mamookho; Mekuto, Lukhanyo; Uche-Okereafor, Nkemdinma; Sebola, Tendani; Mavumengwana, Vuyo (January 2020). "Toxic Metal Implications on Agricultural Soils, Plants, Animals, Aquatic life and Human Health". International Journal of Environmental Research and Public Health. 17 (7): 2204. doi:10.3390/ijerph17072204. ISSN 1660-4601. PMC 7178168. PMID 32218329.

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Rausch AK, Brockmeyer R, Schwerdtle T. 2021. Development and validation of a liquid chromatography-tandem mass spectrometry multi-method for the determination of 41 freeReceived: 3 February 2019; Accepted: 3 March 2019; Published: 8 March 2019 Slagboom, J. 2018. Neurotoxicity fingerprintingofvenomsusingon-linemicrofluidicAChBP-profiling.Toxicon148,213–222.

WHO. 2018. World Health Organization, Mycotoxins Yaling W, Tongjie C, Guozhong L, Chansons Q, Huiyong D, Meiling Y, Bert-Andree Z, Gerd S. 2008. Simultaneous detection of airborne aflatoxin, Ochratoxin and zearalenone in poultry house by immuneaffinity column and high-performance liquid chromatography. Environ. Res., (107): 139-144.

Zhiguang, Xiao; Wedd, Anthony G. 2021. "Coping with Toxic Metals", pp 271-298 in "Metals, Microbes and Minerals: The Biogeochemical Side of Life" (2021) pp xiv + 341. Walter de Gruyter, Berlin. "Metals, Microbes and Minerals: . Walter de Gruyter, Berlin. Editors Kroneck, Peter M.H. and Sosa Torres, Martha. Gruyter.com/document/doi/10.1515/9783110589771-009 DOI 10.1515/9783110589771-009.