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Omega-3 Fatty Acids and Health Benefits

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Abstract

Unsaturated fatty acids according to the number of bonds are examined in four groups. Omega-3 is very important for other groups. Because of that the essential fatty acid omega-3 fatty acid is metabolized in the body in the form of EPA and DHA. EPA and DHA accelerate the development of brain, nervous system and eye in infants, slow the development of rheumatoid arthritis in adults, decrease high blood triglyceride values, prevent cardiac arrhythmias, increase the survival rate after infarction long chain fatty acids that reduce clotting, prevent arteriosclerosis, reduce blood pressure and slow Alzheimer's disease and DHA is a key component of all cell membranes and is found in abundance in the brain and retina, reduce triglycerides, slow the development of plaque in the arteries, reduce the chance of abnormal heart rhythm, reduce the likelihood of heart attack and stroke.

Key words: omega-3 fatty acid, EPA, DHA, PUFA, health benefits

Review article

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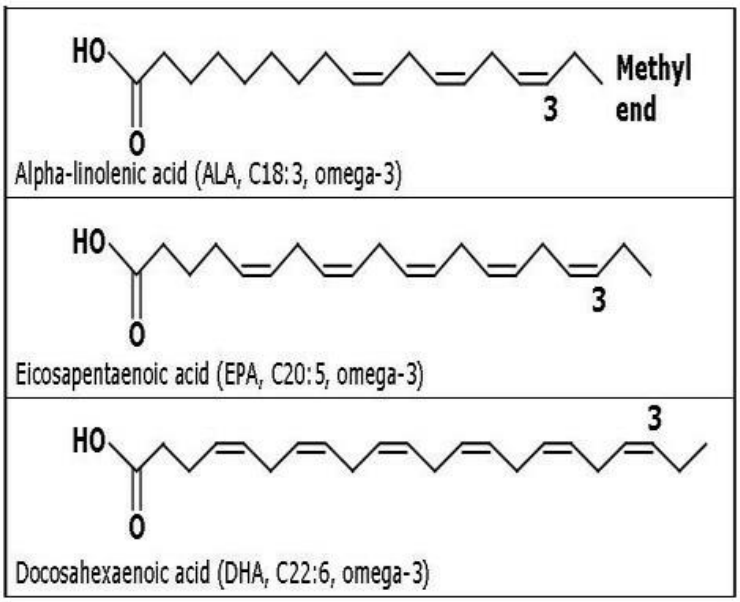
INTRODUCTION

Unsaturated fatty acids according to the number of bonds are examined in four groups. These are monoethylenic acids, diethyleneic acids, triethyleneic acids, tetraethylenenic acids. Omega-3 is in the group of monoethylenic acids and Omega-3 (ω-3) long-chain polyunsaturated fatty acids (PUFA), including eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (Su, 2008; Lazzarin, 2009). Omega-3 is very important for other groups. Because of that the essential fatty acid omega-3 fatty acid is metabolized in the body in the form of EPA and DHA. EPA and DHA accelerate the development of brain, nervous system and eye in infants, slow the development of rheumatoid arthritis in adults, decrease high blood triglyceride values, prevent cardiac arrhythmias, increase the survival rate after infarction long chain fatty acids that reduce clotting, prevent arteriosclerosis, reduce blood pressure and slow Alzheimer's disease and DHA is a key component of all cell membranes and is found in abundance in the brain and retina (Krauss-Etschmann, 2007). EPA and DHA are also the precursors of several metabolites that are potent lipid mediators, considered by many investigators to be beneficial in the prevention or treatment of several diseases (Serhan, 2008).

Description of Omega 3 fatty acids

Structural Properties of omega-3 acids

Important ω-3 fatty acids in human physiology are αlinolenic acid (18:3, ω−3; ALA), eicosapentaenoic acid (20:5, ω-3; EPA), and docosahexaenoic acid (22:6, ω−3;DHA). In a carbon chain of 18, 20, or 22 carbon atomsthese polyunsaturates have either 3, 5, or 6 double bonds, respectively (Kaur et al., 2015). All double bonds are in the cisconfiguration; i.e. the two hydrogen atoms are on the same side of the double bond. EPA and DHA are polyunsaturated fatty acids that are found in marine products (20–40 % of the total fat contents) and algae (40%) (Garg et al., 2006). Both are important fatty acids that enter the body through consumption of marine products, fortification, or as ALA. Several studies have revealed that these fatty acids play an important role in maintaining a healthy mind and body (Garg et al., 2006). Sources of DHA and EPA can be broadly categorized as following.



Structure of ALA, EPA and DHA (Adapted from https://funfood16.blogspot.com/2016/12/omega-3-means-nothing-in-terms-of.html).

Omega-3 Nutritional Resources

Fish as an animal source (herring, mackerel, sardines, trout and salmon) and a small amount of eggs. Vegetable; green leafy vegetables such as flaxseed oil, canola oil, soybean oil, walnuts, pumpkin seeds, hemp oil and purslane, are rich in legumes and rapeseed ALA. 3 fatty acids are found in human milk. The main source of EPA and DHA are marine fish (Serhan, 2006; Meyer, 2003; Sanders, 1988).

Table 1. The sources of omega-3.

Omega-3 resources		
Fish meat sources	**Amount required for 1 g EPA + DHA(g)**	**Essential fatty acid**
Fresh Tuna	66-357	DHA, EPE
Canned Tuna	323	DHA, EPE
Pacific Salmon	42.5-70.9	DHA, EPE
Sardine	50-87	DHA, EPE
Trout	323	DHA, EPE
Mackerel	54-250	DHA, EPE
Cod fish	323	DHA, EPE
Whiting	417	DHA, EPE
Flounder	8-213	DHA, EPE
oyster	500	DHA, EPE
Herbal resources	**Content**	**Essential fatty acid**
lax seeds	2.2g/5 ml	ALA
Flax seed oil	8.5g/5 ml	ALA
Purslane	Very low	ALA
Hemp oil	3.1g/5 ml	ALA
Canola oil	1.3g/5 ml	ALA
Soy oil	0.9g/5 ml	ALA
Walnut and pine nut oil	0.7g/5 ml	ALA

(Schwalfenberg, 2006; Nordøy, 2001).

Omega-3s and Health Implications

The potential health benefits of consuming omega-3s are the focus of a great deal of scientific research. By far, the majority of research has focused on EPA and DHA from foods (e.g., fish) and dietary supplements (e.g., fish oil) as opposed to ALA from plant-based foods. Many observational studies link higher intakes of fish and other seafood with improved health outcomes (Hussein, 2005). However, it is difficult to ascertain whether the benefits are due to the omega-3 content of the seafood (which varies among species), other components in the seafood, the substitution of seafood for other less healthful foods, other healthful behaviors, or a combination of these factors. Data from randomized clinical trials are needed to shed light on these questions (Mcguire, 2011; Swanson, 2012; Schwalfenberg, 2006).

Findings show omega-3 fatty acids may help to

- Lower blood pressure
- Reduce triglycerides

- Slow the development of plaque in the arteries
- Reduce the chance of abnormal heart rhythm
- Reduce the likelihood of heart attack and stroke
- Lessen the chance of sudden cardiac death in people with heart disease (Bang, 1972; Dyerberg, 1975).

Omega-3 fatty acids and cardiovascular disease

Omega-3 fatty acids help your heart in different shapes. These fatty acids eliminate inflammation in blood vessels (and other parts of the body). High levels of omega-3s can reduce the risk of irregular heart rhythms and also reduce the level of fasting blood or triglycerides. And finally, omega-3 fatty acids can slow down the formation of blood clots in the veins. The American Heart Association suggests daily 1 g of EPA plus DHA for people with heart disease. Eat fatty fish is better, but your doctor may prescribe a fish oil capsule. If you have a heart attack, the prescription of omega-3 can protect your heart. Some studies have shown that people who consume more omega-3s are less likely to have a heart attack, or fewer deaths from heart attacks. Omega-3 appears to have a stabilizing effect on the heart. Omega 3 can reduce heart rate and prevent arrhythmias, or irregular heartbeats (Ruxton, 2004; Kris-Etherton, 2013).Omega-3s can help lower blood pressure. A good diet plan is to replace red meat on some meals, which is also effective in lowering high blood pressure. For foods containing omega-3, it prevents the accumulation of blood clots in the veins and prevents the rate of circulation of the blood Inside the veins. Therefore, omega-3 can prevent stroke caused by blood clots in the veins (Lee, 2003).

The effect of omega-3 fatty acids on the fetus during pregnancy

Omega-3 is essential for the development of the fetal neurological and visual system. Postpartum also is essential for breast milk production. With each pregnancy, the mother's body is cleared of omega-3s. Studies have shown that adding EPA and DHA to a pregnant mother's diet is directly linked to the development of the fetus. Also, increased consumption of omega-3s reduces the risk of allergies in infants. DHA reduces premature pain, reduces the risk of preeclampsia and increases birth weight. Omega-3 deficiency increases the risk of postpartum depression (Ramakrishnan,2010). The fetus in the mother's womb receives a lot of food from the mother. In fact, the fetus completely removes the nutrients it needs from the mother's body, which is why many mothers who do not receive the necessary nutrients during pregnancy become deficient after giving birth. A mother who has omega-3 deficiency after childbirth may develop postnatal depression (PND) (Helland,2008).

Therefore, it is essential for mothers to use omega-3s during pregnancy and after birth. Specialists believe that maternal body needs improvement and improvement, especially after childbirth. So the body needs the necessary ingredients. In addition, these substances play a very important role in the growth of a born baby. Omega 3 helps to build the baby's brain, the retina, and the fetal nervous system. In addition, omega-3s influence the growth of the cardiovascular system. Getting enough omega-3s to maintain the balance of hormone-producing products called prostaglandins is essential. Hormones regulate. Depending on the type of dietary fatty acid, a particular type of prostaglandin is produced. The imbalance in these prostaglandins causes the disease (Dunstan,2008). Omega-3 therefore has many health benefits, preventing heart disease, improving blood coagulation function and controlling inflammation in the body. High doses of omega-3s help treat and prevent mood disorders and broadly prevent diseases such as cancer, inflammatory bowel disease and autoimmune diseases such as lupus and rheumatoid arthritis. Pregnant women are one of the most important people who should pay special attention to proper Omega 3 diet. For pregnant

women apart from prenatal examinations and exercises, eating balanced meals daily is essential to maintaining a healthy pregnancy. Doctors usually prescribe some folic acid or multivitamin supplements during pregnancy. Most women have been aware of the effect of folic acid on accelerating fetal growth, but the benefits and effects of essential fatty acids have not yet been reported (Helland, 2008).

Omega-3 acids are important for pregnant women because they help reduce the risk of prenatal seizures. Prenatal seizures are a potentially dangerous complication that may occur late in pregnancy and result in seizures and other dangerous effects if left untreated. Symptoms of prenatal seizures include hypertension, fluid retention, overweight, and protein in the urine (Judge, 2007).

CONCLUSION

Omega-3 fatty acids are important for human health. However, it is important to note that these fatty acids are taken up at a certain rate and the balance between them is maintained. Essential fatty acid may play a role in inflammatory diseases, neurological, neuropsychiatric diseases, cancer and chronic diseases (such as diabetes, arthritis, colitis) and the positive effects of adding these fatty acids to treatment protocols are observed.

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Protection of Seafood by Edible Films and Genetic Modification of Protective Culture

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Abstract

Seafood is a good source of nutrients like protein, fats, vitamins and many other micronutrients. The texture of seafood makes it more vulnerable to degrade due to microorganisms. As with the passage of time, seafood consumption increased seafood industries tries to overcome this problem and to extend the shelf life of seafood by controlling the growth of microorganisms and improve the quality of seafood by retarding different metabolic and enzymatically reactions which leads fast towards degradation. For this purpose scientists use different techniques like protective culture made from a starter culture of microorganisms and some protective culture is made from the genetic changes in the genome of microorganisms with the help of recombinant DNA technology. Scientists used edible films to cover the seafood products to prevent the interference of the external environment with food product so it can store for long without any deterioration. This review will cover different microbial protective culture, genetically modified protective culture and about properties of the coating or edible films on seafood products.

Keywords: Seafood, Genetic modification, Micro-organisms and shelf life

Review article

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INTRODUCTION

Seafoods are the water animals having habitat in different water sources from small rivers to ponds and from lakes to saltwater, which are used as a rich nutrient source for human health. Fish is identified as a full healthy diet containing various valuable nutrients like protein, fatty acid, vitamins, minerals, micronutrients, Omega 3- fatty acids and taurine (Basurco et al., 2014). Fatty acids are the important health constituent especially in children for brain and heart development, therefore, seafood should be included in our daily food. People interest in seafood across the globe increased day by day even nutritionists also suggest the intake of seafood in daily life. As consumption increased it is notified that seafood is more vulnerable to decompose by various microorganisms and due to different chemical and biological reactions (Dalgaard et al., 2006; Mejlholm et al., 2008). Instead of the highest nutritionist value fish also can cause many foodborne diseases names.

Seafood has the main problem to become deteriorate easily rather than other foods because of its structure, to overcome this problem different methods are used. Conventionally pathogenic microorganisms were controlled by steam and drying but now various new methods are developed like there is a technique known as bio protection in which live microorganisms are added to food to control the risk of food toxicity. These microorganisms are got from fermentation cultures and are called protective cultures (Hansen, 2002). It is a good practice to inhibit the degradability of food. These protective cultures also act as a good indicator of risk under bad conditions of food such as abnormal temperature, bad handling conditions and biochemical reactions of food after degradation.

Some chemical methods are also used for the preservation and to increase the shelf life of food but customers prefer natural product over the artificial in such case biopreservation method become more reliable and considerable for use than other techniques (Rodgers, 2001; Calo-Mata et al, 2008; Dortu & Thonart, 2009).

Generally, Lactic acid bacteria are used for this process as inoculum to use against microorganisms to retard their growth and it considered safer because it is already used in human food for years. In the beginning, lactic acid bacteria neglected as inoculum for seafood because normally seafood does not have this bacteria. But if seafood is treated with salt, smoke and with other types of packaging than these bacteria can become more effective, and they will change according to fish and bacterial species change (Leroi, 2010).

Seafood is more susceptible to degrade by microorganisms, to increase the shelf life of such foods there is a method of edible film or coating on food material. These eatable coverings of food are much better than synthetic coverings because these are harmless for human and can easily consume with food (Bourtoom, 2008). These films make a natural layer on a food product to save the food from external environmental factors like control the exchange of gases (oxygen, Carbon dioxide, and ethylene) which are important in respiration process of the food product. It also helps food to stop moisture loss (Embuscado & Huber, 2009). This coating material fully covered the food material and become a permanent part of the food product (Guilbert, 1995). The first edible film used for food safety was made from soymilk in 15th century in japan (Sánchez-Ortega et al., 2014).

In this review, we will discuss different seafood protective techniques like protective cultures and edible films to increase their shelf life.

Fish is very healthy nutritious seafood but it is perishable food so after death its degradation process starts in a short time due to different microorganisms and biochemical reactions (Matak et al., 2015). When we talk about the quality of fish different complicated parameters like nutritional, (Pietrowski et al., 2012) microbiological, metabolically, physicochemical and biochemical are involved. To avoid the loss of this rich nutritional source protective cultures and edible films are a good idea to protect fish from any physical, mechanical and microbiological damage. (Min et al., 2005).

Protective Cultures

Bio-preservation is the most suitable technique used to increase the quality of hygiene and improve microbiological sensory parameters. This technique uses natural microflora and their antimicrobial metabolites (Nilsson et al., 2005; Garcia et al., 2010). The most commonly used microflora is Lactic acid bacteria which produce many types of antimicrobial metabolites like organic acids, acetoin, diacetyl, hydrogen peroxide, antifungal peptides, and bacteriocins. In recent research, there were great advancements to use lactic acid bacteria for biological food preservation (Cleveland et al., 2001; Nilsson et al., 2005; Galvez et al., 2007; Nes, 2011). Seafood texture provides a suitable environment for the production of pathogenic microorganisms (Emborg et al., 2002; Dalgaard et al., 2006). Lactic acid bacteria which are borne by seafood can also be able to grow at refrigerated temperatures and these are completely fit for seafood environment. Their growth can control the potential of pathogenic microorganisms by producing antimicrobial metabolites (Nilsson, 1997; Nilsson et al., 1999; Nilsson et al., 2005; Nes, 2011). Some antifungal compounds also produce from Lactic acid bacteria, so it prevents the growth of a wide range of fungi and used for improvement in sensory characters and microbiological safety of food products (Florou-Paneri et al., 2013).

Genetically modified protective cultures

Some bacterial cultures have very less antimicrobial effects so these are not perfect to use for protective cultures. To solve this problem scientists use genetic engineering for improving the characteristics of already available strains. By using this molecular biology technique some specific genes and enzymes can be targeted and new characteristics can be added by addition or deletion of any specific genes. This idea of genome changes in microorganisms by using genetic engineering was started in Lactic acid bacteria by (McKay & Baldwin, 1990) then yeasts (Chapman, 1991) and fungi (Geisen, 1993).

These changes can be produced by some mutagenic agents or by radiations but this method can also produce some undesirable changes in the genome so other ways of genetic modifications are used for perfect results like genes can be transferred through conjugation process in which plasmids are naturally transferred between cells of closely related species bacteria.

One other method is a transformation in which Pure DNA or genetically modified DNA can be inserting artificially from one species of bacteria to another species of bacteria. So in this process, there is no limitation of related species. These all modifications should be according to the GRAS (Generally recognized as safe) status; either strains of bacteria or their genes all should be safe for food consumers according to food and drug administration (FDA). Those plasmids which are used for the transfer from one species to others should never contain

antibiotic resistance markers or DNA sequence which does not fulfill the requirements of GRAS (generally recognized as safe).

Integrative transformation is a technique through which only genes of interest can be transferred to other bacteria and attached to its chromosome (Berghof & Stahl, 1991). This integration process minimizes the risk of undesirable transfer of genes to other microorganisms because after integration these genes are mostly very stable, so they also overcome the pleiotropic effects of genes. Some starter cultures produce toxic metabolites which have negative effects (Le Bars, 1979). To control this situation gene disruption process can be used through which genes of those useless products can be eliminated from microbial strain (Geisen et al, 1990) or recombinant DNA technology can be used by which these non-desired genes can be inactivated by integration of DNA fragments on the homologous chromosomal site of gene between identical sequences of DNA.

Edible Films

Any light material covering on food is used to increase the shelf life of food product is called coating of edible films. These coatings can be eatable with food or it can be removed from food before eating. Edible films and coatings have the same purpose but the main difference between them like coating is directly applied on food for covering, but the edible film is prepared separately and then applied on food for covering (Cordeiro de Azeredo, 2012).

Edible films should have complete characteristics as its name show like as first part is "edible" it should have all properties of that food on which it applied according to the "Food and Drug administration" because it should be completely safe and healthy for humans (Erkmen & Bozoglu, 2016). The second part is "film" used for covering so it should cover the food material properly that no outer air and moisture disturb the food that it should control the transportation of gas and moisture between food and outer environment. Moreover, it should not have any effect on the physical and mechanical properties of food (Han, 2014; Erkmen & Bozoglu, 2016). Food products quality can be increased by using edible films because they can control the microbiological, oxidative and enzymatic reactions of food and also improve the sensory qualities of food.

Instead of all these qualities, there is a problem that limits the use of edible films to specific applications like their permeability is weaker than synthetic films. Scientists are trying to overcome this problem with further research because customers like natural products more than synthetic products (Kester & Fennema, 1986). Moreover, biodegradability of the edible film is very attractive approach in food industry business because it is cheaper than synthetic packaging material and more attractive for health-conscious customers (Krochta & De Mulder-Johnston, 1997; Arnarante & Banks, 2001).

Characteristics of Edible films

As discussed above the function of edible films to protect food from the interference of external environment and keep food safe and fresh with extending the shelf life. These coverings should be matched with food material compounds to keep it healthy for humans. For this purpose edible films should have the following characteristics:

Edible films should be healthy and approved by food and drug administration and it should be biodegradable after digestion but remain stable physically and mechanically during storage and transportation from one place to another place to avoid external disturbance. This covering should be evenly attached on food surface and with good tensile strength and

permeability of this film should be proper to keep balance environment of air, gases, and moisture for a food product (Guilbert et al., 1996; Bourtoom, 2008; Pavlath & Orts, 2009; Erkmen & Bozoglu, 2016). For keeping all these characteristics maintained in edible films there are some specific components which are mostly used for the formation of film and these all materials are getting from both plants and animals. The detail of these components is given in the Table 1.

Table 1. Components of edible film formation. Source: (Erkmen & Barazi, 2018)

	Food Materials	Examples
Film-forming materials	Animal proteins	Whey protein, collagen, gelatin, casein, egg-white protein, fish myofibrillar protein, feather keratin
	Plant Proteins	Soy protein, corn zein, wheat gluten, pea protein, rice bran protein, cottonseed protein, peanut Protein
	Linear, neutral polysaccharides	Agar, curdlan, cereal b-glucan, methylcellulose, hydroxypropyl methylcellulose, Microcrystalline Cellulose, pullulan, konjac glucomannan, inulin.
	Linear, anionic polysaccharides	Sodium alginate, propylene glycol alginate, carrageenan, pectin, gellan gum, carboxymethylcellulose or cellulose gum
	Linear, cationic polysaccharides	Chitosan
	Linear, substituted, neutral polysaccharides	Fenugreek (*Trigonella foenum-graecum*), guar gum, tara gum, locust bean gum
	Linear, substituted, anionic polysaccharides	Xanthan gum
	Branched polysaccharides	Gum arabic, gum ghatti, karaya, larch arabinogalactan
	Lipids	Waxes (beeswax, paraffin, carnauba wax, candelilla wax, rice bran wax), acetoglycerides
	Resins	Shellac, terpene, asafoetida, benjoin, chicle, guarana, myrrhe, opoponax, sandaraque, styrax
Plasticizers	Polyols	Glycerol, propylene glycol, polypropylene glycol, sorbitol, polyethylene glycol, corn syrup
	Others	Sucrose and water
Additives	Flavors	Oil based flavors, Citrus, Mints, Volatile oils
	Colors	Pigments
	Antimicrobials	Organic acids (acetic, benzoic, lactic, propionic, sorbic); Fatty acid esters (glyceryl monolaurate); Polypeptides (lysozyme, peroxidase, lactoferrin); nitrites and sulfites, chitosan, bacteriocins (nisin, pediocin), parabens, liquid smoke, sodium chloride.
	Antioxidants	Ascorbic acid, 4-hexylresorcinol, amino acids (cysteine and glutathione), citric acid.
	Nutrients	Vitamin E, calcium, zinc, aluminum
	Emulsifiers	Lecithins, mono- and diglycerides, mono- and diglyceride esters, Fatty sucrose esters, fatty alcohols, fatty acids
	Lipid emulsions	Edible waxes, fatty acids
	Probiotic organisms	*Bifidobacterium* (*Bifidobacterium lactis* Bb-12)
	Plant essential oils	Cinnamon, oregano, lemongrass, savory, sweet inula, vanilin, clove, citronella, thyme

Active food Packaging

There is an optimistic approach of edible films is to act as a carrier of active substances like antimicrobial compounds that are used to control the biodegradation of food. This method is called active food packaging (Cuq et al., 1995; Han (2000, 2001). Edible films also have an advantage that makes it more suitable than artificial packaging is eatable and biodegradable (Cuq et al, 1995; Han, 2002). These antimicrobial compounds are probiotics, chemical agents and natural extracts.

Antimicrobial compounds should be selected carefully according to the nature of food material and on the basis of the chemical, physical and organoleptic property of active compounds, on the physiology of target microorganisms and on other different regulatory mechanisms (Coma, 2012).

Chemical antimicrobial agents include organic acids and these are produced by different chemical reactions of natural acids (Han, 2005). Mostly used organic acids are acetic acid, lactic acid, sorbic acid, citric acid, and their salts. These acids control microorganisms by reducing the pH, cytoplasm acidification and controlling the permeability of cell membrane (Naidu, 2000). The second category of antimicrobial compounds is natural extracts including essential oils obtained from plants (Burt, 2004). These essential oils are used for food flavor. These have strong aromatic property; to solve this problem can be packed into edible films. Mostly used essential oils are cinnamon, lemongrass, marjoram, clove, ginger, oregano, Eucalyptus globulus, and Ziziphora clinopodioides. These oils are used against many microorganisms due to their phenolic characteristics up to 85% (Burt, 2004; Ahmad et al, 2012; Ejaz et al., 2017; Martucci et al., 2015).

The third category of antimicrobial agents is probiotics and they can stop the growth of other microorganisms. Probiotics are useful to live microorganisms for health (Dehghani et al., 2018) and they include Lactobacillus and Bifidobacterium genus and they can easily compete with harmful microorganisms (Han, 2005). These probiotics also can be packed within edible films due to its efficacy.

Scientific Parameters of Edible Films:

Edible films are important for food safety that's why their composition should be an important concern for food industries. Scientists consider all chemical and physical parameters during the formation of edible films according to specific food components (Han, 2002; Nussinovitch, 2003). Film-forming material should be soluble in water, ethanol, and acetone for wet casting and other properties like glass transition, phase transition, and gelatinization property are important for dry casting (Guilbert et al., 1997). Other properties like viscosity, hydrophilic, hygroscopicity and lipophilic should also be considered for film formation. Those edible films which are formed from protein, polysaccharides, their pH, solubility, salt condition, and denaturation all depend on chemical modifications (Yildirim & Hettiarachchy, 1997; Were et al., 1999). Edible films formation also depends on physical changes like the formation of composites, the addition of particles, lamination, annealing, perforation, over-coating, and heat curing (Gennadios et al., 1996; Miller et al., 1997; Micard et al., 2000).

Edible film formation also depends on mechanical parameters and on the physical chemistry of forming material involves elasticity, strength, the cohesion of polymers, adhesion of film on the surface of food material, light transmittance, gases permeability (Sothornvit & Krochta, 2000). The most important property of edible film should be adhesion (Peyron, 1991; Guilbert et al, 1996) that is an attractive force between the coating film and food product (Anonymous, 1992). So, if adhesion force will be less can't completely cover the food material or can be easily removed from the food material.

CONCLUSION

Seafood is a fully nutritious food with proteins, fats, and vitamins but due to its perishable texture, it leads towards degradation. To solve this problem bioprotective cultures have been developed from starter cultures of microorganisms. These bio-protective cultures produce antimicrobial compounds to kill microbes.

Some protective cultures developed by genetic modification in microbial strains to get desirable functions of microorganisms. Secondly, edible films are used to increase the shelf life of food, improve taste, quality and maintain sensory of food. These films also used for carrying the antimicrobial strains to protect food are called active food packaging. All these food protective techniques should be according to GRAS (Generally recognized as safe) and FDA (Food and drug administration) rules and should be appropriate for consumer need.

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EURASIAN JOURNAL OF FOOD SCIENCE AND TECHNOLOGY

Importance of Seafood Gelatin for Food Industry

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Abstract

The gelatin food industry is a very important biopolymer.İs widely used by various industries because of its functional and technological properties.The majority of industrial gelatin is obtained from mammals.But due to many sociocultural and religious reasons, there is an increasing demand for alternative sources. The gelatin obtained from by-products formed during the processing of seafood produces a serious potential for the industry. In this review, a general definition of gelatin is made and we will talk about the properties of the gelatin obtained from aquatic products and their production method.

Keywords: Seafood gelatin, Fish, Gelatin, Gelatin Market Analysis

Review article

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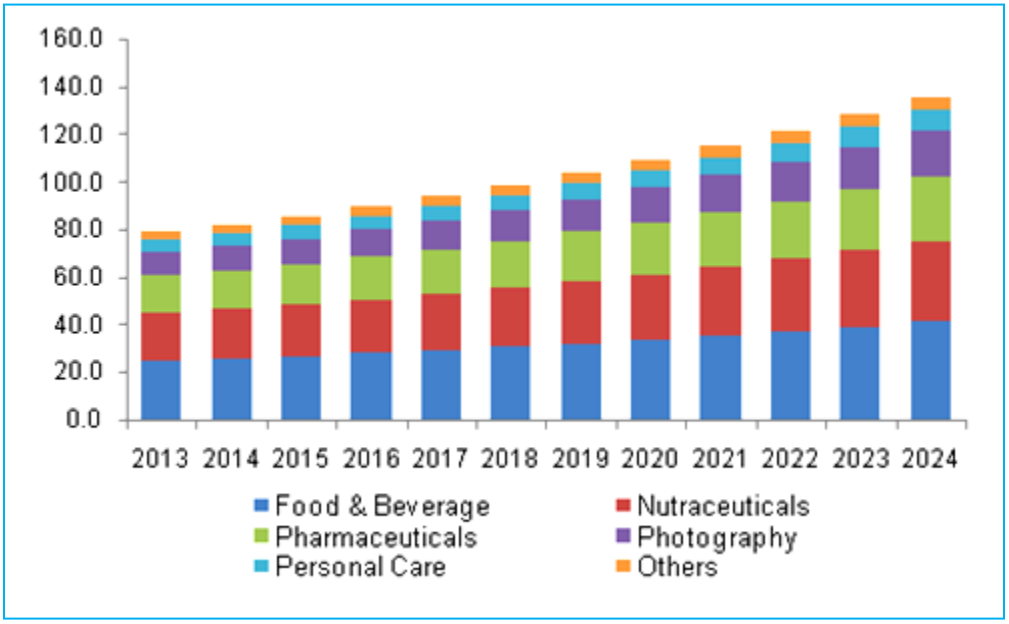
INTRODUCTION

Gelatin is an important biopolymer widely used in foods to improve elasticity, consistency, and stability. Gelatin is a substantially pure protein food ingredient, obtained by the thermal denaturation of collagen, which is the structural mainstay and most common protein in the animal kingdom (Bailey and Paul 1998). Gelatin is a form of protein that creates a gel when cooled and melts at below the body temperature. As such characteristic has not been observed in any carbohydrate or hydrocolloid to date, gelatin is considered the largest single food ingredient used (by weight) in the food industry (Gómez-Guillén and Montero, 2001).

Technically, the term gelatin, applies for a series of proteins obtained from collagen after partialhydrolysis, obtained from bones, skin, hides and cartilages, etc. (Gómez-Guillén and Montero, 2001). In the conversion process of collagen to gelatin, acid or alkali pretreatment hydrolyze the cross-linking bonds between polypeptides and irreversibly results in gelatin (Yang et al., 2008). The gelatin is water soluble and forms thermo-reversible gels with the melting temperature near to the body temperature (Norziah et al., 2009).

Gelatin is used in shampoos, face masks, and other cosmetics as a thickener for fruit gelatins and puddings in candies, marshmallows, cakes, ice cream, and yogurts; on photographic film and in vitamins as a coating and as capsules, and it is sometimes used to assist in "clearing" wines. Gelatine is widely used in various fields of food industry due to its stabilizing, gelling, clarification, balancing, foaming, emulsion forming and stabilization, and film forming properties.Gelatine is also used for clarification of wines and juices, in meat and milk products and also since gelatin is a pure protein, it is also used in the supplementary nutriments and drinks that are used by sportsmen. The global gelatin market size was 412.7 kilo tons in 2015. The increasing application of the product in food & beverage and pharmaceutical applications on account of exhibiting excellent stabilizing characteristics and good binding features is expected to remain a favorable factor for growth over the forecast period (Gelatin Market Analysis By Raw Material 2015).

Over the past few years, polysaccharides are being increasingly used as an important constituent in healthcare and food & beverage applications on account of providing excellent hydrolyzing enzymatic properties. Therefore, industry presence of polysaccharide is expected to pose a substitutional threat to gelatin market over the next eight years (Gelatin Market Analysis By Raw Material 2015).



(Gelatin Market Analysis By Raw Material 2016)

As the global demand for gelatin is continuously on the rise, many potential sources are being sought for derived from pig skin, bovine hides, bones and others sources contributing 46%, 29.4%, 23.1% and 1.5%, respectively. Due to the fact that half of the production is harvested from porcine source, concerns about Halal or Kosher market strongly dominate. Moreover, in the case of bovine gelatin, the prevalence of spongiform encephalopathy necessitates a look up for possible alternatives (Karim and Bhat, 2009). Pig skin was the majorly used raw material, accounting for 40.6% of the market volume in 2015 owing to the high level of collagen content. However, increasing occurrences of seasonal disorders associated with swine is expected to refrain gelatin manufacturers for procuring pig skin as a raw material (Gelatin Market Analysis By Raw Material 2015).Bovine hides are also used as a raw material on account of the presence of high levels of peptide and fibrous content. Cattle bones release protein rich collagen which is boiled and filtered repeatedly post which it is ground into a powder. Consumption of this powder helps in improving digestion and connective tissue. As a result, cattle bones are expected to witness the fastest growth at a CAGR of 4.9% from 2016 to 2024, in terms of volume (Gelatin Market Analysis By Raw Material 2015). The increasing popularity of halal foods in food & beverage industry of Middle East countries is expected to promote the usage of cattle bones as raw materials to produce gelatin over the forecast period (Gelatin Market Analysis By Raw Material 2015). Fish skin, horse hair, and sheep covering are other raw materials which are used for the production of gelatin. Technological advancement for the development of fish gelatin in China is expected to open new markets over the next eight years (Gelatin Market Analysis By Raw Material 2015). Gelatin is normally obtained from collagen, which is one of the major structural components of vertebrates and invertebrates. Collagen is mainly found in the skin, bones and connective tissues of animals. Gelatin, on the other hand, is a class of protein fractions derived from the parent protein collagen using procedures that destroys it, which is later extracted in hot water. This process separates the natural protein chains and breaks the peptide bonds that makh as skin, scales and bones have drawn much industry interest (Ladislaus et al., 2007). This is

partly due to the need to comply with the requirements for Kosher- and Halal-certified products. In recent years studies on collagen and gelatin obtained from by-products of processed seafood. Gelatin is a high molecular weight polypeptide and an important hydrocolloid, which has proved popular with the general public and finds its uses in a wide range of food products largely because of its gelling and thickening properties. It differs from other hydrocolloids because most of them are polysaccharide, whereas gelatin is a digestible protein containing all the essential amino acids except tryptophan. The amino acid composition particularly with respect to proline and hydroxyproline can vary from species to species, as a result of exposure to a wide range of environmental conditions, particularly temperature (Ladislaus et al., 2007).

Fish gelatins have lower rheological properties than mammalian gelatins. The gelatin properties are influenced by two main factors: the characteristics of the initial collagen and the extraction process. Different fish species vary greatly in the amino acid composition of collagen . However, the extraction process is very important because it determines the molecular weight distribution of gelatin (Alexandre et al., 2014). The collagen from fish bones, has greater microbiological stability due to an increased incidence of cross-links, when compared to the collagen of other tissues such as skin. All types of gelatin have a similar composition, that is, water, small amounts of minerals and pure protein of connective tissue. However, depending on the material used, on the pretreatment process employed and the intensity of hydrolysis, various types of gelatin with different properties can be obtained (Alfaro At et al., 2012).

Studies related to the use of fish to obtain gelatins have reported that the applicability, functionality and commercial value of this type of product are essentially dependent on their physical (viscosity, gel strength and stiffness, intumescence capacity and thermal stability) and chemical characteristics (moisture, ash and pH). These characteristics or properties can be especially affected by the amino acid composition, molecular weight and proportion of a chains (Alexandre et al., 2014).

Production stages of fish gelatin

In step one, cleaning the fish at low temperature and separating the boneless meat, swim bladder, cartilage and other impurities from skin, bones, and scales of the fish.

In step two, soaking the mixture of skin, bones, scales, of step one with protease enzyme while maintaining low temperature for about up to 4 hours

In step three, washing the mixture of step two with o water at low temperature.

In step four, soaking the mixture of step three with alkali for at-Ieast 2 hours while maintaining low ternperature.

In step five, washing the mixture of step four with water at low temperature.

In step six, soaking the mixture of step five, with acid for at least 2 hours while maintaining low temperature.

In step seven, washing the mixture of step six with water at low temperature.

In step eight, extracting gelatin from the mixture of step seven at about neutral pH at temperature of about 40°C to (World Intellectual 2012).

Gelatin application areas

Cosmetic

Collagen peptides are natural collagen peptides that can be used in such cosmetics applications as skin and body care. In creams, lotions and masks, they add the amino acids that are essential for properly functioning skin cells.

Health

In addition to joint and bone diseases, these include obesity and malnourishment. Collagen peptide can help prevent these disorders or alleviate their effects.

Food

Gelatine is a high-quality ingredient and has many positive properties as a foodstuff. Thanks to its gelling abilities, gelatine is indispensable in modern cuisine. For example, foam formation, stabilisation and texturising are essential properties in the creation of tasty desserts. Gelatine is also an important source of protein. It can effectively replace carbohydrates and fat in many foods and is thus better suited to meet nutritional needs.

Medicine

Gelatine is an important raw material for the production of hard and soft capsules as well as film-coated and effervescent tablets. Manufacturers make use of its unique adhesive, gelling and film-building properties. Orally administered medicines and dietary supplements in particular are protected by gelatine-containing capsules or tablets from light, moisture and oxygen and given a long shelf life.

Photo and print

Thanks to gelatine, amateur films, colourful paper, graphic films and X-ray films can be produced on an industrial scale. Silver photography forms the basis for analogue picture development for both black-and-white films as well as X-ray films. Silver-salt photographic material is composed of film or paper with up to 15 layers of a coating that contains gelatine. In this, the gelatine acts as a binding agent for the light-sensitive silver halides.

Animal feed

Gelatine, collagen peptides and the pure by-products that are generated during their manufacture such as fats, proteins and minerals play a crucial role in the preparation of highly nutritious animal feeds.

CONCLUSION

The rapid increase of world population; It raises a number of global problems such as insufficient natural resources and environmental pollution, and raises a number of new searches for their solution. Perhaps the most important of these problems is the decrease in the available natural resources and their inability to use them at the optimum level. Considering the fact that animal production wastes are left to the environment without being evaluated in many countries even today, and developed countries are considered as animal feed at best, it is seen that gelatin obtained from animal wastes such as skin and bone has an important added value when considering the functional and technological advantages mentioned in this review. Therefore, although gelatin has been obtained from animal by-products such as pigs and cattle to date, fish and by-products have been tried to be evaluated in recent years and the researches have started to focus on this subject. At this point, fish gelatin is an excellent source for businesses that want to produce Kosher and Halal standards. In the future, fish gelatin may be a competitive alternative biopolymer on the market; However, expanding its use is mainly related to higher technological development and improvement of its functional properties.

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Bailey A.J., Paul R.G. 1998. Collagen A not so simple protein. J. Soc. Leather Techn. Chem. 82 (3), 104-110.

Gelatin Market Analysis By Raw Material (Pig Skin, Bovine Hides, Cattle Bones), By Function (Stabilizer, Thickener, Gelling Agent), By Application [Food & Beverage (Confectionery, Dairy Products, Meat & Poultry Products, Desserts, Beverage), Nutraceuticals, Pharmaceuticals, Photography, Personal Care] And Segment Forecasts To., 2024

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Utilization of Nanotechnology in Aquaculture and Seafood Sectors

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Abstract

Nanotechnology is described as a newly developed technological aspects of science which combines the physical, chemical and biological properties and results in an Improve technology. The Unique ability of nanotechnology includes: Improvement of fish packaging techniques, enhancement of quality, tastes, texture, flavor, improve fish nutrients absorption and ability to detect pathogen in the system. Nano encapsulation is technologically designed to contain substances in minute and functional way to monitor the release of the core. Hydrophobic beta-carotene is applied for preservation of bioactive compounds like lipids, vitamins, proteins and also carbohydrate, Nanotechnology is applied to get color, taste, and odour ,Improve bioavailability of functional compounds, elimination of decomposition; Encapsulation and monitoring the release of food materials; Improve bioavailability; stability, and shelf-life of delicate ingredients;
Preservation of food products from microbial attack; carrier channels of nutrients, nutraceuticals, food additives and food antimicrobials; The aquaculture and seafood sectors can be transformed with the application of nanotechnology, this techniques helps in detection of disease quickly and improve the ability of fish to absorb hormones, vaccines, controlling diseases, and biofouling control processes all these are enhanced to achieve maximum advantages of nanotechnology. It also helps in water filtration and thereby making more successful feed for aquaculture. Positive results have been recorded for nanotechnology as Antifouling in fishing and aquaculture nets, antibacterial material for aquaculture tanks and it's a newly developed packaging materials for seafood products.

Keywords: Aquaculture, Nanoemulsion, Nanomaterial, Nanotechnology, Seafood products

Review article

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INTRODUCTION

Fish is an essential aquatic animal impacting human life at all stages, it is highly rich in nutrients. Fish provides various nutrients such as proteins, vitamins (A, D and E), fats and several other macro nutrients (Brasky et al., 2010). The minerals contents of fish include calcium, Iron, Iodine, Magnesium, sodium, Phosphorus and many others (Melanson et al., 2005). Fish Proteins contains the amino acids that are not available in plant proteins. Fisheries products are essential both nutritionally, medically and economically. Several species of fish are very rich in Omega 3 fatty acids which are Eicosapentaenoic acid (EPA) and Docosahexanoic acids (DHA) (Khawaja et al., 2012). Aquatic products are of great benefit to humans due to its positive Impacts on health, nutrition and economics, this has led to scientific and technology development to produce an acceptable products. Nanotechnology is a newly developed technology widely applied in many sectors (Can et al., 2011). Nanotechnology incorporates various discipline such as, chemistry, engineering, physics and biotechnology, hence, it is called the application of nanomaterial with nanoscale whose structure is between 1-100nm (Chandra and Segal, 2016). Several dimensions of structural elements, crystallites, molecules and clusters are manifest in Nanomaterials which includes zero dimension (nanoparticles, nanoclusters, and quantum dots), one dimension, (nanorods and nanotubes), two dimensions (nano-thin films), and three dimensions (nanomaterials) in the 1-100nm ranges (Pathakoti et al., 2017). Several sectors are largely into application of nanomaterials which include agriculture, food, cosmestics, medicine, clothing and public health as a result of their special ability to expand solubility and bioavailability and also to preserve bioactive components during processing and storage(Fu, 2014).The physiochemical and antimicrobial ability of nanomaterials results in its widely application against various pathogenic microbes and in healthcare, water treatment and food preservation (Baranwal, et al., 2018). Nanoencapsulation is technologically designed to contain substances in minute and functional way to monitored the release of the core. Hydrophobic beta-carotene is applied for preservation of bioactive compounds like lipids, vitamins, proteins and also carbohydrate (Sekhon, 2010). Nanoencapsulation has potentials to provide several opportunities to food industry by improving the stability of the encapsulated material, offers buffering effects against severe pH, temperature, ionic strength differences (Yurdugul & Mozafari, 2004). The aquaculture and seafood sectors can be transformed with the application of nanotechnology, this techniques helps in detection of disease quickly and improve the ability of fish to absorb hormones, vaccines, controlling diseases, and biofouling control processes all these are enhanced to achieve maximum advantages of nanotechnology. The daily nutritional requirement of fish feed components which are carbohydrates, fats, proteins, minerals and vitamins are easily absorbed by the nanotechnology. A new suggestion on nanoparticles is that it will improve aqua feeds through enlargement of fish feed nutrients proportion which pass across gut tissue to the fish system, rather than direct movement of the fish feeds nutrients without digestive system (Bhattacharyya et al., 2015).

The use of nanotechnology is aquaculture and fisheries sectors

- Nanotechnology is applied to get colour, taste, and odour.
- Improve bioavailability of functional compounds, elimination of decomposition;
- Encapsulation and monitoring the release of food materials; Improve bioavailability; stability, and shelf-life of delicate ingredients;

- Preservation of food products from microbial attack; carrier channels of nutrients, nutraceuticals, food additives and food antimicrobials;
- It helps in water filtration and helps in making more successful feed for aquaculture (Reza Mozafari et al., 2008).
- It serves as Antifouling in fishing and aquaculture nets, antibacterial material for aquaculture tanks and it's a newly developed packaging materials for seafood products (Can et al., 2011).

Nanostructucture

The structure of fish proteins are globular ranges between 1-10 nm in their sizes, fish protein consists of a significant quantity of lipids and many polysaccharides, and the sizes of these polysaccharides showed to be linear polymers having a thickness less than nanometers. Nanotechnology can be applied in the extraction of protein and fish lipids particles and could be organized specifically to obtain better end results products, the Omega 3 acids can be extracted and be used as coating materials on other food products such as biscuits and other ready to eat food (Shiv Mohan Singh et al., 2018).

Nanoemulsions/Nanoencapsulation

Fish contain several phenolics compounds which includes catechin, caffeic acid, tannic acid and ferulic acid, with poor oral bioavailability in form of capsules and tablets, hence, a delivery system which is effective is required to improve the bioavailability of the compounds, such a delivery system must be generally recognized as safe and should be capable to transfer the active components to the expected location through the channel of the gastrointestinal tract(Shiv Mohan Singh et al., 2018). Emulsion is described as a mixture of two or more several liquids which does not easily incorporate into one another, hence nanoemulsion is an emulsion with diameters of the distributed droplets with measurement of 500nm or less (Ravichandran, 2010). Nano emulsion has specific characteristics which showed a point of attraction, as a result of their miniature size and high kinetic energy (Murata et al., 1997). Encapsulation of fish oil and the stabilities of freeze-dried oil was carried out in research due to its health benefits, along with strong odors and quick oxidation processes, these led to the investigation of beta-cyclodextrin (this polymer is soluble in water and polycaprolactone a polymer insoluble in water). It was aimed to determine the rate at which fish oil releases at separate relative humidities and storage of temperatures, it was deduced that water- insoluble polymer showed better preservation of fish oil as a result of its water- insolubility (Choi et al., 2010).

Nanocomposites films

Nanotechnology can be applied in seafood as preservation to delay enzymatic and microbial spoilage as conservation and packaging techniques to ascertain food safety. Nanocomposites films are incorporated into foods along with active packaging (antimicrobial films) and edible coating techniques, Nanocomposites films which include polysaccharides, protein and lipid are derived from natural biopolymers. These substitutes packaging materials are widely adopted as replacement of petrochemical source of plastics, as a result of their edibility, environmental –friendly and anticarcinogenic nature they possessed (Dursun , et al., 2010).

Nanofiltration was applied to reverse osmosis processes and to reduce the salinity of drilling water used in washing and processing units of seafood, nanofiltration was employed as pre-treatment approach before thermal the membrane of the seawater desalination process was carried out(Walha, et al., 2008).

masking undesirable flavors and Tastes

Harvested fish from rivers and oceans often possessed undesirable flavors and tastes, this novel technology (nanotechnology) can be employed in masking the undesirable flavors or tastes to increase consumer interest in its consumption (Shiv Mohan Singh et al., 2018).

Nanodelivery of nutraceuticals

The application of Nanomaterial as neutraceutical in fish and shellfish health managements, stress reduction, and value addition are currently at early stage in aquaculture sectors, the disadvantage associated with the use of nutraceutical is high cost. A delivery system consists of various purposes which includes transportation of functional ingredients to its destination, It also help in enhancement of food attributes like taste, texture and shelf life (Ravichandran, 2010). Hence, its application require control of resources to prevent wastage for effective utilization and products economically feasible (Rather et al., 2011).To achieve this nutraceutic material as a nanodelivery system for these types of molecules, consideration should be given to the complication that may arise during its application in aquaculture usage especially for commercial purpose. Several feeds formulated base on nanomaterial helps to sustain good stability and enhancement of feed tastes (FOE, 2008).

Nanoparticles for improvement of fish development

Nanoparticles of iron fed to juvenile carp and sturgeon fish showed a rapid rate of development between (30% &24%) development report is according to a Russian Academy of science, (ETC, 2003)Their research illustrated that separate selenium of different sources(nano-Se and selenomethionine) augmented in the basal diet may enhance the relative weight rate, final weight, and the antioxidants condition and also glutathione Peroxidase (GSH-Px) activities and concentration of Se on crucian carp muscle (*Carassius auratus gibelio*) (Rather,et al.,2011).additionally, nano-Se showed to be efficient than natural selenomethionine improving the content of selenium muscle (Roy, 1997), comparably, the development and yield of the trial fishes was rated higher at nano level delivery of nutraceuticals. This whole idea is that nanoparticles will enrich fish feeds by increasing the quantity of nutrients that move across the gut material to fish body instead of allowing it to pass through the digestive tract without been absorbed (Handy, 2012). Aquafeeds in form of nanoparticles could penetrate cells easily than bigger size and thereby increase the rate of absorption (Zhou et al., 2009).

DNA nano–vaccines

The major problems in the growth and sustainability of aquaculture is the occurrence of diseases, several strategies have been employed to overcome this disease obstacle in the aquaculture sector, one of the major steps is DNA nano vaccination, The application of oil emulsion to administer the vaccine could lead to a significant setback in which some fish and shellfish reacted negatively to the effects it caused.

Thus, the application of nanoparticles carriers such as chitosan and poly-lactide-co-glycolide acid (PLGA) (Rajeshkumar, et al., 2009) of vaccine antigens incorporated with mild inflammatory inducers which could supply strong protection to fisheries products against many bacterial diseases and viral diseases. More so, an extensive vaccination of fish and shellfish can be carried out with the application of nanocapsules which consist of nanoparticles (Rather et al., 2011). Normally, polymeric nanoparticles has various benefits in vaccine delivery; it provides reliable delivery of vaccines, they provides a dissolved drugs for intravascular delivery, they can enhance solvent of vaccine antigens against enzymatic deterioration (Bhattacharyya, et al., 2015. Nanoencapsulated vaccines acts against the bacterium *Listonella anguillarum* could be applied in Asian Carp. A trials system on mass vaccination of fishponds filled with fish application of ultrasound was carried out by the United State Department of Agriculture. It consists of nanocapsules of small strands of DNA added to the fish tank in which the fish cells take up the DNA, the nanocapsules was burst with the mechanisms of the Ultrasound, the ruptured capsuled in turns allows the DNA and then triggers the fish immune to respond (Can et al., 2011). Clearsprings food (Idaho US) have successfully applied these Techniques on rainbow trout (Mongillo, 2007).

Nanofiltration

Water treatment and purification is very essentials in all sectors and it includes elimination of toxic ions, organic contaminants, microbes, and other pollutants. The elimination of organic pollutants from the water is of great concerns to industries, the disintegrated organic compound results in bacterial growth, odour, and biofouling and this can alter the water quality (Bhattacharyya et al., 2015). The research was conducted successfully with the application of titanium dioxide, a nano-sized particles applied as films on the ceramic for treatment of water in the fish bowls. Ceramics coated with titanium dioxide nano-particles has potential to remove moss and bacteria in fish tank. These techniques can be used in commercial fish farms and Aquariums as it will reduce water treatment cost (Can et al., 2011). Also, helps in the elimination of water contamination and filtration making more successful feed for aquaculture, Nano-particles in the appearance of active materials such as carbon or aluminum incorporated with zeolite and iron compounds, these can be applied in aquaculture for influencing aerobic and anaerobic biofilm in order to be able eliminate ammonia, nitrites, and nitrates contaminants(Reza Mozafari et al., 2008). Nanotechnology has potential to protect fishponds that are free from diseases and pollution, Nano check was manufactured by Altair Nanotechnologies for cleaning and purifying the water, this Nano Check operates with 40-nanometer particles of lanthanum-based compounds which absorbs and prevent algae growth through absorptions of phosphate from the water (Mongillo, 2007).

Chemical/Toxins elimination

Nanotechnology can be applied to eliminate dangerous chemicals and toxins presents in the fish harvested from polluted rivers which may be highly concentrated with dangerous chemicals like pesticides and natural toxins like tetraodotoxin in puffer fish, nano techniques can be applied to effectively eliminate such chemicals without affecting the fish nutrients (Murata et al., 1997).

Gene delivery techniques

The occurrence of advanced carrier systems for delivering gene appears as a potential techniques for treatment of several genetic problems. Although, critical obstacles for successful gene treatment proofs as the effective and safe methods of delivering the gene (Rather, et al., 2011). Non-viral delivery systems have been greatly recommended as solutions to viral vectors as a result of their protection, strength and potentials to be manufactured in larger quantities. (Tomlison, E. and Rolland, A.P.,1996) several perspectives employed DNA complexes consist of protein, peptides, lipids, the reports of the research were encouraging in the formation of complexes between chitosan and DNA yet, chitosan resulted in the improved transformation effectively, A great and effective gene delivery is achieved with the combination of DNA-chitosan complex through receptor- mediated endocrytosis (Murata, et al.,1997)This outcome assumes that chitosan has comparable potentials without the combination of the toxicity of other synthetic vectors, thereby, it could be an efficient gene-delivery channel in vivo.

Nanotechnology as tagging and nano-barcoding

The application of nanomaterial in the form of a nanoscale component which bears an identification code inscribed in it with a chip of radio circuit called Radio frequency ID (Rfid). The chip identity is use as a tag which is applied from a distance to scan a product to verify the information embedded in it, the tags has the potential to occupy several information and it can be operated automatically at any distance for tracking and also as a device for monitoring fish feeding behavior, swimming metabolism patterns. It also serves as nano-barcode which is a device for monitoring an objects, it made up of metallic stripes with nanoparticles in which the differences in the striping patterns supply the techniques for encoding information. The incorporation of nanobarcoding makes the monitoring of processing industry and exporters to be achieved easily and movement/status of aqua product can be tracked to the point of its delivery to the sales or distribution center. Furthermore, nanosensors and synthetic DNA tagged along with nanobarcodes and color coded probes have great potential to discover pathogens and also monitor the changes in temperature and leakages thereby enhance the product quality (Rather et al., 2011).

CONCLUSION

Nanotechnology is widely applied in all sectors which includes food technology, medicines, pharmacy, Aquaculture and seafood technology applied as nanoparticles, nanofiltration and also in fish packaging and processing. These techniques assured various opportunity for advancement and stability of fisheries resources, Nanotechnology is still underemployed at the moment in the aquaculture and fisheries sector, but with researches and continuous usage of nanotechnology the importance will be acknowledged and it would be applied by the industries as a solution to developments.

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