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MICROPLASTICS AND ITS IMPACT

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Abstract - *Every period of human civilization has been named by archaeologists based on the substance that inhabitants of that period used in abundance, often helping in raising the living standards of their respective eras, so it is comprehensible that the current era is known as the era of the "Plastic" Age, ever since the advent of synthetic polymers in the 1950's. Ever since then, plastics have become extremely integral in a wide spectrum of fields because of their utilitarian properties. Today, majority of the human race has included these plastics in their day to day activities leading to immense environmental scrutiny. The used plastics are easily disposed in water bodies such as oceans and rivers. Unlike decomposable materials, plastics are complex polymers meaning that they do not decompose often taking take aeons. This disposed plastic breaks down into numerous small pieces in different size ranges and is ingested by the various marine organisms and affects the entire food chain. This presents a gargantuan problem to our ecosystem. Scientists have experimented with various solutions to help solve the Microplastics problem but these solutions have proven to not be as effective as intended. A substance once invented to be a boon to mankind has very well turned into its bane. Overall, this paper encapsulates the intricate topic of Microplastics, including brief information about them and their composition, and their role in environmental degradation while also addressing the most efficient solutions to dispose Microplastics without having any detrimental effect on the environment and our ecosystem.*

Key Words: *Plastic age, Microplastics, non-biodegradable, environmental scrutiny*

1. INTRODUCTION

Microplastics are plastics whose size is less than five millimetres in length, or about the size of sesame seed. It could be reported as small plastic particles on beaches and in coastal water in the 1970's. The evidence showed that the microplastics are distributed in all regions from land to ocean. Microplastics can be subdivided into microbeads and microfibers (Browne et al. 2011). According to the United Nations Environment Programme, plastic microbeads were appeared in personal care and cosmetic products replacing the natural ingredients. As of 2012, microbeads present in lot of products but there was no awareness in consumers (NOAA, 2020). The carbon and hydrogen atoms bound together in polymeric chain in microplastics. Some of the chemicals present in microplastics are phthalates, polybrominated diphenyl ethers and tetrabromobisphenol A (Kara Rogers, 2019). The two main categories of microplastics are primary and secondary microplastics. Primary microplastics are released in the environment directly as small particles. Laundering of synthetic clothes, abrasion of tyres through driving and microbeads in personal care products are considered to be the source of primary microplastics. Secondary microplastics are obtained from the fragmentation of large plastic objects and it accounted for 69-81% of microplastics in ocean. These plastics found in ocean can be consumed by marine animals and it can be end up in human through the food chain. It may be harmful to animals or humans because of the presence of certain toxic chemical substances in the plastic (Society, 2018). Since the microplastics are small, it cannot be removed through water filtration. It can be constantly fragmented into smaller particles and it persists because it is not biodegradable (Elena, 2018). The microplastics pollution in ocean was found to be 4 million to 14 million tons in the early 21st century. Since the microplastics occurring in dust and airborne fibrous particles, it is also act as a source of air pollution. Microplastics had been found in more than 114 aquatic species in marine and freshwater ecosystems by 2018. These microplastics have been settled in the digestive tract and tissues of various sea animals. In case of human consumption, microplastics have been found in drinking water, beer and food products including sea food and table salts (Kara Rogers, 2019). A chemical found in plastic and some food packaging called styrene has created many health issues including nervous system problems, hearing loss and cancer. The simple steps to avoid the exposure to microplastics are drinking water from tap, not to heat food in plastic, avoid plastic food containers, eat more fresh food, minimizing household dust (Consumer Report, 2019). The aim of our paper is to review the intricate topics of microplastics including the routes by which microplastics enter the marine environment, it's impact on aquatic species and how it passed through the food chain. The impact of microplastics on human health also be discussed based on the available literatures and also the most efficient solutions to dispose microplastics without having any harmful effects to the ecosystem.

2. MARINE POLLUTION

Thomson (2018) examined the scope and impact of microplastic pollution from theory of various scientists.

Carpenter figured that the tiny bits of plastics floating amidst the Atlantic Ocean. Chelsea Rochman found that the microplastic hidden not only in the ocean but also in the river, lakes, farm and soil. Microplastic was not a single thing, it is of many different things having a wide range of size said by Richard Thompson. Melanie Bergmann suggested that 1% of plastic was entering into the ocean and the remaining 99% of plastics were not found. Luca Nizzetto found that the microplastics last for years in the soil which came from reservoirs. The microplastics would even degrade further into nanoplastics but Thompson said that there was not any method to isolate nanoplastics. Biello (2008) investigated about the compound Bisphenol A (BPA) which was a major ingredient in many plastics. US Environmental Protection Agency (EPA) and the European Union considered consumption of lesser than fifty micrograms per kg of body weight per day to be safe. Steven Hentges suggested that the BPA which broken down into glucuronide in most urine samples implied that there was low level exposure but regular low level exposure. The Food and Drug Administration also approved its use since the ill effects were not yet proved. U.S. Scientists recommended to use the cardboard cartons instead of plastics in purchasing canned foods. Rita et al. (2014) discussed about the quality and quantity of micro debris and microplastics in six beaches along Slovenia coast. The author resulted that the plastic was the primary resource found in the beach although glass and ceramic also found at two beaches. Thus the report explained about the beach microplastic pollution in relation to tourism in Slovenia. Lisa et al. (2015) investigated about the effect of microplastics in marine environment especially in marine sediments. This could be done by analysing the already reported literatures on techniques used for extracting microplastics from sediments, distribution of microplastics in marine sediments and its impact on wildlife. The author brought about unequivocal size based definition for standardisation of microplastics. The harmonisation of microplastics will be proposed by reporting the complete set of sampling details and difference between sampling techniques could be avoided and comparisons made easy. Wyles et al. (2016) aimed to research in the Social and Behavioural Sciences and tried to find a way to prevent the environmental microplastics. The author stressed nine key points such as studying human perceptions and behaviour, qualitative social research methods, measuring people perceptions and behaviour, quantitative approach, experimental approaches, challenges, designing and evaluation interventions, standardising analytical methods and future social research on microplastics. The author concluded that those social and behavioural science offered guidelines in tackling microplastic pollution. Syakti (2017) investigated about the monitoring of microplastic in seawater, sediment and marine biota samples. They used Fourier Transform Infrared Spectroscopy for the identification of microplastic and analysed using different methods. They resulted that the enumeration methods were time consuming and it was difficult to differentiate between microplastic and other small materials. Paul et al. (2018) noticed the contamination of microplastics in freshwater and explained about the various sampling methods and analysis of microplastics through purification and identification steps. Further they concluded that the combination of different techniques had been improved for the better understanding of effects of microplastics. Tony et al. investigated about the status of microplastics, its impact on human health, the bathing environment and also the formation of biofilms on the plastic debris. They concluded that the plastic sphere community would inform the risk from plastic and other environmental conditions on pathogens and microorganisms. Deng et al. discussed the effect of microplastic in mammals. In order to investigate the tissue accumulation in mice, the author used fluorescent and pristine polystyrene microplastic particles with two diameters. Biomarkers and metabolic profiling were used to determine the toxic effect of microplastics in mice. It had greater impact on impairment in energy metabolism, lipid metabolism, imbalance in antioxidant defence system and disruption in neurotoxic responses in mice. They resulted that microplastics could accumulate in liver, kidney and gut depend upon its particle size. Talvitie et al. (2019) researched that the wastewater treatment plants used to remove microplastics with advanced methods. They suggested that wastewater treatment plants had the potential of blocking microplastic and reducing its impact on the environment. Since the effective methods of treating wastewater were not possible everywhere it was a challenge for the researchers to tackle the leakage of microplastics.

2.1 INTERACTION OF MARINE ORGANISMS WITH MICROPLASTICS

Most studies have concentrated on individual level impacts of microplastic ingestion in case of adult organisms and often united with the effects of microplastics at the cellular and sub-cellular level. Ingestion is the most possibly interaction between microplastics and organisms as they may be ingested accidently while filter feeding or their small size can make them indistinguishable from natural prey items (Lusher et al. 2015). The ingested microplastics pass directly through the digestive system and excreted (Dos Santos & Jobling 1991). Cole et al. (2013) investigated on the uptake of fluorescent microspheres from the water column by zooplankton. The results showed that a reduction in feeding after ingestion of plastics but also egestion of microspheres. Oliveira et al. (2013) reported 100% death rate of common goby (Pomatoschistus microps) when exposed to polyethylene with 200μg/l for 96 hrs. The results showed that decreased predatory performance, lethargy and abnormal swimming behaviour. Ugolini et al. (2013) investigated on microplastic debris in Sandhoppers. Sandhoppers (Talitrus saltator) were found to ingest microplastics mixed with food but again microplastics were egested over a 24 hrs to 1-week period and there were no detrimental impacts were observed. Hamer et al. (2014)

demonstrated on microplastic ingestion of the marine isopod Idotea emarginata. They were also seen to ingest microspheres but were readily egested and did not accumulate in the gut. Katrina L Kaposi et al. (2014) investigated on ingestion of polyethylene microspheres by larvae of the sea urchin Tripneustes gratilla. These larvae had the ability to egest microspheres within hours of ingestion from their stomach. The microspheres had limited effect both on larval growth and survival. Mattsson et al. (2015) noticed metabolic and behavioural effects of pre-exposed prey on predatory Crucian carps (Carassius carassius). They observed that these predators led reduced feeding and activity. Mazurais David et al. (2015) studied the impact of polyethylene (10-45µm) microbead ingestion in European sea brass (Dicentrarchus labrax) larvae. Larval growth and inflammatory response were not found to be affected while cytochrome-P450-1A1 expression level was significantly correlated positively with the number of microbeads scored per larva at 20 days post hatching. The ingestion of polyethylene microbeads had a limited effect on sea brass larva due to their high ability of egestion. Desforges et al. (2015) researched about the ingestion of microplastics by zooplankton in the Northeast Pacific Ocean. They examined two species namely calanoid copepod Neocalanus cristanus and the eupahusiid and detected the amount of microplastics using acid digestion method. The intake of microplastic was higher in eupahusiids than in copepod indicated that organisms in lower trophic level mistaken the microplastics as food. John Wiley (2016) researched on toxicity of microplastic especially its effects in gastrointestinal tract of marine organisms. They concluded that there was limited information for the presence of microplastic and nanoplastic on the gastrointestinal tract. There were not any analytic methods for the presence of nanoplastic in food. The microplastics and nanoplastics were consumed by human but its consequences were not found. Welden and Cowie (2016) investigated on the microplastic ingestion by the decapod crustacean Nephrops norvegicus. They ingested the microplastic fibres present in food. The long term exposure to microplastics greatly reduced the nutritional health and availability of energy stores. Jeong et al. (2016) noticed the negative effects of polystyrene microbead ingestion by rotifers on the adult growth rate, fecundity and lifespan. In order to relate these impacts they used invitro tests for the activation of anti-oxidant related enzymes and mitogen- activated protein kinases (MAPK) combined with inflammation and apoptosis. Paul-Pont et al. (2016) studied about the accumulation of fluoranthene in the mussels (Mytilus spp.) by using highly concentrated (0.032mg/l) micro polystyrene particles (2µm and 6µm diameter). A higher fluoranthene concentration was detected in mussels exposed to microplastics and fluoranthene after a 7-day exposure and a 7-day depuration period. They also found that highest histopathological damages and levels of antioxidant markers in mussels. Overall microplastics led to direct toxic impacts at tissues, cellular and molecular levels and modulated fluoranthene kinetics in marine mussels. Reproductive output is a specifically sensitive endpoint, with energetic exhaustion resulting from microplastic exposure affecting fertility and fecundity. Sussarellu et al. (2016) investigated on exposure of polystyrene microbeads on oyster. In Crassostrea gigas (adult pacific oysters), the polystyrene microbeads (2-6µm) were exposed for 8 weeks across a reproductive cycle resulted in reduced oocyte numbers, size and sperm motility. The following fertilisation, larval yield and growth were also reduced significantly. Similar impacts have been found in copepods Tigriopsus japonicus (Lee et al. 2013), Calanus helgolandicus (Cole et al. 2015) and rotifer Brachinous koreanus (Jeong et al. 2016) with decreased fecundity, egg size, hatching and survival progeny. Rist et al. (2016) reported 0% survival of Asian green mussel (Perna viridis) when exposed to polyvinyl chloride with 2160mg/l for 91 days. Ogonowski et al. (2016) reported 50% survival of Daphnia magna newborns after 14 days when exposed to polyethylene with 100,000particles/ml. Lu et al. (2016) discussed about the ingestion of polystyrene microplastics by Zebra fish. Microplastics were isolated in the gills, digestive tract and liver of the Zebra Danio (Danio rerio). It caused inflammation, disrupted energy metabolism and oxidative stress. Peda et al. (2016) observed the physiological effect which includes intestinal tract alterations and compromised intestinal function in European sea brass (Dicentrarchus labrax) after 90-day exposure through 0.1% polyvinyl chloride. Grigorakis et al. (2017) determined the gut retention of plastic microbeads and microfibers in goldfish. The ingested microplastics (50-500µm) in goldfish (Carassius auratus) would not accumulate over successive meals. The retention times of microplastic were similar to those of other contents of gastrointestinal tract. Ory et al. (2018) examined the ingestion and egestion of microplastic by Seriotella Violacea. They resulted that the fishes were susceptible to microplastics similar to their prey since S.Violacea consumed black colour microplastics which was similar to their prey. Thus microplastics were not intentionally targeted by fish it would be swallowed along with food and be egested after some days. Ying Wang et al. (2019) studied on ingestion and elimination of polystyrene particles by the brine shrimp Artemia parthenogenetica. Brine shrimp larvae have a large capacity to consume 10µm polystyrene microspheres. They egested 97% of microplastics within 3 hrs of ingestion. Microplastics were persisted in individuals for up to 14 days (1.23particles/individual). Microalgal feeding was significantly decreased in the presence of microplastics.

3. MICROPLASTICS IN FOOD

Setala et al. discussed about the consumption of microplastics by marine organisms. Ingestion, Inhalation, Entanglement and Trophic transfer were considered to be the routes of microplastics in organisms. Almida et al. evaluated the presence of microplastic fibres in marine ecosystem around Samos Island in Greece. They compared the effect of microplastics in higher and lower trophic level of Sphyraena viridensis. The composition of microplastics in fishes at lower trophic level was more harmful than at higher trophic level but intake of fibres was vice versa. Choy et al. suggested that the plastic pollution also found in the depth of the ocean through mesopelagic food webs. They also showed that the consumption of microplastics was highly in large pelagic fishes. Farrell et al. (2013) aimed to investigate the trophic transfer of microplastics from Mytilus edulis (mussels) to Carcinus maenas(crab). The microplastics translocate to haemolymph and tissues of the crab. It had been a chance of exposure of microplastics to higher trophic levels and had greater impact on health risks of animals. Hollman et al. (2013) investigated about the presence of microplastics in food, its toxicity and its impact on health. The author concluded that the fishes were the major food source of microplastics but its effects on body were not reported. The intake of nanoplastics was higher than that of microplastic particles and this could penetrate into all organs but its impact data was incomplete. The methods had to be developed for the measurement of microplastic in food and its level of toxicity. The microplastic presented in bivalves namely Mytilus edulis and Crassostrea gigas were investigated by Janssen et al. (2014). They detected microplastic in both the animals and its annual dietary exposure for consumers was about 11000 microplastic. Thus seafood was the source of intake of microplastic for humans but its impact on human health was not yet found. Li et al. (2015) discussed about the consumption of microplastics in a commercial bivalve. The most common microplastics found in the species were fibres. They suggested that the microplastics were found everywhere and the commercial bivalves consumed a lot. Gerd et al. (2015) investigated the presence of synthetic fibres in the honey. They collected 47 honey samples and on analysis they found both fibres and fragments of certain size present in it. They suggested that the microplastics affecting the environment to a larger extent directly or indirectly. Prabhu et al. (2015) measured the contamination of abiotic sea products by microplastics. They collected the fifteen brands of three types of table salts from sea, lake and well and confirmed the composition of microplastics using µ FT-IR (Fourier Transform Infrared Spectroscopy). They observed that the microplastic pollution was higher in sea salts than in lake and well salts and it was due to the presence of microplastics in the coastal and estuarine environment. Sedat (2018) aimed to show the amount of microplastics contamination in table salts. The author collected sixteen brands of table salts from three different sources. The major polymer found was polyethylene and polypropylene in those salts. Sea salt had the highest composition of microplastics when compared to lake salt and rock salt. It showed that the human exposed to microplastics through aquatic foods. Abbasi et al. (2018) analysed the presence of microplastics in fish and prawn along the coastal waters of the Persian Gulf. The microplastics had been found in the guts, skin muscles, gills and liver of pelagic fish. The presence of microplastics outside digestive system suggested that material could be translocate while non-digestive organs had the potential to induce toxic effects set a route to humans through its consumption. Microplastic had greater impact on foodstuff but the researches on microplastic in food and its effect on human health were not sufficient. Sandra et al. (2019) discussed about the microplastic affecting the food and the future measures to be taken. They suggested that it was an alarming situation hence there was an urge to find its impact and to rectify it. Kuna Aparna (2019) reported the amount of microplastics presented in the food. About 0.36-0.47 particles of microplastic per gram in fishes, mussels and oysters were consumed by humans. Water bottles contained 2-44 microplastics per litre and returnable bottles had 28-241 microplastics per litre. 70000 microplastics in dust were settled on food per year. Thus the consumption of plastic material had to be reduced hence the entry of microplastics in food chain will be minimized.

3.1 MICROPLASTICS AFFECTING HUMAN HEALTH

Fendall et al. (2009) determined the effect of microplastic from facial cleansers on the marine environment. They collected four water based facial cleansers containing polyethylene and did the experiment. They resulted that the microplastic obtained in these different brands contained irregular shapes. Further they concluded that the microplastic used in facial cleansers released into the oceans and affected the small organisms in food chain which in turn had a long term negative impact in the environment. Leslie (2014) discussed about the microplastics in personal care and cosmetic products and its consequences in environment. They described about the various plastic ingredients in PCCP and its presence in various products along with its effect in environment. They concluded that the cleaner production was the effective way to reduce microplastic emission from PCCP in short term. Piyal (2016) discussed about the source, toxicity and impact of microplastic beads in personal care and cosmetic products. They referred that the microplastic beads in cosmetic released the harmful plastic materials in the environment and also suggested that the traditional microbeads like biodegradable polyhydroxy alkaonate microbeads was the better alternative to microplastic beads. They also gathered the information of several steps taken on banning the microplastics. Dris et al. (2017) investigated about the fibres found in the air and estimated the level of microplastics among these fibres. They spotted three different sites and collected samples of dust fall, vacuum cleaner bags and found the characterization using Fourier Transform Infra-Red micro spectroscopy. The result showed that microplastics found both in indoor and outdoor air and this fibre could be inhaled by humans. But the data was inadequate to figure the effects on human health. Josep et al. (2017) investigated about the mechanism of cytotoxicity of nanomaterials and microplastics using High Content Analysis. They evaluated the individual toxicity of certain nanomaterials and microplastics. Then they took two cellular lines from cerebral and epithelial human cells namely T98G and Hela and exposed to various contaminants. The author resulted that there were no effects of nanomaterials and microplastics on the two cellular lines, hence catalysis was not produced. Oxidative stress was found to be one of the mechanisms of cytotoxicity found in both the cell lines hence it contributed to know the impacts of nanomaterials and microplastics. Davies et al. evaluated the consumption of microplastics through inhalation and compared its impact on consuming bottled water and tap water. They concluded that avoiding consumption in bottled water reduced the exposure to microplastics. Johnny et al. (2017) discussed about the occurrence of microplastics and its impact on the human health. Fibrous microplastics above certain size inhaled by human beings and subjected to munociliary clearance mechanisms of the lung. They observed that the fibrous microplastics avoid clearance mechanism and persisted in the lungs since the microplastics were durable based on their length. Messika et al. (2018) discussed about the various exposure routes of microplastic and nanoplastic and its impact on human health. The author discussed about the exposure of microplastics through drinking water, marine products, honey, beer, cosmetics and inhalation of air. Choi et al. (2019) discussed about the microplastic toxicity and proposed putative Adverse Outcome Pathways (AOP) by matching the toxicity mechanism with key elements and adverse outcome information from AOP Wiki. They resulted that molecular initiating event was Reactive Oxygen Species formation which led to increasing mortality, decreasing rate of growth and reproduction failure. Thus AOP is helpful in identifying data gaps in microplastic toxicity.

3.2 REMOVAL OF MICROPLASTICS FROM THE SAMPLE

The most widely used technique for the isolation of microplastics from seawater samples is floatation separation methods either standalone (Carpenter et al. 1972) with elutriation, combined with a density separation (Lima et al.2014) or with a surfactant like sodium dodecyl sulphate 150g/l (Enders et al. 2015). Cole et al. (2014) investigated on the three digestion methods including acid (HCl), alkaline (NaOH) and enzymatic Proteinase-K. This was done both alone and paired with ultrasonication. The highest digestion efficiency of 88.9% yielded by enzymatic treatment. Lusher et al. (2014) demonstrated using 250μm mesh sieves followed by a visual assessment to remove particles from seawater samples. The single mesh sieve was <100% effective at removing particles from the sample of seawater. These results showed an underestimation of microplastics abundance across the water samples. Julie Masura et al. (2015) investigated on the laboratory methods for the analysis of microplastics in the marine environment. They collected the surface water samples by manta net in Thea Foss Waterway and it was subjected to sieving. The dried and weighed solid samples (>0.33mm fraction) were subjected to Wet Peroxide Oxidation (WPO) in presence of Fe(II) catalyst to digest labile organic matter. The WPO mixture was then subjected to density separation in NaCl (aq) to isolate the plastic debris through floatation. This method is applicable only for the determination of plastics including polyethylene (0.91-0.99 g/ml), polypropylene (0.94 g/ml), polyvinyl chloride (1.4 g/mi) and polystyrene (1.05 g/ml). Masura et al. (2015) demonstrated using a commercial separator Lithium metatungstate solution as an alternative to NaCl due to its greater density (1.62g/cm^3). This method allowed the denser particles like polyvinyl chloride and polyethylene terephthalate to be recovered more readily. Fuller and Gautam (2016) demonstrated the pressurized fluid extraction to extract the microplastics chemically by using methanol and dichloromethane. This procedure dissolved the plastics thereby producing residues which destroy the morphology of microplastics and also making the physical characterization impossible. Majewsky et al. (2016) used a $ZnCl_2$ solution for initial density floatation separation before the organic residue was oxidized with 30% H_2O_2. The recovery rates were found to be 85% and 91% for polyethylene and polyvinyl chloride. Dehaut Alexandre et al. (2016) tested the integrity of 15 plastics using 6 protocols of digestion. The protocol using nitric acid led to significant polyamide degradation while 10% KOH solution did not affect the integrity of all tested plastics except for cellulose acetate. It provides effective digestion of mussel, crab and fish tissues and it is the best compromise for identification and extraction of microplastics. Crichton et al. (2017) implemented a cost effective and innovative floatation technique by using retail grade Canola oil to exploit the oleophilic properties of microplastics. The average recovery rate was 96.1% and also a time efficient method as compared to NaI or $CaCl_2$) determined a recovery of 87% for polystyrene beads by methods. Dyachenko et al. (2017using a combination of 30% H_2O_2 and 0.05M iron(II) sulphate ($FeSO_4$ used as a catalyst).Maes et al. (2017) suggested the $ZnCl_2$ density separation and the plastics like polyamide, polystyrene, polyvinyl chloride, polyethylene terephthalate, polyethylene and polypropylene were floated on a solution with a density of 1.37g/ml. He proposed an alternative method to identify the plastic particles from sediments by staining with Nile Red (NR) acetone solution. This method proved effective over other methods. Horton et al. (2017) developed a 3-step procedure that include visual sorting of whole sample, $ZnCl_2$ density separation and again visual sorting of unfloated sample. The visual sorting through sediment samples yielded 37% recovery of total plastics and 75% recovery with $ZnCl_2$ density separation. Fionn Murphy et al. determined the effective way of removing microplastics from municipal effluent by wastewater treatment works. The influent contained an average of 15.70 (±5.23) microplastics/litre was reduced to 0.25 (±0.04) microplastics/litre in final effluent (a decrease of 98.41%). Despite the efficient removal rates of microplastics, large volume of effluent being released into the environment. Brian et al. (2017) observed the separation of microplastics from sediments using the brine solution for less than 1mm of microplastic polymers. The recovery rate of microplastics was influenced by their size and the brine solution of higher density. Alicia Herrera et al. (2018) investigated on novel methodology to isolate microplastics from vegetal-rich samples. They found that a protocol using 96% ethanol for density separation was better than the five digestion methods tested (3%HCl, 40%NaOH, 4%NaOH+SDS, 10%KOH, catalytic 30%H_2O_2). The separation efficiency was 97.3±2.1% and recovery rates were 100% polyethylene, polypropylene, polystyrene, nylon 6.6, pellets. This technique is most efficient, simple, safe and inexpensive method for removing microplastics from the samples. Katrin Schuhen et al. (2018) determined the technological approaches for the reduction of microplastic pollution in seawater desalination plants and for sea salt extraction. In this, defined amount of organosilanes was blended with the sea water in partial reactor through a mechanical mixing concept. The reaction was repeated for several times. Through injection or chemical interaction, the concentration of free and non-bonded microplastics continuously decreased along the length of the reactor. The Residence time distribution (RTD) was maintained to prevent the disintegration of agglomerates. Alvise Vianello & Jes Vollertsen (2019) investigated on removal of >10μm microplastic particles from treated wastewater by a disc filter. The disc filter hold 89.7% of particles and 75.6% of their mass. The concentration of micoplastics in effluent was 3 microplastics/l corresponding to an estimated mass concentration of 0.31mg/l. Even though some microplastics either bypassed or passed through the disc filter, it achieved high removal efficiencies and prevented 90 billion microplastics from reaching the environment in a year. Lucas P Timmerman & Thomas D Velders (2019) investigated on different development phases of one such design named 'The Banana' from its distinctive shape. The front wall of the Banana prevented the larger litter from entering and the remaining litter follow the net of the Banana, flow through the storage containers where storage bag is attached which collects the microplastics. Heart valves in storage containers prevent the water from flowing back. This system does not consume energy so it is a passive system, it requires less maintenance and cost efficient and it is much easier to empty the storage containers.

4. CONCLUSION

The Analytical methods for the identification and classification of microplastics in the environment (water, sediment and biota) must be employed. The occurrence data (including particle size) and toxicological data must also be generated. Food should be standardized with a focus of less than 150 micrometer particles. These smaller particles are more hazardous and their study must be done with proper care. The translocation of microplastics should be generated for both aquatic organisms and humans. The studies on microplastics need to be carried out for the sources of pathogens to fishery and aquaculture products. No information is available regarding effects of processing or cooking of seafood at high temperature on the toxicity of microplastic particles. The data on physical and chemical changes in microplastics are required and also the chemical interactions between microplastics and nutrients.

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