



Chemoenzymatic and micro-wave assisted reactions for control of selectivity in organic synthesis

Virinder S Parmar

Bioorganic Laboratory, Department of Chemistry, University of Delhi, Delhi – 110 00, India
virparmar@gmail.com

Green Chemistry is currently one of the most important philosophies in chemistry since it represents a major change in the way we think about practicing chemistry and using chemicals. The challenges for chemists and researchers are to develop new products, processes and services that achieve all the benefits of sustainable development.

To these ends, we have been working for the past two decades in the areas of biocatalysis, and reactions under microwave conditions and in ionic liquids. We have used lipases and oxidases in transesterification and epoxidation reactions on different types of organic compounds, for control of stereoselectivity and achieving efficiency in organic synthesis.

We have recently developed chemo-enzymatic syntheses of a few highly novel amphiphilic polymer systems based on PEG having a broad range of additional chemical functionalities under mild conditions. Our methodology and polymeric systems offer numerous advantages over the existing systems and methods. The key enzymatic step makes the present methodology very useful as it overcomes the limitations of the chemical methods, *i.e.* the use of organo-metallic catalysts and drastic conditions (high temperature and pressure).

The unique alternating copolymer micelle nanoparticles were used as delivery vehicles targeted to human cancer cells expressing the underglycosylated mucin-1 antigen, which is found on almost all epithelial cell adenocarcinomas. The solubility of the drug doxorubicin increased by encapsulation in these nanoparticles, and cellular uptake, and hence cell death, was enhanced as compared to that with the free drug. Further a very flexible methodology and system using lipases for the synthesis of silicone-based monomers, macromers and polymers has been developed. The thermal stability of the synthesized organo-silicone polymers was found to be superior than those of the materials available today, and these polymers showed excellent flame retardant properties.

We have also used reactions under microwave conditions, and in ionic liquids towards the synthesis of novel bioactive heterocyclic compounds and for transformation of nucleosides at ambient temperature and under bulk (solvent-less) conditions.

Acknowledgements: Department of Biotechnology (DBT, New Delhi, India), Nucleic Acid Centre (NAC, University of Southern Denmark) and the University of Delhi (India) are thanked for financial assistance.

1. R Kumar, R Tyagi, VS Parmar, LA Samuelson, J Kumar and AC Watterson. *Green Chem.* **6**, 2004, 516-520.
2. R Kumar, M-H Cheng, VS Parmar, LA Samuelson, J Kumar, R Nicolosi, S Yoganathan and AC Watterson. *J. Am. Chem. Soc.* **126**, 2004, 10640-10644.
3. R Kumar, R Tyagi, VS Parmar, LA Samuelson, J Kumar, A Schoemann, PR Westmoreland and AC Watterson. *Adv. Mat.* **16**, 2004, 1515-1520; *Science* **306**, 2004, 375.
3. BK Singh, P Appukkuttan, S Claerhout, VS Parmar and EV Eycken. *Org. Lett.* **8**, 2006, 1863-1866.
4. P Appukkuttan, M Husain, RK Gupta, VS Parmar and EV Eycken. *Synlett* 2006, 1491-1496.
5. AK Prasad, N Kalra, Y Yadav, R Kumar, SK Sharma, S Patkar, L Lange, J Wengel and VS Parmar. *Chem. Comm.* 2007, 2616-2617.
6. SV Malhotra, V Kumar and VS Parmar. *Current Organic Synthesis* **4**, 2007, 370-380.
7. AK Prasad, N Kalra, Y Yadav, SK Singh, SK Sharma, S Patkar, L Lange, CE Olsen, J Wengel and VS Parmar. *Org. Biomol. Chem.* **5**, 2007, 3524-3530.
8. V Kumar, CE Olsen, SJC Schaffer, VS Parmar and SV Malhotra. *Org. Lett.* **9**, 2007, 3905-3908.
9. BK Singh, N Kaval, S Tomar, EV Eycken and VS Parmar. *Org. Pro. Res. Devel.* **12**, 2008, 468-474.
10. V Kumar, C Pei, CE Olsen, SJC Schaffer, VS Parmar and S Malhotra. *Tetrahedron: Asymmetry* **19**, 2008, 664-671.
11. J Maity, G Shakyia, S Singh, VT Ravikumar, VS Parmar and AK Prasad. *J. Org. Chem.* **73**, 2008, 5629-5632.
12. V Kumar, S Tomar, R Patel, A Yousaf, VS Parmar and SV Malhotra. *Synth. Commun.* **38**, 2008, 2646-2654.
13. BK Singh, VS Parmar and EV Eycken. *Synlett* 2008, 3021-3025.
14. BK Singh, CV Stevens, DRJ Acke, VS Parmar and EV Eycken. *Tet. Lett.* **50**, 2009, 15-18.