References

References

[1] Q. Li, S. He, Y. Chen, F. Feng, W. Qu, H. Sun, Donepezil-based multi-functional cholinesterase inhibitors for treatment of Alzheimer's disease, Eur J Med Chem, 158 (2018) 463-477.

[2] C.A. Raji, O.L. Lopez, L.H. Kuller, O.T. Carmichael, J.T. Becker, Age, Alzheimer disease, and brain structure, Neurology, 73 (2009) 1899-1905.

[3] Y.P. Singh, H. Rai, G. Singh, G.K. Singh, S. Mishra, S. Kumar, S. Srikrishna, G. Modi, A Review on Ferulic Acid and Analogs Based Scaffolds for the Management of Alzheimer's Disease, European Journal of Medicinal Chemistry, (2021) 113278.

[4] D. Kumar, A. Ganeshpurkar, D. Kumar, G. Modi, S.K. Gupta, S.K. Singh, Secretase inhibitors for the treatment of Alzheimer's disease: Long road ahead, European Journal of Medicinal Chemistry, 148 (2018) 436-452.

[5] Y.P. Singh, A. Pandey, S. Vishwakarma, G. Modi, A review on iron chelators as potential therapeutic agents for the treatment of Alzheimer's and Parkinson's diseases, Molecular Diversity, (2018).

[6] D.V. Patel, N.R. Patel, A.M. Kanhed, S.P. Patel, A. Sinha, D.D. Kansara, A.R. Mecwan, S.B. Patel, P.N. Upadhyay, K.B. Patel, D.B. Shah, N.K. Prajapati, P.R. Murumkar, K.V. Patel, M.R. Yadav, Novel Multitarget Directed Triazinoindole Derivatives as Anti-Alzheimer Agents, ACS Chemical Neuroscience, 10 (2019) 3635-3661.

[7] G. Gerenu, K. Liu, J.E. Chojnacki, J.M. Saathoff, P. Martínez-Martín, G. Perry, X. Zhu, H.-g. Lee, S. Zhang, Curcumin/Melatonin Hybrid 5-(4-Hydroxy-phenyl)-3-oxo-pentanoic Acid [2-(5-Methoxy-1H-indol-3-yl)-ethyl]-amide Ameliorates AD-Like Pathology in the APP/PS1 Mouse Model, ACS Chemical Neuroscience, 6 (2015) 1393-1399.

[8] C. Albertini, A. Salerno, P. de Sena Murteira Pinheiro, M.L. Bolognesi, From combinations to multitarget-directed ligands: A continuum in Alzheimer's disease polypharmacology, Med Res Rev, (2020).

[9] L.S. Honig, R. Mayeux, Natural history of Alzheimer's disease, Aging (Milan, Italy), 13 (2001) 171-182.

[10] R.J. Perry, J.R. Hodges, Attention and executive deficits in Alzheimer's disease. A critical review, Brain : a journal of neurology, 122 (Pt 3) (1999) 383-404.

[11] T.H. Ferreira-Vieira, I.M. Guimaraes, F.R. Silva, F.M. Ribeiro, Alzheimer's disease: Targeting the Cholinergic System, Curr Neuropharmacol, 14 (2016) 101-115.

[12] P.R. Hof, P. Glannakopoulos, C. Bouras, The neuropathological changes associated with normal brain aging, Histology and histopathology, 11 (1996) 1075-1088.

[13] C.L. Masters, R. Bateman, K. Blennow, C.C. Rowe, R.A. Sperling, J.L. Cummings, Alzheimer's disease, Nature Reviews Disease Primers, 1 (2015) 15056.

[14] A. Cavalli, M.L. Bolognesi, A. Minarini, M. Rosini, V. Tumiatti, M. Recanatini, C. Melchiorre, Multi-target-directed ligands to combat neurodegenerative diseases, J Med Chem, 51 (2008) 347-372.

[15] 2017 Alzheimer's disease facts and figures, Alzheimer's & Dementia: The Journal of the Alzheimer's Association, 13 (2017) 325-373.

[16] 2019 Alzheimer's disease facts and figures, Alzheimer's & Dementia, 15 (2019) 321-387.
[17] https://www.who.int/news-room/fact-sheets/detail/dementia, WHO, 2020.

[18] J.L. Muir, Acetylcholine, aging, and Alzheimer's disease, Pharmacology Biochemistry and Behavior, 56 (1997) 687-696.

[19] S. Camandola, M.P. Mattson, Brain metabolism in health, aging, and neurodegeneration, EMBO J, 36 (2017) 1474-1492.

[20] J.L. Cummings, H.V. Vinters, G.M. Cole, Z.S. Khachaturian, Alzheimer's disease: etiologies, pathophysiology, cognitive reserve, and treatment opportunities, Neurology, 51 (1998) S2-17; discussion S65-17.

[21] T.H. Ferreira-Vieira, I.M. Guimaraes, F.R. Silva, F.M. Ribeiro, Alzheimer's disease: Targeting the Cholinergic System, Curr Neuropharmacol, 14 (2016) 101-115.

[22] J. Cheung, M.J. Rudolph, F. Burshteyn, M.S. Cassidy, E.N. Gary, J. Love, M.C. Franklin, J.J. Height, Structures of human acetylcholinesterase in complex with pharmacologically important ligands, J Med Chem, 55 (2012) 10282-10286.

[23] M. Mesulam, The cholinergic lesion of Alzheimer's disease: pivotal factor or side show?, Learn Mem, 11 (2004) 43-49.

[24] A. Nordberg, C. Ballard, R. Bullock, T. Darreh-Shori, M. Somogyi, A review of butyrylcholinesterase as a therapeutic target in the treatment of Alzheimer's disease, The primary care companion for CNS disorders, 15 (2013) PCC.12r01412.

[25] G. Mushtaq, N.H. Greig, J.A. Khan, M.A. Kamal, Status of acetylcholinesterase and butyrylcholinesterase in Alzheimer's disease and type 2 diabetes mellitus, CNS Neurol Disord Drug Targets, 13 (2014) 1432-1439.

[26] R.M. Lane, S.G. Potkin, A. Enz, Targeting acetylcholinesterase and butyrylcholinesterase in dementia, International Journal of Neuropsychopharmacology, 9 (2006) 101-124.

[27] E. Sawatzky, S. Wehle, B. Kling, J. Wendrich, G. Bringmann, C.A. Sotriffer, J. Heilmann, M. Decker, Discovery of Highly Selective and Nanomolar Carbamate-Based Butyrylcholinesterase Inhibitors by Rational Investigation into Their Inhibition Mode, J Med Chem, 59 (2016) 2067-2082.

[28] Y. Zhou, S. Wang, Y. Zhang, Catalytic Reaction Mechanism of Acetylcholinesterase Determined by Born−Oppenheimer Ab Initio QM/MM Molecular Dynamics Simulations, The Journal of Physical Chemistry B, 114 (2010) 8817-8825.

[29] H. Dvir, I. Silman, M. Harel, T.L. Rosenberry, J.L. Sussman, Acetylcholinesterase: from 3D structure to function, Chem Biol Interact, 187 (2010) 10-22.

[30] R.J. Bateman, C. Xiong, T.L. Benzinger, A.M. Fagan, A. Goate, N.C. Fox, D.S. Marcus, N.J. Cairns, X. Xie, T.M. Blazey, D.M. Holtzman, A. Santacruz, V. Buckles, A. Oliver, K. Moulder, P.S. Aisen, B. Ghetti, W.E. Klunk, E. McDade, R.N. Martins, C.L. Masters, R. Mayeux, J.M. Ringman, M.N. Rossor, P.R. Schofield, R.A. Sperling, S. Salloway, J.C. Morris, Clinical and biomarker changes in dominantly inherited Alzheimer's disease, N Engl J Med, 367 (2012) 795-804.

[31] F. Olsson, S. Schmidt, V. Althoff, L.M. Munter, S. Jin, S. Rosqvist, U. Lendahl, G. Multhaup, J. Lundkvist, Characterization of intermediate steps in amyloid beta (Aβ) production under near-native conditions, J Biol Chem, 289 (2014) 1540-1550.

[32] U. Sengupta, A.N. Nilson, R. Kayed, The Role of Amyloid-β Oligomers in Toxicity, Propagation, and Immunotherapy, EBioMedicine, 6 (2016) 42-49.

[33] K. Luan, J.L. Rosales, K.-Y. Lee, Viewpoint: Crosstalks between neurofibrillary tangles and amyloid plaque formation, Ageing Research Reviews, 12 (2013) 174-181.

[34] E.K. Kim, E.-J. Choi, Compromised MAPK signaling in human diseases: an update, Archives of Toxicology, 89 (2015) 867-882.

[35] Y.J. Lee, S.B. Han, S.Y. Nam, K.W. Oh, J.T. Hong, Inflammation and Alzheimer's disease, Arch Pharm Res, 33 (2010) 1539-1556.

[36] F. Zemek, L. Drtinova, E. Nepovimova, V. Sepsova, J. Korabecny, J. Klimes, K. Kuca, Outcomes of Alzheimer's disease therapy with acetylcholinesterase inhibitors and memantine, Expert Opin Drug Saf, 13 (2014) 759-774.

[37] R.E. González-Reyes, M.O. Nava-Mesa, K. Vargas-Sánchez, D. Ariza-Salamanca, L. Mora-Muñoz, Involvement of Astrocytes in Alzheimer's Disease from a Neuroinflammatory and Oxidative Stress Perspective, Frontiers in molecular neuroscience, 10 (2017) 427-427.

[38] C.K. Combs, J.C. Karlo, S.C. Kao, G.E. Landreth, beta-Amyloid stimulation of microglia and monocytes results in TNFalpha-dependent expression of inducible nitric oxide synthase and neuronal apoptosis, J Neurosci, 21 (2001) 1179-1188.

[39] J. Tan, T. Town, T. Mori, Y. Wu, M. Saxe, F. Crawford, M. Mullan, CD45 opposes beta-amyloid peptide-induced microglial activation via inhibition of p44/42 mitogen-activated protein kinase, J Neurosci, 20 (2000) 7587-7594.

[40] Y. Li, L. Liu, S.W. Barger, W.S. Griffin, Interleukin-1 mediates pathological effects of microglia on tau phosphorylation and on synaptophysin synthesis in cortical neurons through a p38-MAPK pathway, J Neurosci, 23 (2003) 1605-1611.

[41] R.A. Quintanilla, D.I. Orellana, C. González-Billault, R.B. Maccioni, Interleukin-6 induces Alzheimer-type phosphorylation of tau protein by deregulating the cdk5/p35 pathway, Exp Cell Res, 295 (2004) 245-257.

[42] P. Sharma, P. Srivastava, A. Seth, P.N. Tripathi, A.G. Banerjee, S.K. Shrivastava, Comprehensive review of mechanisms of pathogenesis involved in Alzheimer's disease and potential therapeutic strategies, Prog Neurobiol, 174 (2019) 53-89.

[43] N. Braidy, A. Poljak, C. Marjo, H. Rutlidge, A. Rich, B.-E. Jugder, T. Jayasena, N.C. Inestrosa, P.S. Sachdev, Identification of Cerebral Metal Ion Imbalance in the Brain of Aging Octodon degus, Frontiers in Aging Neuroscience, 9 (2017).

[44] A.C. Kim, S. Lim, Y.K. Kim, Metal Ion Effects on Aβ and Tau Aggregation, Int J Mol Sci, 19 (2018) 128.

[45] R.J. Ward, F.A. Zucca, J.H. Duyn, R.R. Crichton, L. Zecca, The role of iron in brain ageing and neurodegenerative disorders, Lancet Neurol, 13 (2014) 1045-1060.

[46] G.A. Salvador, Iron in neuronal function and dysfunction, BioFactors (Oxford, England), 36 (2010) 103-110.

[47] A. Ndayisaba, C. Kaindlstorfer, G.K. Wenning, Iron in Neurodegeneration – Cause or Consequence?, Frontiers in Neuroscience, 13 (2019).

[48] D.J.R. Lane, S. Ayton, A.I. Bush, Iron and Alzheimer's Disease: An Update on Emerging Mechanisms, J Alzheimers Dis, 64 (2018) S379-S395.

[49] S. Boopathi, P. Kolandaivel, Fe(2+) binding on amyloid β-peptide promotes aggregation, Proteins, 84 (2016) 1257-1274.

[50] R.J. Ward, F.A. Zucca, J.H. Duyn, R.R. Crichton, L. Zecca, The role of iron in brain ageing and neurodegenerative disorders, Lancet Neurol, 13 (2014) 1045-1060.

[51] G.-F. Chen, T.-H. Xu, Y. Yan, Y.-R. Zhou, Y. Jiang, K. Melcher, H.E. Xu, Amyloid beta: structure, biology and structure-based therapeutic development, Acta Pharmacol Sin, 38 (2017) 1205-1235.

[52] F. Hane, G. Tran, S.J. Attwood, Z. Leonenko, Cu2+ Affects Amyloid-β (1–42) Aggregation by Increasing Peptide-Peptide Binding Forces, PLOS ONE, 8 (2013) e59005.

[53] H.J. Lee, K.J. Korshavn, A. Kochi, J.S. Derrick, M.H.J.C.S.r. Lim, Cholesterol and metal ions in Alzheimer's disease, 43 (2014) 6672-6682.

[54] X. Chen, C. Guo, J. Kong, Oxidative stress in neurodegenerative diseases, Neural regeneration research, 7 (2012) 376-385.

[55] A. Gella, N. Durany, Oxidative stress in Alzheimer disease, Cell adhesion & migration, 3 (2009) 88-93.

[56] A. Alhasawi, F. Legendre, S. Jagadeesan, V. Appanna, V. Appanna, Chapter 10 - Biochemical Strategies to Counter Nitrosative Stress: Nanofactories for Value-Added Products, in: S. Das, H.R. Dash (Eds.) Microbial Diversity in the Genomic Era, Academic Press2019, pp. 153-169.

[57] M. Simunkova, S.H. Alwasel, I.M. Alhazza, K. Jomova, V. Kollar, M. Rusko, M. Valko, Management of oxidative stress and other pathologies in Alzheimer's disease, Arch Toxicol, 93 (2019) 2491-2513.

[58] A. Nunomura, G. Perry, M.A. Pappolla, R. Wade, K. Hirai, S. Chiba, M.A. Smith, RNA oxidation is a prominent feature of vulnerable neurons in Alzheimer's disease, J Neurosci, 19 (1999) 1959-1964.

[59] A. Nunomura, T. Hofer, P.I. Moreira, R.J. Castellani, M.A. Smith, G. Perry, RNA oxidation in Alzheimer disease and related neurodegenerative disorders, Acta Neuropathol, 118 (2009) 151-166.

[60] R.J. O'Brien, P.C. Wong, Amyloid precursor protein processing and Alzheimer's disease, Annu Rev Neurosci, 34 (2011) 185-204.

[61] V.W. Chow, M.P. Mattson, P.C. Wong, M. Gleichmann, An overview of APP processing enzymes and products, Neuromolecular Med, 12 (2010) 1-12.

[62] H.S. Nhan, K. Chiang, E.H. Koo, The multifaceted nature of amyloid precursor protein and its proteolytic fragments: friends and foes, Acta Neuropathol, 129 (2015) 1-19.

[63] M.B. Colović, D.Z. Krstić, T.D. Lazarević-Pašti, A.M. Bondžić, V.M. Vasić, Acetylcholinesterase inhibitors: pharmacology and toxicology, Curr Neuropharmacol, 11 (2013) 315-335.

[64] Y. Bourne, P. Taylor, Z. Radić, P. Marchot, Structural insights into ligand interactions at the acetylcholinesterase peripheral anionic site, EMBO J, 22 (2003) 1-12.

[65] G.T. Grossberg, Cholinesterase inhibitors for the treatment of Alzheimer's disease:: getting on and staying on, Curr Ther Res Clin Exp, 64 (2003) 216-235.

[66] Y. Sun, M.S. Lai, C.J. Lu, R.C. Chen, How long can patients with mild or moderate Alzheimer's dementia maintain both the cognition and the therapy of cholinesterase inhibitors: a national population-based study, Eur J Neurol, 15 (2008) 278-283.

[67] R. Howard, R. McShane, J. Lindesay, C. Ritchie, A. Baldwin, R. Barber, A. Burns, T. Dening, D. Findlay, C. Holmes, A. Hughes, R. Jacoby, R. Jones, R. Jones, I. McKeith, A. Macharouthu, J. O'Brien, P. Passmore, B. Sheehan, E. Juszczak, C. Katona, R. Hills, M. Knapp, C. Ballard, R. Brown, S. Banerjee, C. Onions, M. Griffin, J. Adams, R. Gray, T. Johnson, P. Bentham, P. Phillips, Donepezil and memantine for moderate-to-severe Alzheimer's disease, N Engl J Med, 366 (2012) 893-903.

[68] K. Hager, A.S. Baseman, J.S. Nye, H.R. Brashear, J. Han, M. Sano, B. Davis, H.M. Richards, Effects of galantamine in a 2-year, randomized, placebo-controlled study in Alzheimer's disease, Neuropsychiatr Dis Treat, 10 (2014) 391-401.

[69] S. Dhillon, Rivastigmine transdermal patch: a review of its use in the management of dementia of the Alzheimer's type, Drugs, 71 (2011) 1209-1231.

[70] R. Rajmohan, P.H. Reddy, Amyloid-Beta and Phosphorylated Tau Accumulations Cause Abnormalities at Synapses of Alzheimer's disease Neurons, J Alzheimers Dis, 57 (2017) 975-999.
[71] L. Santarpia, I. Grandone, F. Contaldo, F. Pasanisi, Butyrylcholinesterase as a prognostic marker: a review of the literature, J Cachexia Sarcopenia Muscle, 4 (2013) 31-39.

[72] J. Jasiecki, B. Wasąg, Butyrylcholinesterase Protein Ends in the Pathogenesis of Alzheimer's Disease—Could BCHE Genotyping Be Helpful in Alzheimer's Therapy?, Biomolecules, 9 (2019) 592.

[73] B.R. Stockwell, J.P. Friedmann Angeli, H. Bayir, A.I. Bush, M. Conrad, S.J. Dixon, S. Fulda, S. Gascón, S.K. Hatzios, V.E. Kagan, K. Noel, X. Jiang, A. Linkermann, M.E. Murphy, M. Overholtzer, A. Oyagi, G.C. Pagnussat, J. Park, Q. Ran, C.S. Rosenfeld, K. Salnikow, D. Tang, F.M. Torti, S.V. Torti, S. Toyokuni, K.A. Woerpel, D.D. Zhang, Ferroptosis: A Regulated Cell Death Nexus Linking Metabolism, Redox Biology, and Disease, Cell, 171 (2017) 273-285.

[74] X.-x. Dong, Y. Wang, Z.-h. Qin, Molecular mechanisms of excitotoxicity and their relevance to pathogenesis of neurodegenerative diseases, Acta Pharmacol Sin, 30 (2009) 379-387.

[75] S.A. Lipton, Failures and successes of NMDA receptor antagonists: molecular basis for the use of open-channel blockers like memantine in the treatment of acute and chronic neurologic insults, NeuroRx, 1 (2004) 101-110.

[76] C. Geula, S. Darvesh, Butyrylcholinesterase, cholinergic neurotransmission and the pathology of Alzheimer's disease, Drugs Today (Barc), 40 (2004) 711-721.

[77] M.M. Mesulam, A. Guillozet, P. Shaw, A. Levey, E.G. Duysen, O. Lockridge, Acetylcholinesterase knockouts establish central cholinergic pathways and can use butyrylcholinesterase to hydrolyze acetylcholine, Neuroscience, 110 (2002) 627-639.

[78] M. Horak, K. Holubova, E. Nepovimova, J. Krusek, M. Kaniakova, J. Korabecny, L. Vyklicky, K. Kuca, A. Stuchlik, J. Ricny, K. Vales, O. Soukup, The pharmacology of tacrine at N-methyl-d-aspartate receptors, Prog Neuropsychopharmacol Biol Psychiatry, 75 (2017) 54-62.

[79] H. Sugimoto, Y. Yamanishi, Y. Iimura, Y. Kawakami, Donepezil hydrochloride (E2020) and other acetylcholinesterase inhibitors, Curr Med Chem, 7 (2000) 303-339.

[80] V. Tumiatti, A. Minarini, M.L. Bolognesi, A. Milelli, M. Rosini, C. Melchiorre, Tacrine derivatives and Alzheimer's disease, Curr Med Chem, 17 (2010) 1825-1838.

[81] P. Zhang, S. Xu, Z. Zhu, J. Xu, Multi-target design strategies for the improved treatment of Alzheimer's disease, European Journal of Medicinal Chemistry, 176 (2019) 228-247.

[82] S. Matsunaga, T. Kishi, N. Iwata, Memantine monotherapy for Alzheimer's disease: a systematic review and meta-analysis, PLoS One, 10 (2015) e0123289.

[83] S.A. Lipton, The molecular basis of memantine action in Alzheimer's disease and other neurologic disorders: low-affinity, uncompetitive antagonism, Curr Alzheimer Res, 2 (2005) 155-165.

[84] E. Tönnies, E. Trushina, Oxidative Stress, Synaptic Dysfunction, and Alzheimer's Disease, Journal of Alzheimer's disease : JAD, 57 (2017) 1105-1121.

[85] L. Cassidy, F. Fernandez, J.B. Johnson, M. Naiker, A.G. Owoola, D.A. Broszczak, Oxidative stress in alzheimer's disease: A review on emergent natural polyphenolic therapeutics, Complementary therapies in medicine, 49 (2020) 102294.

[86] M. Hepel, S. Andreescu, Oxidative Stress and Human Health, Oxidative Stress: Diagnostics, Prevention, and Therapy Volume 2, American Chemical Society2015, pp. 1-33.

[87] B.L. Tan, M.E. Norhaizan, W.-P.-P. Liew, H. Sulaiman Rahman, Antioxidant and Oxidative Stress: A Mutual Interplay in Age-Related Diseases, Front Pharmacol, 9 (2018) 1162-1162.

[88] K. Krumova, G. Cosa, Chapter 1 Overview of Reactive Oxygen Species, Singlet Oxygen: Applications in Biosciences and Nanosciences, Volume 1, The Royal Society of Chemistry2016, pp. 1-21.

[89] M. Nita, A. Grzybowski, The Role of the Reactive Oxygen Species and Oxidative Stress in the Pathomechanism of the Age-Related Ocular Diseases and Other Pathologies of the Anterior and Posterior Eye Segments in Adults, Oxidative medicine and cellular longevity, 2016 (2016) 3164734-3164734.

[90] M. Hayyan, M.A. Hashim, I.M. AlNashef, Superoxide Ion: Generation and Chemical Implications, Chemical Reviews, 116 (2016) 3029-3085.

[91] C. Carvalho, P.I. Moreira, Oxidative Stress: A Major Player in Cerebrovascular Alterations Associated to Neurodegenerative Events, Front Physiol, 9 (2018) 806-806.

[92] A.K. Singh, M.P. Kashyap, V. Kumar, V.K. Tripathi, D.K. Yadav, F. Khan, S. Jahan, V.K. Khanna, S. Yadav, A.B. Pant, 3-methylcholanthrene induces neurotoxicity in developing neurons derived from human CD34+Thy1+ stem cells by activation of aryl hydrocarbon receptor, Neuromolecular Med, 15 (2013) 570-592.

[93] D.J. Newman, G.M. Cragg, Natural Products as Sources of New Drugs from 1981 to 2014, Journal of Natural Products, 79 (2016) 629-661.

[94] W. Chang, D. Huang, Y.M. Lo, Q. Tee, P. Kuo, J.S. Wu, W. Huang, S. Shen, Protective Effect of Caffeic Acid against Alzheimer's Disease Pathogenesis via Modulating Cerebral Insulin

Signaling, β-Amyloid Accumulation, and Synaptic Plasticity in Hyperinsulinemic Rats, J Agric Food Chem, 67 (2019) 7684-7693.

[95] M. Chen, Z.-Y. Du, X. Zheng, D.-L. Li, R.-P. Zhou, K. Zhang, Use of curcumin in diagnosis, prevention, and treatment of Alzheimer's disease, Neural regeneration research, 13 (2018) 742-752.

[96] T. Hamaguchi, K. Ono, M. Yamada, REVIEW: Curcumin and Alzheimer's Disease, 16 (2010) 285-297.

[97] E. Chainoglou, D. Hadjipavlou-Litina, Curcumin in Health and Diseases: Alzheimer's Disease and Curcumin Analogues, Derivatives, and Hybrids, Int J Mol Sci, 21 (2020).

[98] A. Karthikeyan, N. Senthil, T. Min, Nanocurcumin: A Promising Candidate for Therapeutic Applications, 11 (2020).

[99] Y. Chen, J. Zhu, J. Mo, H. Yang, X. Jiang, H. Lin, K. Gu, Y. Pei, L. Wu, R. Tan, J. Hou, J. Chen, Y. Lv, Y. Bian, H. Sun, Synthesis and bioevaluation of new tacrine-cinnamic acid hybrids as cholinesterase inhibitors against Alzheimer’s disease, Journal of Enzyme Inhibition and Medicinal Chemistry, 33 (2018) 290-302.

[100] J.-S. Lan, J.-W. Hou, Y. Liu, Y. Ding, Y. Zhang, L. Li, T. Zhang, Design, synthesis and evaluation of novel cinnamic acid derivatives bearing N-benzyl pyridinium moiety as multifunctional cholinesterase inhibitors for Alzheimer's disease, Journal of enzyme inhibition and medicinal chemistry, 32 (2017) 776-788.

[101] T. Beg, S. Jyoti, F. Naz, Rahul, F. Ali, S.K. Ali, A.M. Reyad, Y.H. Siddique, Protective Effect of Kaempferol on the Transgenic Drosophila Model of Alzheimer's Disease, CNS Neurol Disord Drug Targets, 17 (2018) 421-429.

[102] S. Kouhestani, A. Jafari, P. Babaei, Kaempferol attenuates cognitive deficit via regulating oxidative stress and neuroinflammation in an ovariectomized rat model of sporadic dementia, Neural regeneration research, 13 (2018) 1827-1832.

[103] T.M. Holland, P. Agarwal, Y. Wang, S.E. Leurgans, D.A. Bennett, S.L. Booth, M.C. Morris, Dietary flavonols and risk of Alzheimer dementia, 94 (2020) e1749-e1756.

[104] D.-S. Lee, G.-S. Jeong, Butein provides neuroprotective and anti-neuroinflammatory effects through Nrf2/ARE-dependent haem oxygenase 1 expression by activating the PI3K/Akt pathway, British journal of pharmacology, 173 (2016) 2894-2909.

[105] J. Liu, X. Li, R. Cai, Z. Ren, A. Zhang, F. Deng, D. Chen, Simultaneous Study of Anti-Ferroptosis and Antioxidant Mechanisms of Butein and (S)-Butin, Molecules, 25 (2020).

[106] N.R. Jabir, F.R. Khan, S. Tabrez, Cholinesterase targeting by polyphenols: A therapeutic approach for the treatment of Alzheimer’s disease, 24 (2018) 753-762.

[107] N. Seyed Fazel, D. Kasi Pandima, M. Dicson Sheeja, S. Antoni, D. Maria, N. Seyed Mohammad, Ferulic Acid and Alzheimer's Disease: Promises and Pitfalls, Mini-Reviews in Medicinal Chemistry, 15 (2015) 776-788.

[108] M. Benchekroun, A. Romero, J. Egea, R. León, P. Michalska, I. Buendía, M.L. Jimeno, D. Jun, J. Janockova, V. Sepsova, O. Soukup, O.M. Bautista-Aguilera, B. Refouvelet, O. Ouari, J. Marco-Contelles, L. Ismaili, The Antioxidant Additive Approach for Alzheimer's Disease Therapy: New Ferulic (Lipoic) Acid Plus Melatonin Modified Tacrines as Cholinesterases Inhibitors, Direct Antioxidants, and Nuclear Factor (Erythroid-Derived 2)-Like 2 Activators, J Med Chem, 59 (2016) 9967-9973.

[109] N. Kumar, V. Pruthi, Potential applications of ferulic acid from natural sources, Biotechnology Reports, 4 (2014) 86-93.

[110] E. Barone, V. Calabrese, C. Mancuso, Ferulic acid and its therapeutic potential as a hormetin for age-related diseases, Biogerontology, 10 (2009) 97-108.

[111] M. Srinivasan, A.R. Sudheer, V.P. Menon, Ferulic Acid: therapeutic potential through its antioxidant property, Journal of clinical biochemistry and nutrition, 40 (2007) 92-100.

[112] Y.P. Singh, G.N.V.C. Tej, A. Pandey, K. Priya, P. Pandey, G. Shankar, P.K. Nayak, G. Rai, A.G. Chittiboyina, R.J. Doerksen, S. Vishwakarma, G. Modi, Design, synthesis and biological evaluation of novel naturally-inspired multifunctional molecules for the management of Alzheimer's disease, European Journal of Medicinal Chemistry, 198 (2020) 112257.

[113] M. Kikugawa, H. Tsutsuki, T. Ida, H. Nakajima, H. Ihara, T. Sakamoto, Water-soluble ferulic acid derivatives improve amyloid-β-induced neuronal cell death and dysmnesia through inhibition of amyloid-β aggregation, Bioscience, Biotechnology, and Biochemistry, 80 (2016) 547-553.

[114] Z. Sang, K. Wang, X. Han, M. Cao, Z. Tan, W. Liu, Design, Synthesis, and Evaluation of Novel Ferulic Acid Derivatives as Multi-Target-Directed Ligands for the Treatment of Alzheimer's Disease, ACS Chemical Neuroscience, 10 (2019) 1008-1024.

[115] A. Sgarbossa, D. Giacomazza, M. di Carlo, Ferulic Acid: A Hope for Alzheimer's Disease Therapy from Plants, Nutrients, 7 (2015) 5764-5782.

[116] C. Mancuso, G. Scapagini, D. Currò, A.M. Giuffrida Stella, C. De Marco, D.A. Butterfield, V. Calabrese, Mitochondrial dysfunction, free radical generation and cellular stress response in neurodegenerative disorders, Front Biosci, 12 (2007) 1107-1123.

[117] M. Stefani, S. Rigacci, Protein folding and aggregation into amyloid: the interference by natural phenolic compounds, Int J Mol Sci, 14 (2013) 12411-12457.

[118] J.J. Yan, J.Y. Cho, H.S. Kim, K.L. Kim, J.S. Jung, S.O. Huh, H.W. Suh, Y.H. Kim, D.K. Song, Protection against beta-amyloid peptide toxicity in vivo with long-term administration of ferulic acid, Br J Pharmacol, 133 (2001) 89-96.

[119] W. Xu, X.-B. Wang, Z.-M. Wang, J.-J. Wu, F. Li, J. Wang, L.-Y. Kong, Synthesis and evaluation of donepezil–ferulic acid hybrids as multi-target-directed ligands against Alzheimer's disease, MedChemComm, 7 (2016) 990-998.

[120] M. Ries, M. Sastre, Mechanisms of Aβ Clearance and Degradation by Glial Cells, Frontiers in aging neuroscience, 8 (2016) 160-160.

[121] T. Hamaguchi, K. Ono, M. Yamada, REVIEW: Curcumin and Alzheimer's disease, CNS Neurosci Ther, 16 (2010) 285-297.

[122] T. Hamaguchi, K. Ono, A. Murase, M. Yamada, Phenolic compounds prevent Alzheimer's pathology through different effects on the amyloid-beta aggregation pathway, Am J Pathol, 175 (2009) 2557-2565.

[123] Z. Sang, W. Pan, K. Wang, Q. Ma, L. Yu, Y. Yang, P. Bai, C. Leng, Q. Xu, X. Li, Z. Tan, W. Liu, Design, synthesis and evaluation of novel ferulic acid-O-alkylamine derivatives as potential multifunctional agents for the treatment of Alzheimer's disease, European Journal of Medicinal Chemistry, 130 (2017) 379-392.

[124] M. Tsuchiyama, T. Sakamoto, T. Fujita, S. Murata, H. Kawasaki, Esterification of ferulic acid with polyols using a ferulic acid esterase from Aspergillus niger, Biochimica et Biophysica Acta (BBA) - General Subjects, 1760 (2006) 1071-1079.

[125] J.-S. Lan, R.-F. Zeng, X.-Y. Jiang, J.-w. Hou, Y. Liu, Z.-H. Hu, H.-X. Li, Y. Li, S.-S. Xie, Y. Ding, T. Zhang, Design, synthesis and evaluation of novel ferulic acid derivatives as multi-target-directed ligands for the treatment of Alzheimer’s disease, Bioorganic Chemistry, 94 (2020) 103413.

[126] H. Liu, L. Liu, X. Gao, Y. Liu, W. Xu, W. He, H. Jiang, J. Tang, H. Fan, X. Xia, Novel ferulic amide derivatives with tertiary amine side chain as acetylcholinesterase and butyrylcholinesterase inhibitors: The influence of carbon spacer length, alkylamine and aromatic group, European Journal of Medicinal Chemistry, 126 (2017) 810-822.

[127] C.A. Rice-Evans, N.J. Miller, G. Paganga, Structure-antioxidant activity relationships of flavonoids and phenolic acids, Free Radic Biol Med, 20 (1996) 933-956.

[128] P.A. Kroon, G. Williamson, Hydroxycinnamates in plants and food: current and future perspectives, 79 (1999) 355-361.

[129] M. Kikugawa, T. Ida, H. Ihara, T. Sakamoto, Ferulic acid and its water-soluble derivatives inhibit nitric oxide production and inducible nitric oxide synthase expression in rat primary astrocytes, Bioscience, Biotechnology, and Biochemistry, 81 (2017) 1607-1611.

[130] J.-S. Jung, J.-J. Yan, H.-M. Li, M.T. Sultan, J. Yu, H.-S. Lee, K.-J. Shin, D.-K. Song, Protective effects of a dimeric derivative of ferulic acid in animal models of Alzheimer's disease, European Journal of Pharmacology, 782 (2016) 30-34.

[131] A. Panossian, G. Wikman, J. Sarris, Rosenroot (Rhodiola rosea): traditional use, chemical composition, pharmacology and clinical efficacy, Phytomedicine, 17 (2010) 481-493.

[132] V.D. Petkov, D. Yonkov, A. Mosharoff, T. Kambourova, L. Alova, V.V. Petkov, I. Todorov, Effects of alcohol aqueous extract from Rhodiola rosea L. roots on learning and memory, Acta Physiol Pharmacol Bulg, 12 (1986) 3-16.

[133] S.K. Hung, R. Perry, E. Ernst, The effectiveness and efficacy of Rhodiola rosea L.: a systematic review of randomized clinical trials, Phytomedicine, 18 (2011) 235-244.

[134] B. Michels, H. Zwaka, R. Bartels, O. Lushchak, K. Franke, T. Endres, M. Fendt, I. Song, M. Bakr, T. Budragchaa, B. Westermann, D. Mishra, C. Eschbach, S. Schreyer, A. Lingnau, C. Vahl, M. Hilker, R. Menzel, T. Kähne, V. Leßmann, A. Dityatev, L. Wessjohann, B. Gerber, Memory enhancement by ferulic acid ester across species, 4 (2018) eaat6994.

[135] K.S. Dias, C.T. de Paula, T. Dos Santos, I.N. Souza, M.S. Boni, M.J. Guimarães, F.M. da Silva, N.G. Castro, G.A. Neves, C.C. Veloso, M.M. Coelho, I.S. de Melo, F.C. Giusti, A. Giusti-Paiva, M.L. da Silva, L.E. Dardenne, I.A. Guedes, L. Pruccoli, F. Morroni, A. Tarozzi, C. Viegas, Jr., Design, synthesis and evaluation of novel feruloyl-donepezil hybrids as potential multitarget drugs for the treatment of Alzheimer's disease, Eur J Med Chem, 130 (2017) 440-457.

[136] Z. Sang, W. Pan, K. Wang, Q. Ma, L. Yu, Y. Yang, P. Bai, C. Leng, Q. Xu, X. Li, Z. Tan, W. Liu, Design, synthesis and evaluation of novel ferulic acid-O-alkylamine derivatives as potential multifunctional agents for the treatment of Alzheimer's disease, Eur J Med Chem, 130 (2017) 379-392.

[137] M. Benchekroun, L. Ismaili, M. Pudlo, V. Luzet, T. Gharbi, B. Refouvelet, J. Marco-Contelles, Donepezil–ferulic acid hybrids as anti-Alzheimer drugs, 7 (2015) 15-21.

[138] L. Fang, B. Kraus, J. Lehmann, J. Heilmann, Y. Zhang, M. Decker, Design and synthesis of tacrine-ferulic acid hybrids as multi-potent anti-Alzheimer drug candidates, Bioorg Med Chem Lett, 18 (2008) 2905-2909.

[139] M. Benchekroun, M. Bartolini, J. Egea, A. Romero, E. Soriano, M. Pudlo, V. Luzet, V. Andrisano, M.-L. Jimeno, M.G. López, S. Wehle, T. Gharbi, B. Refouvelet, L. de Andrés, C. Herrera-Arozamena, B. Monti, M.L. Bolognesi, M.I. Rodríguez-Franco, M. Decker, J. Marco-Contelles, L. Ismaili, Novel Tacrine-Grafted Ugi Adducts as Multipotent Anti-Alzheimer Drugs: A Synthetic Renewal in Tacrine–Ferulic Acid Hybrids, 10 (2015) 523-539.

[140] M. Digiacomo, Z. Chen, S. Wang, A. Lapucci, M. Macchia, X. Yang, J. Chu, Y. Han, R. Pi, S. Rapposelli, Synthesis and pharmacological evaluation of multifunctional tacrine derivatives

against several disease pathways of AD, Bioorganic & Medicinal Chemistry Letters, 25 (2015) 807-810.

[141] Y. Fu, Y. Mu, H. Lei, P. Wang, X. Li, Q. Leng, L. Han, X. Qu, Z. Wang, X. Huang, Design, Synthesis and Evaluation of Novel Tacrine-Ferulic Acid Hybrids as Multifunctional Drug Candidates against Alzheimer's Disease, Molecules, 21 (2016).

[142] Y. Chen, J. Sun, L. Fang, M. Liu, S. Peng, H. Liao, J. Lehmann, Y. Zhang, Tacrine-ferulic acid-nitric oxide (NO) donor trihybrids as potent, multifunctional acetyl- and butyrylcholinesterase inhibitors, J Med Chem, 55 (2012) 4309-4321.

[143] M. Digiacomo, Z. Chen, S. Wang, A. Lapucci, M. Macchia, X. Yang, J. Chu, Y. Han, R. Pi, S. Rapposelli, Synthesis and pharmacological evaluation of multifunctional tacrine derivatives against several disease pathways of AD, Bioorganic & medicinal chemistry letters, 25 (2015) 807-810.

[144] M. Estrada, C. Herrera-Arozamena, C. Pérez, D. Viña, A. Romero, J.A. Morales-García, A. Pérez-Castillo, M.I. Rodríguez-Franco, New cinnamic – N-benzylpiperidine and cinnamic – N,N-dibenzyl(N-methyl)amine hybrids as Alzheimer-directed multitarget drugs with antioxidant, cholinergic, neuroprotective and neurogenic properties, European Journal of Medicinal Chemistry, 121 (2016) 376-386.

[145] M. Rosini, E. Simoni, R. Caporaso, F. Basagni, M. Catanzaro, I.F. Abu, F. Fagiani, F. Fusco, S. Masuzzo, D. Albani, C. Lanni, I.R. Mellor, A. Minarini, Merging memantine and ferulic acid to probe connections between NMDA receptors, oxidative stress and amyloid-β peptide in Alzheimer's disease, European Journal of Medicinal Chemistry, 180 (2019) 111-120.

[146] S.F. Traynelis, L.P. Wollmuth, C.J. McBain, F.S. Menniti, K.M. Vance, K.K. Ogden, K.B. Hansen, H. Yuan, S.J. Myers, R. Dingledine, Glutamate receptor ion channels: structure, regulation, and function, Pharmacol Rev, 62 (2010) 405-496.

[147] H. Takahashi, P. Xia, J. Cui, M. Talantova, K. Bodhinathan, W. Li, S. Saleem, E.A. Holland, G. Tong, J. Piña-Crespo, D. Zhang, N. Nakanishi, J.W. Larrick, S.R. McKercher, T. Nakamura, Y. Wang, S.A. Lipton, Pharmacologically targeted NMDA receptor antagonism by NitroMemantine for cerebrovascular disease, Scientific Reports, 5 (2015) 14781.

[148] Z. Sang, K. Wang, P. Bai, A. Wu, J. Shi, W. Liu, G. Zhu, Y. Wang, Y. Lan, Z. Chen, Y. Zhao, Z. Qiao, C. Wang, Z. Tan, Design, synthesis and biological evaluation of novel O-carbamoyl ferulamide derivatives as multi-target-directed ligands for the treatment of Alzheimer’s disease, European Journal of Medicinal Chemistry, 194 (2020) 112265.

[149] L. Fang, M. Chen, Z. Liu, X. Fang, S. Gou, L. Chen, Ferulic acid–carbazole hybrid compounds: Combination of cholinesterase inhibition, antioxidant and neuroprotection as multifunctional anti-Alzheimer agents, Bioorganic & Medicinal Chemistry, 24 (2016) 886-893.

[150] W. Pan, K. Hu, P. Bai, L. Yu, Q. Ma, T. Li, X. Zhang, C. Chen, K. Peng, W. Liu, Z. Sang, Design, synthesis and evaluation of novel ferulic acid-memoquin hybrids as potential

multifunctional agents for the treatment of Alzheimer's disease, Bioorg Med Chem Lett, 26 (2016) 2539-2543.

[151] M. Jones, J. Wang, S. Harmon, B. Kling, J. Heilmann, J.F. Gilmer, Novel Selective Butyrylcholinesterase Inhibitors Incorporating Antioxidant Functionalities as Potential Bimodal Therapeutics for Alzheimer's Disease, Molecules, 21 (2016) 440.

[152] A. Tripathi, P.K. Choubey, P. Sharma, A. Seth, P. Saraf, S.K. Shrivastava, Design, synthesis, and biological evaluation of ferulic acid based 1,3,4-oxadiazole hybrids as multifunctional therapeutics for the treatment of Alzheimer's disease, Bioorg Chem, 95 (2020) 103506.

[153] S. Gunesch, M. Hoffmann, C. Kiermeier, W. Fischer, A.F.M. Pinto, T. Maurice, P. Maher, M. Decker, 7-O-Esters of taxifolin with pronounced and overadditive effects in neuroprotection, anti-neuroinflammation, and amelioration of short-term memory impairment in vivo, Redox Biology, 29 (2020) 101378.

[154] H. Jiang, X. Wang, L. Huang, Z. Luo, T. Su, K. Ding, X. Li, Benzenediol-berberine hybrids: multifunctional agents for Alzheimer's disease, Bioorg Med Chem, 19 (2011) 7228-7235.

[155] C. Chen, X. Yang, H. Fang, X. Hou, Design, synthesis and preliminary bioactivity evaluations of 8-hydroxyquinoline derivatives as matrix metalloproteinase (MMP) inhibitors, Eur J Med Chem, 181 (2019) 111563.

[156] P. Gisbert, P. Trillo, I.M. Pastor, Comparative Study of Catalytic Systems Formed by Palladium and Acyl-Substituted Imidazolium Salts, 3 (2018) 887-893.

[157] J. Verghese, T. Nguyen, L.M. Oppegard, L.M. Seivert, H. Hiasa, K.C. Ellis, Flavone-based analogues inspired by the natural product simocyclinone D8 as DNA gyrase inhibitors, Bioorg Med Chem Lett, 23 (2013) 5874-5877.

[158] M. Iwamura, R. Koyama, Y. Nonaka, F. Dai, R. Matsuoka, M. Nakamura, H. Iwabuchi, T. Okada, T. Hasegawa, High-Throughput Evaluation System based on Fluorescence Intensity Distribution Analysis-Polarization to Investigate Carbohydrate–Carbohydrate Interactions, 89 (2016) 617-625.

[159] K.G. Liu, A.J. Robichaud, A general and convenient synthesis of N-aryl piperazines, Tetrahedron Letters, 46 (2005) 7921-7922.

[160] V. Kaushik, S.T. Smith, E. Mikobi, M.A. Raji, Acetylcholinesterase Inhibitors: Beneficial Effects on Comorbidities in Patients With Alzheimer’s Disease, American Journal of Alzheimer's Disease & Other Dementias®, 33 (2017) 73-85.

[161] G.L. Ellman, K.D. Courtney, V. Andres, R.M. Featherstone, A new and rapid colorimetric determination of acetylcholinesterase activity, Biochemical Pharmacology, 7 (1961) 88-95.
[162] S. Losada-Barreiro, C. Bravo-Díaz, Free radicals and polyphenols: The redox chemistry of neurodegenerative diseases, European Journal of Medicinal Chemistry, 133 (2017) 379-402.

[163] P. Taylor, S. Lappi, Interaction of fluorescence probes with acetylcholinesterase. Site and specificity of propidium binding, Biochemistry, 14 (1975) 1989-1997.

[164] X. Zhang, Z. Fu, L. Meng, M. He, Z. Zhang, The Early Events That Initiate β-Amyloid Aggregation in Alzheimer's Disease, Frontiers in aging neuroscience, 10 (2018) 359-359.
[165] Maestro, Schrödinger, LLC:, New York, NY, USA,, 2016.

[166] P. Pandey, K.K. Roy, R.J. Doerksen, Negative allosteric modulators of cannabinoid receptor 2: protein modeling, binding site identification and molecular dynamics simulations in the presence of an orthosteric agonist, J Biomol Struct Dyn, 38 (2020) 32-47.

[167] I. Khan, K.R. Garikapati, A. Setti, A.B. Shaik, V.K. Kanth Makani, M.A. Shareef, H. Rajpurohit, N. Vangara, M. Pal-Bhadra, A. Kamal, C.G. Kumar, Design, synthesis, in silico pharmacokinetics prediction and biological evaluation of 1,4-dihydroindeno[1,2-c]pyrazole chalcone as EGFR /Akt pathway inhibitors, European Journal of Medicinal Chemistry, 163 (2019) 636-648.

[168] M.V. Berridge, P.M. Herst, A.S. Tan, Tetrazolium dyes as tools in cell biology: New insights into their cellular reduction, Biotechnology Annual Review, Elsevier2005, pp. 127-152.

[169] J. Zielonka, B. Kalyanaraman, Hydroethidine- and MitoSOX-derived red fluorescence is not a reliable indicator of intracellular superoxide formation: another inconvenient truth, Free radical biology & medicine, 48 (2010) 983-1001.

[170] R.A. Kirkland, G.M. Saavedra, J.L. Franklin, Rapid Activation of Antioxidant Defenses by Nerve Growth Factor Suppresses Reactive Oxygen Species during Neuronal Apoptosis: Evidence for a Role in Cytochrome c Redistribution, The Journal of Neuroscience, 27 (2007) 11315-11326.

[171] L. Di, E.H. Kerns, K. Fan, O.J. McConnell, G.T. Carter, High throughput artificial membrane permeability assay for blood-brain barrier, Eur J Med Chem, 38 (2003) 223-232.

[172] H.-L. Yang, S.-Q. Fang, Y.-W. Tang, C. Wang, H. Luo, L.-L. Qu, J.-H. Zhao, C.-J. Shi, F.-C. Yin, X.-B. Wang, L.-Y. Kong, A hemicyanine derivative for near-infrared imaging of β-amyloid plaques in Alzheimer's disease, European journal of medicinal chemistry, 179 (2019) 736-743.

[173] R.K. Saini, S. Shuaib, D. Goyal, B. Goyal, Insights into the inhibitory mechanism of a resveratrol and clioquinol hybrid against Aβ(42) aggregation and protofibril destabilization: A molecular dynamics simulation study, J Biomol Struct Dyn, 37 (2019) 3183-3197.

[174] W. Kabsch, C. Sander, How good are predictions of protein secondary structure?, FEBS Lett, 155 (1983) 179-182.

[175] W. Kabsch, C. Sander, Dictionary of protein secondary structure: pattern recognition of hydrogen-bonded and geometrical features, Biopolymers, 22 (1983) 2577-2637.

[176] W. Wang, W. Wang, G. Yao, Q. Ren, D. Wang, Z. Wang, P. Liu, P. Gao, Y. Zhang, S. Wang, S. Song, Novel sarsasapogenin-triazolyl hybrids as potential anti-Alzheimer's agents: Design, synthesis and biological evaluation, European Journal of Medicinal Chemistry, 151 (2018) 351-362.

[177] B.H. Chen, J.H. Park, D.W. Kim, J. Park, S.Y. Choi, I.H. Kim, J.H. Cho, T.-K. Lee, J.C. Lee, C.-H. Lee, I.K. Hwang, Y.-M. Kim, B.C. Yan, I.J. Kang, B.N. Shin, Y.L. Lee, M.C. Shin, J.H. Cho, Y.J. Lee, Y.H. Jeon, M.-H. Won, J.H. Ahn, Melatonin Improves Cognitive Deficits via Restoration of Cholinergic Dysfunction in a Mouse Model of Scopolamine-Induced Amnesia, ACS Chemical Neuroscience, 9 (2018) 2016-2024.

[178] G.L. Ellman, Tissue sulfhydryl groups, Arch Biochem Biophys, 82 (1959) 70-77.
[179] F. Cheng, W. Li, Y. Zhou, J. Shen, Z. Wu, G. Liu, P.W. Lee, Y. Tang, admetSAR: A Comprehensive Source and Free Tool for Assessment of Chemical ADMET Properties, Journal of Chemical Information and Modeling, 52 (2012) 3099-3105.

[180] A.S. Mehanna, J.Y. Kim, Design, synthesis, and biological testing of thiosalicylamides as a novel class of calcium channel blockers, Bioorganic & medicinal chemistry, 13 (2005) 4323-4331.
[181] G.M. Sastry, M. Adzhigirey, T. Day, R. Annabhimoju, W. Sherman, Protein and ligand preparation: parameters, protocols, and influence on virtual screening enrichments, J Comput Aided Mol Des, 27 (2013) 221-234.

[182] D.E.S. Research, Desmond Molecular Dynamics System, in: D.E.S. Research (Ed.) Maestro-Desmond Interoperability Tools, Schrödinger, LLC, New York, NY, , 2019.

[183] N.D. Chaurasiya, J. Zhao, P. Pandey, R.J. Doerksen, I. Muhammad, B.L. Tekwani, Selective Inhibition of Human Monoamine Oxidase B by Acacetin 7-Methyl Ether Isolated from Turnera diffusa (Damiana), Molecules (Basel, Switzerland), 24 (2019) 810.

[184] H.M. Berman, J. Westbrook, Z. Feng, G. Gilliland, T.N. Bhat, H. Weissig, I.N. Shindyalov, P.E. Bourne, The Protein Data Bank, Nucleic Acids Research, 28 (2000) 235-242.

[185] T. Lührs, C. Ritter, M. Adrian, D. Riek-Loher, B. Bohrmann, H. Döbeli, D. Schubert, R. Riek, 3D structure of Alzheimer's amyloid-β(1–42) fibrils, 102 (2005) 17342-17347.

[186] I. Sánchez-Linares, H. Pérez-Sánchez, J.M. Cecilia, J.M. García, High-Throughput parallel blind Virtual Screening using BINDSURF, BMC Bioinformatics, 13 Suppl 14 (2012) S13.

[187] J. Huang, A.D. MacKerell Jr, CHARMM36 all-atom additive protein force field: Validation based on comparison to NMR data, 34 (2013) 2135-2145.

[188] D. Van Der Spoel, E. Lindahl, B. Hess, G. Groenhof, A.E. Mark, H.J.C. Berendsen, GROMACS: Fast, flexible, and free, 26 (2005) 1701-1718.

[189] K. Vanommeslaeghe, E. Hatcher, C. Acharya, S. Kundu, S. Zhong, J. Shim, E. Darian, O. Guvench, P. Lopes, I. Vorobyov, A.D. Mackerell Jr., CHARMM general force field: A force field

for drug-like molecules compatible with the CHARMM all-atom additive biological force fields, 31 (2010) 671-690.

[190] P. Mark, L. Nilsson, Structure and dynamics of the TIP3P, SPC, and SPC/E water models at 298 K, The Journal of Physical Chemistry A, 105 (2001) 9954-9960.

[191] M. Parrinello, A. Rahman, Polymorphic transitions in single crystals: A new molecular dynamics method, Journal of Applied Physics, 52 (1981) 7182-7190.

[192] G. Bussi, D. Donadio, M. Parrinello, Canonical sampling through velocity rescaling, J Chem Phys, 126 (2007) 014101.

[193] T. Darden, D. York, L. Pedersen, Particle mesh Ewald: An N·log(N) method for Ewald sums in large systems, 98 (1993) 10089.

[194] R. Kumari, R. Kumar, A. Lynn, g_mmpbsa—A GROMACS Tool for High-Throughput MM-PBSA Calculations, Journal of Chemical Information and Modeling, 54 (2014) 1951-1962.
[195] L. Skjærven, X.-Q. Yao, G. Scarabelli, B.J. Grant, Integrating protein structural dynamics and evolutionary analysis with Bio3D, BMC Bioinformatics, 15 (2014) 399.

[196] B.J. Grant, A.P. Rodrigues, K.M. ElSawy, J.A. McCammon, L.S. Caves, Bio3d: an R package for the comparative analysis of protein structures, Bioinformatics, 22 (2006) 2695-2696.
[197] F. Nachon, E. Carletti, C. Ronco, M. Trovaslet, Y. Nicolet, L. Jean, P.Y. Renard, Crystal structures of human cholinesterases in complex with huprine W and tacrine: elements of specificity for anti-Alzheimer's drugs targeting acetyl- and butyryl-cholinesterase, Biochem J, 453 (2013) 393-399.

[198] R.A. Friesner, R.B. Murphy, M.P. Repasky, L.L. Frye, J.R. Greenwood, T.A. Halgren, P.C. Sanschagrin, D.T. Mainz, Extra Precision Glide: Docking and Scoring Incorporating a Model of Hydrophobic Enclosure for Protein−Ligand Complexes, Journal of Medicinal Chemistry, 49 (2006) 6177-6196.

[199] A. John, V. Umashankar, S. Krishnakumar, P.R. Deepa, Comparative Modeling and Molecular Dynamics Simulation of Substrate Binding in Human Fatty Acid Synthase: Enoyl Reductase and β-Ketoacyl Reductase Catalytic Domains, Genomics & informatics, 13 (2015) 15-24.

[200] A. Gahlawat, N. Kumar, R. Kumar, H. Sandhu, I.P. Singh, S. Singh, A. Sjöstedt, P. Garg, Structure-Based Virtual Screening to Discover Potential Lead Molecules for the SARS-CoV-2 Main Protease, Journal of Chemical Information and Modeling, 60 (2020) 5781-5793.

[201] N. Kumar, A. Gahlawat, R.N. Kumar, Y.P. Singh, G. Modi, P. Garg, Drug repurposing for Alzheimer's disease: in silico and in vitro investigation of FDA-approved drugs as acetylcholinesterase inhibitors, Journal of biomolecular structure & dynamics, (2020) 1-15.
[202] K. Cho, J.D. Joannopoulos, L. Kleinman, Constant-temperature molecular dynamics with momentum conservation, Physical Review E, 47 (1993) 3145-3151.

[203] S. Genheden, O. Kuhn, P. Mikulskis, D. Hoffmann, U. Ryde, The Normal-Mode Entropy in the MM/GBSA Method: Effect of System Truncation, Buffer Region, and Dielectric Constant, Journal of Chemical Information and Modeling, 52 (2012) 2079-2088.

[204] S. Nosé, A unified formulation of the constant temperature molecular dynamics methods, The Journal of Chemical Physics, 81 (1984) 511-519.

[205] P.D. Lyne, M.L. Lamb, J.C. Saeh, Accurate prediction of the relative potencies of members of a series of kinase inhibitors using molecular docking and MM-GBSA scoring, J Med Chem, 49 (2006) 4805-4808.

[206] M. Redza-Dutordoir, D.A. Averill-Bates, Activation of apoptosis signalling pathways by reactive oxygen species, Biochimica et Biophysica Acta (BBA) - Molecular Cell Research, 1863 (2016) 2977-2992.

[207] M.-V. Clément, A. Ponton, S. Pervaiz, Apoptosis induced by hydrogen peroxide is mediated by decreased superoxide anion concentration and reduction of intracellular milieu, FEBS Letters, 440 (1998) 13-18.

[208] A. Phaniendra, D.B. Jestadi, L. Periyasamy, Free radicals: properties, sources, targets, and their implication in various diseases, Indian journal of clinical biochemistry : IJCB, 30 (2015) 11-26.

[209] E.A. Motea, A.J. Berdis, Terminal deoxynucleotidyl transferase: the story of a misguided DNA polymerase, Biochim Biophys Acta, 1804 (2010) 1151-1166.

[210] D. Yedlapudi, L. Xu, D. Luo, G.B. Marsh, S.V. Todi, A.K. Dutta, Targeting alpha synuclein and amyloid beta by a multifunctional, brain-penetrant dopamine D2/D3 agonist D-520: Potential therapeutic application in Parkinson’s disease with dementia, Scientific Reports, 9 (2019) 19648.

[211] R. D’Hooge, P.P. De Deyn, Applications of the Morris water maze in the study of learning and memory, Brain Research Reviews, 36 (2001) 60-90.

[212] P.A. Dudchenko, An overview of the tasks used to test working memory in rodents, Neurosci Biobehav Rev, 28 (2004) 699-709.

[213] Y.P. Singh, H. Rai, G. Singh, G.K. Singh, S. Mishra, S. Kumar, S. Srikrishna, G. Modi, A Review on Ferulic Acid and Analogs Based Scaffolds for the Management of Alzheimer's Disease, European Journal of Medicinal Chemistry, (2021) 113278.

[214] Y.P. Singh, A. Pandey, S. Vishwakarma, G. Modi. A review on iron chelators as potential therapeutic agents for the treatment of Alzheimer's and Parkinson's diseases. Molecular Diversity. 2018

[215] N.Jadid, D. Hidayati, S.R. Hartanti, B.A. Arraniry, R.Y. Rachman, and W. Wikanta, "Antioxidant activity of different solvent extrats of Piper retrofractum Vahl. using DPPH assay" AIP Conference Proceedings 1854, 020019 (2017).

Appendix

Appendix

Supplementary data of first series of compounds

Figure A1. ^{1}H NMR spectra of (*E*)-N-(4-hydroxy-3-methoxyphenyl)-N-(2-((3-methoxyphenyl)amino)-2oxoethyl)acrylamide (**4f**).

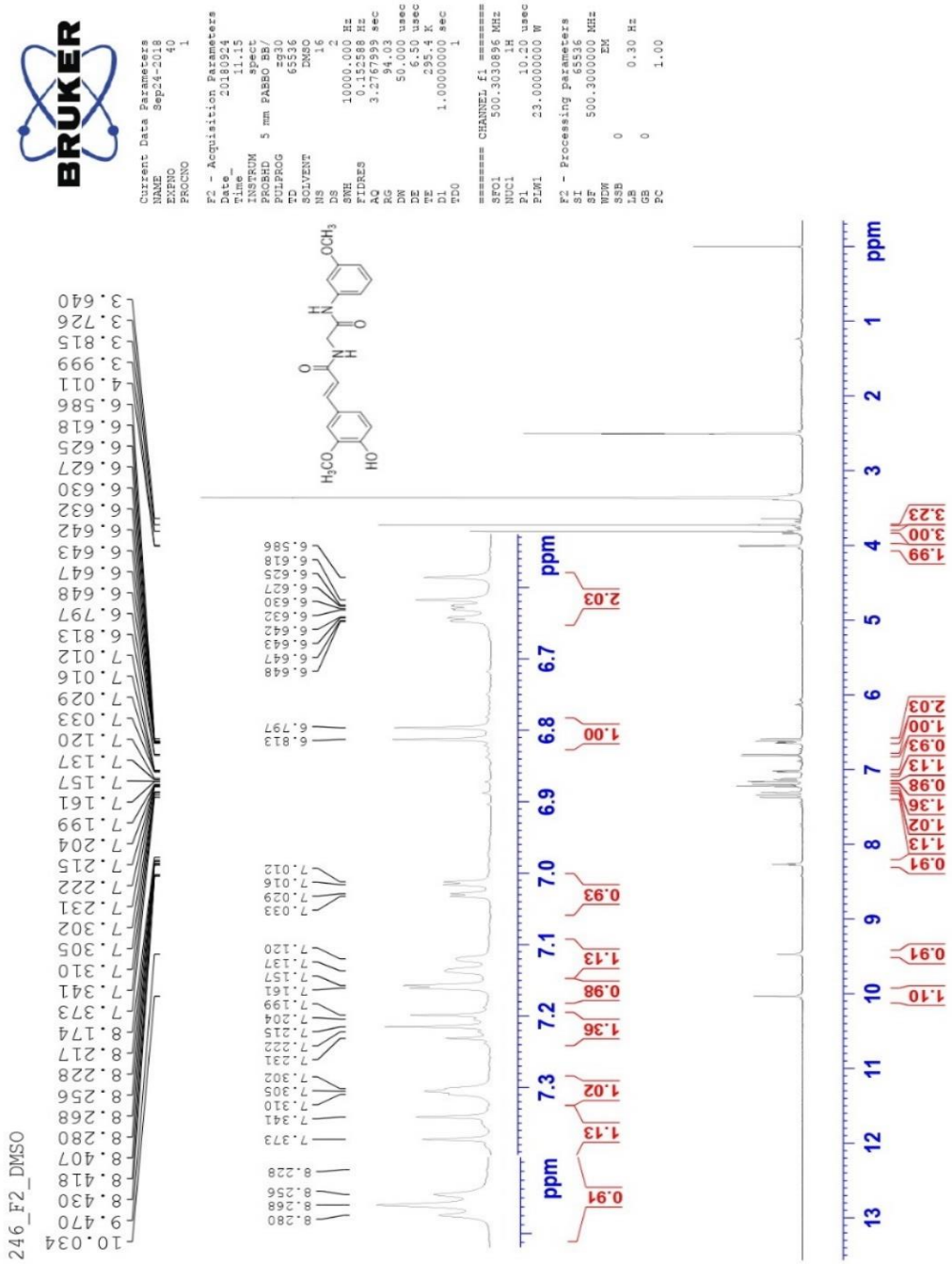


Figure A2. ^{13}C NMR spectra of (*E*)-N-(4-hydroxy-3-methoxyphenyl)-N-(2-((3-methoxyphenyl)amino)-2oxoethyl)acrylamide (**4f**).

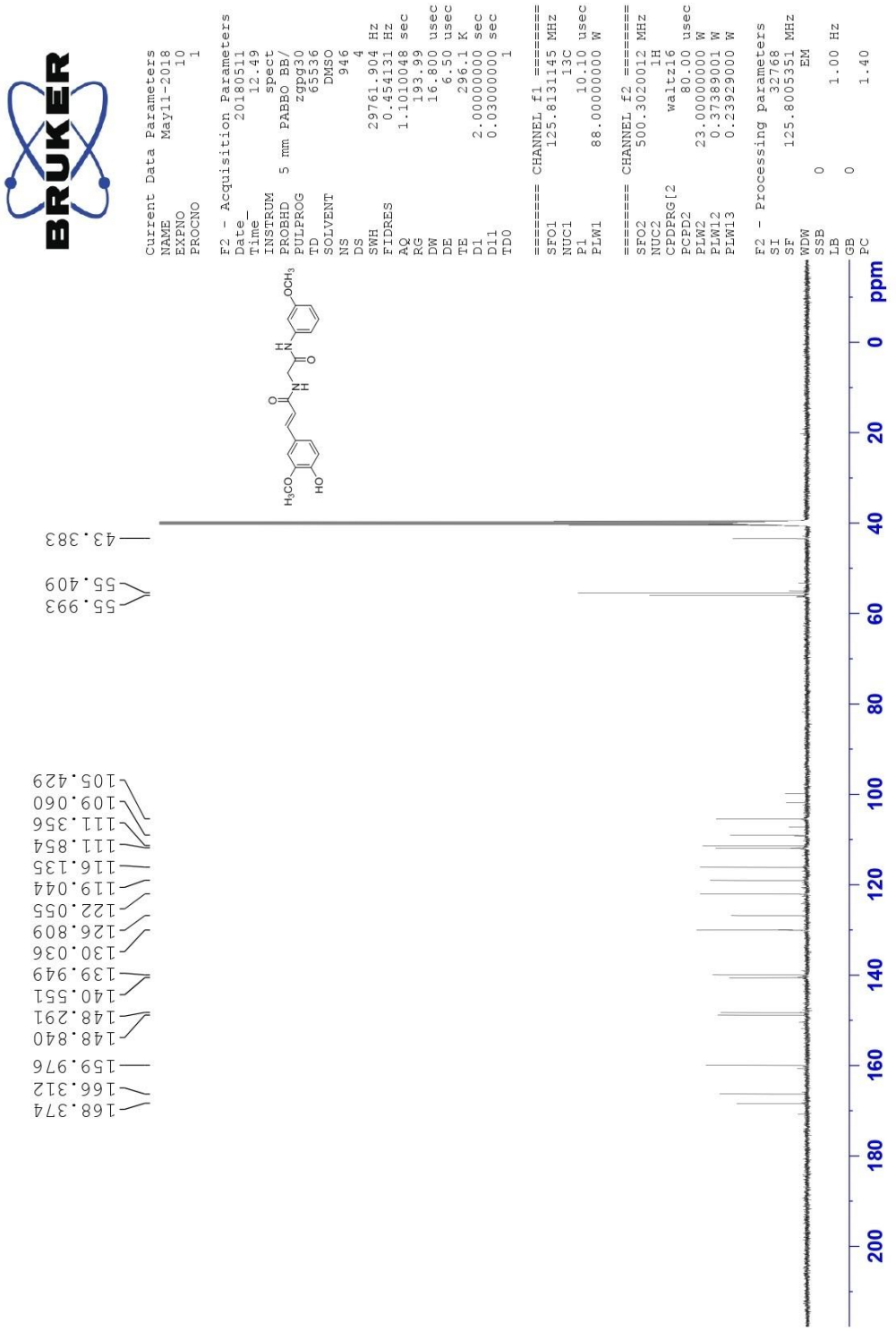


Figure A3. HRMS spectra of (*E*)-N-(4-hydroxy-3-methoxyphenyl)-N-(2-((3-methoxyphenyl)amino)-2oxoethyl)acrylamide (**4f**).

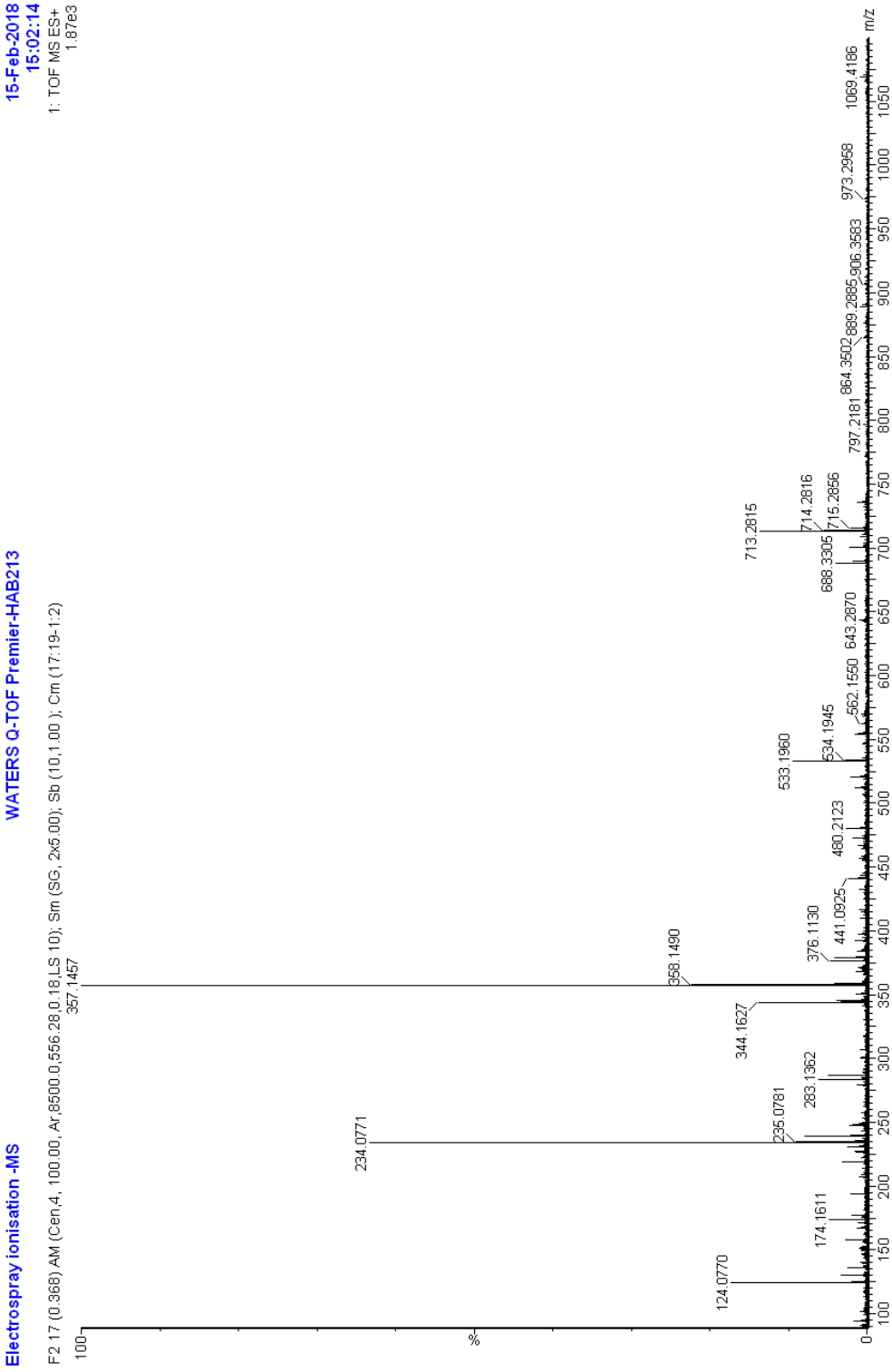


Figure A4. [1]H NMR spectra of (*E*)-N-(2-((1H-indol-5-yl)amino)-2-oxoethyl)-3-(4-hydroxy-3-methoxyphenyl) acrylamide (**7a**).

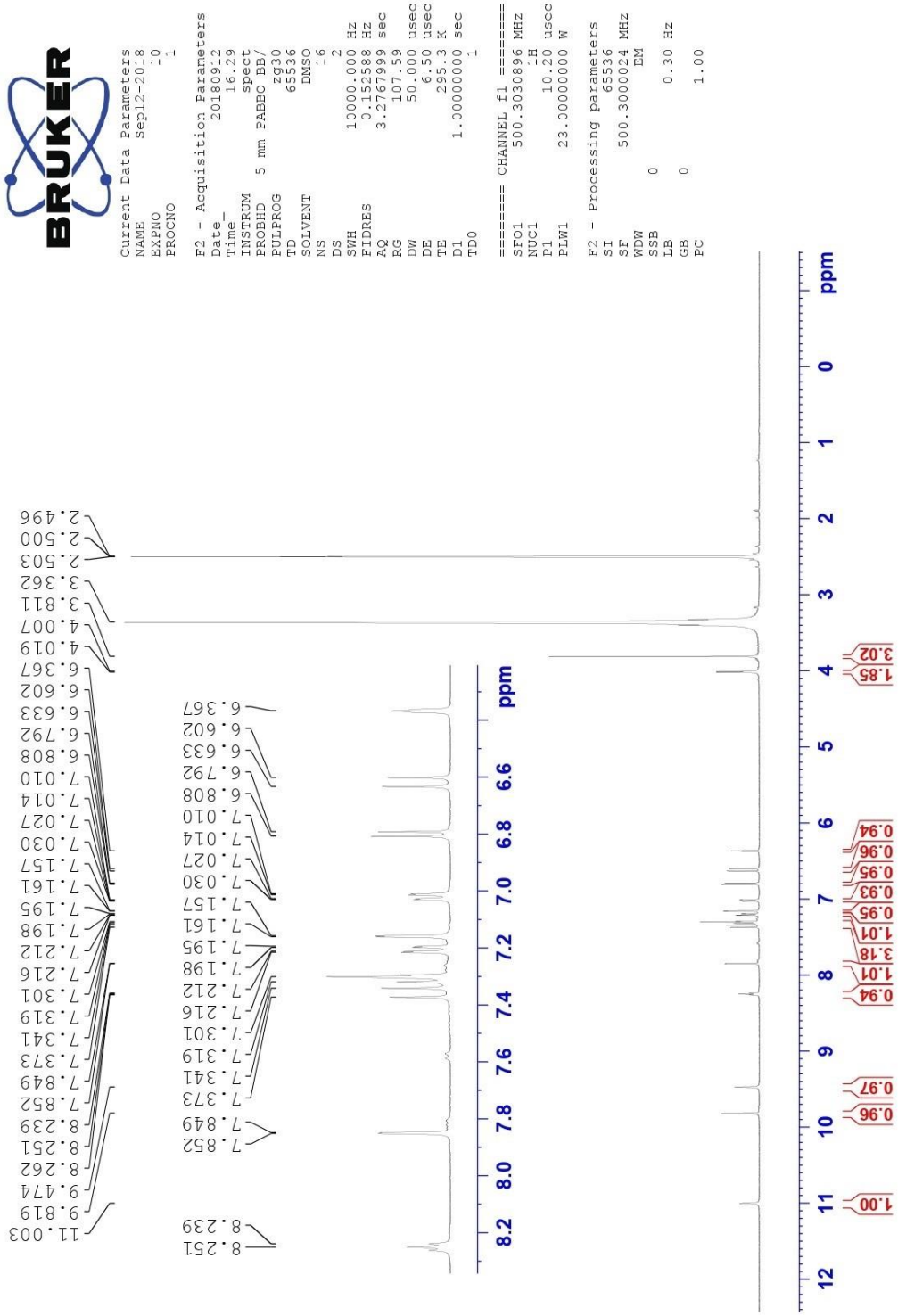


Figure A5. ^{13}C NMR spectra of (*E*)-N-(2-((1H-indol-5-yl)amino)-2-oxoethyl)-3-(4-hydroxy-3-methoxyphenyl)acrylamide (**7a**).

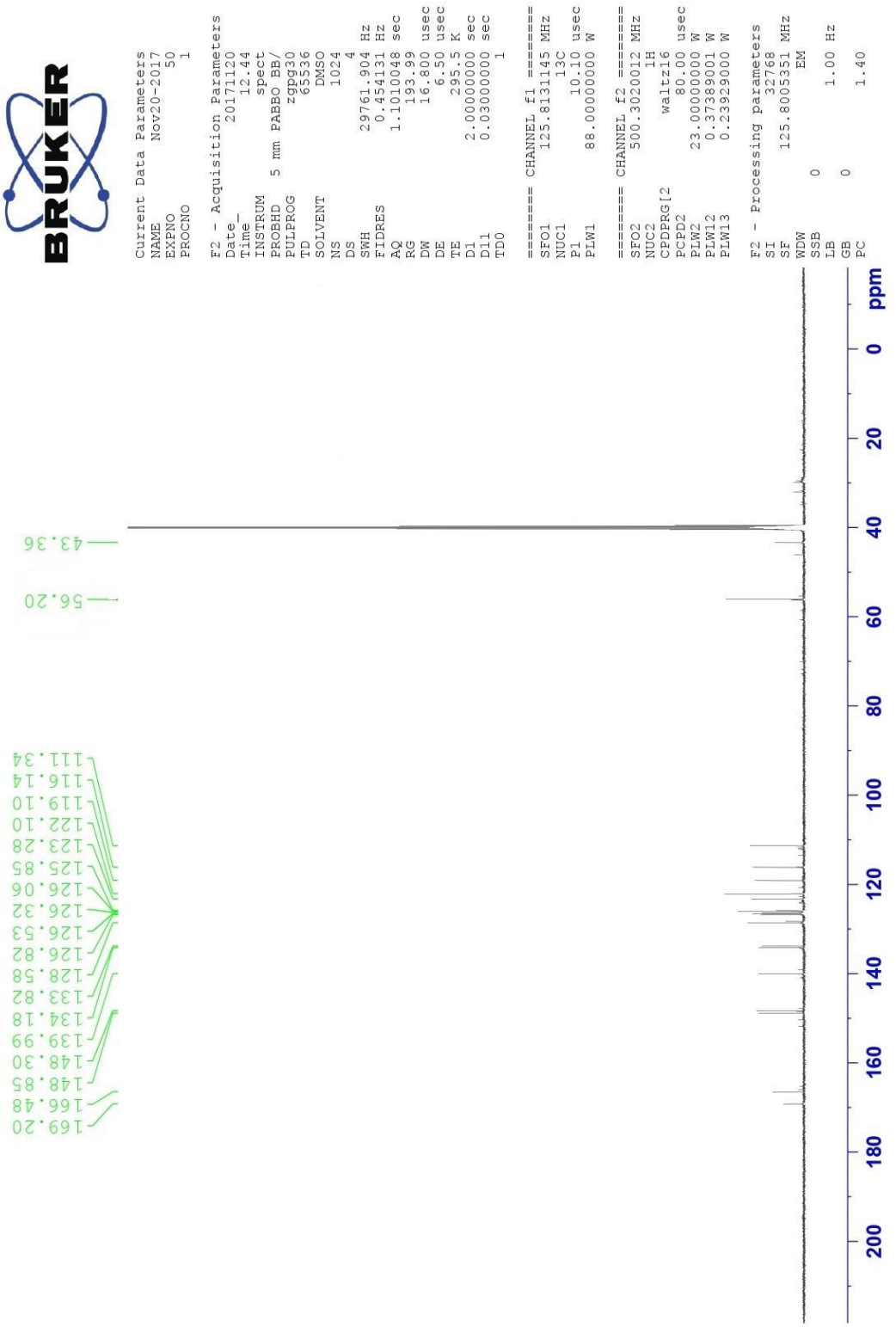
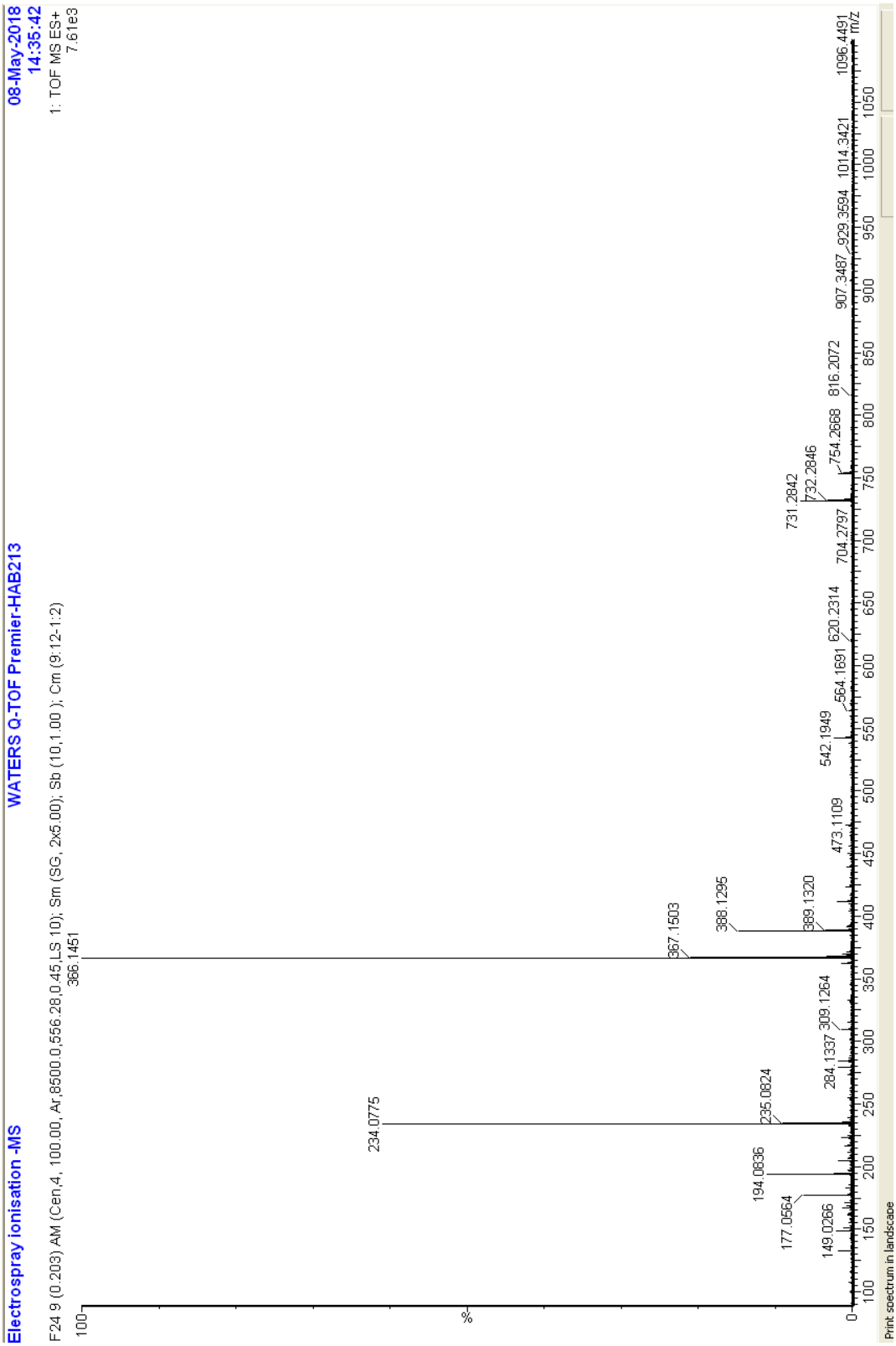


Figure A6. HRMS spectra of (*E*)-N-(2-((1H-indol-5-yl)amino)-2-oxoethyl)-3-(4-hydroxy-3-methoxyphenyl) acrylamide (**7a**).



Supplementary data of second series of compounds

Figure A7. ^{1}H NMR spectra of (*E*)-1-(4-(3-fluorobenzyl)piperazin-1-yl)-3-(4-hydroxy-3-methoxyphenyl)prop-2-en-1-one (**13k.HCl**).

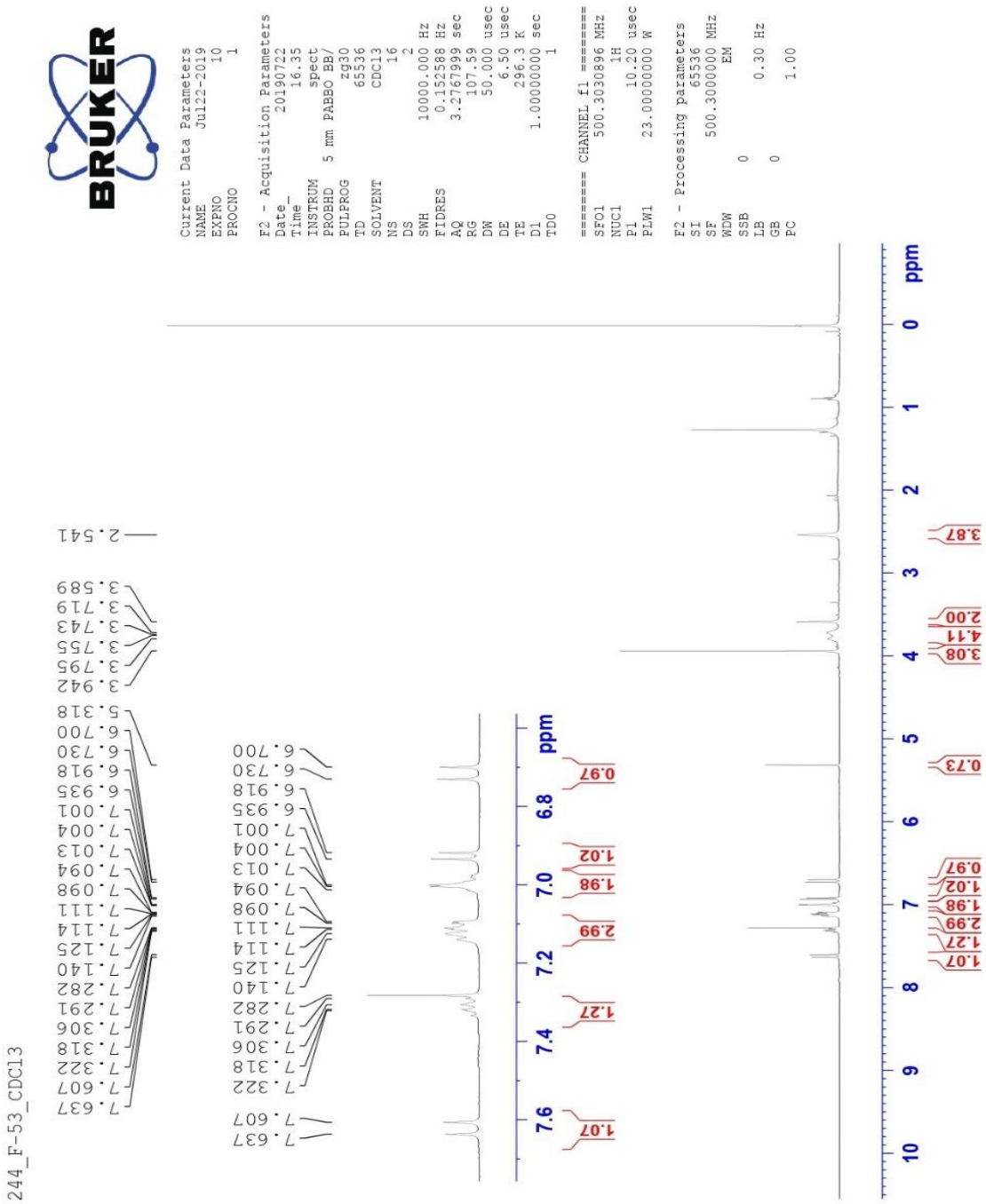


Figure A8. ^{13}C NMR spectra of (*E*)-1-(4-(3-fluorobenzyl)piperazin-1-yl)-3-(4-hydroxy-3-methoxyphenyl)prop-2-en-1-one (**13k.HCl**).

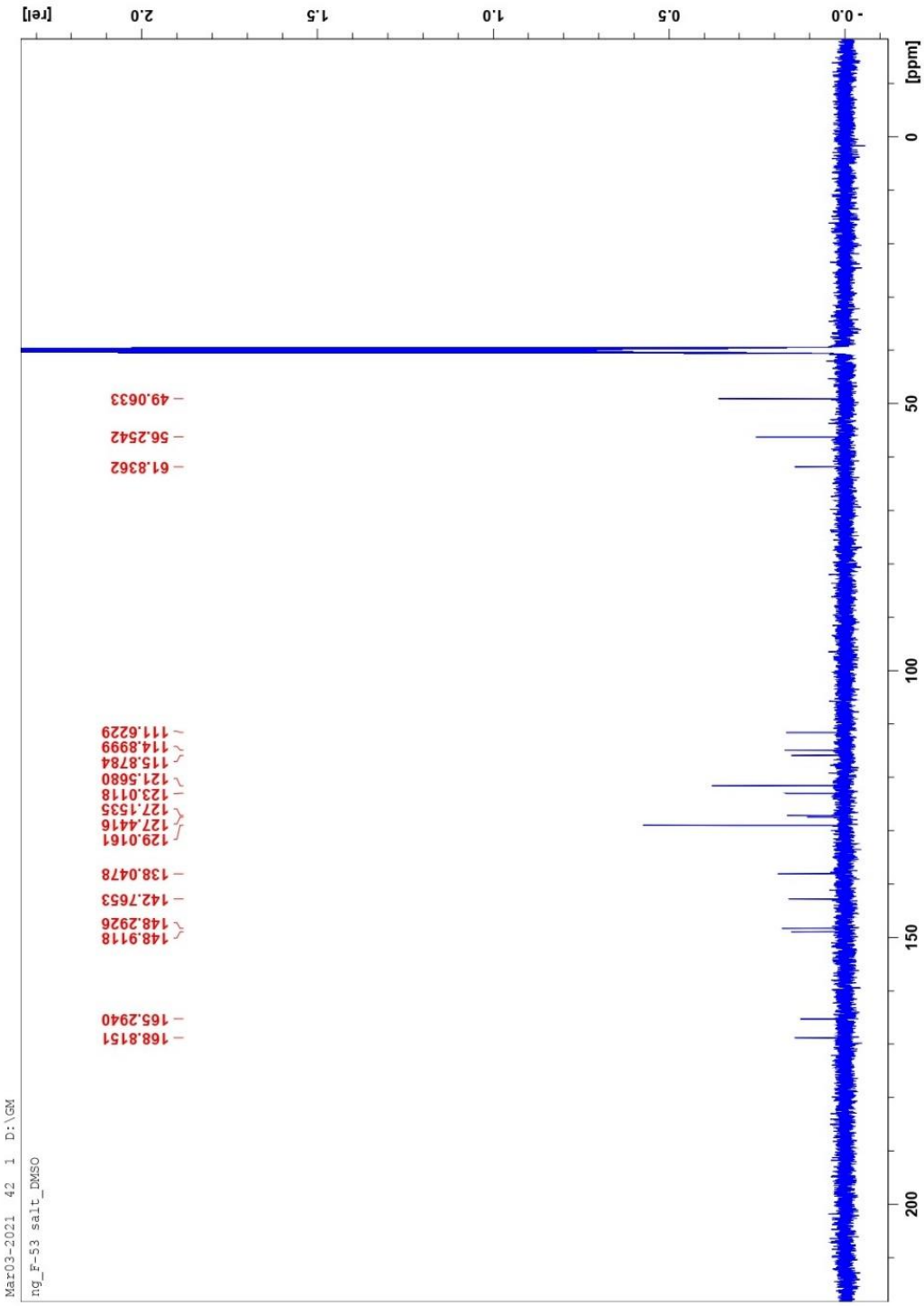


Figure A9. HRMS spectra of (*E*)-1-(4-(3-fluorobenzyl)piperazin-1-yl)-3-(4-hydroxy-3-methoxyphenyl)prop-2-en-1-one (**13k.HCl**).

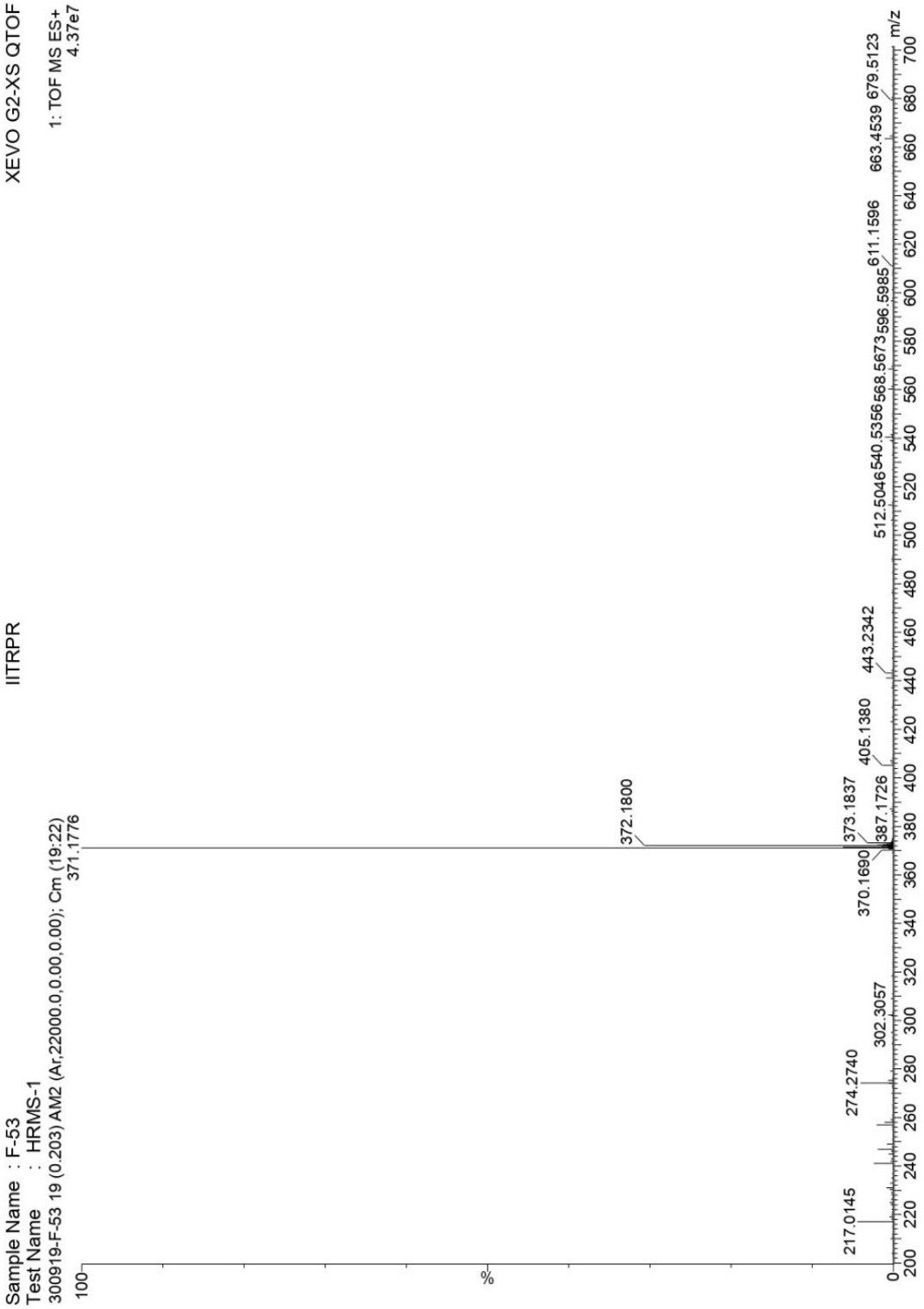


Figure A10. ^{1}H NMR spectra of (*E*)-3-(4-hydroxy-3-methoxyphenyl)-N-(2-((2-(5-methoxy-1H-indol-3-yl)ethyl)amino)-2-oxoethyl)acrylamide (**23b**).

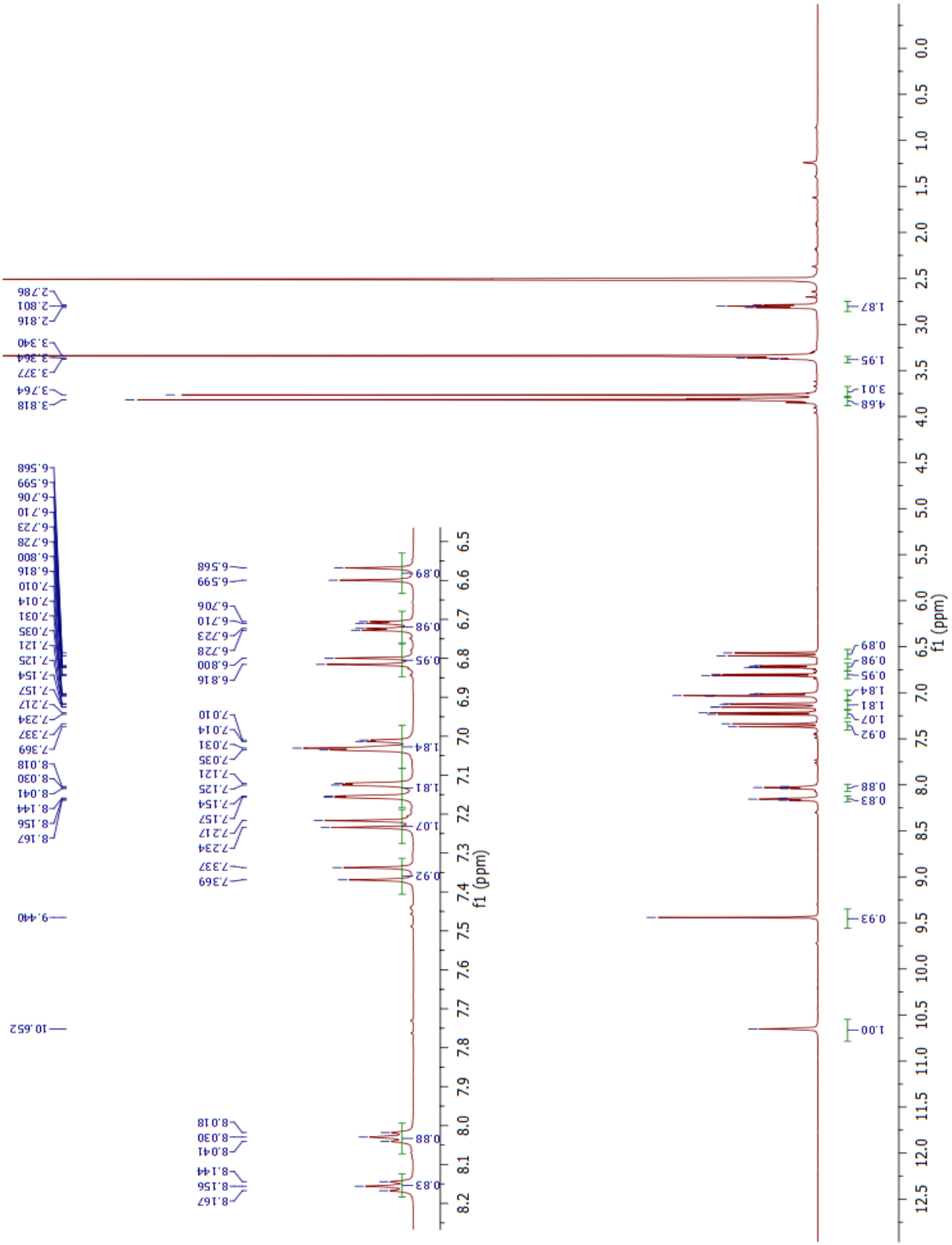


Figure A11. ^{13}C NMR spectra of (*E*)-3-(4-hydroxy-3-methoxyphenyl)-N-(2-((2-(5-methoxy-1H-indol-3-yl)ethyl)amino)-2-oxoethyl)acrylamide (**23b**).

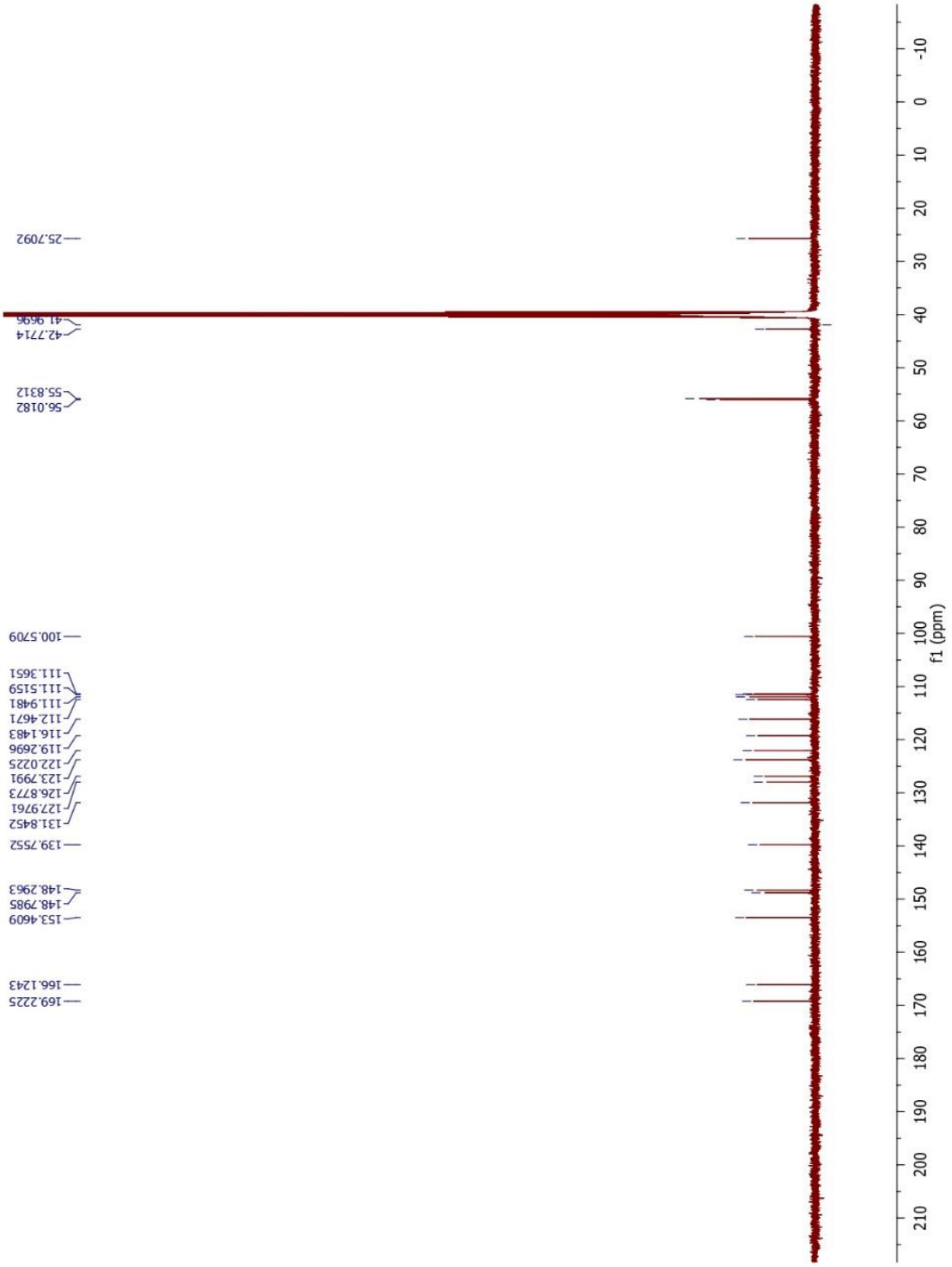
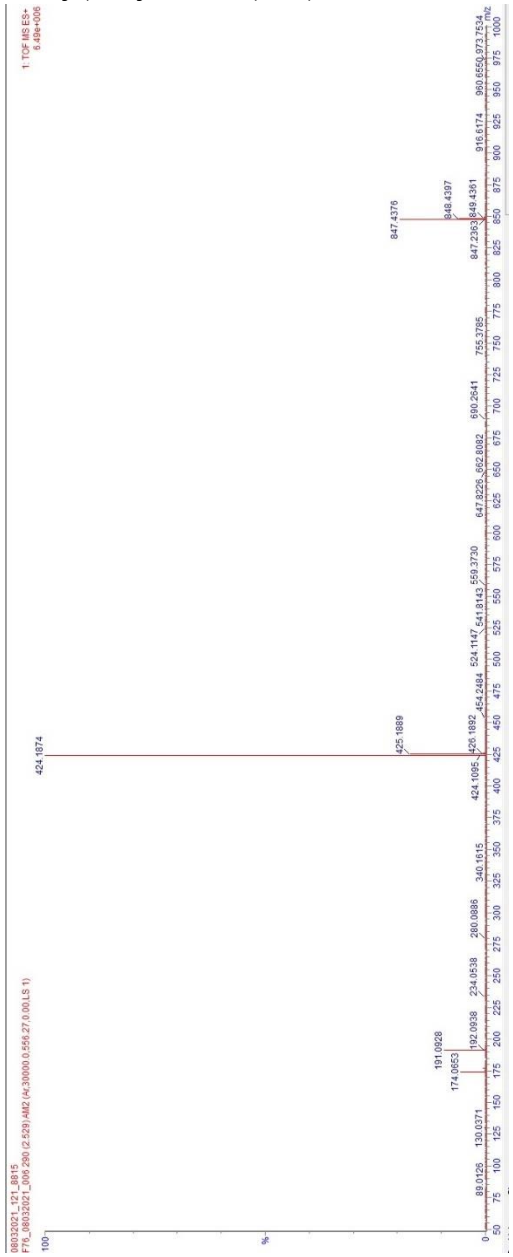


Figure A12. HRMS spectra of (*E*)-3-(4-hydroxy-3-methoxyphenyl)-N-(2-((2-(5-methoxy-1H-indol-3-yl)ethyl)amino)-2-oxoethyl)acrylamide (**23b**)



List of Publications

Publications from the research work

1. **Y.P. Singh**, G.N.V.C. Tej, A. Pandey, K. Priya, P. Pandey, G. Shankar, P.K. Nayak, G. Rai, A. G.Chittiboyina, R. J. Doerksen, S. Vishwakarma, G. Modi. Design, synthesis and biological evaluationof novel naturally-inspired multifunctional molecules for the management of Alzheimer's disease. ***European journal of medicinal chemistry*** (IF 5.57, 2019). 2020;198:112257.
2. **Y. P. Singh**, G. Shankar, S. Jahan, G. Singh, N. Kumar, A. Barik, P. Upadhyay, L. Singh, K. Kamble,G. K. Singh, N. Ranjan, P. Garg, S. Gupta, G. Modi. Further SAR Studies on Natural Template Based Neuroprotective Molecules for the Treatment of Alzheimer's Disease. ***Bioorganic and medicinal chemistry*** (IF 3.64, 2021, 2021).
3. **Y.P. Singh**, H. Rai, G. Singh, G.K. Singh, S. Mishra, S. Kumar, S. Srikrishna, G. Modi, A Review on Ferulic Acid and Analogs Based Scaffolds for the Management of Alzheimer's Disease, ***European Journal of Medicinal Chemistry*** (IF 5.57,2021) 113278.
4. **Y.P. Singh**, A. Pandey, S. Vishwakarma, G. Modi. A review on iron chelators as potential therapeutic agents for the treatment of Alzheimer's and Parkinson's diseases. ***Molecular Diversity***. 2018 (IF 2.0, 2018).

Publication under review

1. **Y. P. Singh**, N. Kumar, K. Priya, B. S. Chauhan, G. Shankar, S. Kumar, G. K. Singh, S. Srikrishna, P. Garg, G. Rai, G. Modi. Exploration of Neuroprotective Properties of Naturally Inspired Multifunctional Molecule (F24) Against Oxidative Stress and Amyloid β Induced Neurotoxicity in Alzheimer's Disease Models. ***ACS Chemical Neuroscience*** (Revised article under review).

Other Publications

1. N. Kumar, A. Gahlawat, R.N. Kumar, **Y.P. Singh**, G. Modi, P. Garg. Drug repurposing for Alzheimer’s disease: in silico and in vitro investigation of FDA-approved drugs as acetylcholinesterase inhibitors, ***Journal of Biomolecular Structure and Dynamics***, (2020) 1-15.
2. H. Rai, A. Barik, **Y.P. Singh**, A. Suresh, L. Singh, G. Singh, U.Y. Nayak, V.K. Dubey, G. Modi, Molecular docking, binding mode analysis, molecular dynamics, and prediction of

ADMET/toxicity properties of selective potential antiviral agents against SARS-CoV-2 main protease: an effort toward drug repurposing to combat COVID-19, ***Molecular Diversity***, 25 (IF 2.0, 2019) 1905-1927.

List of Patents filed

1. G. Modi, **Y.P. Singh**, A. Pandey, Development of multifunctional hybrid 3-(4-hydroxy-3-methoxy-phenyl)prop-2-enoic acid and substituted amine /piperazine derivatives for the treatment of neurodegenerative disorders (Patent Application # **201911000362**).
2. G. Modi, **Y.P. Singh**, C. P. Kumar, M. Yadav, G. Shankar, G. Singh, S. Kumar, S Srikrishna. A Multifunctional diarylurea-hydroxyamidine based compound for treatment of Alzheimer disease, **TEMP/E-1/1680/2021-DEL,** Jan, 2021.
3. G. Modi, **Y.P. Singh**, G. Shankr, G. Singh, A. Barik, L. Singh A natural template based anticholinesterase inhibitors and antioxidants for the treatment of Alzheimer's disease, Indian patent application # **202111016470,** Filled on April 07, 2021**.**

List of conferences attended

1. Design, synthesis and biological evaluation of novel molecules for the management of Alzheimer's disease, Meenu Yadav*, Yash Pal Singh, Prince Kumar, Prem Chopra, Amruta Pandey, Gyan Modi, **Indian Acdemy of Neuroscience, 2018**.
2. Design, Synthesis and Biological Evaluation of Novel Molecules for The Management of Alzheimer's Disease, C.S. Praveen Kumar, Yash Pal Singh, Khusbu Priya, Meenu Yadav, Geeta Rai, Gyan Modi, **ISCB, 2018**.
3. Development of Novel Dual Acting Neuroprotective Agents for the Treatment of Alzheimer's Disease. Yash Pal Singh, Amruta Pandey, Swati Vishwakarma, Gyan Modi* (**EMBO workshop** to be held from August 29- September 01, 2018).
4. Design, synthesis and characterization of novel molecules used in the treatment of Alzheimer disease" Yash Pal Singh, Amruta Pandey, Swati Vishwakarma and Gyan Modi (**ETDDD, 2018, IIT (BHU), Varanasi**).
5. Participated in seminar on "Recent Applications of Carbohydrates in Chemistry and Biology (RACCB-2017)" organized by **IIT BHU, Varanasi in Feb 14-16, 2017**
6. Participated in workshop on "Emerging Trends in Drug Design and Molecular Modelling" organized by DIC, **IIT BHU, Varanasi** in16-21 July 2017.

Curriculum Vitae

YASH PAL SINGH
Research Scholar, Department of Pharmaceutical Engineering & Technology,
Indian Institute of Technology (BHU), Varanasi, India,
Mobile : +91 9418550828
Email: yashps.rs.phe16@itbhu.ac.in

Academic Qualification

Year	Degree	Institute	CGPA/%AGE
2016-21	Ph.D. thesis submitted (Pharmaceutical Chemistry)	IIT (BHU), Varanasi	8.75/10
2016	M.S. (Medicinal Chemistry)	NIPER-Kolkata	8.96/10
2013	B.Pharmacy	GPC, Rohru	69.75%
2009	CLASS XII	HPBOSE, Dharmshala	69.56%
2007	CLASS X	HPBOSE, Dharmshala	70.62%

RESEARCH EXPERIENCE

Doctor of Philosophy (PhD) ……...July 2016-Sep. 2021
Supervisor: Dr. Gyan Prakash Modi
Dept. of Pharma. Engg. & Tech. IIT (BHU), Varanasi, INDIA
Thesis: "Design, Synthesis, and Biological Evaluation of Ferulic Acid Template Based Naturally Inspired Novel Neuroprotective Multifunctional Molecules for the Treatment of Alzheimer's Disease"
Master of Science (Pharma)…….June 2014-July 2016
Supervisor: Prof. Uday Bandyopadhyay (IICB-India), Director Bose Institute, Kolkata (Project work), INDIA.
Supervisor: Prof. V. Ravichandiran, Director NIPER-Kolkata (course work), INDIA.
Thesis: "A novel synthetic route towards the synthesis of 11*H* Benzo[a] Carbazole derivatives by using Palladium catalyzed C-H activation".

PUBLICATIONS

1. **Y. P. Singh**, N. Kumar, K. Priya, B. S. Chauhan,G. Shankar, S. Kumar, G. K. Singh, S. Srikrishna, P. Garg, G. Rai, G. Modi. Exploration of Neuroprotective Properties of Naturally Inspired Multifunctional Molecule (F24) Against Oxidative Stress and Amyloid β Induced Neurotoxicity in Alzheimer's Disease Models, ***ACS Chemical Neuroscience***, 2021 (Under minor revision)

2. **Y. P. Singh**, G. Shankar, S. Jahan, G. Singh, N. Kumar, A. Barik, P. Upadhyay, L. Singh, K. Kamble, G. K. Singh, N. Ranjan, P. Garg, S. Gupta, G. Modi. Further SAR Studies on Natural Template Based Neuroprotective Molecules for the Treatment of Alzheimer's Disease, ***Bioorganic and Medicinal Chemistry***, 2021, 116385.
3. **Y.P. Singh**, H. Rai, G. Singh, G.K. Singh, S. Mishra, S. Kumar, S. Srikrishna, G. Modi, A Review on Ferulic Acid and Analogs Based Scaffolds for the Management of Alzheimer's Disease, ***European Journal of Medicinal Chemistry***, (2021) 113278.
4. H. Rai, A. Barik, **Y. P. Singh**, A. Suresh, L. Singh, G. Singh, U. Y. Nayak, V. K. Dubey, G. Modi. Molecular docking, binding mode analysis, molecular dynamics, and prediction of ADMET/toxicity properties of selective potential antiviral agents against SARS-CoV-2 main protease: an effort toward drug repurposing to combat COVID-19, ***Molecular Diversity***, 2021.
5. **Y.P. Singh**, G.N.V.C. Tej, A. Pandey, K. Priya, P. Pandey, G. Shankar, P.K. Nayak, G. Rai, A.G. Chittiboyina, R.J. Doerksen, S. Vishwakarma, G. Modi, Design, synthesis and biological evaluation of novel naturally-inspired multifunctional molecules for the management of Alzheimer's disease, ***European Journal of Medicinal Chemistry***, 198 (2020) 112257.
6. N. Kumar, A. Gahlawat, R.N. Kumar, **Y.P. Singh**, G. Modi, P. Garg, Drug repurposing for Alzheimer's disease: in silico and in vitro investigation of FDA-approved drugs as acetylcholinesterase inhibitors, ***J Biomol Struct Dyn***, (2020) 1-15.
7. **Y.P. Singh**, A. Pandey, S. Vishwakarma, G. Modi, A review on iron chelators as potential therapeutic agents for the treatment of Alzheimer's and Parkinson's diseases, ***Molecular Diversity***, 2018,.

PATENT FILED

1. A multifunctional diarylurea-hydroxyamidine based compound for treatment of Alzheimer disease, G. modi, Y. P. Singh, C. P. Kumar, M. Yadav, Gauri Shankar, Gourav Singh, Saroj Kumar, S Srikrishna. temp-1/1680/2021-del, 12 jan, 2021.
2. Development of multifunctional hybrid 3-(4-hydroxy-3-methoxy-phenyl)prop-2-enoic acid and substituted amine/piperazine derivatives for the treatment of neurodegenerative disorders G. Modi, Y. P. Singh, and A. Pandey (Patent Application # 201911000362).

3. G. Modi, Y.P. Singh, G. Shankr, G. Singh, A. Barik, L. Singh A natural template based anticholinesterase inhibitors and antioxidants for the treatment of Alzheimer's disease, Indian patent application # 202111016470, Filled on April 07, 2021.

AREA OF INTEREST

Medicinal Chemistry, Process Chemistry.
Chemistry of Natural Products, Pharmacognosy**.**

KEY SKILLS AND KNOWLEDGE

- Synthesis, purification and characterization of novel intermediates.
- Ability to deliver small to large quantities of novel chemical entities for drug discovery.
- Knowledge of functional group conversion and multiple step synthesis.
- Knowledge of retro- synthetic analysis and handling exposure of various pyrophoric reactions.
- Exposure to TLC, Column Purification, Extraction and Analysis of NMR, IR and Mass Spectrometry Data.
- Good understanding of Microsoft Office and Structure drawing (Chem Draw/ISIS) and literature search using SCI Finder, etc.
- Good understanding of GraphPad prism, Kinetica, EndNote, and Autodock software.
- Animal dissection skills: Organ isolation (Brain, liver, kidney)
- Behavioral assessment (Y maze, Morris water maze, Passive avoidance)

SCHOLASTIC ACHIEVEMENTS

- GPAT qualified in 2013 and 2014
- NIPER JEE qualified 2014 (M.S. pharma admission)
- NIPER JEE qualified 2016 (Ph.D. admission)
- IIT BHU entrance qualified in 2016 (Ph.D. admission)
- Received M.H.R.D. fellowship from AICTE, New Delhi.
- Received M.H.R.D. fellowship during Ph.D. (2016-2021)

WORK EXPERIENCE

Worked in Smilex Pharma. for one-month industrial training.

SEMINARS & WORKSHOPS ATTENDED:

- Design, synthesis and biological evaluation of novel molecules for the management of Alzheimer's disease, Meenu Yadav*, Y. P. Singh, Prince Kumar, Prem Chopra, Amruta Pandey, Gyan Modi, **Indian Academy of Neuroscience**, 2018.

- Design, Synthesis and Biological Evaluation of Novel Molecules for The Management of Alzheimer's Disease, C.S. Praveen Kumar, Y. P. Singh, Khusbu Priya, Meenu Yadav, Geeta Rai, Gyan Modi, **ISCB**, 2018.
- Development of Novel Dual Acting Neuroprotective Agents for the Treatment of Alzheimer's Disease Y. P. Singh, Amruta Pandey, Swati Vishwakarma, Gyan Modi* (**EMBO** workshop to be held from August 29- Spetember 01, 2018)
- Design, synthesis and characterization of novel molecules used in the treatment of Alzheimer disease" Amruta Pandey, Swati Vishwakarma, Y. P. Singh and Gyan Modi (ETDDD, 2018, **IIT (BHU)**, Varanasi).
- Participated in seminar on "Recent Applications of Carbohydrates in Chemistry and Biology (RACCB-2017)" organized by IIT BHU, Varanasi in Feb 14-16, 2017
- Participated in workshop on "Emerging Trends in Drug Design and Molecular Modelling" organized by DIC, IIT BHU, Varanasi in16-21 July 2017
- Participated in workshop on "Metals in Genetics Chemical Biology and therapeutics" organized by Indian Institute of Science Bangalore inFab 17-20, 2016.
- Participated in seminar on "Molecules from Laboratory to Clinics" Organised by NIPER-Kolkata in February 2015.
- Participated in seminar on "Integrated approach for promotion and development of herbal medicine" organized by School of Natural Product Studies, JU-Kolkata, Nov 24, 2015.
- Participated in workshop on "Laboratory Safety, Radiation Safety, Chemical Safety and Bio Safety" organized by IICB-Kolkata, Kolkata in September, 2014.

LANGUAGES KNOWN

- English
- Hindi
- Pahari

HOBBIES

- Playing Cricket, Volleyball
- Traveling

PERSONAL DETAILS

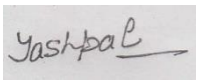
Father's name : Om Prakash
Mother's name : Urmila Devi
Dob : 01/01/1992

Gender : Male
Religion : Hindu
Blood group : A+
Address- Vill-Samnos, PO-Jachh, Teh- Chachyot Mandi (HP), 175039

DECLARATION

I hereby declare that the above said particulars are true to the best of my knowledge and belief.

Date: 05/08/2021
Place: Varanasi, U.P.



(Yash Pal Singh)