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Pyrethroids

From Chrysanthemum to Modern Industrial Insecticide

Volume Editors: Noritada Matsuo · Tatsuya Mori

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Aims and Scope

The series *Topics in Current Chemistry* presents critical reviews of the present and future trends in modern chemical research. The scope includes all areas of chemical science, including the interfaces with related disciplines such as biology, medicine, and materials science.

The objective of each thematic volume is to give the non-specialist reader, whether at the university or in industry, a comprehensive overview of an area where new insights of interest to a larger scientific audience are emerging.

Thus each review within the volume critically surveys one aspect of that topic and places it within the context of the volume as a whole. The most significant developments of the last 5–10 years are presented, using selected examples to illustrate the principles discussed. A description of the laboratory procedures involved is often useful to the reader. The coverage is not exhaustive in data, but rather conceptual, concentrating on the methodological thinking that will allow the non-specialist reader to understand the information presented.

Discussion of possible future research directions in the area is welcome.

Review articles for the individual volumes are invited by the volume editors.

In references *Topics in Current Chemistry* is abbreviated *Top Curr Chem* and is cited as a journal.

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Preface

Pyrethrum has been used as an insecticide for around 150 years, and there has been no other insecticide which has so successfully contributed to the control of sanitary pests. Numerous analogs have been developed by chemists worldwide since the elucidation of the chemical structure of pyrethrins, which are the insecticidal ingredients of pyrethrum. As a result, their application has expanded extensively to various fields. To date, many eminent books have been published by scientists in this field and have contributed to advancing pyrethroid science.

Pyrethroids refer to the general name for pyrethrins, insecticidal ingredients of pyrethrum, and their synthetic analogs. They exhibit quick action on insects in a small amount. At the same time, they show selective toxicity to insects over mammals. These features of pyrethroids are therefore ideal for use as household insecticides. Since both humans and insects are organisms with a nervous system, compounds with high insecticidal potency may be highly toxic also to humans, as seen in many organophosphorous compounds and carbamates. In the previous century, the absolute configuration of 6 insecticidal ingredients consisting of natural pyrethrins were elucidated and, with the advancement from natural pyrethrins to synthetic pyrethroids, their applications have developed from household insecticides for indoor use against sanitary pests to outdoor use in agriculture, forestry, construction and livestock. The development of photostable pyrethroids has led to their infinite use in various fields throughout the world.

While many drugs and agricultural chemicals have been developed from natural products with biological activities, no other compounds have been studied for a longer time and in more countries than pyrethroids. Synthetic pyrethroids have advanced markedly by modifying the chemical structure of pyrethrins and now even compounds with structures far from natural pyrethrins are called pyrethroids. This is probably the result of pursuing higher insecticidal activities, although they belong to pyrethroids in terms of electrophysiological activities. Notably,

[*] Please see the section entitled "Further Reading" for details about these books.

household insecticides should be discriminated from photostable pyrethroids for outdoor use from development stages. For household insecticides, safety for humans and pets is extremely important, and residues of photostable synthetic pyrethroids and impurities, degraded products and secondary synthetic products contained in the compounds in rooms and their influence on the environment are to be evaluated strictly. In this century, the most awaited development is that of highly safe pyrethroids which are produced based on the original natural pyrethrins with excellent insecticidal activity, safety and less resistance. However, for pyrethrum, it takes about 2 years from seeding to flowering and therefore, investigations of the mechanism of biosynthesis to improve production efficiency and advancements in this field are also expected.

Although "pyrethroids" have been developed without a concrete definition, it is quite difficult to define this group of compounds based on their chemical structures. As such, I would like to propose the following definition:

"Pyrethroids" are a collective term for compounds that are obtained by modifying the structure of natural insecticidal ingredients, pyrethrins, contained in pyrethrum while maintaining safety, to improve efficacy and provide different characteristics from pyrethrins that show high selective toxicity comparable to pyrethrins.

Since 1995 some new types of pyrethroids with high insecticidal potency have been developed for practical use. For this reason we decided to publish a volume written by experts in various fields to review the development of new pyrethroids and offer future perspectives. This volume includes chapters on the progress and the future of pyrethroids, the biosynthesis of natural pyrethrins, newly developed polyfluorobenzyl-type pyrethroids with potent insecticidal activity, the mode of action, mammal toxicology, biotransformation and enzymatic reactions, environmental behavior, and ecotoxicology of pyrethroids. We hope that this book will contribute greatly to the further development of pyrethroids.

October 2011 Dr. Yoshio Katsuda

Further Reading

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