International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

Studies on Fish Waste Disposal

Narendra Satyavijay Gawade

Abstract: ***Fish waste management has been one of the problems having the greatest impact on the environment. Fish farming detrimental effects on the marine environment in particular have become an issue of public concern. Treated fish waste has found many applications among which the most important are animal feed, biodiesel/biogas, dietic products (chitosan), natural pigments (after extraction), food-packaging applications (chitosan), cosmetics (collagen), enzyme isolation, Cr immobilisation, soil fertilizer and moisture maintenance in foods (hydrolysates). In this review, an update of both environmental impact (inputs and outputs) and treated fish waste use.***

Keywords: fish waste, utilization of fish waste

1. Introduction

1. Discards

The discarded fish constitute 8% of the total weight of the world's captures, or more than 7.3 million tons of fish that are thrown away at sea. Oceana affirms that this practice is most troubling in the fisheries. Discards are those parts of the catch which are returned to the sea. Not all fisheries produce discards; some are completely 'clean', while others may even discard more fish than they retain. There are many reasons for discarding, including:

- Market conditions. Fish may be discarded because they are of no economic value, low economic value, or damaged and therefore of a reduced value.
- Management regulations. Fish may be discarded because they are below the legal minimum landing size (MLS), restricted by a quota, or non-marketable because of catch composition restrictions.

Both of these sets of conditions can change by the season or fishing area, even within one fishery. Assessing how much of a problem discarding poses, and to whom, can be difficult. There is no doubt that the discarding of fish wastes resources and there is an urgent need to implement measures to reduce the level of discards.

Discards result from poor fishing practices and adequate management, according to the researchers. Fish may be too small, damaged, inedible, or of little market value. Multiple causes are likely driving the decline in discards, the study said. Aquaculture is booming, so there's more demand for previously undesirable fish, especially in Southeast Asia. Discards could also be declining because the abundance of non-target species is dropping, meaning there are fewer non-target species for fishermen to accidentally catch. The discarded fish include unmarketable ones that are damaged during the fishing process.

2. About Fish waste

The problem of fishery wastes has increased in the last years, becoming a global concern which is affected by several biological, technical and operational factors as well as socio-economic drivers. The "fish wastes" includes many fish species or by-catch products having no or low commercial value, undersized or damaged commercial species as well as species of commercial value but not caught in sufficient amounts to sale. However, the use of fish as feed cannot be governed only by fishery market forces and, on the other hand, the need for responsible fisheries and aquaculture development has recently been underlined in order to preserve aquatic biodiversity.

It has been estimated that more than 50% of fish tissues including fins, heads, skin and viscera are discarded as they are considered "wastes". Every year discards from the world's fisheries exceed 20 million tons equivalent to 25% of the total production of marine fishery catch and include "non-target" species, fish processing wastes and by-products. The amount and the composition in species of fishery wastes are different with fishing areas, therefore the overall amount of discarding is highly variable. In the Mediterranean Sea, Gonçalves et al. reported considerable amounts of trammel net discards, with a total of 137 species (79.7% of the total) discarded and an overall discard rate ranging from 15 to 49% for Greece to Portugal, respectively. In addition, discards of fish processing industry have been estimated to reach up to 75% of the total volume of products.

An important feature is related to the environmental impact that fish wastes could have on aquatic ecosystems, since the release of organic wastes might change significantly the community structure and biodiversity of the benthic assemblages. Consequently, the management of fish discards involves different aspects mostly related to the need to abate this pollution source and to search for the best ways to solve this problem. For example, in Europe, the new Common Fisheries Policy (CFP) aims to reduce the discard rate.

In spite of the low value traditionally assigned to fishery by-products, from this huge mass of unused/under-utilized resources a significant amount of bioactive compounds with wide pharmaceutical and biotechnological applications could be produced, such as proteins (enzymes, collagen), protein hydrolysates, lipids, astaxanthin and chitin. Among the bioactive compounds extracted from fishery wastes and byproducts, proteins and oils rich in Polyunsaturated Fatty Acids (PUFAs), especially eicosapentaenoic acid (EPA) and Docosaesaenoic Acid (DHA) are particularly interesting for their high commercial value, as well as for their possible use as fish feed components. Since fishery wastes

are rich in high quality nutrients, there is a great potential in marine bioprocess industry to convert and utilize.

On the other hand, fishery discards and by-products may lead to significant problems in terms of management and environmental impacts. In many Countries particular emphasis is given to explore the possibility of using of by-products of fishing, aquaculture and traditional fishing rather than to face the problem of their disposal. The use for aqua feeds production of the wastes from fishing and fish processing industry could be an important tool for setting plant of fishery by-products and discards at a local or regional level.

The objective of reducing fishery discards can be achieved by establishing technologies to enhance and transform fish wastes in an economic resource, for example by developing techniques of extraction and concentration of the bioactive compounds they contain and defining strategies for their use for fish meal and oil for animal feeding.

In the waters of the Mediterranean and Black Seas, trawling is the fishing gear with the highest percentage of discards due to the large number of non-target species captured. It is estimated that, on average, half of the catch taken by these trawlers is discarded. Furthermore, there are other practices not directly related to targeted species that engage in discarding, such as the well-known practice of shark-finning. This practice consists of cutting off the shark's fin and discarding the rest of the body at sea while it is often still alive. Discarding also takes place when certain protected species are incidentally caught, such as marine turtles or cetaceans, which are then also thrown away at sea.

3. Composition of Fish Waste

- The composition of the fish varies according to the type of species, sex, age, nutritional status, time of year and health. Most of the fish contains 15-30% protein, 0-25% fat and 50-80% moisture
- For example: Mackerel had the highest fat content (11.7%) and cod had the lowest (0.1%). Salmon had the highest protein content (23.5%) and flounder had the lowest (14%). the moisture content of the fin fishes varied between 69 and 84.6% but the ash content of all species was similar.
- Solid fish waste consists of head, tails, skin, gut, fish and frames.
- These byproducts of the fish processing industry can be a great source of value added products such as proteins and amino acids, collagen and gelatin, oil and enzymes.
- These wastes contain proteins (58%), ether extract or fat (19%) and minerals.
- Also, mono-saturated acids, palmitic acid and oleic acid are abundant in fish waste (22%).

Table 1: Average composition of fish

Component	Average Weight
Head	21
Gut	7
Liver	5
Roe	4
Backbone	14
Fins and lungs	10
Skin	3
Fillet skinned	36

2. Review of literature:

1. This supposed decrease is not necessarily good news, because discard estimates are based on landed catches and not actual catches. Furthermore, this practice leads to false data regarding the actual state of the fisheries, making the management measures put in to practice useless"-- Maria Jose Cornax, Oceana researcher,
2. Another paper refereed in concern with the proposed studies represents "The major reason for fish discards is low economic value. Some things come up in nets that no one either wants or has a way to sell,"--Ray Hilborn, a professor at the University of Washington, told Seafood Source. "Is this actually a problem? I don't see that discarding threatens the food security from major fisheries except in cases where it is juveniles of desirable species."
3. According to declarations made by the European Commissioner for fisheries, Joe Borg, to the Financial Times: "It is morally wrong to literally dump fish back into the sea. We are wasting a precious resource."
4. Ricardo Aguilar concludes that, "It is not enough that we overexploit fish populations, now we waste them also. We need to take urgent measures to minimize this practice, at the very least."
5. "Discards are now declining because we have already fished these species down so much that fishing operations are catching less and less each year, and therefore there's less for them to throw away," Dirk Zeller, the study's lead author and a professor at the University of Western Australia.
6. The composting is one of best alternative method for waste management, which allows their reuse as soil conditioners or organic fertilizers at agricultural land for food and feed crops without toxic effects -- Villasenor, Rodriguez et al. 2011) (Awasthi, Pandey et al. 2016)
7. Food industry wastes are an important environmental contamination source. Research has been carried out in order to develop methods to convert these wastes into useful products (Perea et al., 1993; Kristinsson & Rasco, 2000; Larsen et al., 2000; Guerard et al.,2001; Coello et al., 2002; Laufenberg et al., 2003).
8. Probably, more than 50% of the remaining material from the total fish capture is not used as food and involves almost 32 million tonnes of waste (Kristinsson & Rasco, 2000).
9. Nowadays, the use of food wastes as animal feed is an alternative of high interest, because it stands for environmental and public benefit besides reducing the

cost of animal production (Samuels et al., 1991; Westendorf et al., 1998; Myer et al., 1999; Westendorf, 2000).

10. Offal from the fishing industry could be used as a feed ingredient, as it represents a valuable source of high-quality protein and energy (New, 1996; Gabrielsen & Austreng, 1998).
11. Chitin is a structural component in crustacean exoskeletons, which contain 15–20% chitin by dry weight. The production of chitin and chitosan from food industry waste (crustacean canning) has proved environmentally attractive and economically feasible, especially when it includes the recovery of carotenoids. Considerable amounts of chitin are present in the wastes and are marketed as a fish food additive (Arvanitoyannis, 1999; Kumar, 2000). Coward-Kelly et al.(2006) treated shrimp head waste (Penaeus indicus) with lime at different temperatures (75, 100 and 125 °C) and lime/shrimp ratios [0, 0.05, 0.1, 0.2 g $Ca(OH)_2$ per gram dry shrimp] in order to determine the repeatability, the effect of temperature and the effect of lime loading on solubilizing protein in shrimp head waste.
12. The shrimp waste consisted of 71.4% head and 28.6% shell (Meyers, 1986). his waste contains useful components such as protein, lipid and astaxanthin pigment, thus making the commercial shrimp waste an attractive material for extraction of the above-mentioned components in order to utilise them in seafood products (Mandeville et al., 1992). Whole shrimp heads from Northern pink shrimp (Pandalus eous), Endeavour shrimp (Metapenaeus endeavouri) and Black tiger shrimp (Penaeus monodon) were used for shrimp head protein hydrolysates (SHPH) isolation. The preparation of hydrolysate was carried out according to Iwamoto et al. (1991)
13. Fish silage is a liquid product resulting from the liquefaction of a whole fish or a part (Tatterson & Windsor, 1974). Liquefaction is an autolytic process carried out by enzymes already present in the fish and accelerated by an acid that induces the proper conditions for the enzymes to breakdown the tissues and limits the growth of spoilage bacteria (Gildberg, 1993).
14. Shrimp waste is one of the most important natural sources of carotenoids (Shahidi et al., 1998).

Aims & Objectives

1. To study the effects of fish waste and its impact on sea.
2. Collection and preservation of fish waste.
3. Sustainable development.
4. Biochemical analysis of waste.
5. To overcome problem faced by aquatic organisms due to dumping of waste fish in ocean.
6. To utilize fish waste in profitable way.
7. Try to find out new methods for waste utilizations.
8. To provide a comprehensive review of technologies currently available and proven for recovering and disposing of fish wastes.
9. Determine the degree to which these technologies are currently utilized in India.
10. Study will help us to find out how much waste is produced per year.
11. People belonging to coastal areas can built small scale plant for waste disposal.
12. As new industry will set up it will create more job profile to village people.
13. Awareness in the local people related to fish waste and way of utilization.

3. Current Utilization of Spoiled Fish and Fish Waste

1- Fish silage

Fish silage is an excellent protein source having high biological properties for animal feeding. Fish silage is a liquid product made from whole fish or parts of fish that are liquefied by the action of enzymes in the fish in the presence of added acid. The enzymes present in the acidic medium breakdown fish proteins into smaller soluble units while the acid helps to speed up their activity and prevent bacterial spoilage. Fish silage can be made from spoiled fish, sub-utilized species, and byproducts from marine fish, commercial fish waste and industrial residues from the fileting industry. The proteins present in the fish silage can also be hydrolyzed to free amino acids, making the silage the most available source of amino acids for protein bio synthesis. During fish silage preparation, the raw material is chopped into small pieces and a 3% by weight solution of 98% formic acid is added and mixed well and then stored for 48 days. The pH of the mixture should be less than 4 to prevent bacterial action. Fish silage can also be prepared by a fermentation method in which fish is chopped, minced and mixed with 5% (w/w) sugar beet molasses. A culture of Lactobacillus plantarum is inoculated into molasses and incubated until a population of 107 bacteria per g of molasses is obtained. This culture is then added in the ratio of 2 ml/kg to the minced fish.

2- Fish meal

Fish meal is a dry powder prepared from whole fish or from fish filleting wastes which are unacceptable for human consumption. The production of fish meal is carried out in six steps: heating, pressing, separation, evaporation, drying and grinding. When the fish is heated the protein present in it coagulates and ruptures the fat deposits. This liberates oil and water. The fish is then pressed which removes large amounts of liquid from the raw material. The liquid is collected to separate oil from water. The water which is also known as stick water is evaporated to a thick syrup containing 30 to 40% solids. Then it is subjected to drying using press cake method to obtain a stable meal.

This meal is grinded to the desired particle size. It is estimated that 25% (1.23 million tones in 2008) of the total fish meal produced is from fish by-products. In 1988, around 80% of the total fish meal produced was used as feed for pigs and poultry and 10% of the total was used for aquaculture. Currently, 63% of the fish meal is being consumed by the aquaculture industry, 25% by the pigs, 8% by the poultry and 4% by other animals

3-For bio-diesel production

Bio-diesel is comprised of monoalkyl esters of vegetable oils, animal fats or fish oils which can be synthesized from edible, non-edible and waste oils. It is a non-toxic, biodegradable and renewable energy source. Bio-diesel can be produced chemically or enzymatically. Chemically, using alkali (NaOH) as catalyst due to high conversion ratio of triglycerols (TAG) to methyl esters (biodiesel) and low reaction times (4-10 h). There are several disadvantages using chemical catalysts including high reaction temperature, soap formation, waste generation and contamination of glycerol with alkali catalysts. Enzymatic trans-esterifiation is mainly carried out using lipases such as Canadida Antarctica, Carica papaya, Rhizopusoryzae, Pseudomonas cepacia, Pseusdomonas floresces, Rhizomucormiehei and Mucormiehei. The advantages of using enzymatic method are: there is no soap formation, low temperature requirement, no waste generation and high quality of glycerol.The disadvantages of using enzymatic transesterification are: high reaction times (12-24 h) and high cost of enzymes

4-Production and Utilization of Fish Oil

Fish oils are readily available sources for long chain polyunsaturated fatty acids which consist of omega-3 fatty acids mainly composed of cis-5,8,11,14,17-eicosapentaenoic acid (EPA) and cis-4,7,10,13,16,19-docosahexaenoic acid (DHA). The omega-3 fatty acids have many beneficial bioactivities including prevention of atherosclerosis, protection against arrhythmias, reduced blood pressure, benefit to diabetic patients, protection against manicdepressive illness, reduced symptoms in asthma patients, protection against chronic obstructive pulmonary diseases, alleviating the symptoms of cystic firosis, improving survival of cancer patients, reduction in cardiovascular disease and improved learning ability.

5-Production and Utilization of Fish Amino Acids

Amino acids can be produced by hydrolyzing proteins.

Chemical (acid or alkali) and biological (enzymatic) methods are most commonly used for the hydrolysis of proteins. Microwave induced hydrolysis of protein has also been reported. The aim of the hydrolysis process is to liberate amino acids and recover them without degrading their properties. The factors affecting the hydrolysis of proteins are temperature, time, hydrolysis agent and additives. These factors affect the quality and yield. The largest consumer of amino acids is the food flavoring industry which uses mono sodium glutamate, alanine, aspartate and arginine to improve the flavor of food. The second largest consumer of amino acids is the animal feed industry which uses lysine, methionine, threonine, tryptophan and others to improve the nutritional quality of animal feed. The amino acids can also used in various pharmaceutical applications such as protein purification and formulations and production of antibiotics such as jadomycin. The total amino acid market in 1996 was estimated to be $4.5 billion. The market value of amino acids has drastically increased since 1996. Amino were the second most important category after antibiotics in 2009.

In conclusion, management of fish wastes represents an attracting topic, since this suggests a possible way to solve environmental impacts of fishery discards and, at the same time, it provides a tool to exploit them as a source of feeds for farmed fish, so promoting future aquaculture growth in a sustainable way. The use of fishery wastes and by-products allows the potential abatement of wastes that otherwise will be discarded, causing nutrient enrichment and water eutrophication. Fishery wastes and by.-products are an important source of high-added value compounds, however possible risks related to the presence of contaminants must be considered before their utilization. In this context, scientific research can contribute to the sustainable exploitation of such fish resources, suggesting the most suitable methodologies and strategies for the valorization of these high added value products.

We just see fish by its size what really don't matters to we human beings but it does matter to ocean and environment and such small waste by everyone makes countless, untraceable and uncontrolled waste. If those fish have spawn once they could have make millions there breeds.

References

[1] Arvanitoyannis IS & Kassaveti A (2008) Fish industry waste: treatments, environmental impacts, current and potential uses. International J Food SciTechnol43: 726-745.
[2] Efficacy and Marketability of Liquid Fish Fertilizer in Southern New Jersey. Nona R. Henderson and Dan B. Strombom, Rutgers University, Report to National Coastal Resources and Development Institute. June 1995.
[3] Fish Liquifaction: An Alternative to the Present Waste Handling Practices of the Great Lakes Fishing Industry. University of Wisconsin-Extension, Dept of Food Science and Meat and Animal Science. 46pp. 1976.
[4] Fish Waste Utilization - Development of Fish Oil and Fish Fertilizer for Agricultural Uses. Fruit Builder, Inc. National Marine Fisheries Service contract #82-ABH-00156. February 23, 1984.
[5] Ghaly AE, Ramakrishnan VV, Brooks MS, Budge SM, Dave D (2013) Fish Processing Wastes as a Potential Source of Proteins, Amino Acids and Oils: A Critical Review. J Microb Biochem Technol 5: 107-129. doi:10.4172/1948-5948.1000110
[6] Indiana Clean Marina Guidebook
[7] Kim S-K and Mendis E (2006) Bioactive compounds from marine processing by-products- a review. Food Res Int39: 383-393.
[8] Model Business development and Marketing Plan for Fish Hydrolysate Fertilizer. Nona R. Henderson and Dan B Strombom, Rutgers University, Report to National Coastal Resources and Development Institute. June 1995.
[9] Production and Testing of Seafood Waste Amended Lime Materials for Resources Conservation and Crop Production. Kuo, S et. al. National Marine Fisheries

Service Saltonstall- Kennedy Cooperative Agreement #NA36FD0156. September 1994. 159 pp.
[10] Rustad T (2003) Utilization of marine by-products. Electr J Environ, Agriculture and Food Chem2 (4): 458−463.
[11] SPECIFIC GUIDELINES FOR ASSESSMENT OF FISH WASTE, OR MATERIAL RESULTING FROM INDUSTRIAL FISH PROCESSING OPERATIONS -- NOAA Office of General Counsel.