Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol. 3, No.7, 2013 

# Human Health Risks: Impact of Pesticide Application

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**Abstract**
This article reviews the application of pesticides in Gaza Strip, Palestine and discusses its associated health risks. This study is based on data collection and analysis.
Data showed that large quantities of pesticides are used in Gaza Strip and the quantities are increased annually. Analyzing the data indicates that large numbers of pesticides are used for controlling different types of pests. Some pesticides are restricted by law but are available in the local market. Classification of pesticides according to its biological activity indicates that insecticides are the largest uses among other pesticides. Reviewing the acute poisonous cases in health records indicates that the reported acute toxic cases were among local farmers in Gaza and the number of acute toxic cases increased annually indicating direct health risks associated with pesticide use. In addition, the increased number of congenital malformation among the newborns indicates indirect health risks. Moreover, the number of cancer cases in Khan Younis governorate indicates a positive association with pesticide use. Classification of pesticides according to WHO standards identified extreme toxic pesticides (e.g parathion), highly toxic (dichlorvos), moderately toxic (malathion) and less toxic ones. These Pesticides have a wide range of octanol-water partitioning coefficient ($K_{ow}$, log P) values (-0.8 - 6.6), which results in a variety of storage and transport patterns in human bodies. They may move from the storage sites (e.g fat bodies) via partitioning to other parts of the human body. A pesticide with high $K_{ow}$ log P value (hydrophobic) such as Fenvalerate can be stored in fat containing particles and be released in milk secretion exposing fetus, mother, and infants to health risks. A satisfactory solution to these problems is the implementation of restriction measures and the performance of frequent pesticide residue analysis of food samples.
**Key words:** Contamination, health risk, toxicology, log $K_{ow}$ value.

## 1. Introduction

Synthetic pesticides have been widely used for many years ago. For instance more than
18,000 pesticide products were licensed for use, and each year about 2 billion pounds of pesticides are applied to different places (Environmental Protection Agency 2002).
The application of pesticides has greatly contributed to the increase of world food and improved the human and animal health.
However, this application may have resulted in human health impacts. It has been documented that occupational exposure to pesticides resulted in an annual incidence of 18 cases of pesticide-related illness for every 100,000 workers in the United States (Calvert et al. 2004). Moreover the non- occupational exposure to pesticides may have side effects to non-target organism, including humans.
However, direct application of pesticide resulted in the accumulation of pesticides residues in vegetable and/or fruit samples in many countries. For instance, Malhat et al., (2013a) evaluated the residues of kresoxim methyl in apple and found that the terminal residues of kresoxim methyl were below the FAO/WHO maximum residue limit (MRL, 0.2 mg/kg) in apple when measured 14 days after the final application. In addition, Malhat et al. (2013b) determined etoxazole residues in in apples, strawberries and green beans by solid phase extraction clean-up and HPLC-DAD and found considerable concentrations but they were below Egyptian maximum residue limit. Mandour (2012) studied the contamination of ground water with insecticides in Egypt. His results confirmed the presence of high concentrations of insecticides, including organonitrogenous and organochlorine in tap drinking surface and ground water.
Osman et al., (2010) determined pesticide residues in vegetables marketed in Al-Qassim region, Saudi Arabia and found that 55% of the samples contained different residues in which 60% of the contaminated samples contained residues above the maximum residue limit,
Barakat et al., (2013) determined and identified 25 Organochlorine pesticides (OCPs) and 29 polychlorinated biphenyls (PCBs) in sediment samples collected from 34 locations in Lake Qarun. They concluded that according to the established sediment quality guidelines, OCPs (e.g. γ-HCH, endrin and chlordanes) would be more concerned OCP species for the ecotoxicological risk in Lake Qarun. Malhat and Nasr (2011) monitored the concentration of organophosphorus pesticides in fish samples from different tributaries of the Nile River in Egypt. They found considerable concentrations of Chloropyrifos, cadusafos, diazinon, prothiphos and malathion were detected in fish tissues samples at level below the maximum residue limit.
Moreover, Mahmoud et al., (2013) determined organochlorine pesticides (OCPs) in the edible offal of Egyptian

buffalo and found that Tongues had the highest concentration of OCPs in a comparison to livers and kidneys in the examined samples. Somia and Madiha (2012) studied the pathological effects of dichlorvos and fenitrothion in mice and found that both insecticides caused degenerative changes in the liver and kidney of mice. Furthermore, Elserougy et al., (2013) detected organochlorine pesticides (OCPs) in placental and breast milk (BM) samples donated from healthy lactating mothers in Egypt. Amer et al., (2002) studied skin diseases among workers exposed to pesticides. Dermatological findings were positive in 78%, 76% and 54% of workers exposed to organophosphates, pyrethroids and carbamate pesticides respectively.

However, pesticides residues in food samples are hot topics in many countries. For instance in Egypt (Abbassy, 2001; Dogheim et al., 2001; Saleh et al., 1996), Jordan (Al-Nasir et al., 2001) Palestine ( Safi et al., 2001a,b), Kuwait (Sawaya et al., 1999, 2000) Iran (Sdergern et al., 1978) and Pakistan (Tahir et al., 2001).

Furthermore, the indirect application of pesticides resulted in the accumulation of pesticide residues in many food samples. For instance: 1) honey samples (Boxter and Saliba 1996, Al-Rifai and Akeel, 1997), 2) human milk (Dagher et al., 1999; Alawi et al., 1992; Saleh et al., 1998; Dogheim et al., 1996; Hashemy et al., 1977), 3) chichen eggs (Hashemy and Mosstofian 1979), and 4) fish (Paz 1976; Dogheim et al 1996a; El-Zorgani 1980).

Serious problems to non-target organisms and human beings leading to a number of pathological and disturbed biochemical processes (Abu-Murad 2000; Rashatwar and Ilyas 1984; Rambabu and Rao 1994; Soliman et al., 1997; Amr et al., 1997; Safi et al., 1993, Safi 2002) and toxicity to cycnobacteria (Kerkez 2012) and Fish (El-Najjar 2013).

The best-documented health effects involve the nervous system. The neurotoxic consequences of acute high-level pesticide exposure are well established: Exposure is associated with a range of symptoms as well as deficits in neurobehavioral performance and abnormalities in nerve function (Keifer and Mahurin 1997). Pesticide exposure may also be associated with increased risk of neurodegenerative disease, particularly Parkinson disease (Le Couteur et al. 1999).

This paper investigates the application of pesticides and surveys the acute and the non-acute toxic effects, and discusses their health-related risk.

## 2. Materials and Methods

2.1 Description of the study area

Gaza strip, the southern part of Palestine, a semiarid land of total area of 365 $km^2$ lies on the Mediterranean sea . About 181 $km^2$ is considered as a cropland and is dominated by vegetables (tomato, cucamber, peper) and fruits (citrus,graps). Farmes use intensive agriculture via green house technology. Due to the growing population, many of green houses are being established each year to protvide sufficient amounts of vegetables.

These agricultural practices use large amounts of pesticides which may be harmfull to the local population.

2.2 Data collection

Pesticides data: Several meetings with officials from Ministry of agriculture were conducted. In these meetings raw data of pesticides were handled. The data were classified according to historical information, target group, chemical class, and lethal dose that kill 50% of tested organisms ($LD_{50}$).

Pesticide markets in Gaza Strip were surveyed by site visits to the shops. These shops were licensed by Ministry of agriculture in Gaza, Palestine.

Data on the acute and non-acute toxic effect of pesticides were collected from the health Department, local hospitals and with direct meeting with the technical staff working in the hospitals and/or private clinics. The data were screened, historically arranged and presented in a suitable way to provide a good data unit.

2.3 Field visits: several field visits were conducted to the agricultural land to view the application of pesticides by farmers. Some photos were collected.

## 3. Results and Discussion

3.1 Pesticide use in Gaza

The amounts of pesticides used in Gaza are shown in Table 1.

**Table 1.** Quantities (ton) of pesticides used in the past years

| Year | Herbicide | Insecticide | Fungicide | Soil sterilants | Total |
|---|---|---|---|---|---|
| 2002 | 9.86 | 95.58 | 123.91 | 303.00 | 532.35 |
| 2005 | 20.44 | 56.71 | 74.34 | 300.70 | 452.19 |
| 2006 | 24.94 | 55.27 | 55.65 | 111.60 | 247.46 |
| 2007 | 18.80 | 35.58 | 43.27 | 93.80 | 191.45 |
| 2008 | 18.20 | 49.65 | 42.20 | 193.60 | 303.65 |
| 2009 | 39.43 | 139.34 | 123.69 | 394.40 | 696.86 |
| 2010 | 18.78 | 144.68 | 99.63 | 162.40 | 425.49 |

It can be seen that the amounts of herbicides used in Gaza increased from year 2002 up 2006. Then sharp a reduction in herbicide use was observed in the following year except that in 2009. In contrast, the used amounts of insecticide and fungicide were high in the year 2002 and sharp reductions in the amount used were observed up to the year 2008 followed by a sharp increase in following year (Table 1). The amount of soil sterilants used followed the same trend. Furthermore, in Figure 1 the total amount of pesticide used in the last 10 years is presented.

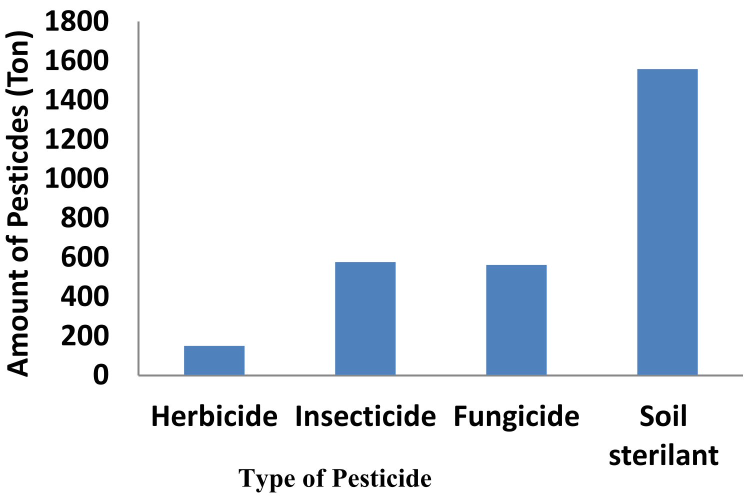


**Figure 1.** Total amounts of pesticides used in the last ten years in Gaza

It is obvious from Figure 1 that the amount of soil sterilants is the largest among all, whereas the amount of herbicides is the lowest among all. The reason for that is the application rate of soil sterilants is several times larger than that of herbicide. Furthermore, it can be seen that the amounts of insecticides and fugicides are nearly equal to each other and several fold larger than that of herbicides. The explanation of these results is that farmers used herbicides one time a year whereas insecticides and fungicides are used several times a year due to intensive agriculture. Similar observations were seen in the surrunding countries (Mansour 2008). Furthermore, surveying the pesticide market provides detailed information on the current situation of pesticide names, and chemical groups and distribution of selling shops. More details are shown in Table 2-3.

**Table 2.** Distribution of pesticide shops in Gaza Strip

| Place | selling shops |
|---|---|
| South zone (Rafah + Khan Younis) | 53 |
| Meddle zone | 21 |
| Gaza City | 13 |
| North zone | 22 |

It is obvious that a large number of pesticide selling shops (109) are distributed all over Gaza Strip area. This is due to the agricultural nature of Gaza Strip. Beside the fact that large quantities of pesticides are used in the public health sector for controlling mosquitoes and flies by different municipalities in Gaza Strip. Table 3 provides more details on the active ingredients of pesticides

 

**Table 3.** Names of pesticide and their target groups used in Gaza.

| Insecticides | Herbicides | Fungicides | Rodenticide | Soil Sterilants |
|---|---|---|---|---|
| Chlorfluazuron | Prometryne | Propineb | Bromadiolone | Methm Sodium |
| Abamectin | Bentazone | Penconazole | Coumatetralyl | Methy bromide |
| Methamidophos | Oxyfluorfen | Chlorothalonil | Metaldehyde | |
| Cyhexatin | 2,4-D | Carbendazim | | |
| Chlorpyrifos | Metamitron | Tetraconazole | | |
| Novaluron | Oxadiazon | Sulphur | | |
| Bifenazat | Pendimethalin | Trifloxystrobin | | |
| *Fenamiphos | *Bromacil | Mancozeb | | |
| *Imidacloprid | *Alachlor | Sulphur | | |
| *Acetamiprid | *Atrazine | *Thiophanate methyl | | |
| *Methyl-Parathion | *Terbutryne | | | |
| *Carbaryl | *Cyhexatin | | | |

It can be seen that at least 12 insecticides, 12 herbicides, 10 fungicides, 3 rodenticide, and 2 soil sterilants are used annually in Gaza. However, reviewing the records of WHO and Ministry of Agriculture in Palestine, it appeared that some pesticides are internationally banned or have a restricted use but are still available for use in Gaza pesticide market. These pesticides are marked with a star (*) to indicate a restriction on use. Furthermore, physicochemical properties and LD50 values of these pesticides are shown in Table 4. It is obvious that the solubility of the listed pesticides in Table 4 ranges from insoluble and/or few micrograms/l (e.g. Cypermethrin) to very soluble (solubility equal to 57.9 g/l, Methomoyl). This variety in solubility gives different leaching potentials and a possibility of growndwater conatamination in Gaza. The solubility value of the pesticide above 30 mg/l may have the potential for growndwater conatmination as previously reported (Williams et al, 1988). Accordingly, large fraction of the pesticides listed in Table 4 may contaminate the ground water in Gaza. However, there are other factors such as soil type $K_{ow}$ log P. However, the value of $K_{ow}$ log P ranges from (-0.8) to (6.6). These values in soil may result in a retention of the pesticides in the soil due to the possibility of binding to the soil organic matter and/or clay fraction. In the way around, the pesticide that has a high value of $K_{ow}$ log P (e.g.6.6, Cypermethrin) may result in a variety of storage and transport patterns in human bodies and create health problems. Moreover, the value of Henry constant ($K_H$) has a direct rule in the environmental fate of pesticides in Gaza. However, $K_H$ values range from $2*10^{-10}$ (e.g Imidacloprid) to 3.5 as in Metaldehyde. These varations enabled different environmental fates of pestucides in Gaza. In addition the 50% degradation ($DT_{50}$) ranges from few days 4d as in Matam Sodium to large number of days as in Atrazine (200d). This indicates persistence of some pesticides in Gaza. Moreover, the acute lethal dose that kill 50% of the tested organisms ($LD_{50}$) of the listed pesticides in Table 4 ranged from extremely toxic pesticide (e.g parathion with $LD_{50}$ equals to 2mg/kg), high toxic (Dichlorvos 50 mg/kg), moderate toxic (Cypermethrin with $LD_{50}$ equals to 250 mg/kg) and less toxic one (Oxyfluorfen with $LD_{50}$ equals to 5000 mg/kg). According to the values of $LD_{50}$, it is expected that some poisonous cases, direct effect of pesticide application, and congenital malformation cases occurred from one year to another. Table 5, provide cases of poisonous and congenital malformation. Studies of pesticide neurotoxicity have typically evaluated either the long-term effects of pesticide poisoning or the effects of occupational exposure. Pesticide poisoning may go undiagnosed, especially among farm workers with poor access to medical care (Moses et al. 1993) and particularly among women (London et al. 2002).

**Table 4.**Physicochemical properties of pesticides in Gaza Strip

| Common name | Solubility in water | $LD_{50}$ mg/kg | $K_H$ Pa $m^3$ $mol^{-1}$ | $K_{ow}$ logP | $DT_{50}$ |
|---|---|---|---|---|---|
| Abamectin | 10µg/l | 10 | $2.7*10^{-3}$ | 4.4 | - |
| *Carbaryl | 120 mg/l | 850 | - | 1.59 | 28 d |
| Carbofuran | 320 mg/l | 8 | - | 1,52 | 30-60d |
| *Acetamiprid | 4.25g/l | 217 | $5.3*10^{-8}$ | 0.88 | 15-30 |
| Bifenazat | 3.76 mg/l | 5000 | $1*10^{-3}$ | 3.4 | 80d |
| Chlorfluazuron | 0.01mg/l | 8500 | $5.41*10^{-4}$ | 5.8 | - |
| Cypermethrin | 4µg/l | 250 | $2*10^{-2}$ | 6.6 | |
| Chlorpyrifos | 1.44 | 133 | $6.76*10^{-1}$ | 4.7 | |
| *Fenamiphos | 400mg/l | 10 | $9.2*10^{-5}$ | | |
| Methamidophos | 0.12 mg/l | 200 | $1.6*10^{-2}$ | -0.8 | |
| Azocyclin | 0.12 mg/l | 209 | $7*10^{-2}$ | 5.3 | |
| *Imidacloprid | 0.61g/l | 5000 | $2*10^{-10}$ | 0.57 | - |
| Diazinon | 60 mg/l | 1250 | $6.09*10^{-2}$ | 3.3 | |
| Malathion | 145 mg/l | 1375 | - | 2.75 | |
| Parathion | 11mg/l | 2 | 0.0302 | 3.83 | - |
| Dichlorvos | 18g | 50 | $2.58*10^{-2}$ | 1.8 | |
| Fenvalerate | 10µg/l | 451 | - | 5.01 | |
| Oxyfluorfen | 0.116mg/l | 5000 | - | 4.47 | 292d |
| Methomoyl | 57.9 g/l | 30 | $2.13*10^{-6}$ | 0.093 | |
| Oxamyl | 280 g/l | 3.1 | $3.9*10^{-8}$ | -0.44 | |
| Methidathion | 200 mg/l | 25 | $3.3 *10^{-4}$ | 2.2 | |
| Pendimethalin | 0.3 | 1250 | - | 5.18 | 100 d |
| *Bromacil | 807 mg/l | 2000 | - | 1.88 | 150 d |
| *Alachlor | 170.3mg/l | 930 | $3.2 *10^{-3}$ | 3.09 | 42-70d |
| *Atrazine | 33mg/l | 1869 | $1.5 *10^{-4}$ | 2.5 | 105-200d |
| *Terbutryne | 22mg/l | 2500 | $1.5 *10^{-3}$ | 3.65 | 70 d |
| *Cyhexatin | 1 mg/l | 540 | - | - | - |
| Propineb | 10mg/l | >5000 | - | -0.26 | - |
| Penconazole | 730mg/l | 2125 | $6.6 *10^{-4}$ | 3.72 | 343 d |
| Chlorothalonil | 0.81 mg/l | >5000 | $2.50 *10^{-2}$ | 2.92 | 36 d |
| Carbendazim | 29 mg/l | 15000 | $3.6 *10^{-3}$ | 1.38 | >50 d |
| Tetraconazole | 156 mg/l | 1248 | $3.6 *10^{-4}$ | 3.56 | - |
| Trifloxystrobin | 0.61 mg/l | >5000 | $2.3 *10^{-3}$ | 4.5 | 8 d |
| Mancozeb | 6.2 mg/l | >5000 | - | - | 15 d |
| Sulphur | Insoluble | >5000 | - | - | - |
| *Thiophanate methyl | Insoluble | 7500 | - | 1.5 | 28d |
| Bromadiolone | 19 mg/l | 1.125 | $5.55 *10^{-5}$ | - | - |
| Coumatetralyl | 4 mg/l | 16.5 | $1*10^{-7}$ | 3.46 | 90 d |
| Metaldehyde | 222 mg/l | 283 | 3.5 | 0.12 | - |
| Metam Sodium | 722g/l | 1800 | - | <1 | 4d |
| Methy bromide | 17.5g/l | *3.03 | $1.03 *10^{-3}$ | - | - |

Source: Tomlin 2000.

Reviewing the health records showed that only the acute poisoning cases are admitted in the hospital for urgent medical care. These cases are reported in Table 5. The non-acute toxic cases are medically treated and sent back home. These cases are not registered in the health record. In addition, pesticide training courses on the safe and effective use of pesticides were conducted to the farmers. Accordingly, a reduction of poisonous cases among farmers is observed (Table 5). Moreover, the number of congenital malformation among children (Table 5) is increased annually. These data are in accordance with the increasing amount of pesticide used in Gaza (Table 1). These data are nearly similar to those reported in Egypt (Mansour 2008). The explanation of these results is that the application of pesticides resulted in accumulation of pesticides residues in vegetable and/or fruit samples (Malhat et al., 2013a,b, Osman et al., 2010) and contamination of groundwater (Mandour 2012). These residues have been shown to be stored in the human body and released again in milk secretion and placental samples in lactating mothers (Elserougy et al.,2013). It has been found that pesticide residues caused damage to livers and kidneys of Egyptian buffalo (Mahmoud et al., 2013), pathological degenerative changes in the liver and kidney of mice (Somia and Madiha , 2012) and skin diseases among workers exposed to pesticides (Amer et al., 2002). These data support our suggestion that the growing incidence of congenital malformation among the children is strongly correlated with pesticide application and/or consumption of food samples contaminated with pesticide residues.

**Table 5.** Number of poisonous and congenital malformation cases reported in Gaza Strip

| Year | Acute poisonous | Congenital malformation |
|---|---|---|
| 2008 | 49 | 20 |
| 2009 | 40 | 32 |
| 2010 | 32 | 45 |
| 2011 | 25 | Na |
| Total | 164 | 97 |

Na= not available

3.2 The dynamics of pesticides in the human body

The hydrophobic nature of pesticides (Table 4) allows them to accumulate in the adipose tissues and redistribute to different organs in the human bodies. The dynamics and the fate of pesticide in the human body are primarily controlled by a combination of factors such as transports, subsequent residence time, metabolism, concentration and physicochemical properties, sex, age, species, tissue and the integrity of the detoxifying organ especially liver and kidney. The most important physicochemical properties regarding the behavior of hydrophobic organic pesticides are aqueous solubility and octanol water partitioning coefficient ($K_{ow}$).

The pesticides listed in Table 4 have a wide range of log $K_{ow}$ values starting from relatively hydrophilic, Oxamyl, ($K_{ow}$=-0.44) to extremely hydrophobic, Cypermethrin, ($K_{ow}$=6.6). Consequently, the pesticides of high $K_{ow}$ values (e.g. Cypermethrin, Azocyclin) may be stored in human adipose tissues at different rates due to log $K_{ow}$ variations, which control differences in bio-transformation or execration.

Due to the high fat content of the breast, it tends to be a suitable organ to accumulate and store highly hydrophobic organic contaminants. This may result in a very slow rate of elimination of pesticide (Matsumura, 1985). The partitioning of these chemicals in the adipose may protect them from metabolism by the active enzymes and make the reaction with DNA of the cells easier. The dynamics of pesticide in the human body may result in a distribution and/or transfer of pesticide from high concentration level (e.g. mothers) to a low level acceptor (e.g. stillbore, infants). Accordingly, the adipose tissue may act as a sink of the pesticide in the human body. An evidence of dynamic movements of contaminants is that their diffusion out through milk secretion. Previous analysis found high concentrations of chlorinated hydrocarbons (HCB, alpha, beta and gama BHC,DDT, DDE) in milk secretions from nursing women (Saleh et al.,1996; Dagher et al., 1999; Saeed et al., 2000). Polychlorinated dibenzo-p-dioxines, polychlorinated dibenzo-furans and polychlorinated biphenyls were found in the human milk (Tunstra et al., 1994; Beck et al., 1994; Gonzalez et al., 1996; Kiviranta et al., 1999; Malisch et al., 2000; Yang et al., 2002). Further evidence of dynamic movements of pesticides (e. g. organochlorine compounds) is that their detection in the body of infants. For instance organochlorine were found in newborn in America (O'Leary et al.,1970), Canada (McLeod et al., 1971), Israel (Polishuk et al., 1977) India (Saxena et al., 1981, Siddiqui and Saxena 1985), Western Slovakia (Rosival et al., 1983) and Japan (Ando et al., 1985).

These findings suggest that the distribution and partitioning of pesticides from mother to infants may occur through milk secretion.

An alternative mechanism is that the pesticide moves from mother to stillborn through placenta. Previous reports found organochlorine contaminants in tissues of stillborns, and cord blood of the newborn babies and in the

human placenta (Curley et al., 1969; Polishuk et al., 1970). Polishuk et al. (1977) found greater concentrations of DDT, HCH and polychlorenated biphenyls in the lipids of human fetal blood than in the lipids of maternal blood. These findings reflect the prenatal exposure resulting from the transplacental passage of these contaminants. However, the movement of the contaminants through the placenta depends on its $K_{ow}$ value. However, contaminants of low $K_{ow}$ (2.31) such as carbaryl can cross the placenta and rapidly be distributed in all fetal tissues (Strother and Wheeler 1980).
However, the distribution of contaminants in the human body is controlled by $K_{ow}$ value. Thus, the serum concentration of contaminants is positively correlated to the bulk concentration in the adipose tissues. This process may result in an even distribution of pesticide residues to different fat containing organs. Previous analysis (Petreas et al., 2004) did not report significant difference between the concentrations of a contaminant in the breast and in the abdominal adipose tissues. However, the fraction of the contaminants found in the blood serum may be adsorbed on the surface of the blood cells or be partitioned again with the lung tissue resulting in a leukemia, lung cancer, and other malignant tumers. Whereas the fraction of the contaminant remained in the adipose (e.g. breast) may develop a breast cancer.
However, the movements of the organic pesticide from the source (e.g. mother) to the acceptor (e.g. fetus, infant) may occur through one or more of the following modes:
1. Simple diffusion, pesticides of high hydrophobicity such as Chlorfluazuron (Table 4) can cross the placenta from regions of high concentrations (mother) to regions of low concentrations (fetus) up to equilibrium balance.
2. Facilitated diffusion, placental transfer or milk secretion, may also occur in accordance with the concentration gradients but more rapidly than simple diffusion.
3. Active transport, contaminant transfers opposite an electrochemical gradient and requires the expenditure of metabolic energy.
4. Special processes, these movements include, phagocytosis, pinocytosis and a break in the placental barriers. However, the movement of organic contaminants such as pesticides from mother to their fetus was early described by Ginsburg, (1971), Klaassen, (1986) and Salama, (1993) who reported similar mode of transfer.

3.3 Potential health risk associated with pesticide contamination

The dynamics of pesticide residues in the human body may be a matter of serious concern to public health especially for pregnant women, their fetus and their new babies. It has been shown that mother age can influence the accumulation of pesticide residues in circulating blood and its subsequent transfer to the fetus. A long life span may cause a great accumulation of contaminants (Salama et al., 1993). Mothers with high concentration of pesticide residues may transfer a fatal concentration to stillborn through cordial code which may result in a late abortions of pregnancy, or via milk recreation result in health risk to infants. These pesticide residues may have resulted in a serious health problems to non-target organisims and human beings leading to a number of pathological and disturbed biochemical processes (Abu Murad, 2000, Rashatwar and Ilyas 1984, Rambabu and Rao 1994, Soliman et al., 1997, Amer et al., 1997, Safi et al., 1993, Safi 2002). Olszyna-Marzys (1978) reported prenatal and postnatal intoxication of the infants with hexachlorobenzene in Turkey and methylmercury in Iraq due to the consumption of fungicide-treated seed wheat by pregnant and lactating mothers. The growing incidence of cancer cases among the children in Lebanon (average cancer cases 786 case/year) (El Saghir et al. 1998) might be attributed to the consumption of contaminated milk samples with pesticide residues (Elserougy et al., 2013). Furthermore, DDE and polychlorinated biphenyls (PCBs) were detected in blood serum samples collected from 43 females diagnosed with invasive adenocarcinoma of the breast, Port Said region of Egypt (Ahmed et al. 2002). The concentration of polychlorinated biphenyls in breast adipose tissue was possitively correlated with the fish consumption in Canada (Paris-Pombo et al., 2003). Recent study (El-Nahhal and Harrarah 2013) showed an increased number of cancer cases in Khan Younis governorate. This indicates a positive association with pesticide use and/or agrochemicals due to the agricaltural nature of Khan Younis governorate.
Extremely toxic pesticides, which have $LD_{50}$ values less than 20 mg/kg, (Aldicarb, parathion, carbufuran, and monocrotophos) may be a cause of deathes to infants and children in Palestine (MOH 2001). A positive association was found between the pattern of food consumption and the increasing incidence of coronary heart disease in Saudi Arabia (Musaiger, 2002).
El-Hag et al. (2002) found that Carcinoma of breast, lymphomas and leukemias, in Saudi Arabia. However, the cases reported in Saudi Arabia may be attributed to the consumption of high fat food (Musaiger 2002) which might be contaminated with mycotoxin (Al-Julafi and Al-Fatih, 2001) and/or poly aromatic hydrocarbon (Al-Saleh and Al-Doush, 2002). These data are similar to those found in Palestine (Safi et al., 1993; Safi 2002) and correlated as consequences of overuse of banned pesticides.

## 4. Concluding remarks

Pesticides are commonly used in the agricultural sectors for pest control. Thus direct application of pesticides may result in the contamination of food, soil and groundwater. The pesticides in Gaza are insecticides, herbicides, fungicides, rodenticides and soil sterilants. The quantities of insecticides and fungicides were higher than herbicides. Poisonous cases in Gaza are among the farm workers and the number of cases reduced annually. In contrast, the number of congenital malformation among the children is increased annually indicating indirect health risks.

The pesticides in Gaza belong to different chemical groups with a hydrophobic or hydrophilic nature. The hydrophobic ones may be accumulated in the fat tissue in the body and be built up to toxic or genotoxic levels. Pesticide can move in the human body by different ways and reach the fetus and be a cause of death. The movement of pesticide through milk secretion may be a cause of infant mortality due to the pre-maturity or low birth weight, malignant neoplasm for children or breast cancer. However, these contaminants may be of high risk exposure to women as shown by a number of breast cancer cases developed in Palestine (Safi 2002) and Egypt (Ahmed et al., 2002). However, the variation of physicochemical properties especially $K_{ow}$ Log P values of pesticides (Table 4) make the partitioning and distribution quite different. Accordingly, the health risk is a pesticide dependent. It becomes obvious that a strong positive correlation may exist between the pesticide application and the growing incidence of non communicable diseases (cancer cases or heart disease) in Saudi Arabia, Egypt, Lebanon and Palestine.

The following steps may be implemented to reduce the health risk associated with pesticide application: 1) reduction of pesticide use to the minimum level; 2) pesticide residue analysis for vegetable, fruit samples before harvesting and marketing; 3) Analysis of the breast milk during the nursing period to avoid infant exposure to contaminated milk mainly with pesticide; and 3) Consumption of fat free food.

## 5. Acknowledgement

Dr. El-Nahhal acknowledges Alexander von Humboldt Stiftung/ Foundation Fellowship Grant no IV-PAL/1104842 STP, Germany

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