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The Risk of using Plastic Packaging's in Food Industry Referring to Phthalate Hazards

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The most common plastics used for packaging of food and beverages are thermoplastics. Thermoplastics are polymers of plastic materials capable to melt with some technological enhancers, and then re-solidified without degradation. The polymers of polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS) and polyethylene (PE) are the most common polymers used to manufacturer food packaging plastics. To select the appropriate materials for each food category, certain industrial and technical properties should be considered. The water vapor transmission rate is of prime importance, especially when such plastic products intended to be used in bottled water and/or other beverages. As well, the strength of the package seal, the hardness of the bottle after a period of time, bottle transparency and other desired optical properties, gas and moisture transmission rates, all these parameters should be considered. To meet the desired technical and industrial properties, plasticizers were added to the raw materials at different percentages could reach up to 60% (w/w). Phthalate plasticizers (PAE's) are benzene di-carboxylic acid esters with different degrees of toxicity. Phthalate plasticizers are degraded slowly by the hydrolysis process of an ester bond to corresponding mono-ester followed by hydroxylation of the alkyl moiety and finally mineralization. Unfortunately, phthalate congeners are easily migrating from the packaging material and containers to the inner and surrounded media of food, beverage, water and environment. Thus, phthalate congeners could enter and reach the environment either during production and manufacturing (minor pathway) or by leaching, migration and volatilization (major pathway) during use and after disposal of plastic products. The wide usage of plastic products in food and beverage industries leads to suggest the high risk of exposure to phthalate hazards. Considering the recent report of European Union (2007) which exhibited that the annual production of phthalate plasticizers exceed 6 million tons. Moreover, phthalate plasticizers are used in large such as enteric coating of pharmaceutical pills, lubricants, electronics, building materials, furniture, personal care, care, children toys, waxes, paints and textile. This widespread use of phthalates leads to give more attention to such hazards and taking enough care when the process of risk assessment of phthalate hazards would.

Regarding exposure and the risk of phthalate hazards, the collaborative study published in 2013 referred to the routes and levels of exposure to phthalate hazards in different countries including Sweden, Bulgaria and USA. The study showed that children were exposed more to PAE's not only from food ingestion but also by inhalation and skin contact due to their mouthing habits and regular contacting with body personal care products "Sweden study, 2012" [1]. Most people in USA have metabolites of multiple mono-ester phthalate(s) in their urine samples "CDC, 2005" [2]. In Bulgarian study 2008 [1], higher dust concentrations of phthalates were found in homes of children suffering from asthma and allergies. It's logic to state that children, infants and hospitalized patients are particularly more exposed to phthalate hazards because medical devices and tubing contains up to 60% phthalate (w/w), which easily leach out and release when using warm saline or blood [1]. It is worthy to mention that the name "phthalate" was derived from phthalic acid which is consequently derived from the word "naphthalene". Recently, about 24 congener of phthalates were available in industry. Phthalate congeners are di-esters of phthalic "di-carboxylic" acid, varied in their properties and toxic effects due to their molecular weights and the length of chain of the radicals representing the R, R' of each ester. On industrial scale, small changes in the length of R, R' chains produce significant changes in the level of plasticization "ECPI, 2003" [3]. As well as, the behavior and distribution of phthalate(s) in the products and/or in the environment characterized by the same criteria of the length of C-chain of both R and R'. The better solubility of short chain alkyl phthalates such di-methyl and di-ethyl phthalates leads to higher toxic effects, while the compounds with higher molecular weight and low solubility are absorbed to soil and the suspending particulate matter in water. However, as phthalate hazards are only physically bound to polymers, they are easily able to migrate and release to the surrounded media and environment. Although, phthalate hazards could threaten human body through the 3 known routes of exposure "ingestion, inhalation and dermal contact", diet is still believed to such as milk, milk products, meats and oils assumed to be at higher risk of contamination due to the lipophilic properties of most of phthalates. During the period 2007-2012 the competent authorities in the European Union members stated that only 12 countries had the interest to inspect food for the hazards of phthalates [1]. A collaborative data obtained from the 12 participated countries showed that each country applied different methods of analysis to determine phthalate residues in food. So, the obtained results were not orthogonal and revealed wide range of variance due to the different degrees of uncertainty of measurement.

In Egypt, the National Research Centre initiated a research project starting 2013 and extended up to 2016 to develop a reliable and validated method using GC-MS to search for and detect the most common phthalate congeners involved in the manufacturing of plastic bottles and other plastic packaging or containers used in food industry. The study aims to determine phthalate residues qualitatively and quantitatively in different kinds of food including; bottled natural water, milk and dairy products and several kinds of edible oils [4]. The variables of phthalate congeners, bottle or container size, temperature of keeping and storage, the time length "shelf-life". Data revealed that the congeners of di-ethylhexyl phthalate (DEHP) and di-n-octyl phthalate (DnOP) were proved to be the dominated phthalate hazards contaminating food and natural water. Bottled natural water remain phthalate(s)-free up to 3 months of storage at room temperature, while the observed traces were obtained after 6 months of storage [5]. In brief, data obtained from analyzed samples and/or food showed that the levels of phthalate(s) contamination were significantly affected by the variables of the hardness of the packaging plastics, temperature, time, the length of the storage period and the nature of food. Statistically, the number of positive phthalate(s)-contaminated samples was not significant in bottled water, pasteurized milk, fermented milk and cheese. Also, the determined concentrations of phthalates were less than the recommended tolerable limits. As conclusion, the problem of employing phthalate plasticizers in the industry of packaging materials used to keep and handle foods and beverages and to avoid the current consequences of releasing phthalate hazards into edible food and drinking water, such problem needs combined efforts between scientific community, industry and statutory regulation authorities. As well, the new trend to innovate and produce non-phthalate plasticizers should get the appropriate attention and support.

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