

Signed details of the excellence in research work

Prof Rawat research group has been involved in the synthesis of small organic molecules as anti-cancer, anti-malarial, anti-TB and anti-Parkinson agents. This work led to the discovery of many potent molecules which shows low nano-molar anti-malarial activity (**ACS Med Chem Lett** 2019, 2012; **IN 283657**, 2017). Most of these compounds exhibit low dose in vivo activity with no toxicity. Subsequent studies proved that these hybrids can activate Nurr1 enzyme thus stops the death of dopamine neurons, aggregation of α -synuclein and they also improve the autophagy [Pub no: US 11,026,943 B2 (2021), US 2017/0209441 A1 (2017); EP Application No. 13758678 (2014); PCT/US2013/28329 (2013); WO2013134047 A3, PCT/US2013/028329 (2013)]. This opened a new dimension in the area of Parkinson drug discovery. **This work has been recently published in Nature Communications 14:4283, 2023** (<https://doi.org/10.1038/s41467-023-39970-9>). The work in an area of medicinal chemistry resulted eight patents and technology has been transferred to NurrOn Pharmaceuticals, a Boston Based pharmaceuticals. Recently, NurrOn entered into co-development agreement with HanAll Biopharma and Daewoong Pharmaceuticals to develop ATH-399A for Parkinson's disease and MJ Fox foundation has funded the phase I clinical trials (<https://nurronpharma.com/media-relation>).

nature communications

Concept design and execution DSR

Article


<https://doi.org/10.1038/s41467-023-39970-9>

An optimized Nurr1 agonist provides disease-modifying effects in Parkinson's disease models WK and MT Equal contribution

Received: 29 December 2022

Accepted: 5 July 2023

Published online: 18 July 2023

 Check for updates

Woori Kim^{1,2,5}, Mohit Tripathi^{3,5}, Chunhyung Kim^{1,2}, Satyapavan Vardhini³, Young Cha^{1,2}, Shamseer Kulangara Kandi³, Melissa Feitosa^{1,2}, Rohit Kholiya³, Eric Sah^{1,2}, Anuj Thakur³, Yehan Kim^{1,2}, Sanghyeok Ko^{1,2}, Kaiya Bhatia^{1,2}, Sunny Manohar³, Young-Bin Kong^{1,2}, Gagandeep Sindhu³, Yoon-Seong Kim^{1,2}, Bruce Cohen¹, Diwan S. Rawat³✉ & Kwang-Soo Kim^{1,2}✉

The nuclear receptor, Nurr1, is critical for both the development and maintenance of midbrain dopamine neurons, representing a promising molecular target for Parkinson's disease (PD). We previously identified three Nurr1 agonists (amodiaquine, chloroquine and glafenine) that share an identical chemical scaffold, 4-amino-7-chloroquinoline (4A7C), suggesting a structure-activity relationship. Herein we report a systematic medicinal chemistry search in which over 570 4A7C-derivatives were generated and characterized. Multiple compounds enhance Nurr1's transcriptional activity, leading to identification of an optimized, brain-penetrant agonist, 4A7C-301, that exhibits robust neuroprotective effects in vitro. In addition, 4A7C-301 protects midbrain dopamine neurons in the MPTP-induced male mouse model of PD and

Media Relation

March 29, 2023

NurrOn entered into co-development agreement with HanAll Biopharma and Daewoong Pharmaceuticals to develop ATH-399A for Parkinson's disease.

<https://www.prnewswire.com/news-releases/hanall-biopharma-and-daewoong-pharmaceutical-enter-into-co-development-agreement-with-nurron-pharmaceuticals-to-develop-therapy-for-parkinsons-disease-301834508.html>

December 1, 2022

NurrOn received the award of the translational pipeline program 2022 for a Phase I trial of ATH-399A from Michael J. Fox Foundation.

<https://www.michaeljfox.org/grant/development-nurr1-activator-novel-therapeutic-parkinsons-disease>



US011026943B2

(12) **United States Patent**
Rawat et al.

(10) **Patent No.: US 11,026,943 B2**
(45) **Date of Patent: *Jun. 8, 2021**

(54) **AMINOQUINOLINE DERIVATIVES AND USES THEREOF**

(56) **References Cited**

U.S. PATENT DOCUMENTS

(71) Applicants: **UNIVERSITY OF DELHI**, Delhi (IN);
THE MCLEAN HOSPITAL CORPORATION, Belmont, MA (US)

3,196,155 A	7/1965	Gailliot et al.
2003/0119026 A1	6/2003	Le et al.
2003/0229119 A1	12/2003	Kym et al.
2004/0072818 A1	4/2004	Dunning et al.
2005/0186591 A1	8/2005	Bumcrot et al.
2009/0226401 A1	9/2009	Kim et al.
2011/0251210 A1	10/2011	Peyton et al.

(72) Inventors: **Diwan S. Rawat**, Delhi (IN); **Sunny Manohar**, Delhi (IN); **Ummadisetty Chinna Rajesh**, Delhi (IN); **Deepak Kumar**, Delhi (IN); **Anuj Thakur**, Delhi (IN); **Mohit Tripathi**, Delhi (IN); **Panyala Linga Reddy**, Delhi (IN); **Shamseer Kulangara Kandi**, Delhi (IN); **Satyapavan Vardhineni**, Delhi (IN); **Kwang-Soo Kim**, Lexington, MA (US); **Chun-Hyung Kim**, Lexington, MA (US)

FOREIGN PATENT DOCUMENTS

WO	00/59510 A1	10/2000
WO	03/070244 A1	8/2003
WO	2004/002960 A1	1/2004
WO	2004/002960	1/2004
WO	2008/036374 A2	3/2008
WO	2009/148659 A2	12/2009
WO	2010/059738 A1	5/2010
WO	2010/065932 A1	6/2010

(73) Assignees: **The McLean Hospital Corporation**, Belmont, MA (US); **University of Delhi**, Delhi (IN)

OTHER PUBLICATIONS

We have been working on nano-catalysis with a goal to develop a catalytic system that can be useful in making some of the Active Pharmaceutical Ingredients or industrially important chemicals. During this, we developed a catalytic system which can be used for the C-C bond formation and reduction of nitro compounds. This has resulted many high impact publications (**12 papers in ACS Sus Chem Eng, IF = 9.088**).

One of the catalytic systems developed was used for the selective reduction of nitro compounds using hydrazine hydrate as a source of hydrogen and the process is being used for the synthesis of some industrially relevant molecules.

Research work Highlighted in the Cover Page:

- Tetrahedron Letters 59 (24), 13 June 2020
- Tetrahedron Letters 59 (24), 13 June 2018
- Tetrahedron Letters 57 (4), 5 October 2016
- ACS Sustainable Chemistry and Engineering 3 (1), 2015

Research work Highlighted by Synfacts:

Green Chemistry 22, 3170 (2020)	SYNFACTS 2020, 16(08): 0995
Tetrahedron Letters 59, 2341 (2018)	SYNFACTS 2018, 14(08): 0883
Chemistry - An Asian Journal 12, 785 (2017)	SYNFACTS 2017, 13(07), 0766
Tetrahedron Letters 57, 4468 (2016)	SYNFACTS 2016, 12(12), 1314
RSC Advances 6, 2935 (2016)	SYNFACTS 2016, 12(4), 0427
RSC Advances 5, 92121 (2015)	SYNFACTS 2016, 12(2), 0214



प्रोफेसर दीवान एस रावत
एफएनएससी, एफआरएससी, सीकेएम (लंदन)
Professor Diwan S Rawat
FNASc, FRSC, CChem (London)
रसायन विज्ञान विभाग
Department of Chemistry
दिल्ली विश्वविद्यालय, दिल्ली-110007
University of Delhi, Delhi-110007