N-Nitroso-N-methylurea is reasonably anticipated to be a human carcinogen based on sufficient evidence of carcinogenicity in experimental animals (IARC, 1972, 1978, 1987).

The National Toxicology Program of the US Public Health Service produces a regularly updated list of carcinogens. The International Agency for Research on Cancer (IARC) was one of the first organizations to identify and classify chemicals according their carcinogenicity. Environmental Protection Agency (EPA) and the Chemical Manufacturers Association have also developed lists and classification schemes for carcinogenic substances. The American Conference of Governmental Industrial Hygienists (ACGIH) and the Occupational Safety and Health Administration (OSHA) are concerned with exposure of individuals to carcinogens in the workplace.

Nitrosamines are present in water, soil and air. They can be found contaminating food, feeding stuff (where they create the highest risk for health), drugs, cosmetics, and pesticides (Karlowski, 1985 and Osterdahil, 1990). Nitrosamines are absorbed by skin, airways and the alimentary tract (Low, 1974). There is evidence that nitroso compounds may be generated in vivo from nitrites or nitrates and primary, secondary and tertiary amines in organs of people who apparently were not exposed to these compounds (Brendler et al., 1992 and Szumilak, 1983).
NMU belongs to a class of compounds generally known as N-nitrosamides, which are unstable in aqueous solution, especially at pH > 5. Therefore, it is highly unlikely that NMU or other nitrosamides would be found in foods or beverages in appreciable concentration. It is, however, possible that these compounds could be formed in vivo in the human stomach from ingested precursors because the rate of formation of some of the nitrosoamides (NMU) from the corresponding amide precursors (NMU) is very high under the acidic conditions existing in the human stomach (Mirvish, 1975).

In the experiments of (Druckrey et al., 1964 and 1967), it was found that the water-soluble compound N-nitroso-N-methylurea (NMU) elicits mammary cancer in high incidence in certain rat strains, whereas other stocks are resistant in this regard. Druckrey et al. (1964) determined that the dose of NMU causing death of half of a group of rats (LD$_{50}$) at 108 mg/kg of body weight. The outstanding manifestation of acute toxicity of NMU is severe damage to the bone marrow and lymphatic apparatus.

NMU is toxic and carcinogenic, following p.o. or parenteral administration, to a wide range of organs in mice (Terracini and Testa, 1970; Terracini et al., 1976), rats (Craddock, 1973; Craddock and Frei, 1974; Druckrey et al., 1965; Leaver et al., 1969 and Swenberg et al., 1975) hamsters (Herrold, 1966) and guinea pigs (Druckrey et al., 1968; Narisawa et al., 1975; Reddy and Rao, 1975). However, there are only isolated reports on its hepatotoxicity and
hepatocarcinogenicity. Injection i.p. of NMU increased the incidence of “heptomass” both male newborn and adult mice (Terracini and Testa, 1970; Terracini et al., 1976). Liver cell adenomas were induced in partially hepatectomized rats by i.p. injection of NMU (Craddock and Frei, 1974). Hepatotoxic effects have been reported in rats, following the i.v. administration of a single high dose (Leaver, 1969) or repeated s.c. injections of NMU (Swenberg, 1975). Fatty degeneration of hepatic parenchymal cells was observed following repeated i.g. administration of NMU in guinea pigs (Reddy and Rao, 1975) and in the F1 progeny of Hartley guinea pigs following p.o. administration of NMU during maternal pregnancy (Hasumi et al., 1975).

Repeated administration to adult rats induces tumours of brain, spinal cord and peripheral nerves in high proportion of the animals (Druckrey et al., 1965), a single treatment of the adult rat is carcinogenic for stomach, large and small intestine, kidney, skin, jaw, heart, urinary bladder, lung, pituitary, and lymphoid tissue (Leaver et al., 1969; Schreiber et al., 1972; Hicks and Wakefield, 1972; Murthy et al., 1973; and Fort et al. 1974). When given to pregnant rats, while a single administration cause tumours to develop in uterus, vagina, ovary and mammary gland (Alexandrov, 1969). However, there is no evidence known that NMU induces tumours in rat liver, suggesting that the liver is resistant to carcinogenic action of NMU. Even when NMU was administered by intraportal injection, no hepatocellular
carcinomata were induced (Lijinsky et al., 1972). Effect of NMU on insects is not available.

Several authors have studied the effects of insecticides on midgut epithelium of different insects (Pilat, 1935; Woke, 1940; Salked, 1951; Chadourne and Rainwater, 1953; Soliman and Soliman, 1958). Ahi (1985) studied the effect of organo chlorines and aromatic amine on the midgut of the *P. pictus*. and reported that “brown coloured bodies” were evident. Singh (2006) studied the effect of benzidine and 1-nitroso-2-napthol on the midgut of *Periplaneta americana* and reported that additional epithelial layer was noticed towards lumen. Some out growths were also formed due to mitotic activity in the nidi.

The fatbody of insects serve as a storage organ. It is the principle tissue where the specific protein is synthesized. The histological features of fat body have been investigated in some insects such as *Drosophila melanogaster* (Gaudeckar, 1963), *Odontopus varicornis* (Premavathi 1993, and Selvisabhanayakam, 1995), *Gryllotalpa affricana* (Sumathi et al., 2001). However the effects of phytopesticide and other known toxic substances on histological changes of fat body have not been well documented as these studies appear to be limited to a few species of insects using, dimethoate (Jayakumar, 1988), endosulfan (Sumathi et al., 2001), neem gold (Umapathi, 2007), and zoopesticide pygidial secretion (Lousia and Selvisabhanayagam, 2009).
Exposure of sub-lethal doses of the insecticides greatly affect the growth development of gonads in insects (Irving et al., 1985, Shizugi et al., 1987; Garcera et al., 1989; Mahmood et al., 1991; Ahi 1992; Shehata et al., 2006; Ghazawi et al., 2007; Habluetzel et al., 2007 and Senthil et al., 2008).

The histopathological effects of certain insecticides on different insects have been studied in (Woke, 1940; Salkeld, 1950; Chadobourne and Rainwater, 1953; El-Deeb and Zeid, 1961 and Soliman et al. (1971). Histopathological effects of y-BHC have been reported on the gonads of Periplaneta americana (Bhide, 1986). Ahi (1987, 1988a and b) studied the effects of aldrin and HCH on the gonads of P. pictus.

Proteins, carbohydrates and lipids which are the major components of the body play an important role in the body construction and energy metabolism. These constituents are affected by many factors especially by pesticide (Jabakumar and Jayaraman, 1988).

Proteins are the known biological compounds which regulate and integrate several physiological and metabolic processes in the body through hormones, enzymes and nucleoproteins. Wigglesworth (1979) has stated that the fat body in insect is the main site for protein synthesis as well as the intermediating metabolism of amino acids, which are utilized for the production of hormones and enzymes.
and the composition of protein in the body as a whole may be greatly modified (Wigglesworth, 1979). Effects of IGRs on the protein content on *M. domestica* were studied by (Ishaaya and Casida, 1974) with diflubenzuron; (El-Kordy, 1985) by diflubenzuron and triflumuron; (Bakr, 1986) with dimilin, BAY SIR and altosid; (Hamdy, 1988) with chlorfluazuron and teflubenzuron and (El-Bermawy, 1994) with atabron (IKI 7899), BAY SIR and pyriproxyfen. In silkworm, the protein synthesis activity of the body wall and the midgut decreases when the larvae begins to moult and increases from the midstage of the moulting period (Nagota, 1976).

Investigations on the effects of pesticides have revealed their interference with carbohydrate metabolism in different species (Mansingh, 1972 and Babu et al., 1988). In most insects carbohydrates reserves are present as glycogen and trehalose which can be readily converted into glucose (Islam and Ray, 1981). DDT showed that the glycogen and glucose content of *Periplaneta americana* were affected during poisoning and these changes were associated with the release of hyperglycaemic factor (Granett and Leeling, 1972). The biochemical effects of IGRs on the carbohydrate content on *M. domestica* were studied by (Ishaaya and Casida, 1974) with diflubenzuron and (El-Kordy, 1985) using diflubenzuron and triflumuron. Lohar and Wright (1990) observed that malathion treatment increased the concentration of total carbohydrates in the haemolymph of female *T. molitor*. 

**Introduction**
Lipids are the chief form in which energy is stored in insects. The ability to synthesize lipids for storage is widespread, but except for specific item as small amounts, they are not usually essential constituents of the diet. Insects utilize lipids and can also synthesize from protein and carbohydrates. Insect growth hormones, pheromones and sex attractants are lipoid in nature (Gilbert, 1967) and they are also important constituents of cell membrane (Robbins et al., 1971). It has been established that lipids provide the energy reserve which can be used during starvation periods or in some insects such as *Schistocerca gregaria* for sustained flight activity (Chapman, 1982).

Alteration of carbohydrate and lipid concentration in haemolymph and tissue of *L. disper* due to metals have been determined (Bischof, 1995 and Ortel, 1995).

The amount of DNA, the primary carrier of genetic information, is stable under changing environmental situations within the somatic cells of a species, whereas the amount of RNA, directly involved in protein synthesis, is known to vary with age, life-stage, organism size, disease state and changing environmental conditions (Bulow, 1970). Thus, organisms in good condition tend to have higher RNA:DNA ratios than those in poor condition (Robinson and Ware, 1988; Clemmesen, 1994). In fact RNA:DNA ratios have been used on a wide range of marine organisms, mainly plankton, phytoplankton (Berdalet and Dortch, 1991), Zooplankton (Ikeda et al., 2007); larval fish (Buckley, 1984; Caldarone and Buckley, 1991; Clemmesen, 1994 and
Ramirez et al., 2001), juvenile and adult fish (Goolish et al., 1984), bivalves (Gremare and Vetion, 1994), cephalopods (Sykes et al., 2004) and shrimps (Chicharo et al., 2007).

Philip and Loughton (1979) reported that haemolymph treated with DFB and cyclohexamide inhibited RNA and protein synthesis in the fourth and fifth-instar larvae of the L. migratoria. Shakoori and Saleem (1989) reported the effects of sub-lethal treatments of malathion and malathion-permethrin on sixth-instar larvae of the red flour beetle, Tribolium castaneum Herbst (Coleoptera: Tenebrionidae). Permethrin (200 ppm) and malathion (20 ppm) mixtures increased the activities of choline esterase (70.8%) and raised the concentrations of cholesterol (21%), DNA (24%) and RNA (8%). Miltin et al. (1985) reported that when the boll weevil, Anthonomus grandis (Boheman) (Coleoptera: Curculionidae) was treated with DFB, the biosynthesis of DNA was inhibited in females, but RNA was not, neither was protein synthesis affected.

Diminished sexual function may, therefore, result in part from inhibition of DNA by DFB.

Alkaline phosphatase and acid phosphatase are hydrolytic enzymes, which hydrolyze phosphomonoesters under alkaline or acid conditions, respectively. ALP is primarily found in the intestinal epithelium of animals and its major function is to provide phosphate ions from mononucleotide and ribonucleo-proteins for a variety of metabolic processes. ALP is involved in the transphosphorylation
reaction (Sakharov, 1989). ATPases are essential for the transport of glucose, amino acids, and other organic molecules. Any impairment in their activity will affect the physiology of the insect gut. These enzymes are located in the midgut, malpighian tubules, muscles, and nerve fibers of the lepidopteran insects (Horie, 1958). The midgut has the highest ALP and ACP activity as compared to other tissues. The ALP and ACP activities are low during the larval moulting stage and increased gradually after moulting (Miao, 2002). The highest activity appeared before the full-appetite, gluttonous stage of the fourth instar and the lowest activity was found in the mature larval stage (Wu and Lam, 1997).

Phosphatases have been included in the list of detoxifying enzymes of insecticides; mostly of organophosphorus (Oppenoorth, 1985), however, fenvalerate and cypermethrin resistant larvae of Helicoverpa armigera (Hubner) showed higher activities of phosphatases and methylparaoxon hydrolase compared with susceptible larvae (Srinivas et al., 2003). Abdel-Hafez et al. (1985) also reported the changes in the level of phosphatases in moths of Pectinophora gossypiella (Saund.) during the course of insecticide poisoning. There are instances where phosphatases were not only detected in red flour beetle, Tribolium castaneum, but also changes in level of these enzymes upon exposure to cypermethrin and bifenthrin insecticide were reported (Saleem and Shakoori, 1985, 1986, 1987, 1996 and Tufail et al., 1994).
Introduction

The present investigations were undertaken to study whether the established carcinogen cause tumor in *Periplaneta americana* and also to study whether the tumors formed if any, are of melanotic or mitotic origin. As the literature survey shows that even benzidine, a known established carcinogen does not cause formation of tumors in *Poekilocerus pictus*. (Ahi, 1985) Thus, in both cases, the histopathological and biochemical aspects of tumors formed, if any will be explored.