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Determining the Percentage of Endocrine Disruptor Chemicals in Pesticides used in Fars Province

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Abstract

Recent studies have shown that certain man-made compounds (including some pesticides) have the capability to induce developmental and reproductive abnormalities in humans and animals by interfering with endocrine system. Pesticides are currently being used a on large scale 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 liters of pesticides from 86 different brands, have been used in Fars province during the Iranian year 1380 (2001/2) and 25.93% (34 types) of them had at least one carcinogenic agent. At least 30 pesticides (711,720 liters or 44.99%) had one endocrine disruptor agent and therefore can be classified as environmental hormones or endocrine disruptor chemicals. The percentage of pesticides found to be interfering with normal endocrine system activity were 7.82% (66,572 liters), 4.54% (39,975 liters), 22.02% (348,400 liters), 5.12% (81,000 liters) and 21.18% (34,500 liters) which were antiestrogenic, antiandorgenic, antityroidic, antigonadotropin and anitestroid hormones, respectively. The results showed that about 50% of pesticides currently being used in Fars Province should be prohibited.

Keywords: endocrine disruptor agents, fars province, pesticides.

تعیین درصد عوامل برهم‌زننده سیستم درون‌ریز در آفت‌کش‌های مورد استفاده در استان فارس

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چکیده

در دو دهه اخیر توجه برخی از محققان علوم زیستی به این فرضیه معطوف شده است که برخی از مواد شیمیایی ساخته شده در آزمایشگاه‌ها و کارخانجات می‌توانند در صورت جذب به بدن همانند هورمون‌های ضعیفی عمل کرده و در فعالیت طبیعی سیستم غدد درون‌ریز اختلال ایجاد نموده و بروز بسیاری از اختلالات مشاهده شده در جانوران همچون کاهش جمعیت، نازک شدن پوسته تخم، اختلالات ریخت شناسی و افزایش مرگ و میر و همچنین افزایش موارد سرطان‌های وابسته به هورمون، افزایش موارد ناباروری و اختلالات تولید مثلی، کاهش اسپرم در مردان و بروز اختلالات هوشی و یادگیری در انسان را به دلیل افزایش تماس با این مواد می‌دانند. حشره‌کش‌ها به میزان زیاد در کشورهای در حال توسعه و حتی توسعه یافته استفاده شده ولی این نوع مصرف تاکنون مخالفت‌های زیادی را ایجاد نموده است. بسیاری از مطالعات انجام گرفته وجود یک رابطه مستقیم بین مصرف حشره‌کش‌ها و سموم با اختلالات هورمونی (و عوارض حاصل از آن) را به اثبات رسانیده‌اند. این مطالعه برای بررسی میزان سموم حشره‌کش با قابلیت هورمونی محیطی در استان فارس در سال ۱۳۸۱ انجام گرفته است. نتایج حاصله نشان داد که بیش از ۱/۵ میلیون لیتر سم (۸۶ نوع مختلف) در استان فارس استفاده شده که ۲۳/۹۳ درصد از آنها (۳۴ نوع یا ۴۴/۹۹ درصد) دارای عوامل سرطان‌زا بوده و حداقل ۳۰ سم جزء مواد آلاینده هورمون‌های محیطی طبقه‌بندی گردیدند. برخی از سموم به طور اختصاصی در فعالیت هورمون‌های خاص بدن اختلال ایجاد نموده که به ترتیب ۷/۸۲، ۴/۵۴، ۲۲/۰۲، ۵/۱۲ و ۲۱/۱۸ درصد با هورمون‌های استروژن، آندروژن، تیروئید، گنادوتروپین و استروئیدی تداخل داشته‌اند.

کلیدواژه‌ها: عوامل برهم زننده سیستم درون‌ریز، آفت‌کش‌ها، استان فارس.

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Introduction

Over the last two decades, a great deal of attention and interest has been directed towards the hypothesis that exposure, particularly during the developmental phase, to certain environmental chemicals might be capable of causing a spectrum of adverse effects as a result of endocrine modulation. In particular, this hypothesis has focused on the idea that certain man-made compounds, acting as weak hormones (particularly estrogens and androgens), have the capability of inducing developmental and reproductive abnormalities in humans and animals. Studies of wildlife have already showed associations between hormone-disrupting chemicals in the environment and declining populations of wildlife, thinning eggshells, morphologic abnormalities, and impaired viability of offspring (Holm and Berg., 2001) 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, such as cognitive and neurobehavioral effects (Markey, *et al*., 2003; Singleton and Khan, 2003). Various terms, such as 'environmental hormones', 'environmental estrogens', 'xenoestrogens', 'phytoestrogens', 'endocrine modulator compounds', 'endocrine disruptors' and 'estrogen-like compounds' have been used to identify the pollutants (Iguchi, 1998; Sonnenschein and Soto, 1998).

Nowadays, pesticides play a major role in combating pests both in agriculture and veterinary medicine. They are being used in a large scale in many developing countries (including Iran), but the environmental pollution and adverse effects on human and animal health they cause has raised much speculation (Guillette, 2000). It has been shown that alligator populations are declining in the Florida lakes contaminated with hormonally active pesticides, such as DDT, dicofol, and toxaphene (Guillette and Brock., 1999) 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 contamination especially DDE, an active metabolite of DDT (Fry, 1995; Lorenzen and Moon, 1999). DDE, active metabolite of DDT (Lorenzen and Casley, 2001). It has been shown that consumption of contaminated fish and other food products with pesticides by mothers has increased prenatal exposure and affected the normal development of the nervous system (Hoyer and Grandjean, 2000; Tollefsen and Mathisen, 2002). Studies so far have confirmed that some pesticides contain agents that interfere with normal endocrine system and this study has investigated the percentage of pesticides with endocrine disruptor agents used in Fars Province during the Iranian year 1380 (2000/1).

Materials and Methods

Data on the amounts and the types of pesticides used during 1380 (2000/1) were obtained from the official offices responsible for purchasing and distributing pesticides in Fars Province. Some pesticides are currently imported and distributed by smugglers and so those data were not accessible, but they were gathered as far as possible. The ingredients of pesticides were defined by data presented by the manufacturers. All chemicals used to manufacture pesticides consumed in Fars Province during the aforementioned year were checked for endocrine disruptor activities by examining scientific papers and published articles. Finally, the 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 liters of pesticides from 86 different brands have been used in Fars Province during the year in question. From the 86 pesticides used, 39 were insecticides, 28 were herbicides and 19 were fungicides (Figure 1).

Aluminum phosphid and ADE phenous were the most and the least used pesticides, respectively. 34 pesticides (25.93%) had at least one carcinogenic agent in them and haloxy fobmethyl and alachlor were the most and the least carcinogenic chemicals found, respectively (Figure 2).

The results also revealed that 30 pesticides (711720 liters) 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 was 44.99% (Figure 2). Premtrine and 2,4,D were, respectively, the chemicals with the lowest and the highest levels used in pesticides that had environmental hormone activities. It has already been reported that some pesticides can contribute to male infertility and 522,170 liters (33.01%) of the pesticides used in Fars during the year under study had at least one hormonally active substance which interferes with male fertility. We also found that 7.82% (66,572 liters), 4.54% (39,975 liters), 22.02% (348,400 liters), 5.12% (81,000 liters) and 21.18% (34,500 liters) of pesticides used there were classified as antiestrogenic, antiandorgenic, antityroidic, antigonadotropin and anitestroid hormones, respectively, and so can disturb normal endocrine glands (Figure 2).

Pesticide manufacturers add some inert chemicals to chemically active substances to increase their product weights. From 1,581,690 liters of total pesticides used in Fars Province, 634,008 liters (40.08%) were active substances and the rest were inert substances. Pesticides with endocrine disruptor activity contained 22.30% active substances, and pesticides with male infertility action, carcinogenic, antithyroidic, estrogenic, antigonadotropic, antiandrogenic and antiesteroid hormones contained 42.68%, 25.93%, 31.61%, 10.5%, 6.3%, 7.57%, 4.17% of the active substances, respectively (Figure3).

Discussion

It is undisputed that a number of substances (known as environmental hormones or endocrine disruptors) are able to disrupt endocrine processes, with the potential for impairing development and reproduction or

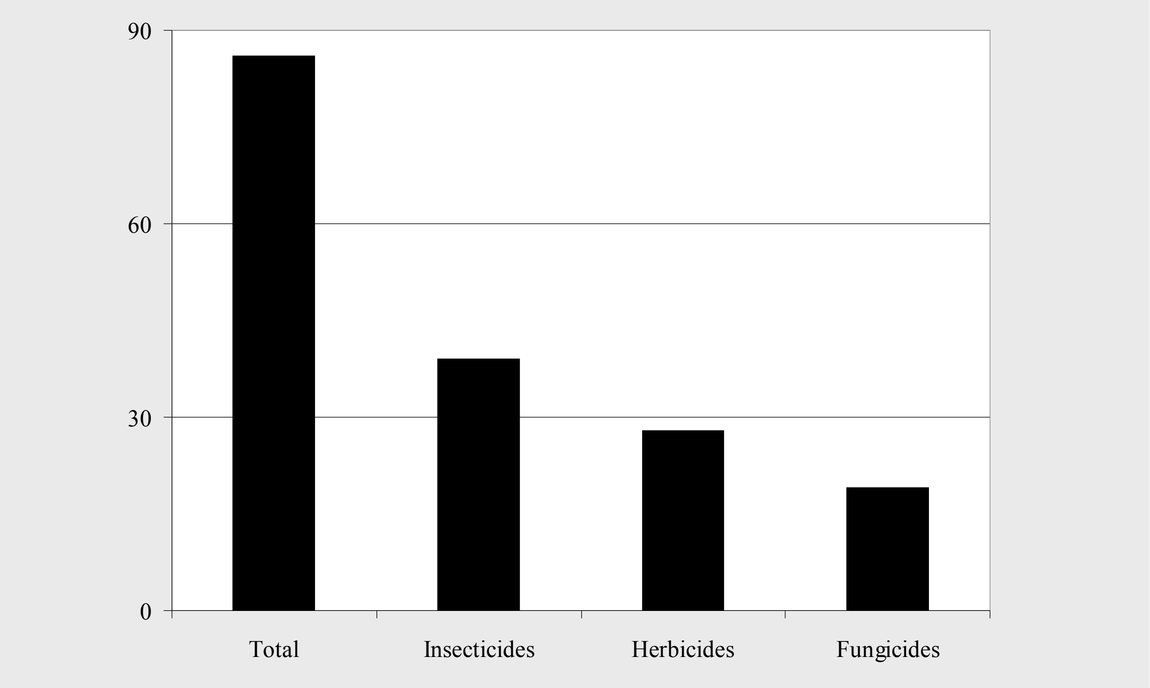

Figure 1- Different types of pesticides used in 1380 in Fars province

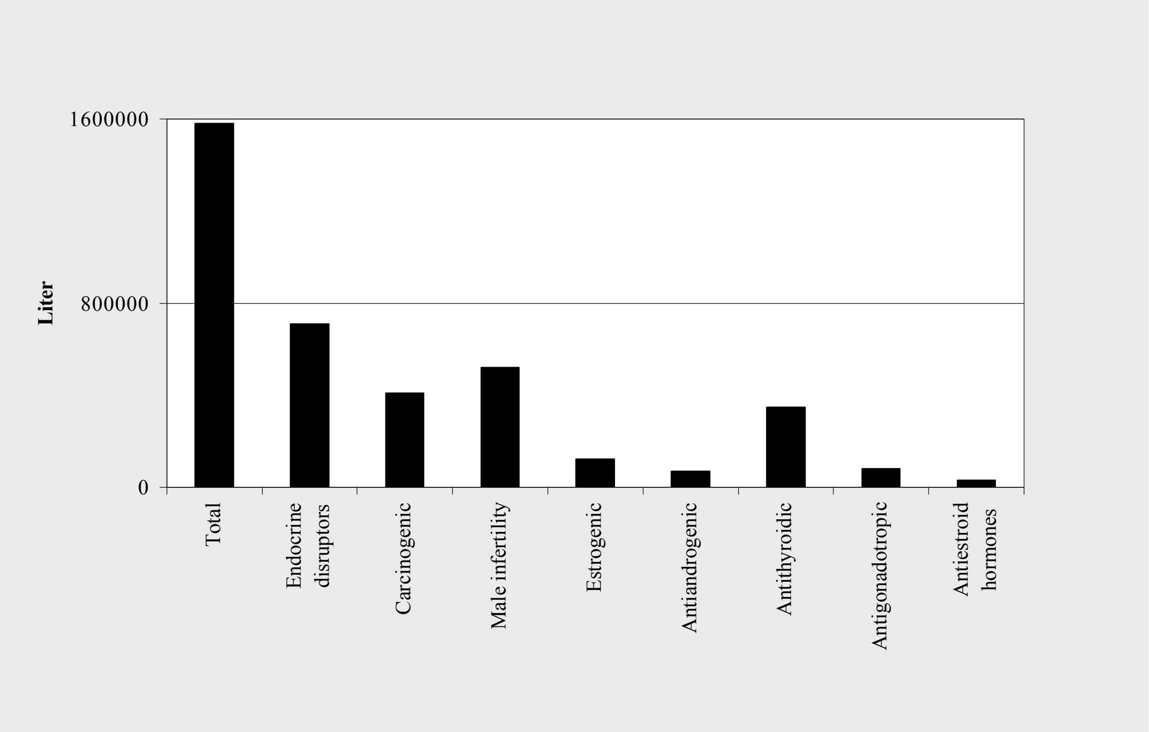

Figure 2- Total pesticides, carcinogenic and side effects on endocrine system

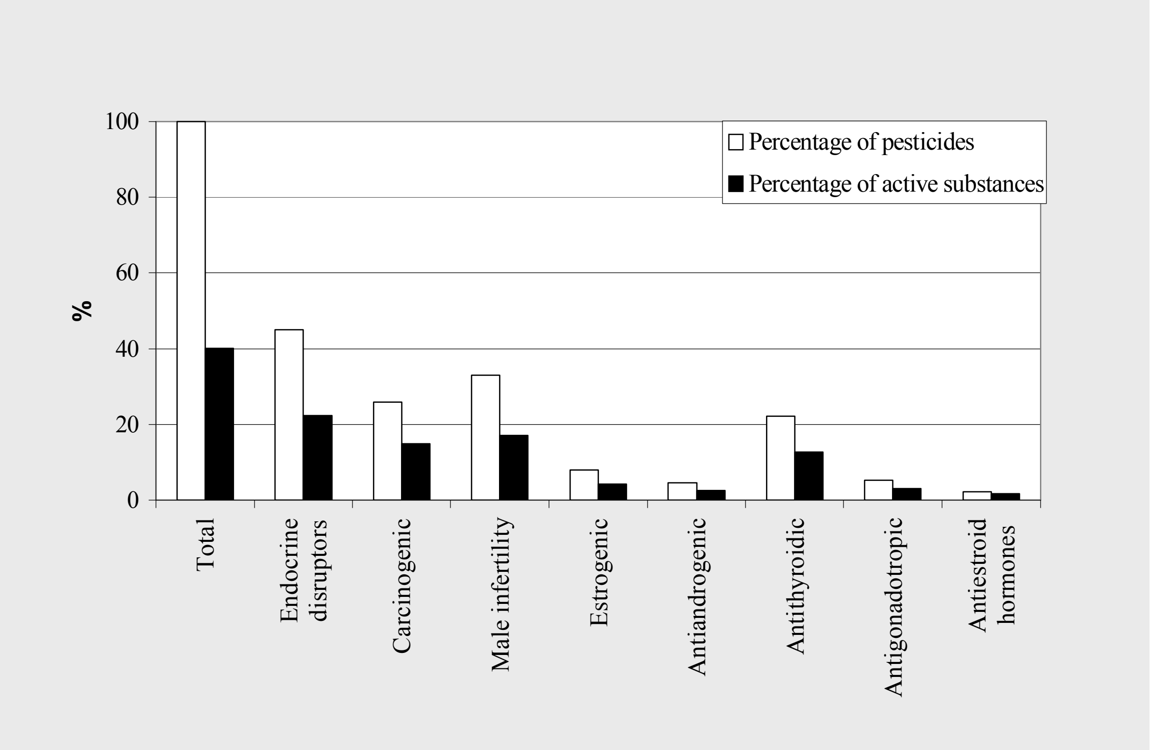

Figure3- Percentage of all pesticides groups and the percentage of their active substances

increasing the risk of certain cancers (Iwamoto and Nozawa, 2000; Rittler and Castilla, 2002). Many studies have shown that the sperm count in ejaculate has fallen up to 50% in Western Europe (Akingbemi and Hardy, 2001: 391-403) 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 link between levels of DDT and its metabolites in the body with the incidence of breast cancer has been shown (Markey and Coombs *et al.*, 2003; Singleton and Khan, 2003). 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 evidence that prenatal exposure to pesticides can affect the developing nervous system (Charlier and Plomteux, 2002).

The pesticide DDT was the first product 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 defoliants for fighting jungle warfare (Calle and Frumkin *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, a combination almost never found in the natural world (Snedeker, 2001).

These pesticides are lipophilic and persistent in the environment (Martin and Harlow, 2002; Tapiero and Ba, 2002), and tend to accumulate in body fat (Kelce and Stone, 1995). In view of its widespread usage (Shekhar and Werdell, 1997), 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 up till 1960, when their usage was banned in the western countries, although it is still being used in developing countries (Jaga and Duvvi, 2001).

These 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 levels of DDT/DDE in their breast milk than USA-born women (Eriksson and Talts, 2000).

Moreover, 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 has been observed in these alligators due to reduced plasma testosterone in the polluted water (Guillette and Gross, 1994).

A governmental company is responsible for importing and distributing pesticides currently used in Iran, although small-scale smuggling in has contributed to this process and so we have tried to find and analyze all pesticides available in the market. This fact may contribute to the large numbers of different pesticides available in the market.

Our results showed that nearly 26% of pesticides are carcinogenic and, taking into account the process of preparation, spraying, cleaning and storage of pesticides, reveal the depth of the threat to 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 relationship between pesticides and cancer incidence has been reported (Calle and Frumkin, 2002).

About 45% of pesticides had at least one endocrine disruptor substance and so can been classified as endocrine disruptor or environmental hormones. Many of these pesticides have already been banned in developed countries. The endocrine disruptors enter and are absorbed by body via food, water, air and even through the skin and due to their lipophilic specification accumulate in body fat until their concentration reaches a critical point, and are then released into the blood stream. By attaching to hormonal receptors, they exert harmful effects on the body. It has been reported that some pesticides can, directly or indirectly, increase infertility (Harrison, 2001: 1317-8) and 33.01% of the 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 are called antiestrogenic, antiandrogenic, antigonadotripin and antithyroidic chemicals, respectively (Singleton and Khan, 2003). The percentages of these chemicals in our study were high and the threat they pose to public will be high.

The results reported here confirm that some pesticides should be banned immediately and proper warnings should be given to farmers and the public to avoid using those pesticides. The government must adopt tougher regulations and actions for importing, distributing and usage of banned pesticides and custom inspections should be increased to prevent pesticide smuggling. Some foreign companies and manufacturers have been allowed to produce certain banned pesticides only for export and this is the main reason why the percentage of prohibited pesticides used in Iran are high.

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