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Discussion on emergency management of food safety from the perspective of foodborne diseases caused by mycotoxins

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Abstract

Mycotoxins exists in foods such as grains, vegetables, fruits, milk, nuts, and meat, which can cause foodborne illnesses seriously harmful to human health. However, people have not paid enough attention to foodborne mycotoxin poisoning. This paper reviews the food in some common mycotoxin cause foodborne disease, the potential danger of mycotoxin contaminated food to human body and other issues related to food science were revealed from the clinical point of view, also concerned with the immunomodulatory effects of mycotoxin and the antitumor properties of patulin, the applicable conditions of several risk assessment models are briefly compared the emergency management measures of food safety problems caused by mycotoxin were also discussed from the perspective of prevention.

Keywords: mycotoxins; foodborne illness; food safety; risk assessment model; emergency management.

Practical Application: This paper reviews the food in some common mycotoxin cause foodborne disease, the potential danger of mycotoxin contaminated food to human body and other issues related to food science were revealed from the clinical point of view, the applicable conditions of several risk assessment models are briefly compared the emergency management measures of food safety problems caused by mycotoxin were also discussed from the perspective of prevention.

1 Introduction

Food is the paramount necessity of the people and food safety is the priority. Food science and technology are developing rapidly (Yuan & Sun, 2022), food safety is closely related to human health. Diseases caused by food contamination are one of the most common health problems in the world today. Foodborne pathogens caused approximately 600 million illnesses and 420,000 deaths in 2010 (Chhetri et al., 2021; Lu et al., 2021). In 1984, WHO adopted the term "foodborne disease" as a formal technical term to replace the term "food poisoning" in historical use, and defined foodborne disease as a class of diseases that usually has the nature of infection or poisoning caused by various pathogenic agents that enter the body through ingestion. When we buy food, we try to choose fresh vegetables and fruits and tend to buy products with no or fewer food additives. Is the food we buy really safe? One toxic substance we may not be able to avoid, even if we choose our foods carefully, is mycotoxin, which don't appear on ingredient lists but can be found in foods like grains, milk, fruits, and vegetables. Mycotoxin comes from the Greek word mycosis, which means fungus, and the Latin word Toxium, which means poison, is a low molecular weight metabolic secretion produced by fungi (Nji et al., 2022; Janik et al., 2020).

The main mycotoxin that affects food safety and human health includes aflatoxin (B1,M1 etc), ochratoxin and aspergillus toxin, fumonisin, zearalenone, etc. (El-Sayed et al., 2022; Alshannaq & Yu, 2017), most mycotoxin on human blood, kidneys, skin, central nervous system, and the immune system is poisonous, their effects can be deadly. Certain mycotoxin can be used as antibiotics (e.g. penicillin) for the clinical treatment of diseases (Phillips & Zhang, 2019; Marrez & Ayesh, 2022). The Co-occurrence of multiple mycotoxin in food may affect their toxicological effects in humans and animals (Zhao et al., 2022; Flores-Flores et al., 2015). Studies have shown that because of strict mycotoxin standards in developed countries, southern Africa's least contaminated foods are exported, while highly contaminated products are retained for local consumption, contributing to the high exposure levels of local populations (Matumba et al.,2016). In a survey conducted by Matumba et al. (2016) in Malawi; studies have shown that because strict mycotoxin standards in developed countries, the least contaminated foods in Southern Africa are exported, while highly contaminated products are retained for local consumption, contributing to high exposure levels in local populations. In an investigation conducted by Matumba et al. (2016) in Malawi and whether the problem of cheap food is a common phenomenon of food safety problems in countries around the world, and what is the real reason for the promotion, is there a similar reason for the big difference in the price of the same kind of food? And whether the production process and cooking technology will affect the contamination of food by mycotoxins (Feknous et al., 2021; Akman et al., 2022; Cui et al., 2022). These questions need to be answered on the premise of real and accurate data, which also suggests that more relevant investigations and studies are necessary to explore the real cause of food-borne diseases caused by mycotoxins (Matumba et al., 2016; Misihairabgwi et al., 2019).

The second part of this review is about the food in which various mycotoxin exist and the limit value of mycotoxins.The third part introduces mycotoxin and foodborne diseases. The fourth part is several common mycotoxin caused by foodborne diseases.

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The fifth part is about food safety emergency management. To study foodborne diseases caused by mycotoxin from the clinical perspective, and to discuss food safety emergency management from the perspective of prevention, hope people can pay more attention to fungal toxins in food problems, and more relevant research, to promote the improvement of food safety standards, achieve the purpose of protecting public health.

2 Mycotoxins in food

Mycotoxin exists in our daily food, the main mycotoxin that can be found in grains is aflatoxin, fumonisins, deoxynivalenol (DON), ochratoxin (OT) and zearalenone (ZEN) (Neme & Mohammed, 2017). Low levels of AFB1, DON, OTA and ZEA residues were found during barley processing to beer . Aflatoxin F1 can be detected in dairy products such as milk, and studies have shown a higher incidence of AFM1 contamination in commercial samples of milk in South Africa than in rural samples. Corn, peanuts and their products are the most susceptible to aflatoxin infection (Adejumo & Adejoro, 2014). OT can appear in grapes and grape products, dried figs, dried apricots, barley, soybean products, pistachios, peanuts, coffee and other foods, with relatively low content (Neme & Mohammed, 2017; Shen et al., 2018). PAT is commonly found in fruits and vegetables and their products, mainly contaminates apples, concentrated apple juice, hawthorn, hawthorn products, citrus, kiwi, cherry, blueberry, banana, strawberry, grape and other foods (Misihairabgwi et al., 2019; Adejumo & Adejoro, 2014; Shen et al., 2018). According to United States Department of Agriculture (2017) sorted out several See Table 1 for the various common mycotoxins in which foods they are found and their limited amounts in foods.

Table 1. Distribution of the various common mycotoxin in which foods they are found and their limited amounts in foods, according to United States Department of Agriculture (2017).

Mycotoxins	Foods	Limit (μg/kg)
AFM1	Milk and dairy products, infant formula/complementary food, nutritional supplements for pregnant and lactating mothers, formula food for special medical purposes, supplementary food supplements, sports nutrition	0.5
AFB1	Infant/infant formula/ supplementary food, nutritional supplements for pregnant and lactating mothers, formula food for special medical purposes, supplementary food supplements, sports nutrition	0.5
	Wheat and its products, barley and its products, other cereals, legumes and its products, other cooked nuts and seeds(except peanuts), soy sauce, vinegar, brewing sauces	5.0
	Rice A, brown rice, rice, vegetable oil (except peanut oil and corn oil)	10
	Corn and its products, peanut and its products	20
Ochratoxin A	Wine	2.0
	Nuts and seeds, Ground coffee (roasted coffee)	5.0
	Instant Coffee	10
Patulin	Fruit and its products	50
Zearalenone	Grain and its products	60
Deoxynivalenol	Corn, corn meal (residue, flakes), barley, wheat, cereal, wheat flour	1000

3 Mycotoxins and foodborne illness

Foodborne disease outbreaks (FBDO) are cases of two or more similar diseases resulting from the ingestion of a common food. Mild cases of foodborne diseases may be self-limited vomiting and diarrhea, and severe cases may lead to life-threatening neurological diseases. Correct diagnosis of foodborne diseases is of great significance for food safety and human health. Pathogens of foodborne diseases include bacteria, viruses, fungi, and parasites (Zhou et al., 2015). Fungi is among the most lethal organisms that cause foodborne illness, with aspergillus, fusarium graminis, and other molds linked to about 0.5% of incidents, causing 1% of illness and 0.5% of death (Pascari et al., 2022). However, people often ignore the pathogens of some foodborne diseases (Xue & Zhang, 2013), studies have shown that fruits and vegetables are the main food for some foodborne disease outbreaks, but only some common pathogens such as viruses have been found in the literature examination results (Bennett et al., 2018), most of the research may be aware of the dangers of foodborne diseases, however, mycotoxin as pathogens of foodborne diseases have not received sufficient attention, and literature is not clear on whether mycotoxin have been tested. Of course, the detection of mycotoxin requires sample preparation, the need to prepare the reagent consumables and highly effective liquid phase color spectrometer, the time cost and the economic cost is higher, could lead to fewer tests for mycotoxin, nevertheless, mycotoxin can do great damage to human health, and underreporting and misdiagnosis may lead to serious consequences. In addition, a lack of good differential diagnoses of diseases may also lead to underreporting and misdiagnosis. Diarrhea is a common clinical symptom of foodborne diseases. Furthermore, in this case, patients may not be aware of the occurrence of foodborne diseases and fail to check the pathogens in the hospital in time. Moreover, some survey results may not be published in professional journals, which also hinders the collection and collation of research data in the later stage (Xue & Zhang, 2013; Chen et al., 2022; Scallan et al., 2011). Mycotoxin is carcinogenic and teratogenic. Patients with low immune function, such as AIDS patients, some cancer patients, patients receiving immunosuppressive drugs such as organ transplantation and bone marrow transplantation, and underweight newborns are more susceptible to fungal infection (Neme & Mohammed, 2017; Saleh & Goktepe, 2019; Li et al., 2021), it can lead to a variety of human diseases, including in many tropical and liver cancer in developing countries, Reye syndrome, Indian children malnutrition in liver cirrhosis, chronic gastritis,physical and mental retardation, reproductive and nervous system diseases, etc., which may also cause occupational cancers of lung and skin (Adeyeye, 2020; Benkerroum, 2020). Liver cancer is the third leading cause of cancer death worldwide. The global burden of aflatoxins may play a pathogenic role in

4.6E 28.2% of global hepatocellular carcinoma (HCC) or liver cancer. Exposure to aflatoxins increases the risk of liver cancer exponentially in patients with chronic hepatitis B virus (HBV) infection. The pathogenesis of aflatoxin and other mycotoxins will be discussed later (Neme & Mohammed, 2017).

4 Several common mycotoxins cause foodborne illness

4.1 Aflatoxin

Patients with aflatoxin poisoning may have jaundice, abdominal pain, vomiting, diarrhea, ascites, and other clinical symptoms. The pathogenic mechanism of aflatoxin is related to its high fat-soluble compound, which can be rapidly absorbed into the bloodstream from the exposed site through the gastrointestinal tract or respiratory tract. Its primary target organ is the liver, which typically produces acute cirrhosis and necrosis with edema and bleeding, but high concentrations of aflatoxin have also been found in the kidneys, lungs, heart, and brain (Marrez & Ayesh, 2022). In addition, some diseases such as malaria and AIDS may be due to the immunomodulatory effects of aflatoxin, because of immune regulation, the repeated infection of children leads to growth disorders or changes in intestinal integrity, making the host more vulnerable to foreign intestinal microorganisms (Nji et al., 2022; Matumba et al., 2016).It has also been suggested that aflatoxins may cause nutritional disorders by interfering with the absorption, protein synthesis, and metabolic enzyme activities of micronutrients (such as zinc, iron, and vitamins) (Benkerroum, 2020; Degen, 2017; Degen et al., 2017). It may, together with other mycotoxin, affect the development of edema in malnourished people and is also associated with Kwashiorkor disease (Misihairabgwi et al., 2019; International Agency for Research on Cancer, 2012).

There are four common types of aflatoxin, namely B1, B2, G1, and G2. The most dangerous one is AFB1, which is classified as a human carcinogen (Group 1 carcinogen) by the International Agency for Research on Cancer (IARC) and can cause death at high doses (Misihairabgwi et al., 2019). Long-term exposure to AFB1 has strong toxic effects such as carcinogenesis, teratogenicity, mutagenicity, immunosuppression, and nutritional disorders (Sun et al., 2015; Theumer et al., 2018), which may cause primary jaundice, liver cancer, chronic hepatitis, and cirrhosis (Marrez & Ayesh, 2022; Schabo et al., 2021). AFB1 has strong acute and subacute toxicity in humans and animals after short exposure. The main acute toxicity of AFB1. Sex is to cause the liver injury, including liver cell swelling, vacuolar degeneration, liver swelling, bleeding, necrosis, degeneration, etc. Subacute toxicity is mainly reflected in cirrhosis, bile duct hyperplasia, gastrointestinal disorders, anemia, etc. AFB1 is carcinogenic mainly because it is activated by liver drug metabolism enzyme to form the active metabolite, AFB1-EXO 8, 9-epoxide, which damages DNA structure and affects its function. Afb1-Exo 8, 9-epoxides are currently considered to be the ultimate cause of genotoxicity (Benkerroum, 2020). It is produced through the metabolism of cytochrome oxidase P450 (CYP3A4), and this active product can react with DNA nucleophilic reaction to form AFB1-DNA admixture, resulting in STRUCTURAL changes of DNA, and thereby promoting or leading to carcinogenesis. Studies have shown that AFB1 can also cause mutation of p53 and activation of RAS oncogene (Shen et al., 2018).

There is also evidence that AFB1 has an equally significant or higher effect on the cell function and integrity by inducing oxidative stress (OS) (Benkerroum, 2020; Omara et al., 2020). Aflatoxin M1 is a mammalian hydroxylated metabolite of AFB1 excreted through urine and has been classified as a possible human carcinogen in breast milk (Group 2B) (Misihairabgwi et al., 2019; International Agency for Research on Cancer, 2012; Pimpitak et al., 2020; Abdullah Murshed et al., 2022; Jakšić et al., 2021). Studies have shown that the effect of AFB1 and AFM1-induced injury and its ability to induce cancer initiation is related to a group of genes/proteins/miRNAs (Bilandžić et al., 2022; Marchese et al., 2018).The decline in aflatoxin levels depends on the combination of time and temperature and is not affected by fermentation. Aflatoxins can be destroyed by acid and base hydrolysis and the activity of oxidizing agents. Ozone is used to purify aflatoxins (Marrez & Ayesh, 2022; Jardon-Xicotencatl et al., 2015). Some chemicals, such as antifungal agents, anthocyanin, flavonoids, polyphenols, carotenoids, silymarin, etc., may also inhibit the growth of Aspergillus flavus (Shen et al., 2018; Zhou et al., 2015; Bovo et al., 2014; Mamo et al., 2020; Valencia-Quintana et al., 2020). Studies have found that low carbohydrate intake and the calorie restriction can reduce the symptoms associated with aflatoxin, and a high protein diet can help detoxify aflatoxin in the body. There are also conflicting results on the impact of dietary fats, as high fat intake promotes the development of aflatoxin compared to a low-fat diet (Nurul Adilah & Mohd Redzwan, 2017).

4.2 Patulin

Patulin has antibiotic properties and has a variety of complex toxic effects, including acute toxicity, carcinogenicity, neurotoxicity, cytotoxicity, genetic immunity, and reproductive toxicity (Misihairabgwi et al., 2019; Sohrabi et al., 2022; Assunção et al., 2016). It will damage the liver, kidney, gastrointestinal tract, endocrine glands, immune system, and other important organs and systems (Pal et al., 2017). Patulin has been shown to have a toxic effect on intestinal barrier function, which may significantly alter the composition of normal intestinal flora (Robert et al., 2017; Akbari et al., 2017). In addition, patulin shows an inhibitory effect on a variety of enzymes (ATPase, lysosomal enzyme, RNA polymerase, etc.) due to its affinity for sulfhydryl groups (Saleh & Goktepe, 2019; Ramalingam et al., 2019). PAT-induced intestinal barrier disruption is associated with endotoxemia, systemic inflammation, and tissue damage(Zhai et al., 2019). PAT may be sex-dependent men are more sensitive than women and endocrine-disrupting activity (Saleh & Goktepe, 2019; Nan et al., 2022; Soler & Oswald, 2018).The carcinogenic intensity of PAT is controversial. WHO considers PAT to be a strong genotoxic substance. The International Agency for Research on Cancer (IARC) considers that the carcinogenicity of PAT to humans cannot be determined and defines it as a suspected carcinogen to humans. Patulin is classified as a Group 3 human and animal carcinogen by the International Agency for Research on Cancer (IARC) (Shen et al., 2018; Ramalingam et al., 2019). Drug development initially found that PAT had similar pharmacological activity to β -lactam antibiotics, but subsequent studies stopped drug development due to its multiple toxicities (International Agency for Research on Cancer, 2012). PAT may have anti-tumor effects, which can lead to apoptosis of tumor cells and affect the expression of several key proteins including cell connection, membrane potential, protein synthesis, cell signal transduction, and the gene expression. By activating oxidative stress response, as a result, overexpression of apoptosis-related proteins p53, Bax, and caspase-3 can be induced (Ramalingam et al., 2019). However, since the growth arrest mechanism of tumor cells is similar to that of non-tumor cells, PAT may not be able to distinguish tumor cells from normal cells when it plays a role. This requires further research to solve the problem (Saleh & Goktepe, 2019). If we can pay more attention to mycotoxin, develop a method that allows patulin to distinguish tumors from normal cells, or find an intermediary to play the anticancer effect of patulin, food safety problems will be alleviated to a certain extent. Patulin may be associated with allergic diseases. Cytochrome P450 inhibitor (Proadifen) increased patulin toxicity while cysteine decreased it (Saleh & Goktepe, 2019; Tokarova et al., 2019; Puel et al., 2010).

Patulin in fruit juices can be removed or degraded by physical treatments such as heat treatment, ultraviolet radiation, pulsed light, and high hydrostatic pressure. Ascorbic acid, potassium permanganate, ammonia, sulfur dioxide, ozone, Vitamin B, and other chemical additives can also be used for patulin degradation, among which ozone has great potential to degrade patulin in liquid food, but ozone is very harmful to the human body, so whether it can be applied to patulin degradation needs further study. The combination of sodium bicarbonate and citric acid as additives in apple juice may be considered to reduce patulin levels (Kim et al., 2018; Diao et al., 2018). When testing patulin in food after that, attention should be paid to whether the detection rate of patulin in samples with additives is reduced, but at the same time, consumers may, in the future, whether to consider mycotoxin when buying goods should be taken into account to decide whether to buy fresh-squeezed food or juice with additives, which also requires further comparative research on the damage degree of mycotoxin and additives to the human body. A 2017 study showed that patulin levels in breast milk was not at dangerous levels after a single dose of maternal exposure (using mathematical models) and multiple exposures, while other mycotoxin were at risk (Degen, 2017; Degen et al., 2017; Li et al., 2020). A study conducted in France assessed the exposure of pregnant women to patulin and showed that pregnant women consumed a higher amount of food daily associated with patulin exposure. Vegetarian mothers who ate more fruit a day were expected to be at risk for another fungal toxin, including patulin. The average daily intake of penicillin in the French population was determined to be 18-30 ng/kg BW, while the estimated average intake in the vegetarian population in the same study was significantly higher (34-50 ng/kg BW) (Saleh & Goktepe, 2019; Shen et al., 2018). Some biological agents (lactic acid bacteria, saccharomyces cerevisiae, saccharomyces cerevisiae, filamentous fungi, lactone degrading enzymes)can also be used to reduce patulin, but the effect of the remove method on the nutritional composition and taste of food needs to be further studied (Shen et al., 2018).

4.3 Other mycotoxins

Ochratoxin, zearalenone and deoxynivalenol

There are 7 ochratoxin species with obvious toxicity, among which OTA is the most toxic and is classified as a class 2B carcinogen by WHO and IARC (Shen et al., 2018; Wang et al., 2016). OTA has a variety of toxicity to animals and humans, including carcinogenic and teratogenic toxicity, neurotoxicity, nephrotoxicity, genetic toxicity, immunosuppression, etc. The first toxic effect of OTA is immunosuppression (Shen et al., 2018; Darif et al., 2016; Stoev, 2015). Zearalenone is a toxin that is fatal to animals and humans, can cause vomiting, nausea, and diarrhea at high concentrations, and has strong estrogen activity, which may lead to human high estrogen syndrome, female reproductive organ changes, cervical cancer and other diseases (Neme & Mohammed, 2017; Adeyeye, 2020; Desjardins & Proctor, 2007; Alvito et al., 2021). It also has strong genotoxicity, cytotoxicity, and the anabolism activity mainly manifested as apoptosis, strong embryological toxicity, and oxidative stress, which may lead to esophageal cancer (Phillips & Zhang, 2019; Adeyeye, 2020; Awuchi et al., 2022). Consumption of cereals contaminated with DON may cause acute gastroenteritis (Misihairabgwi et al., 2019).

Alternaria mycotoxin, fumonisin and ergot alkaloids

Alternaria toxin has an acute toxicity, carcinogenic, teratogenic, mutagenic, and other toxicity to humans and animals. According to epidemiological investigation reports, it may be related to the continued high incidence of esophageal cancer (Ülger et al., 2020). The mutagenic mechanism of AOH may be through the inhibition of topoisomerase I and II activities, leading to the abnormal topological structure of DNA in the replication process, thus making DNA unable to replicate normally (Fernández-Blanco et al., 2016a, b). Fumonisin is a cancer promoter associated with developmental delay in children and may cause birth defects(Adeyeye, 2020). FB1 is classified as a group 2B carcinogen (possibly carcinogenic to humans) by the International Agency for Research on Cancer is a pathogenic factor for esophageal and liver cancer in humans(Misihairabgwi et al., 2019). It may cause idiopathic congestive heart disease (ICC) (International Agency for Research on Cancer, 2012; Stoev, 2013, 2015). Ergot alkaloids is nephrotoxic, immunosuppressive, teratogenic, and carcinogenic in animals and has been classified as a probable human carcinogen (Cicoňová et al., 2010). Ergot, the disease it causes, is now eliminated as a human disease, but it is still present in animal feed. Ergot alkaloids are widely used in the pharmaceutical industry (Adeyeye, 2020).

5 Food safety emergency management

5.1 Risk assessment

Food safety risk assessment refers to the use of existing scientific data and scientific means to identify, confirm and quantitative analysis of food hazards to human health factors. Hazard identification refers to the determination of the toxicity of a substance, and the identification of the inherent nature of its adverse effects; Hazard characteristic description refers to the qualitative and hierarchical assessment of hazards by comparing the size of overdose with the corresponding dose response relationship standard. The dose response assessment defines the relationship between the exposure intensity and the probability of occurrence of the possible health impact spectrum. Exposure assessment qualitative or quantitative assessment of biological, chemical and physical factors based on dietary survey and survey data of exposure levels of harmful substances in food; Exposure assessment refers to the estimation of the likelihood of a health hazard from exposure. It is the core of the food safety risk analysis system, and the formulation of food safety limit standards and related regulations should be based on the results of risk analysis (European Food Safety Authority, 2020; Song & Zhao, 2008). The following Figure 1 shows the basic model of food safety risk assessment and the sequence of the process (European Food Safety Authority, 2019; Gorris & Yoe, 2014; Nie & Li, 2014; Akbari et al., 2017).

Much of our knowledge about risk assessment of the incidence of pathogens or toxins in food, dose-response knowledge, the incidence of acute food-borne diseases, the incidence of chronic sequelae, and the cost of food-borne diseases is qualitative and needs to be paid enough attention to carry out more relevant studies (Karsauliya et al., 2022). The HACCP system was first proposed at the National Food Protection Conference in 1971. It is a preventive plan to ensure consumers have access to a safe food supply. The main purpose of HACCP is to try to minimize and eliminate metal fragments, pathogenic microorganisms, and harmful chemicals to maintain food safety (Wu & Rodricks, 2020). HACCP consists of the following seven parts: Harvard analysis, identification of critical control points, implement control measures and determination standards, monitoring of critical control points, taking corrective actions, establishing and maintaining HACCP system records, and verifying HACCP system (Karsauliya et al., 2022; Wu & Rodricks, 2020). The design,

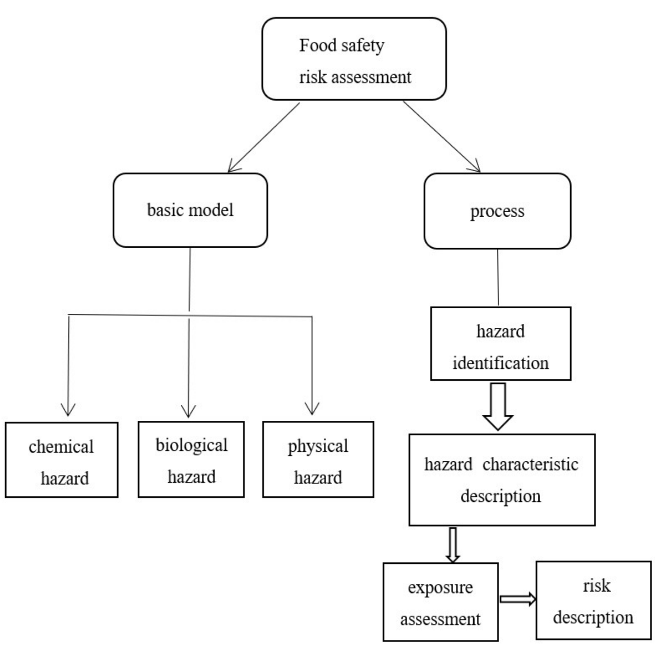

Figure 1. The basic model of food safety risk assessment and the sequence of the process.

implementation, control, and management of the 2014 HACCP system is crucial to the production of safe food products, which is also of great significance to food safety risk assessment. Risk assessment methods include fuzzy comprehensive evaluation, index scoring, and GRA-based Analytic Hierarchy Process (AHP) combined with Monte Carlo Algorithm (MC) and rough set model. The first three evaluation methods are greatly influenced by subjective indicators. While MC can evaluate the distribution and frequency of possible results under various conditions (Huang et al., 2018), it does not combine subjective indicators to reflect risk preference (Yang, 2011)., but when the number is small, the accuracy of MC is low (Smith & Thrane, 2018; Han et al., 2019). The rough set model does not require prior knowledge beyond data and is complementary to fuzzy theory, thus becoming a research hotspot (Nie & Li, 2014).

In recent years, some researchers proposed a hidden Markov model (HMM) based on grey correlation analysis (GRA). The weight of evaluation indicators adopts nonlinear correlation analysis to ensure the objectivity of research results. GRA is a multi-factor statistical analysis method. It can divide the geometric relations of statistical sets of complex systems by comparing the relations among multiple factors in complex systems (Han et al., 2019; Lin et al., 2019). In addition, some scholars proposed a cuckoo search algorithm based on the improved Hidden Markov model. Dynamic risk assessment of food safety -- disinfection milk study (Lin et al., 2021). Risk assessment is of great significance to the proposal of food safety emergency management measures, but the application of the risk assessment model still needs sufficient research data to be brought into the model, to intuitively compare which model has greater research value.

5.2 Food safety emergency management

Surveillance studies of foodborne disease outbreaks in the United States from 2009 to 2019 showed that some outbreaks may have an unknown etiology, most foodborne diseases occur outside the range of confirmed outbreaks, and unknown pathogenic pathogens are sometimes reported as confirmed or suspected causes. And the use of culture-independent Diagnostic Tests (CIDTs) to identify previously unrecognized infections may increase the incidence (Dewey-Mattia et al., 2018; Tack et al., 2020; Iwamoto et al., 2015). Health hazards associated with mycotoxin ingestion are not fully recognized (Matumba et al., 2016; Misihairabgwi et al., 2019; Mboya & Kolanisi, 2014; Mukanga et al., 2011). How can we avoid mycotoxin hidden in the foods we eat regularly? Corresponding food safety emergency management measures are very important. This paper only discusses the corresponding measures of food safety emergency management from the perspective of prevention. It is often too late to carry out emergency management after food safety accidents. Effective preventive measures are the key to solving the problems. For example, strengthening the supervision of mycotoxin in food can promote cooperation between supermarkets or food processing plants and research institutions related to mycotoxins (Chen et al., 2019; Al-Tayyar et al., 2020). Having qualified laboratories help determine the presence of mycotoxin in other processed or supermarket foods would increase consumer awareness of mycotoxins, moreover, the detection report of a professional organization will make consumers feel more assured when shopping, which may enable sellers to have healthy competition. To increase sales, sellers are more willing to take the initiative to go to the professional organization for testing, which is conducive to food safety testing, reduces the safety risk of promotional food, and thus achieves the purpose of preventing foodborne diseases (Hislop & Shaw, 2009; Lamm et al., 2021). However, due to random inspection, there may be omissions, but also pay attention to the occurrence of relevant situations. And usually, for clinical symptoms and foodborne diseases, similar cases should also pay attention to the detection of true toxins, to reduce the occurrence of missed diagnoses. The key to effective prevention is to pay enough attention to existing problems. Some researchers believe that mass media can publicize food safety risks more and increase the public's attention to food safety issues (Xue & Zhang, 2013; Ruiz-Capillas & Herrero, 2019; Manning et al., 2021; Awuchi et al., 2021).

6 Conclusion

Food-borne diseases caused by mycotoxin seriously harm human health, but in most cases, only some common pathogens are detected, while mycotoxins are ignored. The clinical symptoms of food-borne mycotoxin poisoning are not specific, and it is easy to lead to under-reporting and misdiagnosis. Moreover, mycotoxin may exist in all kinds of food in daily life and have coordinated pathogenic effects. Once eating relevant food for a long time accumulates over a long period time, the harm to human health caused by excessive amounts is immeasurable. Further studies are needed on the immunosuppressive and carcinogenicity of mycotoxin and the growth retardation of tumor and non-tumor cells by patulin. In addition, from the point of view of cost-saving and food safety, food safety emergency management can have corresponding preventive measures is worth exploring, the cooperation between scientific research institutions and manufacturers and sellers may help solve food safety problems. The importance of food safety issues caused by mycotoxin may influence whether more research can be carried out. Previous studies have shown that public awareness of mycotoxin-contaminated products is insufficient and relevant knowledge education is needed. This article from the perspective of mycotoxin causes foodborne illness aimed at more intuitively reflect the mycotoxin the harm to human body health, to further raise awareness of mycotoxin the problems existing in the food, food safety risk assessment through more relevant data, and further promote the food safety emergency management measures proposed, however, it remains to be further discussed whether quantitative and qualitative research can be combined for emergency management research.

Conflict of interest

None.

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