



K. C. Nicolaou : Architect of Natural products

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Keywords - Natural products, total synthesis, bioactive molecule, designing, retrosynthesis

A compound or substance which is produced by a living organism, found in nature is called natural product. Natural products can also be synthesized by chemical method (both semi synthesis and total synthesis). They have played a central role in the development of the field of organic chemistry by providing challenging synthetic targets. Natural products are used for commercial purposes to refer to cosmetics, dietary supplements and foods produced from natural sources without adding artificial ingredients.

Natural products are not only used in cosmetics but also used in medicines. Most of the products have medicinal value i.e. anti-cancer, anti-viral, anti-bacterial, anti-malarial etc. There were many reports where plant extracts were used to cure different diseases. Population of world is around 9 billion and nature is not able to provide these natural products to human beings. Taxol is a natural product which is isolated from yew tree. This yew tree is found in north America, Taxol is an anti-cancer property. If we exploit a hundred years old yew tree, we isolate approximately 300 mg of taxol. This quantity is sufficient for one single dose for cancer patient. Therefore, there is need and challenge to synthesize these natural products in laboratory. Different organic chemists are doing their research in synthesis of natural products.

In this article we will focus on a well-known scientist an organic chemist K. C. Nicolaou. K. C. Nicolaou was born on July 5, 1946, in Karavas (Cyprus). He grew up and went



to school until the age of 18. In 1964, he went to England where he spent two years learning English and preparing to enter University. He studied chemistry at the University of London (B.Sc., 1969, Bedford College; PhD. 1972, University College London, with Professors F. Sondheimer and P. J. Garratt). In 1972, he moved to the United States. After postdoctoral appointments at Columbia University (1972–1973, Professor T. J. Katz) and Harvard University (1973–1976, Professor E. J. Corey), he joined the faculty at the University of Pennsylvania where he became the Rhodes-Thompson Professor of Chemistry. He won the prestigious Sloan Fellowship when he was at penn.

In 1989, he relocated to San Diego. He took up a joint appointment at the University of California, San Diego, where he served as Professor of Chemistry. At The Scripps Research Institute he was Darlene Shiley Professor of Chemistry and Chairman of the Department of Chemistry. In 1996, he was appointed Aline W. and L.S. Skaggs Professor of Chemical Biology in The Skaggs Institute for Chemical Biology, The Scripps Research Institute. From 2005 to 2011, he directed Chemical Synthesis Laboratory ICES-A*STAR, Singapore. Nicolaou moved to Rice University in 2013. His research interest in the area of synthetic organic chemistry, bioorganic chemistry, chemistry and biology of natural products.

In the field of organic chemistry the Nicolaou group is active with research interests in methodology development and total synthesis. He is responsible for the synthesis of many complex molecules found in nature, such as Taxol and vancomycin. His group's route to Taxol, completed in 1994 at roughly the same time as a synthesis by the group of Robert A. Holton, attracted national news media attention due to Taxol's structural complexity and its potent anti-cancer activity. He published his research work in reputed journal Nature.¹

K. C. Nicolaou synthesized following biologically active molecules and synthesis were reported in reputed journals.

- Endiandric acids A–D (1982)
- Amphoteronolide B and Amphotericin B (1987)



- Calicheamicin \tilde{a}_1 (1992)
- Sirolimus (1993)
- Taxol (1994)
- Zaragozic acid A (1994)
- Brevetoxin B (1995)
- Vancomycin (1998)
- Uncialamycin (2008)
- Sporolide B (2009)
- Viridicatumtoxin B (2013)
- Shishijimicin A (2015)
- Thailanstatin A (2016)
- Gukulenin B (2022)

He is also the co-author of three popular books on total synthesis:

1. Classics in Total Synthesis I, 1996²
2. Classics in Total Synthesis II, 2003³
3. Classics in Total Synthesis III, 2011⁴

Additionally, he authored or co-authored several other books:

1. Molecules That Changed the World, 2008
2. Handbook of Combinatorial Chemistry: Drugs, Catalysts, Materials, 2002
3. Selenium in Natural Products Synthesis, 1984

K. C. Nicolaou has received numerous awards and honors including:

- 2021 Robert Koch Gold Medal (Germany)
- 2016 Wolf Prize in Chemistry (Israel)
- 2011 Benjamin Franklin Medal in Chemistry (Franklin Institute USA)
- 2005 Arthur C. Cope Award (USA)
- 2003 Nobel Laureate Signature Award in Graduate Education (with Phil S. Baran)
- 2002 Tetrahedron Prize
- 2001 Ernst Schering Prize (Germany)
- 2000 Paul Karrer Gold Medal (Switzerland)
- 1998 Esselen Award (USA)
- 1996 Linus Pauling Award (USA)
- 1996 William H. Nichols Medal (USA)
- Aspirin Prize (Spain)



- Max Tishler Prize Lecture (Harvard)
- Yamada Prize (Japan)
- Janssen Prize (Belgium)
- Nagoya Medal (Japan)
- Centenary Medal (Royal Society UK)
- Inhoffen Medal (Germany)
- ACS Award for Creative Work in Synthetic Organic Chemistry (USA)
- ACS Guenther Award in Natural Products Chemistry (USA)
- Fellow of the American Academy of Arts and Sciences
- Member of the National Academy of Sciences
- Member of the American Philosophical Society
- Foreign Member of the Royal Society (2013)
- Several honorary degrees

He is the author or co-author of over 800 scientific articles, reviews and book chapters, 76 patents and six books. His dedication to chemical education is evidenced by his training of hundreds of graduate students and postdoctoral fellows and the hundreds of lectures he gave in more than 30 countries around the world.

Acknowledgement -

DGH thankful to Principal Dr. Kailas Jagdale, Mahatma Phule Mahavidyalaya Pimpri, Pune for encouragement.

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