**ADVERSE HEALTH EFFECTS ASSOCIATED WITH AFLATOXIN HAZARDS**

Aflatoxins, pose significant health risks, including cancer, liver damage, and immunosuppression. Acute aflatoxicosis, caused by high doses, can be fatal due to liver damage, while chronic exposure increases the risk of liver cancer. Children are particularly vulnerable to the effects of aflatoxin, such as stunted growth and developmental delays.

**Neurological Effects:** **Aflatoxins, particularly aflatoxin B1 (AFB1), can cause significant neurological effects, including neurodegeneration, cognitive impairment, and behavioral abnormalities. These effects are linked to AFB1's ability to damage brain cells, disrupt synaptic transmission, and induce neuroinflammation.** **Chronic exposure to AFB1 can lead to neuronal damage and neurodegeneration, potentially mimicking conditions like Huntington's or Alzheimer's disease.**

**Neuroinflammation: Aflatoxin B1 (AFB1) exposure can lead to neuroinflammation by triggering the production of inflammatory molecules and free radicals, damaging brain cells, and disrupting signaling pathways. This can lead to a variety of neurological problems, including Parkinson's disease (PD). AFB1 can also increase soluble epoxide hydrolase (sEH) in the brain, which contributes to neuroinflammation and dopaminergic neurotoxicity. AFB1 can activate microglia, the brain's immune cells, leading to the release of inflammatory cytokines.**

**Blood Abnormalities:** Aflatoxins, particularly aflatoxin B1 (AFB1), can cause various blood abnormalities, including an increased risk of bleeding, anemia, and altered blood cell counts. These effects can result from aflatoxin's impact on the liver, immune system, and bone marrow, leading to impaired blood clotting, reduced red blood cell production, and changes in white blood cell populations.

**Cardiovascular Effects:** Aflatoxins, particularly aflatoxin B1 (AFB1), can negatively impact the cardiovascular system, causing heart damage, vascular fragility, and potentially leading to cardiac dysfunction. This can include weakened blood vessel walls, impaired blood flow, and increased risk of hemorrhaging.

**Carcinogenic Effects:** Aflatoxins are carcinogenic substances, particularly known for causing liver cancer (hepatocellular carcinoma), and are also linked to other cancers. They are produced by certain molds (fungi) like Aspergillus flavus and Aspergillus parasiticus, and can contaminate various foods and feeds, including peanuts, maize, and other grains. Aflatoxin B1 (AFB1) is the most potent and commonly found aflatoxin and is a known human carcinogen.

**Acute Toxicity:** Acute aflatoxin toxicity, or aflatoxicosis, results from consuming a high dose of aflatoxins in a short period, leading to severe liver damage and potentially death. Symptoms include nausea, vomiting, abdominal pain, jaundice, and in severe cases, bleeding, edema, convulsions, coma, and death. Aflatoxins are potent hepatotoxins (liver toxins). High doses can cause acute liver failure, leading to a range of symptoms:

* **Initial:** Nausea, vomiting, abdominal pain, and jaundice (yellowing of the skin and eyes).
* **Progressive:** Bleeding, edema (fluid buildup in tissues), lethargy, and in severe cases, convulsions and coma.
* **Ultimately:** Death due to liver damage.

Long-term exposure to lower doses of aflatoxins can lead to chronic liver damage and an increased risk of liver cancer.

**Immunosuppression:** Aflatoxins, particularly Aflatoxin B1 (AFB1), are mycotoxins that can suppress the immune system, increasing susceptibility to infections and other diseases. They can directly damage immune cells, interfere with immune responses, and impair the production of immune factors like cytokines and antibodies. This immunosuppression can lead to weakened defenses against pathogens and, in some cases, the reactivation of chronic infections. AFB1 can interfere with the production of inflammatory mediators and cytokines, which are crucial for activating the immune response and fighting infections. Immunosuppression caused by aflatoxins can increase the risk of various infections, including those caused by bacteria, viruses, and fungi.

**Hepatotoxicity:** Aflatoxins, potent carcinogens, primarily cause hepatotoxicity (liver damage). This damage can range from acute liver injury to chronic conditions like cirrhosis and hepatocellular carcinoma (liver cancer). Aflatoxins are particularly harmful in the presence of hepatitis B virus infection, significantly increasing the risk of liver cancer. Repeated exposure to aflatoxins can cause scarring of the liver, leading to cirrhosis.

**Autophagy and Apoptosis:** Aflatoxins, particularly AFB1, induce both autophagy and apoptosis in cells, often with a complex interplay between the two processes. Aflatoxins can trigger autophagy, a cellular self-eating process, and also lead to apoptosis, programmed cell death, which can have both protective and detrimental effects. The specific outcome depends on factors like cell type, environmental conditions, and the concentration of aflatoxins.

* **Autophagy Induction:**

Aflatoxins can induce autophagy, potentially as a cellular response to damage caused by the toxin. This process can involve the increased expression of autophagy-related genes like LC3, Beclin-1, and Atg5, and the degradation of proteins like p62. Autophagy can help remove damaged cellular components, potentially mitigating the effects of aflatoxins.

* **Apoptosis Induction:**

Aflatoxins can also induce apoptosis, a programmed cell death pathway. This can be mediated by various mechanisms, including mitochondrial dysfunction, oxidative stress, and activation of caspase-3.

**Growth Retardation and Development:** Aflatoxins, mycotoxins produced by certain molds, can negatively impact child growth and development, particularly in regions with high aflatoxin exposure. Chronic exposure to aflatoxins, especially in children, can lead to impaired growth and development, stunting, wasting, and low weight. Additionally, aflatoxin exposure can affect cognitive development and learning ability.

* **Stunting:**

Aflatoxin exposure has been associated with stunting (low height for age), a common indicator of chronic malnutrition.

* **Wasting:**

Exposure can also lead to wasting (low weight for height), indicating acute malnutrition.

* **Low Weight:**

Aflatoxin exposure is linked to lower birth weight and slower weight gain in children.

* **Reduced Head Circumference:**

Studies have shown that aflatoxin exposure, particularly during infancy, can lead to a persistent deficit in head circumference, suggesting reduced brain size.

**Mutagenic Effects:** Aflatoxins are known to be mutagenic, meaning they can cause changes in DNA, leading to mutations. They are also genotoxic, meaning they can damage DNA and other genetic material. Specifically, aflatoxins can form DNA adducts and cause mutations, including the G→T transversion in codon 249 of the p53 tumor suppressor gene.

1. **Chromosomal Aberrations**: Aflatoxins, particularly Aflatoxin B1 (AFB1), induce various chromosomal aberrations, including stickiness, gaps, fragments, and Robertsonian Centric Fusion (RFC), in both plant and animal cells. These aberrations are often concentration-dependent, with higher concentrations of AFB1 leading to a greater frequency of chromosomal abnormalities.
2. **Protein Profile Alterations:** Aflatoxins, potent environmental toxicants produced by certain molds, can alter protein profiles by inducing the expression of cancer-associated proteins and by causing epigenetic modifications. These modifications, such as DNA methylation and histone modifications, can influence gene expression and lead to changes in protein production.
3. **Genetic Stability Assessment**: Aflatoxins are potent genotoxins, meaning they can damage DNA and lead to genetic instability, including DNA adduct formation, chromosomal aberrations, and mutations. This genetic instability can contribute to increased cancer risk, especially liver cancer (hepatocellular carcinoma). Aflatoxins also disrupt DNA replication and repair, potentially leading to heritable changes in genetic material.
4. **Cell Cycle and Apoptosis Indicators:** Aflatoxins, particularly Aflatoxin B1 (AFB1), can disrupt cell cycle progression and induce apoptosis (programmed cell death) in various tissues. AFB1 exposure can cause cell cycle arrest, meaning cells stop progressing through the cell cycle at specific checkpoints, and also trigger apoptosis, leading to cell death.

**Oxidative Stress:** AFB1 can increase reactive oxygen species (ROS), which can damage DNA and other cellular components, leading to apoptosis**.**

**Conclusion**

Aflatoxins pose a serious health problem as the can affect the blood system, immune system, the cardio system, the neurological system, affect growth and development, lead to gene mutation and more especially the AFB1.

**References**

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