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Editorial

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Mycotoxins as Agroterrorism Nanoweapon

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Introduction

Mycotoxins can be divided into 4 groups (polycetoacids, terpenes, cyclopeptides, and nitrogenous metabolites[1]. The main group ofmycotoxins, aflatoxin (AFs), zearalenone (ZEA), trichothecenes, ochratoxin A (OTA), deoxynivalenol (DON), and fumonosins (FUM). Aflatoxins, nivalenol usually produced at preharvest stages, while FMN and OTA are generally produced during storage and transport[2]. *Aspergillus* species can fabricate diverse kinds of mycotoxins such as AFs, OTA, cyclopiazonic acid, patulin, citrinin, and ergot alkaloids[1]. *Penicillium* species produce AFs, OTA, cyclopiazonic acid, patulin, citrinin, and ergot alkaloids. FMN and ZEA are produced by some *Fusarium* species[3], although trichothecenes (DON, T-2 toxin, diacetoxyscirpenol, and nivalenol) are produced by several fungal genera such as Fusarium, Trichoderma, and Myrothecium. Utilization of food and feed contaminated with mycotoxins results in acute or chronic effects such as carcinogenic, teratogenic, immune suppressive, or estrogenic effects[4]. Harmful effects caused by various mycotoxins include nephropathy, sterility, cancer or death. Different effect for the biological actions of mycotoxins ranges from weak and/or normally helpful effects like antimicrobial efficacy (e.g. penicillin antibiotics produced by *Penicillium* species) to high mutagenic potential (e.g. aflatoxins, patulin) carcinogenic (e.g. aflatoxins), teratogenic, neurotoxic (e.g. ochratoxins) nephrotoxic (e.g. fumonisins, citrinin), hepatotoxic, and immunotoxic (e.g. ochratoxins, diketopiperazines) behaviors. A little plant pathogenic fungican be nominees for use as potential agent of bioweapons, such as toxigenic producing fungi. A number of these mycotoxins very practical as agroterrorist agents[5]. Different types of mycotoxins can be used as agroterrorist agents for example trichothecenes and aflatoxins. Their production is uncomplicated by fermentation, and they are tasteless, chemically stable, resistant to temperature and shelf life is high and therefore may be stored for a long time[6,7]. There is no cure; treatment is focused only on improved diet and hydration of patients[8]. The most candidate mycotoxins including, the trichothecenes, aflatoxins, ergot alkaloids, ochratoxins, and vomitoxins are most screened to cause human disease; the trichothecene being the most discussed as probable bioweapon agents. Also compounds from these may begin to be considered more dangerously as mycotoxins e.g. destruxins[9].

Trichothecene (e.g., yellow rain) is one of the major groups of mycotoxins[10]. Trichothecene-producing fungi are plant pathogens and attack different agricultural commodities. Although several fungi can produce trichothecenes, Fusarium genus is the main source of weaponized trichothecene mycotoxin, especially by *Fusarium graminearum*[11]. The trichothecene (T-2) mycotoxins are inexpensive, simple to produce and can be applied for a small group of enemies. A novel trichothecene mycotoxin (named NX-2) was differentiated by liquid chromatography-tandem mass spectrometry[12]. Trichothecene mycotoxinscan be delivered via dusts, droplets, aerosols or smoke from aircraft, rockets, missiles, artillery, portable sprayers or by using plans without pilots. The deleterious effects caused by diversemycotoxins on human health include nephropathy, sterility, tumor or death[10]. When trichothecenes deposited at low amounts, causes skin, eye, and digestive problems. T-2 toxin can cause severe skin irritation including; erythema, edema, and necrosis) when using in nanogram amounts[13].Tricothecene mycotoxins would be a rare exception, as they can be absorbed directly through the skin.When contaminated grain is consumed, a chronic condition known as alimentary toxic aleukia (ATA) results[14]. Nausea, diarrhea, abdominal pain, dizziness, vomiting, and headache are symptoms of trichothecenemycotoxicosis in humans[1]. Continuous exposure to a toxin with group Atrichothecenes results in immune system disorders and significant changes in the blood cell number[15].Group B trichothecenes cause reduction in dietary intake in animals especially in pigs[1,15]. Toxicity of T-2 toxin is 10 times more than DON in mammals. Exposure to T-2 toxin of a few milligram quantities is potentially lethal[9]. Fusarium species and other trichothecene-producing fungi can infest the most important food stuff, they have been associated worldwide with intoxication of humans and animals. Thus, these fungi have potential as bioweapons[14].

The ability to use aflatoxin-producing fungi as a vital bioweapon against human and animal is considered low. Aflatoxins might cause both acute and chronic disease symptoms make them a probable agroterrorism nanoweapon[16]. The presence of AFB1 in cereals could be hazardous for human and animal health, in order to avoid its destructive effects and several economic problems. The highest legal limit allowed for AFB1 in baby food in the European Union is 0.1 μg kg−1[17,18]. More than 5 billion people in the third world have a great risk of chronic exposure to naturally occurring aflatoxins through contaminated food[19]. Acute aflatoxicosis, related to the high doses of aflatoxin, is described by the following symptoms; hemorrhaging, acute liver harm, edema, and high mortality rates in humans. The first symptoms of acute aflatoxicosis include appetite loss, angst, and low fever; later stage of symptoms, which include heave, hemorrhage, interfere with protein metabolism and hepatitis can signal potentially fatal liver[15,19,20]. In 1960 acute aflatoxicosis in animals was detected, more than 100,000 turkeys subsequent an epidemic in the United Kingdom[20]. Additionally concerns related to increased susceptibility to liver disease[21]. Bioterrorism using afltoxins to infest feed stuff could contaminate a large quantity of dairy products with afltoxin M1[22].

The use of toxigenic fungi and mycotoxins for bioterrorism can have economic penalty. Increasing the environmental occurrence of a highly aflatoxin producers may leading to widespread crop losses due to mycotoxins average $630 million to $2.5 billion per annum[23]. T-2 mycotoxin has been supposedly used during the armed conflicts; more than 6300 deaths in Laos, 1000 in Kampuchea, and 3000 in Afghanistan have been recognized to yellow rain exposure[24]. China in 1991, an epidemic affecting 130,000 people was screened due to the consumption of wheat and barley infested with toxigenic fungi[25]. There are endemic exposures to mycotoxins in Africa because of drought, economic hardships, wars, and agricultural practice[26].

Climate change is one of the most important factors effects on thermo-tolerant mycotoxin producing fungi in different countries which cause mycotoxin contamination of agricultural products. The ability of toxigenic fungi to produce aflatoxins has been observed in Europe, with consequent aflatoxin contamination in agricultural products including maize and milk in different European countries[27].

Plant Pathologist can develop new aggressive mycotoxin-producing fungi strains to produce more quantity of mycotoxins at specific moisture levels, oxygen levels in the air, low temperature and different storage conditions[28,29]. Though genetically-modified toxigenic fungi have a potential to produce more toxin quantity and specific type of mycotoxins. Molecular nanobiotechnology manufacturing raises the opportunity of terribly efficient new bioweapons.Very soon, mycotoxicology researchers will prepare mycotoxins in nanomaterial formula. This new strategy allocates the economical establishment of extremely novel products. How many of these products will develop? What is the target? What ecological damage will they do? We would like clear and straightforward answers for questions.

Conclusion

Agricultural sector corresponding to a great and feasible terrorist objective, agri-terrorism can target specific agriculture and food industries. Defense against agri-terrorism and agri-crimes requires diversion of resources that could otherwise be used for economic growth. Also, the polyphasic method for the identification of the toxigenic fungi needs to be re-evaluated. Emergency preparedness must include infrastructure and professional personnel for all events and hazards inclusive of terrorism and criminal acts against the livestock, poultry, and companion animals and the animal-to-human food web.

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