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THE IMPORTANCE OF NANO TECHNOLOGY IN AQUACULTURE

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Abstract

Aquaculture has become increasingly important in recent decades in meeting the enormous demand for animal protein requirements and, as a result, contributing to food security. Nonetheless, illness prevalence and environmental degradation are regarded as crucial issues facing the industry. In order to properly address these difficulties, new technological avenues have been paved. Among these, nanotechnology is a cutting-edge instrument with a wide range of applications, including aquaculture and the preservation of seafood. It can offer novel medication management solutions, such as the release of vaccines, and so guarantee the civilized defense of farmed fish against pathogens that cause sickness.

An overview of nanotechnology and its uses in aquaculture is given in this article. It also provides a basic overview of fish disease and traditional pathogen management measures. However, as this analysis makes clear, nanotechnology is a potentially useful new tool that could improve the management and control of disease prevalence. Thus, it has also been emphasized how important this technique is to advancing sustainable aquaculture. This article also discusses the function of selenium nanoparticles as an effective component.

Introduction

Different marine and terrestrial animal sources of protein exist. Nonetheless, aquatic protein sources are preferred because of their favourable health impacts and important dietary compositional properties. In almost every nation on earth, fish is regarded as a necessary component of the human diet (Mohanty 2015). It makes up roughly 17% of the animal protein consumed worldwide. Fish are essential for livelihoods, food security, and nutrition. The best sources of protein are found in fish, which also contain a variety of other nutrients, particularly the important fatty and amino acids that our bodies require, vitamins, and other essential elements like iodine and selenium that are not present in other foods or meat.

Fish contain iron, calcium, zinc, phosphorus, selenium, fluorine, and iodine (found in marine fish). Once ingested by the body, these minerals are highly bioavailable. Vitamin B complex can be found in fish, and liver oil has a large amount of fat-soluble vitamins A, E, K, and D in addition to other vitamins like C, E, and K (Mohanty 2015). Polyunsaturated fatty acids (PUFAs), particularly omega fatty acids, which the human body is unable to produce, are abundant in fish oil (Mohanty 2015). The main components of our neurological system are omega-3 fatty acids, specifically docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA).

Since fish are the most readily available and least expensive form of animal protein when compared to other sources, there will likely be a rise in demand for fish and fish products as the global population grows. According to Mohanty (2015), fish is thought to be a vital part of the diets of the impoverished who rely on staple foods like rice, corn, and other cereals. Fish also aid in balancing the calorie/protein ratio, with 150 g of fish protein providing between 50 and 60 percent of an adult's daily protein requirement.

Aquaculture and Nanotechnology

Nanoscience and nanotechnology are two fields that are extremely promising and developing quickly in terms of scientific and technical innovation. Numerous multidisciplinary activities are demonstrated by nanotechnology in the sectors of aquaculture and agriculture.

Definition of nanoparticles

Generally, a structure is considered to be a nanoparticle (NP) if its size is between 0.1 and 100 nm (1/1,000,000 mm). The potential benefits of nanotechnology have been acknowledged by numerous industrial sectors, and as a result, products based on nanotechnology or containing nanoparticles are already produced in the pharmaceutical, consumer products (such as paint, automobile, and personal care items), and microelectronics industries. Regarding food and agriculture, a number of beneficial uses are also emerging. These include packaging technologies, nanosensors for detecting pathogens or analyzing storage conditions, pesticide formulations at the nanoscale, and the encapsulation and delivery of food ingredients at the nanoscale. (2009, Bhattacharyya)

Application of Nanotechnology

Improvement of fish growth

There is much room for application of nanotechnology in the seafood and aquaculture sectors. Information regarding the effects on marine organisms is scarce. It has been demonstrated that the presence of iron nanoparticles causes young carp and sturgeon to grow more quickly. Additionally, it was observed that crucian carp (Carassius auratus gibelio) muscle selenium concentrations and glutathione peroxidase activity could all be increased by feeding fish a diet enriched with nano-selenium. These findings were made in Handy et al. (2012).

2014's Bhupinder Furthermore, tests conducted on fish development and performance using the aforementioned nanomaterials have demonstrated that nutraceuticals delivered at the nanoscale can enhance fish growth. While a silver nanoparticle-coated water filter may protect rainbow trout fish from fungal infections in fish farming, the direct application of silver nanoparticles in water for the treatment of fungal diseases has been found to be detrimental to juvenile trout. In summary, fish health may be controlled by the use of nanotechnology in aquaculture systems, porous nanostructures for the delivery of veterinary products in fish food, and nanosensors for pathogen detection in fish farming systems. Thus, nanomaterials have demonstrated remarkable potential in a variety of pond-ecosystem situations (Gustavo and Dominguez 2014).

Filtration and cleanup of water

There are currently nano-enabled technologies available for the removal of pollutants from water. Nanomaterials can be utilized in aquaculture applications to hold aerobic and anaerobic biofilm for the removal of nitrate, nitrite, and ammonia pollutants. These materials can be activated materials like carbon or alumina, with additions like zeolite and compounds containing iron. The use of ultrafine nanoscale iron powder is a significant technique that paves the way for nano-aquaculture by eliminating less hazardous, simpler carbon compounds such dioxins, trichloroethane, carbon tetrachloride, and polychlorinated biphenyls (Rather et al. 2011).

Fish harvesting

Fish are drawn to fishing lures that are painted to resemble light in order to catch them. But these conventional lures only reflect light in one way. To address this issue, the surface of the lure is coloured and then nanocoated with a polyimide film, increasing the likelihood of catching fish two or three times as compared to the scenario where a lure without a polyimide coating is utilized (Rather et al. 2011).

Devices using nanotechnology to manage aquatic environments

The use of nanotechnology in seawater shrimp farming shown that the device could lower the rate of water exchange, improve the water's quality, raise the shrimp's survival rate, and ultimately boost production (Wen et al. 2003). The results indicated a 100% increase in fish survival rate, a decrease in both water nitrite and nitrate, and a reduction in nitrite to as low as 1/4 of the control group, making nanonet therapy the most effective of various nanodevices. Additionally, nanotechnology has raised the pH of water and significantly enhanced the water efficiency (Liu et al., 2008). Currently, nano-863 is a widely used high-tech agriculture product in China. This product is the result of combining excellent light-absorbing qualities with high-temperature sintering nanoparticles on a ceramic material carrier. Aquaculture, crop cultivation, and livestock rearing have all made extensive use of Nano-863.

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