Chapter 3
Microplastics as Emerging Contaminants:
Occurrence, Toxicology, and Analysis

Bowa O. Kwach
Maseno University, Kenya

Victor Odhiambo Shikuku
Kaimosi Friends University College, Kenya

ABSTRACT

The ever-increasing production of plastics and concomitant poor plastic waste disposal systems explain the recent rising concerns over the occurrence of microplastics in freshwater resources. Microplastics are presently recognized as emerging contaminants owing to the increasing reports on their occurrence in the environment and the associated toxicological effects. This chapter discusses the recent trends in the monitoring of microplastics in freshwater resources, the toxicological effects of microplastics, and the sampling and analysis techniques available for detection and quantification. The challenges in analysis and comparison of various studies and future prospects have also been highlighted.

INTRODUCTION

In 2016, the world production of plastic, mostly used for packaging, exceeded the 320 million tons' mark. This rise in production was accompanied by an unprecedented exponential increase in the occurrence of plastic wastes in different environmental compartments with 5-13 million tons reported to leak into the oceans annually (World Economic Forum, 2016). Inappropriate disposal of plastic wastes accounts for the major fraction of the plastics in both soil and aquatic environments (Jambeck et al., 2015) followed by their breakdown through various mechanisms such as photo-oxidative processes and mechanical forces among others (da Costa et al., 2017). Figure 1 is an illustration of inappropriate disposal of plastic wastes. The aforementioned processes breakdown those larger plastic residues into microplastics (with particles less than 5mm) and nanoplastics (with particles between 1 and 100 nm).

DOI: 10.4018/978-1-7998-1871-7.ch003

The presence of microplastics in the environment is a subject of increasing concern and microplastics are considered as contaminants of emerging concern (CEC). To this effect, microplastic pollution has been recognized as one of the leading environmental issues facing the mankind today (Lambert and Wagner, 2018). Besides compromising the aesthetic value of water, microplastics have been reported to have potential toxicity on biota and humans (Wright et al., 2013; von Moos et al., 2012). Additionally, microplastics present a pathway for introduction of plastic additives and persistent organic pollutants (POPs) into the aquatic environment (Andrady, 2011; Brennecke et al., 2016). Some of the additives are listed in Table 1. The health problems associated with POPs in the food chain are well documented and the details will not be reiterated here (Beckingham and Ghosh, 2017). Therefore, sea-foods from contaminated waters are a potential source of entrance of microplastics and related toxic compounds into the food chain (GESAMP, 2015). As such, the development of analytical tools for detection and quantification of micro and nano-plastics is a crucial step towards efficient monitoring of the environmental fate of these plastics. This chapter summarizes the recent reports and reviews on the occurrence of microplatics in aquatic environments, published data relating to the toxicity of microplastics and the trends in analytical tools for detection and quantification of microplastics are also brought to perspective. The challenges and future opportunities are also highlighted.

Occurrence of Microplastics In the Aquatic Environment

Microplastics are water-insoluble solid polymer particles with dimensions of less than 5mm (Thompson et al., 2009). Those that are less than 1mm in size are informally known as nano-plastics. Though the larger plastics mainly find their way into the environment through inappropriate waste disposal, microplastics on the other hand are primarily generated from fragmentation of the larger plastics. The rate of fragmentation of the larger plastics in the natural environment is, however, unknown and presents an open field of scientific inquiry (Lambert and Wagner, 2018). The paucity of data on the dynamics and fate of microplastics presents a challenge in the assessment of the health risks posed to the aquatic life and man (Wright et al., 2013). Despite these limitations, there has been agitation and attempts to regulate the usage of microplastic for public safety.

Figure 1. Poor plastic waste disposal

Green IT and the Struggle for a Widespread Adoption

Edward T. Chen (2019). *Advanced Methodologies and Technologies in Engineering and Environmental Science (pp. 157-166).*

www.igi-global.com/chapter/green-it-and-the-struggle-for-a-widespread-adoption/211870?camid=4v1a