2. LITERATURE REVIEW

No doubt extensive work has been carried out by various workers in different group of pesticides. However, pyrethroid being a one of the new generation synthetic insecticide has been more or less neglected. The reports on the potential of bioefficacy of the pyrethroid indicates that it provides a broad spectrum to control the pests and is also considered to be safe in application (Bradbury and Coats 1989). Pyrethroids are lipophilic in nature, they undergo rapid absorption and distribution following ingestion by birds and mammals. Pyrethroid have unpercented biological activities against target species, with low acute toxicities to mammals (Heald et al. 1992). Its low toxicity and limited soil persistence have encouraged their use in agriculture (Litchfield 1985). They are quickly metabolized and eliminated from the body (Gaughan et al. 1977; Gray et al. 1980).

Ruzo et al. (1978), Casida et al. (1979) and Hutson et al. (1981) have reported that cyanide is liberated as thiocynate during the metabolism of cypermethrin, decamethrin and fenvalerate. Crawford et al. (1981) have reported that there is a rapid elimination of cypermethrin from rats primarily due to the efficient cleavage of the esterbond, giving rise to polar metabolites which are further oxidized and conjugated before excretion.

The relative resistance of mammals to pyrethroids is almost wholly ascribable to their ability to hydrolyze pyrethroids rapidly into their inactive acid and alcohol components (Lawrence and Casida 1982). Further, the resistance of homeothermic organisms including mammals can
be attributed to the negative temperature coefficient of action of the pyrethroid (Wouters and Vonden et al. 1978). Gong (1990) studied the toxicokinetics of 14- C fenvalerate in animals and concluded that the plasma and brain of animals have greater affinity for it and its half time is longer in brain. Anadon et al. (1991) reported that the presence of permethrin in plasma and other selected organs of the rat.

Irritation and sensitization testing has indicated that the pyrethroids do not cause significant problems in standard types of eye and skin tests (Litchfield 1985). Wang and Zhai (1991) recorded that fenvalerate is toxic to rat lungs but easily degradable. Lovava (1984) noted that the level of chromosome aberrations increased in mice bone marrow only at high dose level of cypermethrin. However, Miadokova et al. (1992) observed that supercypermethrin is nonmutagenic after studying its genotoxic potential in Salmonella typhimurium.

Kluwe et al. (1982) observed mild and focal tubular vacuolation and necrosis predominantly in the proximal tubules in the kidney of rats exposed to PBB-CCl₄. Parker et al. (1984 b) reported histological deformities in the dog kidney treated with fenvalerate. Gupta et al. (1988) recorded capillary thickening and increased nuclearity in the renal corpuscles in the kidney of the pyrethroid treated rat. However, Lukowicz et al. (1991) recorded no nephrotoxic effect in the rat kidney treated with
decamethrin and cypermethrin. Further, Mistri et al. (1994) observed degenerative and necrotic changes in the kidney of chicken acutely exposed to fenvalerate.

Vitro studies of cypermethrin metabolism by trout liver preparation also indicated an overall deficiency in the enzymatic activity relative to the mouse and quail (Edwards and Millburn 1985). Shakoori et al. (1988) noted hepatitis in the rat liver exposed to cypermethrin toxicity. Ansari et al. (1987) observed inflamed hepatic cells associated with significant decrease in the hepatic cell count in the fish acutely exposed to malathion. Ishmael et al. (1988) reported liver necrosis associated with microsomal enzyme activity in permethrin treated rats and mice. Flodstrom et al. (1988) observed no hepatotoxic effects of fenvalerate (75 mg/kg/body wt.) for ten weeks in rat. However, cypermethrin treated rat liver revealed extensive degenerative changes associated with necrosis of hepatocytes (Gupta 1988). Baronia and Sahai (1989) observed hypertrophy and vacuolization in the hepatic cells of the rat treated with DDT. Later they (1991) reported hyperplasia, hepatocellular proliferation associated with fibrosis in carbaryl treated rat liver. While Yasuyoshi et al. (1986) recorded various mononuclear phagocytic cells in rat and mice liver under chronic stress of fenvalerate. Catinot et al. (1989) reported that the chronic exposure of deltamethrin induces an increase in the number of mitochondria and alter their shape in rat liver.

The microgranulomatous lesions in liver due to fenvalerate toxicity have
observed by Parker et al. (1983 and 1984 b) in mouse and in dogs respectively. Similar findings have been made by Yasuyoshi et al. (1986) in rats and mice, and Hagiwara et al. (1990) in dogs.

Parker et al. (1984 a) recorded splenic hemosiderosis and hematopoiesis activity in fenvalerate treated rat spleen. Yasuyoshi et al. (1986) and Mistri et al. (1994) in rat and chicken spleen respectively, observed degenerative and necrotic changes due to fenvalerate toxicity. Rao and Banerji (1990) observed degeneration in the red pulp associated with infiltration of the lymphatic activity and extensive fibrosis in rats treated with biphenyl. Further, Igbedioh (1992) stated that benomyl caused cellular swelling and oedema in the rat spleen.

No gross or microscopic abnormalities of the testis have been reported in cypermethrin treated males (WHO 1984). Dikshith et al. (1988) noted the presence of few sperms associated with necrosis in the seminiferous tubules in CCl₄ treated rats. John et al. (1985) reported degenerated changes which include swollen and enlarged zona reticularis and fasciculate moreover, vacuolation was also noted in rat adrenal gland exposed to DMNM. Unlike, Ahmed (1986), Gupta (1988) reported degenerative changes in the spermatogonia with occasional necrotic cells in the seminiferous tubules of cypermethrin treated testis. Similarly, Aziz et al. (1994) administered oral deltamethrin doses to male rats for 65 consecutive days and observed an increase in percentage of dead and morphologically abnormal spermatozoa. Shayin and Usharani (1996) observed necrosis, loosening of
germ cells, vacuolation, breakage of sperms and spermatids in the testis of cypermethrin treated *P. pictus*.

Bayoumi *et al.* (1981) recorded proliferation in the reticularis cells which were separated by dilated sinusoids in the rat adrenal gland chronically exposed to tetradoxtoxin (100 mg/kg). Similarly, Parker *et al.* (1984 a) and Yasuyoshi *et al.* (1986) reported degenerative changes in the cortex and medulla of the rat adrenal gland chronically exposed to fenvalerate. Similarly, Baronia and Sahai (1992 and 1993) observed spaces and vacuolation in cortex and medulla of rats treated with carbaryl and malathion respectively.

A host of workers have studied the histochemical localization of acid phosphatase in different tissue of rats (Essner and Novikoff 1961; Hayashi 1967; Wachestine and Meisel 1957). Schar *et al.* (1985) observed strong acid phosphatase activity in the parenchymal cells of the mammalian liver particularly at the biliary poles of the hepatocytes while the bile ducts reacted faintly. Similarly, Singh *et al.* (1973) revealed that the alkaline phosphatase activity in avain liver is primarily confined at the bile passages and blood capillaries whereas, acid phosphatase mainly occurs in the lysosomes. Scott *et al.* (1977) noticed, in comparison to the control, intense acid phosphatase activity in the testis, mild in kidney while no significant change was observed in the adrenal gland exposed to acetyl salicylic acid for 12 days in rats. Similar observations were made by Gazdzik and Kaminski (1987) in testis treated with CdCl$_2$. Kaminski *et al.* (1974)
reported an increase in the intensity of the acid phosphatase while a
decrease in the alkaline phosphatase was observed in the rat kidney
exposed to furfural (50 mg/kg).

Gomori (1941) stated that the distribution of alkaline phosphatase in
different mammals exhibited negative reaction in the glomerulus. Contrarily,
Kabat and Furth (1941) and Wang and Grossman (1949) reported intense
alkaline phosphatase reaction in the glomerulus of the mouse and dog
kidneys respectively. Furthermore, Kazimerczak (1971) described strong
depositions of the alkaline phosphatase in the proximal tubules especially
in the brush border of the pig kidney. Likewise, McComb et al. (1979)
reported that the alkaline phosphatase was normally localized on the brush
border of the proximal tubules. Briere et al. (1983) observed alkaline
phosphatase to be present on the epithelial cells of the proximal tubules,
scattered in glomerulus while absent from the distal tubules in the mouse
kidney. Similarly, Wilmer (1944) reported mild reaction of the alkaline
phosphatase in the distal tubules of the rat kidney. Positive acid phosphatase
reaction was seen in the glomerulus in mice kidney (Wolf et al. 1943), in rat
(Stefanescu and Hagi 1973) and in human kidney (Bonting et al. 1960).
Whereas, it was moderate in the mammalian distal tubule of the kidney
(Rana and Agarwal 1972). While the activity is week in the proximal tubule
of the rat kidney (Jacobsen et al. 1968).

In the bovine spleen, acid phosphatase has been mainly localized within
phagocytosing cells of the red pulp while no enzymatic reaction was
observed in the lymphocytes, blood cells, endothelial and in the connective tissue (Schindelmeiser et al. 1987).

Lynch et al. (1951) and Kaul et al. (1974) studied the lipid distribution in the sertoli cells and Leydig cells of the *Rattus norvegicus* and *Presbytis entellus entellus* testis respectively. Niemi and Kormanom (1965) correlated the cyclic changes and significance of lipid and acid phosphatase activity in the seminiferous tubules of the rat testis. Barbara et al. (1966) and Guraya (1968) revealed the presence of lipid in the spermatogenic cells and sertoli cells of lizard and goat testis.

The alteration in biochemical parameters after being exposed to pyrethroid have been observed by few workers (Litchfield 1985; McKnee and Knowles 1986). Parker et al. (1984 a) observed nonsignificant alteration in serum protein of rats exposed to fenvalerate. However, a decrease in liver protein observed by Igbedioh (1992) in rat due to benomyl toxicity, Dubhat and Bapat (1984) in *C. orientalis* and Patel and Parmar (1993) in *B. dussurnieri* treated with metal.

Similarly, Balasubramanian et al. (1987) and Reddy and Bashamohideen (1987) noted a decline in protein level in kidney and testis of *C. carpio* exposed malathion. Contrarily, Dubale (1982) observed an increase in the protein content in liver and kidney of catfish exposed to dimethoate. Shakoori et al. (1988) reported that the soluble proteins and glucose content of liver exhibited a significant increase in the cypermethrin treated rats.
Cremer and Seville (1982) reported an increase in blood glucose and catecholamines in rat brain exposed to deltamethrin. Shastry and Abad (1982) noted a reduction in liver glycogen in *C. punctatus* exposed to sevin. Gupta et al. (1974) stated that glycogen content increases in liver, kidney and spleen of the malathion exposed rats. Hyperglycemia and blood glucose disturbances in the regulation of carbohydrate transformation in rat have also been documented (Wegier et al. 1985). Ghosh (1987) reported enhanced blood glucose and lowered liver and muscle glycogen content in the catfish exposed to sublethal concentrations of the pesticide. Igbedioh (1992) observed a decline in the liver glycogen in rats due to benomyl toxicity for 7 days.

Reddy et al. (1991) recorded a significant change in lipid metabolic profile of *T. mossambica* under chronic exposure of cypermethrin. However, the total lipid content of kidney was unaffected by organohalides (Kluwe et al. 1982). Gupta et al. (1986) observed significant elevation in the total lipid and cholesterol level in the kidney of furadan treated mice. Pandey et al. (1990) recorded induction in liver lipid peroxidation activity after oral administration of *ziram* (25 mg/kg/day) to rats for 90 days. However, Arasta et al. (1996) reported a decrease in lipid and protein content while glycogen did not show any significant change in liver of cat fish exposed to nuvan.

Bulusu and Chakravarty (1987) reported significant increase in liver acid phosphatase exposed to organophosphorus toxicity in male
albino rats. Reddy et al. (1986) studied an elevation in the phosphatase level of crab liver treated with methylparathion for 30 days. Szepvolgyi et al. (1989) observed an inhibition in serum acid phosphatase activity in mice treated with mancozeb at different concentrations for 12 weeks. Parker et al. (1984 b) noted an elevation in serum alkaline phosphatase level in dogs exposed to fenvalerate for 6 months. Dikshith et al. (1975) reported a decrease in liver alkaline phosphatase while it showed non-significant alteration in kidney of male albino rats treated with diazinon. James and Soni (1990) noted an inhibition in the alkaline phosphatase level in liver and kidney of mice exposed to mercuric chloride for 16 days. Nonsignificant alteration was observed in liver alkaline phosphatase content exposed to endosulfan for 30 days. (Dikshith et al. 1988). Dikshith et al. (1975) recorded a slight decrease in alkaline phosphatase content in the testis of rats exposed to diazinon. Garszel et al. (1986) observed an increase in kidney alkaline phosphatase level treated with carbaryl for 4 weeks.

The literature pertaining to the toxic effect of pyrethroids on AchE system is very scanty (Elderefawi et al. 1985; Sherby et al. 1986; Flodstrom et al. 1988; Reddy 1992). Narahashi et al. (1992) suggested that pyrethroids are responsible for the opening of sodium channels for unusual long period of time causing a prolonged sodium current to flow, which in turn, leads to hyperexcitation of the nervous system. Dorman and Beasley (1991) postulated that pyrethroid insecticides interact with sodium channels, receptors, ionophore complexes, neurotransmitters and ATPase. Reports
indicate that the level of AchE declines in mammalian brain due to pyrethroid toxicity (Bandyopadhyay 1982; Parker et al. 1984 b; Krasnijih and Pavalov 1985; Eells et al. (1992). Reddy (1992) has also reported a decrease in the AchE activity level whereas, Ach content increased in brain of C. carpio during fenvalerate (sublethal dose) exposure.