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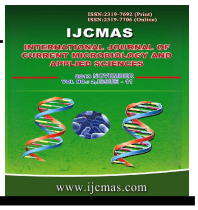

Review Article

Harmful Health Effects of Some Common Organic Compounds Used in Daily Life as Households

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A B S T R A C T

The present paper deals with the study of some commonly used compounds in daily life for various purposes. These compounds have become essential for life activities. Without the use of these compounds the day to day activities of human life cannot be performed. However these compounds have very adverse effect on human health. Some of these compounds are Bisphenol A, phthalates, perfluorinated compounds (PFC), LPG, volatile organic compounds (VOC), mothballs etc. The present study includes the composition, occurrence, route of entry, mode of action and harmful health effects of these compounds.

Keywords

Bisphenol A; phthalates; perfluorinated compounds; plastic.

Introduction

The scientific community and the public have become aware of and concerned about the presence of toxic substances in their working and living environments and about the health impact of these substances. There is increasing demand to evaluate the potential health risk of these substances under the conditions in which they are used. Most of these compounds are synthetic and have been made for useful purpose; however their prolonged use has become harmful. Now there is a need for their complete replacement or at least some modifications are essential in their structures or compositions so that their harmful effects may be minimized. When it is not possible to work without these substances as in case of LPG then sufficient preventive measures are required during their use.

Substances Considered For Their Harmful Effects

These compounds include Bisphenol A, phthalates, perfluorinated compounds (PFCs), LPG, volatile organic compounds (VOCs) and mothballs.

Bisphenol A (BPA)

Occurrence

It is used to make plastics (Bisphenol A Global Industry Group, 2002). It is a key monomer of epoxy resins (Replogle, 2009;

Ridding life of Bisphenol A a challenge, 2008) and most of the co-Polycarbonate plastic. The plastic materials manufactured from them are used to make a variety of products such as baby bottles, water bottles, sports equipment, medical devices, dental devices, dental fillings, CDs, DVDs, household electronics, eyeglass lenses etc. BPA is also used as an antioxidant in some plasticizers, and as an inhibitor in polymerization of PVC. Epoxy resins made from Bisphenol A are used as inner coatings of almost all food and beverage cans (Erickson, 2008). At least 3.6 million tones of BPA are used by manufacturers every year (Studies Report More Harmful Effects From BPA, 2009).

Harmful Effects

Bisphenol A is a weak endocrine disruptor. It can mimic's estrogenic activity. It results in attention deficits, hyperactivity, and increased sensitivity to drugs of abuse (Poimenova et al., 2010). It has adverse effects on thyroid hormone action (Zoeller , 2007). It may increase cancer risk (Kashiwagi et al., 2009). Studies on workers in Chinese BPA factories have shown that they were four times more likely to report erectile dysfunction, reduced sexual desire and overall dissatisfaction with their sex life than other workers with no BPA exposure (Tamara et al., 2010).Even they have ejaculation problems.

Phthalates
Occurrence

They are used in a variety of substances such as enteric coatings of pharmaceutical pills, nutritional supplements, viscosity control agents, gelling agents, stabilizers, dispersants, lubricants, binders, emulsifying agents, etc. Other uses include adhesives, glues, building materials, medical devices, detergents, packaging, children's toys, modeling clay, waxes, paints, printing inks, food products and textiles.

They are also used in soft plastic fishing lures, paint pigments and sex toys made of so-called "jelly rubber". In household they are used as shower curtains, vinyl upholstery, floor tiles, food containers, wrappers and cleaning materials. In Personal-care products of daily use phthalates are present in perfume, eye shadow, moisturizer, nail polish, liquid soap and hair spray (Rudel and Perovich, (2008). They are also used in manufacturing of modern electronics and medical applications such as catheters and blood transfusion devices. The commonly used phthalates are di (2-ethylhexyl) phthalate (DEHP), diisodecyl phthalate (DIDP), diisononyl phthalate (DINP) and benzylbutylphthalate (BBP). Phthalates with small R (CH_3, C_2H_5 etc.) groups are used as solvents in perfumes and pesticides.

Harmful Effects

When phthalates and plastic are mixed no covalent bond is formed, therefore phthalates are released readily in air. Their release is more when the plastic become old or it breaks down. The outdoor air concentrations of phthalates are more in urban areas than in rural and remote areas. [(10)] The exposure of phthalate can be through direct use or by indirect means through leaching or environmental contamination. The diet is believed to be the main source of DEHP and other phthalates from food. They are also inhaled by breathing and through the skin, the more volatile phthalates (Ursel et al., 2007) being inhaled more readily.

The effects of phthalates exposure are mainly concentrated on children and men's health, (Lopez-Carillo et al., 2010) however, due to increased cosmetic use by women, they may be at higher risk. Much of the current research on effects of phthalate exposure include personal care products (Waring and Harris, 2011). The *in vivo* and observational studies by Davis *et al.* (1994) and Lopez-Carillo *et al.*, (2010), has shown relation between phthalate exposure and endocrine disruption which leads to development of breast cancer. As endocrine disruptor they can have additive effects, thus their very small amounts can interact with other harmful chemicals to have cumulative, adverse "cocktail effects" ((Waring and Harris, 2011).

The prenatal phthalate exposure in infants is related to low birth weights which is the main cause of death in children under 5 years of age and increased risk of cardiovascular and metabolic disease in adulthood (Yunhui et al., 2009).

It has been found that phthalates were associated with disrupted insulin production. Thus people with higher phthalate levels had roughly twice the risk of developing diabetes as compared with those having lower level of phthalates

Liquefied Petroleum Gas (LPG)

Occurrence: It is used as fuel in houses, bakeries, shops, industries, factories, automobiles etc.

Harmful Effects

combustion products of LPG are H_2O and CO_2 which have little adverse effect as it causes you to breathe a little faster. When there is insufficient supply of O_2 as in a closed room or a kitchen the problem arises. If the oxygen supply falls below a certain level, the propane will burn with yellow instead of blue flame and carbon monoxide (CO) is produced which is highly toxic to humans. It binds to hemoglobin with 200 times more affinity than oxygen, thereby starving the brain of oxygen. As the hemoglobin gets polluted with CO the affected person feels sleepy and ultimately dies. Now a days the LPG is used in geysers in bathrooms where again the supply of oxygen is less and incomplete combustion produce CO which proves fatal to a person in bathroom. To avoid this situation there should be adequate ventilation. Moreover the addition of ethyl mercaptan to check leakage in LPG has been enlisted as a hazardous and toxic chemical under the chemical accidents rules of 1996.

Volatile organic compounds (VOCs)

Occurrence

These are the organic compounds which evaporate easily at ordinary temperature and pressure. They are present in paints, varnishes, waxes, coatings etc. They are used as solvents in many household chemicals.They include mainly chlorofluorocarbons, benzene, methylene chloride, perchloroethylene chloride. All these substances are volatile therefore they cause air pollution.

Health effects

They cause irritation in eye, nose and throat, loss of coordination, damage to liver, kidney and central nervous system. The symptoms include conjunctival irritation, nose and throat discomfort, headache, allergic skin reaction, fatigue, dizziness. As people spend most of their time at home or in offices the exposure to

VOCs can contribute to sick building syndrome (Wang et al., 2007). The new furnishings, wall coverings, the photocopy machines etc. in offices can contribute VOCs into the air (Yu and Crump, 1998). In infants or children the man made VOCs and other indoor or outdoor air pollutants (Mendell, 2007) can cause respiratory problems, allergy and immune effects. Some of these compounds are suspected of causing, or are known to cause, cancer in humans (Wolkoff et al., 2006).

Perfluorinated compounds (PFCs)

Occurrence

They are organofluorine compound in which all hydrogen atoms are replaced by fluorine atoms on a carbon chain and the molecule also contains at least one different atom or functional group. They have properties similar to fluorocarbons (a wholly carbon and fluorine containing compound) as they are fluorocarbon derivatives. They are widely used in diverse applications. PFCs persist in the environment as important organic pollutants because they are not known to degrade by any natural processes due to large strength of the carbon–fluorine bond (Lee, Jennifer (2003).

There are many PFCs, but the two most important studied (Guo et al., 2009) compounds are:

PFOA or perfluorooctanoic acid, used to make fluoropolymers such as Teflon, among other applications.
PFOS or perfluorooctanesulfonic acid, used in the semiconductor industry.

Harmful effects

The studies on consumers have been published noting multiple associations. Blood serum levels of PFOA were associated with an increased time to pregnancy or "infertility." (Fei et al., 2009). PFOA exposure has been shown associated with decreased semen quality, (Joensen et al., 2009) increased amount of serum alanine aminotransferase and increased occurrence of thyroid disease. Along with other related compounds, PFOA exposure was associated with an increased risk of attention deficit hyperactivity disorder (ADHD) in a study of US children aged 12–15 (Hoffman et al., 2010). PFOS levels in pregnant women have been associated with preeclampsia (Stein et al., 2009). Levels have also been associated with altered thyroid hormone values (Dallaire et al., 2009) and an increased risk of high cholesterol (Nelson et al., 2009).

Moth Balls

Occurrence

Earlier mothballs consisted of naphthalene which is highly inflammable. These days' modern mothballs consist of 1, 4-dichlorobenzene (p-dichlorobenzene, or PDB). Both of these ingredients have a strong, pungent, sickly-sweet odour. These two should not be mixed, as they react chemically to produce a liquid which may cause damage to items being preserved (Collecting and Preserving Insects and Mites: Tools and Techniques, 2011).

Both naphthalene and 1, 4-dichlorobenzene undergoes sublimation readily. The gas thus produced is toxic to moths and moth larvae.

For either of these insecticidal chemicals to be effective, they are placed with the clothing in a sealed container so that the vapours can build up and kill the moths. In

a sealed atmosphere, these vapours are not as harmful to people. The main exposures would occur on filling or opening the containers, or from wearing clothes immediately after opening. The exposures are more harmful for infants. A possible solution is to open the containers outside and let the clothes hang and air out for a day before wearing, though this practice will also expose the clothes to any moths that may be flying about, risking re-infestation.

In addition to repelling or killing insects such as moths and silverfish, mothballs have been used as a stovepipe cleaner, snake repellent, and to keep away mice or other pests (Frank, 2000).

Harmful effects

The main concern about the use of the mothballs is used as a snake, mouse, or animal repellent or as poison. However their easy access to children, pets, and beneficial animals is fatal. Leaving them in a living space unprotected makes it very easy for unintended victims such as children and pets to gain access to them. Mothballs are highly toxic when ingested and can cause serious illness or death. In addition to this, using a very large quantity of mothballs in a basement or a living space may cause serious respiratory problems in people living in the space (Health Effects of Mothballs, 2013).

Mothballs have been promoted as a squirrel repellent, and are an ingredient in some commercial repellent products. They are generally ineffective, and are no substitute for physical measures to exclude squirrels from building interiors (Mothballs (Naphthalene and Para dichlorobenzene, 2013).

Mothballs are a neurotoxin especially those made of para-dichlorobenzene and need to be treated as such. They have also been found to be carcinogenic (Guide to Safe Removal, 2012).

Also they have been used for solvent abuse by adolescents, causing a variety of neurotoxic effect (Problem Wildlife in the House, 2013). Older-formula mothballs have also been used by drag racers to enhance the octane value of petrol by dissolving the mothballs in some of the fuel and filtering out the remains with a filter paper.

Route of Entry

Most of these compounds are volatile, therefore the route of entry is mainly inhalation. However some of them may be absorbed by skin. Some of these compounds enter the body along with the packing material, food articles or the man made material such as polymer which we use in our daily life.

Mode of Action

The mode of action depends upon the concentration of the chemical, exposure time, type of victims etc. Most of these chemicals are described as endocrine disruptor, e. g. BPA and phthalates. The highest estimated daily intake of BPA is assumed to be for infants and children, via their food where it has been in contact with polycarbonate baby bottles and baby food cans lined with epoxy resins. The main concern is neurodevelopmental toxicity, based upon the concept that the developing brain of a human foetus or infants is more susceptible to injury from toxic agents than that of an adult. It is suggested that metabolic disorders and carcinogenicity are other biological effects that might be related to BPA exposure.

The incomplete combustion of LPG in limited supply of O_2 produces CO which pollutes hemoglobin thereby causing fatal environment for the victim. The VOC being highly volatile enter the body mainly through inhalation and attack the respiratory as well as the nervous system.

The studies on perfluorinated compounds such as PFOS and PFOA have shown that these compounds are distributed mainly to the serum, kidney, and liver, with liver concentrations being several times higher than serum concentrations; the distribution is mainly extracellular. Both compounds have a high affinity for binding to B-lipoproteins, albumin, and liver fatty acid binding protein. The presence of PFOS, PFOA and several other PFCs has been reported in umbilical cord blood indicating these chemicals cross the placenta.

The mode of action of moth balls (p-dichlorobenzene) on non-target organisms is not precisely known, but may involve the binding of its oxidative metabolites such as the epoxide to proteins within the cells of mammals. The endocrine-disrupting potential of p-dichlorobenzene has been evaluated by the researchers.

Preventive Measures

Prevention from the harmful effects of these substances includes implementation of engineering control, general room ventilation, local exhaust ventilation, reduced usage, alternate arrangement, replacement by non or less-toxic materials, out of reach of unintended victims etc. When local exhaust ventilation is not available or feasible, personal respiratory protection should be used.

The reduced use includes the applications of natural personal-care substances, minimal exposure span etc. The alternate arrangement means the use of traditional packaging materials, natural finishing methods etc. The above mentioned substances can be replaced by non or less-toxic. For example, camphor, an insect repellent, can also be used as a less-toxic ingredient in mothballs.

Similarly Mehandi can be used for colouring hairs instead of synthetic agents. These chemicals should be kept out of reach of children or illiterate people which are unintended victims. If effects of any of these chemical is observed medical and environmental surveillance measures should be undertaken.

Every year large number of people suffers from various diseases caused by health hazardous chemicals. All chemical substances are toxic at some concentration. A concentration exists for substances from which no injurious effect will result, no matter how often the exposure is repeated. This concentration is known as threshold limit value (TLV). In other words, TLV is a time related average concentration of hazardous agent in atmosphere. Each chemical have a threshold limit value e.g. TLV for moth balls is 10 ppm, for LPG it is 1000 ppm per day.

To minimize their effect thorough study of the causes and preventive measures are necessary. Knowledge of the diseases by the medical practitioners helps them to minimize the use and abuse of the chemicals. This also helps in recommending various preventive measures to the affected persons. A proper history from the patients also helps to avoid unwanted use and unwarranted exposure for the unintended victims.

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References

Bisphenol A Global Industry Group (2002). Bisphenol A Information Sheet.Collecting and Preserving Insects and Mites: Tools and Techniques.2011. United States Department of Agriculture - Agricultural Research Service.

Dallaire, R., Dewailly E, Pereg D, Dery S and Ayotte, P.2009. *Environ. Health Perspect.* 117 (9):1329-76.

Erickson, B. E., 2008. Chemical and Engineering News, 86(22):36–39

Fei, C., McLaughlin JK, Lipworth L and Olsen, J.2009. *Hum. Repro*

Frank, W., Cawood and Associates .2000. p. 126. ISBN 1890957399.

Guide to Safe Removal, 2012. *Squirrels in the Attic*.

Guo, Z., Liu X and Krebs, K.A. 2009. United States Environmental Protection Agency 1.

Health Effects of Mothballs, 2013. *National Pesticide Information Center*.

Hoffman, K., Webster TF, Weisskopf MG, Weinberg J, and Vieira, V.M. 2010. *Environ. Health Perspect.* 118 (12): 1762–7.

Joensen, U.N., Bossi R, Leffers H, Jensen AA, Skakkebaek NE and Jørgensen N. 2009. *Environ. Health Perspect.* 117 (6): 923–7.

Kashiwagi, K., Furuno N, Kitamura S, Ohta S, Sugihara K, Utsumi K, Hanada H, Taniguchi K,and Suzuki, K.I. 2009. *J. Health Sci*.55 (2):147-160.

Lee, Jennifer . 2003. *The New York Times*.

Lopez-Carillo, L., Hernandez-Ramirez RU et.al. 2010. Environmental Health Perspectives, 118 (4): 539-544.

Mendell, M. J ., 2007. Inter. J. Indoor Environ. Health. 17(4): 259-277.

Mothballs (Naphthalene and Para dichlorobenzene)". 2013. *National Pesticide Information Center*.

Nelson, J.W., Hatch EE, and Webster, T.F. 2009. *Environ. Health Perspect.* 118 (2): 197– 202.

Poimenova, A., Markaki, E, Rahiotis, C, and Kitraki, E.2010. *Neurosci.*167 (3): 741–749.

Problem Wildlife in the House, 2013. *National Pesticide Information Center*.

Replogle, J., 2009 California Progress Report. Lawmakers to press for BPA regulation.

Ridding life of Bisphenol A a challenge. 2008. *Toronto Star*.

Rudel, R.A., and Perovich, L.J. 2008. *Atmos. Environ.* 43 (1): 170–81

Steenland, K., Tinker S, Frisbee S, Ducatman A, and Vaccarino, V.2009. *Am. J. Epidemiol.* 170 (10): 1268–78.

Stein, C.R., Savitz DA, and Dougan, M . 2009. *Am. J. Epidemiol.* 170 (7): 837–46.

Studies Report More Harmful Effects From BPA (2009). *U.S. News & World Report*.

Tamara, G., Riccardo C, Jack G, Luigi F, Stefania B, Anna M C, Cathryn M, Paul M, and David, M. 2010. Environ Health Perspect.118(11): 1603– 1608.

Ursel, H., Volker M-S and Jurgen, A. 2007. *Int J Hyg Environ Health* .210 (5): 623–34.

Wang, S., Ang H. M. and Tade, M. O. 2007. Environment Inter. 33(5): 694-705.

Waring, R.H., and Harris, R.M. 2011. The European Menopause J. 68(2): 111-115.

Wolkoff, P., Wilkins C K, Clausen P A, and Nielsen, G. D. 2006. Inter. J.Indoor Environ. Health. 16(1): 7-19.

Yu, C., and Crump, D. 1998. Building . Environ. 33(6): 357-374.

Yunhui, Z. , Ling L, et.el 2009. The J.Pediatric.55 (4):500-504.

Zoeller, R. T., 2007. Official journal of the American Thyroid Association 17 (9): 811–817.