Chapter 17
Environmental Phthalate Exposure in Relation to Reproduction Outcomes and Health Endpoints

Anjum Afshan
University of Kashmir, India

Md Niamat Ali
https://orcid.org/0000-0002-5128-9284
University of Kashmir, India

Farooz Ahmed Bhat
SKUAST-K, India

ABSTRACT

Environmental pollutants, like xenobiotic substances released as byproducts of anthropogenic actions, naturally lead to pollution of the environment. They negatively affect the environment through unfavorable impacts on growth, development, and reproduction of organisms including humans. One of the outstanding examples of xenobiotics is endocrine disrupting compounds (EDCs) such as phthalate esters (PEs), which have the efficacy to disturb numerous biological systems including the invertebrate, reptilian, avian, aquatic, and also the mammalian systems. Phthalates are family of xenobiotic hazardous compounds amalgamating in plastics to intensify their plasticity, flexibility, longevity, versatility, and durability. Ignoring the rising issue on the hazardous nature of various phthalates and their metabolites, ruthless usage of phthalates as plasticizer in plastics and as additives in innumerable consumer products continues due to their low eminent properties, their cost-effectiveness, and lack of suitable alternatives. Globally epidemiological human studies showed various phthalates and their metabolites ingested passively by man from the general environment, foods, drinks, breathing air, and routine household products cause various dysfunctions. This comprehensive chapter on the hazards of phthalates would benefit the general population, academia, scientists, clinicians, environmentalists, and law or policymakers to decide upon whether usage of phthalates to be continued swiftly without sufficient deceleration or regulated by law or to be phased out from earth forever.

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INTRODUCTION

The word plastic is derived from plasticos (Greek), which means capable of sculping into different shapes. With swift advancement in technology and the geometric progression of the global population growth, plastic materials have found resourceful applications in every aspect of modern human life. A number of substances are blended in plastics at various proportions to improve their performance and reduce cost (Tokiwa et al., 2009). Phthalates are one of such organic compounds used as plasticizers. Phthalate esters (PAEs), one derivative of phthalic acid (PA), are aromatic colorless liquids with high-molecular weight, high stability, low-volatility and low-solubility in water (Chang et al., 2004; Chao et al., 2006). Phthalates are family of xenobiotic hazardous compounds amalgamating in plastics to intensify their plasticity, flexibility, longevity, versatility and durability.

Besides they are also used as lubricants, solvents, additives, softeners etc. They are present in number of day to day used products such as PVC products, building materials (paint, adhesive, wall covering), personal-care products (perfume, eye shadow, moisturizer, nail polish, deodorizer, liquid soap, and hair spray), medical devices, detergents and surfactants, packaging, children's toys, printing inks coatings, pharmaceuticals and food products, textiles, household applications such as shower curtains, floor tiles, food containers and wrappers, cleaning materials. Phthalates are bound to polymer matrix physically and hence released easily to surrounding environment directly or indirectly during manufacture, use and disposal (Cadogan et al., 1993). Phthalates are ubiquitous in environment found in atmospheric aerosols (Xie et al., 2007; Fu et al., 2009), sludge from sewage and treated waste water (Dargnat et al., 2009), River and marine waters/sediments (Xie et al.,2007; Net et al.,2014), drinking water (Gao et al., 2014). Direct release of phthalates to the atmosphere is considered to be the main mode of their entry to the environment (Staples et al., 1997; Wang et al., 2014). Once entering the environment, they pose remarkable toxicological threats to the myriad of non target organisms, discover its way to the food chain, and threaten ecological balance and biodiversity of nature.

In 1856 Caster oil was used as first plasticizer in making cellulose nitrate. Later Camphor replaced it in 1870. To combat the problem related to odorous nature of volatile Camphor, phthalates were introduced as an alternative in 1920s. Use of phthalates in industries began worldwide in 1930s. Presently the overall yearly global use of PAEs is estimated at over 30 million tons with the yearly consumption of Europealone is about 1million ton (Net et al., 2015).The production of phthalates increased from 1.8 million tons in 1975 (Peijnenburg & Struijs,2006) to more the 8 million tons in 2011 (Schreiber et al., 2011). Phthalates are extensively explored as hazardous organic pollutants and their presence in the environment can be of great threat to human beings and wildlife. Few of phthalates are suspected to be hepato-toxins, mutagens and carcinogens. As environmental adulterates, phthalates influence reproduction, harm development and induce genetic impairments in humans even at low doses, so ensuing in an increasing environmental concerns (Heudorf et al., 2007). Some phthalates have endocrine disruptive activity and their environmental behaviour has drawn significant attention because of their possible impact on ecosystem functioning in general and public health in particular. The most notable unfavorable impacts of phthalates are seen in fetal development and reproductive anomalies, especially the so-called "phthalate syndrome" (Sharpe & Skakkebaek, 2008; Le Moal et al., 2015), coupled with insulin resistance and obesity (Swan, 2008; Halden, 2010; Latini et al., 2010; Casals-Casas & Desvergne, 2011; Kuo et al., 2013; Kim & Park,2014). Thus, it is appropriate time to look into unpropitious health impacts of phthalates on humans.