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Dark Side of PPCP: An Unconscious Infiltration into Environment

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Abstract: PPCP (Pharmaceuticals & Personal Care Product) is a general product used by individuals for personal health /cosmetic reasons or used by agribusiness to enhance growth/ health of livestock. This includes prescription, OTC therapeutic drugs, veterinary drugs, fragrances & cosmetics. They are generally ends up in surrounding environment causing havoc at microgram level.

Due to low degradability, it's impossible to get rid of most of personal care originated chemicals during waste water treatment & enters drinking water system during ground water recharge. Biologically active PPCP can interfere with endocrine system to produce undesired effects/disruption of homeostasis so also called EDCs (Endocrine Disruption Chemicals)

EDCs intervene with synthesis, secretion, transport, binding & action /elimination of Natural Hormones. EDCs includes natural/synthetic hormones e.g. Alkyl phenol ethoxycarboxylate which cause endocrine disruption & alteration in reproductive physiology in fishes. Various antibiotics, antineoplastics, analgesics of basically polar non-volatile nature. Estradiol & ethylestradiol induces production of Vitellogenin (a type of protein) in male fish which actually found in female fishes. Discharge from Clandestine drug Labs & illicit drug usage, release of treated/untreated hospital waste to domestic sewage, disposal by pharmacies, physicians & humanitarian drug surplus.

The aim of this work is to innumerate various statistical data about presence of PPCP, their hazards on ecological pyramid , different sources & various effects on human health & conclude about future monitored PPCP with their detection & treatments of disposal.

Keywords - Pharmaceutical Personal care product , Ecological Pyramid, Environment.

Introduction

With the widespread use of chemicals in our day to day life in the form of cosmetics & pharmaceuticals, we are playing with our future by gradually altering the ecological niche. PPCP used by multitudes of individuals which includes prescriptions drugs from various range of medications as – over the counter ,Pain relievers, Depression(anti-anxiety),Colds remedies, Birth control pills, Antibiotics, Control substances (narcotics),Veterinary drugs Supplements (e.g., vitamins) Cosmetics Fragrances Sun-screen products Diagnostic agents

According to IMS report; there was an 8.3 % rise in sales of prescribed drugs in 2006 in USA & India's US $ 3.1 billion pharmaceutical industry growing at rate of 14% every year. Report by World Pharmaceutical Market 2007:- North America is largest pharmaceutical market constituting 49% of worldwide market followed by Europe & Asia-pacific.

PPCP now considered being ubiquitously pollutants, Persistent bio-accumulative toxins in environment released from pharmaceutical industries & hospitals into main water bodies as waste water/sewage sludge water treatment plants. Recent investigations for presence of pharmaceuticals, from water treatment plant shows 31,000 µg/L concentration of Ciprofloxacin (antibiotic) in Patencheru Enviro Tech Limited (PETL) near Hyderabad.

Daily treated-untreated chemicals thrown as effluents; mixed with human sewage to improve efficiency of biological treatment phenomena. Which generate a severe risk factor of exposure of human/animal pathogens to drugs for prolonged period that lead to production of resistant bacterial strains [1].

Objective

Disposition of PPCP in ecological pyramid interfere with developmental cycle & reproduction ability of animals to cope with stress/ communicate chemically, received less attention which carried forward from generation to generation creating irreversible situation. The main objective of this work is to produce awareness in community & to individuals about proper use, disposal & hazards on ecology, human beings to show real challenges for coordinated research for disposal of PPCP.

Types of PPCPs

Biologically active drugs e.g. hormones, antibiotics, lipid regulators, antineoplastics & analgesics. These are basically polar, non-volatile and lipophilic with very low biodegradability.

Natural/synthetic hormones, degradation products of non-ionic surfactants (phenolic compounds), plasticizers and byproducts of mostly used industrial detergents & surfactants. Alkyl phenol ethoxycarboxylate found to persist through tertiary treatment (filtration) which found in rivers, estuaries & top water to cause endocrine disruption & alteration in reproductive physiology in fishes. E.g. Estradiol & ethyl Estradiol induced production of protein (Vitellogenin) in male fish which actually found in female fishes.

Metabolite excretions, caffeine, estrogen derivatives, antibacterial, fragrances, unmetabolised parent drug, parent drug conjugates & bioactive medications, disposal of unused outdated mediations to sewage system [2].

Sources of PPCPs

PPCP dissolved easily in water; don't evaporate at normal temperature and pressure. Found in waters, including wastewater, surface water, ground water, drinking water.

1) Point sources:-definite places where pollutants actually enters environment e.g. discharge of effluents from water treatments plant to water bodies.

2) Non-point sources:-not definite points of entry e.g. Run-off from animal feeding operations, Human excretion

- Release of treated & untreated hospital waste to domestic sewage system, disposal by pharmacies, physicians & humanitarians drug surplus, discharge of treated effluents from domestic sewage treatment plants, transfer of sewage solids to land (soil amendment/fertilization), and release of untreated waste discharged directly to water bodies from straight piping [3].
- Modern agricultural & industrial mechanisms.
- Discharge of industrial manufacturing units, discharge from clandestine drug labs & illicit drug usage, disposal to landfills via domestic refuse, medical wastes & other hazardous waster, leaching from defective landfills & cemeteries , released open waters from aquaculture(medicated feed & resulting excreta).
- Release from molecular farming & pest control drugs.
- Underground leakage from sewage system infrastructure, disposal of euthanized /medicated animal carcasses as food for scavengers [4].

Biohazards/impacts of PPCPs

Endocrine disrupting chemicals (EDCs) produces potentially leads to carcinogenic, reproductive developmental effects by interfering with various hormonal pathways, disruption in general metabolism, producing acute toxicity, immune system effects.

- Due to disruption of development & reproduction, ability of animals to cope with stress/communicate chemically, received less attention.
- Disposition of PPCPS in ecological pyramid interferes with reproductive & developmental cycle which carried forward from generation to generation.
- EDCs interferes with synthesis, secretion, transport, binding action on organs /elimination of natural hormones, endocrine system which responsible for maintenance of homeostasis, reproduction, development/behavior.

New treatments for disposal

- Powdered Activated Carbon Treatment (PACT)
- Reverse Osmosis
- Micro-filtration Techniques-Membrane Bioreactor (MBR)
- Activated Sludge-secondary treatment system
- Thermophilic Treatment for Biosolids-aerobic and anaerobic
- Solar Treatment for Wastewater Effluent

PPCP regulating Agencies

- Drug Enforcement Administration (DEA)
- Food and drug Administration (FDA)
- National Association of Clean Water Agencies
- European Medicines Agency
- USGS
- States Governments
- Harvard School of Public Health
- Other Universities

How we prevent from spreading into environment?

- Don't ask for medication that you do not need
- Don't flush unwanted medication down the toilet or the drain
- Minimize the use of other products (e.g., cleaning, fragrances)
- Start public education
- Labeling program with disposal information
- Leaflets issued by pharmacies
- POTW campaigns through *"bill stuffers*"
- Other options for disposal
- Community collections
- Take-back programs [5]

Experimental Methods

1) LITERATURE SURVEY IN LIBRARY & WEB ACCESS :

We go for books & Journals on various topics of pharmaceuticals drug disposal, expired drug's fate, storing of PPCP, pollution through Industries & Biohazards of Hospitals discharge, Pollutants in drinking water supply. We also go for nearby PPCP disposal units for quantitative estimations.

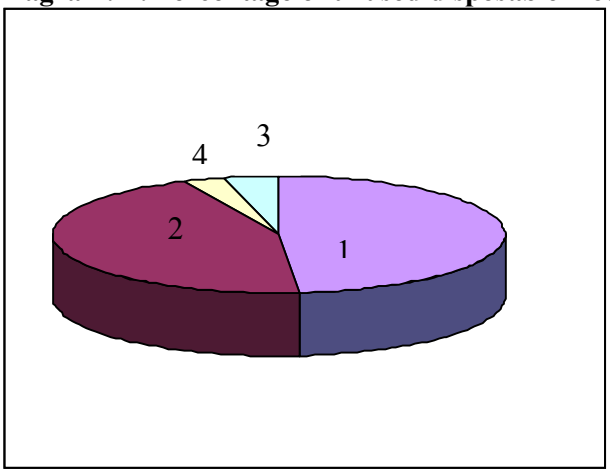
2) PRODUCING ANALYTICAL DATA & DISCUSSION:

We study quantitative PPCP parameters & type of EDCs to draw scientific graphs indicating rate of PPCP increase in environment. We arrange data to give explanatory conclusions through discussions. Through Pharmacological actions, we derive most hazardous PPCP & their minimum conc. in drinking water not to produce harmful effects [6].

Results & Discussion

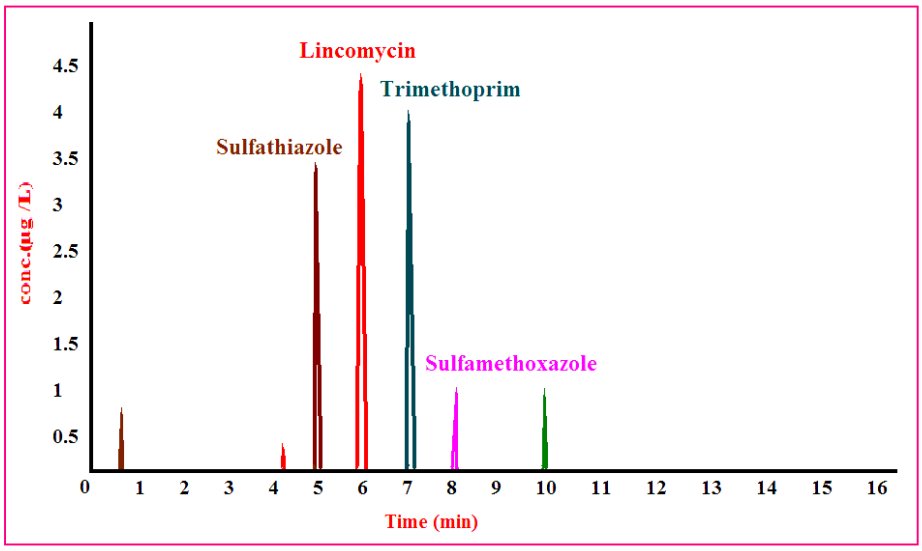
PPCP increases risk of congenital, hereditary disorders in reproductive system of humans as well as other animal (Biota). Investigation reports on EDCs & their consequences on health begins to use data on individuals for development of hypotheses regarding fitness risks, changes in population dynamics & potential for ecosystem level disruption. There is need of production of degradable drugs & development of sustainable treatment process. There is a need to make people aware of the proper use and disposal of the commonly used PPCPs.

Diagram:-1. Percentage of unused disposable medications



1-Toilet 49%
2-Trash 45%
3-Pharmacy 3-4%
4-Other 3-4%

Diagram:-2. Chromatograms for extracted water Samples from Indian waterways. (0.1 µg/L)



Conclusion

Widespread use of chemicals & less efficient water treatment plants, PPCP gradually alters ecological niche E.g. Rivers. Polluting to marine life & indirectly producing Neurotoxin & Genetic disorders due to repeated & prolonged exposure unknowingly to human being. Due to prolonged exposure of PPCP to bacterial pathogens, produces more resistant strains. Increasing incidence of life style diseases leading to high demand of drugs /PPCP by global population directly booms world wide growth of Pharmaceutical market & industry.

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