Research Profile

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Academic Background:

- **M.Sc.** (2000): Chemistry, from the Department of Chemistry, University of Pune
- **Ph.D.** (2006): National Chemical Laboratory (NCL), Pune
- **Post-Doctoral Fellowship** (2006-2008): University of Bologna, Italy

Broad Research Interests:

Development of synthetic methodologies; Synthesis of molecular scaffolds of biological significance and total synthesis; Asymmetric catalysis

Development of synthetic methodologies:

>> Investigating the Morita-Baylis-Hillman (MBH) reaction and applications of MBH adducts:

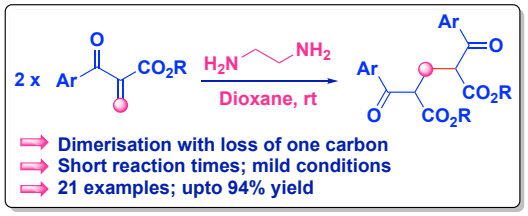
Here, our group works on exploring the MBH ketone, obtained by oxidation of the MBH adduct, in various transformations and toward the development of new synthetic methodologies.

Some of the novel transformations achieved in this regard include:

(i) Insertion of a hydrazine into the MBH ketone framework by an intriguing C–C bond cleavage.
(ii) A diamine-mediated degradative dimerisation featuring a *retro*-Mannich reaction
(iii) Access to isolable cyclic dienamines with a wide range of possibilities for further transformations.

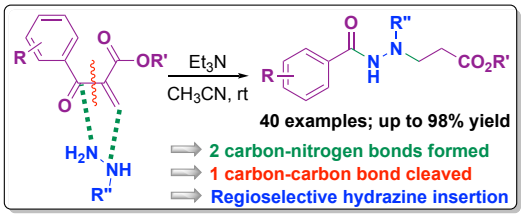
Highlights

Diamine Mediated Degradative Dimerization of MBH Ketones



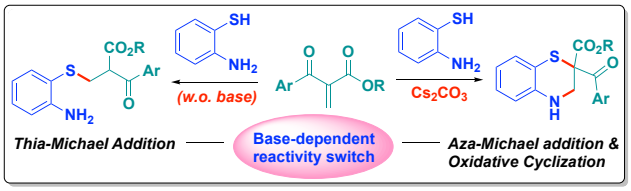
Chem. Commun. 2020, *56*, 2949

Access to Benzohydrazides via an Intriguing Hydrazine Insertion



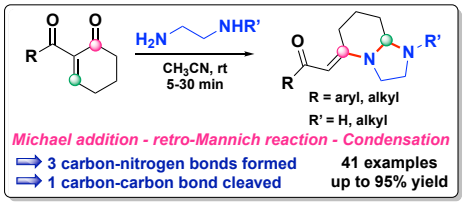
Org. Lett. 2019, *21*, 8191

Mechanistic Investigations on the Interaction of Morita–Baylis–Hillman Ketones with 2-Aminothiophenol



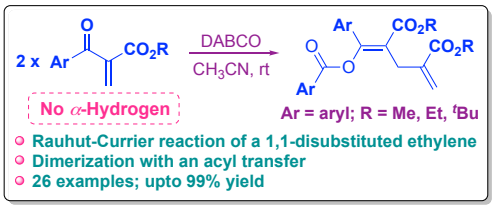
J. Org. Chem. 2024, *89*, 7263

A retro-Mannich Mediated Transformation of MBH Ketones to Saturated Imidazo[1,2-a]pyridines



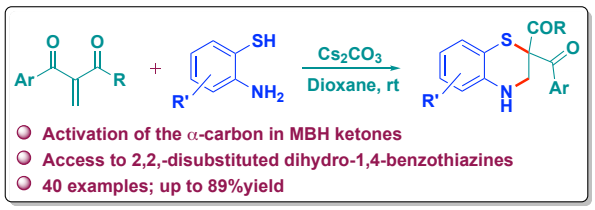
Org. Chem. Front. 2024, *11*, 3137

Acyl Transfer-driven Rauhut-Currier Dimerization of MBH Ketones



J. Org. Chem. 2023, *88*, 2023

Oxidative Annulation of MBH Ketones to access Dihydrobenzothiazines



J. Org. Chem. 2022, *87*, 5760

Asymmetric Organocatalysis:

>> Design of novel bifunctional organocatalysts for asymmetric C–C bond-forming transformations:

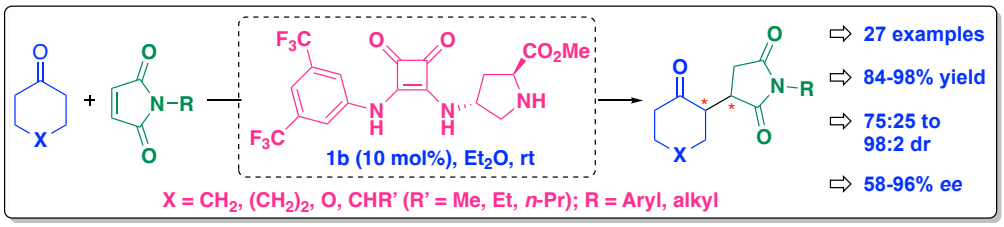
Here, we work on the development of proline-derived bifunctional organocatalysts for enantioselective transformations, asymmetric desymmetrisations and synthesis of enantiomerically enriched molecular frameworks of significance, often involving aqueous-based protocols.

Some of the recent highlights from our group in this domain include:

(i) A squaramide-tagged proline for the enantioselective Michael addition of ketones to maleimides
(ii) Design of a urea-tagged proline as a synergistic catalytic model for the asymmetric aldol addition
(iii) Enantioselective access to tetrahydroxanthenones and carbazoles

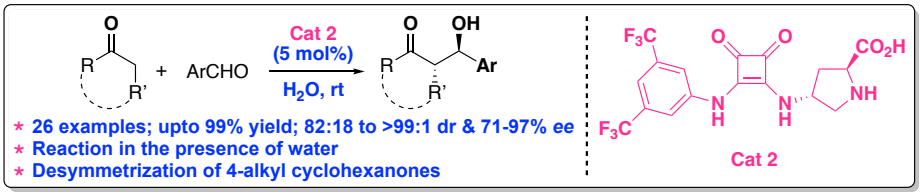
Highlights

Contrasting Facial Selectivity of a Squaramide-Tagged Proline Methyl Ester in the Asymmetric Michael Addition of Ketones to Maleimides



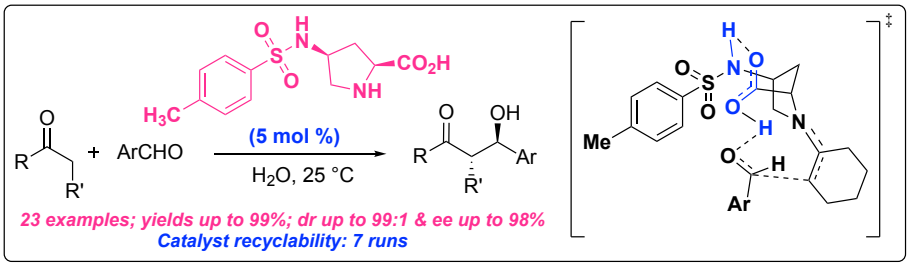
Adv. Synth. Catal. 2024, *366*, 4715

A squaramide-tagged proline as an efficient catalyst for the asymmetric aldol addition in the presence of water



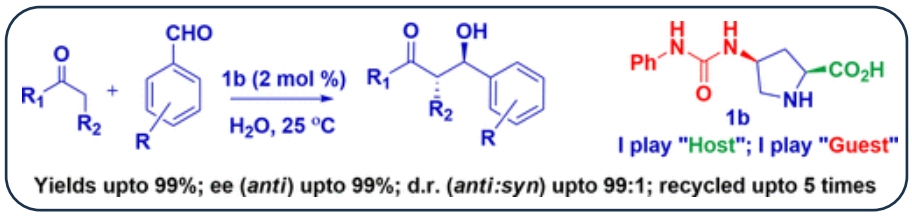
Eur. J. Org. Chem. 2024, *27*, e202400992

A sulfonamide-tagged proline as a bifunctional cooperative catalyst for the asymmetric aldol addition



New J. Chem. 2023, *47*, 17042

A Urea-tagged proline as a synergistic catalytic model for the direct asymmetric aldol reaction



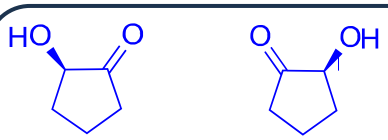
J. Org. Chem.
2018, 83, 8225

Highlights from doctoral and post-doctoral research work

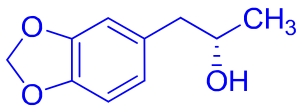
⇒ **Ph.D. thesis work**: *Enzymatic Catalysis and Natural Product Synthesis*

- Lipase catalysed resolutions for the preparation of optically pure key intermediates
- Total synthesis of anhydride based natural products, protoberberine and nuevamine alkaloids

Illustrations of Enzymatic catalysis

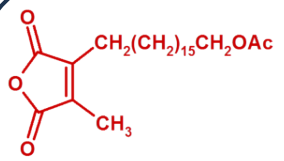


Enzymatic Approach to (+)- & (-)-α-Hydroxycyclopentanones

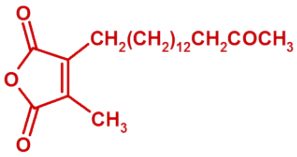


Resolution of Key Intermediate in the Synthesis of the anti-epileptic drug Talampanel

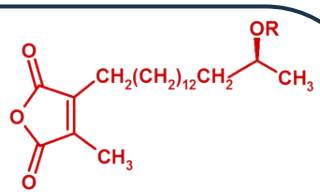
Illustrations of Natural Product Synthesis



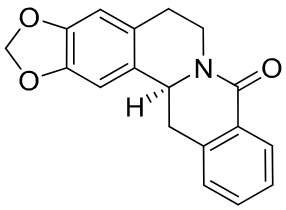
Aspergillus acid A



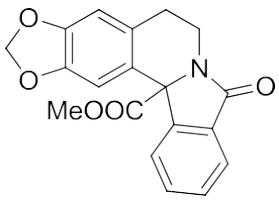
Aspergillus acid B



R = H: (*S*)-Aspergillus acid C
R = OAc: (*S*)-Aspergillus acid D



Gusanlung D

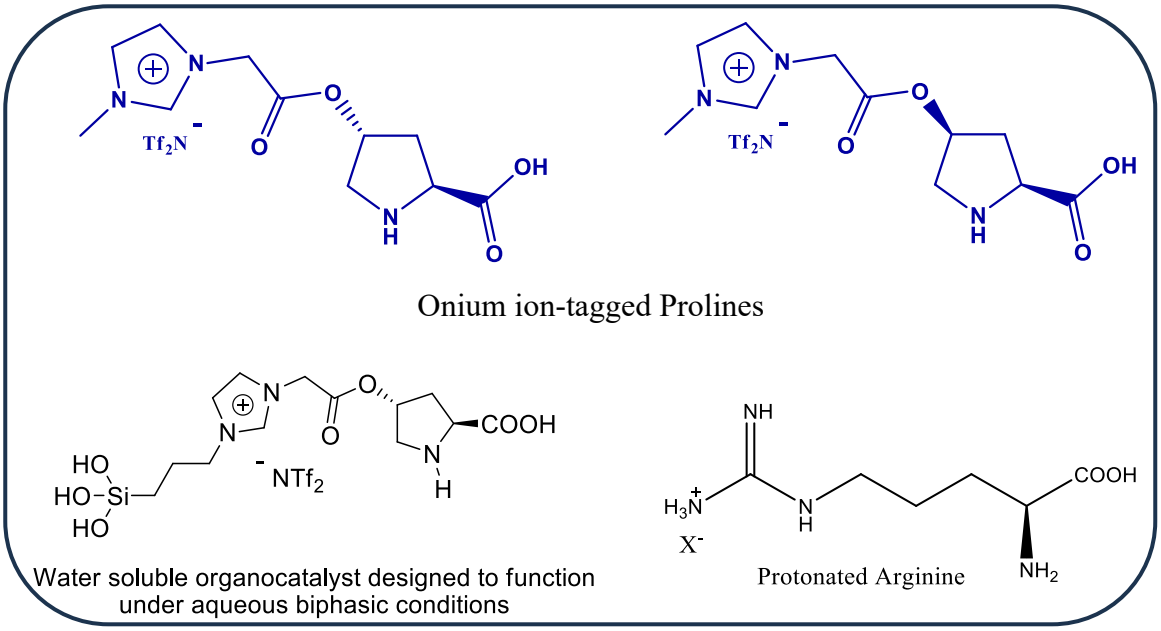


Isoindolo isoquinoline framework for the synthesis of the alkaloids nuevamine, chilenine and lennoxamine

⇒ **Post-doctoral research**: *Asymmetric Organocatalysis*

- Design of new organocatalysts and development of modular approaches for the direct asymmetric aldol reaction
- Development of improved protocols in organocatalysis involving ionic liquids and reactions in aqueous media

Organocatalysts designed for the asymmetric aldol reaction



GRANTS & RESEARCH FUNDING

- Research Grants received from MoE STARS, SERB, DST, CSIR and UGC, India, with a total funding > Rs. 1.5 crore
- Two collaborative projects carried out in collaboration with **RFBR, Russia** (*with Prof. Sergei Zlotin, Zelinsky Institute of Organic Chemistry, Moscow*) and **Academy of Finland** (*with Prof. Petri Pihko, University of Jyvaskyla, Finland*).

Details of Research Projects

Projects In progress:

1. **SERB – CRG**: Investigation of Diverse Reactivity Patterns in Morita–Baylis–Hillman Ketones to access Biologically Significant Heterocyclic Scaffolds
   Duration: 2023-'26; Sanction: ~Rs. 35 lakhs
2. **MoE-STARS**: Exploring Conformationally Constrained and Cooperatively Assisted Bifunctional Organocatalysts for Enantioselective Mannich / Michael Addition Reactions
   Duration: 2023-'26; Sanction: ~Rs. 22 lakhs
3. **SERB – POWER (*Co-PI*)**: Development of L-proline modified magnetoreceptor protein–coated iron beads as recyclable heterogenous biocatalyst for asymmetric transformations
   Duration: 2022-'25; Sanction: ~Rs. 44 lakhs

Projects completed:

1. **SERB – CRG**: Studies on the organocatalytic enantioselective construction of tetrahydroxanthenones
   Duration: 2018-'22; Sanction: ~Rs. 43 lakhs
2. **CSIR – EMR**: Design of Novel Bifunctional Amine-Urea/Thiourea Catalysts for Asymmetric C-C Bond Forming Applications
   Duration: 2018-'21; Sanction: ~Rs. 28 lakhs
3. **DST – Academy of Finland Collaborative Project** – "Studies on the Asymmetric Mannich and Michael Addition Reactions Catalyzed by a Folding Bifunctional Organocatalyst"
   In collaboration with and in the laboratory of ***Prof. Petri Pihko****, University of Jyvaskyla, Finland*
   Duration: Aug-Oct 2019; Rs. 1 lakh (*Mobility Grant*)
4. **DST-RFBR Indo-Russian Collaborative Project** – "Synthesis and studies on catalytic performance of novel ion-tagged recyclable chiral organocatalysts generated from suitable dipeptides"
   In collaboration with ***Prof. Sergei Zlotin****, Zelinsky Institute of Organic Chemistry, Moscow*;
   Duration: 2014-'16; Sanction: ~25 lakhs
5. **UGC Start-up**: Studies towards the total synthesis of protoberberine based natural products
   Duration: 2015-'17; Sanction: Rs. 6 lakhs

Department Level Project:

- Project Coordinator for DST-FIST Level C Grant sanctioned to the Department of Chemistry, C. U. Rajasthan
  Year of sanction: **2023**; Extent of Funding: **Rs. 2.43 Cr**

Awards (*based on research accomplishments*)

- "*Prof. D. K. Banerjee Memorial Lecture Award*" conferred by the **Indian Institute of Science, Bangalore**, *Apr 2023*

Invited (*Research*) Lectures at Conferences (*recent*)

- **61st Annual Convention of Chemists** organized by the *Indian Chemical Society* at Jaipur, *Dec 2024*
- International Conference on "Emerging Trends in Catalysis and Synthesis" at **IIT KGP**, *Mar 2024*
- Indo-French Conference on "Fostering Catalysis for Societal Benefit (FCSB)" at **University of Hyderabad**, *Jan 2024*
- International Conference on Organometallics and Catalysis (ICOC), Goa, *Oct-Nov 2023*
- International Conference on "Recent Advances in Chemical Sciences" at **Central University of Jammu**, *Nov 2022*
- Annual Symposium "*Interactions 2022*", **IISER Bhopal**, *Mar 2022*
- Invited talk at the Department of Chemistry, **University of Bologna, Italy** on "*The Morita-Baylis-Hillman Ketone – A Pandora's Box of Reactivity*", *Oct 2019*
- Invited talk at the **Karolinska Institute, Stockholm, Sweden** on "*Asymmetric Organocatalysis and the Morita-Baylis-Hillman Reaction: Diverse Tools towardsBiologically Active Targets*", *Sep 2019*

Research Supervision

- No. of Ph.D.'s graduated: **6**
- No. of scholars pursuing Ph.D.: **4**
- Master's Dissertations: **~45**

Details of Graduated Doctoral Students

(*latest students first*)

S. No.	Name	Year of Graduation	Current Position
1	Dr. Sachin Sharma	*2024*	Post-doctoral Research Fellow, Indian Institute of Technology Madras, Chennai
2	Dr. Rajkiran Kumari	*2023*	**Post-doctoral Research Fellow, Purdue University, USA**
3	Dr. Kiran Kumari	*2023*	Senior Research Associate, SRF Ltd, Bhiwadi, India
4	Dr. Ajit Kumar Jha	*2021*	**Post-doctoral Research Fellow, Centre of New Technologies (CeNT), University of Warsaw, Poland**
5	Dr. Meeta Bhati	*2019*	Patent Associate, Obhan and Associates, New Delhi, India
6	Dr. Heena Inani	*2018*	Assistant Professor, Lord's University, Rajasthan, India