PREFACE
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Over the last 50-60 years many types of man made chemicals have been manufactured and many of them have become widespread contaminants (Longanathan and Kannan 1994; Simonich and Hites, 1995; Bjerregaard, 1995). There is a growing concern that these man made chemicals (Including pesticides, industrial chemicals, plastics, detergents, paints and cosmetics) are affecting the non target micro-organisms, health of human and wildlife population (Makawi et al., 1971; Roslyck et al., 1977; Liu et al., 1988 and Toledo et al., 1991, Longnecker et al., 1997).

Environmental contaminants by pesticides have been documented in biotic and abiotic components. These persistent organic pollutants are lipid soluble and non-biodegradable. The deleterious effects of various chemicals and other environmental pollutants of the living system has drawn the public attention. Man has also utilized a wide variety of pesticides to combat the crop pests and vectors of human diseases. Pesticides have been largely responsible for increased yields and improved quality and quantity of cereals, roof crops, fruits and vegetables by making them free of insects.

The advancements of scientific knowledge and its applications to human needs in the past few decades has added new dimensions to mans exposure to millions of chemicals whose biological effects are largely unknown. Among these environmental chemicals, pesticides are very important as these are extensively used. Current interest in the state of the environment has resulted in increased research to evaluate the global impacts of pollution on the biosphere. Awareness of the biological effects of pollutants on micro-organisms has led to their use as indicators of bio-assay systems and as biological monitors of environmental contaminants (Anderson and Abdelghani, 1980; Drobnikova and Bacilek., 1982)

Pesticides have been used increasingly and the pesticide residues can affect the human health and also cause environmental pollution. Excessive pesticide use has also created global problems of pest resistance, resurgence and pesticide residues in crops and soil (Qiao et al., 2003; Lan et al., 2003; Qiao et al., 2003; Lan et al., 2003).
ideal pesticide should be toxic only to target organisms, should be biodegradable and should not leach into ground water. Unfortunately this is rarely the case and the widespread use of pesticides in modern agriculture is of increasing concern (Johenson, 2000). Presently there are ca 900 pesticide products and ca 600 active pesticidal ingredients in market (Hall et al., 2001). Millions of tons of pesticides are applied annually. However, less than 5% of these products are estimated to reach the target organism, with the remainder being deposited on the soil and non target organisms, as well as moving into the atmosphere and water (Pimental and Levitan, 1986). The metabolic fate of pesticides is dependent on abiotic conditions (temperature, moisture, soil pH etc), microbial community or plant species or both, pesticide characteristics and biological and chemical reactions (Eerd et al., 2003)

India is one of the largest users of agricultural insecticides (Allen et al., 1984). Pesticides are by nature toxic to all living things and they not only pollute the environment but also cause harm to humans as well as beneficial organisms (Link et al., 1984). The low doses of certain synthetic chemicals in the environment can mimic hormones and disrupt natural growth and development in animals and humans (Colbron et al., 1996). The most widely used pesticides are found in the form of insecticide organochlorines, organophosphates and carbamates.

Several carbamates and organophosphate compounds are used to control a wide variety of insect pests, weeds, and disease-transmitting vectors. These chemicals were introduced to replace the recalcitrant and hazardous chlorinated pesticides. Although newly introduced pesticides were considered to be biodegradable, some of them are highly toxic and their residues are found in certain environments. In addition, degradation of some of the carbamates generates metabolites that are also toxic. In general, hydrolysis of the carbamates and organophosphates yields less toxic metabolites compared with the metabolites produced from oxidation. Although microorganisms capable of degrading many of these pesticides have been isolated, knowledge about the
biochemical pathways and respective genes involved in the degradation is sparse. A great deal of interest in the mechanisms of biodegradation of carbamates and organophosphate compounds has been shown because of an efficient mineralization of the pesticides used for insect control could eliminate the problems of environmental pollution, a balance between degradation and efficacy of pesticides could result in safer application and effective insect control, and knowledge about the mechanisms of biodegradation could help to deal with situations leading to the generation of toxic metabolites and bioremediation of polluted environments. In addition, advances in genetic engineering and biotechnology offer great potential to exploit the degradative properties of microorganisms in order to develop bioremediation strategies and novel applications such as development of economic plants tolerant to herbicides. Advances in the biochemical and genetic aspects of microbial degradation of carbamates and organophosphates are in need of investigation identified (Chapalamadagu and Chaudary, 1992).

Millions of tons of pesticides applied annually are used in modern agriculture to increase production through controlling harmful effects caused by the targets organisms including insects, fungi, bacteria, viruses as well as grasses grown in between the economical crops (Liu and Xiong, 2001). The indiscriminate use of pesticides disturbs the soil environment by affecting the flora and fauna, including the micro flora of soil, and physico-chemical properties of soil like PH, salinity, etc, leading to infertility of the soil (Sarnaik et al., 2006). However, less than 5% of these products are estimated to reach the target organisms. One of the most important problems with the use of pesticides is their possible persistence in the environment and therefore, their possible incorporation into the food chain affects ecosystem and all human beings (Liu and Xiong, 2001; Al-Qurainy and Megeed, 2009).

Microorganisms play an important role in the degradation of pesticide in nature. Bacterial strains isolated from nature are able to degrade a variety of pesticides. Degradation of pesticides is usually beneficial, since the reactions
that destroy pesticides convert most pesticide residues in the environment to inactive, less toxic, harmless compounds (Lan et al., 2006). However, reports on microbial degradation of methomyl are very scanty.

It is therefore, that the present investigation was undertaken to elucidate the toxicogenomic response of *Escherichia coli* to methomyl, with emphasis on biochemical parameters, enzyme interaction, protein profiling, gene sequencing, biodegradation and its comparison to the soil isolate *Pseudomonas aeruginosa*. Thesis of the present study is divided into four chapters.

I. Methomyl induced toxicity on biochemical contents, growth and enzyme activities in *Escherichia coli* and soil isolate- *Pseudomonas aeruginosa*.

II. Protein profiling of *Escherichia coli* and *Pseudomonas aeruginosa* on exposure to methomyl.

III. Gene sequencing of stress enzymes- super oxide dismutase, catalase and peroxidase in *Escherichia coli* on exposure to methomyl.

IV. Bioremediation of methomyl using *Escherichia coli* and soil isolate - *Pseudomonas aeruginosa*.

Each chapter has a separate introduction, materials and methods, observations, discussion, summary and conclusions with pertinent literatures of the earlier works. The relevant literature is cited under references, to avoid disruption in the flow of text, tables, graphs and figures are placed at the end of each chapter.