August 2024 # 65

BNHC E-MAGAZINE

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Contents

***On behalf of BioNatural Healing College (BNHC), it is with great pleasure that we extend Thanks & appreciation to Dr. Pamir Momand for his very informative research article and contribution to this August BNHC E-Magazine edition*. We look forward to receiving his invaluable contribution in the future and wish him much success in future endeavors.**

Message: from the President of BioNatural Healing College (BNHC)

Greetings!

I am thrilled to express my heartfelt gratitude to the Almighty God for granting me the privilege to introduce the BioNatural Healing College (BNHC) E-Magazine August 2024 edition to our esteemed readers. Additionally, I extend my thanks to each one of you, especially our cherished readers, for your invaluable feedback and unwavering support. It's important to emphasize that the content within this magazine is intended solely for educational purposes, the author's perspectives are independent of any affiliation with BNHC.

We have high hopes that this BNHC E-Magazine will prove to be a valuable resource, made possible by the diligent contributions of esteemed researchers and colleagues from across the globe. With gratitude, I wish you all the best in health and a life filled with prosperity.

Warmest regards,

Dr. Nadir Sidiqi, Ph.D.

BioNatural Healing College

BioNatural Healing College Stands on Seven Core Pillar Foundations as follows:

1. All living organisms are made from the water this beautiful connection, connects us to praise the Creator of Creation for the provision of feeding, fueling, and healing to humanity.
2. No harm to public health and environmental health (Biodiversity) including pollinators, surface water, groundwater, soil, and air.
3. A series of complex chains involved with food production from the field to the mouth of the human body desperately needs scientific research to maximize healthy nutritionally food production and end malnutrition and food insecurity.
4. Harmful pests such as insects, and pathogens causing to human and plant health and loss of economic problems. BioNatural chemicals from plants, microorganisms, and ocean-living organisms exist and need further research to discover along with safety to utilize for the health improvement of humans as well as BioNatural Pest Management (insects, fungi, bacteria, various, nematodes, weeds, rodents, etc.).
5. Listen, love, appreciate, and respect with deep conscience and subconscious the connection between the genes of your body and beautifully ecologically in sense of feeling, feeding, fueling, and healing.
6. The brilliant human mind can irrigate with balance drinking clean water as a whole-body system to detoxify the toxicant from their body systems as well as to detoxify the soil, water, and environment from harmful chemicals, particularly pesticides through collaboration, and dedication from the individual, family, community, and scientific community locally and globally.
7. BioNatural Healing College provides a high-quality science base foundation through online education to fit and accommodate the needs of each prospective student for the sustainability and prosperity of his or her own, family, community, and humanity.

Understand the importance of Mycotoxins in Agriculture and Human Health

By Dr. Pamir Momand

Introduction: Mycotoxins are natural, toxic secondary metabolites mainly produced by filamentous fungi such as *Aspergillus, Fusarium, Alternaria,* and *Penicillium* which contaminate agriculture commodities mainly staple food crops including corn, wheat, cereals, groundnuts, tree nuts as well as meat, milk, and eggs worldwide, particularly developing countries. This contamination during growth and production, processing, transport, and storage which are toxic to humans, animals, and plants leading to diseases and economic losses. Mycotoxins may reduce appetite, and general performance and cause sickness or even death in humans. Therefore, they pose some of the most serious threats to human health worldwide. (Kebede, 2020; Reddy *et al.*, 2010). The term mycotoxin was coined in 1962 in the aftermath of an unusual veterinary crisis near London, England, during which approximately 100,000 turkey poults died. When this mysterious turkey X disease was linked to a peanut (groundnut) meal contaminated with secondary metabolites from *Aspergillus flavus* (aflatoxins), (Bennett and Klich, 2003). Mycotoxin contamination of various foodstuffs and agricultural commodities is a major problem in the tropics and sub-tropics, where climatic conditions and agricultural and storage practices are conducive to fungal growth and toxin production. Mycotoxins have been reported to be carcinogenic, teratogenic, tremorogenic, hemorrhagic, and dermatitic to a wide range of organisms and are known to cause hepatic carcinoma in humans. While all mycotoxins are of fungal origin, not all toxic compounds produced by fungi are called mycotoxins.

The target and the concentration of the metabolite are both important. Fungal products that are mainly toxic to bacteria (such as penicillin) are usually called antibiotics. Fungal products that are toxic to plants are called phytotoxins by plant pathologists. Mycotoxins are made by fungi and are toxic to vertebrates and other animal groups in low concentrations. Other low-molecular-weight fungal metabolites such as ethanol that are toxic only in high concentrations are not considered mycotoxins (Bennett, 1987).

Impact of Mycotoxins on Human Health: There are many such compounds but only a few of them are regularly found in food and animal feedstuffs such as grains and seeds. Nevertheless, those that do occur in food have great significance in the health of humans and livestock. In a normal varied human diet, constant exposure to low levels of several toxins is possible. They are produced by fungi, mycotoxins are associated with diseased or moldy crops, although the visible mold contamination can be superficial. The infection symptomatology of mycotoxin contamination is not obvious like other diseases where visible symptoms on plant parts are produced due to infection. With the increasingly stringent regulations for mycotoxins, especially for aflatoxins imposed by importing countries such as the European Union, the export industry of agricultural commodities is in jeopardy (*Reddy et al.,* 2010). Over the last two decades, various international inquiries on worldwide limits and regulations for mycotoxins were published. A study by the United Nations Food and Agriculture Organization (FAO) on worldwide regulations for mycotoxins revealed that at least 77 countries now have specific regulations for mycotoxins (FAO, 2004) —table 1. The risk of contamination by mycotoxins is an important food safety concern for grains and other field crops. Mycotoxins affecting groundnuts/peanuts, cereals (maize, rice, sorghum, wheat, barley, and oats), spices (black pepper, ginger, and nutmeg), and chili are considered to be of greater significance world over for human beings (CAST, 2003; Bryden, 2007).

The exposure to levels of aflatoxins from nanograms to micrograms per day occurs through the consumption of maize and peanuts, which are dietary staples in several tropical countries, while fumonisins are found worldwide, primarily in maize and its products and sorghum. Human exposure to fumonisins is highest in regions like the former Transkei, South Africa, where moldy home-grown maize damaged by insects is often consumed (Bhat and Vasanthi, 2003). The other vulnerable commodities to this menace are copra (dried coconut kernel), cottonseed, peppers, and pistachio nuts. They generally affect organ toxicity, teratogenicity, carcinogenicity, mutagenicity, and genotoxicity. Mycotoxins are prone to appear in all aspects of food production. When consuming food and feed contaminated with mycotoxins above a certain threshold, humans and animals will have severely acute and chronic negative influences on their organs and systems. Moreover, the large accumulation of mycotoxins will increase the incidence of various diseases such as cancer and leukemia (Barac, 2019) as a result they can damage human health seriously. The Food and Agriculture Organization of the United Nations (FAO) estimated that about 25% of cereals in the world are contaminated by mycotoxins (CAST, 2003, Winter & Pereg, 2019). In addition, other foods and various by-products are also contaminated. Mycotoxins are a serious threat to the agricultural industry now and the phenomenon of food contamination is extremely common around the world (Lee & Ryu, 2017). At the same time, the economy and trade will also be greatly affected by mycotoxin contamination. For example, the loss caused by the Hungarian wheat epidemic was about 100 million euros in 1998 (Milićević, Skrinjar, & Baltić, 2010). Human exposure to mycotoxins may result from the consumption of plant-derived foods that are contaminated with toxins, the carry-over of mycotoxins and their metabolites in animal products such as meat and eggs (CAST, 2003) or exposure to air and dust containing toxins.

Currently, more than 300 mycotoxins are known, and scientific attention is focused mainly on those that have proven to be carcinogenic and/or toxic. Human exposure to mycotoxins may result from the consumption of plant-derived foods that are contaminated with toxins, the carry-over of mycotoxins and their metabolites in animal products such as meat and eggs (CAST, 2003) or exposure to air and dust containing toxins (Jarvis, 2002). Most countries now have specific regulations for acceptable concentrations of mycotoxins in foods (van Egmond *et al*., 2007) The regulations have been put in place to address food safety concerns caused by mycotoxins. The agricultural commodities subject to regulation include groundnut (peanut), maize (corn), rice, sorghum, wheat, spices, fruit juices, and many others (Bryden,2007).

Table 1. Global regulation of mycotoxins in agricultural products

		Crops and tolerated levels of mycotoxins (µg/kg)							
Country	Mycotoxins	Groundnut (peanut)	Maize (corn)	Rice	Sorghum	Spices	Pearl millet	Horse gram	Fruit juices
Australia	Total AF	15	-	-	-	-	-	-	-
Brazil	AFB1 and AFG1	30	30	30	30	30	30	30	30
Bulgaria	Total AF	15	4	4	4	5	4	4	10
Canada	Total AF	15	-	-	-	-	-	-	-
China	AFB1	20	10	10	-	-	-	-	-
Egypt	Total AF	10	10	10	10	-	-	-	-
France	FB1	-	1,000	1,000	1,000	-	-	-	-
	ZEA	-	50	50	50	-	-	-	-
Hungary	Total AF	15	4	4	4	10	-	-	-
	OTA	-	5	5	5	-	-	-	-
India	Total AF	30	30	30	30	30	30	30	30
Italy	OTA	-	-	-	-	-	-	-	50
Japan	AFB1	10	10	10	10	10	10	10	-
	Patulin	-	-	-	-	-	-	-	50
Kenya	Total AF	20	-	-	-	-	-	-	-
Korea	AFB1	10	10	10	10	10	10	10	-
	Patulin	-	-	-	-	-	-	-	50
Mexico	Total AF	-	20	20	20	-	-	-	-
	Patulin	-	-	-	-	-	-	-	50
Russia	AFB1	5	5	5	5	-	-	-	-
Taiwan	Total AF	15	10	10	10	-	-	-	-
Turkey	AFB1	5	2	2	2	5	-	-	-
	Patulin	-	-	-	-	-	-	-	50
United States	Total AF	20	20	20	20	20	20	20	-
	Patulin	-	-	-	-	-	-	-	50

AF=aflatoxins. Source: Food and Agriculture Organization, 2004; van Egmond et al., 2007.

Major mycotoxins in agricultural products and foodstuffs: ***Aflatoxins*** Aflatoxins became the focus of mycotoxins research and prevention as "turkey X disease" occurred in the suburbs of London, England in 1960. AFs are difuranocoumarins produced by *A. flavus* and *A. parasiticus* with similar chemical structures (Marin *et al*., 2013). There are 6 main types of AFs in contaminated foods: B1, B2, G1, G2 (based on their fluorescence under UV light (blue or green), M1, and M2 (produced in milk and dairy products). In general, the content of AFB1 is the highest although AF contamination levels vary widely. AFs mainly contaminate maize, wheat, rice, sorghum, ground nuts, tree nuts, and figs (Reddy et al., 2010), and have the highest occurrence rate in foods and feeds under high temperature and humidity. AFs are the most mutagenic and carcinogenic natural substances among several common mycotoxins. They can mainly cause liver lesions, cirrhosis, primary hepatocellular carcinoma, Kwashiorkor, and Reye's syndrome in humans and animals (Karlovsky *et al*., 2016). Chronic aflatoxin exposure can cause Hepatocellular carcinoma (HCC). Aflatoxin B1 is the most potent natural carcinogen known and is usually the major aflatoxin produced by toxigenic strains. There is sufficient evidence to conclude that AFB1 and mixtures of B1, G1, and M1 are proven human carcinogens, thereby warranting Group 1 carcinogen status for them. M1 and B2 are designated as Group 2B probable human carcinogens (IARC, 1993). Aflatoxin contamination has been linked to increased mortality in farm animals and thus significantly lowers the value of grains as animal feed and as an export commodity. Milk products can also serve as an indirect source of aflatoxin.

When cows consume aflatoxin-contaminated feeds, they metabolically biotransform aflatoxin B1 into a hydroxylated form called aflatoxin M1 Aflatoxin is associated with both toxicity and carcinogenicity in human and animal populations. The diseases caused by aflatoxin consumption are loosely called aflatoxicoses. Acute aflatoxicosis results in death; chronic aflatoxicosis results in cancer, immune suppression, and other "slow" pathological conditions. The liver is the primary target organ, with liver damage occurring when poultry, fish, rodents, and nonhuman primates are fed aflatoxin B1. (Zain, 2011). ***Fumonisins:*** Fumonisins were first described and characterized in 1988. The most abundantly produced member of the family is fumonisin B1 This toxin was reported in cereals and other foods throughout the world Fumonisins are produced by several *Fusarium* species, notably *F. verticillioides* (formerly known as *F. moniliforme - Gibberella fujikuroi* species complex), *F. proliferatum*, and *F. nygamai*, as well as *Alternaria alternata* f. sp. *lycopersici* and also *A. niger. Fumonisins* (B1 and B2) are cancer-promoting metabolites of *Fusarium proliferatum* and *Fusarium verticillioides.* The major species of economic importance is *F. verticillioides*, which grows as a corn endophyte in both vegetative and reproductive tissues, often without causing disease symptoms in the plant. However, when weather conditions, insect damage, and the appropriate fungal and plant genotype are present, it can cause a variety of types of disease, including seedling blight, stalk rot, and ear rot, *F. verticillioides* is present in virtually all corn samples (Marasas *et al.*, 2001). Fumonisins affect animals in different ways by interfering with sphingolipid metabolism. They cause leukoencephalomalacia (hole in the head syndrome) in equines and rabbits pulmonary edema and hydrothorax in swine and hepatotoxic and carcinogenic effects. In humans, there is a probable link with esophageal Cancer. Finally, fumonisins can cause neural tube defects in experimental animals and thus may also have a role in human cases.

It has been hypothesized that a cluster of anencephaly and spina bifida cases in southern Texas may have been related to fumonisins in corn products The IARC has evaluated the cancer risk of fumonisins to humans and classified them as group 2B (probably carcinogenic) (*Reddy et al.,* 2010). ***Ochratoxins:*** Although 7 species of *Aspergillus* and 6 species of *Penicillium* can produce OTA, it is mainly produced by *A. ochraceus*, *P. verrucosum*, *A. carbonarius* and *P. viridicatum*, (Marin *et al*., 2013). OTA mainly contaminates grain agricultural products such as oats, barley, dried vine fruit, wine, wheat, animal feed, and animal foods (such as pig kidneys and liver). The toxicity of OTA to humans and animals includes nephrotoxicity, liver toxicity, teratogenicity, carcinogenicity, mutagenicity, and immunosuppressive activity. Therefore, the more common diseases were endemic nephropathy and urothelial tumors (Reddy *et al.*, 2010). **Trichothecenes:** Deoxynivalenol (DON) is a common trichothecene, also known as vomitoxin, mainly produced by *Fusarium graminearum*, *Fusarium moniliforme, Fusarium culmorum* and other *Fusarium* species (Marin *et al*., 2013). *Trichoderma* and other strains also have the ability to produce DON. Corn and small grains such as wheat, oats, and barley and their products are easily contaminated by DON (Reddy *et al*., 2010). The organisms survive on residues left on the field from the previous season's crop, providing an inoculum source for the new crop. The organisms do well in cool, moist conditions with contamination of the crop occurring when conidia of the organism are windblown to the corn silks or in small grains to the anthers, which emerge outside the floret during anthesis. DON has high cytotoxicity and immunosuppressive properties, usually causing acute and potentially chronic toxic effects on humans and animals, like Nausea, vomiting, abdominal pain, diarrhea, dizziness, headache (Yang *et al*., 2014). Apparently, DON production is necessary for the organism to produce disease in some crops. In corn, *F. graminearum* may produce ear rot.

In wheat, heads may appear prematurely and ripen unevenly and the kernels will have a blanched appearance (tombstone kernels) at harvest and may be stained pink as well. Commodities with pink staining are often referred to as pink scabs. Storage under good conditions (<14%moisture), including control of insect pests, will minimize further elaboration of the toxin by these toxigenic fungi. If grains have matured and are stored under appropriate conditions, DON does not further accumulate in storage. Swine are the animals most usually affected by this toxin. They reduce their intake of contaminated grain; and if they do eat it, they may vomit. Levels above 1 μg/g are considered potentially harmful to these animals (Richard, 1998). Humans are thought to exhibit a similar vomiting syndrome when consuming DON-contaminated grain (Bhat *et al*., 1989). In 2010, an analysis was performed on 128 samples of wheat, and DON contamination was observed in 100 samples (78.1%) with 64–4808 μg/kg level of concentration (Jaji *et al*, 2014). Of which 16 (12.5%) of the sample contamination levels were higher than the maximum allowable limits of 1750 μg/kg specified by the European Commission and Serbian regulations (Serbian Regulation, 2011). However, it is more noteworthy that the most serious DON pollution occurs in maize. The establishment of a climate monitoring system can effectively guide the reduction of mold growth and artificial control of mycotoxin contamination. Subsequent processing (sorting, washing, peeling, etc.) can also reduce toxin content and contamination to minimize losses (Edwards *et al*., 2018;). DON is also very common, especially in spring wheat, and it is also found in more than 90% of samples, while winter wheat (72%) is relatively rare.

***Zearalenone*:** ZEN is mainly produced by *Fusarium* species, such as *F. graminearum* and *F. culmorum* (Marin *et al.*, 2013). They usually grow and cereals and cereal products to generate mycotoxins (Reddy *et al*., 2010). The main feature of ZEN is that it has an estrogen-like effect, which is highly toxic to the reproductive system of female animals. ZEN can cause ovarian disease, interfere with animal ovulation, prolong the estrus interval, reduce the number of litters or infertility, and induce sows to have masochism, pseudopregnancy, and endometrial disease (Metzler *et al,* 2010). Zearalenones disrupt estrous cycles, failing to breed successfully. In some parts of the world, zearalenone is second only to aflatoxins in the extent to which it disrupts agriculture. These problems occur because zearalenone resembles 17-estradiol, the principal hormone produced by the human ovary. The structural similarity allows zearalenones to bind to estrogen receptors in mammalian target cells (Zinedine et al., 2007).

Conclusion: Mycotoxins are a chemically diverse group of fungal metabolites that have a wide variety of toxic effects. Though a large number of fungi are associated with groundnut kernel, maize, rice, sorghum grain, chili, and various spices, the most common mycotoxin-producing fungi are *Aspergillus flavus*, *Aspergillus parasiticus*, *Aspergillus ochraceus*, *Fusarium verticillioides*, *Fusarium graminearum* and *Penicillium* spp. They result in major effects on human and animal health. they contaminate foods intended for direct human consumption, and the implications for human health worldwide. In a normal varied human diet, constant exposure to low levels of several mycotoxins is possible.

Information on the potential interactions among all these compounds is still very limited. Furthermore, some mycotoxins, such as aflatoxin B1, are known to be associated with overt human disease. The development of practical control and management strategies is, therefore, essential to ensure consumer safety. Because of the unpredictable, heterogeneous nature of mycotoxin contamination, 100% destruction of all mycotoxins in all food systems is not considered a practical option. However, a practical approach may be the use of a food safety management system based on HACCP, or Hazard Analysis and Critical Control Point methodology, in which contamination is controlled throughout production and post-production operations. Integrated mycotoxin management systems should consider control points from the field to the consumer. This type of management system considers the communication between experts in pre-harvest, harvest, and post-harvest control. With this approach, every phase of production would help reduce the risk, so by the time the final food reaches the consumer the hazards associated with mycotoxin contamination have been minimized. Continued research is required in these areas to provide more effective management of the risks posed by mycotoxin contamination. In the meantime, procedures that have proven effective for specific mycotoxins and/or commodities should be evaluated for other applications.

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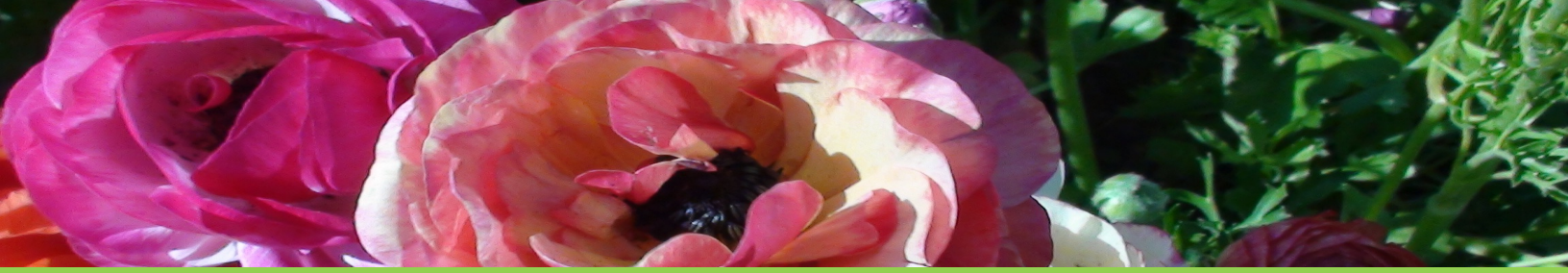

Mission: BioNatural Healing College is a non-profit public benefit institution that has tax-exempt status under the Internal Revenue Service, Section 501(c)(3) of the United States of America. Our goal is to offer a high-quality education a diploma program as well as holistic health and nutrition conferences, seminars, workshop, and continuing education. The focus of these educational programs is to offer healing and holistic nutrition science through online distance learning. These dynamic online education programs will provide diverse adult learners throughout the world the experience of enhancing their quality of life, their health, and their happiness.

Vision: The faculty, staff and management team of BioNatural Healing College are passionately committed to providing the best teaching possible in this field. We seek to encourage, motivate and explain the importance of this field to prospective students so that they may make an informed decision regarding enrollment. We seek an ultimate goal of satisfaction for the student based on responsibility, commitment, respect, awareness and sustainable education for society.

Accreditation and Recognition: BioNatural Healing College is based in California. It is an institution that has the goal to deliver on- demand online distance learning around the globe. This education is of high quality and vocational in nature. BioNatural Healing College is a legal business entity that has been approved to operate by the State of California's Bureau for Private Postsecondary Education that set forth in the educational code. BioNatural Healing College is not accredited by the United States Department of Education. BioNatural Healing College is a member of the American Holistic Health Association (AHHA).