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Endocrine Disrupting Chemicals in Pesticides and Herbicide in Fars Province, Iran

¹M. Ebrahimi and ²N. Shamabadi

¹Green Research Center, Al-Ghadir Blvd., Qom University, Qom, Iran

²Young Research Club, Qom Azad University, Qom, Iran

Abstract: Recent studies have shown that certain man-made compounds (including some pesticides and herbicide) through interfering with endocrine system, have the capability to induce developmental and reproductive abnormalities in humans and animals. Pesticides are currently being used in large scales in many developed and developing countries (including Iran), so this study has been conducted to determine the percentage of endocrine disruptor agents in pesticides used in Fars province. The results showed that more than 1,581,690 L of pesticides, in 86 different brands, have been used in Fars province during year 1380 and 25.93% (34 types) of them had at least one carcinogenic agents. At least 30 pesticides (711720 L, 44.99%) had one endocrine disruptor agent and therefore can be classified as environmental hormones or endocrine disrupting chemicals. The percentage of pesticides whom interfering with normal endocrine system activity were, 7.82% (66572 L), 4.54% (39975 L), 22.02% (348400 L), 5.12% (81000 L) and 21.18% (34500 L) of pesticides were antiestrogenic, antiandrogenic, antityroidic, antigonadotropin and anitestroid hormones, respectively. The results showed that about 50% of pesticides which currently being used in Fars province should be banned.

Key words: Endocrine disruptor agents, pesticides, fars province

INTRODUCTION

In the last two decades, a great deal of attention and interest has been directed toward the hypothesis that exposure, particularly during developmental phase, to certain environmental chemicals might be capable of causing a spectrum of adverse effects as a result of endocrine modulation. In particular, the hypothesis has focused on the idea that certain man-made compounds acting as weak hormones (particularly estrogens and androgens) have the capability to induce developmental and reproductive abnormalities in humans and animals. Studies of wildlife have already showed associations between hormone-disrupting chemicals in the environment and wildlife declining populations, thinning eggshells, morphologic abnormalities and impaired viability of offspring (Birrell *et al.*, 2007). Scientists also have postulated a relationship between these chemicals and abnormalities and diseases in humans, including declining sperm counts; breast, testicular and prostate cancers; and neurological disorders, including cognitive and neurobehavioral effects (Markey *et al.*, 2003; Singleton and Khan, 2003; Lemaire *et al.*, 2004; Ohyama, 2004). Various terms, such as: environmental hormones, environmental estrogens, xenoestrogens,

phytoestrogens, endocrine modulator compounds, endocrine disruptors, estrogen-like compounds have been used to identify the pollutants.

Nowdays, pesticides play major roles in combating pests both in agriculture and veterinary medicine. They are being used in large scales in many developing countries (including Iran), but their environmental pollutions and adverse effects on human and animal healths have raised many speculations (Akingbemi and Hardy, 2001; Lemaire *et al.*, 2004). It has been shown that alligator populations are declining in Florida lakes contaminated with hormonally active pesticides, such as DDT, dicofol and toxaphene (Lind *et al.*, 2004; Rooney *et al.*, 2004) and genital abnormalities and low egg production have been observed in these alligators. Reproductive abnormalities in some species of birds in the Great Lakes regions and the skewed sex ratios of western gull populations have been linked to some pesticides contaminations especially DDE, active metabolite of DDT (Rattner *et al.*, 1984; Dickerson *et al.*, 1999; Guillette, 2006). DDE, active metabolite of DDT (Lorenzen *et al.*, 2001). It has been shown that using contaminated fish and other food products with pesticides by mothers have increased prenatal exposure and affect the normal development of nervous system (Liney *et al.*, 2006;

Correa-Reyes *et al.*, 2007; Hinck *et al.*, 2007). Studies so far have confirmed that some pesticides contain agents that interfere with normal endocrine system (Bretveld *et al.*, 2006; Whitehead and Rice, 2006; Bretveld *et al.*, 2007; Hinck *et al.*, 2007) and this study has investigated the percentage of pesticides with endocrine disruptor agents used in Fars province during year 1380.

MATERIALS AND METHODS

Data on the amounts and the types of pesticides used in 1380 solar calendar year were obtained from the official offices responsible for purchasing and distribution pesticides in Fars province. Some pesticides are currently imported and distributed by smugglers and those data were not accessible, but they were gathered as possible. The ingredients of pesticides were defined by data presented by manufacturers. All chemicals used to manufacture pesticides consumed in Fars province during the mentioned year were checked for endocrine disruptor activities by using scientific papers and published articles. Finally, data were analyzed by descriptive statistical tests using SPSS 10 for Windows software (SPSS Inc., 444 N. Michigan Avenue, Chicago, Illinois 60611, USA).

RESULTS

The results showed that more than 1,581,690 L of pesticides in 86 different brands have been used in Fars province during mentioned year. From 86 pesticides used 39 were insecticides, 28 herbicides and 19 fungicides (Table 1). Aluminum phosphid and ADE phenous were the most and the least pesticides used, respectively. Thirty four pesticides (25.93%) had at least one carcinogenic agent in them and haloxy fobmethyl and alachlor were the most and the least carcinogens chemicals found, respectively.

The results also revealed that 30 pesticides (711720 L) had at least one hormonally active substance and therefore can be classified as environmental hormones or endocrine disruptors, so the percentage of pesticides with endocrine disruptor activities were 44.99% (Table 2). Premtrine and 2,4,D respectively were the lowest and the highest chemicals used in pesticides with environmental hormone activities. It has been already reported that some pesticides can contribute to male infertility and 522170 L (33.01%) of pesticides used in Fars during the mentioned year had at least one hormonally active substance which interfere with male fertility. We also found that 7.82% (66572 L), 4.54% (39975 L), 22.02% (348400 L), 5.12% (81000 L) and 21.18% (34500 L) of pesticides used there were classified as antiestrogenic,

Table 1: No. of different types of pesticides used in 1380 in Fars province

Pesticide	Number
Insecticides	39
Herbicides	28
Fungicides	19
Total	86

Table 2: Disruption routs of pesticides studied in Fars province, Iran

Disruption routes	Number
Endocrine disruptors	711720
Carcinogenic	410140
Male infertility	522170
Estrogenic	123770
Antiandrogenic	71850
Antithyroidic	348400
Antigonadotropic	81000
Antiesteroid hormone	32500

Table 3: Percentage of all pesticides groups and the percentage of their active substances

Disruption routes	Percentage of pesticides	Percentage of active substances
Endocrine disruptors	44.99	22.30
Carcinogene	25.93	14.92
Male infertility	33.01	17.11
Esterogenic	7.82	4.21
Antiandrogenic	4.54	2.26
Antithyroidic	22.02	12.67
Antigonadotropic	5.12	3.03
Antiesteroid hormones	2.18	1.67

antiandrogenic, antityroidic, antigonadotropin and amitestroid hormones, respectively and can disturb normal endocrine glands (Table 2).

Pesticides manufacturers add some inert chemicals to chemically active substances to increase their product weights. From 1,581,690 L of total pesticides used in Fars province, 634008 L (40.08%) were active substances and the rests were inert substances. Pesticides with endocrine disruptor activity had 22.30% active substances and pesticides with male infertility action, carcinogenic, antithyroidic, estrogenic, antigonadotropic, antiandrogenic and antiesteroid hormones had 42.68, 25.93, 31.61, 10.5, 6.3, 7.57 and 4.17% of active substances, respectively (Table 3).

DISCUSSION

It is undisputed that a number of substances (called as environmental hormones or endocrine disruptors) are able to disrupt endocrine processes, with the potential for impairing development and reproduction or increasing the risk of some cancers (Holmes *et al.*, 2004; Recchia *et al.*, 2004; Birrell *et al.*, 2007). Many studies have shown that the sperm count in the ejaculate has fallen up to 50% in Western Europe (Weltje *et al.*, 2005; Bretveld *et al.*, 2007) and the incidence of prostate cancer in men and breast cancer in women have increased sharply (Witorsch, 2002).

The incidence of estrogen-sensitive tumors has risen significantly in recent decades and a linked levels of DDT and its metabolites in the body with the incidence of breast cancer has been shown (Turusov *et al.*, 2002; Charlier *et al.*, 2003; Tsuda *et al.*, 2003; Gupta, 2004; Mansour, 2004). Results of cognitive and neurobehavioral studies of mother-infant cohorts accidentally exposed to high concentrations of polychlorinated biphenyls (PCBs) and of mother-infant cohorts eating contaminated fish and other food products containing mixtures of pesticides (such as DDE, dieldrin and lindane), have provided enough evidences that prenatal exposure to pesticides can affect the developing nervous system (Charlier and Plomteux, 2002).

The pesticide DDT was the first products where perfected and developed during World War II as a means to control body lice and then other herbicides, 2,4-D and 2,4,5-F, were developed as chemical defoliant for fighting jungle warfare (Jaga and Duvvi, 2001; Snedeker, 2001; Calle *et al.*, 2002). These new synthetics were made from petroleum and manufactured in a laboratory and organochlorines such as DDT and PCB's are made by attaching chlorine atoms to carbon chains, which they are almost never found bonded together in natural world (Snedeker, 2001).

These pesticides are lipophilic and persistent in the environment (Martin *et al.*, 2002; Tapiero *et al.*, 2002) and tend to accumulate in body fat (Stevens *et al.*, 1997). In view of its widespread usage (Rudel *et al.*, 2003; Gupta, 2004), its lipophilic nature and its persistence (DDT has a half-life in the body and the environment of 60-100 years) (Bolt and Degen, 2002), it is concluded that human exposure was substantial and widespread till 1960, when the usage was banned in the western countries, although it is still being used in developing countries (Nhan *et al.*, 2001; Calle *et al.*, 2002; Shinomiya and Shinomiya, 2003; Mansour, 2004).

The concerns are reinforced by recent data showing that women born in countries in which DDT is still used (e.g., Mexico and countries in the developing world) and who subsequently become resident in the USA, have substantially higher breast milk levels of DDT/DDE than USA-born women (Alberts *et al.*, 1992; Jin *et al.*, 1999; Kamath *et al.*, 1999).

Also, the studies have shown that alligator populations are declining in Florida lakes contaminated with hormonally active pesticides, such as DDT, dicofol and toxaphene and genital abnormalities and low egg production have been observed in these alligators due to reduce plasma testosterone in polluted water (Gray, 1998; Lind *et al.*, 2004; Guillette and Moore, 2006).

A governmental company is responsible of importing and distributing pesticides currently used in Iran although

smuggling in small scale contributed in this process and we tried to find and analyze all pesticides available in the market. It may contribute to the large numbers of different pesticides available in the market.

Present results showed that nearly 26% of pesticides are carcinogenic and taking into account the process of preparation, spraying, cleaning and storage of pesticides would reveal the dept of threat for public health. It has already been shown that the incidence of some cancers in some agricultural areas was higher than other areas and a clear relation between pesticides and cancer incidence has been reported (Gish, 1970; Buranatrevedh and Roy, 2001; Martin *et al.*, 2002; Mansour, 2004).

About 45% of pesticides had at least one endocrine disruptor substance and so can be classified as endocrine disruptor or environmental hormone. Many of these pesticides have already been banned in developed countries. The endocrine disruptors enter and absorb body by food, water, air and even through skin and due to their lipophilic specification accumulate in body fat till their concentration reach a critical point and then released into blood stream and through attaching to hormonal receptors, they exert deleterious effects on body (Shinomiya and Shinomiya, 2003; Forawi *et al.*, 2004; Gupta, 2004; Mansour, 2004; Steinhardt, 2004; Guillette, 2006). It has been reported that some pesticides can, directly or indirectly; increase infertility (Akingbemi *et al.*, 2000; Veeramachaneni, 2000; Gotz *et al.*, 2001; Cohn *et al.*, 2003) and 33.01% of pesticides used here have been classified in this group. It have been shown that some pesticides can block estrogen androgen, gonadotropin and thyroid hormones receptors and disturb these hormones normal functions and they called antiestrogenic, antiandrogenic, antigonadotropin and antithyroidic chemicals, respectively (Singleton and Khan, 2003). The percentages of these chemicals in our study were high and their thread for public will be high.

The results reported here confirm that our original objective that pesticides and herbicides may be one of the main sources of population exposure to environmental hormones and also some pesticides should be immediately banned and proper warning should be given to farmers and public to avoid using those pesticides. Government must adopt tougher regulations and actions for importing, distributing and usage of banned pesticides and custom inspection should be escalated to prevent pesticide smuggling. Some foreign companies and manufactures have been allowed to produce some banned pesticides only for export and this is the main reason why the percentage of banned pesticides used in Iran are high.

It have been shown that in many countries (especially developing countries) use of pesticides and herbicides are growing fast and many of them either

through food or water contamination enter food chain and so many societies are being exposed to environmental hormones pollutants, directly or indirectly. This study shows that more protective actions should be taken quickly to prevent more exposures through pesticides.

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