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MICROPLASTIC POLLUTION FROM PLASTIC DRINKING BOTTLE, FOOD CONTAINER AND TAP WATER: EMERGING HEALTH CONCERN IN CONTEXT OF BANGLADESH

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ABSTRACT

This Concept paper focuses on the importance of evaluating microplsatic contamination in different consumption sources in perspective of Bangladesh. Microplastic pollution is one of the emerging topic of pollution and health concern in Bangladesh alike rest of the world. Bangladesh is a densely populated country where usage of plastic materials is significantly high. Usage of single used plastic drinking bottle, plastic food box and plastic piping materials for water supply are very popular in the country and the most of the time these plastic containers are used by consumers for several months to years to years and even decades for water supply pipes. The long time repeated usage of plastic materials subsequently cause the microplsatic leaching and pose adverse health effects to the consumers. However, a very little effort has been done so far in perspective of Bangladesh to assess the microplsatic generation scenario and its negative consequences which is necessary to encounter this mounting threat effectively.

REASONS OF MICROPLASTIC POLLUTION

Plastic pollution become ubiquitous around the world in modern age. The low cost, durability, easiness in processing, low production cost, light weight and high thermal insulation characteristics made the plastic as an attractive option in bottle and food package manufacturing industry as well as in water supply piping industry (Richard et al., 2009; Anthony, 2015). Annually more than 300 million metric of plastic are produced around the world and almost half of them are single used plastics constituting mainly packaging materials including drinking bottle, straw, stirrer and take-out food pack (NRDC, 2020).

According to associations of plastic manufacturers in Europe, about 20 types of plastic are used worldwide (Plastics Europe, 2008). However, polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), high density polyethylene (HDPE), low density polyethylene (LDPE), polyvinylchloride (PVC), polyurethane (PUR) resins etc. are widely used in manufacturing of plastic bottles, food packaging industry and water supply piping industry.

Different studies revealed that these plastics can leach out in the environment and subsequently turn to microplsatic. (Mason et al., 2018; Du et al., 2020; Tong et al., 2020). 4 factors could be responsible to leach out plastic materials to microplsatic: (i) physichochemical source (thermal degradation), (ii) environmental source (UV induced photo degradation), (iii) mechanical action (mechanical alteration, stress, pressure abrasion) and (iv) biotic factors (biodegradation). The degradation rate of synthetic polymers is accelerated by repeatedly use of plastic materials that are associated with these factors. These fragmented pieces of microplastics can accumulate in human body and their potential health threat is yet to be revealed more precisely (Du et al. 2020).

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Bangladesh is no different from this global scenario. Study revealed that in 2014, national plastic consumption in Bangladesh was 545,300 tons and a significant amount from this portion was used for single used plastic industry like packaging industry. Generation of microplsatic from plastic materials in Bangladesh has become incredibly harmful convenience now threatening environment and human health alike and in more ways than one (Monjur et al., 2017; Khondoker, 2016). A recent report published by the Earth Day Network (2018) ranked Bangladesh 10th out of the top 20 plastic polluting countries in the world (The Daily Star, 5th June, 2018). Single used Plastic bottle, plastic food box and home piping appliance are widely used in Bangladesh for many months to several years that may pose potential health risks for long time consumption (Lancet, 2017).

EFFECTS OF MICROPLASTIC POLLUTION ON HUMAN HEALTH

According to UN report, plastic item does not get decomposed fully rather it is reduced to its size particles like microplsatic. These microplastics uptake by human body with travelling very short distance (Tanvir, 2019). Research revealed that these microplastics can serve as vectors of transport carrying toxic chemicals in ecosystem as well as in human body. Again microplastics themselves are a cocktail of hazardous substances which are often added voluntarily during their production as additives to improve desirable qualities such as increasing polymer properties and prolonging their lives (Campanale et al., 2020). As plastics degrade through processes such as hydrolytic degradation, photo degradation, thermoxidative degradation and biodegradation by microorganisms (Andrady, 2011), it relates a range of reinforcing filler, plasticizers, antioxidants, UV stabilizers, lubricants, dyes and flame retardants impacting all living organisms at a subcellular level (Hahladakis et al., 2018). These microplastics are associated with many harmful and hazardous substances that could lead to countless health issues like dizziness, eye irritation with impaired vision, respiratory problem, liver dysfunction, cancer, skin diseases, headache, birth defect, reproductive health problems, cardiovascular, genotoxic and gastrointestinal issues (Campanale et al., 2020). The impacts of the most common plastic polymers with their source/usage and known health effects are summarized in Table 1

Table 1. Types of plastic, their sources/usage and health effects

Types of Plastic	Sources/Usage	Health Effects	References
Polyethylene (PE)	Garbage bag, coated paper, milk bottle	Increased cytotoxicity at cell level	Schirinzi et al. (2017)
Polyvinyl chloride (PVC)	Water supply pipe, wrap, cooking oil bottle, drinking bottle, food container	Carcinogenic and Corrosive	Til et al. (1991)
Polystyrene (PS)	Disposable cup, take away food box, food container, trays for carrying meat and egg	Affect human bronchial epithelial cell, decrease in subsequent iron absorption	Lehner et al. (2019)
Polyethylene terephthalate (PET)	Soft drinks bottle, food container, drinking water bottle	Formation of reactive oxygen species (ROS), neurological damage (e.g. hearing & visual impairment)	Hansen et al. (2013)
Polypropylene (PP)	Yogurt containers, straws, food wrapping films, butter tubs	Hypersensitive immune response	Hwang et al. (2019)

Besides these, there are also many additives that are frequently used during production of plastic materials. These additives get leached out with microplsatic and also contaminate the drinking water and food quality. One of the most commonly used additives is BPA. BPA uptake can interfere natural body's hormone with the production, secretion, transport, function and elimination (Brian, 2012). Kenij et al. (2002) demonstrated that BPA weaken thyroid hormone and mimic the behavior of estrogen. BPA exposure in adult population also increases the risk of cardiovascular disease, type 2 diabetes, rapid changes in immune system, body weight, anxiety etc. (Brazier & Falck, 2017). Another commonly used additive is phthalates is widely used in food containers and drinking bottle as well as in PVC water supply pipes. Like BPA, phthalates also responsible for the hormonal imbalance into human body. It can also affect child bearing mother, fetus and new born baby too (Joel et al., 2001). It is also responsible for allergies, rhinitis and cause risk in pubertal development (Meeker et al., 2009; Bornehag et al., 2004). Along with BPA and phthalates, other plastic additives commonly used polymers cause the human health problems and ecological imbalance. So people of all ages who are closely contact with those exposures have been affected highly by health problems.

WHAT TO DO?

Though there has not been enough study on the scenario of microplsatic contamination and their fate in drinking bottle, tap water and food container in perspective of Bangladesh, we can remark citing the limited regional studies and numerous global studies that the country is and will continue to be at high risk of microplsatic pollution I necessary actions are not taken immediately. Though the government of Bangladesh ban the production and uses of polythene bag, it does not reduce the production and uses of polythene bag and does not reduce the piling of microplastic pollution at any level. Hence, to deal with this global problem in a sustainable way, the following suggestions are proposed-

- Enhancing the personal and collaborative research between universities and research institutes to assess microplsatic contamination in different environmental compartments, their fates and consequences.
- Increasing research opportunities and funding for searching economically viable alternative to plastic products especially for packaging and single used plastics.

- Reusing the awareness among the end users against microplsatic pollution by concerning them about the detrimental effects of it through advertisement on media and activities by government and non-government agencies.
- Exploiting the country's huge potential for jute production in manufacturing cost effective biodegradable alternatives to plastics and providing incentives for these kinds of business.
- Strict implementation of existing regulatory laws to stop the use of plastic bags and plastic packaging materials.
- Developing national action plan for monitoring and management of plastic and subsequent microplsatic contamination at the point of sources.

CONCLUDING REMARKS

The analysis of tap water, plastic drinks bottle as well as plastic food box samples around the world showed leaching out characteristics of microscopic plastic fragments that should be controlled in scientific ways. More than 14 crore people living in Bangladesh and usage of plastic bottle, food container and PVC pipe for supplying tap water is very popular to them. However, this large amount of plastic consumption may pose great risk of unrevealed health concern than perhaps we know among the significant population percentage of Bangladesh. Therefore, to assess the scale and urgency of this environmental and health threat, it is essential to build up a précised and comparable data set on the abundance and composition of microplastics in tap water, plastic drinks bottle as well as in food box leachates in context of Bangladesh.

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