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From Feed to Fork: Mycotoxins in Aquaculture as a Threat to the World's Food Security and Human Nutrition

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One of the most crucial pillars of World food security is aquatic production because it offers a source of high-quality protein to billions of inhabitants and livelihood to millions of communities around the world. Nevertheless, in my capacity, this crucial industry has been endangered by a looming menace that stands at all times, and that is mycotoxin contamination [1]. Mycotoxins are heat-resistant and highly toxic secondary metabolites that are synthesized by filamentous fungi such as Aspergillus, Fusarium, and Penicillium, and may enter aquatic environments and production systems through a variety of different pathways. They have greater impacts than reducing the well-being of aquatic life, including fish, shrimp, and benthic invertebrates, as well as imposing dire health risks to the health of well-being of humans in the food chain, hence posing a long-term threat to the sustainability of aquaculture [2].

The large presence of mycotoxins in water bodies can be explained by a variety of interrelated reasons, of which the use of polluted feed contributes significantly to intensive aquaculture. Cereals (e.g., corn and soybean meal) are the most common feed staples vulnerable to fungi during production, harvesting, storage, and processing in warm and damp climates. The sources of protein (e.g., fish meal) are also vulnerable to fungi. Due to this, feeds can have an array of mycotoxins, i.e., aflatoxins, zearalenone, deoxynivalenol, and ochratoxins. When the water creatures ingest these toxins, they might have a direct impact on their health and are thus released back into the water, leading to secondary environmental pollution [3]. Other sources, such as agricultural runoffs, industrial effluents, and improper handling or disposal of mold-infested substances, are some of the other sources that further augment the mycotoxin loads on the environment. Moreover, the impact of toxin-producing fungi is enlarged within the ecological niche due to climate change (high temperatures and more precipitation), which aggravates the risk of contamination. The problems are compounded by the processes of bioaccumulation and biomagnification in the water food webs, whereby the mycotoxins are concentrated in the apex predators and further enhance the potential human health risks [3,4].

Mycotoxins have diverse toxicological impacts on aquatic organisms, which include effects on the digestive systems, immune systems, reproductive systems, and neurological systems. Consumption of polluted food may cause intestinal integrity breach, diminished digestive enzyme activity, and deterioration in growth performance. More importantly, mycotoxins suppress their immune functions, increasing their vulnerability to bacterial and viral diseases, and this increases mortality and causes heavy financial losses to aquaculture. Some of these mycotoxins are also endocrine disruptors, disrupting the balance of reproductive hormones, reducing the quality of gametes, and decreasing reproductive productivity, and as a result jeopardizing the long-term sustainability of wild and farmed populations [5]. Also, the toxins cause oxidative stress and genotoxicity, which causes DNA damage, lipid peroxidation, and tumorigenesis. Regardless of awareness of these negative effects, there are notable gaps in knowledge regarding the molecular pathogenesis of mycotoxin toxicity in aquatic organisms, the interactive effect of many concomitant co-occurring mycotoxins, and the

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ecological implications of chronic low-dose exposure [6].

Mycotoxin contamination of aquaculture needs to be mitigated using a holistic, systems-based, interdisciplinary approach. The quality assurance and quality control should be implemented throughout the feed supply chain, including the optimization of storage and the processing environment, the creation and implementation of efficient detection, prevention, and detoxification technology [7].

The seemingly underestimated risk of mycotoxins in aquatic production systems is the one that should be handled by the scientists and regulators in a concerted effort. It will require concerted interdisciplinary measures, technological advancement, and the systematization of evidence-based policies and management practices to minimize the ecological and economic impacts of them, preserve the aquatic life forms, and guarantee the further provision of this essential source of animal protein to human food.

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