Chapter VII
Summary and Conclusion

A crucial problem, apart from the socio political issues - confronting the Kerala state now- is to solve the inadequacy in the management of ever-increasing wastes, which paves the way to proliferation of insects and other arthropods. Most significant among them are the mosquitoes and weevils. If the mosquitoes are spreading many serious viral diseases, weevils are enthusiastically engaged in destroying the stored food. As both compete with each other in depriving the health and wealth of people, the Govt. of Kerala is still involved in indefinite discussions leading to inordinate delay in the solution.

The hillock of wastes, a very common phenomenon everywhere in Kerala, is providing a comfortable abode for harmful arthropods particularly the mosquitoes. Even the little water collected among the wastes, affords congenial sites for their proliferation. They are the vectors of many viral diseases, most of which are lethal to human beings. The ability of the virus to acquire resistance and to undergo mutation makes the control measures, a thorough failure. It may be recalled, how far the recent outrage of Chikungunya and Dengue fever has threatened our state recently.
Kerala is now reckoned as a consumer state with regard to its food requirements, simply because of the fact that agriculture has become no more feasible. The growing trend towards urbanisation of villages and the reclamation of the paddy fields have reduced the area of paddy cultivation very much. The increase in the demand and reduction in the supply have necessitated the transportation of food materials from the neighbouring states. Kerala once known eulogistically as ‘Granary’ of rice has now become the ‘warehouse of raw rice’, unloaded from railway wagons. The multiplication of weevils and their infestations both on the live as well as stored grains have made the paddy cultivation unadvisable. The taste of fresh ‘champavu’ rice is already left into oblivion. The use of pesticides against the storage weevils becomes inevitable as the time between harvest and consumption is prolonged considerably. Such pesticides naturally bring unwanted miseries along with them to the consumers. The phenomenon of pests gaining resistance leading to the tread mill effect has made the future very bleak.

The application of synthetic pesticides like organochlorines and organophosphates has created many hazards to the non-target organisms like man, and his environment. Sad to note that though awareness about the manifold hazards caused by the synthetic chemicals has increased, the application of such chemicals still continues. The researchers are striving hard
for emerging new phytochemicals that are very effective on the organism but safe and eco-friendly to the non-target organism, and the entire environment. Though umpteen numbers of biocides have now been launched in the market, curiously enough none of them could gain public acclaim.

Plants are now deemed to be the storehouses of easily accessible metabolites that are very essential in maintaining health and even sustaining the life. The potential inquisitive talent in the biologists have helped even reaching the pinnacle of discoveries particularly in interdisciplinary horizons. The progress attained in the phytochemical field of extraction, isolation and characterisation of different components is truly remarkable. Further, the developments in pharmacognosic evaluation at their energy level, as revealed by the bonding pattern, can never be underestimated. The use of plants in medicine is not limited or restricted to any region of the world. It is an age-long practice in various parts of the globe for both preventive and curative purposes. With the upsurge of interests in medicinal plants, there is the need for thorough scientific investigations of these plants for both efficacy and potential toxicity (Ashafa et al., 2010).

In this context a survey was conducted for drawing information from ethnic people of Kerala, for extracting information regarding the insecticidal activity of plants around them. As a result of ensuing investigations a very
common and underestimated plant *Gliricidia sepium* has emerged out as a ‘miraculous’ plant because of its multifaceted properties. The plant was selected for the study and consequently, bioactive molecules which exhibited larvicidal property could be isolated through a series of laborious extraction processes. The phytochemicals were purified by a series of techniques, which included the TLC, column chromatography etc. The isolated and purified molecules were characterised by GCMS, FTIR and NMR spectroscopies. The biomolecules were found to be 8,11,14-eicosatrienoic acid, 9-12,octadecadienoyl chloride, 14–methyl 8- hexadecyn 1-ol and n-octadecanal. It was found that 8,11,14-eicosatrienoic acid among them possesses the maximum toxic activity against mosquitoes and weevils.

The toxic activity was tested on non-target organisms like rats, representing a terrestrial and, fish as an aquatic, members of the ecosystem. The results invariably gave concurrence to the fact that its action is specific on the target organism alone, leaving the non-target organism and the environment least affected. MTT assay could establish the non toxicity in mammalian cell. Results of various tests confirmed and adduced additional evidence for the nontoxicity towards nontarget organisms of the selected biomolecule.
Subsequent to the study on non-target organisms and acute specificity of the non-toxicity of the phytochemical, further studies were carried out to explore its bioactive potential in controlling weevils and mosquitoes. The present findings appear to be very promising in the light of the inexplicable miseries and hazards caused by the Endosulfan and other pesticides leading to their total ban from the market. The activity of the proposed biomolecule has been compared with the mosquito coils now available in the market in terms of toxicity towards animals and their progeny.

8,11,14-eicosatrienoic acid is a fatty acid which is an intermediary in the synthesis of prostaglandin. Though prostaglandins are present in plants (Groenewald and Westhuizen, 1997), no report seems to be available regarding the toxic activity of prostaglandins against mosquitoes and weevils. Similarly, though many fatty acids were reported to have the mosquitocidal activity (Kishore et al., 2011), this is the first report establishing the toxicity of 8,11,14-eicosatrienoic acid. Thus the present investigation has demonstrated the larvicidal and pesticidal activities of 8,11,14-eicosatrienoic acid on mosquitoes and weevils, for the first time.

This work could grab success in extricating ourselves by emanating a safe eco friendly solution from the plant Gliricidia sepium. As the source plant is ubiquitous in Kerala zone and the method of extraction is not any
way cumbersome it may be easily manufactured and launched into the market for the effective application. Furthermore it is noted that even the crude extract of plant is very effective in controlling mosquitoes and it can be used by public in their surroundings.

**Future perspectives**

A significant problem in the present profile of Kerala state is really the apprehension towards health and nutrition. The major threat to health is, at present really the vector-borne diseases awfully spread by mosquitoes while the damage caused to food items by weevils, is no way insignificant. Bearing this in mind, an absolute escape from the twin problems, an attempt is made to find out ways to curb both these hazards using 8,11,14–eicosatrienoic acid extracted from *Gliricidia sepium*. It is presumed that this may open new avenues for further research. Besides the fact that *G. sepium* enjoys wide distribution and that the extraction doesn’t involve any intrinsic procedures, the source plant would surely prove itself as miraculous. Researchers have to expedite the development of expertise for the proper exploitation towards amelioration of the present stifling situation, as the paddy cultivation is on the verge of extinction in Kerala. It is hoped that further research may open new vistas of perspectives. Detailed methodology for extricating the people from the grip of menaces caused by these
arthropods is left to further research programs. So attention may be oriented towards exploiting these phytochemicals in *G. sepium* for the manufacture of creams, coils and lotions as a double edged weapon to fight against both mosquitoes and weevils.