Effect of Micro plastic and Nano plastics on Micro-organism

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Abstract:

Since the middle and the last century, there is a mass production of plastics and there is foundation of more microbes in the world. Which significant that impact of environment and ecological changes. The aim of the review is the effect of microplastic and Nano plastics on micro-organism. Over the decade's scientists are increasing their interest in reaction behind the plastics on various part of the globe. However, the analysis of plastic is associated with microbes and their causes.

Within this content, micro and Nano plastics fragments are the emerging topics. Owing to the small size of the micro-organism colonizing the plastics. We are starting to understand the plastic debris and polymer type, size, and texture of spectrums weather to know about the potential of plastic particle plays as a vector to harmful micro-organism. The main focus of the review is the discuss the research gaps related to Micro and Nano plastics with microbes.

Keyword:

Microplastics, Nano plastics, Microalga, Bacteria.

Introduction

Plastic is most commonly used synthetic and semi synthetic material due to its versatility and cheaper cost (Sami Nathan; 2014). The usage of plastics is more, Because of unique characteristics of plastics such as light weight, low cost, strength, robustness, resistance to corrosion, thermal and electrical insulation, flexible manufacturing and design capabilities that can be Easily shaped into variety of products (Muhammad Ilyas; 2018) (**Figure-1**). Plastics are commonly known as polymers. Mostly polymer substances such as polyethylene(PE), polycarpolactone (PCL), poly vinyl chloride(PVC), polyethylene terephthalate (PET), polypropylene(PP), and polystyrene(PS) are widely used for different purpose(Yoshida; 2016) (**Table-1**). Due to slow degradation and low recycling rate a large number of plastic wastes have been released continuously in the environment. It estimated that by 2025 plastic litter becomes the pollution in the marine environment; it brings the major pollution in the world (Jambeck et al., 2015). Mostly the waste plastic is ending up in the marine water, after reaching the marine degradation of large/macro plastic into small/microplastics are formed in simulated weathering condition (Lambert and Wagner, 2016). The report submits that at 95^{o} C water the plastic is subjected for 5 minutes some plastics like nylon there is a formation of micro and nanoplastics (Hernandez et al., 2019). The environmental changes are also a reason behind the pollution for the plastics (jambecket.al.). Today nearly 300 million tonnes of plastics are producing but nearly 25-35 million tonnes of plastics estimated as wastage in that nearly 80% of plastics are debris in the ocean (Eriksenet.al). Among that 5.25 trillion plastics were floating on the ocean. Most of the particles are microplastic <5mm. Lack of technological device to detect and analysis the small particle size of plastics in the environmental matrix. These are challenges for the researchers have limited source of information on the release and migration of micro and nano plastics in the environment. Some investigation reports are measuring of micro plastic in bottle water as $2649 \pm 2857\ L^{-1}$ (Oßmann et al. 2018), sediments are determine as 123.6 items kg−1 of dry weight (Zhao et al. 2018), detected in sewage sludge as 22.7 ± 12.1 × 103 particles kg−1 dry sludge (Li et al. 2018), found in agriculture land as 7100–42,900 particles kg−1 soil (Zhang and Liu 2018), respectively.

In the marine environment, a wide range of Heterotrophic bacteria are present and it will play an important role in the different cycle for example nitrogen cycling in marine, gram negative halophilic membrane of proteobacteria plays an important role (Cho and Azam, 1988; Sun et al., 2012). In the microbial repository, the plastic act as a vehicle for traveling a long distance, due to their half-life is quite longer then compare to other natural floating material on the surface it will promote microbial biofilm formation and colonization in the pelagic zone (Reisser et al., 2014; Virsek et al., 2017). Some bacteria play important role in the ecosystem and human health, For example, Bacillus subtilis (*B.Subtilis*), Escherichia Coli (*E.Coli*), Pseudomonas aeruginosa (*P.aeruginosa*) found in the environment through anthropogenic sources, which contribute to the ecosystem (Baysal et al., 2019).
This article reviews the source of both microplastic and Nano plastic debris found in the ocean bodies and their effects and occurrence are summarised

Microplastics:

Microplastics are plastics particles of less than 5mm in diameter (**Figure-2**). There are two types of microplastics; primary microplastics and secondary microplastics (Oberbeckmann S.2015). Primary microplastics are produced with a diameter of less than 5mm and used in facial scrubs and other personal care products etc. secondary microplastics are found from larger plastic particles due to environmental conditions such as freezing-thawing, UV radiation, and water current, etc. (Mohammed R.Hossain; 2019). The effect of micro-sized plastic is less studied as compared to macro-sized plastic because of their small size (Tamara S. Galloway; 2017). The deterioration of plastic into smaller parts changes the plastics chemical and physical characteristics and thus its quality and possible biological effects on aquatic organisms also change (K. Mattsson;2019). Potential toxic effects of microplastic are the toxicity from ingesting the microplastic in itself, contamination leaching from the microplastics, accumulation of these particles in the organism(Qiongjie Wang; 2019). Through the epithelial membrane of the stomach, these ingested particles can be translocated into tissue or edge (the method of discharging undigested or waste product from an organism)through defection(M.Classens;2013). These particles may adversely affect the animal's behavior and health. These particles can also disintegrate into smaller particles and potentially accumulate in tissue (Tamara S. Galloway; 2017).

Nano plastics:

Nano plastics are classified as substances with at least two dimensions from 1 to 100 nm (**Figure-**2). The volume of Nanosized plastic particles in the aquatic environment is not known as these smaller particles are excluded by most analytical methods. The degradation processes are unlikely to stop at the micro size but will continue to produce Nano-sized plastic that varies from both the original material and microplastic. The Nano-sized plastic particles will have a high curvature of the surface and other surface structures will be small compared to biological surfaces and molecules which change the interactions and possibly their biology(K. Mattson; 2015). Nano plastics can pose a great threat to marine wildlife than microplastics due to the impact of their smaller size on their ecological fate, allowing for other exposure scenarios and other biological effects (E. Besseling; 2017). In addition, size-dependent uptake was identified in zooplankton, ubiquitous eggs, ubiquitous embryos, and ubiquitous fish, resulting in size-dependent organism effects. Such effects based on absorption and Nano size allow for complex tests. For example, size-dependent uptake was identified in zooplankton, ubiquitous eggs, ubiquitous embryos, and ubiquitous fish, resulting in size-dependent organism effects. Such effects based on absorption and Nano size allow for complex tests. For example, Nano plastics can move from algae to zooplankton via food webs to planktivorous fish (K. Mattsson 2015, Milkael T. Ekvall; 2019).

Plastic Debris:

Around the globe there are different form of plastics are disposed some are settled in the ground surface and debris under the soil and large amount of plastics are transfer through river or drainage system there were transfer into the ocean that are start debris in the ocean. Based on that it is classified into,

1. Land-based debris
2. Ocean-based debris

Land-based debris:

They are 80% of plastics debris in the land-based source in the marine environment like industrial areas and densely populate places are major sources due to the littering plastic bag usage and disposal solid waste is an example (derrick, 2002) shown in (**Figure-3**). A study by Lee et al., (2013) in the coastal recreation activities is the origin of floating and beached plastics debris. Other research found that the manufacturing of raw material was transported on it beached in accidental spillage during the handling process are in large quantities (red ford et al., 1997). Other land-based sources are wastewater effluent (Browne et al., 2010). Plastics are transported in the ocean through the river system that floating plastics are easily traveled (Browne et al., 2010; Cole et al., 2o11). On other hand weather events such as flooding landslide, they increase the transfer of land-based debris into the ocean (Bareness et al., 2009). One of the research has found that increasing the microplastic quantity from 10-60 time after the storm in Californium water were transferred in the ocean (Moore et al., 2002).

Ocean-based debris:

They are only 30% of plastic debris are in the ocean-based source in the marine environment. According to the report 1975 the deposition of plastic fishing gear 1, 35,400 tonnes, and synthetic packing material into the sea 23,600 tonnes (Cawthorn, 1989) shown in (**Figure-4**). On estimated discarded fishing gear are 6, 40,000 tonnes are added in the ocean every year. Which approximately 10% of ocean debris (good et al., 2010). The discarded fishing items are nylon netting, monofilaments lines, sticks, etc... Cause the entanglement of aquatic organisms (Lozano and mount, 2009). Overall these studies suggested that amount of plastic debris in the ocean through only fishing activities.

Microplastic in the environment:

1. **Microplastics in marine sediment:**

According to the density of the microplastic is greater compare to water sink down in sediments where they accumulate (Alomar et al., 2016). Some are less density compare to water so they float on the surface in water (suaria and aliani, 2014). The densities are increasing through biofouling by organisms in the ocean can result in the sinking of microplastic (Reisser et al., 2013; jorissen, 2014). Marine sediment has the potential for microplastic accumulation (nullelle et al., 2014) and demonstrated long term sink of microplastics (cozar et al., 2014). That sedimented plastic heavily impacts beaches because a very high concentration of microplastics now occurs in ocean sediment, approximately 3.3% of plastics of sediment weight (van cauwenberghe et al., 2015a, 2015b; Boucher et al., 2016). It is a fact that deep ocean area and marine coastal sediments are sinks of microplastic (Alomar et al., 2016; Pham et al, 2014)

2. **Microplastics in mangrove sediment:**

It is an enhances of sedimentation because mangroves accumulate carbon, nutrients, sediments, and minerals (Valiela and Cole, 2002). Deposition happens in different sources; autochthonous sediments, allochthonous sediments and comes from other external factors (Adame et al., 2010). In the study conducted by nor and ob board(2014) it revealed that how aquatic environment sedimentation happens similar to accumulate in mangrove sediment were the plastic particles were extracted in Singapore mangrove habitats using the flotation techniques which were a size smaller than 20µm and its contain different types of plastics polystyrene, polypropylene, nylon, polyethylene, and polyvinyl chloride. Were the concentration of the microplastics in dry sediment ranges from (12.0-62.7)? After observing these different kinds of plastics polymers it may due to degradation of ocean microplastic debris it could have accumulated in mangroves sedimentation have observed more than 518 different types of plastic polymerase are recorded (smit 2012).

Plastic as substratum and surface variation:

Plastics are various chemical composition, they can serve as the substratum for biofilm formation in the marine community as a filament or particle, with a rough and smooth surface along with the density medium. Various experiments were conducted along the North Sea, UK, comparing the biofilm colonization communities after 6 weeks at different sites in different seasons (J. A. Ivar do Sul2014). PET colonization have been observed in different bacteria such as Bacteriodetes, Proteobacteria, Cyanobacteria, Phaeophyceae, Bacillariophyceae.

So currently available data for in situ experiments the development of microbial films on different plastics in marine or aquatic systems. Plastic surfaces in marine water are quickly colonized but further controlled experiments are needed for using the whole spectrum of plastic polymers as well.

Global level microplastics distribution in the marine environment:

According to a survey conducted microplastic are presented throughout the world marine system from artic to the Antarctic in beaches, seabed sediment, shorelines (IMO, 2015). The microplastics were sediments through ocean current and wind flow direction the distribution of the plastic influenced by the density of the particle (kukulka et al., 2012; Magnusson et al., 2016). Because of less weight and persistent nature of microplastics allow easily dispersed via ocean current and hydrodynamic processes (car valho and Baptiste neto, 2016). In the 20th century, the investigations are stared under microplastics in the marine system which included North Pole to south pole (lusher et al., 2015a; Barnes et al., 2009). Mid-ocean Island (Ivar do Sul et al., 2013) and deep sea9classens et al. 2013). Only in California estimated more than 2 billion plastic particles were observed in two rivers that also just a period of three days (Moore et al., 2005; reddy et al., 2006). In the site near shipwreck yard in India discovered 81vppm micro plastics sediments and in artic water observed the microplastics range between 1.31 to 11.5 particles m-3 respectively (lusher et al., 2015a,b). In Belgium, wastewater along with the coastal harbor sediment (Isobe et al., 2015). In japan around East Asian seas, the plastic particles of 1.72 million pieces km-2 have been counted. Which is 27 times greater than the World Ocean and 10 times greater than the North Pacific Ocean (nel and franeman, 2015)? Studies were conducted in the six beaches in Malaysia totally 2542 piece of microplastic debris was collected 9fauziah et al., 2015). In magnolia 20,264 particles km-2 of average microplastic density have been recorded in Lake Hovsgol (free et al., 2014). The study was first reported the ubiquitous nature of microplastic pollution in the North Atlantic Ocean, that investigation found that 2.46 particles m-3 were calculated (lusher et al., 2014). In the mid-west we there is 7 million microplastics is discharged through the wastewater treatment facility and daily around 2 million plastic particles are recorded in the northeast US. In San Francisco bay approximately 56 million microplastic fragments were discharged into the ocean (Sutton et al., 2016)'. In Denmark, around 5,600 tonnes of microplastic were discharged from textiles and chemical industries. These are some places were research are conducted and shown in the (**Table-2**).

Effects of Nano plastics and bioaccumulation:

The properties of the polystyrene in Nano size are very harmful to all the organisms which can easily be travelled into the lipid membrane and disrupted the cell function (Rossi et al., 2014) are observed under Scanning Electron Microscope which shown in the (**Figure-5**). In different macro-organisms, they experimented with different endocytosis pathways the carboxylate Nano polystyrene conducted by Salvati et al., 2011. The response of inflammation in the particular tissue ward and kach(2009). Show that it is very little chance of ingestion of Nano plastics as per direct bioavailability. In summary, there is only limited literature on microorganisms. In meanwhile the research is an on-going pathway in bacteria fungi with the Nano plastics currently no environmental concentrations as the compared value but the low effect of Nano plastic concentration of 0.54mg/l (casa do et al., 2013). However, the data which we have is very limited and absences from the actual exposure of Nano plastic data in some microorganisms.

Specific challenges on Nano plastics:

They are several problems in the Nano plastics that arise in the research. Things to concern that manufacture of Nano plastics is different from naturally present in environment and properties behavioural changes can be happens while artificially synthesized one and very limited type of plastics we are used in the research (PS beads) but in the world, they are many other different types of plastics are present. Nano plastics toxicity testing becomes useless to prevent bacterial growth during storing and delivery instead of that commercial. Nano plastics are often delivered with a biocide (handy et al., 2012).sometimes the surface-modified Nano plastics or otherwise hydrophobic Nano plastics.

Effect of Nano plastics and microplastics on microalgae:

The effect of smaller organisms will affect the other organisms at higher tropic levels. They are different types of algae species have conducted in this test. Interact with PS beads and different algae Chaetoceros neogracile (diatom), Heterocapsa triquetra (dinoflagellate)(Long et al. (2017)). The author found that hetero aggregate of phytoplankton cells with microplastics fragments depending on the physiological status of microalgae specious. The stationary growth phases were observed in hetero aggregate microplastics with diatoms. Physiological observation of growth and chloroplast fluorescence was not the effect of microplastics which increasing the sedimentation rate when the increase of particle density. The plastics were easily ingested by many organisms and entered and affect food wed (Lagarde et al., 2016). In Yokota et al., (2017) the author found that the irregular form of bundles attached to corners filamentous microalgae in microplastics.

In cyanobacteria not that much adhesion pattern. The study indicated that microalgae are the best suitable surfaces for forming colonies on microplastics are shown in (**Figure-6**). The experiments were conducted for 21 days period. Which will not affect the growth and biomass of microalgae in microplastics their growth cycle. A study investigates by Zhang et al., 2017. Which is a habit of the growth of diatoms when the PVC (" diameter 1m) interacted with skeletonema costatum. They recorded the highest growth inhibitor ratio of 39.7% after 96 hours of exposures. The author observes the toxic effects on physical damages due to precipitates from an algal cell and hetero aggregation of microplastics. Adsorption micro PVC on the surface which not able to transfer the sunlight directly and nutrient uptake also decreases and availability of free surroundings also restricted by the plastics. In sjollema et al., 2016. The author reported that polystyrene particles interact with microalgae. The things to concern in this interaction

In the food chain, microorganisms play an important role in primary produce besides that many other things to concern such as animal feeds, potential medicine, food additives, and bioremediation of contained environment(chu 2012; chu and pheng 2016; pheng et al., 2015). Yet they have only limited study on micro and Nano plastics on microorganisms. The potential toxic effects on microplastics and Nano plastics. On microorganisms is are the charges of PS (both positive and negative) are a negligible effect on photosynthesis efficiency on different microalgae.

Note et al., 2017 research observes that which inhibited the growth of pseudokirchneriella subcapitate. When interacting with PS-CHOOH particles(110nm). They postulated the growth inhibition caused by several factors such as increase osmotic pressure and nutrient depletion. When pseudokirchneriella subcapituta has interacted with polyethyleneimine polystyrene(PS-PE) on the size of (55-110nm), which brings great growth inhibition (Casado et al.., 2013). The author suggested that the low toxicity of nano plastic could be due to a high degree of surface functionalization. Besseling et al.., (2014) reported that freshwater alga Scenedesmus obliquus increases proportionally to the concentration of the nano plastics which inhibitory growth in polystyrene. Most of the studies investigating the microplastic and nanoplastics toxicity on microalgae are focused on using polystyrene, more studies need to carried forward on research on other types of plastics polymers.

Bacterial biofilm formation in microplastics and nanoplastics:

They are only limited sources under the research area of bacteria are interacting with the plastics are identified in the Scanning Electron Microscope are shown in (**Figure-7**). Have to identify the molecules present (organic matter), bacterial stains, surface charge, and concentration of plastics (Duis and Coors, 2016). The studies were conducted in an indoor hydrodynamic flume of biofilms cultivation (lin et al., 2018). Carbon nanotubes are closed both in the end and cylindrical structures (Huang et al., 2003). The high microbial immobilization capacity of CNT has properties of environmental application (Akasaka and Watari 2009; upadhyayala et al., 2009). The biofilm formation conductive anode for immobilization in the microbial fuel cell. The bioremediation of harboring productive biofilm formation at the surface and increases the micro pore content while reducing the degradation process get delayed (Lao et al., 2008). The plastic concentration chemical start reacts with bacteria. The author observes that the concentration of chemical gets a change in the microbial activity.

Biofilms which spread diseases to a human:

The research would find that cystic fibrosis pneumonia in an autosomal recessive disease can be affected through dysfunctional electrolyte secretion and absorption. There may be many other factors primarily because of respiration (cacarella et al., 2001). Chronic endobronchial bacterial infection. This leads to the distribution of airway and finally brings the respiratory failure. The common bacteria found in the pulmonary colonies are Haemophilus influenza and s. aureus. Mostly it is affected by the early adolescence period (hunt.sm and humilton, 2003). The author was observing that quorum sensing of sputum inpatient which the result indicates the presence of biofilm formed bacteria was present in that transference (costerton and stoodley 2002), and consume of the marine organisms through that also it will entire in the humans it may also spread some diseases such as diarrhoea, stomach disorder etc.., which are shown in the (**Figure-8**) in the cyclic ecosystem. These are some disease which possible to spread to humans and some gum diseases which can be entered in our body.

Recommendation for further research:

Heavy metals and oxidative stress needed to observe more (Hamed et al., 2017). And also growth inhibition (wan et al.,2018). Decrease the photosynthesis activity (Lau et al., 2018). Metabolic and biochemical distribution (goncalus et al., 2018) and the influence of metal toxicity in microorganism has not been studied. There has been evidence of adsorption of heavy metals such as lead (Pb), cadmium (Cd), zinc (Zn). They reported in the study on the Beijing River littoral zone (wang et al., 2017b). above-mentioned area to further research gain insights into the potential impact of microplastic and Nano plastics on microalgae.

Conclusion:

In summary, the plastics debris is commonly found in the environment have the potential to fragment into microplastic and Nano plastics. The present plastic debris in the environment which affect a wide range of organisms. Large quantities of plastics found in water bodies and mostly in area developed countries. This is considering because microplastics in concern of any cause significant harm to humans and the environment. The government needs to play an important role to control plastic [pollution which to prevent the hazardous material from entire into public use and safety action plan to need on research natural cleaning of contaminated environment. In addition every on to be aware of future environments by-products introducing plastic upgrading and plastic recycling programming.

Reference:

1. Aamer ali shah, fariha hasan, abdul hameed, safia ahmed, biological degradation of plastics: a comprehensive review. Biotechnology advances 26, 2018, 246-265.

2. Fatimah alshehrei, biodegradation of synthetic and natural plastic by microorganisms, journal of applied and environmental microbiology, 2017, vol.5, no.1, 8-9.

3. Mohammed R. Hossain, miao jiang, qihuo wei, laura G. leff, micro plastic surface properties affect bacterial colonization in freshwater, journal basic microbiology, 2019; 59:54-61.

4. Tamar S. Galloway, matthew cole and ceri lewis, interactions of micro plastic debris throughout the marine ecosystem, nature ecology and evolution, 2017, 1, 0116.

5. K. mattsson, L-A. Hanssonb, T.Cedervall, Nano plastics in the aquatic environment, environ.sci.processes impacts, 2015, 17, 1712.

6. Mikael T. Ekvall, martin lundqvist, egle kelpsiene, eimantas sileikis, Stefan B.gunnarsson and tommy cedervall, Nano plastics formed during the mechanical breakdown of daily use polystyrene products, Nanoscale adv., 2019, 1, and 1055.

7. Silvia casabianca, samuela capellacci, antonella penna, michela cangiotti, alberto fattori, ilaria corsi, maria Francesca ottaviani, Riccardo carloni, physical interactions between marine phytoplankton and PET plastics in seawater, j.chemosphere.2019, 238, 1245560.

8. Anaid meza-villezcas, ana L. Gallego-Herna'ndez, fitnat H. Yildiz, Oscar E. Jaime- acuna, Oscar Raymond-herrera, alejandro huerta-saquero, effect of antimicrobial nanocomposites on vibrio cholera lifestyles: pellicle biofilm, planktonic and surface attached biofilm, PLoS ONE 14(6), 2019, e0217869.

9. Robert G. Price and dirk wildeboer, e.coli as an indicator of contamination and health risk in environmental waters, Escherichia coli – recent advances on physiology, pathogenesis and biotechnological applications, 2017.

10. Fionn murphy, Ciaran ewins, Frederic carbonnier, and brian Quinn, wastewater treatment works (WwTW) as a source of microplastics in the aquatic environment, environ. Sci. technol, 2016.

11. Qiongjie wang, yong zhang, xiaoxue wangjin, yulai wang, guanhua meng, yihua chen, the adsorption behaviour of metals in aqueous solution by microplastics effected by UV radiation, journal of environmental science, 2019, 01850.

12. Kai song, fariborz, taghipour, madjid mohseni, microorganisms inactivation by wavelength combination of ultraviolet light-emitting diodes (UV-LEDs), science of the total environment 665, 2019, 1103-1110.

13. Line roager and eve C. Sonnenschein, bacterial candidates for colonization and degradation of marine plastic debris, environ. Sci. technol. 2019.

14. Ana G. Rodriguez-hernandez, J. Alejandro murioz-tabares, J. Cristobal Aguilar-Guzman and Rafael Vazquez-duhalt, a novel and simple method for polyethylene terephthalate (PET) nanoparticle production, environ. Sci. anno, 2019, 6, 2031-2036.

15. Archana, V. Moses, S. Sagar, V. Shivaraj, S. Chetan, A. Review on processing of waste PET (polyethylene terephthalate) plastics, internationaljournal of polymer science engineering, 2015, 1-13.

16. Muhammad ilyas, waqas ahmad, hizbullah khan, saeeda yousaf, kifayatullah khan and shah nazir, plastic waste as a significant threat to environment- a systematic literature review, rev environ health 2018; 33(4): 383-406.

17. Temoor ahmed1& Muhammad shahid 1 & farrukh azeem 1 & ijar rasul 1& asad ali shah 1& Muhammad narman1 & amir hameed1& Natasha manzoor2 & irfan manzoor1 & sher Muhammad, biodegradation of plastics: current scenario and future prospects for environmental safety, environmental science & pollution research, 2018, 25:7287-7298.

18. John N. Hahladakisa, Costas A. Velis a, roland weberb, eleni iacovidoua, Phil purnell, an overview of chemical additives present in plastic: migration, release, fate and environmental impact during their use, disposal and recycling, journal of hazardous material 344, 2018, 179-199.

19. Wenfeng wang jun wang, investigation of micro plastics in aquatic environments: an overview of the methods used, from field sampling to laboratory analysis, trends in analytical chemistry, 2018, 195-202.

20. Ana b. silva, ana s. bastos, celine i.l.justino, joao p. da costa, Armando c. Duarte, Teresa a.p.rocha-santos, micro plastics in the environment: challenges in analytical chemistry- a review, analytica chimica acta; 2018, 1-19

21. Joana correia prate, jo¬ao P. da coasta, Armando C. Duarte, Teresa rocha- santos, methods for sampling and detection of micro plastics in water and sediment: a critical review, trends in analytical chemistry, 2019, 150-159.

22. J. A. Ivar do Sul, M. F. Costa, The present and future of microplastic pollution in the marine environment. Environ. Pollut. 2014, 185, 352. doi:10.1016/J.ENVPOL.2013.10.036

23. Marine Debris in the North Pacific – A Summary of Existing Information and Identification of Data Gaps 2011 (United States Environmental Protection Agency: San Francisco, CA).

24. D. K. A. Barnes, F. Galgani, R. C. Thompson, M. Barlaz, Accumulation and fragmentation of plastic debris in global environments. Philos. T. Roy. Soc. B 2009, 364, 1985. doi:10.1098/RSTB.2008.0205

25 F. Galgani, G. Hanke, S. Werner, L. De Vrees, Marine litter within the European marine Strategy Framework Directive. ICES J. Mar. Sci. 2013, 70, 1055. doi:10.1093/ICESJMS/FST122

26. J. R. Jambeck, R. Geyer, C. Wilcox, T. R. Siegler, M. Perryman, A. Andrady, R. Narayan, L. Lavender Law, Plastic waste inputs from land into the ocean. Science 2015, 347, 768. doi:10.1126/SCIENCE. 1260352

27. S. B. Sheavly, K. M. Register, Marine debris & plastics: environmental concerns, sources, impacts and solutions. J. Polym. Environ. 2007, 15, 301. doi:10.1007/S10924-007-0074-3

28. A. L. Andrady, Microplastics in the marine environment. Mar. Pollut. Bull. 2011, 62, 1596. doi:10.1016/J.MARPOLBUL.2011.05.030

29. M. Eriksen, L. C. M. Lebreton, H. S. Carson, M. Thiel, C. J. Moore, J. C. Borerro, F. Galgani, P. G. Ryan, J. Reisser, Plastic pollution in the world's oceans: more than 5 trillion plastic pieces weighing over 250 000 tons afloat at sea. PLoS One 2014, 9, e111913. doi:10.1371/ JOURNAL.PONE.0111913 30. C. Arthur, J. Baker, H. Bamford, (Eds)Proceedings ofthe International Research Workshop on the Occurrence, Effects, and Fate of Microplastic Marine Debris, 9–11 September 2008, Tacoma, WA, USA 2009, NOAA Technical Memorandum NOS-OR&R-30 (National Oceanic and Atmospheric Administration: Silver Spring, MD

31. L. S. Fendall, M. A. Sewell, Contributing to marine pollution by washing your face: microplastics in facial cleansers. Mar. Pollut. Bull. 2009, 58, 1225. doi:10.1016/J.MARPOLBUL.2009.04.025

32. [11] M. R. Gregory, Plastic 'scrubbers' in hand cleansers: a further (and minor) source for marine pollution identified. Mar. Pollut. Bull. 1996, 32, 867. doi:10.1016/S0025-326X(96)00047-1

33. M. A. Browne, P. Crump, S. J. Niven, E. Teuten, A. Tonkin, T. Galloway, R. Thompson, Accumulation of microplastic on shorelines worldwide: sources and sinks. Environ. Sci. Technol. 2011, 45, 9175. doi:10.1021/ES201811S

34. Y. Ogata, H. Takada, K. Mizukawa, H. Hirai, S.Iwasa, S. Endo, Y. Mato, M. Saha, K. Okuda, A. Nakashima, M. Murakami, N. Zurcher, R. Booyatumanondo, M. P. Zakaria, L. Q. Dung, M. Gordon, C. Miguez, S. Suzuki, C. Moore, H. K. Karapanagioti, S. Weerts, T. McClurg, E. Burres, W. Smith, M. Van Velkenburg, J. Selby Lang, R. C. Lang, D. Laursen,B. Danner, N. Stewardson, R. C. Thompson, International pellet watch: global monitoring of persistent organic pollutants (POPs) in coastal waters. 1. Initial phase data on PCBs, DDTs, and HCHs. Mar. Pollut. Bull. 2009, 58, 1437. doi:10.1016/J.MARPOLBUL.2009.06.014

35. D. A. Cooper, P. L. Corcoran, Effects of mechanical and chemical processes on the degradation of plastic beach debris on the island of Kauai, Hawaii. Mar. Pollut. Bull. 2010, 60, 650. doi:10.1016/ J.MARPOLBUL.2009.12.026

36. R. C. Thompson, C. J. Moore, F. S. vom Saal, S. H. Swan, Plastics, the environment and human health: current consensus and future trends. Philos. T. Roy. Soc.B2009, 364, 2153. doi:10.1098/RSTB. 2009.0053

37. M. A. Browne, T. S. Galloway, R. C. Thompson, Spatial patterns of plastic debris along estuarine shorelines. Environ. Sci. Technol. 2010, 44, 3404. doi:10.1021/ES903784E

38. M. Claessens, S. De Meester, L. Van Landuyt, K. De Clerck, C. R. Janssen, Occurrence and distribution of microplastics in marine sediments along the Belgian coast. Mar. Pollut. Bull. 2011, 62, 2199. doi:10.1016/J.MARPOLBUL.2011.06.030

39. J. P. Desforges, M. Galbraith, N. Dangerfield, P. S. Ross, Widespread distribution of microplastics in subsurface seawater in the NE Pacific Ocean. Mar. Pollut. Bull. 2014,79,94. doi:10.1016/ J.MARPOLBUL.2013.12.035

40. V. Hidalgo-Ruz, L. Gutow, R. C. Thompson, M. Thiel, Microplastics in the marine environment: a review of the methods used for identification and quantification. Environ. Sci. Technol. 2012, 46, 3060. doi:10.1021/ES2031505 [20] K. L. Ng, J. P. Obbard, Prevalence of microplastics in Singapore's coastal marine environment. Mar.Pollut. Bull. 2006, 52, 761. doi:10.1016/J.MARPOLBUL.2005.11.017

41 M. Claessens, S. De Meester, L. Van Landuyt, K. De Clerck, C. R. Janssen, Occurrence and distribution of microplastics in marine sediments along the Belgian coast. Mar. Pollut. Bull. 2011, 62, 2199. doi:10.1016/J.MARPOLBUL.2011.06.030

42. M. R. Gregory, Virgin plastic granules on some beaches of eastern Canada and Bermuda. Mar. Environ. Res. 1983, 10, 73. doi:10.1016/ 0141-1136(83)90011-9

43. J. P. Harrison, M. Sapp, M. Schratzberger, A. M. Osborn, Interactions between microorganisms and marine microplastics: a call for research. Mar. Technol. Soc. J. 2011, 45, 12. doi:10.4031/MTSJ.45.2.2

44. S. Moret-Ferguson, K. L. Law, G. Proskurowski, E. K. Murphy, E. E. Peacock, C. M. Reddy, The size, mass, and composition of plastic debris in the western North Atlantic Ocean. Mar. Pollut. Bull. 2010, 60, 1873. doi:10.1016/J.MARPOLBUL.2010.07.020

45. S. Ye, A. L. Andrady, Fouling of floating plastic debris under Biscayne Bay exposure conditions. Mar. Pollut. Bull. 1991, 22, 608. doi:10.1016/0025-326X(91)90249-R

46. T. Kiessling, L. Gutow, M. Thiel, Marine litter as habitat and dispersal vector, in Marine Anthropogenic Litter(Eds M. Bergmann, L. Gutow, M. Klages) 2015, pp. 141–181 (Springer International Publishing: Cham, UK).

47. M. Thiel, L. Gutow, The ecology of rafting in the marine environment. I. The floating substrata. Oceanogr. Mar. Biol. Annu. Rev. 2005, 42, 181.

48. M. Thiel, L. Gutow, The ecology of rafting in the marine environment. II. The rafting organisms and community. Oceanogr. Mar. Biol. Annu. Rev. 2005, 43, 279. doi:10.1201/9781420037449.CH7

49. M. R. Gregory, Environmental implications of plastic debris in marine settings – entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. Philos. T. Roy. Soc. B 2009, 364, 2013. doi:10.1098/RSTB.2008.0265

50. D. K. A. Barnes, Human rubbish assists alien invasions of seas. ScientificWorldJournal 2002, 2, 107.

51. S. Aliani, A. Molcard, Hitch-hiking on floating marine debris: macrobenthic species in the western Mediterranean Sea. Hydrobiologia 2003, 503, 59. doi:10.1023/B:HYDR.0000008480.95045.26

52. D. K. A. Barnes, Biodiversity – invasions by marine life on plastic debris. Nature 2002, 416, 808. doi:10.1038/416808A

53. J. C. Astudillo, M. Bravo, C. P. Dumont, M. Thiel, Detached aquaculture buoys in the SE Pacific: potential dispersal vehicles for associated organisms. Aquat. Biol. 2009, 5, 219. doi:10.3354/AB00151

54. D. K. A. Barnes, K. P. P. Fraser, Rafting by five phyla on man-made flotsam in the Southern Ocean. Mar. Ecol. Prog. Ser. 2003, 262, 289. doi:10.3354/MEPS262289

55. C. West, The significance of small plastic boats as seed dispersal agents. Tane 1981, 27, 175.

56. M. R. Gregory, Accumulation and distribution of virgin plastic granules on New Zealand beaches. N. Z. J. Mar. Freshw. Res. 1978, 12, 399. doi:10.1080/00288330.1978.9515768

57. D. K. A. Barnes, P. Milner, Drifting plastic and its consequences for sessile organism dispersal in the Atlantic Ocean. Mar. Biol. 2005, 146, 815. doi:10.1007/S00227-004-1474-8

58. M. Maso, E. Garces, F. Pages, J. Camp, Drifting plastic debris as a potential vector for dispersing harmful algal bloom (HAB) species. Sci. Mar. 2003, 67, 107.

59. M. C. Goldstein, M. Rosenberg, L. Cheng, Increased oceanic microplastic debris enhances oviposition in an endemic pelagic insect. Biol. Lett. 2012, 8, 817. doi:10.1098/RSBL.2012.0298

60. S. L. Wright, R. C. Thompson, T. S. Galloway, The physical impacts of microplastics on marine organisms: a review. Environ. Pollut. 2013, 178, 483. doi:10.1016/J.ENVPOL.2013.02.031

61. L. R. Pomeroy, P. J. I. Williams, F. Azam, J. E. Hobbie, The microbial loop. Oceanography 2007, 20, 28. doi:10.5670/ OCEANOG.2007.45

62. D. P. Bakker, A. van der Mats, G. J. Verkerke, H. J. Busscher, H. C. van der Mei, Comparison of velocity profiles for different flowchamber designs used in studies of microbial adhesion to surfaces. Appl. Environ. Microbiol. 2003, 69, 6280. doi:10.1128/AEM.69.10. 6280-6287.2003

Figure-1, Plastics is used in various purposes.

Figure-2, Different form of microplastics.

Figure-3, Plastics is dispersed in the land surface.

Figure-4, fishing gears are floating on the surface of the ocean.

Figure-5, Nano plastic under Scanning electron Microscope

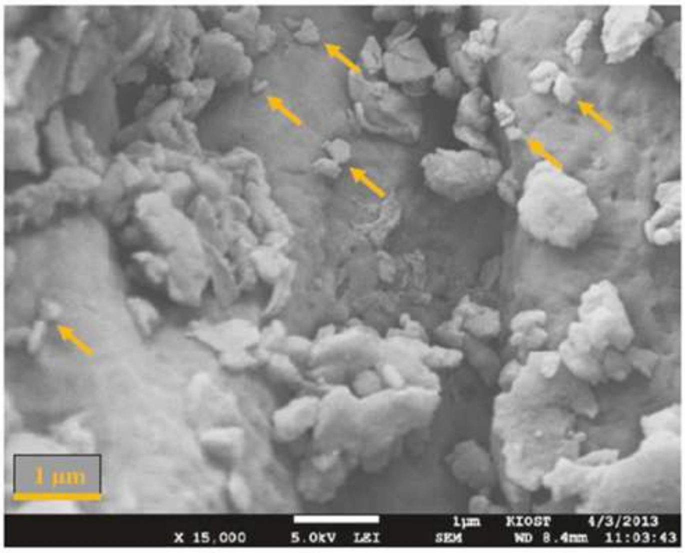


Figure-6, Microplastics are interact with algae

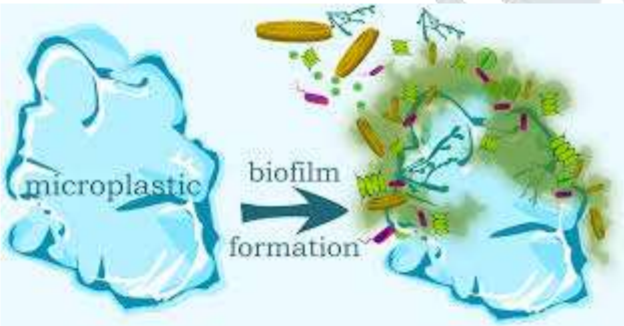


Figure-7, Microplastics are interacted with Bacteria

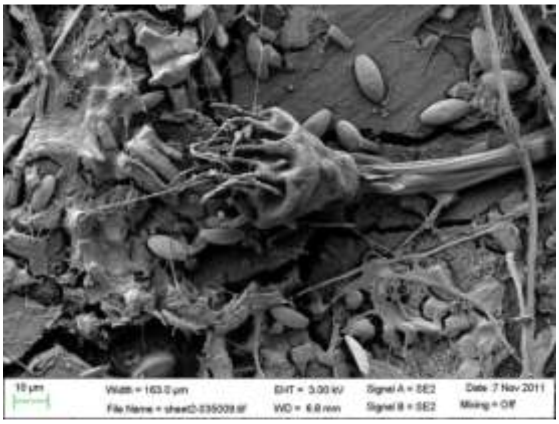
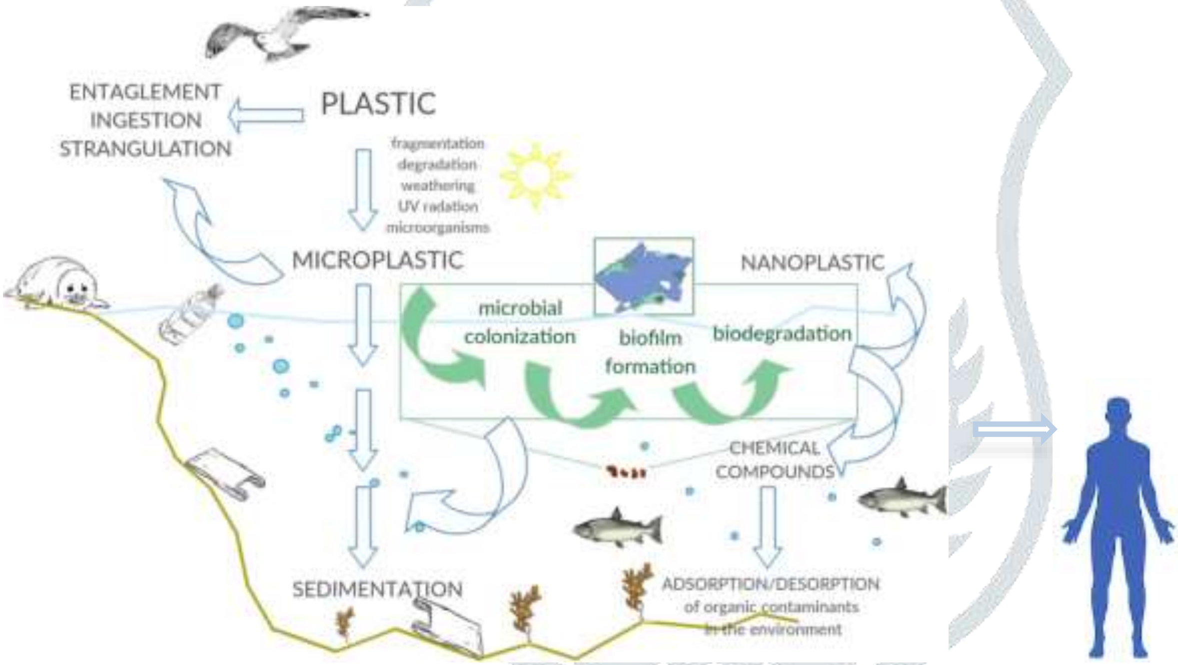


Figure-6, these are the ecosystem that plastics are circulating in the environment



While consuming marine animals and food through it will spread diseases to human

Table 1: Specific gravity of different plastics and their application

Type	Specific gravity	Application	Health effects
Polyethylene (PE)	0.19-0.96	Wide range of inexpensive uses including supermarket bags, plastic bottles	-
Polyethylene terephthalate (PET	1.37	Carbonated drinks bottles, peanut butter jars, plastic film, microwavable packaging, tubes, pipes, insulation molding	Potential human carcinogen (Ecology Center, 1996).
Polyester (PES)	1.40	Fibers, textiles	Cause eye and respiratory-tract irritation and acute skin rashes (Ecology Center, 1996).
Polycarbonate (PC)	1.20-1.22	Compact discs, eyeglasses, riot shields, security windows, traffic lights, lenses, construction materials	Bisphenol-A could be leached from polycarbonate products, which leads to liver function alternation, changes in insulin resistance, reproductive system and brain function (Srivastava and Godara, 2013).
Polycarbonate/acrylonitrile butadiene styrene (PC/ABS)	-	A blend of PC and ABS that creates a stronger plastic. Used in car interior and exterior parts and mobile phone bodies	More exposure leads to lungs disorder to humans
Polystyrene (PS)	1.05	Packaging foam, food containers, plastic tableware, disposable cups, plates, cutlery, CD, cassette boxes, tanks, jugs, building materials (insulation)	Irritate eyes, nose and throat and can cause dizziness and unconsciousness. Migrates into food and stores in body fat. Elevated rates of lymphatic and hematopoietic cancers for workers (Ecology Center, 1996).

Acrylonitrile butadiene styrene (ABS)	1.06-1.08	Electronic equipment cases (e.g., computer monitors, printers, keyboards), drainage pipe, automotive bumper bars	Airborne ultrafine particle (UFP) concentrations maybe generated while printing with ABS, which leads to oxidative stress, inflammatory mediator release, and could induce heart disease, lung disease, and other systemic effects (Card et al.,2008).
High impact polystyrene (HIPS)	1.08	Refrigerator liners, food packaging, vending cups, electronics	-
Polyvinyl chloride (PVC)	1.38	Plumbing pipes and guttering, shower curtains, window frames, flooring, films	Lead to cancer, birth defects, genetic changes, chronic bronchitis, ulcers, skin diseases, deafness, vision failure, indigestion, and liver dysfunction (Ecology Center, 1996).
Polypropylene (PP)	0.85-0.83	Bottle caps, drinking straws, yogurt containers, appliances, car fenders (bumpers), plastic pressure pipe systems, tanks and jugs	Long term effect the mucous membrane in gastro intestine part get affect(Srivastava and Godara, 2013).
Polyamides (PA) (nylons)	1.13-1.35	Fibers, toothbrush bristles, fishing line, under-the-hood car engine moldings, making films for food packaging	Lead to cancer, skin allergies, dizziness, headaches, spine pains and system dysfunction (Ecology Center, 1996)
High-density polyethylene (HDPE)	0.94	Detergent bottles, milk jugs, tubes, pipes, insulation molding	Release estrogenic chemicals resulting in changes in the structure of human cells (Ecology Center, 1996)
Low-density polyethylene (LDPE)	0.91- 0.93	floor tiles, shower curtains, clamshell packaging, films	Mixture of chemical affect the skin diseases to humans

Table 2: plastics that are found in different part at different size

Location	Occurrence	Plastic type	Plastic sizes	Reference
Malta Island	N1000 particles m−2	Micro plastics	1.9 to 5.6 mm	Tuner and Homes 2011
Hong Kong	Average abundance of 5595 items m−2 and maximum 258,408 items m−2	Micro plastic	0.315 to N5 mm	Fok and Cheung 2015
Belgian coast	Average 92.8 particles kg−1 dry sediment	Micro plastics	38 µm to 1 mm	Claessens et al.., 2011
Mumbai, India	Average abundance of 7.49 g and 68.83 items m−2	Micro plastics and macro plastic	b5 mm to 100 mm	jayasiri et al., 2013.
Norderney	Mean 1.76 kg−1 dry sediment	Micro plastics and macro plastic	b1 mm to N2 cm	Dekiff et al.., 2014
Nakdong River Estuary, South Korea	Average abundances of 8205 particles m−2 in May and 27,606 particles m−2 in September	Micro plastics and macro plastic	1 mm to N25 mm	Lee et al.., 2013
Hawaii	Average weight of debris per sample was 23.38 g plastic	Micro plastics and macro plastic	1–2.8 mm (43%), 2.8–4.75 mm (48%), N4.75 mm (9%	Mc Dermid and Mc Mullen 2004
Western coast of Portugal	Average density of 185.1 items m−2	Micro plastics (72%), macro plastic (18%)	50 µm to 20 cm	Martins and Sobral 2011
San Diego, California	2453 individual plastic debris	Micro plastics and macro plastic	b5 mm to 50 mm	Van et al.., 2012
Nakdong River Estuary, South Korea	Average abundances of 8205 particles m−2 in May and 27,606 particles m−2 in September	Micro plastics and macro plastic	1 mm to N25 mm	
Edinburgh coast, UK	Average density of 0.8 items m−2	Micro plastics and macro plastic	38 µm to 2 mm	Velandar and mocogni(1999)
East Frisian Islands, Germany	Maximum 621 particles per 10 g	-	-	Liebezeit and Dubaish 2012
Northeast Brazilian Coast	Average density of 82.1 items /m^2	-	-	Santhos et al.., 2009
North Atlantic Coast	Average density of 0.15–12.5 items m−2	-	-	Barnes and Milner 2005
	Maximum 3	-	-	Ng and Obbard

Singapore	particles kg−1			2006
Tasmania, Australia	Average abundance of 113 items or 1.69 kg of debris per beach	-	-	Slavin et al.., 2012
UK	Maximum 8 particles kg−1	-	-	Tompson et al.., 2004