IUPHAR/BPS Guide to Pharmacology CITE
https://doi.org/10.2218/gtopdb/F69/2025.3

Calcium- and sodium-activated potassium channels (K_{Ca}, K_{Na}) in GtoPdb v.2025.3

Richard Aldrich[1], K. George Chandy[2], Stephan Grissmer[3], George A. Gutman[2], Leonard K. Kaczmarek[4], Aguan D. Wei[5] and Heike Wulff[6]

1. Stanford University, USA
2. University of California Irvine, USA
3. Ulm University, Germany
4. Yale University, USA
5. Washington University, USA
6. University of California Davis, USA

Abstract

Calcium- and sodium- activated potassium channels are members of the 6TM family of K channels which comprises the voltage-gated K_V subfamilies, including the KCNQ subfamily, the EAG subfamily (which includes hERG channels), the Ca^{2+}-activated Slo subfamily (actually with 6 or 7TM) and the Ca^{2+}- and Na^{+}-activated SK subfamily (**nomenclature as agreed by the NC-IUPHAR Subcommittee on Calcium- and sodium-activated potassium channels** [144]). As for the 2TM family, the pore-forming a subunits form tetramers and heteromeric channels may be formed within subfamilies (*e.g.* K_V1.1 with K_V1.2; KCNQ2 with KCNQ3).

Contents

This is a citation summary for Calcium- and sodium-activated potassium channels (K_{Ca}, K_{Na}) in the Guide to Pharmacology database (GtoPdb). It exists purely as an adjunct to the database to facilitate the recognition of citations to and from the database by citation analyzers. Readers will almost certainly want to visit the relevant sections of the database which are given here under database links.

GtoPdb is an expert-driven guide to pharmacological targets and the substances that act on them. GtoPdb is a reference work which is most usefully represented as an on-line database. As in any publication this work should be appropriately cited, and the papers it cites should also be recognized. This document provides a citation for the relevant parts of the database, and also provides a reference list for the research cited by those parts. For further details see [42].

Please note that the database version for the citations given in GtoPdb are to the most recent preceding version in which the family or its subfamilies and targets were substantially changed. The links below are to the current version. If you need to consult the cited version, rather than the most recent version, please contact the GtoPdb curators.

Database links

Calcium- and sodium-activated potassium channels (K_{Ca}, K_{Na})
https://www.guidetopharmacology.org/GRAC/FamilyDisplayForward?familyId=69
Introduction to Calcium- and sodium-activated potassium channels (K_{Ca}, K_{Na})
https://www.guidetopharmacology.org/GRAC/FamilyIntroductionForward?familyId=69
- Channels and Subunits
  - K_{Ca}1.1
    https://www.guidetopharmacology.org/GRAC/ObjectDisplayForward?objectId=380
  - K_{Ca}2.1
    https://www.guidetopharmacology.org/GRAC/ObjectDisplayForward?objectId=381

$K_{Ca}2.2$
https://www.guidetopharmacology.org/GRAC/ObjectDisplayForward?objectId=382
$K_{Ca}2.3$
https://www.guidetopharmacology.org/GRAC/ObjectDisplayForward?objectId=383
$K_{Ca}3.1$
https://www.guidetopharmacology.org/GRAC/ObjectDisplayForward?objectId=384
$K_{Na}1.1$
https://www.guidetopharmacology.org/GRAC/ObjectDisplayForward?objectId=385
$K_{Na}1.2$
https://www.guidetopharmacology.org/GRAC/ObjectDisplayForward?objectId=386
$K_{Ca}5.1$
https://www.guidetopharmacology.org/GRAC/ObjectDisplayForward?objectId=387

References

1. Adelman JP, Maylie J and Sah P. (2012) Small-conductance Ca2+-activated K+ channels: form and function. *Annu Rev Physiol* **74**: 245-69 [PMID:21942705]
2. Agarwal S, Kim ED, Lee S, Simon A, Accardi A and Nimigean CM. (2025) Ball-and-chain inactivation of a human large conductance calcium-activated potassium channel. *Nat Commun* **16**: 1769 [PMID:39971906]
3. Allen D, Nakayama S, Kuroiwa M, Nakano T, Palmateer J, Kosaka Y, Ballesteros C, Watanabe M, Bond CT and Luján R *et al.*. (2011) SK2 channels are neuroprotective for ischemia-induced neuronal cell death. *J Cereb Blood Flow Metab* **31**: 2302-12 [PMID:21712833]
4. Alviña K and Khodakhah K. (2010) KCa channels as therapeutic targets in episodic ataxia type-2. *J Neurosci* **30**: 7249-57 [PMID:20505091]
5. Amrutkar DVm Foster K, Jacobsen TA, Jefson MR, Keaney GF, Larsen JS and Nielsen KS. (2018) Potassium channel modulators Patent number: US9975886B1. Assignee: Cadent Therapeutics Inc. Priority date: 23/01/2018. Publication date: 22/04/2018.
6. Anderson NJ, Slough S and Watson WP. (2006) In vivo characterisation of the small-conductance KCa (SK) channel activator 1-ethyl-2-benzimidazolinone (1-EBIO) as a potential anticonvulsant. *Eur J Pharmacol* **546**: 48-53 [PMID:16925994]
7. Andolfo I, Russo R, Manna F, Shmukler BE, Gambale A, Vitiello G, De Rosa G, Brugnara C, Alper SL and Snyder LM *et al.*. (2015) Novel Gardos channel mutations linked to dehydrated hereditary stomatocytosis (xerocytosis). *Am J Hematol* **90**: 921-6 [PMID:26178367]
8. Armstrong WE, Rubrum A, Teruyama R, Bond CT and Adelman JP. (2005) Immunocytochemical localization of small-conductance, calcium-dependent potassium channels in astrocytes of the rat supraoptic nucleus. *J Comp Neurol* **491**: 175-85 [PMID:16134141]
9. Asano S, Bratz IN, Berwick ZC, Fancher IS, Tune JD and Dick GM. (2012) Penitrem A as a tool for understanding the role of large conductance Ca(2+)/voltage-sensitive K(+) channels in vascular function. *J Pharmacol Exp Ther* **342**: 453-60 [PMID:22580348]
10. Ataga KI, Orringer EP, Styles L, Vichinsky EP, Swerdlow P, Davis GA, Desimone PA and Stocker JW. (2006) Dose-escalation study of ICA-17043 in patients with sickle cell disease. *Pharmacotherapy* **26**: 1557-64 [PMID:17064199]
11. Ayabe T, Wulff H, Darmoul D, Cahalan MD, Chandy KG and Ouellette AJ. (2002) Modulation of mouse Paneth cell alpha-defensin secretion by mIKCa1, a Ca2+-activated, intermediate conductance potassium channel. *J Biol Chem* **277**: 3793-800 [PMID:11724775]
12. Bao L, Rapin AM, Holmstrand EC and Cox DH. (2002) Elimination of the BK(Ca) channel's high-affinity Ca(2+) sensitivity. *J Gen Physiol* **120**: 173-89 [PMID:12149279]
13. Barcia G, Fleming MR, Deligniere A, Gazula VR, Brown MR, Langouet M, Chen H, Kronengold J, Abhyankar A and Cilio R *et al.*. (2012) De novo gain-of-function KCNT1 channel mutations cause malignant migrating partial seizures of infancy. *Nat Genet* **44**: 1255-9 [PMID:23086397]
14. Barfod ET, Moore AL and Lidofsky SD. (2001) Cloning and functional expression of a liver isoform of the small conductance Ca2+-activated K+ channel SK3. *Am J Physiol, Cell Physiol* **280**: C836-42 [PMID:11245600]
15. Bausch AE, Dieter R, Nann Y, Hausmann M, Meyerdierks N, Kaczmarek LK, Ruth P and Lukowski R. (2015) The sodium-activated potassium channel Slack is required for optimal cognitive flexibility in mice. *Learn Mem* **22**: 323-35 [PMID:26077685]
16. Begenisich T, Nakamoto T, Ovitt CE, Nehrke K, Brugnara C, Alper SL and Melvin JE. (2004) Physiological roles of the intermediate conductance, Ca2+-activated potassium channel Kcnn4. *J Biol Chem* **279**: 47681-7 [PMID:15347667]
17. Benton DC, Monaghan AS, Hosseini R, Bahia PK, Haylett DG and Moss GW. (2003) Small conductance Ca2+-activated K+ channels formed by the expression of rat SK1 and SK2 genes in HEK 293 cells. *J Physiol (Lond.)* **553**: 13-9 [PMID:14555714]
18. Bentzen BH, Bomholtz SH, Simó-Vicens R, Folkersen L, Abildgaard L, Speerschneider T,

Muthukumarasamy KM, Edvardsson N, Sørensen US and Grunnet M *et al*.. (2020) Mechanisms of Action of the KCa2-Negative Modulator AP30663, a Novel Compound in Development for Treatment of Atrial Fibrillation in Man. *Front Pharmacol* **11**: 610 [PMID:32477117]

19. Bentzen BH, Nardi A, Calloe K, Madsen LS, Olesen SP and Grunnet M. (2007) The small molecule NS11021 is a potent and specific activator of Ca2+-activated big-conductance K+ channels. *Mol Pharmacol* **72**: 1033-44 [PMID:17636045]
20. Bhattacharjee A, Gan L and Kaczmarek LK. (2002) Localization of the Slack potassium channel in the rat central nervous system. *J Comp Neurol* **454**: 241-54 [PMID:12442315]
21. Bhattacharjee A, Joiner WJ, Wu M, Yang Y, Sigworth FJ and Kaczmarek LK. (2003) Slick (Slo2.1), a rapidly-gating sodium-activated potassium channel inhibited by ATP. *J Neurosci* **23**: 11681-91 [PMID:14684870]
22. Bhattacharjee A and Kaczmarek LK. (2005) For K+ channels, Na+ is the new Ca2+. *Trends Neurosci* **28**: 422-8 [PMID:15979166]
23. Bhattacharjee A, von Hehn CA, Mei X and Kaczmarek LK. (2005) Localization of the Na+-activated K+ channel Slick in the rat central nervous system. *J Comp Neurol* **484**: 80-92 [PMID:15717307]
24. Bildl W, Strassmaier T, Thurm H, Andersen J, Eble S, Oliver D, Knipper M, Mann M, Schulte U and Adelman JP *et al*.. (2004) Protein kinase CK2 is coassembled with small conductance Ca(2+)-activated K+ channels and regulates channel gating. *Neuron* **43**: 847-58 [PMID:15363395]
25. Bischoff U, Vogel W and Safronov BV. (1998) Na+-activated K+ channels in small dorsal root ganglion neurones of rat. *J Physiol (Lond.)* **510 (Pt 3)**: 743-54 [PMID:9660890]
26. Biton B, Sethuramanujam S, Picchione KE, Bhattacharjee A, Khessibi N, Chesney F, Lanneau C, Curet O and Avenet P. (2012) The antipsychotic drug loxapine is an opener of the sodium-activated potassium channel slack (Slo2.2). *J Pharmacol Exp Ther* **340**: 706-15 [PMID:22171093]
27. Blanc E, Romi-Lebrun R, Bornet O, Nakajima T and Darbon H. (1998) Solution structure of two new toxins from the venom of the Chinese scorpion Buthus martensi Karsch blockers of potassium channels. *Biochemistry* **37**: 12412-8 [PMID:9730813]
28. Blank T, Nijholt I, Kye MJ and Spiess J. (2004) Small conductance Ca2+-activated K+ channels as targets of CNS drug development. *Curr Drug Targets CNS Neurol Disord* **3**: 161-7 [PMID:15180477]
29. Boettger MK, Till S, Chen MX, Anand U, Otto WR, Plumpton C, Trezise DJ, Tate SN, Bountra C and Coward K *et al*.. (2002) Calcium-activated potassium channel SK1- and IK1-like immunoreactivity in injured human sensory neurones and its regulation by neurotrophic factors. *Brain* **125**: 252-63 [PMID:11844726]
30. Bond CT, Herson PS, Strassmaier T, Hammond R, Stackman R, Maylie J and Adelman JP. (2004) Small conductance Ca2+-activated K+ channel knock-out mice reveal the identity of calcium-dependent afterhyperpolarization currents. *J Neurosci* **24**: 5301-6 [PMID:15190101]
31. Bond CT, Maylie J and Adelman JP. (2005) SK channels in excitability, pacemaking and synaptic integration. *Curr Opin Neurobiol* **15**: 305-11 [PMID:15922588]
32. Bond CT, Sprengel R, Bissonnette JM, Kaufmann WA, Pribnow D, Neelands T, Storck T, Baetscher M, Jerecic J and Maylie J *et al*.. (2000) Respiration and parturition affected by conditional overexpression of the Ca2+-activated K+ channel subunit, SK3. *Science* **289**: 1942-6 [PMID:10988076]
33. Bowen T, Williams N, Norton N, Spurlock G, Wittekindt OH, Morris-Rosendahl DJ, Williams H, Brzustowicz L, Hoogendoorn B and Zammit S *et al*.. (2001) Mutation screening of the KCNN3 gene reveals a rare frameshift mutation. *Mol Psychiatry* **6**: 259-60 [PMID:11326292]
34. Brenker C, Zhou Y, Müller A, Echeverry FA, Trötschel C, Poetsch A, Xia XM, Bönigk W, Lingle CJ and Kaupp UB *et al*.. (2014) The Ca2+-activated K+ current of human sperm is mediated by Slo3. *Elife* **3**: e01438 [PMID:24670955]
35. Brenner R, Jegla TJ, Wickenden A, Liu Y and Aldrich RW. (2000) Cloning and functional characterization of novel large conductance calcium-activated potassium channel beta subunits, hKCNMB3 and hKCNMB4. *J Biol Chem* **275**: 6453-61 [PMID:10692449]
36. Brown MR, Kronengold J, Gazula VR, Chen Y, Strumbos JG, Sigworth FJ, Navaratnam D and Kaczmarek LK. (2010) Fragile X mental retardation protein controls gating of the sodium-activated potassium channel Slack. *Nat Neurosci* **13**: 819-21 [PMID:20512134]
37. Brown MR, Kronengold J, Gazula VR, Spilianakis CG, Flavell RA, von Hehn CA, Bhattacharjee A and Kaczmarek LK. (2008) Amino-termini isoforms of the Slack K+ channel, regulated by alternative promoters, differentially modulate rhythmic firing and adaptation. *J Physiol (Lond.)* **586**: 5161-79 [PMID:18787033]
38. Brugnara C, de Franceschi L and Alper SL. (1993) Inhibition of Ca(2+)-dependent K+ transport and cell dehydration in sickle erythrocytes by clotrimazole and other imidazole derivatives. *J Clin Invest* **92**: 520-6 [PMID:8326017]
39. Brugnara C, Gee B, Armsby CC, Kurth S, Sakamoto M, Rifai N, Alper SL and Platt OS. (1996)

Therapy with oral clotrimazole induces inhibition of the Gardos channel and reduction of erythrocyte dehydration in patients with sickle cell disease. *J Clin Invest* **97**: 1227-34 [PMID:8636434]
40. Brähler S, Kaistha A, Schmidt VJ, Wölfle SE, Busch C, Kaistha BP, Kacik M, Hasenau AL, Grgic I and Si H *et al.*. (2009) Genetic deficit of SK3 and IK1 channels disrupts the endothelium-derived hyperpolarizing factor vasodilator pathway and causes hypertension. *Circulation* **119**: 2323-32 [PMID:19380617]
41. Budelli G, Hage TA, Wei A, Rojas P, Jong YJ, O'Malley K and Salkoff L. (2009) Na+-activated K+ channels express a large delayed outward current in neurons during normal physiology. *Nat Neurosci* **12**: 745-50 [PMID:19412167]
42. Buneman P, Christie G, Davies JA, Dimitrellou R, Harding SD, Pawson AJ, Sharman JL and Wu Y. (2020) Why data citation isn't working, and what to do about it *Database* **2020** [PMID:32367113]
43. Burnham MP, Bychkov R, Félétou M, Richards GR, Vanhoutte PM, Weston AH and Edwards G. (2002) Characterization of an apamin-sensitive small-conductance Ca(2+)-activated K(+) channel in porcine coronary artery endothelium: relevance to EDHF. *Br J Pharmacol* **135**: 1133-43 [PMID:11877319]
44. Butler A, Tsunoda S, McCobb DP, Wei A and Salkoff L. (1993) mSlo, a complex mouse gene encoding "maxi" calcium-activated potassium channels. *Science* **261**: 221-4 [PMID:7687074]
45. Bychkov R, Burnham MP, Richards GR, Edwards G, Weston AH, Félétou M and Vanhoutte PM. (2002) Characterization of a charybdotoxin-sensitive intermediate conductance Ca2+-activated K+ channel in porcine coronary endothelium: relevance to EDHF. *Br J Pharmacol* **137**: 1346-54 [PMID:12466245]
46. Cao Y, Dreixler JC, Roizen JD, Roberts MT and Houamed KM. (2001) Modulation of recombinant small-conductance Ca(2+)-activated K(+) channels by the muscle relaxant chlorzoxazone and structurally related compounds. *J Pharmacol Exp Ther* **296**: 683-9 [PMID:11181893]
47. Cao YJ, Dreixler JC, Couey JJ and Houamed KM. (2002) Modulation of recombinant and native neuronal SK channels by the neuroprotective drug riluzole. *Eur J Pharmacol* **449**: 47-54 [PMID:12163105]
48. Cardno AG, Bowen T, Guy CA, Jones LA, McCarthy G, Williams NM, Murphy KC, Spurlock G, Gray M and Sanders RD *et al.*. (1999) CAG repeat length in the hKCa3 gene and symptom dimensions in schizophrenia. *Biol Psychiatry* **45**: 1592-6 [PMID:10376120]
49. Castle NA, London DO, Creech C, Fajloun Z, Stocker JW and Sabatier JM. (2003) Maurotoxin: a potent inhibitor of intermediate conductance Ca2+-activated potassium channels. *Mol Pharmacol* **63**: 409-18 [PMID:12527813]
50. Chandy KG, Fantino E, Wittekindt O, Kalman K, Tong LL, Ho TH, Gutman GA, Crocq MA, Ganguli R and Nimgaonkar V *et al.*. (1998) Isolation of a novel potassium channel gene hSKCa3 containing a polymorphic CAG repeat: a candidate for schizophrenia and bipolar disorder? *Mol Psychiatry* **3**: 32-7 [PMID:9491810]
51. Chandy KG, Wulff H, Beeton C, Pennington M, Gutman GA and Cahalan MD. (2004) K+ channels as targets for specific immunomodulation. *Trends Pharmacol Sci* **25**: 280-9 [PMID:15120495]
52. Chang SH, Chang SN, Hwang JJ, Chiang FT, Tseng CD, Lee JK, Lai LP, Lin JL, Wu CK and Tsai CT. (2012) Significant association of rs13376333 in KCNN3 on chromosome 1q21 with atrial fibrillation in a Taiwanese population. *Circ J* **76**: 184-8 [PMID:22019810]
53. Chen H, Kronengold J, Yan Y, Gazula VR, Brown MR, Ma L, Ferreira G, Yang Y, Bhattacharjee A and Sigworth FJ *et al.*. (2009) The N-terminal domain of Slack determines the formation and trafficking of Slick/Slack heteromeric sodium-activated potassium channels. *J Neurosci* **29**: 5654-65 [PMID:19403831]
54. Chen MX, Gorman SA, Benson B, Singh K, Hieble JP, Michel MC, Tate SN and Trezise DJ. (2004) Small and intermediate conductance Ca(2+)-activated K+ channels confer distinctive patterns of distribution in human tissues and differential cellular localisation in the colon and corpus cavernosum. *Naunyn Schmiedebergs Arch Pharmacol* **369**: 602-15 [PMID:15127180]
55. Chen Y, Yu FH, Surmeier DJ, Scheuer T and Catterall WA. (2006) Neuromodulation of Na+ channel slow inactivation via cAMP-dependent protein kinase and protein kinase C. *Neuron* **49**: 409-20 [PMID:16446144]
56. Christophersen P and Wulff H. (2015) Pharmacological gating modulation of small- and intermediate-conductance Ca(2+)-activated K(+) channels (KCa2.x and KCa3.1). *Channels (Austin)* **9**: 336-43 [PMID:26217968]
57. Chung I, Zelivyanskaya M and Gendelman HE. (2002) Mononuclear phagocyte biophysiology influences brain transendothelial and tissue migration: implication for HIV-1-associated dementia. *J Neuroimmunol* **122**: 40-54 [PMID:11777542]
58. Church TW, Weatherall KL, Corrêa SA, Prole DL, Brown JT and Marrion NV. (2015) Preferential assembly of heteromeric small conductance calcium-activated potassium channels. *Eur J Neurosci* **41**: 305-15 [PMID:25421315]

59. Cingolani LA, Gymnopoulos M, Boccaccio A, Stocker M and Pedarzani P. (2002) Developmental regulation of small-conductance Ca2+-activated K+ channel expression and function in rat Purkinje neurons. *J Neurosci* **22**: 4456-67 [PMID:12040053]
60. Coghlan MJ, Carroll WA and Gopalakrishnan M. (2001) Recent developments in the biology and medicinal chemistry of potassium channel modulators: update from a decade of progress. *J Med Chem* **44**: 1627-53 [PMID:11356099]
61. Coleman N, Brown BM, Oliván-Viguera A, Singh V, Olmstead MM, Valero MS, Köhler R and Wulff H. (2014) New positive Ca2+-activated K+ channel gating modulators with selectivity for KCa3.1. *Mol Pharmacol* **86**: 342-57 [PMID:24958817]
62. Coleman N, Nguyen HM, Cao Z, Brown BM, Jenkins DP, Zolkowska D, Chen YJ, Tanaka BS, Goldin AL and Rogawski MA *et al.*. (2015) The riluzole derivative 2-amino-6-trifluoromethylthio-benzothiazole (SKA-19), a mixed KCa2 activator and NaV blocker, is a potent novel anticonvulsant. *Neurotherapeutics* **12**: 234-49 [PMID:25256961]
63. Cox DH. (2005) The BKCa channel's Ca2+-binding sites, multiple sites, multiple ions. *J Gen Physiol* **125**: 253-5 [PMID:15738047]
64. Crest M, Jacquet G, Gola M, Zerrouk H, Benslimane A, Rochat H, Mansuelle P and Martin-Eauclaire MF. (1992) Kaliotoxin, a novel peptidyl inhibitor of neuronal BK-type Ca(2+)-activated K+ channels characterized from Androctonus mauretanicus mauretanicus venom. *J Biol Chem* **267**: 1640-7 [PMID:1730708]
65. D'hoedt D, Hirzel K, Pedarzani P and Stocker M. (2004) Domain analysis of the calcium-activated potassium channel SK1 from rat brain. Functional expression and toxin sensitivity. *J Biol Chem* **279**: 12088-92 [PMID:14761961]
66. Dai L, Garg V and Sanguinetti MC. (2010) Activation of Slo2.1 channels by niflumic acid. *J Gen Physiol* **135**: 275-95 [PMID:20176855]
67. Damkjaer M, Nielsen G, Bodendiek S, Staehr M, Gramsbergen JB, de Wit C, Jensen BL, Simonsen U, Bie P and Wulff H *et al.*. (2012) Pharmacological activation of KCa3.1/KCa2.3 channels produces endothelial hyperpolarization and lowers blood pressure in conscious dogs. *Br J Pharmacol* **165**: 223-34 [PMID:21699504]
68. de Los Angeles Tejada M, Stolpe K, Meinild AK and Klaerke DA. (2012) Clofilium inhibits Slick and Slack potassium channels. *Biologics* **6**: 465-70 [PMID:23271893]
69. DeCoursey TE, Chandy KG, Gupta S and Cahalan MD. (1985) Voltage-dependent ion channels in T-lymphocytes. *J Neuroimmunol* **10**: 71-95 [PMID:2414315]
70. Desai R, Peretz A, Idelson H, Lazarovici P and Attali B. (2000) Ca2+-activated K+ channels in human leukemic Jurkat T cells. Molecular cloning, biochemical and functional characterization. *J Biol Chem* **275**: 39954-63 [PMID:10991935]
71. Deschaux O and Bizot JC. (2005) Apamin produces selective improvements of learning in rats. *Neurosci Lett* **386**: 5-8 [PMID:15985330]
72. Deschaux O, Bizot JC and Goyffon M. (1997) Apamin improves learning in an object recognition task in rats. *Neurosci Lett* **222**: 159-62 [PMID:9148239]
73. Devor DC, Singh AK, Lambert LC, DeLuca A, Frizzell RA and Bridges RJ. (1999) Bicarbonate and chloride secretion in Calu-3 human airway epithelial cells. *J Gen Physiol* **113**: 743-60 [PMID:10228185]
74. Di L, Srivastava S, Zhdanova O, Sun Y, Li Z and Skolnik EY. (2010) Nucleoside diphosphate kinase B knock-out mice have impaired activation of the K+ channel KCa3.1, resulting in defective T cell activation. *J Biol Chem* **285**: 38765-71 [PMID:20884616]
75. Dick GM, Rossow CF, Smirnov S, Horowitz B and Sanders KM. (2001) Tamoxifen activates smooth muscle BK channels through the regulatory beta 1 subunit. *J Biol Chem* **276**: 34594-9 [PMID:11454866]
76. Diness JG, Skibsbye L, Jespersen T, Bartels ED, Sørensen US, Hansen RS and Grunnet M. (2011) Effects on atrial fibrillation in aged hypertensive rats by Ca(2+)-activated K(+) channel inhibition. *Hypertension* **57**: 1129-35 [PMID:21502564]
77. Diness JG, Skibsbye L, Simó-Vicens R, Santos JL, Lundegaard P, Citerni C, Sauter DRP, Bomholtz SH, Svendsen JH and Olesen SP *et al.*. (2017) Termination of Vernakalant-Resistant Atrial Fibrillation by Inhibition of Small-Conductance Ca^{2+}-Activated K^{+} Channels in Pigs. *Circ Arrhythm Electrophysiol* **10**: e005125 [PMID:29018164]
78. Dolga AM, Terpolilli N, Kepura F, Nijholt IM, Knaus HG, D'Orsi B, Prehn JH, Eisel UL, Plant T and Plesnila N *et al.*. (2011) KCa2 channels activation prevents [Ca2+]i deregulation and reduces neuronal death following glutamate toxicity and cerebral ischemia. *Cell Death Dis* **2**: e147 [PMID:21509037]
79. Dreixler JC, Bian J, Cao Y, Roberts MT, Roizen JD and Houamed KM. (2000) Block of rat brain recombinant SK channels by tricyclic antidepressants and related compounds. *Eur J Pharmacol* **401**: 1-7 [PMID:10915830]
80. Dryer SE. (2003) Molecular identification of the Na+-activated K+ channel. *Neuron* **37**: 727-8 [PMID:12628162]
81. Egan TM, Dagan D, Kupper J and Levitan IB. (1992) Na(+)-activated K+ channels are widely

distributed in rat CNS and in Xenopus oocytes. *Brain Res* **584**: 319-21 [PMID:1515948]
82. Egan TM, Dagan D, Kupper J and Levitan IB. (1992) Properties and rundown of sodium-activated potassium channels in rat olfactory bulb neurons. *J Neurosci* **12**: 1964-76 [PMID:1578280]
83. Eichler I, Wibawa J, Grgic I, Knorr A, Brakemeier S, Pries AR, Hoyer J and Köhler R. (2003) Selective blockade of endothelial Ca2+-activated small- and intermediate-conductance K+-channels suppresses EDHF-mediated vasodilation. *Br J Pharmacol* **138**: 594-601 [PMID:12598413]
84. Ellinor PT, Lunetta KL, Glazer NL, Pfeufer A, Alonso A, Chung MK, Sinner MF, de Bakker PI, Mueller M and Lubitz SA *et al*.. (2010) Common variants in KCNN3 are associated with lone atrial fibrillation. *Nat Genet* **42**: 240-4 [PMID:20173747]
85. Ellory JC, Culliford SJ, Smith PA, Wolowyk MW and Knaus EE. (1994) Specific inhibition of Ca-activated K channels in red cells by selected dihydropyridine derivatives. *Br J Pharmacol* **111**: 903-5 [PMID:8019767]
86. Enemchukwu EA, Kalota S, Robertson K, Ge S, Lu J, Badger H, Mujais S and Peters KM. (2025) Gene Therapy With URO-902 (pVAX/*hSlo*) for the Treatment of Female Patients With Overactive Bladder and Urge Urinary Incontinence: Safety and Efficacy From a Randomized Phase 2a Trial. *J Urol* **213**: 417-427 [PMID:39693268]
87. Faber ES and Sah P. (2003) Calcium-activated potassium channels: multiple contributions to neuronal function. *Neuroscientist* **9**: 181-94 [PMID:15065814]
88. Fanger CM, Ghanshani S, Logsdon NJ, Rauer H, Kalman K, Zhou J, Beckingham K, Chandy KG, Cahalan MD and Aiyar J. (1999) Calmodulin mediates calcium-dependent activation of the intermediate conductance KCa channel, IKCa1. *J Biol Chem* **274**: 5746-54 [PMID:10026195]
89. Fanger CM, Rauer H, Neben AL, Miller MJ, Rauer H, Wulff H, Rosa JC, Ganellin CR, Chandy KG and Cahalan MD. (2001) Calcium-activated potassium channels sustain calcium signaling in T lymphocytes. Selective blockers and manipulated channel expression levels. *J Biol Chem* **276**: 12249-56 [PMID:11278890]
90. Fay AJ, Qian X, Jan YN and Jan LY. (2006) SK channels mediate NADPH oxidase-independent reactive oxygen species production and apoptosis in granulocytes. *Proc Natl Acad Sci USA* **103**: 17548-53 [PMID:17085590]
91. Feranchak AP, Doctor RB, Troetsch M, Brookman K, Johnson SM and Fitz JG. (2004) Calcium-dependent regulation of secretion in biliary epithelial cells: the role of apamin-sensitive SK channels. *Gastroenterology* **127**: 903-13 [PMID:15362045]
92. Feske S, Wulff H and Skolnik EY. (2015) Ion channels in innate and adaptive immunity. *Annu Rev Immunol* **33**: 291-353 [PMID:25861976]
93. Figueroa KP, Chan P, Schöls L, Tanner C, Riess O, Perlman SL, Geschwind DH and Pulst SM. (2001) Association of moderate polyglutamine tract expansions in the slow calcium-activated potassium channel type 3 with ataxia. *Arch Neurol* **58**: 1649-53 [PMID:11594924]
94. Fioretti B, Castigli E, Calzuola I, Harper AA, Franciolini F and Catacuzzeno L. (2004) NPPB block of the intermediate-conductance Ca2+-activated K+ channel. *Eur J Pharmacol* **497**: 1-6 [PMID:15321728]
95. Friebel K, Schönherr R, Kinne RW and Kunisch E. (2015) Functional role of the KCa3.1 potassium channel in synovial fibroblasts from rheumatoid arthritis patients. *J Cell Physiol* **230**: 1677-88 [PMID:25545021]
96. Galeotti N, Ghelardini C, Caldari B and Bartolini A. (1999) Effect of potassium channel modulators in mouse forced swimming test. *Br J Pharmacol* **126**: 1653-9 [PMID:10323599]
97. Galvez A, Gimenez-Gallego G, Reuben JP, Roy-Contancin L, Feigenbaum P, Kaczorowski GJ and Garcia ML. (1990) Purification and characterization of a unique, potent, peptidyl probe for the high conductance calcium-activated potassium channel from venom of the scorpion Buthus tamulus. *J Biol Chem* **265**: 11083-90 [PMID:1694175]
98. Garcia ML, Knaus HG, Munujos P, Slaughter RS and Kaczorowski GJ. (1995) Charybdotoxin and its effects on potassium channels. *Am J Physiol* **269**: C1-10 [PMID:7543240]
99. Garcia-Valdes J, Zamudio FZ, Toro L, Possani LD and Possan LD. (2001) Slotoxin, alphaKTx1.11, a new scorpion peptide blocker of MaxiK channels that differentiates between alpha and alpha+beta (beta1 or beta4) complexes. *FEBS Lett* **505**: 369-73 [PMID:11576530]
100. GARDOS G. (1958) The function of calcium in the potassium permeability of human erythrocytes. *Biochim Biophys Acta* **30**: 653-4 [PMID:13618284]
101. Garg P, Gardner A, Garg V and Sanguinetti MC. (2013) Structural basis of ion permeation gating in Slo2.1 K+ channels. *J Gen Physiol* **142**: 523-42 [PMID:24166878]
102. Garg P and Sanguinetti MC. (2012) Structure-activity relationship of fenamates as Slo2.1 channel activators. *Mol Pharmacol* **82**: 795-802 [PMID:22851714]
103. Ghanshani S, Coleman M, Gustavsson P, Wu AC, Gargus JJ, Gutman GA, Dahl N, Mohrenweiser H and Chandy KG. (1998) Human calcium-activated potassium channel gene KCNN4 maps to chromosome 19q13.2 in the region deleted in diamond-blackfan anemia. *Genomics* **51**: 160-1 [PMID:9693050]

104. Ghanshani S, Wulff H, Miller MJ, Rohm H, Neben A, Gutman GA, Cahalan MD and Chandy KG. (2000) Up-regulation of the IKCa1 potassium channel during T-cell activation. Molecular mechanism and functional consequences. *J Biol Chem* **275**: 37137-49 [PMID:10961988]
105. Giangiacomo KM, Kamassah A, Harris G and McManus OB. (1998) Mechanism of maxi-K channel activation by dehydrosoyasaponin-I. *J Gen Physiol* **112**: 485-501 [PMID:9758866]
106. Gibbs RA, Weinstock GM, Metzker ML, Muzny DM, Sodergren EJ, Scherer S, Scott G, Steffen D, Worley KC and Burch PE *et al.*. (2004) Genome sequence of the Brown Norway rat yields insights into mammalian evolution. *Nature* **428**: 493-521 [PMID:15057822]
107. Glogowska E, Lezon-Geyda K, Maksimova Y, Schulz VP and Gallagher PG. (2015) Mutations in the Gardos channel (KCNN4) are associated with hereditary xerocytosis. *Blood* **126**: 1281-4 [PMID:26198474]
108. Grgic I, Eichler I, Heinau P, Si H, Brakemeier S, Hoyer J and Köhler R. (2005) Selective blockade of the intermediate-conductance Ca2+-activated K+ channel suppresses proliferation of microvascular and macrovascular endothelial cells and angiogenesis in vivo. *Arterioscler Thromb Vasc Biol* **25**: 704-9 [PMID:15662023]
109. Gribkoff VK, Starrett Jr JE, Dworetzky SI, Hewawasam P, Boissard CG, Cook DA, Frantz SW, Heman K, Hibbard JR and Huston K *et al.*. (2001) Targeting acute ischemic stroke with a calcium-sensitive opener of maxi-K potassium channels. *Nat Med* **7**: 471-7 [PMID:11283675]
110. Griffin AM, Kahlig KM, Hatch RJ, Hughes ZA, Chapman ML, Antonio B, Marron BE, Wittmann M and Martinez-Botella G. (2021) Discovery of the First Orally Available, Selective $K_{Na}1.1$ Inhibitor: *In Vitro* and *In Vivo* Activity of an Oxadiazole Series. *ACS Med Chem Lett* **12**: 593-602 [PMID:33859800]
111. Grissmer S, Lewis RS and Cahalan MD. (1992) Ca(2+)-activated K+ channels in human leukemic T cells. *J Gen Physiol* **99**: 63-84 [PMID:1371308]
112. Grissmer S, Nguyen AN and Cahalan MD. (1993) Calcium-activated potassium channels in resting and activated human T lymphocytes. Expression levels, calcium dependence, ion selectivity, and pharmacology. *J Gen Physiol* **102**: 601-30 [PMID:7505804]
113. Grunnet M, Jespersen T, Angelo K, Frøkjaer-Jensen C, Klaerke DA, Olesen SP and Jensen BS. (2001) Pharmacological modulation of SK3 channels. *Neuropharmacology* **40**: 879-87 [PMID:11378158]
114. Hammond RS, Bond CT, Strassmaier T, Ngo-Anh TJ, Adelman JP, Maylie J and Stackman RW. (2006) Small-conductance Ca2+-activated K+ channel type 2 (SK2) modulates hippocampal learning, memory, and synaptic plasticity. *J Neurosci* **26**: 1844-53 [PMID:16467533]
115. Haugaard MM, Hesselkilde EZ, Pehrson S, Carstensen H, Flethøj M, Præstegaard KF, Sørensen US, Diness JG, Grunnet M and Buhl R *et al.*. (2015) Pharmacologic inhibition of small-conductance calcium-activated potassium (SK) channels by NS8593 reveals atrial antiarrhythmic potential in horses. *Heart Rhythm* **12**: 825-35 [PMID:25542425]
116. Herrera GM, Pozo MJ, Zvara P, Petkov GV, Bond CT, Adelman JP and Nelson MT. (2003) Urinary bladder instability induced by selective suppression of the murine small conductance calcium-activated potassium (SK3) channel. *J Physiol (Lond.)* **551**: 893-903 [PMID:12813145]
117. Hess D, Nanou E and El Manira A. (2007) Characterization of Na+-activated K+ currents in larval lamprey spinal cord neurons. *J Neurophysiol* **97**: 3484-93 [PMID:17329626]
118. Higham J, Sahu G, Wazen RM, Colarusso P, Gregorie A, Harvey BSJ, Goudswaard L, Varley G, Sheppard DN and Turner RW *et al.*. (2019) Preferred Formation of Heteromeric Channels between Coexpressed SK1 and IKCa Channel Subunits Provides a Unique Pharmacological Profile of Ca^{2+}-Activated Potassium Channels. *Mol Pharmacol* **96**: 115-126 [PMID:31048549]
119. Hilgers RH and Webb RC. (2007) Reduced expression of SKCa and IKCa channel proteins in rat small mesenteric arteries during angiotensin II-induced hypertension. *Am J Physiol Heart Circ Physiol* **292**: H2275-84 [PMID:17209000]
120. Hirschberg B, Maylie J, Adelman JP and Marrion NV. (1998) Gating of recombinant small-conductance Ca-activated K+ channels by calcium. *J Gen Physiol* **111**: 565-81 [PMID:9524139]
121. Hite RK, Yuan P, Li Z, Hsuing Y, Walz T and MacKinnon R. (2015) Cryo-electron microscopy structure of the Slo2.2 Na(+)-activated K(+) channel. *Nature* **527**: 198-203 [PMID:26436452]
122. Holst AG, Tomcsányi J, Vestbjerg B, Grunnet M, Sørensen US, Diness JG, Bentzen BH, Edvardsson N, Hohnloser SH and Bhatt DL *et al.*. (2024) Inhibition of the $K_{Ca}2$ potassium channel in atrial fibrillation: a randomized phase 2 trial. *Nat Med* **30**: 106-111 [PMID:38092897]
123. Hopf FW, Bowers MS, Chang SJ, Chen BT, Martin M, Seif T, Cho SL, Tye K and Bonci A. (2010) Reduced nucleus accumbens SK channel activity enhances alcohol seeking during abstinence. *Neuron* **65**: 682-94 [PMID:20223203]
124. Hopf FW, Seif T and Bonci A. (2011) The SK channel as a novel target for treating alcohol use disorders. *Channels (Austin)* **5**: 289-92 [PMID:21712648]
125. Hopf FW, Simms JA, Chang SJ, Seif T, Bartlett SE and Bonci A. (2011) Chlorzoxazone, an SK-type potassium channel activator used in humans, reduces excessive alcohol intake in rats. *Biol Psychiatry* **69**: 618-24 [PMID:21195386]
126. Hosseini R, Benton DC, Dunn PM, Jenkinson DH and Moss GW. (2001) SK3 is an important

component of K(+) channels mediating the afterhyperpolarization in cultured rat SCG neurones. *J Physiol (Lond.)* **535**: 323-34 [PMID:11533126]
127. Hougaard C, Eriksen BL, Jørgensen S, Johansen TH, Dyhring T, Madsen LS, Strøbaek D and Christophersen P. (2007) Selective positive modulation of the SK3 and SK2 subtypes of small conductance Ca2+-activated K+ channels. *Br J Pharmacol* **151**: 655-65 [PMID:17486140]
128. Hougaard C, Hammami S, Eriksen BL, Sørensen US, Jensen ML, Strøbæk D and Christophersen P. (2012) Evidence for a common pharmacological interaction site on K(Ca)2 channels providing both selective activation and selective inhibition of the human K(Ca)2.1 subtype. *Mol Pharmacol* **81**: 210-9 [PMID:22046005]
129. Hougaard C, Jensen ML, Dale TJ, Miller DD, Davies DJ, Eriksen BL, Strøbaek D, Trezise DJ and Christophersen P. (2009) Selective activation of the SK1 subtype of human small-conductance Ca2+-activated K+ channels by 4-(2-methoxyphenylcarbamoyloxymethyl)-piperidine-1-carboxylic acid tert-butyl ester (GW542573X) is dependent on serine 293 in the S5 segment. *Mol Pharmacol* **76**: 569-78 [PMID:19515965]
130. Huang F, Wang X, Ostertag EM, Nuwal T, Huang B, Jan YN, Basbaum AI and Jan LY. (2013) TMEM16C facilitates Na(+)-activated K+ currents in rat sensory neurons and regulates pain processing. *Nat Neurosci* **16**: 1284-90 [PMID:23872594]
131. Iraci N, Carotenuto L, Ciaglia T, Belperio G, Di Matteo F, Mosca I, Carleo G, Giovanna Basilicata M, Ambrosino P and Turcio R *et al.*. (2024) *In Silico* Assisted Identification, Synthesis, and *In Vitro* Pharmacological Characterization of Potent and Selective Blockers of the Epilepsy-Associated KCNT1 Channel. *J Med Chem* **67**: 9124-9149 [PMID:38782404]
132. Ishihara T, Ikigai K, Kuriwaki I, Hisamichi H, Takeshita N and Takezawa R. (2014) Benzothiophene compound Patent number: WO2014196644A1. Assignee: Astellas Pharma Inc.. Priority date: 16/06/2014. Publication date: 11/12/2014.
133. Ishii TM, Maylie J and Adelman JP. (1997) Determinants of apamin and d-tubocurarine block in SK potassium channels. *J Biol Chem* **272**: 23195-200 [PMID:9287325]
134. Ishii TM, Silvia C, Hirschberg B, Bond CT, Adelman JP and Maylie J. (1997) A human intermediate conductance calcium-activated potassium channel. *Proc Natl Acad Sci USA* **94**: 11651-6 [PMID:9326665]
135. Jacobson D, Herson PS, Neelands TR, Maylie J and Adelman JP. (2002) SK channels are necessary but not sufficient for denervation-induced hyperexcitability. *Muscle Nerve* **26**: 817-22 [PMID:12451607]
136. Jensen BS. (2002) BMS-204352: a potassium channel opener developed for the treatment of stroke. *CNS Drug Rev* **8**: 353-60 [PMID:12481191]
137. Jensen BS, Strobaek D, Christophersen P, Jorgensen TD, Hansen C, Silahtaroglu A, Olesen SP and Ahring PK. (1998) Characterization of the cloned human intermediate-conductance Ca2+-activated K+ channel. *Am J Physiol* **275**: C848-56 [PMID:9730970]
138. Jiang Z, Wallner M, Meera P and Toro L. (1999) Human and rodent MaxiK channel beta-subunit genes: cloning and characterization. *Genomics* **55**: 57-67 [PMID:9888999]
139. Joiner WJ, Tang MD, Wang LY, Dworetzky SI, Boissard CG, Gan L, Gribkoff VK and Kaczmarek LK. (1998) Formation of intermediate-conductance calcium-activated potassium channels by interaction of Slack and Slo subunits. *Nat Neurosci* **1**: 462-9 [PMID:10196543]
140. Joiner WJ, Wang LY, Tang MD and Kaczmarek LK. (1997) hSK4, a member of a novel subfamily of calcium-activated potassium channels. *Proc Natl Acad Sci USA* **94**: 11013-8 [PMID:9380751]
141. Jäger H, Adelman JP and Grissmer S. (2000) SK2 encodes the apamin-sensitive Ca(2+)-activated K(+) channels in the human leukemic T cell line, Jurkat. *FEBS Lett* **469**: 196-202 [PMID:10713270]
142. Jäger H, Dreker T, Buck A, Giehl K, Gress T and Grissmer S. (2004) Blockage of intermediate-conductance Ca2+-activated K+ channels inhibit human pancreatic cancer cell growth in vitro. *Mol Pharmacol* **65**: 630-8 [PMID:14978241]
143. Kaczmarek LK. (2013) Slack, Slick and Sodium-Activated Potassium Channels. *ISRN Neurosci* **2013** [PMID:24319675]
144. Kaczmarek LK, Aldrich RW, Chandy KG, Grissmer S, Wei AD and Wulff H. (2017) International Union of Basic and Clinical Pharmacology. C. Nomenclature and Properties of Calcium-Activated and Sodium-Activated Potassium Channels. *Pharmacol Rev* **69**: 1-11 [PMID:28267675]
145. Kaczorowski GJ, Knaus HG, Leonard RJ, McManus OB and Garcia ML. (1996) High-conductance calcium-activated potassium channels; structure, pharmacology, and function. *J Bioenerg Biomembr* **28**: 255-67 [PMID:8807400]
146. Kameyama M, Kakei M, Sato R, Shibasaki T, Matsuda H and Irisawa H. (1984) Intracellular Na+ activates a K+ channel in mammalian cardiac cells. *Nature* **309**: 354-6 [PMID:6328309]
147. Kasumu AW, Hougaard C, Rode F, Jacobsen TA, Sabatier JM, Eriksen BL, Strøbæk D, Liang X, Egorova P and Vorontsova D *et al.*. (2012) Selective positive modulator of calcium-activated potassium channels exerts beneficial effects in a mouse model of spinocerebellar ataxia type 2. *Chem Biol* **19**: 1340-53 [PMID:23102227]
148. Kaushal V, Koeberle PD, Wang Y and Schlichter LC. (2007) The Ca2+-activated K+ channel

KCNN4/KCa3.1 contributes to microglia activation and nitric oxide-dependent neurodegeneration. *J Neurosci* **27**: 234-44 [PMID:17202491]
149. Khanna R, Chang MC, Joiner WJ, Kaczmarek LK and Schlichter LC. (1999) hSK4/hIK1, a calmodulin-binding KCa channel in human T lymphocytes. Roles in proliferation and volume regulation. *J Biol Chem* **274**: 14838-49 [PMID:10329683]
150. Khanna R, Roy L, Zhu X and Schlichter LC. (2001) K+ channels and the microglial respiratory burst. *Am J Physiol, Cell Physiol* **280**: C796-806 [PMID:11245596]
151. Kim GE and Kaczmarek LK. (2014) Emerging role of the KCNT1 Slack channel in intellectual disability. *Front Cell Neurosci* **8**: 209 [PMID:25120433]
152. Kim GE, Kronengold J, Barcia G, Quraishi IH, Martin HC, Blair E, Taylor JC, Dulac O, Colleaux L and Nabbout R *et al*.. (2014) Human slack potassium channel mutations increase positive cooperativity between individual channels. *Cell Rep* **9**: 1661-72 [PMID:25482562]
153. Kimura T, Takahashi MP, Okuda Y, Kaido M, Fujimura H, Yanagihara T and Sakoda S. (2000) The expression of ion channel mRNAs in skeletal muscles from patients with myotonic muscular dystrophy. *Neurosci Lett* **295**: 93-6 [PMID:11090982]
154. King B, Rizwan AP, Asmara H, Heath NC, Engbers JD, Dykstra S, Bartoletti TM, Hameed S, Zamponi GW and Turner RW. (2015) IKCa channels are a critical determinant of the slow AHP in CA1 pyramidal neurons. *Cell Rep* **11**: 175-82 [PMID:25865881]
155. Koh DS, Jonas P and Vogel W. (1994) Na(+)-activated K+ channels localized in the nodal region of myelinated axons of Xenopus. *J Physiol (Lond.)* **479 (Pt 2)**: 183-97 [PMID:7799220]
156. Kohler M, Hirschberg B, Bond CT, Kinzie JM, Marrion NV, Maylie J and Adelman JP. (1996) Small-conductance, calcium-activated potassium channels from mammalian brain. *Science* **273**: 1709-14 [PMID:8781233]
157. Kolski-Andreaco A, Tomita H, Shakkottai VG, Gutman GA, Cahalan MD, Gargus JJ and Chandy KG. (2004) SK3-1C, a dominant-negative suppressor of SKCa and IKCa channels. *J Biol Chem* **279**: 6893-904 [PMID:14638680]
158. Koronyo-Hamaoui M, Danziger Y, Frisch A, Stein D, Leor S, Laufer N, Carel C, Fennig S, Minoumi M and Apter A *et al*.. (2002) Association between anorexia nervosa and the hsKCa3 gene: a family-based and case control study. *Mol Psychiatry* **7**: 82-5 [PMID:11803450]
159. Kuzmenkov AI, Peigneur S, Nasburg JA, Mineev KS, Nikolaev MV, Pinheiro-Junior EL, Arseniev AS, Wulff H, Tytgat J and Vassilevski AA. (2022) Apamin structure and pharmacology revisited. *Front Pharmacol* **13**: 977440 [PMID:36188602]
160. Köhler R, Brakemeier S, Kühn M, Behrens C, Real R, Degenhardt C, Orzechowski HD, Pries AR, Paul M and Hoyer J. (2001) Impaired hyperpolarization in regenerated endothelium after balloon catheter injury. *Circ Res* **89**: 174-9 [PMID:11463725]
161. Köhler R, Eichler I, Schönfelder H, Grgic I, Heinau P, Si H and Hoyer J. (2005) Impaired EDHF-mediated vasodilation and function of endothelial Ca-activated K channels in uremic rats. *Kidney Int* **67**: 2280-7 [PMID:15882269]
162. Köhler R and Hoyer J. (2007) The endothelium-derived hyperpolarizing factor: insights from genetic animal models. *Kidney Int* **72**: 145-50 [PMID:17457372]
163. Köhler R, Wulff H, Eichler I, Kneifel M, Neumann D, Knorr A, Grgic I, Kämpfe D, Si H, Wibawa J, Real R, Borner K, Brakemeier S, Orzechowski HD, Reusch HP, Paul M, Chandy KG and Hoyer J. (2003) Blockade of the intermediate-conductance calcium-activated potassium channel as a new therapeutic strategy for restenosis. *Circulation* **108**: 1119-25 [PMID:12939222]
164. Lam J, Coleman N, Garing AL and Wulff H. (2013) The therapeutic potential of small-conductance KCa2 channels in neurodegenerative and psychiatric diseases. *Expert Opin Ther Targets* **17**: 1203-20 [PMID:23883298]
165. Lappin SC, Dale TJ, Brown JT, Trezise DJ and Davies CH. (2005) Activation of SK channels inhibits epileptiform bursting in hippocampal CA3 neurons. *Brain Res* **1065**: 37-46 [PMID:16336949]
166. Lee CH and MacKinnon R. (2018) Activation mechanism of a human SK-calmodulin channel complex elucidated by cryo-EM structures. *Science* **360**: 508-513 [PMID:29724949]
167. Lee K, Rowe IC and Ashford ML. (1995) NS 1619 activates BKCa channel activity in rat cortical neurones. *Eur J Pharmacol* **280**: 215-9 [PMID:7589189]
168. Leonetti MD, Yuan P, Hsiung Y and Mackinnon R. (2012) Functional and structural analysis of the human SLO3 pH- and voltage-gated K+ channel. *Proc Natl Acad Sci U S A* **109**: 19274-9 [PMID:23129643]
169. Li C, Wang F, Yang Y, Fu F, Xu C, Shi L, Li S, Xia Y, Wu G and Cheng X *et al*.. (2011) Significant association of SNP rs2106261 in the ZFHX3 gene with atrial fibrillation in a Chinese Han GeneID population. *Hum Genet* **129**: 239-46 [PMID:21107608]
170. Li M, Chang S, Yang L, Shi J, McFarland K, Yang X, Moller A, Wang C, Zou X and Chi C *et al*.. (2014) Conopeptide Vt3.1 preferentially inhibits BK potassium channels containing β4 subunits via electrostatic interactions. *J Biol Chem* **289**: 4735-42 [PMID:24398688]
171. Ling TY, Wang XL, Chai Q, Lau TW, Koestler CM, Park SJ, Daly RC, Greason KL, Jen J and Wu LQ *et al*.. (2013) Regulation of the SK3 channel by microRNA-499--potential role in atrial

fibrillation. *Heart Rhythm* **10**: 1001-9 [PMID:23499625]
172. Lingle CJ. (2002) Setting the stage for molecular dissection of the regulatory components of BK channels. *J Gen Physiol* **120**: 261-5 [PMID:12198086]
173. Litt M, LaMorticella D, Bond CT and Adelman JP. (1999) Gene structure and chromosome mapping of the human small-conductance calcium-activated potassium channel SK1 gene (KCNN1). *Cytogenet Cell Genet* **86**: 70-3 [PMID:10516439]
174. Liu G, Shi J, Yang L, Cao L, Park SM, Cui J and Marx SO. (2004) Assembly of a Ca2+-dependent BK channel signaling complex by binding to beta2 adrenergic receptor. *EMBO J* **23**: 2196-205 [PMID:15141163]
175. Logsdon NJ, Kang J, Togo JA, Christian EP and Aiyar J. (1997) A novel gene, hKCa4, encodes the calcium-activated potassium channel in human T lymphocytes. *J Biol Chem* **272**: 32723-6 [PMID:9407042]
176. Lu R, Bausch AE, Kallenborn-Gerhardt W, Stoetzer C, Debruin N, Ruth P, Geisslinger G, Leffler A, Lukowski R and Schmidtko A. (2015) Slack channels expressed in sensory neurons control neuropathic pain in mice. *J Neurosci* **35**: 1125-35 [PMID:25609627]
177. Lu S, Das P, Fadool DA and Kaczmarek LK. (2010) The slack sodium-activated potassium channel provides a major outward current in olfactory neurons of Kv1.3-/- super-smeller mice. *J Neurophysiol* **103**: 3311-9 [PMID:20393063]
178. Lucchesi K, Ravindran A, Young H and Moczydlowski E. (1989) Analysis of the blocking activity of charybdotoxin homologs and iodinated derivatives against Ca2+-activated K+ channels. *J Membr Biol* **109**: 269-81 [PMID:2477548]
179. Lyon M, Li P, Ferreira JJ, Lazarenko RM, Kharade SV, Kramer M, McClenahan SJ, Days E, Bauer JA and Spitznagel BD *et al.*. (2023) A selective inhibitor of the sperm-specific potassium channel SLO3 impairs human sperm function. *Proc Natl Acad Sci U S A* **120**: e2212338120 [PMID:36649421]
180. Magleby KL. (2003) Gating mechanism of BK (Slo1) channels: so near, yet so far. *J Gen Physiol* **121**: 81-96 [PMID:12566537]
181. Mahida S, Mills RW, Tucker NR, Simonson B, Macri V, Lemoine MD, Das S, Milan DJ and Ellinor PT. (2014) Overexpression of KCNN3 results in sudden cardiac death. *Cardiovasc Res* **101**: 326-34 [PMID:24296650]
182. Marshall DL, Vatanpour H, Harvey AL, Boyot P, Pinkasfeld S, Doljansky Y, Bouet F and Ménez A. (1994) Neuromuscular effects of some potassium channel blocking toxins from the venom of the scorpion Leiurus quinquestriatus hebreus. *Toxicon* **32**: 1433-43 [PMID:7533951]
183. Martin HC, Kim GE, Pagnamenta AT, Murakami Y, Carvill GL, Meyer E, Copley RR, Rimmer A, Barcia G and Fleming MR *et al.*. (2014) Clinical whole-genome sequencing in severe early-onset epilepsy reveals new genes and improves molecular diagnosis. *Hum Mol Genet* **23**: 3200-11 [PMID:24463883]
184. Matteson DR and Deutsch C. (1984) K channels in T lymphocytes: a patch clamp study using monoclonal antibody adhesion. *Nature* **307**: 468-71 [PMID:6320008]
185. Mauler F, Hinz V, Horváth E, Schuhmacher J, Hofmann HA, Wirtz S, Hahn MG and Urbahns K. (2004) Selective intermediate-/small-conductance calcium-activated potassium channel (KCNN4) blockers are potent and effective therapeutics in experimental brain oedema and traumatic brain injury caused by acute subdural haematoma. *Eur J Neurosci* **20**: 1761-8 [PMID:15379997]
186. Meera P, Wallner M, Song M and Toro L. (1997) Large conductance voltage- and calcium-dependent K+ channel, a distinct member of voltage-dependent ion channels with seven N-terminal transmembrane segments (S0-S6), an extracellular N terminus, and an intracellular (S9-S10) C terminus. *Proc Natl Acad Sci USA* **94**: 14066-71 [PMID:9391153]
187. Messier C, Mourre C, Bontempi B, Sif J, Lazdunski M and Destrade C. (1991) Effect of apamin, a toxin that inhibits Ca(2+)-dependent K+ channels, on learning and memory processes. *Brain Res* **551**: 322-6 [PMID:1913161]
188. Miller MJ, Rauer H, Tomita H, Rauer H, Gargus JJ, Gutman GA, Cahalan MD and Chandy KG. (2001) Nuclear localization and dominant-negative suppression by a mutant SKCa3 N-terminal channel fragment identified in a patient with schizophrenia. *J Biol Chem* **276**: 27753-6 [PMID:11395478]
189. Milligan CJ, Li M, Gazina EV, Heron SE, Nair U, Trager C, Reid CA, Venkat A, Younkin DP and Dlugos DJ *et al.*. (2014) KCNT1 gain of function in 2 epilepsy phenotypes is reversed by quinidine. *Ann Neurol* **75**: 581-90 [PMID:24591078]
190. Moczydlowski EG. (2004) BK channel news: full coverage on the calcium bowl. *J Gen Physiol* **123**: 471-3 [PMID:15111642]
191. Molinari EJ, Sullivan JP, Wan Y, Brioni JD and Gopalakrishnan M. (2000) Characterization and modulation of [125I]iberiotoxin-D19Y/Y36F binding in the guinea-pig urinary bladder. *Eur J Pharmacol* **388**: 155-61 [PMID:10666507]
192. Monaghan AS, Benton DC, Bahia PK, Hosseini R, Shah YA, Haylett DG and Moss GW. (2004) The SK3 subunit of small conductance Ca2+-activated K+ channels interacts with both SK1 and SK2

subunits in a heterologous expression system. *J Biol Chem* **279**: 1003-9 [PMID:14559917]
193. Mourre C, Fournier C and Soumireu-Mourat B. (1997) Apamin, a blocker of the calcium-activated potassium channel, induces neurodegeneration of Purkinje cells exclusively. *Brain Res* **778**: 405-8 [PMID:9459560]
194. Mouse Genome Sequencing Consortium, Waterston RH, Lindblad-Toh K, Birney E, Rogers J, Abril JF, Agarwal P, Agarwala R, Ainscough R and Alexandersson M *et al.*. (2002) Initial sequencing and comparative analysis of the mouse genome. *Nature* **420**: 520-62 [PMID:12466850]
195. Mulholland PJ, Becker HC, Woodward JJ and Chandler LJ. (2011) Small conductance calcium-activated potassium type 2 channels regulate alcohol-associated plasticity of glutamatergic synapses. *Biol Psychiatry* **69**: 625-32 [PMID:21056409]
196. Nam YW, Im D, Garcia ASC, Tringides ML, Nguyen HM, Liu Y, Orfali R, Ramanishka A, Pintilie G and Su CC *et al.*. (2025) Cryo-EM structures of the small-conductance Ca^{2+}-activated $K_{Ca}2.2$ channel. *Nat Commun* **16**: 3690 [PMID:40246884]
197. Nanou E and El Manira A. (2007) A postsynaptic negative feedback mediated by coupling between AMPA receptors and Na+-activated K+ channels in spinal cord neurones. *Eur J Neurosci* **25**: 445-50 [PMID:17284185]
198. Nausch B, Rode F, Jørgensen S, Nardi A, Korsgaard MP, Hougaard C, Bonev AD, Brown WD, Dyhring T and Strøbæk D *et al.*. (2014) NS19504: a novel BK channel activator with relaxing effect on bladder smooth muscle spontaneous phasic contractions. *J Pharmacol Exp Ther* **350**: 520-30 [PMID:24951278]
199. Navarro B, Kirichok Y and Clapham DE. (2007) KSper, a pH-sensitive K+ current that controls sperm membrane potential. *Proc Natl Acad Sci USA* **104**: 7688-92 [PMID:17460039]
200. Neelands TR, Herson PS, Jacobson D, Adelman JP and Maylie J. (2001) Small-conductance calcium-activated potassium currents in mouse hyperexcitable denervated skeletal muscle. *J Physiol (Lond.)* **536**: 397-407 [PMID:11600675]
201. Neylon CB, Lang RJ, Fu Y, Bobik A and Reinhart PH. (1999) Molecular cloning and characterization of the intermediate-conductance Ca(2+)-activated K(+) channel in vascular smooth muscle: relationship between K(Ca) channel diversity and smooth muscle cell function. *Circ Res* **85**: e33-43 [PMID:10532960]
202. North KC, Shaw AA, Bukiya AN and Dopico AM. (2023) Progesterone activation of β_1-containing BK channels involves two binding sites. *Nat Commun* **14**: 7248 [PMID:37945687]
203. Novello JC, Arantes EC, Varanda WA, Oliveira B, Giglio JR and Marangoni S. (1999) TsTX-IV, a short chain four-disulfide-bridged neurotoxin from Tityus serrulatus venom which acts on Ca2+-activated K+ channels. *Toxicon* **37**: 651-60 [PMID:10082164]
204. Nuwer MO, Picchione KE and Bhattacharjee A. (2010) PKA-induced internalization of slack KNa channels produces dorsal root ganglion neuron hyperexcitability. *J Neurosci* **30**: 14165-72 [PMID:20962237]
205. Okazaki N, Kikuno R, Ohara R, Inamoto S, Koseki H, Hiraoka S, Saga Y, Nagase T, Ohara O and Koga H. (2003) Prediction of the coding sequences of mouse homologues of KIAA gene: III. the complete nucleotide sequences of 500 mouse KIAA-homologous cDNAs identified by screening of terminal sequences of cDNA clones randomly sampled from size-fractionated libraries. *DNA Res* **10**: 167-80 [PMID:14621295]
206. Olesen SP, Munch E, Moldt P and Drejer J. (1994) Selective activation of Ca(2+)-dependent K+ channels by novel benzimidazolone. *Eur J Pharmacol* **251**: 53-9 [PMID:8137869]
207. Oliván-Viguera A, Valero MS, Coleman N, Brown BM, Laría C, Murillo MD, Gálvez JA, Díaz-de-Villegas MD, Wulff H and Badorrey R *et al.*. (2015) A novel pan-negative-gating modulator of KCa2/3 channels, fluoro-di-benzoate, RA-2, inhibits endothelium-derived hyperpolarization-type relaxation in coronary artery and produces bradycardia in vivo. *Mol Pharmacol* **87**: 338-48 [PMID:25468883]
208. Ong ST, Nam YW, Nasburg JA, Ramanishka A, Ng XR, Zhuang Z, Goay SSM, Nguyen HM, Singh L and Singh V *et al.*. (2025) Design and structural basis of selective 1,4-dihydropyridine inhibitors of the calcium-activated potassium channel $K_{Ca}3.1$. *Proc Natl Acad Sci U S A* **122**: e2425494122 [PMID:40294255]
209. Orfila JE, Shimizu K, Garske AK, Deng G, Maylie J, Traystman RJ, Quillinan N, Adelman JP and Herson PS. (2014) Increasing small conductance Ca2+-activated potassium channel activity reverses ischemia-induced impairment of long-term potentiation. *Eur J Neurosci* **40**: 3179-88 [PMID:25080203]
210. Ouadid-Ahidouch H, Roudbaraki M, Delcourt P, Ahidouch A, Joury N and Prevarskaya N. (2004) Functional and molecular identification of intermediate-conductance Ca(2+)-activated K(+) channels in breast cancer cells: association with cell cycle progression. *Am J Physiol, Cell Physiol* **287**: C125-34 [PMID:14985237]
211. Ozgen N, Dun W, Sosunov EA, Anyukhovsky EP, Hirose M, Duffy HS, Boyden PA and Rosen MR. (2007) Early electrical remodeling in rabbit pulmonary vein results from trafficking of intracellular SK2 channels to membrane sites. *Cardiovasc Res* **75**: 758-69 [PMID:17588552]

212. Pandita RK, Rønn LC, Jensen BS and Andersson KE. (2006) Urodynamic effects of intravesical administration of the new small/intermediate conductance calcium activated potassium channel activator NS309 in freely moving, conscious rats. *J Urol* **176**: 1220-4 [PMID:16890729]
213. Parajuli SP, Hristov KL, Soder RP, Kellett WF and Petkov GV. (2013) NS309 decreases rat detrusor smooth muscle membrane potential and phasic contractions by activating SK3 channels. *Br J Pharmacol* **168**: 1611-25 [PMID:23145946]
214. Parihar AS, Coghlan MJ, Gopalakrishnan M and Shieh CC. (2003) Effects of intermediate-conductance Ca2+-activated K+ channel modulators on human prostate cancer cell proliferation. *Eur J Pharmacol* **471**: 157-64 [PMID:12826234]
215. Paulais M, Lachheb S and Teulon J. (2006) A Na+- and Cl- -activated K+ channel in the thick ascending limb of mouse kidney. *J Gen Physiol* **127**: 205-15 [PMID:16446508]
216. Pedarzani P, D'hoedt D, Doorty KB, Wadsworth JD, Joseph JS, Jeyaseelan K, Kini RM, Gadre SV, Sapatnekar SM and Stocker M *et al*.. (2002) Tamapin, a venom peptide from the Indian red scorpion (Mesobuthus tamulus) that targets small conductance Ca2+-activated K+ channels and afterhyperpolarization currents in central neurons. *J Biol Chem* **277**: 46101-9 [PMID:12239213]
217. Pedarzani P, McCutcheon JE, Rogge G, Jensen BS, Christophersen P, Hougaard C, Strøbaek D and Stocker M. (2005) Specific enhancement of SK channel activity selectively potentiates the afterhyperpolarizing current I(AHP) and modulates the firing properties of hippocampal pyramidal neurons. *J Biol Chem* **280**: 41404-11 [PMID:16239218]
218. Pedarzani P, Mosbacher J, Rivard A, Cingolani LA, Oliver D, Stocker M, Adelman JP and Fakler B. (2001) Control of electrical activity in central neurons by modulating the gating of small conductance Ca2+-activated K+ channels. *J Biol Chem* **276**: 9762-9 [PMID:11134030]
219. Persohn E, Malherbe P and Richards JG. (1992) Comparative molecular neuroanatomy of cloned GABAA receptor subunits in the rat CNS. *J Comp Neurol* **326**: 193-216 [PMID:1336019]
220. Peña TL, Chen SH, Konieczny SF and Rane SG. (2000) Ras/MEK/ERK Up-regulation of the fibroblast KCa channel FIK is a common mechanism for basic fibroblast growth factor and transforming growth factor-beta suppression of myogenesis. *J Biol Chem* **275**: 13677-82 [PMID:10788486]
221. Qi XY, Diness JG, Brundel BJ, Zhou XB, Naud P, Wu CT, Huang H, Harada M, Aflaki M and Dobrev D *et al*.. (2014) Role of small-conductance calcium-activated potassium channels in atrial electrophysiology and fibrillation in the dog. *Circulation* **129**: 430-40 [PMID:24190961]
222. Qunies AM, Spitznagel BD, Du Y, David Weaver C and Emmitte KA. (2023) Design, synthesis, and biological evaluation of a novel series of 1,2,4-oxadiazole inhibitors of SLACK potassium channels: Identification of in vitro tool VU0935685. *Bioorg Med Chem* **95**: 117487 [PMID:37812884]
223. Qunies AM, Spitznagel BD, Du Y, Peprah PK, Mohamed YK, Weaver CD and Emmitte KA. (2024) Structure-Activity Relationship Studies in a Series of Xanthine Inhibitors of SLACK Potassium Channels. *Molecules* **29** [PMID:38893312]
224. Rapetti-Mauss R, Lacoste C, Picard V, Guitton C, Lombard E, Loosveld M, Nivaggioni V, Dasilva N, Salgado D and Desvignes JP *et al*.. (2015) A mutation in the Gardos channel is associated with hereditary xerocytosis. *Blood* **126**: 1273-80 [PMID:26148990]
225. Rauer H, Lanigan MD, Pennington MW, Aiyar J, Ghanshani S, Cahalan MD, Norton RS and Chandy KG. (2000) Structure-guided transformation of charybdotoxin yields an analog that selectively targets Ca(2+)-activated over voltage-gated K(+) channels. *J Biol Chem* **275**: 1201-8 [PMID:10625664]
226. Raychaudhuri SK, Wulff H and Raychaudhuri SP. (2016) KCa3.1(-/-) Mice Do Not Develop CIA: Regulatory Role for KCa3.1 in Autoimmune Arthritis. *J Cell Physiol* **231**: 2313-4 [PMID:26910182]
227. Reich EP, Cui L, Yang L, Pugliese-Sivo C, Golovko A, Petro M, Vassileva G, Chu I, Nomeir AA and Zhang LK *et al*.. (2005) Blocking ion channel KCNN4 alleviates the symptoms of experimental autoimmune encephalomyelitis in mice. *Eur J Immunol* **35**: 1027-36 [PMID:15770697]
228. Ro S, Hatton WJ, Koh SD and Horowitz B. (2001) Molecular properties of small-conductance Ca2+-activated K+ channels expressed in murine colonic smooth muscle. *Am J Physiol Gastrointest Liver Physiol* **281**: G964-73 [PMID:11557517]
229. Romano S, Coarelli G, Marcotulli C, Leonardi L, Piccolo F, Spadaro M, Frontali M, Ferraldeschi M, Vulpiani MC and Ponzelli F *et al*.. (2015) Riluzole in patients with hereditary cerebellar ataxia: a randomised, double-blind, placebo-controlled trial. *Lancet Neurol* **14**: 985-91 [PMID:26321318]
230. Romi-Lebrun R, Lebrun B, Martin-Eauclaire MF, Ishiguro M, Escoubas P, Wu FQ, Hisada M, Pongs O and Nakajima T. (1997) Purification, characterization, and synthesis of three novel toxins from the Chinese scorpion Buthus martensi, which act on K+ channels. *Biochemistry* **36**: 13473-82 [PMID:9354615]
231. Romine JL, Martin SW, Meanwell NA, Gribkoff VK, Boissard CG, Dworetzky SI, Natale J, Moon S, Ortiz A and Yeleswaram S *et al*.. (2007) 3-[(5-Chloro-2-hydroxyphenyl)methyl]-5-[4-(trifluoromethyl)phenyl]-1,3,4-oxadiazol-2(3H)-one, BMS-191011: opener of large-conductance

Ca(2+)-activated potassium (maxi-K) channels, identification, solubility, and SAR. *J Med Chem* **50**: 528-42 [PMID:17266205]
232. Rovner E, Chai TC, Jacobs S, Christ G, Andersson KE, Efros M, Nitti V, Davies K, McCullough AR and Melman A. (2020) Evaluating the safety and potential activity of URO-902 (hMaxi-K) gene transfer by intravesical instillation or direct injection into the bladder wall in female participants with idiopathic (non-neurogenic) overactive bladder syndrome and detrusor overactivity from two double-blind, imbalanced, placebo-controlled randomized phase 1 trials. *Neurourol Urodyn* **39**: 744-753 [PMID:31945197]
233. Roy S, Large RJ, Akande AM, Kshatri A, Webb TI, Domene C, Sergeant GP, McHale NG, Thornbury KD and Hollywood MA. (2014) Development of GoSlo-SR-5-69, a potent activator of large conductance Ca2+-activated K+ (BK) channels. *Eur J Med Chem* **75**: 426-37 [PMID:24561672]
234. Rufo PA, Merlin D, Riegler M, Ferguson-Maltzman MH, Dickinson BL, Brugnara C, Alper SL and Lencer WI. (1997) The antifungal antibiotic, clotrimazole, inhibits chloride secretion by human intestinal T84 cells via blockade of distinct basolateral K+ conductances. Demonstration of efficacy in intact rabbit colon and in an in vivo mouse model of cholera. *J Clin Invest* **100**: 3111-20 [PMID:9399958]
235. Safronov BV and Vogel W. (1996) Properties and functions of Na(+)-activated K+ channels in the soma of rat motoneurones. *J Physiol (Lond.)* **497 (Pt 3)**: 727-34 [PMID:9003557]
236. Sanchez M and McManus OB. (1996) Paxilline inhibition of the alpha-subunit of the high-conductance calcium-activated potassium channel. *Neuropharmacology* **35**: 963-8 [PMID:8938726]
237. Sankaranarayanan A, Raman G, Busch C, Schultz T, Zimin PI, Hoyer J, Köhler R and Wulff H. (2009) Naphtho[1,2-d]thiazol-2-ylamine (SKA-31), a new activator of KCa2 and KCa3.1 potassium channels, potentiates the endothelium-derived hyperpolarizing factor response and lowers blood pressure. *Mol Pharmacol* **75**: 281-95 [PMID:18955585]
238. Santi CM, Ferreira G, Yang B, Gazula VR, Butler A, Wei A, Kaczmarek LK and Salkoff L. (2006) Opposite regulation of Slick and Slack K+ channels by neuromodulators. *J Neurosci* **26**: 5059-68 [PMID:16687497]
239. Santi CM, Martínez-López P, de la Vega-Beltrán JL, Butler A, Alisio A, Darszon A and Salkoff L. (2010) The SLO3 sperm-specific potassium channel plays a vital role in male fertility. *FEBS Lett* **584**: 1041-6 [PMID:20138882]
240. Schilling T, Stock C, Schwab A and Eder C. (2004) Functional importance of Ca2+-activated K+ channels for lysophosphatidic acid-induced microglial migration. *Eur J Neurosci* **19**: 1469-74 [PMID:15066143]
241. Schreiber M and Salkoff L. (1997) A novel calcium-sensing domain in the BK channel. *Biophys J* **73**: 1355-63 [PMID:9284303]
242. Schreiber M, Wei A, Yuan A, Gaut J, Saito M and Salkoff L. (1998) Slo3, a novel pH-sensitive K+ channel from mammalian spermatocytes. *J Biol Chem* **273**: 3509-16 [PMID:9452476]
243. Schumacher MA, Rivard AF, Bächinger HP and Adelman JP. (2001) Structure of the gating domain of a Ca2+-activated K+ channel complexed with Ca2+/calmodulin. *Nature* **410**: 1120-4 [PMID:11323678]
244. Shah M and Haylett DG. (2000) The pharmacology of hSK1 Ca2+-activated K+ channels expressed in mammalian cell lines. *Br J Pharmacol* **129**: 627-30 [PMID:10683185]
245. Shakkottai VG, Chou CH, Oddo S, Sailer CA, Knaus HG, Gutman GA, Barish ME, LaFerla FM and Chandy KG. (2004) Enhanced neuronal excitability in the absence of neurodegeneration induces cerebellar ataxia. *J Clin Invest* **113**: 582-90 [PMID:14966567]
246. Shakkottai VG, do Carmo Costa M, Dell'Orco JM, Sankaranarayanan A, Wulff H and Paulson HL. (2011) Early changes in cerebellar physiology accompany motor dysfunction in the polyglutamine disease spinocerebellar ataxia type 3. *J Neurosci* **31**: 13002-14 [PMID:21900579]
247. Shakkottai VG, Regaya I, Wulff H, Fajloun Z, Tomita H, Fathallah M, Cahalan MD, Gargus JJ, Sabatier JM and Chandy KG. (2001) Design and characterization of a highly selective peptide inhibitor of the small conductance calcium-activated K+ channel, SkCa2. *J Biol Chem* **276**: 43145-51 [PMID:11527975]
248. Shi J, Krishnamoorthy G, Yang Y, Hu L, Chaturvedi N, Harilal D, Qin J and Cui J. (2002) Mechanism of magnesium activation of calcium-activated potassium channels. *Nature* **418**: 876-80 [PMID:12192410]
249. Shmukler BE, Bond CT, Wilhelm S, Bruening-Wright A, Maylie J, Adelman JP and Alper SL. (2001) Structure and complex transcription pattern of the mouse SK1 K(Ca) channel gene, KCNN1. *Biochim Biophys Acta* **1518**: 36-46 [PMID:11267657]
250. Si H, Heyken WT, Wölfle SE, Tysiac M, Schubert R, Grgic I, Vilianovich L, Giebing G, Maier T and Gross V *et al.*. (2006) Impaired endothelium-derived hyperpolarizing factor-mediated dilations and increased blood pressure in mice deficient of the intermediate-conductance Ca2+-activated K+ channel. *Circ Res* **99**: 537-44 [PMID:16873714]
251. Simó-Vicens R, Kirchhoff JE, Dolce B, Abildgaard L, Speerschneider T, Sørensen US, Grunnet M,

Diness JG and Bentzen BH. (2017) A new negative allosteric modulator, AP14145, for the study of small conductance calcium-activated potassium (K_{Ca} 2) channels. *Br J Pharmacol* **174**: 4396-4408 [PMID:28925012]
252. Singh S, Syme CA, Singh AK, Devor DC and Bridges RJ. (2001) Benzimidazolone activators of chloride secretion: potential therapeutics for cystic fibrosis and chronic obstructive pulmonary disease. *J Pharmacol Exp Ther* **296**: 600-11 [PMID:11160649]
253. Skibsbye L, Poulet C, Diness JG, Bentzen BH, Yuan L, Kappert U, Matschke K, Wettwer E, Ravens U and Grunnet M *et al.*. (2014) Small-conductance calcium-activated potassium (SK) channels contribute to action potential repolarization in human atria. *Cardiovasc Res* **103**: 156-67 [PMID:24817686]
254. Srivastava S, Li Z, Ko K, Choudhury P, Albaqumi M, Johnson AK, Yan Y, Backer JM, Unutmaz D and Coetzee WA *et al.*. (2006) Histidine phosphorylation of the potassium channel KCa3.1 by nucleoside diphosphate kinase B is required for activation of KCa3.1 and CD4 T cells. *Mol Cell* **24**: 665-75 [PMID:17157250]
255. Srivastava S, Zhdanova O, Di L, Li Z, Albaqumi M, Wulff H and Skolnik EY. (2008) Protein histidine phosphatase 1 negatively regulates CD4 T cells by inhibiting the K+ channel KCa3.1. *Proc Natl Acad Sci USA* **105**: 14442-6 [PMID:18796614]
256. Stackman RW, Hammond RS, Linardatos E, Gerlach A, Maylie J, Adelman JP and Tzounopoulos T. (2002) Small conductance Ca2+-activated K+ channels modulate synaptic plasticity and memory encoding. *J Neurosci* **22**: 10163-71 [PMID:12451117]
257. Stocker JW, De Franceschi L, McNaughton-Smith GA, Corrocher R, Beuzard Y and Brugnara C. (2003) ICA-17043, a novel Gardos channel blocker, prevents sickled red blood cell dehydration in vitro and in vivo in SAD mice. *Blood* **101**: 2412-8 [PMID:12433690]
258. Stocker M. (2004) Ca(2+)-activated K+ channels: molecular determinants and function of the SK family. *Nat Rev Neurosci* **5**: 758-70 [PMID:15378036]
259. Stocker M, Hirzel K, D'hoedt D and Pedarzani P. (2004) Matching molecules to function: neuronal Ca2+-activated K+ channels and afterhyperpolarizations. *Toxicon* **43**: 933-49 [PMID:15208027]
260. Stocker M, Krause M and Pedarzani P. (1999) An apamin-sensitive Ca2+-activated K+ current in hippocampal pyramidal neurons. *Proc Natl Acad Sci USA* **96**: 4662-7 [PMID:10200319]
261. Stocker M and Pedarzani P. (2000) Differential distribution of three Ca(2+)-activated K(+) channel subunits, SK1, SK2, and SK3, in the adult rat central nervous system. *Mol Cell Neurosci* **15**: 476-93 [PMID:10833304]
262. Strassmaier T, Bond CT, Sailer CA, Knaus HG, Maylie J and Adelman JP. (2005) A novel isoform of SK2 assembles with other SK subunits in mouse brain. *J Biol Chem* **280**: 21231-6 [PMID:15797870]
263. Strausberg RL, Feingold EA, Grouse LH, Derge JG, Klausner RD, Collins FS, Wagner L, Shenmen CM, Schuler GD and Altschul SF *et al.*. (2002) Generation and initial analysis of more than 15,000 full-length human and mouse cDNA sequences. *Proc Natl Acad Sci USA* **99**: 16899-903 [PMID:12477932]
264. Strøbaek D, Christophersen P, Holm NR, Moldt P, Ahring PK, Johansen TE and Olesen SP. (1996) Modulation of the Ca(2+)-dependent K+ channel, hslo, by the substituted diphenylurea NS 1608, paxilline and internal Ca2+. *Neuropharmacology* **35**: 903-14 [PMID:8938721]
265. Strøbaek D, Hougaard C, Johansen TH, Sørensen US, Nielsen EØ, Nielsen KS, Taylor RD, Pedarzani P and Christophersen P. (2006) Inhibitory gating modulation of small conductance Ca2+-activated K+ channels by the synthetic compound (R)-N-(benzimidazol-2-yl)-1,2,3,4-tetrahydro-1-naphtylamine (NS8593) reduces afterhyperpolarizing current in hippocampal CA1 neurons. *Mol Pharmacol* **70**: 1771-82 [PMID:16926279]
266. Strøbaek D, Jørgensen TD, Christophersen P, Ahring PK and Olesen SP. (2000) Pharmacological characterization of small-conductance Ca(2+)-activated K(+) channels stably expressed in HEK 293 cells. *Br J Pharmacol* **129**: 991-9 [PMID:10696100]
267. Strøbaek D, Teuber L, Jørgensen TD, Ahring PK, Kjaer K, Hansen RS, Olesen SP, Christophersen P and Skaaning-Jensen B. (2004) Activation of human IK and SK Ca2+ -activated K+ channels by NS309 (6,7-dichloro-1H-indole-2,3-dione 3-oxime). *Biochim Biophys Acta* **1665**: 1-5 [PMID:15471565]
268. Strøbæk D, Brown DT, Jenkins DP, Chen YJ, Coleman N, Ando Y, Chiu P, Jørgensen S, Demnitz J and Wulff H *et al.*. (2013) NS6180, a new K(Ca) 3.1 channel inhibitor prevents T-cell activation and inflammation in a rat model of inflammatory bowel disease. *Br J Pharmacol* **168**: 432-44 [PMID:22891655]
269. Syme CA, Gerlach AC, Singh AK and Devor DC. (2000) Pharmacological activation of cloned intermediate- and small-conductance Ca(2+)-activated K(+) channels. *Am J Physiol, Cell Physiol* **278**: C570-81 [PMID:10712246]
270. Sánchez-Carranza O, Torres-Rodríguez P, Darszon A, Treviño CL and López-González I. (2015) Pharmacology of hSlo3 channels and their contribution in the capacitation-associated hyperpolarization of human sperm. *Biochem Biophys Res Commun* **466**: 554-9 [PMID:26381170]

271. Sørensen US, Strøbaek D, Christophersen P, Hougaard C, Jensen ML, Nielsen EØ, Peters D and Teuber L. (2008) Synthesis and structure-activity relationship studies of 2-(N-substituted)-aminobenzimidazoles as potent negative gating modulators ofsmall conductance Ca2+-activated K+ channels. *J Med Chem* **51**: 7625-34 [PMID:18998663]
272. Tamarina NA, Wang Y, Mariotto L, Kuznetsov A, Bond C, Adelman J and Philipson LH. (2003) Small-conductance calcium-activated K+ channels are expressed in pancreatic islets and regulate glucose responses. *Diabetes* **52**: 2000-6 [PMID:12882916]
273. Tang QY, Zhang Z, Xia XM and Lingle CJ. (2010) Block of mouse Slo1 and Slo3 K+ channels by CTX, IbTX, TEA, 4-AP and quinidine. *Channels (Austin)* **4**: 22-41 [PMID:19934650]
274. Tao J, Zhou ZL, Wu B, Shi J, Chen XM and Ji YH. (2014) Recombinant expression and functional characterization of martentoxin: a selective inhibitor for BK channel (α + β4). *Toxins (Basel)* **6**: 1419-33 [PMID:24759175]
275. Tao X and MacKinnon R. (2019) Molecular structures of the human Slo1 K^+ channel in complex with β4. *Elife* **8** [PMID:31815672]
276. Tao X, Zhao C and MacKinnon R. (2023) Membrane protein isolation and structure determination in cell-derived membrane vesicles. *Proc Natl Acad Sci U S A* **120**: e2302325120 [PMID:37098056]
277. Taylor MS, Bonev AD, Gross TP, Eckman DM, Brayden JE, Bond CT, Adelman JP and Nelson MT. (2003) Altered expression of small-conductance Ca2+-activated K+ (SK3) channels modulates arterial tone and blood pressure. *Circ Res* **93**: 124-31 [PMID:12805243]
278. Teramoto N, Brading AF and Ito Y. (2003) Multiple effects of mefenamic acid on K(+) currents in smooth muscle cells from pig proximal urethra. *Br J Pharmacol* **140**: 1341-50 [PMID:14623761]
279. Terstappen GC, Pula G, Carignani C, Chen MX and Roncarati R. (2001) Pharmacological characterisation of the human small conductance calcium-activated potassium channel hSK3 reveals sensitivity to tricyclic antidepressants and antipsychotic phenothiazines. *Neuropharmacology* **40**: 772-83 [PMID:11369031]
280. Tharp DL, Wamhoff BR, Turk JR and Bowles DK. (2006) Upregulation of intermediate-conductance Ca2+-activated K+ channel (IKCa1) mediates phenotypic modulation of coronary smooth muscle. *Am J Physiol Heart Circ Physiol* **291**: H2493-503 [PMID:16798818]
281. Thomson SJ, Hansen A and Sanguinetti MC. (2015) Identification of the Intracellular Na+ Sensor in Slo2.1 Potassium Channels. *J Biol Chem* **290**: 14528-35 [PMID:25903137]
282. Tomita H, Shakkottai VG, Gutman GA, Sun G, Bunney WE, Cahalan MD, Chandy KG and Gargus JJ. (2003) Novel truncated isoform of SK3 potassium channel is a potent dominant-negative regulator of SK currents: implications in schizophrenia. *Mol Psychiatry* **8**: 524-35, 460 [PMID:12808432]
283. Tonggu L and Wang L. (2022) Structure of the Human BK Ion Channel in Lipid Environment. *Membranes (Basel)* **12** [PMID:36005673]
284. Tsai CT, Hsieh CS, Chang SN, Chuang EY, Juang JM, Lin LY, Lai LP, Hwang JJ, Chiang FT and Lin JL. (2015) Next-generation sequencing of nine atrial fibrillation candidate genes identified novel de novo mutations in patients with extreme trait of atrial fibrillation. *J Med Genet* **52**: 28-36 [PMID:25391453]
285. Tseng-Crank J, Foster CD, Krause JD, Mertz R, Godinot N, DiChiara TJ and Reinhart PH. (1994) Cloning, expression, and distribution of functionally distinct Ca(2+)-activated K+ channel isoforms from human brain. *Neuron* **13**: 1315-30 [PMID:7993625]
286. Tuteja D, Xu D, Timofeyev V, Lu L, Sharma D, Zhang Z, Xu Y, Nie L, Vázquez AE and Young JN *et al*.. (2005) Differential expression of small-conductance Ca2+-activated K+ channels SK1, SK2, and SK3 in mouse atrial and ventricular myocytes. *Am J Physiol Heart Circ Physiol* **289**: H2714-23 [PMID:16055520]
287. Uchino S, Wada H, Honda S, Hirasawa T, Yanai S, Nakamura Y, Ondo Y and Kohsaka S. (2003) Slo2 sodium-activated K+ channels bind to the PDZ domain of PSD-95. *Biochem Biophys Res Commun* **310**: 1140-7 [PMID:14559234]
288. Urbahns K, Goldmann S, Krüger J, Horváth E, Schuhmacher J, Grosser R, Hinz V and Mauler F. (2005) IKCa-channel blockers. Part 2: discovery of cyclohexadienes. *Bioorg Med Chem Lett* **15**: 401-4 [PMID:15603962]
289. Vaeth M and Feske S. (2018) Ion channelopathies of the immune system. *Curr Opin Immunol* **52**: 39-50 [PMID:29635109]
290. Valverde MA, Rojas P, Amigo J, Cosmelli D, Orio P, Bahamonde MI, Mann GE, Vergara C and Latorre R. (1999) Acute activation of Maxi-K channels (hSlo) by estradiol binding to the beta subunit. *Science* **285**: 1929-31 [PMID:10489376]
291. Vandorpe DH, Shmukler BE, Jiang L, Lim B, Maylie J, Adelman JP, de Franceschi L, Cappellini MD, Brugnara C and Alper SL. (1998) cDNA cloning and functional characterization of the mouse Ca2+-gated K+ channel, mIK1. Roles in regulatory volume decrease and erythroid differentiation. *J Biol Chem* **273**: 21542-53 [PMID:9705284]
292. Villalobos C, Shakkottai VG, Chandy KG, Michelhaugh SK and Andrade R. (2004) SKCa channels

mediate the medium but not the slow calcium-activated afterhyperpolarization in cortical neurons. *J Neurosci* **24**: 3537-42 [PMID:15071101]
293. Vitello R, Taouba H, Derand M and Liégeois JF. (2024) The Bis(1,2,3,4-tetrahydroisoquinoline) Alkaloids Cepharanthine and Berbamine Are Ligands of SK Channels. *ACS Med Chem Lett* **15**: 215-220 [PMID:38352826]
294. Wang G and Lemos JR. (1992) Tetrandrine blocks a slow, large-conductance, Ca(2+)-activated potassium channel besides inhibiting a non-inactivating Ca2+ current in isolated nerve terminals of the rat neurohypophysis. *Pflugers Arch* **421**: 558-65 [PMID:1331975]
295. Wang J, Shen B, Guo M, Lou X, Duan Y, Cheng XP, Teng M, Niu L, Liu Q and Huang Q *et al.*. (2005) Blocking effect and crystal structure of natrin toxin, a cysteine-rich secretory protein from Naja atra venom that targets the BKCa channel. *Biochemistry* **44**: 10145-52 [PMID:16042391]
296. Wang J and Xiang M. (2013) Targeting potassium channels Kv1.3 and KC a 3.1: routes to selective immunomodulators in autoimmune disorder treatment? *Pharmacotherapy* **33**: 515-28 [PMID:23649812]
297. Wang RX, Chai Q, Lu T and Lee HC. (2011) Activation of vascular BK channels by docosahexaenoic acid is dependent on cytochrome P450 epoxygenase activity. *Cardiovasc Res* **90**: 344-52 [PMID:21187320]
298. Waroux O, Massotte L, Alleva L, Graulich A, Thomas E, Liégeois JF, Scuvée-Moreau J and Seutin V. (2005) SK channels control the firing pattern of midbrain dopaminergic neurons in vivo. *Eur J Neurosci* **22**: 3111-21 [PMID:16367777]
299. Warth R, Hamm K, Bleich M, Kunzelmann K, von Hahn T, Schreiber R, Ullrich E, Mengel M, Trautmann N and Kindle P *et al.*. (1999) Molecular and functional characterization of the small Ca(2+)-regulated K+ channel (rSK4) of colonic crypts. *Pflugers Arch* **438**: 437-44 [PMID:10519135]
300. Weatherall KL, Goodchild SJ, Jane DE and Marrion NV. (2010) Small conductance calcium-activated potassium channels: from structure to function. *Prog Neurobiol* **91**: 242-55 [PMID:20359520]
301. Wei A, Solaro C, Lingle C and Salkoff L. (1994) Calcium sensitivity of BK-type KCa channels determined by a separable domain. *Neuron* **13**: 671-81 [PMID:7917297]
302. Wei AD, Gutman GA, Aldrich R, Chandy KG, Grissmer S and Wulff H. (2005) International Union of Pharmacology. LII. Nomenclature and molecular relationships of calcium-activated potassium channels. *Pharmacol Rev* **57**: 463-72 [PMID:16382103]
303. Weiger TM, Hermann A and Levitan IB. (2002) Modulation of calcium-activated potassium channels. *J Comp Physiol A Neuroethol Sens Neural Behav Physiol* **188**: 79-87 [PMID:11919690]
304. Weiger TM, Holmqvist MH, Levitan IB, Clark FT, Sprague S, Huang WJ, Ge P, Wang C, Lawson D, Jurman ME, Glucksmann MA, Silos-Santiago I, DiStefano PS and Curtis R. (2000) A novel nervous system beta subunit that downregulates human large conductance calcium-dependent potassium channels. *J Neurosci* **20**: 3563-70 [PMID:10804197]
305. Wisden W, Laurie DJ, Monyer H and Seeburg PH. (1992) The distribution of 13 GABAA receptor subunit mRNAs in the rat brain. I. Telencephalon, diencephalon, mesencephalon. *J Neurosci* **12**: 1040-62 [PMID:1312131]
306. Wittekindt OH, Visan V, Tomita H, Imtiaz F, Gargus JJ, Lehmann-Horn F, Grissmer S and Morris-Rosendahl DJ. (2004) An apamin- and scyllatoxin-insensitive isoform of the human SK3 channel. *Mol Pharmacol* **65**: 788-801 [PMID:14978258]
307. Wolfart J, Neuhoff H, Franz O and Roeper J. (2001) Differential expression of the small-conductance, calcium-activated potassium channel SK3 is critical for pacemaker control in dopaminergic midbrain neurons. *J Neurosci* **21**: 3443-56 [PMID:11331374]
308. Wrighton DC, Muench SP and Lippiat JD. (2015) Mechanism of inhibition of mouse Slo3 (KCa 5.1) potassium channels by quinine, quinidine and barium. *Br J Pharmacol* **172**: 4355-63 [PMID:26045093]
309. Wu SN, Chen CC, Li HF, Lo YK, Chen SA and Chiang HT. (2002) Stimulation of the BK(Ca) channel in cultured smooth muscle cells of human trachea by magnolol. *Thorax* **57**: 67-74 [PMID:11809993]
310. Wu SN, Li HF, Jan CR and Shen AY. (1999) Inhibition of Ca2+-activated K+ current by clotrimazole in rat anterior pituitary GH3 cells. *Neuropharmacology* **38**: 979-89 [PMID:10428416]
311. Wu Y, Yang Y, Ye S and Jiang Y. (2010) Structure of the gating ring from the human large-conductance Ca(2+)-gated K(+) channel. *Nature* **466**: 393-7 [PMID:20574420]
312. Wulff H and Castle NA. (2010) Therapeutic potential of KCa3.1 blockers: an overview of recent advances, and promising trends *Expert Rev Clin Pharmacol* **3**: 385–396
313. Wulff H, Knaus HG, Pennington M and Chandy KG. (2004) K+ channel expression during B cell differentiation: implications for immunomodulation and autoimmunity. *J Immunol* **173**: 776-86 [PMID:15240664]
314. Wulff H, Kolski-Andreaco A, Sankaranarayanan A, Sabatier JM and Shakkottai V. (2007)

Modulators of small- and intermediate-conductance calcium-activated potassium channels and their therapeutic indications. *Curr Med Chem* **14**: 1437-57 [PMID:17584055]
315. Wulff H and Köhler R. (2013) Endothelial small-conductance and intermediate-conductance KCa channels: an update on their pharmacology and usefulness as cardiovascular targets. *J Cardiovasc Pharmacol* **61**: 102-12 [PMID:23107876]
316. Wulff H, Miller MJ, Hansel W, Grissmer S, Cahalan MD and Chandy KG. (2000) Design of a potent and selective inhibitor of the intermediate-conductance Ca2+-activated K+ channel, IKCa1: a potential immunosuppressant. *Proc Natl Acad Sci USA* **97**: 8151-6 [PMID:10884437]
317. Xia XM, Fakler B, Rivard A, Wayman G, Johnson-Pais T, Keen JE, Ishii T, Hirschberg B, Bond CT and Lutsenko S *et al.*. (1998) Mechanism of calcium gating in small-conductance calcium-activated potassium channels. *Nature* **395**: 503-7 [PMID:9774106]
318. Xia XM, Zeng X and Lingle CJ. (2002) Multiple regulatory sites in large-conductance calcium-activated potassium channels. *Nature* **418**: 880-4 [PMID:12192411]
319. Xu Y, Tuteja D, Zhang Z, Xu D, Zhang Y, Rodriguez J, Nie L, Tuxson HR, Young JN and Glatter KA *et al.*. (2003) Molecular identification and functional roles of a Ca(2+)-activated K+ channel in human and mouse hearts. *J Biol Chem* **278**: 49085-94 [PMID:13679367]
320. Yamanouchi D, Kasuya G, Nakajo K, Kise Y and Nureki O. (2023) Dual allosteric modulation of voltage and calcium sensitivities of the Slo1-LRRC channel complex. *Mol Cell* **83**: 4555-4569.e4 [PMID:38035882]
321. Yan J and Aldrich RW. (2010) LRRC26 auxiliary protein allows BK channel activation at resting voltage without calcium. *Nature* **466**: 513-6 [PMID:20613726]
322. Yan J and Aldrich RW. (2012) BK potassium channel modulation by leucine-rich repeat-containing proteins. *Proc Natl Acad Sci USA* **109**: 7917-22 [PMID:22547800]
323. Yang B, Desai R and Kaczmarek LK. (2007) Slack and Slick K(Na) channels regulate the accuracy of timing of auditory neurons. *J Neurosci* **27**: 2617-27 [PMID:17344399]
324. Yang B, Gribkoff VK, Pan J, Damagnez V, Dworetzky SI, Boissard CG, Bhattacharjee A, Yan Y, Sigworth FJ and Kaczmarek LK. (2006) Pharmacological activation and inhibition of Slack (Slo2.2) channels. *Neuropharmacology* **51**: 896-906 [PMID:16876206]
325. Yao J, Chen X, Li H, Zhou Y, Yao L, Wu G, Chen X, Zhang N, Zhou Z and Xu T *et al.*. (2005) BmP09, a "long chain" scorpion peptide blocker of BK channels. *J Biol Chem* **280**: 14819-28 [PMID:15695820]
326. Yao JL, Zhou YF, Yang XJ, Qian XD and Jiang WP. (2015) KCNN3 SNP rs13376333 on Chromosome 1q21 Confers Increased Risk of Atrial Fibrillation. *Int Heart J* **56**: 511-5 [PMID:26370375]
327. Yi F, Ling TY, Lu T, Wang XL, Li J, Claycomb WC, Shen WK and Lee HC. (2015) Down-regulation of the small conductance calcium-activated potassium channels in diabetic mouse atria. *J Biol Chem* **290**: 7016-26 [PMID:25605734]
328. Yuan A, Santi CM, Wei A, Wang ZW, Pollak K, Nonet M, Kaczmarek L, Crowder CM and Salkoff L. (2003) The sodium-activated potassium channel is encoded by a member of the Slo gene family. *Neuron* **37**: 765-73 [PMID:12628167]
329. Yuan P, Leonetti MD, Hsiung Y and MacKinnon R. (2012) Open structure of the Ca2+ gating ring in the high-conductance Ca2+-activated K+ channel. *Nature* **481**: 94-7 [PMID:22139424]
330. Yuan P, Leonetti MD, Pico AR, Hsiung Y and MacKinnon R. (2010) Structure of the human BK channel Ca2+-activation apparatus at 3.0 A resolution. *Science* **329**: 182-6 [PMID:20508092]
331. Zeng XH, Yang C, Kim ST, Lingle CJ and Xia XM. (2011) Deletion of the Slo3 gene abolishes alkalization-activated K+ current in mouse spermatozoa. *Proc Natl Acad Sci USA* **108**: 5879-84 [PMID:21427226]
332. Zhang BM, Kohli V, Adachi R, López JA, Udden MM and Sullivan R. (2001) Calmodulin binding to the C-terminus of the small-conductance Ca2+-activated K+ channel hSK1 is affected by alternative splicing. *Biochemistry* **40**: 3189-95 [PMID:11258935]
333. Zhang G, Xu X, Jia Z, Geng Y, Liang H, Shi J, Marras M, Abella C, Magleby KL and Silva JR *et al.*. (2022) An allosteric modulator activates BK channels by perturbing coupling between Ca^{2+} binding and pore opening. *Nat Commun* **13**: 6784 [PMID:36351900]
334. Zhang J, Liu S, Fan J, Yan R, Huang B, Zhou F, Yuan T, Gong J, Huang Z and Jiang D. (2023) Structural basis of human Slo2.2 channel gating and modulation. *Cell Rep* **42**: 112858 [PMID:37494189]
335. Zhang M, Nam YW, Ramanishka A, Xu Y, Yasuda RM, Im D, Cui M, Chandy G and Wulff H. (2025) Structural basis for the subtype-selectivity of $K_{Ca}2.2$ channel activators. *Res Sq* [PMID:40470184]
336. Zhang X, Zeng X and Lingle CJ. (2006) Slo3 K+ channels: voltage and pH dependence of macroscopic currents. *J Gen Physiol* **128**: 317-36 [PMID:16940555]
337. Zhang X, Zeng X, Xia XM and Lingle CJ. (2006) pH-regulated Slo3 K+ channels: properties of unitary currents. *J Gen Physiol* **128**: 301-15 [PMID:16940554]
338. Zhang XD, Timofeyev V, Li N, Myers RE, Zhang DM, Singapuri A, Lau VC, Bond CT, Adelman J and Lieu DK *et al.*. (2014) Critical roles of a small conductance Ca^{2+}-activated K^+ channel (SK3)

in the repolarization process of atrial myocytes. *Cardiovasc Res* **101**: 317-25 [PMID:24282291]
339. Zhang Y, Brown MR, Hyland C, Chen Y, Kronengold J, Fleming MR, Kohn AB, Moroz LL and Kaczmarek LK. (2012) Regulation of neuronal excitability by interaction of fragile X mental retardation protein with slack potassium channels. *J Neurosci* **32**: 15318-27 [PMID:23115170]