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THE PARADOX OF MALATHION USED FOR HUMAN LIFE

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Abstract

Malathion is an organophosphorus insecticide and has been used in public health and agriculture since World War II (1945). It has been intensively treated on crops against warehouse and storehouse pests and other many organisms over years. But the risk of its usage could not be determined completely for ecosystem and human health. Many studies have shown that the potential carcinogenicity potential of malathion and similar compounds because of the direct usage in agricultural products and it also had indirectly contamination (water, soil and air pollution) while and after malathion application in the agriculture and public health issues. In this review, the directly effect of malathion on some experimental animals is studied how malathion negatively affected body weight, cerebral alterations and reproductive system on rats. Furthermore, the pesticide had alteration of protein, fat and energy metabolisms, and oxidative balance. There are many results about indirect effects of malathion on human life and pesticide residues on animal products (honey, milk and meat) from livestock, bees, fishes and poultry. Besides, malathion has been observed in many vegetables such as onions, cucumbers, tomatoes and peppers. Consequently, we recommend that direct and indirect malathion effects on human life should be investigated practically more in the near future.

Key words: *malathion, side effect of malathion, pesticide residues.*

INTRODUCTION

Pesticides are the chemicals that are used for the controlling of the reproduction of unwanted organisms such as insects, weeds, fungi and rodents in agriculture as well as in public health (Bhanti and Taneja, 2007; Kumari et al., 2012). The American continent takes the first place over the World (about 153 thousand tons active ingredients) with the highest pesticide use (FAO, 2013). European Union's pesticide use (approximately 26 thousand tons active ingredient) has been one sixth according to the Americans (FAO, 2013). Pesticides are used in many different applications such as stored commodities, empty storage facilities, home and garden, the golf courses, ornamental nursery stock and turf, Christmas tree plantations, parks, cemeteries, garbage areas, irrigation systems, intermittently flooded areas, sewage systems, pastures, and rangeland (Ergonen et al., 2005).

Malathion, one of the important pesticides is an organophosphorus insecticide used in public health and agricultural areas (Sweeney and Lyon, 1999; Brocardo et al., 2007) as early as 1950. Products containing malathion may be in liquids, dusts, wettable powders, or emulsion forms (Blasiak et al., 1999). Over 100 food crops can be treated with malathion which are grains of cereals, fibre crops, oil crops and thus forage crops are disinfected with the insecticide. Besides, malathion may also be found in some personal things like body, hands, facial or hair shampoos. Two main impurities found in technical malathion include isomalathion and malaoxon (Bavcon-Kralj et al., 2007; Gervais et al., 2009) which has substantially more toxic in the organic metabolism (Edwards, 2006).

Environmental contamination

Because of being used outdoors to control a wide variety of insects in agricultural settings and around people's homes, malathion can

cause serious contamination to the soil, water and atmosphere; hence, it should be seen as a threat to plants, animals and humans (Cheng et al., 2015; Clemens, 2006; Singer et al., 2007). It has also been accepted by the United States Food and Drug Administration (FDA) to be added into shampoos for controlling the head lice (Anonymous, 2006). Malathion is released into the environment by using in management of agricultural pests. It can be transported by rainfall, precipitation or wind. It can soak into the soil and pass into water supplies or enter the air and can also spread to other areas where no pesticides are used (Turgut et al., 2011). Malathion can be degraded in soil within a few weeks by hydrolysis, photolysis or biodegradation by microorganisms. It has been reported that half-life of malathion in soil is approximately 18 days (Bradman et al., 1990; Getenga et al., 2000). However, low concentration of malathion was observed in water (Larromendy and Soloneski., 2015; Leilanie and Lu., 2015). Hydrolisis and bacteria in water can break down the malathion in water. The half-life of malathion in water was observed until 1.65 days at pH 8 and 17.4 days at pH 6 (Wang, 1991). In air, malathion reacts with other chemicals and can break down to malaoxon by sunlight. On Sierra Nevada Mountains, low malathion concentrations were observed in air (< 1 $ng.m^{3-1}$) and 64 to 83 $ng.L^{-1}$ in surface water (Larromendy and Soloneski, 2015). Published data indicate that Malathion exceeded the acceptable maximum residue limit in soil of Sta. Maria, Pangasinan and it was reported that farmers had been using malathion for 25 years at about 16.5 ml. application $equivalent^{-1}$ to 0.4 lt years of exposure (Leilanie and Lu, 2015). In one experiment, malathion residues in the soil was observed to be higher at a depth of 21-30 cm while the lowest concentrations were observed at a depth of 0-10 cm (Mahmud et al., 2015).

Residues in food

Environmental pollutants such as pesticides are widespread used chemicals in agriculture for different purposes in the world (Voigt et al., 2014). The intensive usage of pesticide causes residues on food such as fruits and vegetables. In one experiment grapes were collected from different vineyards in three different Aegean regions and 27 pesticide residues were analyzed in the investigation. As a result, some pesticide residues were frequently observed. According to the results, it was mentioned that preharvest intervals should be discussed (Turgut et al., 2011). On the other hand, because of the intensive usage of pesticides, some chemicals play an important role in our environment and daily life, they could be carcinogenic in laboratory animals and they could be implicated to lung, breast and colon cancers. In one experiment, some human milk samples were collected from Mersin province, organochlorine and polycyclic hydrocarbons were detected in human breast milk (Çok et al., 2012). Malathion was observed in milk samples (Bedi et al., 2015; Shaker and Elsharrkawy, 2014). U.S. EPA presented the MRL (maximum residue limit) of Malathion as 8 parts per million (ppm) (Larromendy and Soloneski, 2015). According to the experiment, goats were fed with 86 ppm malathion and chickens with 28 ppm malathion for 4 days. Parent chemicals weren't found in any tissues except goat kidney. Because of the rapid metabolization, oral ingestion of goats and chickens wasn't found dangerous. Ingested malathion was converted to acetate or acids and in the end components were incorporated to the carbon pool (Cannon et al., 1996). The estimated daily intakes of these chemicals could possess health problems. Royal jelly and honey, the most important bee products, were contaminated by malathion (Karazafiris et al., 2008; Bezerra et al., 2010) For example, the OPs concentrations in fresh vegetables from China were examined. The results showed that 23.4% of samples contained OPs above maximum residue limit and %12.1 of samples contained malathion (Yu et al., 2016). Due to the bioaccumulation of malathion in lipophilic tissues, for example, in liver, pesticide residues can be found in this organ. The study about fish liver confirmed this claim (Caldas et al., 2013).

Side effect of malathion on some experimental animals

Malathion kills insects by preventing nervous system from working fairly (De Silva et al., 2006). When healthy nerves send signals to each other, a special chemical messenger travels from one nerve to another to continue

the message. The nerve signal stops when an enzyme is released into the space between the nerves. Malathion binds to the enzyme and prevents the nerve signal from stopping. This causes the nerves to signal each other without stopping. The constant nerve signals make it so that the insects can't move or breathe normally and they die.

Exposure to pesticides (direct effects) has been associated with many hazardous effects, including: acute and chronic toxicosis (Yarsan et al, 1999; Dahamna et al., 2004; Bonner et al., 2007). Therefore, due to extensive and unconscious usage, malathion may have some undesirable effects (side effects) on other plants, poultry, fishes and mammals during its application to limited insecticides population (Garg et al., 2004; Gwinn et al., 2005; Mahmoud et al., 2012). The researchers discovered that mitodepressive action on mitosis mitotic abnormalities increased and the mitotic index decreased depending on the concentration and duration time of the pesticide applied on plants (Amer and Mohamed 2002; Gharib, 2006; Pandey, 2008; Sibhghatulla et al., 2012). Furthermore, some abnormalities on chromosome stickness and contraction, scattered chromosome, lagging chromosome on plants were observed (Asita and Makhalemele, 2013; Adam et al., 2014) and inducing chromosomal aberration or DNA damage in cells of fungicides and different organisms with malathion treatment (Asya et al., 2012; Mahfouz et al., 2013; Karabag-Coban et al., 2015). It is considered that the pesticide may have genotoxic effects in human beings (Eryigit, 2002; Pandey, 2008).

Toxic chemicals in fish received considerable stimulus when it was shown that it could affect human health when fishes containing this toxicity were consumed (Martinez-Tabche et al., 2002). Malathion treatment was shown acute toxicity on Poecilia reticulate (lepistes fish) (Bakal, 2010) and it was investigated that it would cause the unpaired swimming and unbalanced movements, loss of equilibrium and to fall to the bottom and respiration problems (Surucu, 2000). And some hormones such as cortisol, estradiol and testosterone, lipid peroxidation and glutathione levels decreased on Cyprinus carpio (carp fish) with malathion toxicity (Ozturk, 2009). Furthermore, the activity of acetylcholinesterase and the levels of glutathione decreased at malathion exposures (Oren, 2009) and the malathion caused neurotoxicity and oxidative stress-mediated endocrine disruption effect (John et al., 2001; Fortunato et al., 2006) in Oreochromis niloticus (The Nile tilapia) and salmon (Oren, 2009; Wang et al., 2015).

Other experiments were observed that there were malathion side effects (direct effects) on rats. Their body and kidney weights decreased with malathion treatment (Uzun, 2007) while their liver weight increased and pathological changes in liver were detected (Karaduman, 1998). Moreover, it was observed in the experiments that less thyroid activity were measured than the control groups (Uzun, 2007). The histopatological investigations were also found out to have several damages. The damages to fatty degeneration, hyperemia in sinusoid in liver and fatty degenerations on apical cytoplasm, metaplasic degenerations on simple prismatic epithelium and degenerations from single epithelium to stratified epithelium in small intestine in Kidney were observed (Karaduman, 1998). Other studies were reported that cellular damage in rats' heart and kidney tissues was detected and some intoxication may be the cause of the results (Tugyan, 2001; Mossa and Abbassy, 2012). Even low concentration of malathion (10 $mg.kg^{-1}$ dose from drinking water) was claimed to have genotoxic effects for rats (Hornga et al., 2007; Ermis, 2014). Moreover, the effects may also cause the development of cancer cells (Muniz, 2008). No studies have been done regarding cancer in humans following oral exposure to malathion, but several bioassays have been conducted to examine the carcinogenicity of malathion in animals. So it may be comprehensible according to this result that low dose of malathion may cause health problems on human beings as well (Ergonen et al., 2005).

CONCLUSIONS

Malathion is almost an indispensable thing for standard human life because of pests and other many organisms onto agricultural products and around people's homes, garages, stores and warehouses. Moreover, it can cause serious

contamination to the soil, water and atmosphere during treatments onto plants or anywhere else. Even if low concentration of malathion is claimed to have genotoxic effects, cancer cells into such organisms can be thrived with the insecticide treatment. Furthermore, no studies were carried out regarding cancer in human beings following oral exposure to malathion. However, several bioassays have been conducted to examine the carcinogenicity of malathion in animals. So, we can claim that low dose of malathion may cause health problems. There have been no studies done about whether children are more sensitive than adults to malathion or not. Therefore, we suggest that malathion effects (direct and side effect) should be determined for all ages of children and adults. Consequently, we recommend that malathion effects on human life should be searched and its results obtained be put into practice in the near future.

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