SUMMARY

The six species of cockroaches around the world can become pests: German cockroach, brown banded cockroach, oriental cockroach, smoky brown cockroach, American cockroach, and Turkestan cockroach. It is usually found outdoors, but sometimes comes indoors when it is hot or dry. Of these six species, the one that has the greatest potential for becoming persistent and troublesome is the American cockroach, which prefers indoor locations. Oriental and American cockroaches occasionally pose problems in moist, humid areas. Indeed, cockroaches may become pests in homes, schools, restaurants, hospitals, warehouses, offices, and virtually in any structure that has food preparation or storage areas. They contaminate food eating utensils, destroy fabric and paper products, and they impart stains and unpleasant odours to surfaces, which they contact.

People are repulsed, when they find cockroaches in their homes and kitchens. Cockroaches (especially the American cockroach, which comes into contact with human excrement in sewers or with pet droppings) may transmit bacteria that cause food poisoning (Salmonella spp. and Shigella spp.). German cockroaches are believed to be capable of transmitting disease-causing organisms such as Staphylococcus spp., Streptococcus spp., hepatitis virus, and coliform bacteria. They also have been implicated in the spread of typhoid and dysentery. Indoor infestations of cockroaches are an important source of allergens and risk for asthma among some populations. The levels of cockroaches and allergens are directly related to cockroach density, housing disrepair, and sanitary conditions.

In particular, the American cockroach, Periplaneta americana, is a wide geographic distribution throughout much of Asia and particularly in developing countries like
India, China, and as is one of the few household insect species known. It is more annoyance to the public. Hence, it is the need of the hour to manage the over populated species of cockroach in human dwellings. Accordingly, a series of experiments have been designed to isolate, identify and characterize the sex pheromone and its receptor in the American cockroach. However, there is not a great deal known about the pheromone and behaviour of this species. The present findings address the issues related to how pheromones are secreted and act upon the other individuals of the same species? They also show that (i) short distance pheromones are involved in mating and (ii) cuticular histological profiles with reference to pheromone sources.

In insects, pheromones are detected by neurons housed in olfactory sensilla on the antennae. Before the molecules reach the receptor proteins bound to the membrane of the dendrites inside the sensillum, they have to penetrate the sensillar cuticle and be solubilized in the hydrophilic sensillar lymph. The latter process is mediated by pheromone and odorant binding proteins that ferry the molecules to the receptor cells in the male American cockroaches.

In order to convey their message, pheromones and other semiochemicals must reach the dendritic surfaces of olfactory receptor neurons where the olfactory receptor proteins are located. These odorant receptors are surrounded by an aqueous environment – the sensillar lymph. Although thin, this aqueous layer is impenetrable for hydrophobic compounds per se. Thus, the transport through this barrier is assisted by odorant-binding proteins (OBPs) which are reported as 30kDA protein with the net negative charge. OBPs that are localized predominantly in pheromone-detecting sensilla with demonstrated ability to bind pheromones are referred to as pheromone-binding proteins (PBPs). The specific motif
called “GAEAAE” is identified and its proteomic details have been documented in this work. Throughout this investigation, the terms OBPs and PBPs are used as synonyms, although PBPs are OBPs which bind pheromones. PBPs are not only specific to antennae, but in some cases, they occur mainly (if not only) in the sensillar lymph of male antennae. Strictly speaking, PBPs are not expressed in the sensillar cavity. They are expressed in antennal epithelial cells and secreted into the lumen; thus, the mature protein can be detected in the sensillar lymph.

Odorant-binding proteins (OBPs) are expressed in antennae of both sexes, or predominantly in female antennae, which are assumed to bind semiochemicals other than sex pheromones. OBPs were initially identified in Lepidoptera and later isolated and/or cloned from various insect orders, namely, Coleoptera, Diptera, Hymenoptera and Hemiptera. Binding data and homology suggest that the OBPs from American cockroach are indeed PBPs. On the other hand, at least two OBPs have been identified in male cockroach. One of the two OBPs shows remarkable similarity to the pheromone-binding proteins from route lines, whereas the second type of OBP forms a divergent group.

The keys to control cockroaches are sanitation and exclusion: Cockroaches are likely to reinvade as long as a habitat is suitable to them (i.e., food, water, and shelter are available). Hence, the conditions that promote the infestation must be changed. In addition to sanitation and exclusion, baits can be effective against most species of cockroaches. Pesticide spray products are registered for use on cockroaches and may temporarily suppress populations, but they usually do not provide long-term solutions and are not generally recommended. Commercially available devices that emit ultrasound to repel cockroaches are not effective.
However, managing cockroaches is not easy. We must first determine where the roaches are located? The more hiding places you locate and manage, the more successful your control program will be. Remember that cockroaches are tropical and most like warm hiding places with access to water. Some locations may be difficult to get to. Reduction of food and water sources and hiding places is essential. If cockroaches have access to food, baits (which are a primary control tool) have limited effect. Sprays alone will not eliminate cockroaches. An Integrated Pest Management (IPM) approach that integrates several strategies is usually required.

The data presented in this thesis will pave the way for cockroach pest management at proteomic cum pheromone level. In this study, two distinguished strategies have been described to control cockroach. One is the make use of sex pheromone as tool to attract the opposite sex by which the pest population can be controlled. The other one, sex pheromone is one among the scientifically proved molecules which effectively regulates or upgrades the reproductive status of the cockroach. If its receptor mechanism is imperialized, that will effectively minimize the cockroach population. However, the second school of thought requires a lot of experimentations to generate transgenic cockroach with special attention on mutant olfactory receptors. Perhaps, the proteomic analysis of OBP in this cockroach species makes a mile stone to execute further studies in Transgenic based insect pest control programme.