Biodegradation of Pesticides

Biodegradation: Breakdown of a substance catalyzed by enzymes *in vitro* or *in vivo*. The Biodegradation characterized depending on the purpose of hazard assessment:

1) Primary biodegradation: Alteration of the chemical structure of a substance resulting in loss of a specific property of that substance.

2) Acceptable biodegradation: remove undesirable properties of the compound. This often corresponds to primary biodegradation but it depends on the circumstances under which the products are discharged into the environment.

3) Ultimate. Complete breakdown of a compound to either fully oxidized or reduced simple molecules (such as carbon dioxide/methane, nitrate/ammonium and water).

Type of pesticides

1) Organochlorine pesticides

The organochlorine pesticides are known to be highly persistant in the environment. This class of pesticides includes the chlorinated derivatives of diphenyl ethane. for example: DDT and chlordane

DDT is the most well known pesticide from the organochlorine group. The use of organochlorine pesticides started in 1939 was an efficient insecticide, its low water solubility, its high persistence in the environment and its mode of action, unknown until that moment.

Microbial degradation of organophosphate pesticides

The fate of pesticides in the environment is determined by both biotic and abiotic factors.

The rate at which different pesticides are biodegraded varies widely. Some pesticides suchas DDT and dieldrin remain in the environment for a long time and accumulate into food chains for decades after their application to the soil.

The degradation of organochlorine pesticides by *Pseudomonas* sp. have been studied, the bacteria was isolated from a soil sample .DDT-metabolising microbes have been isolated from a range of habitats, including soil, sewage, activated sludge, and marine and freshwater sediments.

Biodegradation of DDT residues involves co-metabolism, that is, it requires the presence of an alternative carbon source, in which microorganisms growing are able to transform DDT residues without deriving any nutrient or energy for growth from the process.

Some of the microorganisms that were able to degrade organochlorine pesticides belonging to genera *Bacillus, Pseudomonas, Arthrobacter* and *Micrococcus*.

Fungi also have the ability for biodegradation of organochlorine pesticides for example *Penicillium*, *Aspergillus*, and *Trichoderma* sp.

2) Organophosphate pesticides (OP)

The organophosphorus pesticides (**OP**) are all esters of phosphoric acid and form the major and most widely used group that accounts for more than 36% of the total world market. The most used among these is methyl parathion. Most OP compounds are degraded by microorganisms in the environment as a source of phosphorus and carbon

The **OP** possess an efficient insecticide activity, due to its characteristic of irreversibly inhibiting the enzyme acetylcholinesterase in the nervous system, which acts in both insects and in mammal.

In man, the organophosphates are absorbed through all routes, reaching high concentrations in fatty tissues, liver, kidneys, salivary glands, thyroid,
pancreas, lungs, stomach, intestines and, at smaller proportions, in the central nervous system (SNC) and muscles.

Microbial degradation of organophosphate pesticides

Methyl parathionis widely used throughout the world and its residues are regularly detected in a range of fruits and vegetables. Bacteria with the ability to degrade methyl parathion have been isolated worldwide.

The OP pesticides can be hydrolyzed and detoxified by carboxylesterase and phosphotriesterase enzymes. Two bacteria identified as *Pseudomonas putida* and *Acinetobacter rhizosphaerae,* able to rapidly degrade the organophosphate