Chapter 1

Introduction
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Today, man, in his varying nature of unquenching thirst for comforts, is arrogantly misusing his environment. The massive urbanisation, industrialisation, commercialisation and motorisation etc lead to a never-ending problem of pollution. Population explosion and industrialisation are the two main causes of world-wide pollution.

Pollutants are discharged by man as a result of his industrial, agricultural and urban activities. Industries release large quantities of air, land and water pollutants. The type of pollutants released by an industry is related to the process adopted in that industry. The pollutants can be of three types - degradable, non-degradable and biologically accumulative. Degradable pollutants undergo biological degradation while non-degradable pollutants are inert to biological action. Some pollutants can be accumulated in food chain. These are referred to as persistent substances.

Different contaminants of land and water are domestic wastes, agricultural wastes and industrial wastes. These include metals, heavy metals, radioactive substances, detergents, plastics, pesticides, rubber, leather etc. Land pollution will ultimately lead to destruction of soil, soil erosion, creation of dust bowls and deterioration of the environment. Land pollution is a localised one. Addition of chemicals in land will reduce its productive capacity. Accumulation of sewage on land will cause spreading of infectious diseases. Land pollutants are fertilizers, garbage, metals, heavy metals, pesticides etc. In Kerala, land pollution is mainly due to insecticides, pesticides, garbage, solid industrial wastes etc.
Water covers nearly 70% of the earth's surface and is one of the fundamental media in which life exists. Water pollution affects all aquatic organisms including fish. Biological effects of water pollution on fish include morphological and physiological changes, effects on migration, behaviour, disease incidence, lifecycle and genetic effects. Various types of suspended solid particles discharged into water bodies cause turbidity and reduction of dissolved oxygen in water.

Toxic chemicals such as metals and pesticides are absorbed into the tissues of aquatic animals of polluted water and through them, this will enter into higher animals and man. A number of anthropogenic activities such as mass bathing, burning of dead bodies and throwing of dead bodies directly into the rivers will increase the pollution problem. Maintaining the quality of water in the environment is the most important since it is directly linked with man's daily life. There is possibility for the transmission of diseases such as typhoid, cholera, jaundice etc. through the polluted water. According to an estimate, more than 80% of Indians suffer from water-borne diseases.¹

In India, water pollution is mainly due to untreated industrial effluents and sewage that are entered into different rivers. Rivers like Yamuna, Ganga, Sabarmati, Periyar etc. are highly polluted. Water pollution is due to different industrial effluents and a considerable amount of pollution in water is caused by processing of fish. Coir production is one of the major industry in Kerala. Husk retting zones are mainly Alappuzha and Kollam. Due to husk retting, the rivers are highly polluted. Numerous microorganisms are involved in this process.

The different contaminants of air are particulate matter, oxides of nitrogen, sulphur dioxide, carbon monoxide, ozone, other photochemical oxidants and other organic substances like carbon disulphide, trace metals etc. Air pollution is one of the greatest environmental evils. Depending upon the
nature of pollutants, some are harmful when present in the air even in small concentrations and others only if they are present in high concentrations.

The prime factors affecting human health are (1) nature of pollutants, (2) concentration of pollutants, (3) duration of exposure, (4) state of health of the receptor and (5) the age group of the receptor. Air pollution may produce irritation to the eyes, nose and throat, to the respiratory tract etc. Carbon monoxide combines with the haemoglobin in the blood and consequently increases stress on those suffering from cardiovascular and pulmonary diseases. Similarly, carcinogenic agents will cause cancer, dust particles cause silicosis etc. Air pollution damages materials chiefly by corrosion of metals, destroys rubber etc. Damage to vegetation is an important aspect of economic loss due to air pollution.

Widespread use of pesticides to control insect pests of agricultural crops and insect vectors of diseases has resulted in accumulation of some of the persistent chemicals in the environment. Majority of these pesticides is not biodegradable even at elevated temperatures, they leave behind a toxic residue in the environment. It is now well established that past human activities have resulted in widespread environmental contamination with pesticides. These effects are seen in lithosphere, atmosphere and biosphere. Pesticides are cumulative poisons in the body. They usually accumulate in food chain and are hazardous. Few of them undergo metabolic changes and biodegradation. Some of the pesticides residue so formed by degradation is more dangerous than the parent compound. The use of this chemicals in land and water management has posed potential health hazards not only to livestock and wildlife but also to fishes, birds, mammals including human beings.

Exposure of humans to pesticides occurs either by direct or indirect or through the food chain, or through contact and through occupational exposure.
Long term exposure can adversely affect a number of biological functions such as nervous system in many organisms, reproduction in birds and fishes, hormonal balance in mice, the temperature regulating mechanism in fishes, liver functions in man, etc.

In India, the demand for pesticides as a plant protection agent has rapidly increased after introduction of high-yielding seeds. Pesticides are used in about 25% of our total cultivated land. Of the different types of pesticides, organochlorides, organophosphates and carbamates are the important ones. The large scale usage of both HCH and DDT has lead to their ubiquitous presence in the Indian environment. Food is responsible for more than 90% of the intake of these chemicals in humans. Many reports are available about the residue levels of pesticides in fruits and vegetables. Residues of BHC and its isomers were reported in eggs, rice, milk, commercial baby foods, meat etc. DDT levels in human body fat and human milk were detected in samples from Delhi. According to a survey conducted by ICMR during 1993 October showed a widespread occurrence of HCH residues (BHC) in bovine milk, in Andhra Pradesh, Bihar and Uttar Pradesh and a survey conducted in the milk of lactating females from India and other countries indicated that maximum residues of HCH were recorded in India. Recently, increased levels of DDT were reported in breast tissue of women with breast cancer. DDT and HCH have been withdrawn from use in most of the advanced countries of the world but still being used freely in India. India was the biggest consumer and manufacturer of DDT and HCH in the world. Although the production of DDT had been stopped in early nineties and BHC restricted in mid-nineties, their levels are still seen in the environment. The major use of DDT in India has been in public health, whereas that of HCH in agriculture. Studies on market samples of vegetables like brinjal, okra, cabbage, cauliflower, cow pea, spinach and radish in Delhi region by Indian Agriculture Research Institute, Delhi, has found to
contain DDT above the human tolerance level. Almost all samples of meat, fish, milk, butter and ghee collected from different parts of India showed presence of DDT and BHC. HCH and DDT contamination of rural ponds of Delhi were reported recently.

In Kerala also, the pesticide use is very high resulting in heavy pollution of the environment. In Kuttanad, Thanneermukkom regulator is closed for most part of the year and at that time the water flow in that area will be relatively less. The periodical tidal flow, which is used to flush the water body, is completely prevented with the result that the drained water from the paddy fields with a heavy load of pesticides and fertiliser residues remains stagnant. So the entire Kuttanad forms a static pool after the closure of the barrage. Along with these agricultural wastes and industrial effluents that are emptied into this highly polluted area. Due to all these, many infectious diseases are also spreading out.

In Kuttanad, people use 500-1000 tons of pesticides per year under different categories, mainly organophosphates and organochlorides. BHC and DDT were still used in Kuttanad region in early nineties.

A number of pesticides particularly organochlorines, have an affinity for lipid materials and accumulate in animal systems. Organochlorines as a class are regarded as having low acute toxicity, but possesses a greater potential for chronic toxicity when compared to other classes, viz. organophosphates, carbamates etc. In general, the signs of poisoning produced by different chlorinated hydrocarbon insecticides are similar, that is, expressions of neuronal hyperactivity. From toxicological point of view, they are mainly central nervous system (CNS) poisons eliciting a variety of symptoms especially neuromuscular and behavioural symptoms. Lindane is capable of causing serious blood diseases in addition to some allergic reactions. In general, the total dietary intake of organochlorine pesticides by an Indian per day is over 30 μg and in case of organophosphates, their dietary intake is 5 to 10 μg/Indian/day.
Organophosphates and carbamates are believed to act primarily by inhibiting (phosphorylating or carbamylating) acetyl cholinesterase (AchE). Carbamates and some organophosphates are potent "direct" inhibitors of AchE. Neurophysiological and behavioural changes occur when birds and animals are exposed to organophosphate and carbamate pesticides. The usual symptoms of OP poisoning in mammals are defecation, urination, lachrymation, muscular twitching, fibrillation and convulsions. Death usually follows a chronic convolution. Small doses result in less severe symptoms and occasionally local paralysis.

People all over the world use different types of food ingredients (food additives) for preparing their dishes. Indians, especially Keralites use these for preparing soups, pickles and curries. Among these food ingredients, garlic, turmeric and ginger are important. Garlic and ginger are commonly ingested by most of the Indians in fairly large quantities (6-8 g/day) usually in combination, as a seasoning food.

Garlic (Allium sativum) has been used for the last 6,000 years by people and has so many properties. Therapeutic importance of garlic was revealed earlier by several researchers. It has so many properties like anodyne, antiasthmatic, antimicrobial etc. The cholesterol raising effect of fatty foods could be controlled by proper administration of garlic. Most of the effects of garlic have been ascribed to its sulphur compounds. The non-volatile, non-protein sulphur amino acids present in garlic give rise to its flavour pungency. Among them S-allyl cysteine sulphoxide (SACS) commonly called alliin is the precursor of allicin and garlic oil. SACS has a potent antihypercholesterolemic effect on cholesterol fed rats. Long term feeding of the aqueous extracts of water soluble proteins and the essential oil of garlic lowered lipid levels of serum and livers of normal rats. Fujiwara et al. reported that garlic extracts were effective in developing immunity to tumour cells.
Turmeric (*Curcuma longa*) is also used as a home-medicine for its antiinflammatory action. Recently it has been shown that turmeric powder fed to female mice and Wistar rats significantly decreased the incidence of mammary tumours. Turmericin, from turmeric has been found to be an efficient antioxidant/DNA-protectant/antimutagen. Turmeric has the ability to increase bile production and secretion so it is used in the treatment of certain liver disorders. Curcumin, the active principle in turmeric has been reported to prevent tumour development in animals and curcumin inhibit carcinogen-DNA interaction in vitro.

Ginger (*Zingiber officinale*) is found to be useful in inflammatory, rheumatic and neurological disorders. The long-term dietary intake of ginger has hypoglycaemic and hypolipidemic effects. The rhizome of ginger is used as a stimulant, carminative and flavouring agents, given in dyspepsia, and flatulent conditions. Rhizomes yield about 1-3% of a volatile oil containing camphene, phellandrenes, cineol, citral, borneol and zingiberenes.

Even though some properties of these food ingredients are known to us, many are unknown and the metabolic effects of these are yet to be studied. Keeping all these in mind, the study was conducted to know whether these food ingredients have any effect in detoxifying toxic effects caused by the pesticides.