

## Curcumin: Pharmaceutical Solids as a Platform to Improve Solubility and Bioavailability

Kuthuru Suresh,\*<sup>a</sup> and Ashwini Nangia\*<sup>a,b</sup>

<sup>a</sup> School of Chemistry, University of Hyderabad, Prof. C.R. Rao Road, Gachibowli, Central University P.O., Hyderabad 500 046, India.

<sup>b</sup> CSIR-National Chemical Laboratory, Dr. Homi Bhabha Road, Pune 411 008, India

E-mail: [ashwini.nangia@gmail.com](mailto:ashwini.nangia@gmail.com), [ak.nangia@ncl.res.in](mailto:ak.nangia@ncl.res.in), [kuturusuresh@gmail.com](mailto:kuturusuresh@gmail.com)

### Supporting Information

**Table S1** List of patents on Curcumin formulations during 1990 to early 2017.<sup>a</sup>

S. No.	Patent Application Number	Original Assignee	Date of filing	Title of the patent
1	US20160374962A1 US Application	Louisiana State University and Agricultural and Mechanical College	2016-09-08	Microsized curcumin compositions
2	WO2017017148A1 WO Application	Rodos Biotarget GmbH Augustus Biotarget, Inc.	2016-07-27	Immunotherapies for malignant, neurodegenerative and demyelinating diseases by the use of targeted nanocarriers
3	US20160193159A1 US Application	University of Texas System	2016-03-14	Liposomal curcumin for treatment of cancer
4	CN105726516A CN Application	Jinling Institute of Science and Technology Jiangsu Oook Animal Pharmaceutical Co., Ltd	2016-02-03	Film coating agent for promoting animal wound healing and preparation method thereof
5	US20160184330A1 US Application	Avanti Polar Lipids Inc Signpath Pharma Inc	2015-12-30	Suppression of Cytokine Release and Cytokine Storm
6	US20160166516A1 US Application	Designs For Health Inc	2015-12-08	Novel curcuminoid formulations and related methods of treatment
7	CN105343003A CN Application (China)	Nanjing University of Chinese Medicine	2015-11-16	Nasal dry powder inhalation for treating Alzheimer's disease and preparation method thereof
8	WO2016057839A1	Boston Biopharm, Inc.	2015-10-08	Compositions and methods

	WO Application			for increasing the bioavailability of one or more compounds
9	JP6080923B2 JP Grant	Omni Active Health Technologies Limited	2015-09-03	Water-soluble compositions and their preparation containing curcumin with enhanced bioavailability
10	WO2016013026A1 WO Application	Council Of Scientific & Industrial Research (CSIR)	2015-07-23	Curcumin-sophorolipid complex
11	DE102015008823A1 DE Application (Germany)	Hans Muerth	2015-07-15	Using the method and the Vorrichtungen for evaporating curcumin powder with a high performance evaporator for the purpose of generating an inhalable aerosol curcumin
12	US20160051492A1 US Application (US)	Louisiana State University and Agricultural and Mechanical College	2015-07-10	Continuous local slow-release of therapeutics for head and neck problems and upper aerodigestive disorders
13	CN104997727A CN Application (China)	Shandong Province Institute of Ophthalmology	2015-07-06	Curcumin micelle nasal solution and preparation method thereof
14	WO2015195458A1 WO Application	Albert Einstein College Of Medicine, Inc.	2015-06-11	Therapeutic nanoparticles and methods thereof
15	US20150258026A1 US Application	SIGNPATH PHARMA Inc University of North Texas Health Science Center	2015-05-29	Curcumin-er, a liposomal-plga sustained release nanocurcumin for minimizing qt prolongation for cancer therapy
16	EP3079674A1 EP Application	Mogon Pharmaceuticals Sagl	014-12-10	Modified-release therapeutic systems for oral administration of curcumin in the treatment of intestinal disorders
17	WO2015077640A1	Signpath Pharma, Inc.	2014-11-21	Intravenous synthetic

	WO Application			curcumin (s-curcumin) for the treatment of proliferative disorders
18	EP3071190A1 EP Application	Signpath Pharma Inc	2014-11-21	Intravenous synthetic curcumin (s-curcumin) for the treatment of proliferative disorders
19	US20150072012A1 US Application	Laila Pharmaceuticals Pvt Ltd (India).	2014-11-13	Novel highly bioavailable, water soluble and sustained release nanoformulations hydrophobic plant derived compounds and extracts
20	US20160166513A1 US Application	University of Illinois	2014-07-11	Nanoparticles and Methods of Producing the Same
21	US20140322303A1 US Application	Signpath Pharma Inc University of Texas System	2014-05-13	Liposomal curcumin for treatment of diseases
22	US20140234402A1 US Application	Signpath Pharma Inc	2014-04-30	Intravenous Infusion of Curcumin and a Calcium Channel Blocker
23	US20140271530A1 US Application	South Dakota Board of Regents	2014-03-14	Curcuminoid complexes with enhanced stability, solubility and/or bioavailability
24	US20140234420A1 US Application	South Dakota State University	2013-08-14	Method of Treating Skin Disorders using Nanoscale Delivery Devices and Transdermal Enhancing Compositions
25	WO2014028608A1 WO Application	South Dakota State University	2013-08-14	Method of treating skin disorders using nanoscale delivery devices and transdermal enhancing composition
26	CN103393684A CN Application	Sichuan Guokang Pharmaceutical Co., Ltd	2013-08-09	Formulation of antitumor pharmaceutical composition and preparing method thereof

27	EP2934185A1 EP Application	Aquanova Ag	2013-05-15	Curcumin solubilisate
28	CN103083289A CN Application	Guangdong Provincial Hospital of Traditional Chinese Medicine	2013-01-25	Application of curcumin in preparation of medicine for treating psoriasis
29	EP2685963A2 EP Application	Signpath Pharma Inc	2012-03-15	Curcumin combination with anti-type 2 diabetic drugs for prevention and treatment of disease sequelae, drug-related adverse reactions, and improved glycemic control
30	JP2014503470A JP Application	Abbott GmbH, Und Company Carge Abbott Laboratories	2011-10-13	Curcuminoids solid dispersion formulation
31	CN102283373A CN Application	Henan Zhongda Biological Engineering Co., Ltd	2011-08-30	Preparation method of preparation of curcumin
32	US20130143969A1 US Application	Ohio State University	2011-08-17	Curcumin compositions and uses thereof
33	US20140228318A1 US Application	Sanford Research USD	2011-07-15	Curcumin formulations and methods for making such formulations
34	WO2011152370A1 WO Application	House Foods Co., Ltd.	2011-05-31	Turmeric beverage in a container
35	JP2013525412A JP Application	Orphanidis Pharma Research GmbH	2011-04-29	Tackiness of the slow-acting formulations for topical administration of a curcumin
36	EP2549981A1 EP Application	Signpath Pharma Inc	2011-03-22	Intravenous curcumin and derivatives for treatment of neurodegenerative and stress disorders
37	CN102068419A CN Application	Shenwei Pharmaceutical Co., Ltd.	2010-12-28	Curcumin composition
38	US8568815B2	Novobion Oy	2010-08-16	Soluble complexes of

	US Grant			curcumin
39	CN101869692A CN Application	Jiang Yunhua	2010-06-30	Curcumin self-microemulsion and preparation method thereof
40	JP2011250707A JP Application	House Foods Co., Ltd.	2010-05-31	Packaged turmeric beverage
41	JP5634752B2 JP Grant	House Food Group Headquarters Co., Ltd.	2010-05-31	Packaged turmeric beverage
42	CN102405046A CN Application	B & B shares	2010-03-22	Pharmaceutical composition presenting anti-inflammatory properties
43	KR20110095409A KR Application	Chordman & amp; Shuttles Reef, Inc.	2009-12-09	Use of nitrogen-containing curcumin analogs for the treatment of alzheimer's disease
44	WO2010010431A1 WO Application	National Institute Of Pharmaceutical Education And Research	2009-04-02	Self-nano-emulsifying curcuminoids composition with enhanced bioavailability
45	US20110206739A1 US Application	University of Massachusetts (UMass)	2009-03-30	Compositions and methods for the preparation of nanoemulsions
46	CN101502498B CN Grant	Shaanxi University of Science and Technology	2009-03-04	Curcumin preparation for percutaneous administration and preparation method thereof
47	CA2708449A1 CA Application	Asac Compania De Biotecnologia E Investigacion, S.A. Villa Angel Sanchez-Covisa Alperi Joaquin Diaz Bosca Ana Adela Ramirez August Bernd	2008-12-19	Method for improving the therapeutic efficacy of the curcuminoids and their analogues
48	US20100197584A1	University of New York City Research	2008-07-25	Use of curcumin to block brain tumor formation in

	US Application	Foundation		mice
49	US20100316631A1 US Application	University of Alabama at Birmingham Research Foundation	2007-10-19	Water Soluble Curcumin-Based Compounds
50	US20080103213A1 US Application	University of Texas System	2007-10-05	Liposomal curcumin for treatment of neurofibromatosis
51	CN1895239A CN Application	The Second Military Medical University of Chinese People's Liberation Army	2006-06-20	Curcumin preparation and its making method
52	CA2536738A1 CA Application	Research Development Foundation Bharat B. Aggarwal Jack V. Knight	2004-08-25	Aerosol delivery of curcumin
53	WO2004080396A2 WO Application	The University Of Texas Md Anderson Cancer Center	2004-03-05	Liposomal curcumin for treatment of cancer
54	CN1278676C CN Grant	Zhang qinglong	2003-11-19	Curcumin injection and method for preparing the same
55	CN1302559A CN Application	BASF Company	2000-11-24	Curcumin preparation
56	US20130209523A1 US Application	IMRA America Inc	2013-02-13	Amorphous Medicinal Fine Particles Produced By Pulsed Laser Ablation In Liquid And The Production Method Thereof
57	CN103070825A CN Application	Suzhou Reina Drug Research and Development Co., Ltd.	2012-11-23	Curcumin particle suspension used for intramuscular injection and hypodermic injection, preparation method and application
58	CN103054807A CN Application	Suzhou Reina Drug Research and Development Co., Ltd.	2012-11-23	Curcumin micro-powder composition for intramuscular or hypodermic injection as well as

				preparation method and application thereof
59	KR101418058B1 KR Grant	Korea Institute of Science and Technology	2014-07-11	Melted tumeric extract and curcumin with high solubility in biocompatible solvents
60	CN101585757B CN Grant	Hebei Food Additives Co., Ltd	2009-06-03	Method for preparing curcumin, demethoxycurcumin and bisdemethoxycurcumin
61	CN100340238C CN Grant	Sun Yat - Sen University	2005-06-09	Curcumin solid dispersion, and its preparing method and use