INTRODUCTION
The mechanisms by which learning occurs and information is stored (i.e., memory) have been of vital interest to neuroscientists for a long time. This phenomenon has particularly become important in the aging society where at least 10 percent of people aged 65 and over have been detected to suffer from mild to moderate dementia (Hollister, 1985; Ineichen, 1987; Muller, 1989). The learning and memory deficits have been recognised as severe and consistent neurological disorders associated with chronic neurodegenerative states. Neuropathological studies have recently demonstrated loss of neurons in distinct brain areas leading to alterations in different neurotransmitter milieu in memory disorders (Perry et al., 1981a,b; Bowen et al., 1986). However, the majority of evidences have implicated central cholinergic system in governing learning, memory and cognition (DeFeudis, 1988; Perry, 1984; Perry et al., 1985; Fibiger, 1991; Smith, 1988).

The cholinergic deficits observed in Alzheimer's disease and senile dementia of Alzheimer's type and such similar patterns in Parkinson's disease and Huntington's chorea suggested the predominant role of cholinergic neurotransmission in dementia associated with these
neurodegenerative disorders (Heindel et al., 1988; Rossor, 1982; Rossor and Iversen, 1986; Perry et al., 1985). The improvement of learning and memory deficits in various experimental paradigms in animals by cholinomimetics further substantiated such a role of cholinergic neuroreceptor system(s) in information processing mechanisms (Smith, 1988; Fibiger; 1991). Further, manipulation of cholinergic neurotransmission with anticholinergics, viz, atropine, scopolamine and pirenzepine (Caulfield et al., 1981; Izquierdo, 1989a; Fisher et al., 1991) has been implicated in the development of animal models for dementia. The lesions of nucleus basalis of Meynert (Fibiger, 1991) and neurotoxicity with selective cholinotoxin, AF64A (Fisher and Hanin, 1986) give rise to similar pathological, biochemical and behavioural changes associated with short- and long-term memory dysfunctions. The cholinergic deficits induced by scopolamine are not only amenable to cholinomimetics like physostigmine but can be reversed with a variety of drugs having diverse pharmacological actions suggesting the participation of more than one neurotransmitter and receptor system(s) in the modulation of scopolamine-induced amnesia (Smith, 1988). Though scopolamine-induced learning and memory impairment is one of the most widely studied experimental tool, there is still disagreement about what scopolamine actually does to memory (Izquierdo, 1989a).

Though, most of the research workers emphasize the cholinergic system being the predominant neurotransmitter deficit associated with learning and memory, the role of other neurotransmitter and receptor system(s) can not be ruled out. Benzodiazepine-induced memory deficits are quite evident in both human and nonhuman subjects (Thiebot, 1985; Pereira et al., 1989). Studies with benzodiazepine
antagonists, CGS-8216, and flumazenil (Ro 15-1788) have demonstrated enhanced acquisition and retention in several experimental paradigms (Jensen et al., 1987; Sarter and Stephens, 1988; Kumar et al., 1988; Lal et al., 1988) and in humans (Preston et al., 1989a). These studies suggested the involvement of central benzodiazepine receptor complex. Recent investigation with β-carbolines, benzodiazepine inverse agonists suggested the efficacy of this new class of drugs in the treatment of Alzheimer's disease primarily by disinhibiting the cholinergic neurons of basal forebrain (Sarter et al., 1988). The influence of GABA/BZ receptor ionophore complex on cholinergic neurotransmission is quite evident. Nabeshima and coworkers (1990b) demonstrated that benzodiazepine-induced amnesia is at least in part, the result of dysfunction of cholinergic neuronal system. Lal and coworkers (1988) suggested that the enhancement of acquisition by benzodiazepine inverse agonists and antagonists may result from arousal or anxiety. Further, Izquierdo (1989b) described that anxiety and learning and memory might be reflected by same mirror. In intact animals GABA_A receptors are known to be associated with antianxiety action (Williams, 1983). GABA receptor ligands both GABA_A and GABA_B agonists, muscimol and (±)baclofen, respectively, have been shown to facilitate cholinergic neurotransmission and enhance learning of various tasks in animals (Yonkov et al., 1989; Nabeshima et al., 1988a,b). Nabeshima and coworkers (1991) demonstrated a decrease of both GABA_A and muscarinic receptors in cycloheximide-induced amnesia. Pantoyl-y-aminobutyric acid has been shown to facilitate cholinergic function in CNS (Nakahiro et al., 1985). The exact molecular mechanism of GABAergic system and its interaction with cholinergic neurotransmission is far from clear.
Excitatory amino acids (EAA), namely aspartate and glutamate, are now accepted as one of the main neurotransmitters mediating synaptic excitation in the mammalian CNS through well characterized EAA receptor systems (Watkins and Evans, 1981; Lodge, 1989). Glutamate, the endogenous precursor of GABA, acting through particularly NMDA receptor system(s) has provided several evidences for their implication in learning, memory and various neurodegenerative disorders (Olney, 1990; DeFeudis, 1989; Monaghan et al., 1989; Woodruff et al., 1988). It has been suggested that N-methyl-D-aspartate (NMDA) agonists (i.e., glutamate, NMDA) induce long-term potentiation (LTP) in CA1/CA2/CA3 hippocampal and neocortical neuronal pathways (Collingridge et al., 1983; Collingridge and Singer, 1990). NMDA receptors are not only involved exclusively in synaptic plasticity but also contribute to synaptic transmission (Collingridge et al., 1988b). The phenomenon of LTP formation has attracted a considerable attention in recent years and is proposed to have a significant role in information processing mechanisms (Coan et al., 1987; Collingridge and Singer, 1990). NMDA receptor antagonists, both competitive and noncompetitive, block the LTP formation (Collingridge et al., 1983; Collingridge and Singer, 1990). Number of evidences have shown that the NMDA antagonists induce impairment of acquisition in spatial navigation (Whinshaw and Auer, 1989; Upchurch and Wehner, 1990; Morris et al., 1986; Butelman, 1989b) and radial arm maze task (Butelman, 1990). Noncompetitive NMDA receptor antagonists such as MK 801 (dizocilpine) possess anticonvulsant and apparent anxiolytic action via acting through selective NMDA-ion channels (Kulkani and Ticku, 1989; Wong et al., 1986; Dingledine et al., 1990) The MK 801 induced memory impairment in hippocampal dependent working memory supports
the status of LTP in delayed stages of memory formation. Histopathological studies in Alzheimer’s disease described the loss of glutamatergic neurons (Greenamyre et al., 1985b; 1987 Maragos et al., 1987; Swanson and Cowen, 1977). Further an application of acetylcholine potentiated glutamate mediated neurotoxicity (Defeudis, 1990; Mattson and Kater, 1988a,b). Loss of cholinergic neurons is a predominant feature when NMDA is stereotaxically applied to cortex (Sofroniew and Pearson, 1985). GABA$_B$ agonist, (±)baclofen has been found to decrease hippocampal synaptic transmission (Ault and Nadler, 1982; 1983a,b). Recently, Knott (1990) demonstrated that baclofen induces LTP formation in hippocampus. The role of presynaptic GABA$_B$ receptors in NMDA-induced LTP has also recently been suggested (Collingridge and Singer, 1990; Davies and Collingridge, 1989). Though the animal model for behavioural expression of LTP is not available, till date, these evidences suggested a crucial role of NMDA receptor ionophore complex in learning, memory and cognition.

Besides putative neurotransmitters, various neuropeptides including angiotensin converting enzyme (ACE) have been implicated in learning and memory. Postmortem studies of Alzheimer’s patients have indicated altered states of somatostatin, vasoactive intestinal polypeptide, angiotensin and opiates (Arregui et al., 1982; Perry et al., 1981a,b; Rossor, 1982). Several reports in recent years have suggested the memory enhancing action of ACE inhibitors in humans (Croog et al., 1986; Zubenko and Nixon, 1984). In animal studies influence of GABAergic neurotransmission in the memory effects of angiotensin II has been recently demonstrated (Yonkov et al., 1986; 1989; Georgiev et al., 1988). The ameliorative effect of ACE inhibitors against
Electroshock-induced amnesia was found comparable to piracetam, a known nootropic (Mondadori and Etienne, 1990). Though several mechanisms for memory enhancing action of ACE inhibitors have been suggested, the phenomenon is not clear so far.

These extensive studies dealing with neurochemical mechanisms associated with learning, memory and cognition tend to point out the need for research involving multiple neurotransmitter and neuroreceptor approaches to unfold the mystery of information processing mechanisms. With this background the present study was undertaken to investigate the role of neurotransmitter and their receptor(s) interaction in learning, memory and cognition using animal models. However, the emphasis has been on GABA/benzodiazepine receptor complex and its modulation by cholinergic and excitatory neurotransmitters and receptor mechanisms.