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Nutritional Fish Disease and Public Health Concern

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Abstract

Nutritionally sound food is the most important basic requirement for proper growth, good health and mental development of human beings. Aquaculture foods are a unique source of the essential long-chain omega-3 fatty acids, important for optimal brain and neurodevelopment in children and aquatic animals also. Aquaculture, the single most important animal food producing agricultural sector for human is facing a lot of challenges to provide secured animal food. This review was conducted to investigate the significance, underlying causes and negative effects of nutritional diseases of fish on aquaculture food production, food security, and public health safety. Investigation reveals that the nutritional diseases are very dangerous threat to aquaculture food production as these are very difficult to identify which can result in increased production cost, investment lost, increased fish mortality, susceptibility to infectious disease and finally decreased yield quality and quantity. Food security and public health safety are at great risk due to the frequent outbreak of disease and treatment involving synthetic drugs. It is very essential to control nutritional diseases to increase fish supply through aquaculture production because the shortage of specific nutrients will make the immune system weaker to perform their roles against the foreign invader. It is well established that not only the deficiencies of various nutrients can compromise the immuno-competence, excess nutrient supply than required levels for optimal growth also influences the immune responses and disease resistance significantly.

Keywords: Aquaculture; Nutrition; Deficiency disease; Docosahexaenoic acid; Essential fatty acids; PUFA; Pelleted feed

Abbreviation: EFA: Essential Fatty Acids; EPA: Eicosa-Pentanoic Acid; DHA: Docosahexaenoic Acids; PUFA: Polyunsaturated Fatty Acids; PCBs: Polychlorinated Biphenyl Residues; GM: Genetically Modified

Introduction

Nutritionally sound food is the most important basic requirement for proper growth, good health and mental development of human beings. Aquaculture is currently the fastest growing agricultural sector in the world. Aquaculture production has shifted from extensive to semi-intensive and intensive culture systems within the last decades [1-3]. In 2050, the global population will be increased to around nine billion which will require 50% more food fish to sustain the human generation. The disease is an important constraint to aquaculture development and sustainability because production cost increases through investment loss as a result of fish mortality, cost of disease treatment and loss of product quality and quantity [4,5]. Due to frequent disease outbreak, public health and environmental safety are also threatened because human health hazards are related to disease occurrence and drugs resistance [1,2]. This sector is facing more challenges to make sure its sustainable development due to the emerging of the new disease. The disease is a disturbed condition of living organisms in which normal physiological function of different parts of the body get changed expressing distinguishing signs and symptoms. Development of an active fish disease is directly associated with the effect of different pathogenic microorganism and also with the nutritional value of fish feed [6]. Fish diseases commonly outbreak when fish are stressed due to a variety of physical, chemical and biological factors including poor nutrition [7]. Nutritional diseases are those which the results in due to excess nutrient or nutritional deficiency in fish than the normal requirements. Lipids, carbohydrate, proteins vitamins and mineral salts are some of the important nutrients for proper fish growth [8]. The disease symptom disappears when the existing feed is changed with a new one [4]. Reduced fecundity, slow growth rate, decreased appetite, increased susceptibility to diseases, morbidity with clinical signs and pathological lesions and mortality are some of the important symptoms of nutritional diseases. Wastes derived from artificial feed affects the fish farming environment directly and also through causing aquatic pollution. Uneaten feeds, fish, and other metabolic wastes contribute to particulate nutrient loading of the water which induces stress on the growth of cultured organisms and increases the possibility to disease occurrence [9]. Most of the nutritional diseases are very difficult to identify due to their chronic nature but can be avoided through proper feeding management practices [1-4]. A nutritionally balanced and complete live or artificial diet and healthy farming condition are vital requirements for sustainable aquaculture production and good health management of the cultured fish species to prevent nutritional diseases [9]. This review was conducted to investigate the nutritional requirements of aquaculture fish species, effects of nutritional deficiency and the diseases caused by excess or of fish in aquaculture cause behind the nutritional diseases and possible treatments to control nutritional diseases of fish.

Materials and Methods

Information used in this review paper were collected from different secondary sources such as peer-reviewed national or international journals, newsletters, proceedings, reports, related books, browsing internets etc. Information was also collected from different electronic

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media, visiting websites of different fish disease diagnosis, centers fish health management, expert professionals websites and pharmaceutical company websites. All the information collected from the secondary sources has been compiled systematically and chronologically.

Review of Findings

Proper management of nutrition is crucial to achieve optimal growth and also to maintain the health of aquaculture organisms. The nutritional diseases of fish may occur as a result of deficiency, excess or imbalance of nutrients [10]. Researches on fish nutrition are not only confined to investigate the minimum nutrient requirements for normal growth, but also the immune-modulation and disease resistance has become a top priority research area to reduce the use of chemotherapeutics and disease-related economic losses [11-13].

In general, nutritional disease develops gradually because animals can reserve some nutrients in their body up to the certain extent to fill up the nutritional deficiency. After full utilization of the reserved nutrients, fish gets sick and affected by several pathogenic microorganisms and disease condition develops. In the fish body the fish which receives less nutrition than the requirement levels initially show signs of decreased growth and decreased production [10,14]. Younger fishes are first affected by the disease and then the most productive individuals get affected, even mortality may be increased in the fish population if the malnutrition becomes chronic. Weak fishes are most susceptible to diseases like fin rot disease [14]. Sometimes, the excess feed is converted to fat, deposits different organs of fish and affects the physiological functions of fish severely [10]. Nutritional diseases arising from dietary imbalances continue to cause problems to fish in cultured condition [11]. Diets that are inadequate with respect to protein, amino acid, essential fatty acids, vitamins, and minerals lead to gross malnutrition and high disease susceptibility. Proper feeding of a nutritious diet is important for growth and prevention of nutritional deficiencies, and to cope with a variety of disease-causing agents [7]. Nutritional deficiency diseases are non-specific in nature [1-4]. Affected fish provides favorable environmental or physiological conditions to be predisposed by the organisms to infection. Oversupply of nutrient results in nutrient loss and increase water pollution which can alter the water chemistry and lead to serious health hazards for the entire fish population [9].

Usually, nutritional deficiency signs develop slowly and it is very difficult to detect clear signs in the early stages. However Poor appetite, poor feed efficiency, and reduced weight gain are some of the vitamin deficiency signs [15]. The farmers may obtain indirect clues of vitamin deficiency from this signs [11]. In fish, minerals provide important roles in osmoregulation, scale and skeleton formation, and intermediary metabolism. Difficult to study the mineral requirements of fish are because some minerals are required very minute amounts. Some other minerals are absorbed from water in significant quantities through the gills as well as from the diet [15]. Mineral deficiencies appear due to dietary imbalances and interaction of dietary components. Skeletal deformities, reduced resistance to diseases and anemia are some of mineral deficiency signs [7-9]. Zinc, copper, iron, and selenium are required at trace amount for metal-enzymes which are vital to maintaining cellular functions in the immune system [7-9]. Very little is known about the effects of trace elements on the immune function of finfish species. Iron is a very important nutrient for fish as well as for microorganisms also; even the ability of pathogens to enter to a host depends on the availability of iron. Microcytic Anemia is one of the deficiency sign of iron which can be occurred in several fish species [5-7]. Iron deficiency makes the host fish more susceptible to infectious agents.

Results

Fish diseases and human health

Sustainable development of the aquaculture sector depends on the successful management of diseases. Among the diseases, the nutritional disease is a critical threat to public health safety [4-6]. Pathogen identification and use of unapproved drugs in aquaculture raise the issues to reject the products, law enforcement against involved trade parties, trade disruption, and heavy financial losses. Feed-derived "wastes impact the culture environment through direct pollution, which in turn affects the culture organisms. Extra feeds, feces and metabolic wastes contribute to environmental pollution [8,9]. These factors induce stress, depress the growth of cultured organisms and increase their vulnerability to diseases. A chronic over supplementation of protein results in increased protein excretion by the fish and an increased level of ammonia in the environment. Alteration in water chemistry leads to serious health problems for the farmed populations [16].

In 2050, the global population will be increased to around nine billion which will require 50% more food fish to sustain the human generation [17]. Intensive aquaculture, fish culture system using commercial feeds at higher stocking density will have to fill up the growing food demand. Health condition and nutrient profile of fish depends upon the nutrient composition of supplemented feed to the fish which will directly affect the consumer's nutrition profile, food safety, and health condition [18]. High levels of ω6 fatty acids in feed reduces the concentration of EPA and DHA in farmed fish products. But most of the consumers are not aware of these lowering of DHA and EPA content which is now common in many farmed fish species. Nichols et al. investigated the ω3 fatty acid content of farmed Atlantic salmon and barramundi samples from 2002 compared to samples from 2010-2013 and found lower concentration in the sample of 2013 Atlantic salmon. Atlantic salmon contained 2014 mg/100 g in 2002 which decreased to 975 mg/100 g in 2013 and the Barramundi contained 1970 mg/100 g in 2002 which decreased to 790 mg/100 g in 2013 [19]. So it very important to increase the ω3 PUFA content in the lipid profile of farmed fish (Table 1). These changes also have negative impacts on the fish product quality which can change public perception of farmed fish [18-28].

Conclusion

Aquaculture Health management means the management approaches to prevent and control the outbreak of emerging and re-emerging diseases which begin with prevention of disease. Proper management of water quality and nutrition is the first step in fish disease Prevention. It is impossible to prevent diseases outbreaks without this. Poor water quality, nutrition or immune system is associated with stress which allows the pathogens to cause a disease. Nutritional diseases are not contagious and rarely happen but cannot be cured by medications. Best way to prevent and control through provision of good water quality and good management. Timely observation of fish behavior and feeding helps in the primary detection of disease. It provides an easy diagnosis of odd disease before the majority of the population becomes sick. A balanced diet can provide high nutrients to recover from deficiency diseases and high yields. Diets may also have negative effects inducing nutrient deficiencies, toxin production or induction of pathogens into the fish. Fish health management has become one of the basic requirements for sustainable aquaculture development. But, most of the farmer involved in aquaculture practice do not have sufficient

Name of disease	Causes of disease	Species affected	Signs and symptoms
Fish scurvy	Ascorbic acid deficiency	*Cromileptes altivelis Epinephelus tauvina, E. malabaricus*	Anorexia, erosion of fins, hemorrhages, poor growth exophthalmia, abnormal skull, swollen abdomen, and spinal column abnormality
Broken back syndrome	Vitamin C deficiency	Channel catfish	Biochemical dysfunctions, organ dysfunction, morphological changes, functional changes
Lipidosis	Rancid fatty feeds and poorly stored trash fish	Cultured grouper *Epinephelus malabaricus, E. coioides* and *C. altivelis*	Poor growth, lethargic movement, opaque eyes, abdominal distention, pale appearance of liver
Obesity	Deficiency of biotin or choline or high-fat diet	Pond and aquarium fish and goldfishes	Fatty infiltration of the liver, fatty liver
Nutritional myopathy	Rancid fat or PUFA containing diets and low vitamin E contents.	*Cromileptes altivelis* fingerlings and Bloodstock	Body color darkening, emaciation, petechial at operculum, spinal cord deformity
Steatitis	Vitamin E deficiency	Phocid seals	
Hyponatremia	Salt deficiency	Marine fish, freshwater pinnipeds, saltwater animals, otariids, phocid seals, and other marine mammals	Periodic weakness, tremor, lethargy, incoordination, and anorexia
Blindness-melanism syndrome	Vitamins deficiency	*Ocyurus chrysurus* and *Lutjanus analis*	Loss of appetite, melanism, blindness, lesion, weight loss, muscle degeneration
Granulomatous hypertyrosinemia	Nutrition deficiency	*Scophthalmus maximus, Charax puntazzo, O. chrysurus, L. analis, H. hypoglossus*	Nodules on kidney, viscera, and muscle, melanism, weight loss, abdominal dropsy
Fish eye maladies	Mechanical trauma, hormone imbalances, ultraviolet light, heat shocks, pesticides, heavy metals, fungicides	Salmonids, MW and FW species	Sight loss
Shock syndrome	EFA, EPA and DHA deficiency	*E. tauvina, E. malabaricus, E. fuscoguttatus* broodstocks	Weakness, mortality, fatty liver, caudal fin erosion, and poor food efficiency
Avitaminosis	Absence of particular vitamin	Several species	Non-specific growth retardation
Hypervitaminosis	Accumulation of water-soluble vitamins	Experimental fish	Toxicity signs
Histamine poisoning	Eating high histamine containing fish	Tuna, Mackerel, marine fish, non-scombroid fishes, anchovies, herrings, pinnipeds	Lethargy, anorexia and throat inflammation
Toxicosis	Bio-toxins, pesticides, herbicides, PCBs, aflatoxin, feed contamination	Rainbow trout	Liver cancer
Sekoke disease	Carbohydrate deficiency	Farmed carp species *Cyprinus carpio*	Hypoglycemia, exophthalmia, leprnorthsis, glycosuria, ketonuria, and ascites
Brown bowel syndrome or Gastrointestinal ceroidosis	Vitamin E deficiency	Farmed marine and freshwater fish species	Brown discoloration of the intestinal wall, ceroid pigmentation
Lordosis	Magnesium deficiency	Farmed species	Poor growth and tetany
Microcytic homochronic anemia	Iron deficiency	Farmed species	Reduction in circulating red-cell mass, hypoxia,

Table 1: Common nutritional diseases of Fish with signs and symptoms.

knowledge on aquaculture health management practices. So it is very essential to focus the efforts on disease prevalence and fish pathogens. Farmers should be provided with essential knowledge about good aquaculture management practice. Disease prevention can be achieved through proper nutrition supply, good quality water supply and healthy sanitation condition. Poor water quality, proper nutritional diets or week immune system allow the potential microorganism to cause disease. In order to ensure disease resistance, optimum level of nutrients should be supplied in diets because nutrient requirement level varies from species to species. The following steps can make new windows in nutritional disease control in aquaculture. Consumer perception and satisfaction are an important aspect of fish nutrition; therefore the use of GM ingredients or the production of GM salmon needs to be evaluated for sensory quality due to possible biochemical changes that affect sensory characteristics. In the future it is likely that genetically modified plants with endogenous DHA and EPA will be used in fish feeds. The effect of GM foods on human health is not well known, however, many different types of produce and processed foods available today are non-labeled GM, so many North American consumers have purchased GM foods on a regular basis for at least a decade. However, there have been no studies to date on the long term effect of GM ingredients fed to farmed fish on human health. This will be a critical area of research in the future.

1. Maintaining a suitable stocking density is necessary as overcrowding predispose fish to infections.
2. Store the feed properly in dry, cool and covered place as *Aspergillus flavins* can grow on moldy feedstuff and produce aflatoxins.
3. Increase the shelf life of fish food adding stabilized vitamin C (l-ascorbyl-2-polyphosphate) during manufacturing the process. Avoid feeding food greater than 90 days old.
4. Clinical signs of hypovitaminosis C include scoliosis and lordosis. Adding vitamin C directly to the water can provide necessary supplementation.
5. Vitamin B deficiencies are common nutritional problems. The requirements for certain B vitamins are significant increases after prolonged antibiotic treatment and supplements should be considered for these patients.

6. When fish flakes come into contact with water, up to 90% of water-soluble vitamins are lost within 30 seconds. Owners should feed smaller amounts of food at more frequencies get the greatest benefit of vitamins.

7. Live food can have several benefits, including color enhancement. Live foods should always originate from controlled artificial cultures and wild-caught live food should be avoided.

8. Feeding of the higher vitamin is often reported to provide some protection against disease and to improve tissue regeneration following injury or tissue damage due to low temperatures. The prophylactic use of vitamins in animal nutrition is widely recognized and practiced.

9. Use of high quality feed ingredients free from contaminants, proper nutrient balance in feed formulation, prevention of micronutrients loss during feed processing, better handling, storage and feed management also have good potential to improve health of aquatic animals.

10. Feeds formulation based on blood and fish meal should be closely monitored because they supply high amounts of iron which may predispose fish to common bacterial pathogens.

11. Deficiencies due to presence of anti-vitamin factors in feed can be overcome by heat processing, cooking or heat treatments etc.

12. Avoid feeding the stock with trash fish that cannot provide balanced nutrition. This type of feed lessens the natural resistance of fish and makes them more vulnerable to pathogenic infection.

13. Use dry pellet feed which is hygienic, nutritious and low in bacteria. Dry pellet feed added with vitamins and minerals can further strengthen fish immunity.

References

1. Idowu TA, Adedeji HA, Sogbesan OA (2017) Fish Disease and Health Management in Aquaculture Production. Int J Environ Agri Sci 1: 002.

2. Idowu TA, Onyia LU, Kefas M (2016) Fish diseases and health management. In: Contextual aquaculture and fisheries digest. Paraclete Publisher, USA.

3. Blanco MM, Gibello A, Fernandez-Garayzabal JF (2000) Influence of fish health management: Bases, procedures and economic implications. Cahiers Options Mediterraneennes 51: 45-49.

4. Francis-Floyd R, Wellborn TL (1991) Introduction to fish health management. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Florida.

5. Allsopp M, Johnston P, Santillo D (2008) Challenging the aquaculture industry on sustainability: Technical overview.Greenpeace Research Laboratories Technical, Washington.

6. Schipp G, Bosmans J, Humphrey J (2007) Northern Territory Barramundi Farming Handbook. Department of Primary Industry Fisheries and Mines, Technical Publication.

7. Lall SP (2000) Nutrition and health of fish. Advances in Aquaculture Nutrition V. Memories of the 5th International Aquaculture Nutrition Symposium, Canada.

8. Abowei JFN, Briyai OF, Bassey SE (2011) A Review of Some Viral, Neoplastic, Environmental and Nutritional Diseases of African Fish. Br J Pharmacol 2: 227-235.

9. Joseph I, Raj RP (2002) Nutritional Deficiency Diseases in Fish. Technical paper-8. Central Marine Fisheries Research Institute, Kochi.

10. Amar EC, Lavilla-Pitogo CR (2004) Nutritional diseases. Aquaculture Department, Southeast Asian Fisheries Development Center, Philippines.

11. Pohlenz C, Gatlin DM (2014) Interrelationships between fish nutrition and health. Aquaculture 431: 111-117.

12. Oliva-Teles A (2012) Nutrition and health of aquaculture fish. Journal Fish Diseases 35: 83-108.

13. Kiron V (2012) Fish immune system and its nutritional modulation for preventive health care. Anim Feed Sci Technol 173: 111-133.

14. Mayer J (2012) Excellence in Exotics: Fish Nutrition and Related Problems. VetFolio, Florida.

15. Cho CY (2002) Nutrition and Fish Health.in A guide to integrated fish health management in the Great Lakes Basin. Great Lakes Fishery Commission, USA.

16. Nagasawa K, Cruz-Lacierda ER (2004) Diseases of cultured groupers. Aquaculture Department, Southeast Asian Fisheries Development Center, Philippines.

17. Diana JS, Egna HS, Chopin T, Peterson MS, Cao L, et al. (2013) Responsible aquaculture in 2050: Valuing local conditions and human innovations will be key to success. BioScience 63: 255-262.

18. Hixson SM (2014) Fish nutrition and current issues in aquaculture: The balance in providing safe and nutritious seafood, in an environmentally sustainable manner. J Aquac Res Develop 5: 1.

19. Nichols PD, Glencross B, Petrie JR, Singh SP (2014) Readily available sources of long-chain omega-3 oils: Is farmed Australian seafood a better source of the good oil than wild-caught seafood? Nutrients 6: 1063-1079.

20. Torstensen BE, Bell JG, Rosenlund G, Henderson RJ, Graff IE, et al. (2005) Tailoring of Atlantic salmon (Salmo salar L.) flesh lipid composition and sensory quality by replacing fish oil with a vegetable oil blend. J Agric Food Chem 53: 10166-10178.

21. Turchini GM, Torstensen BE, Ng WK (2009) Fish oil replacement in finfish nutrition. Reviews in Aquaculture 1: 10-57.

22. Horn T, Svendsen LB, Nielsen R (1990) Brown-bowel syndrome: review of the literature and presentation of cases. Scand J Gastroenterol 25: 66-72.

23. Yokote M (1970) Sekoke disease, spontaneous diabetes in carp found in fish farms-III. Response to mammalian insulin. Jap Soc Sci Fish 36: 1219-1223.

24. Aly SM (2013) A review of fish diseases in the Egyptian aquaculture sector: Working report. Suez Canal University, Ismailia, Egypt.

25. Stoskopf MK Nutrition and Nutritional Diseases of Marine Mammals. Veterinary Manual, North Carolina State University, US.

26. Sharma M, Shrivastav AB, Sahni YP, Pandey G (2012) Overviews of the treatment and control of common fish diseases. Int Res J Pharm 3.

27. Tacon AGJ (1992) Nutritional fish pathology. FAO Fish Technical Paper. No. 330. Rome.

28. Sealey WM, Gatlin DM (1999) Overview of nutritional strategies affecting health of marine fish. J Applied Aquaculture 9: 11-26.