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Pesticides and Endocrine Disruption

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Abstract

A large number of chemical pesticides we are using in agriculture for the protection of plants from pests and weeds. Such chemicals directly or indirectly affects the humans and causes a number of diseases. Endocrine system controls various metabolic activities in the body. It consists of hormones, glands and receptors. There are some endocrine disrupting chemicals which disrupt the normal functioning of endocrine glands. Such chemicals mimic the natural hormones and disrupt the normal functioning of endocrine system. Due to disruption of endocrine system so many endocrinological diseases occur in the body because these chemicals may cause hyposecretion and hypersecretion. The focus of this review article is to study how these chemicals affect the endocrine system.

Keywords: *Hormones; Pesticides; Disruption*

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Introduction

Pesticides are the chemical compounds which are used in the agriculture for the protection of crops from pests as well as from diseases and weeds and plant disease vectors. Pesticides disrupt the normal functioning of the nervous system of the pests. There are numerous pesticides have been developed and used worldwide excessively. Extensive use of pesticides may cause various environmental pollution and causes various health problems in humans as well as in animals. According to WHO (World Health Organisation) more than three million pesticide poisonings occur annually which may result in approx. 220,000 deaths in the whole world (WHO, 1992). Pesticides are the chemicals which disrupt the normal functioning of endocrine glands. Such type of chemicals are called Endocrine Disrupting Chemicals (EDCs).

Endocrine system consists of glands which have ducts and these gland distributed throughout the body, hormones which are secreted from these glands and receptors through which hormones bind and circulate in the circulatory system. Every endocrine gland secrete hormones which are chemicals and after secretion these hormones released into the circulatory system. Hormones plays very important role in the body.

Parathyroid	• Parathyroid hormone (PTH)	• It maintains the masculine development in males. • It helps in healthy development of sex organs in males.
Testes	• Androgens i.e., Testosterone	• It maintains the masculine development in males. • It helps in healthy development of sex organs in males.

Endocrine disruptor chemicals mimic the action of natural hormones, due to such antagonist action of these pesticides the receptors get blocked and inhibit the normal action of hormones. It also alter the synthesis, metabolism, and transport of natural hormones. Mostly birds, fishes, reptiles and mammals are affected by these endocrine disrupting pesticides (Bishop., *et al*. 1991; Fry and Toone, 1981; Fry., *et al*. 1987; Tyler., *et al*. 1998; Reijnders, 1986; Oskam., *et al*. 2003). Most of the animals expose to organochlorine pesticide which affect the reproductive functions. Endocrine disrupting chemicals are found in:

- Food as residues and contaminants
- Pesticides
- Personnel care products like Cosmetics
- Metals

Effect of Endocrine disrupting pesticides on humans

Exposure to pesticides causes several diseases in humans such as neurological disorders, reproductive diseases, Endocrine disorders and many type of cancer. These pesticides disrupts the reproductive and sexual development in humans. Mostly damages occur during the formation of gametes i.e., sperm and ovum and during early development of fetus (Sharpe, 2006; Skakkebaek, 2002; Hardell., *et al*. 2006). Endocrine disrupters:

1. It mimic the action of natural hormone like oestrogen's, androgens and thyroid hormones and setting off similar actions in the body.
2. It affect the transport, synthesis, excretion and metabolism of natural hormone.
3. It alter the level of natural hormones in the body.
4. It alter the normal functioning of hormones by blocking the receptors in the cells.

Endocrine disrupter pesticides affects both animals and environment. It declines the number of sperm in males and cause breast cancer in females. Such chemicals also affects children as it delays neurodevelopment as well as it affects the immune system.

Endocrine Gland	Hormones	Function
Pineal	Melatonin	It regulate the circadian or biological rhythm.
Pituitary	• Prolactin • Follicle stimulating hormone (FSH) • Thyroid stimulating hormone (TSH) • Growth hormone (GH) • Leutenizing Hormone (LH) • Vasopressin • Oxytocin	• It stimulates the production of milk • It ensure the normal functioning of ovaries. • It stimulates the thyroid gland. • It maintains the growth in children. • It ensure the normal functioning of ovaries. • It regulate the blood pressure and balance the electrolyte. • It stimulates the production of milk and contract the uterus during child birth.
Hypothalamus	• Dopamine	• It works as neurotransmitter and functions as sending signals from one neuron to another neuron.
Thyroid	• T3 (Tri - iodothyronine) and T4 (Thyroxine) • Calcitonin	• Both regulates the metabolism of the body • It controls the blood calcium level
Thymus	• Thymosin	• It stimulates the development of T cells for immunity.
Pancreas	• Glucagon • Insulin	• It maintains the normal glucose level in the blood. • It drops the glucose level in the blood when the level of glucose rises.

Ovary	• Oestrogen • Progesterone	• It control the normal development of female sex organs. • It also maintain the metabolism. • It increases the secretory action of endometrium and promotes development of breast in females.
Adrenal	• Mineralocorticoids • Glucocorticoids	• It stimulate the retention of sodium in extracellular fluids. • It maintains the sodium and potassium level in the body. • It regulates the blood pressure, immune response and cardiovascular functions.

Table 1: *Endocrine glands with their hormones and functions.*

Acephate (Insecticide)	• It disrupt the expression of hormone in hypothalamus.	Singh, 2002
Alachlor (Herbicide)	• It interfere the enzyme production responsible for steroid hormone metabolism.	Cocco, 2002; Mikamo., *et al*. 2003
Aldicarb (Insecticide)	• It inhibit the normal functioning of beta-estradiol and progesterone.	Klotz., *et al*.1997
Atrazine (Herbicide)	• It inhibit androgen. • It disrupt the hypothalamic control of lutenising hormone. • It disrupt the level of prolactin in blood. • It damages adrenal gland and reduce the metabolism of steroid hormones.	Cocco, 2002; Cooper., *et al*. 2000; Hayes., *et al*. 2003; Sanderson., *et al*. 2000; Thibaut and Porte, 2004
Benomyl (Fungicide)	• It increases the production of oestrogen. • It increases the aromatase activity.	Moringa., *et al*. 2004
Bioallethrin (Insecticide)	• tIt inhibit the proliferation of oestrogen sensitive cells.	Kim., *et al*. 2003
Carbaryl (Insecticide)	• It decreases the effect of oestrogen.	Cocco, 2002
Carbofuran (Insecticide)	• It decreases the level of testosterone and increases the level of oestrogen, progesterone and cortisol. • It disrupt the metabolism of steroid hormones.	Goad., *et al*. 2004
Chlorothalonil (Fungicide)	• It activate the proliferation of androgen-sensitive cells.	Tessier and Matsumura, 2001
Chlordane (Insecticide)	• It inhibit the binding of estradiol.	Cocco, 2002
Dieldrin (Insecticide)	• It stimulates the production of oestrogen receptor.	Andersen., *et al*. 2002; Lemaire., *et al*. 2004; Tapiero., *et al*. 2002; Soto., *et al*. 1994
Dimethoate (Insecticide)	• It increases the insulin in blood. • It increases the insulin in blood.	Rawlings., *et al*. 1998; Mahjoubi-Samet., *et al*. 2005

Diuron (Herbicide)	• It inhibit the action of androgens.	Thibaut and Porte, 2004
Endosulfan (Insecticide)	• It stimulates the production of oestrogen receptor.	Bulayeve and Watson, 2004 Andersen., *et al*. 2002
Fenvalerate (Insecticide)	• It inhibit the proliferation of oestrogen sensitive cells.	Garey and Wolff 1998
Fenitrothion (Insecticide)	• It inhibit the action of oestrogens.	Tamura., *et al*. 2003
Lindane (Insecticide)	• It decreases the concentration of luteal progesterone hormone and reduces the oestrous cycles. • It increases the concentration of insulin and estradiol in blood serum. • It also shows anti-androgenic activity.	Rawlings., *et al*. 1998;, Beard and Rawlings, 1999
Malathion (Insecticide)	• It inhibit the secretion of catecholamines.	Ishihara., *et al*. 2003
Metribuzin (Herbicide)	• It causes hyperthyroidism and it alter the level of somatotropin hormone.	Porter., *et al*. 1993
Permethrin (Insecticide)	• It inhibit the proliferation of oestrogen sensitive cells.	McCarthy., *et al*. 2006
Propanil (Herbicide)	• It increases cellular response to oestrogen.	Salazar., *et al*. 2006
Tetramethrin (Insecticide)	• It causes Oestrogen antagonistic • effects in females	Kim., *et al*. 2005
Toxaphene (Insecticide)	• It inhibit the synthesis of corticosterone in the adrenal cortex.	Soto., *et al*. 1994

Table 2: *Pesticides and their effect on Human Endocrine System.*

References

1. Andersen HR., *et al*. "Effects of currently used pesticides in assays for estrogenicity, androgenicity, and aromatase activity *in vitro*". *Toxicology and Applied Pharmacology* 179.1 (2002): 1-12.
2. Beard AB and Rawlings NC. "Thyroid function and effects on reproduction in ewes exposed to the organochlorine pesticides lindane or pentachlorophenol (PCP) from conception". *Journal of Toxicology and Environmental Health* 58.8 (1999): 509-530.
3. Bishop CA., *et al*. "The case for a cause-effect linkage between environmental contamination and development in egg of the common snapping turtle from Ontario, Canada". *Journal of Toxicology and Environmental Health* 33.4 (1991): 521-547.
4. Bulayeve NN and Watson CS. "Xenoestrogen-induced ERK-1 and ERK- 2 activation via multiple membrane-initiated signaling pathways". *Environmental Health Perspectives* 112 (2004): 1481-1487.
5. Cooper R., *et al*. "Atrazine disrupts the hypothalamic control of pituitary-ovarian function". *Toxicological Sciences* 53.2 (2000): 297-307.
6. Cocco P. "On the rumours about the silent spring. Review of the scientific evidence linking occupational and environmental pesticide exposure to endocrine disruption health effects". *Cadernos de Saúde Pública* 18.2 (2002): 379-402.
7. Fry DM and Toone CK. "DDT-induced feminisation of gull embryos". *Science* 213.45 (1981): 922-924.
8. Fry DM., *et al*. "Sex ratio skew and breeding patterns of gulls, demographic and toxicological considerations". *Studies in Avian Biology* 10 (1987): 26-43.
9. Garey J and Wolff MS. "Estrogenic and antiprogestagenic activities of pyrethroid insecticides". *Biochemical and Biophysical Research Communications* 251.1 (1998): 855-859.
10. Goad R., *et al*. "Carbofuran-Induced endocrine disruption in adult male rats". *Toxicology Mechanisms and Methods* 14.4 (2004): 233-239.
11. Hardell L., *et al*. "In utero exposure to persistent organic pollutants in relation to testicular cancer risk". *International Journal of Andrology* 29.1 (2006): 228-234.

12. Hayes T., *et al*. "Atrazine-induced hermaphroditism at 0.1 ppb in American leopard frogs (Rana pipiens); laboratory and field evidence". *Environmental Health Perspectives* 111.4 (2003): 568-575.
13. Ishihara A., *et al*. "The effect of endocrine disrupting chemicals on thyroid hormone binding to Japanese quail transthyretin and thyroid hormone receptor". *General and Comparative Endocrinology* 134.1 (2003): 36-43.
14. Kim IY., *et al*. "Assessing estrogenic activity of pyrethroid insecticides using in vitro combination assays". *Journal of Reproduction and Development* 50.2 (2004): 245-255.
15. Kim SS., *et al*. "Assessment of estrogenic and androgenic activities of tetramethrin in vitro and in vivo assays". *Journal of Toxicology and Environmental Health* 68.23 (2005): 2277-2289.
16. Klotz D., *et al*. "Inhibition of 17 beta-estradiol and progesterone activity in human breast and endometrial cancer cells by carbamate insecticide". *Life Sciences* 60.17 (1997): 1467-1475.
17. Lamaire G., *et al*. "Effect of organochlorine pesticides on human androgen receptor activation in vitro". *Toxicology and Applied Pharmacology* 196.2 (2004): 235-246.
18. Mahjoubi-Samet A., *et al*. "Dimethoate effects on thyroid function in suckling rats". *Annales d'Endocrinologie* 66.2 (2005): 96-104.
19. McCarthy AR., *et al*. "Estrogenicity of pyrethroid insecticide metabolites". *Journal of Environmental Monitoring Home* 8.1 (2006): 197-202.
20. Mikamo E., *et al*. "Endocrine disruptors induce cytochrome P450 by affecting transcriptional regulation via pregnant X receptor". *Toxicology and Applied Pharmacology* 193 (2003): 66-72.
21. Moringa H., *et al*. "A benzimidazole fungicide; benomyl and its metabolite; carbendazim; induce aromatase activity in a human ovarian granulose-lile tumor cell line (KGN)". *Endocrinology* 145.4 (2004): 1860-1869.
22. Oskam IC., *et al*. "Organochlorines affect the major androgenic hormone; testosterone; in male polar bears at Svalbard". *Journal of Toxicology and Environmental Health* 66.22 (2003): 2119-2139.
23. Porter W., *et al*. "Groundwater pesticides, interactive effects of low concentrations of carbamate aldicarb and methomyl and the triazine metribuzin on thyroxine and somatotropin levels in white rats". *Journal of Toxicology and Environmental Health* 40.1 (1993): 15-34.
24. Rawlings NC., *et al*. "Effects of the pesticides carbofuran; chlorpyrifos; dimethoate; lindane; triallate; trifluralin, 2, 4-D and pentachlorophenol on the metabolic endocrine and reproductive endocrine system in ewes". *Journal of Toxicology and Environmental Health* 54.1 (1998): 21-36.
25. Reijnders PJ. "Reproductive failure in common seals feeding on fish from polluted coastal waters". *Nature Research* 324.6096 (1986): 456-457.
26. Salazar KD., et al. "Evidence for a novel endocrine disruptor, the pesticide propanil requires the ovaries and steroid synthesis to enhance humoral immunity". *Toxicological Sciences* 93.1 (2006): 62-74.
27. Sharpe RRM. "Pathways of endocrine disruption during male sexual differentiation and masculinization". *Best Practice & Research: Clinical Endocrinology & Metabolism* 20.1 (2006): 91-110.
28. Singh AK. "Acute effects of acephate and methamidophos in interleukin-1 on corticotropin-releasing factor (CRF) synthesis in and release from the hypothalamus in vitro". *Comparative Biochemistry and Physiology* 132.1 (2002): 9-24.
29. Skakkebaek NN. "Endocrine disrupters and testicular dysgenesis syndrome". *Hormone Research* 57 (2002): 43.
30. Soto AM., *et al*. "The pesticides endosulfan; toxaphene, and dieldrin have estrogenic effects on human oestrogen-sensitive cells". *Environmental Health Perspectives* 102.4 (1994): 380-383.
31. Tamura H., *et al*. "Interaction of organophosphate pesticides and related compounds with the androgen receptor". *Environmental Health Perspectives* 111.4 (2003): 545-552.
32. Tapiero HT., *et al*. "Estrogens and environmental oestrogen's". *Biomedicine & Pharmacotherapy* 56.1 (2002): 36-44.
33. Tessier D and Matsumura F. "Increased ErbB-2 tyrosine kinase activity; MAPK phosphorylation; and cell proliferation in the prostate cancer cell line LNCaP following treatment by select pesticides". *Toxicological Sciences* 60.1 (2001): 38-43.
34. Thibaut R and Porte C. "Effects of endocrine disrupters on sex steroid synthesis and metabolism pathways in fish". *The Journal of Steroid Biochemistry and Molecular Biology* 92.5 (2004): 485-494.

35. Tyler CR., *et al*. "Endocrine disruption in wildlife, a critical review of the evidence". *Critical Reviews in Toxicology* 28.4 (1998): 319-361.

36. WHO. Our Planet, Our Health; Report of the WHO Commission on Health and Environment; WHO: Geneva, Switzerland. (1992).