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MİNİMİZİNG HEAVY METAL CONTAMİNATİON İN SEAFOOD THROUGH AQUAPONİCS: A SUSTAİNABLE SOLUTİON FOR FOOD SECURİTY

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İNTRODUCTİON

Food safety is one of the main priorities for global health and sustainable development. In recent decades, the impact of various contaminants, particularly heavy metals, on food products has increased, and it has been proven that these substances pose serious threats to human health. To prevent heavy metal contamination and ensure environmentally friendly food production, innovative and sustainable solutions are needed. In this context, aquaponic systems have emerged in recent years as an alternative technology that enhances ecological sustainability and food safety. Aquaponic systems combine hydroponics and aquaculture, allowing plants and aquatic organisms to grow in a symbiotic relationship. In these systems, waste is minimized through natural filtration, and heavy metal contamination can be managed more effectively.

HEAVY METALS

Toxic heavy metals such as lead (Pb), cadmium (Cd), mercury (Hg), and arsenic (As) enter the human body through the food chain, posing serious health risks. These metals have strong carcinogenic and mutagenic properties and are linked to cardiovascular, kidney, neurological, and bone diseases with prolonged exposure.

- *Pb toxicity leads to anemia due to reduced hemoglobin synthesis, kidney dysfunction, and adverse effects on the reproductive and nervous systems. Studies show that Pb is a major cause of poisoning, especially in children.*
- *Cd exposure can cause severe lung issues such as bronchitis and pneumonia. The European Food Safety Authority (EFSA) has set the weekly tolerable Cd intake at 2.5 µg per kg of body weight, but vegetarians, children, and smokers may exceed this limit.*
- *As chronic exposure is associated with skin inflammation, cancer, cardiovascular problems, diabetes, lung dysfunction, neurological symptoms, and reproductive toxicity.*
- *Hg at high concentrations can cause kidney failure, pneumonia, chest pain, and allergic skin reactions.*

AQUAPONİCS

Aquaponics is an innovative and sustainable food production system that combines aquaculture (fish farming) with hydroponics (soilless plant cultivation). This closed-loop system creates a symbiotic relationship between aquatic organisms and plants, where fish waste provides essential nutrients for plant growth, and plants naturally filter and purify the water, which is then recirculated back to the fish tanks. Aquaponic systems offer several advantages, including reduced water consumption, minimal use of chemical fertilizers, and efficient space utilization. They help mitigate environmental pollution by preventing nutrient runoff and reducing the risk of heavy metal contamination in food production. By integrating natural biological processes, aquaponic systems create an eco-friendly solution for producing fresh, organic food while minimizing environmental impact and ensuring food safety.

RESULTS & DİSCUSSİON

Aquaponics effectively minimizes heavy metal contamination in seafood by utilizing a closed-loop system that reduces environmental pollution. The integration of fish farming and hydroponic plant cultivation in aquaponics helps to naturally filter and detoxify water, preventing the accumulation of toxic metals. This system offers a sustainable solution by providing safe, healthy food while reducing heavy metal exposure in seafood, contributing to food security and environmental conservation. Further research is needed to optimize the system and assess long-term impacts on food safety.