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Applied Zoology, Profitable Animal Production, and Health: Current Status and Future Progress (NSAZ-2022) 23rd & 24th September- 2022

Recent Trends in Applied Zoology

Dr.D.S.Rathod
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Associate Editors
Dr. K.S.Raut
Mr.Datta Nalle

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Editor
Dr.D.S.Rathod
Head
Department of Zoology and Fishery Science,
Rajarshi Shahu Mahavidyalaya (Autonomous),

Latur- 413531, Maharashtra

Associate Editors
Dr. K.S.Raut
Mr.Datta Nalle
Department of Zoology and Fishery Science, Rajarshi Shahu Mahavidyalaya (Autonomous),
Latur- 413531, Maharashtra

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Chapter 15

Omega -3 fatty acid and its use in fish feed formulation

Madhuri Y. Bhande and Dnyaneshwar S. Rathod

Ph.D. Research Scholar
Department of Zoology and Fishery Science, Rajarshi Shahu Mahavidyalaya,
(Autonomous) Latur-413512 (MS)

Abstract

Fish disease is a common problem encountered even in these modern days, which is said to be the period of scientific development and awareness of hygiene. Vaccines are being developed and marketed and they generally cannot be used as a universal disease control measure in aquaculture. Juvenile fish are fully immune-competent and do not always respond to vaccination. Vaccination with the' help of injection, sometimes are the only effective path of vaccine delivery, it s impractical when supplied to small fish or a large number of fish. This situation is avoided by an alternative in the production system through the use of fatty acid to fight against diseases, through the use of omega 3 fatty acid which is an acceptable practice in aquaculture. As we know the fish itself is the best source omega 3 fatty acid but they also needful for certain omega derivatives for growth and immunology. here when literature studied, very few indices where significantly study about appropriate omega dietary utilization, hence the acute level should be in consideration, to keep this view in mind present investigating where been tasked.

Key words : Omega -3 fatty acid, fish feed.

Introduction:

Omega Protein Corporation was a publicly traded US company, founded in 1913 as a fishing operation. As of 2015 it still operated a fishing fleet, and produced food ingredients, dietary supplements and animal feed. Their products included fish oil, fish meal, and proteins. In the 2000s it expanded via acquisitions into ingredients produced from milk and plants. On December 19, 2017 Cooke Inc. completed its acquisition of Omega Protein for $22.00 per share Fish meal is a commercial product made from whole wild-caught fish, bycatch and fish by-products to feed farm animals, e.g., pigs, poultry, and farmed fish.[1] Because it is calorically dense and cheap to produce, fishmeal has played a critical role in the growth of factory farms and the number of farm animals it is possible to breed and feed. Fishmeal takes the form of powder or cake. This form is obtained by drying the fish or fish trimmings, and then grinding it. If the fish used is a fatty fish it is first pressed to extract most of the fish oil.

Fish oil is oil derived from the tissues of oily fish. Fish oils contain the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), precursors of certain eicosanoids that are known to reduce inflammation in the body and improve hypertriglyceridemia. There has been a great deal of controversy in recent years about the role of fish oil in cardiovascular disease, with recent meta-analyses reaching different conclusions about its potential impact. The most promising evidence supports supplementation for prevention of cardiac death.Fish oil and omega-3 fatty acids have also been studied in a wide variety of other conditions such as clinical depression, anxiety, cancer, and macular degeneration, yet their benefit in these conditions has also not been verified. The fish used as

sources do not actually produce omega-3 fatty acids. Instead, the fish accumulate the acids by consuming either microalgae or prey fish that have accumulated omega-3 fatty acids. Fatty predatory fish like sharks, swordfish, tilefish, and albacore tuna may be high in omega-3 fatty acids, but due to their position at the top of the food chain, these species may also accumulate toxic substances through biomagnification. For this reason, the United States Environmental Protection Agency recommends limiting consumption (especially for women of childbearing age) of certain (predatory) fish species (e.g., albacore tuna, shark, king mackerel, tilefish and swordfish) due to high levels of the toxic contaminant mercury. Dioxins, like PCBs and chlordane, as well as other chlorinated cyclodiene insecticides are also present. Fish oil is used in aquaculture feed, in particular for feeding farmed salmon.

Marine and freshwater fish oil vary in contents of arachidonic acid, EPA and DHA. The various species range from lean to fatty, and their oil content in the tissues has been shown to vary from 0.7% to 15.5%.They also differ in their effects on organ fatty acid concentrations. Only fatty fish intake, particularly salmonid, and estimated EPA + DHA intake from fatty fish has been observed to be significantly associated with increase in serum EPA + DHA.As of 2019, the US Food and Drug Administration (FDA) has approved four fish oil-based prescription drugs, namely Lovaza, Omtryg (both omega-3 acid ethyl esters), Vascepa (ethyl eicosapentaenoic acid), and Epanova (omega-3 carboxylic acids). Notably, none of these drugs is actually fish oil: they are all derivatives of acids found in fish oil.

What is omega-3 fatty acids and what do they do?

Omega-3 fatty acids are found in foods, such as fish and flaxseed, and in dietary supplements, such as fish oil. The three main omega-3 fatty acids are alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). ALA is found mainly in plant oils such as flaxseed, soybean, and canola oils. DHA and EPA are found in fish and other seafood.

ALA is an essential fatty acid, meaning that your body can’t make it, so you must get it from the foods and beverages you consume. Your body can convert some ALA into EPA and then to DHA, but only in very small amounts. Therefore, getting EPA and DHA from foods (and dietary supplements if you take them) is the only practical way to increase levels of these omega-3 fatty acids in your body. Omega-3s are important components of the membranes that surround each cell in your body. DHA levels are especially high in retina (eye), brain, and sperm cells. Omega-3s also provide calories to give your body energy and have many functions in your heart, blood vessels, lungs, immune system, and endocrine system (the network of hormone-producing glands).

Other conditions

Researchers are studying whether taking omega-3 dietary supplements may help lessen some of the symptoms of attention-deficit/hyperactivity disorder, childhood allergies, and cystic fibrosis. But more research is needed to fully understand the potential benefits of omega-3s for these and other conditions.take a closer look at the total consumption of these essential omega-3 fats (EPA+DHA) by the aquaculture sector. The global production of fish oil is around 1 million tons/yr., and is not expected to increase. Every year roughly 800 000 tons of pure fish oil are used for aquaculture feed. The level of EPA+DHA in fish oil is usually between 15 and 25 percent, so with an average content of 20 percent we would expect 160 000 tons EPA+DHA from fish oil to fish feed purposes. Additionally, fishmeal provides 50 000 tons EPA+DHA for fish feed (based on 3.1m tons fish meal containing 8 percent oil). At present, the aquaculture sector therefore consumes an estimated total of 210 000 tons of EPA+DHA, all originating from the marine environment.the EPA+DHA content in salmon and trout is estimated at an average 22 g/kg fish, providing 53 000 tons of EPA+DHA. This estimate shows that 43 percent of the essential EPA+DHA fats from feed are retained in the fish.

This is in line with commercial feed producers claiming 50 percent of fish oil is retained, and scientific studies showing retention of EPA+DHA in salmon from 30-75 percent depending on the level of fish oil in feed; lower levels of fish oil give higher retention rates.
Since salmonids consume a major part of fish oil in aquaculture, the EPA+DHA retention rate of 43 percent is used for calculating the contribution of these essential fatty acids for other species consuming fish oil, although one would expect better retention in fish having a diet with lower levels of fish oil. Cyprinids do not get fish oil in their diets, but some fishmeal adds some limited amount of EPA+DHA to their feed (Figure 2). However, with an annual production of 24 million tonnes carps, they contribute around 108000 tonnes of EPA+DHA, assuming a level of EPA+DHA of 4.5 g/kg of fish (calculation based on literature values for common carp, silver carp, Catla, and Crucian carp). Mollusks are not consumers of feed, but are net providers of EPA+DHA with an estimated contribution of 6 000 tons
The present research work were focus upon Latur district and its dietary effect on some physiological parameters of Cyprinus carpio semi fingerlings. there was be assessment of growth associated physiological and biochemical changes in these fishes due to the incorporation of different doses of B Mega the Omega 3 From Bioiberica) s dietary supplements. Here we were be focus to make diet economically viable for small farmers.

Omega in fish feed

Omega-3 fatty acids are long-chain polyunsaturated FA commonly having 18, 20, or 22 carbon atoms in chain length with the first of the 3-6 double bonds adjacent to the third carbon atom when counting from the methyl carbon end of the fatty acid molecule (Darren and Bruce, 2004). Figure 1.1 represents the structure of EPA and DHA. Long chain omega-3 fatty acids are mostly obtained from seafood or dietary alpha-linolenic acid, whereas EPA and DHA are synthesized in marine plants such as phytoplankton and micro algae. These are transferred through the food web into lipids in aquatic species like fish and marine mammals (Cho et al., 1987). Increased intake of marine lipid will in turn increase omega-3 fatty acids in the human diet. The health benefits of the omega-3 fatty acids include a major role in the prevention of atherosclerosis, heart attack, depression, stroke, diabetes, obesity, premature aging, hyper tension and cancer as well as improving vision and memory (Chin and Dart, 1995; Connor, 2000). Concentration of omega-3 polyunsaturated FA from fish oil has been carried out by urea complexation (Gamez et al., 2003; Tor and Yi, 2001),

supercritical fluid extraction (Letisse et al., 2006; Mishra et al., 1993) and enzymatic hydrolysis (Zuta, 2003; Wanasundara and Shahidi, 1998; Hoshino et al., 1990). Gas chromatography has been used to analyze and quantify FA composition (Razak et al., 2001). The aim of this study was to investigate the potential of developing environmentally friendly and cost effective enzymatic techniques for the extraction of fish oil from Atlantic herring and separation of omega-3 FA from fish oil.

Dietary Sources of Polyunsaturated Fatty Acids

Daily dose of EPA and DHA combination per day is 0.3-0.5 grams and 0.8-1.1 grams for alpha-linolenic acid (FAO, 1994). Omega-3 fatty acids can be obtained in human diets through marine or plant sources. The marine source (fatty fish) provides EPA and DHA and the plant sources (flax, walnuts, canola oil) provide ALA (Eckert et al., 2010).

Marine Sources

Primary sources of the omega 3 fatty acids are of marine origin: algae, fungi and phytoplankton. They are integrated into phospholipids and fat deposits in fish and other marine animals (seal and whale) via bioaccumulation. Higher levels of EPA are found in the algae Nitzschia spp., Nannochloropsis spp., Navicula spp., Phaeodactylum spp., Porphyridium spp.,

Crypthecodinium cohnii and Schizochytrium spp. were known for their higher level of DHA (Ward and Singh, 2005).

Fungi species like Mucor circinelloides. Mortierella, Pythium, Thraustochytrium, and Entomophthora were used for the production of arachidonic acid (ARA) and eicosapentaenoic acid (EPA) (Sneha, 2008).Table 1shows omega-3 polyunsaturated fatty acids content from various sources. Table 2 shows the content of omega-3 fatty acids, EPA and DHA in various fish. Table 3.6 shows omega-3 fatty acid content in various fish species. Cold water fatty fish including salmon, tuna (bluefin tuna has five times more DHA than other types of tuna), menhaden mackerel, sardines, shellfish and herring are rich sources of omega-3 fatty acids (Singh,)

Table 1. Omega-3 polyunsaturated fatty acids content from various sources.

Source	**Reference**			
(%)* (%)*				
Algae				
Ceramiaceae				
Ceramium boydenii Gepp		16.8	-	Li et al. (2002)
Ceramium kondoi Yendo		20.1	-	Li et al. (2002)
Rhodomelaceae				
Laurencia okamuraiOkam.		23.4	-	Li et al. (2002)
Polysiphonia urceolata		37.5	-	Li et al. (2002)
(Lightf.) Grev.				
Rhodomela confervoides		24.8	-	Li et al. (2002)
(Huds.) Silva				
Corallinaceae				
Corallina pilulifera Post. et		31.5	-	Li et al. (2002)
Rupr.				
Dumontiaceae				
Hyalosiphonia caespitosa		12.5	-	Li et al. (2002)
Okam.				
Gloiosiphoniaceae				
Gloiosiphonia capillaris		3.6	-	Li et al. (2002)
(Huds.) Carm				
Gelidiaceae				
Gelidium amansii Lamour		13.3	-	Li et al. (2002)
Soil microorganism				
Trichoderma sp.	0.298	7.47	Gayathri et al. (2010)	

* Percent of total fatty acids 1- (20:5 n-3)

Table 2. EPA and DHA content in various fish (Newton and Snyder, 1997).

Fish				
(%)*	(%)*			
Sardine	3	9-13		
Pacific anchovy		18	11	
Mackerel	8	8		
Capelin	9	3		
Herring	3-5	2-3		
Freshwater fish		5-13	1-5	

*Percent of total fatty acids

1-(20:5 n-3)

2- (22:6 n-3)

Conclusion

Omega 3 fatty acids are vital for conception through pregnancy and infancy, essential for normal growth and development and maintaining good health (Connor, 2000). DHA has beneficial effect in the development of retina and brain in human being while EPA has been related to anti-inflammatory properties, reduction of obesity related disorders, shrinking of tumors and reduction of human depression levels (Mitsuyoshi et al., 1991). They are also used in prevention and treatment of coronary artery disease, cancer, diabetes, hypertension, rheumatoid arthritis (Shahidi, 2008; Shahidi and Miraliakbari, 2006). Fish oil and blubbers oil of marine mammals including seal, whale and walrus are the rich source of omega-3 fatty acids and a low dose of seal oil can reduce the risk of atherogenic disease. However, seal oil contains high level of DPA, which is the most important fatty acid that keeps artery walls plaque free (Hu et al., 2002).

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