

Nanotechnology as a Drug Delivery Tool in Aquaculture

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SUMMARY

The intensification of the aquaculture system has resulted in outbreak of new diseases. Drugs used for the treatment of the diseases are either partially utilized or it is not able to reach the actual site of target of the drug. However, the use of nanotechnology is a promising tool for the effective drug delivery in the system.

INTRODUCTION

Aquaculture, is fastest growing food sector. The sector contributes to food and nutrition for the growing population by providing highly beneficial aquatic proteins and fats. The production from the sector is also useful in maintaining the socioeconomic status of people (FAO 2018). Because of the increasing demand for fish as food around the world, sustainable aquaculture growth key approach to ensure global food and nutritional safety (Souza et al. 2017). The major hindrance in the development of aquaculture is the incidence of diseases in the system. Several therapeutants are commonly used in aquaculture. However, the efficacy and the bioavailability of the drugs for the fishes can be less due to improper and inefficient drug delivery systems. Under this criterion, the use of nanotechnology as a drug delivery tool can serve as a good and promising measure for the efficient drug delivery in aquaculture. Nanoparticles are compounds with dimensions varying from 1 to 100 nm in at least one dimension. Due to their exclusive physicochemical properties, nanoparticles have been progressively more manufactured and extensively used in various fields, like food processing and packaging, health products, and biomedicine (Yin et al. 2017).

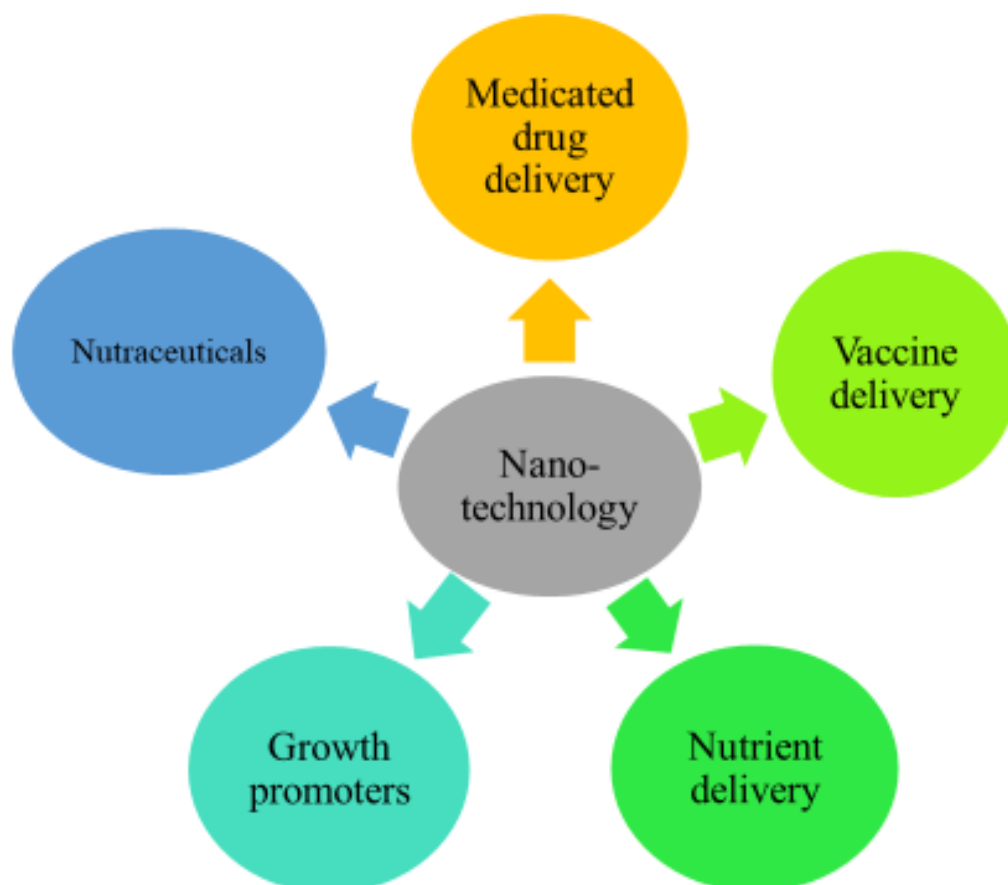


Fig 1: The various compound delivery through nanotechnology

Drug delivery tool:

Numerous medical uses for nanoparticles have been discovered, including medicine and gene delivery, immunisation, and diagnostics. Due to the significant properties of nanoparticles the compounds are significantly explored as an effective drug delivery system in the veterinary field. Also, the use of nanotechnology in aquaculture is being progressively explored. Nanotechnology is a multidisciplinary discipline that plays a vital role in the delivery of nutrients to particular fish parts in the pharmaceutical and nutraceutical industries.

Nanoparticles have multiple advantages in drug administration such as easy penetration due to smaller size, increased bioavailability etc. Nanoparticles are hence considered as an effective tool for vaccine delivery and could provide protection to farmed fishes against pathogenic diseases. The use of nano-chitosan as a vaccine delivery tool is explored in aquaculture. The nano-chitosan can wrap around the vaccine and could act as a carrier used in nanoencapsulation for treatment delivery in the fish physiology. Nano encapsulated vaccines have been used in Asian Carp against the bacterium *Listonellaanguillarum* (Bhattacharyya et al. 2015). Nanotechnology playing important role in delivery of nutrients, vaccine and other biological materials to different systems of fishes (Handy et al., 2008; Hosseini et al., 2015; Shaw & Handy, 2011). There are lots of nanoparticles that have less toxic effects on the different cells of fish immune system. Many of the advancements in nanotechnology can be made to decrease the rate of infectious disease caused by viruses as well as bacteria. (Hosseini et al., 2016; Vimal et al., 2012).

While the other biological materials cannot properly have reached to the site of target where action is necessary, nanoparticles because of their reduced and tiny size can easy reach target sites. Undoubtedly nanoparticles coupled with other beneficial compounds are known to play a significant role in scaling up growth and immunological parameters in fish

A huge literature is available supporting the role of nanotechnology in effective delivery of dietary supplements and nutraceuticals in fisheries. These systems are basically aimed to enhance the bioavailability, bio accessibility and hence efficacy of the nutrients by improving their solubility and protection from harsh environment of the gut. In this perspective, it was found that adding 1 mg of nanoSelenium (Se) per kg of diet showed significant improvement in common carp (*Cyprinus carpio*) growth and antioxidant defence system as compared to the control ones (Fusetani, 2004). The use of nanotechnology for the delivery of the varied compounds are as shown in Figure 1.

CONCLUSION

Nanoparticles are low cost as compared to the other complex drug delivery tools which are used in delivering biological materials. Hence nanoparticle can be used as an effective drug delivery system in aquaculture. However more experimental study is to be done to investigate the different mechanism of action of the particles on the fish body. However, instead of minimal requirements, their incorporation requires higher costs. Therefore, intense care should be taken in their usage to avoid wastage and maximize their utilization. Hence, nanoparticles can be employed as major source for supply of drugs, nutrients and biological fees in right ways (Flemming, 2002).

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