Cannabinoid Receptor Type 1 Agonist ACEA Improves Cognitive Deficit on STZ-Induced Neurotoxicity Through Apoptosis Pathway and NO Modulation

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Abstract

The cannabinoid system has the ability to modulate cellular and molecular mechanisms, including excitotoxicity, oxidative stress, apoptosis, and inflammation, acting as a neuroprotective agent, by its relationship with signaling pathways associated to the control of cell proliferation, differentiation, and survival. Recent reports have raised new perspectives on the possible role of cannabinoid system in neurodegenerative diseases like Alzheimer disease's (AD). AD is a neurodegenerative disorder characterized by the presence of amyloid plaques, neurofibrillary tangles, neuronal death, and progressive cognitive loss, which could be caused by energy metabolism impairment, changes in insulin signaling, chronic oxidative stress, neuroinflammation, Tau hyperphosphorylation, and Aβ deposition in the brain. Thus, we investigated the presumptive protective effect of the cannabinoid type 1 (CB1)-selective

occurs by positive regulation of the anti-apoptotic proteins, suggesting the participation of this system in neurodegenerative processes. Our data suggest that the cannabinoid system is an interesting therapeutic target for the treatment of neurodegenerative diseases.

Keywords

Agonist CB1 ACEA Neuroprotection Streptozotocin Alzheimer's disease Neurodegeneration

Notes

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Author Contributions

F.C. designed the experiments, collected, and analyzed the data and wrote the paper; T.A.V. and A.P.C. collected, analyzed, and discussed the data; A.S.T. designed the experiments, discussed the data, wrote, edited, and commented on the manuscript. All authors approved the final version of the manuscript.

Compliance with Ethical Standards

The experimental protocol was evaluated and approved by the "Ethics Committee for Animal use" of the Institute of Biomedical Sciences, University of São Paulo (Protocol no. 33/55/02) following the Brazilian Federal Law (no. 11794; 10/08/2008). All applicable international,

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References

Abood ME, Rizvi G, Sallapudi N, McAllister SD (2001) Activation of the CB1 cannabinoid receptor protects cultured mouse spinal neurons against excitotoxicity. Neurosci Lett 309:197–201. https://doi.org/10.1016/S0304-3940(01)02065-1 (https://doi.org/10.1016/S0304-3940(01)02065-1)
CrossRef (https://doi.org/10.1016/S0304-3940(01)02065-1)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=11514075)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Activation%20of%20the%20CB1%20cannabinoid%20receptor%20protects%20cultured%20mouse%20spinal%20neurons%20against%20excitotoxicity&author=ME.%20Abood&author=G.%20Rizvi&author=N.%20Sallapudi&author=SD.%20McAllister&journal=Neurosci%20Lett&volume=309&pages=197-201&publication_year=2001&doi=10.1016%2FS0304-3940%2801%2902065-1)

Agrawal R, Tyagi E, Shukla R, Nath C (2011) Insulin receptor signaling in rat hippocampus: a study in STZ (ICV) induced memory deficit model. Eur Neuropsychopharmacol 21:261–273. https://doi.org/10.1016/j.euroneuro.2010.11.009 (https://doi.org/10.1016/j.euroneuro.2010.11.009)
CrossRef (https://doi.org/10.1016/j.euroneuro.2010.11.009)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=21195590)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Insulin%20receptor%20signaling%20in%20rat%20hippocampus%3A%20a%20study%20in%20STZ%20%28ICV%29%20induced%20memory%20deficit%20model&author=R.%20Agrawal&author=E.%20Tyagi&author=R.%20Shukla&author=C.%20Nath&journal=Eur%20Neuropsychopharmacol&volume=21&pages=261-273&publication_year=2011&doi=10.1016%2Fj.euroneuro.2010.11.009)

Ahmad F, Nidadavolu P, Durgadoss L, Ravindranath V (2014) Critical cysteines in Akt1 regulate its activity and proteasomal degradation: implications for neurodegenerative diseases. Free Radic Biol Med 74:118–128. https://doi.org/10.1016/j.freeradbiomed.2014.06.004 (https://doi.org/10.1016/j.freeradbiomed.2014.06.004)
CrossRef (https://doi.org/10.1016/j.freeradbiomed.2014.06.004)

Aso E, Ferrer I (2014) Cannabinoids for treatment of Alzheimer's disease: moving toward the clinic. Front Pharmacol 5:1–11. https://doi.org/10.3389/fphar.2014.00037 (https://doi.org/10.3389/fphar.2014.00037)
CrossRef (https://doi.org/10.3389/fphar.2014.00037)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Cannabinoids%20for%20treatment%20of%20Alzheimer%E2%80%99s%20disease%3A%20moving%20toward%20the%20clinic&author=E.%20Aso&author=I.%20Ferrer&journal=Front%20Pharmacol&volume=5&pages=1-11&publication_year=2014&doi=10.3389%2Ffphar.2014.00037)

Aso E, Palomer E, Juvés S, Maldonado R, Muñoz FJ, Ferrer I (2012) CB1 agonist ACEA protects neurons and reduces the cognitive impairment of AβPP/PS1 mice. J Alzheimers Dis 30:439–459. https://doi.org/10.3233/JAD-2012-111862 (https://doi.org/10.3233/JAD-2012-111862)
CrossRef (https://doi.org/10.3233/JAD-2012-111862)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=22451318)
Google Scholar (http://scholar.google.com/scholar_lookup?title=CB1%20agonist%20ACEA%20protects%20neurons%20and%20reduces%20the%20cognitive%20impairment%20of%20A%CE%B2PP%2FPS1%20mice&author=E.%20Aso&author=E.%20Palomer&author=S.%20Juv%C3%A9s&author=R.%20Maldonado&author=FJ.%20Mu%C3%B1oz&author=I.%20Ferrer&journal=J%20Alzheimers%20Dis&volume=30&pages=439-459&publication_year=2012&doi=10.3233%2FJAD-2012-111862)

Barzegar S, Komaki A, Shahidi S, Sarihi A, Mirazi N, Salehi I (2015) Effects of cannabinoid and glutamate receptor antagonists and their interactions on learning and memory in male rats. Pharmacol Biochem Behav 131:87–90. https://doi.org/10.1016/j.pbb.2015.02.005 (https://doi.org/10.1016/j.pbb.2015.02.005)
CrossRef (https://doi.org/10.1016/j.pbb.2015.02.005)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=25684318)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Effects%20of%20cannabinoid%20and%20glutamate%20receptor%20antagonists%20and%20their%20interactions%20on%20learning%20and%20memory%20in%20male%20rats&author=S.%20Barzegar&author=A.%20Komaki&author=S.%20Shahidi&author=A.%20Sarihi&author=N.%20Mirazi&author=I.%20Salehi&journal=Pharmacol%20Biochem%20Behav&volume=131&pages=87-90&publication_year=2015&doi=10.1016%2Fj.pbb.2015.02.005)

Batinga H, Zúñiga-Hertz JP, Torrão AS (2016) Cannabinoid receptor ligands prevent dopaminergic neurons death induced by neurotoxic, inflammatory and oxidative stimuli in vitro. J Biomed Sci 5:1–16
CrossRef (https://doi.org/10.4172/2254-609X.100016)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Cannabinoid%20receptor%20ligands%20prevent%20dopaminergic%20neurons%20death%20induced%20by%20neurotoxic%2C%20inflammatory%20and%20oxidative%20stimul

20current%20knowledge&author=G.%20Bedse&author=F.%20Domenico&author=G.%20Serviddio&author=T.%20Cassano&journal=Front%20Neurosci&volume=9&pages=1-13&publication_year=2015&doi=10.3389%2Ffnins.2015.00204)

Benito C, Núñez E, Pazos MR, Tolón RM, Romero J (2007) The endocannabinoid system and Alzheimer's disease. Mol Neurobiol 36:75–81. https://doi.org/10.1007/s12035-007-8006-8 (https://doi.org/10.1007/s12035-007-8006-8)
CrossRef (https://doi.org/10.1007/s12035-007-8006-8)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=17952652)
Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20endocannabinoid%20system%20and%20Alzheimer%E2%80%99s%20disease&author=C.%20Benito&author=E.%20N%C3%BA%C3%B1ez&author=MR.%20Pazos&author=RM.%20Tol%C3%B3n&author=J.%20Romero&journal=Mol%20Neurobiol&volume=36&pages=75-81&publication_year=2007&doi=10.1007%2Fs12035-007-8006-8)

Blázquez C, Chiarlone A, Bellocchio L, Resel E, Pruunsild P, García-Rincón D, Sendtner M, Timmusk T, Lutz B, Galve-Roperh I, Guzmán M (2015) The CB1 cannabinoid receptor signals striatal neuroprotection via a PI3K/Akt/mTORC1/BDNF pathway. Cell Death Differ 22:1618–1629. https://doi.org/10.1038/cdd.2015.11 (https://doi.org/10.1038/cdd.2015.11)
CrossRef (https://doi.org/10.1038/cdd.2015.11)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=25698444)
PubMedCentral (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4563779)
Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20CB1%20cannabinoid%20receptor%20signals%20striatal%20neuroprotection%20via%20a%20PI3K%2FAkt%2FmTORC1%2FBDNF%20pathway&author=C.%20Bl%C3%A1zquez&author=A.%20Chiarlone&author=L.%20Bellocchio&author=E.%20Resel&author=P.%20Pruunsild&author=D.%20Garc%C3%ADa-Rinc%C3%B3n&author=M.%20Sendtner&author=T.%20Timmusk&author=B.%20Lutz&author=I.%20Galve-Roperh&author=M.%20Guzm%C3%A1n&journal=Cell%20Death%20Differ&volume=22&pages=1618-1629&publication_year=2015&doi=10.1038%2Fcdd.2015.11)

Café-Mendes CC, Ferro ES, Torrão AS, Crunfli F, Rioli V, Schmitt A, Falkai P, Britto LR, Turck CW, Martins-de-Souza D (2017) Peptidomic analysis of the anterior temporal lobe and corpus callosum from schizophrenia patients. J Proteome 151:97–105. https://doi.org/10.1016/j.jprot.2016.05.025 (https://doi.org/10.1016/j.jprot.2016.05.025)
CrossRef (https://doi.org/10.1016/j.jprot.2016.05.025)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Peptidomic%20analysis%20of%20the%20anterior%20temporal%20lobe%20and%20corpus%20callosum%20from%20schizophrenia%20patients&author=CC.%20Caf%C3%A9-Mendes&author=ES.%20Ferro&author=AS.%20Torr%C3%A3o&author=F.%20Crunfli&author=V.%20Rioli&author=A.%20Schmitt&author=P.%20Falkai&author=LR.%20Britto&author=CW.%20Turck&author=D.%20Martins-de-

Google Scholar (http://scholar.google.com/scholar_lookup?title=Cannabinoids%3A%20a%20new%20hope%20for%20breast%20cancer%20therapy%3F&author=MM.%20Caffarel&author=C.%20Andradas&author=E.%20P%C3%A9rez-G%C3%B3mez&author=M.%20Guzm%C3%A1n&author=C.%20S%C3%A1nchez&journal=Cancer%20Treat%20Rev&volume=38&pages=911-918&publication_year=2012&doi=10.1016%2Fj.ctrv.2012.06.005)

Calderón FH, Bonnefont A, Muñoz FJ, Fernández V, Videla LA, Inestrosa NC (1999) PC12 and neuro 2ª cells have diferente susceptibilities to acetylcholinesterase-amyloid complexes, amyloid $_{25-35}$ fragment, glutamate, and hydrogen peroxide. J Neurosci Res 56:620–631. https://doi.org/10.1002/(SICI)1097-4547(19990615)56:6<620::AID-JNR8>3.0.CO;2-F (https://doi.org/10.1002/(SICI)1097-4547(19990615)56%3A6<620%3A%3AAID-JNR8>3.0.CO%3B2-F)
CrossRef (https://doi.org/10.1002/(SICI)1097-4547(19990615)56%3A6<620%3A%3AAID-JNR8>3.0.CO%3B2-F)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=10374817)
Google Scholar (http://scholar.google.com/scholar_lookup?title=PC12%20and%20neuro%202%C2%AA%20cells%20have%20diferente%20susceptibilities%20to%20acetylcholinesterase-amyloid%20complexes%2C%20amyloid%2025-35%20fragment%2C%20glutamate%2C%20and%20hydrogen%20peroxide&author=FH.%20Calder%C3%B3n&author=A.%20Bonnefont&author=FJ.%20Mu%C3%B1oz&author=V.%20Fern%C3%A1ndez&author=LA.%20Videla&author=NC.%20Inestrosa&journal=J%20Neurosci%20Res&volume=56&pages=620-631&publication_year=1999&doi=10.1002%2F%28SICI%291097-4547%2819990615%2956%3A6%3C620%3A%3AAID-JNR8%3E3.0.CO%3B2-F)

Caltana LR, Heimrich B, Brusco A (2015) Further evidence for the neuroplastic role of cannabinoids: a study in organotypic hippocampal slice cultures. J Mol Neurosci 56:773–781. https://doi.org/10.1007/s12031-015-0499-4 (https://doi.org/10.1007/s12031-015-0499-4)
CrossRef (https://doi.org/10.1007/s12031-015-0499-4)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=25645684)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Further%20evidence%20for%20the%20neuroplastic%20role%20of%20cannabinoids%3A%20a%20study%20in%20organotypic%20hippocampal%20slice%20cultures&author=LR.%20Caltana&author=B.%20Heimrich&author=A.%20Brusco&journal=J%20Mol%20Neurosci&volume=56&pages=773-781&publication_year=2015&doi=10.1007%2Fs12031-015-0499-4)

Carney ST, Lloyd ML, MacKinnon SE, Newton DC, Jones JD, Howlett AC, Norford DC (2009) Cannabinoid regulation of nitric oxide synthase i (nNOS) in neuronal cells. J NeuroImmune Pharmacol 4:338–349. https://doi.org/10.1007/s11481-009-9153-7 (https://doi.org/10.1007/s11481-009-9153-7)
CrossRef (https://doi.org/10.1007/s11481-009-9153-7)

Coffer PJ, Geijsen N, M'rabet L, Schweizer RC, Maikoe T, Raaijmakers JAM, Lammers JWJ, Koenderman L (1998) Comparison of the roles of mitogen-activated protein kinase kinase and phosphatidylinositol 3-kinase signal transduction in neutrophil effector function. Biochem J 329(Pt1):121–130
CrossRef (https://doi.org/10.1042/bj3290121)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=9405284)
PubMedCentral (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1219022)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Comparison%20of%20the%20roles%20of%20mitogen-activated%20protein%20kinase%20kinase%20and%20phosphatidylinositol%203-kinase%20signal%20transduction%20in%20neutrophil%20effector%20function&author=PJ.%20Coffer&author=N.%20Geijsen&author=L.%20M%E2%80%99rabet&author=RC.%20Schweizer&author=T.%20Maikoe&author=JAM.%20Raaijmakers&author=JWJ.%20Lammers&author=L.%20Koenderman&journal=Biochem%20J&volume=329&issue=Pt1&pages=121-130&publication_year=1998)

Colucci-D'Amato L, Perrone-Capano C, Di Porzio U (2003) Chronic activation of ERK and neurodegenerative diseases. BioEssays 25:1085–1095. https://doi.org/10.1002/bies.10355 (https://doi.org/10.1002/bies.10355)
CrossRef (https://doi.org/10.1002/bies.10355)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=14579249)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Chronic%20activation%20of%20ERK%20and%20neurodegenerative%20diseases&author=L.%20Colucci-D%E2%80%99Amato&author=C.%20Perrone-Capano&author=U.%20Porzio&journal=BioEssays&volume=25&pages=1085-1095&publication_year=2003&doi=10.1002%2Fbies.10355)

Crunfli F, Mazucanti CH, De Moraes RCM, Costa AP, Rodrigues AC, Scavone C, Torrão AS (2018) NO-dependent Akt inactivation by S-nitrosylation as a possible mechanism of STZ-induced neuronal insulin resistance. J Alzheimers Dis 65:1427–1443. https://doi.org/10.3233/JAD-180284 (https://doi.org/10.3233/JAD-180284)
CrossRef (https://doi.org/10.3233/JAD-180284)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=30149447)
Google Scholar (http://scholar.google.com/scholar_lookup?title=NO-dependent%20Akt%20inactivation%20by%20S-nitrosylation%20as%20a%20possible%20mechanism%20of%20STZ-induced%20neuronal%20insulin%20resistance&author=F.%20Crunfli&author=CH.%20Mazucanti&author=RCM.%20Moraes&author=AP.%20Costa&author=AC.%20Rodrigues&author=C.%20Scavone&author=AS.%20Torr%C3%A3o&journal=J%20Alzheimers%20Dis&volume=65&pages=1427-1443&publication_year=2018&doi=10.3233%2FJAD-180284)

De Felice F, Ferreira S (2002) β-Amyloid production, aggergation, and clearance as targets for

De Felice FG, Lourenco MV, Ferreira ST (2014) How does brain insulin resistance develop in Alzheimer's disease? Alzheimers Dement 10:S26–S32. https://doi.org/10.1016/j.jalz.2013.12.004 (https://doi.org/10.1016/j.jalz.2013.12.004)
CrossRef (https://doi.org/10.1016/j.jalz.2013.12.004)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=24529521)
Google Scholar (http://scholar.google.com/scholar_lookup?title=How%20does%20brain%20insulin%20resistance%20develop%20in%20Alzheimer%E2%80%99s%20disease%3F&author=FG.%20Felice&author=MV.%20Lourenco&author=ST.%20Ferreira&journal=Alzheimers%20Dement&volume=10&pages=S26-S32&publication_year=2014&doi=10.1016%2Fj.jalz.2013.12.004)

De La Monte SM, Tong M (2014) Brain metabolic dysfunction at the core of Alzheimer's disease. Biochem Pharmacol 88:548–559. https://doi.org/10.1016/j.bcp.2013.12.012 (https://doi.org/10.1016/j.bcp.2013.12.012)
CrossRef (https://doi.org/10.1016/j.bcp.2013.12.012)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=24380887)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Brain%20metabolic%20dysfunction%20at%20the%20core%20of%20Alzheimer%E2%80%99s%20disease&author=SM.%20Monte&author=M.%20Tong&journal=Biochem%20Pharmacol&volume=88&pages=548-559&publication_year=2014&doi=10.1016%2Fj.bcp.2013.12.012)

De la Monte SM, Wands JR (2005) Review of insulin and insulin-like growth factor expression, signaling, and malfunction in the central nervous system: relevance to Alzheimer's disease. J Alzheimers Dis 7:45–61. https://doi.org/10.3233/JAD-2005-7106 (https://doi.org/10.3233/JAD-2005-7106)
CrossRef (https://doi.org/10.3233/JAD-2005-7106)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=15750214)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Review%20of%20insulin%20and%20insulin-like%20growth%20factor%20expression%2C%20signaling%2C%20and%20malfunction%20in%20the%20central%20nervous%20system%3A%20relevance%20to%20Alzheimer%E2%80%99s%20disease&author=SM.%20Monte&author=JR.%20Wands&journal=J%20Alzheimers%20Dis&volume=7&pages=45-61&publication_year=2005&doi=10.3233%2FJAD-2005-7106)

Derkinderen P, Valjent E, Toutant M, Corvol JC, Enslen H, Ledent C, Trzaskos J, Caboche J, Girault JA (2003) Regulation of extracellular signal-regulated kinase by cannabinoids in hippocampus. J Neurosci 23:2371–2382 23/6/2371 **[pii]**
CrossRef (https://doi.org/10.1523/JNEUROSCI.23-06-02371.2003)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=12657697)

as a negative regulator of plasma endocannabinoid levels in obese and nonobese subjects. Eur J Endocrinol 161:715–722. https://doi.org/10.1530/EJE-09-0643 (https://doi.org/10.1530/EJE-09-0643)
CrossRef (https://doi.org/10.1530/EJE-09-0643)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=19745037)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Role%20of%20insulin%20as%20a%20negative%20regulator%20of%20plasma%20endocannabinoid%20levels%20in%20obese%20and%20nonobese%20subjects&author=V.%20Marzo&author=A.%20Verrijken&author=A.%20Hakkarainen&author=S.%20Petrosino&author=I.%20Mertens&author=N.%20Lundbom&author=F.%20Piscitelli&author=J.%20Westerbacka&author=A.%20Soro-Paavonen&author=I.%20Matias&author=L.%20Gaal&author=MR.%20Taskinen&journal=Eur%20J%20Endocrinol&volume=161&pages=715-722&publication_year=2009&doi=10.1530%2FEJE-09-0643)

Di Marzo V, Stella N, Zimmer A (2015) Endocannabinoid signalling and the deteriorating brain. Nat Rev Neurosci 16(1):30–42. https://doi.org/10.1038/nrn3876 (https://doi.org/10.1038/nrn3876)
CrossRef (https://doi.org/10.1038/nrn3876)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=25524120)
PubMedCentral (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4471876)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Endocannabinoid%20signalling%20and%20the%20deteriorating%20brain&author=V.%20Marzo&author=N.%20Stella&author=A.%20Zimmer&journal=Nat%20Rev%20Neurosci&volume=16&issue=1&pages=30-42&publication_year=2015&doi=10.1038%2Fnrn3876)

Downward J (1999) How BAD phosphorylation is good for survival. Nat Cell Biol 1:E33–E35. https://doi.org/10.1038/10026 (https://doi.org/10.1038/10026)
CrossRef (https://doi.org/10.1038/10026)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=10559890)
Google Scholar (http://scholar.google.com/scholar_lookup?title=How%20BAD%20phosphorylation%20is%20good%20for%20survival&author=J.%20Downward&journal=Nat%20Cell%20Biol&volume=1&pages=E33-E35&publication_year=1999&doi=10.1038%2F10026)

El-Mir MY, Detaille D, R-Villanueva G, Esteban MD, Guigas B, Attia S, Fontaine E, Almeida A, Leverve X (2008) Neuroprotective role of antidiabetic drug metformin against apoptotic cell death in primary cortical neurons. J Mol Neurosci 34:77–87. https://doi.org/10.1007/s12031-007-9002-1 (https://doi.org/10.1007/s12031-007-9002-1)
CrossRef (https://doi.org/10.1007/s12031-007-9002-1)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=18040888)

Ellert-Miklaszewska A, Kaminska B, Konarska L (2005) Cannabinoids down-regulate PI3K/Akt and Erk signalling pathways and activate proapoptotic function of Bad protein. Cell Signal 17:25–37. https://doi.org/10.1016/j.cellsig.2004.05.011 (https://doi.org/10.1016/j.cellsig.2004.05.011)
CrossRef (https://doi.org/10.1016/j.cellsig.2004.05.011)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=15451022)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Cannabinoids%20down-regulate%20PI3K%2FAkt%20and%20Erk%20signalling%20pathways%20and%20activate%20proapoptotic%20function%20of%20Bad%20protein&author=A.%20Ellert-Miklaszewska&author=B.%20Kaminska&author=L.%20Konarska&journal=Cell%20Signal&volume=17&pages=25-37&publication_year=2005&doi=10.1016%2Fj.cellsig.2004.05.011)

Esposito G, De Filippis D, Steardo L, Scuderi C, Savani C, Cuomoa V, Iuvone T (2006) CB1 receptor selective activation inhibits β-amyloid-induced iNOS protein expression in C6 cells and subsequently blunts tau protein hyperphosphorylation in co-cultured neurons. Neurosci Lett 404:342–346. https://doi.org/10.1016/j.neulet.2006.06.012 (https://doi.org/10.1016/j.neulet.2006.06.012)
CrossRef (https://doi.org/10.1016/j.neulet.2006.06.012)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=16837132)
Google Scholar (http://scholar.google.com/scholar_lookup?title=CB1%20receptor%20selective%20activation%20inhibits%20%CE%B2-amyloid-induced%20iNOS%20protein%20expression%20in%20C6%20cells%20and%20subsequently%20blunts%20tau%20protein%20hyperphosphorylation%20in%20co-cultured%20neurons&author=G.%20Esposito&author=D.%20Filippis&author=L.%20Steardo&author=C.%20Scuderi&author=C.%20Savani&author=V.%20Cuomoa&author=T.%20Iuvone&journal=Neurosci%20Lett&volume=404&pages=342-346&publication_year=2006&doi=10.1016%2Fj.neulet.2006.06.012)

Esposito G, Ligresti A, Izzo AA, Bisogno T, Ruvo M, Di Rosa M, Di Marzo V, Iuvone T (2002) The endocannabinoid system protects rat glioma cells against HIV-1 tat protein-induced cytotoxicity: mechanism and regulation. J Biol Chem 277:50348–50354. https://doi.org/10.1074/jbc.M207170200 (https://doi.org/10.1074/jbc.M207170200)
CrossRef (https://doi.org/10.1074/jbc.M207170200)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=12388547)
Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20endocannabinoid%20system%20protects%20rat%20glioma%20cells%20against%20HIV-1%20tat%20protein-induced%20cytotoxicity%3A%20mechanism%20and%20regulation&author=G.%20Esposito&author=A.%20Ligresti&author=AA.%20Izzo&author=T.%20Bisogno&author=M.%20Ruvo&author=M.%20Rosa&author=V.%20Marzo&author=T.%20Iuvone&journal=J%20Biol%20Chem&volume=277&pages=50348-

Google Scholar (http://scholar.google.com/scholar_lookup?title=Characterization%20of%20the%20neuroprotective%20effect%20of%20the%20cannabinoid%20agonist%20WIN-55212%20in%20an%20in%20vitro%20model%20of%20hypoxic-ischemic%20brain%20damage%20in%20newborn%20rats&author=D.%20Fern%C3%A1ndez-L%C3%B3pez&author=J.%20Mart%C3%ADnez-Orgado&author=E.%20Nu%C3%B1ez&author=J.%20Romero&author=P.%20Lorenzo&author=MA.%20Moro&author=I.%20Lizasoain&journal=Pediatr%20Res&volume=60&pages=169-173&publication_year=2006&doi=10.1203%2F01.pdr.0000228839.00122.6c)

Fernández-Ruiz J, Pazos MR, García-Arencibia M, Sagredo O, Ramos JA (2008) Role of CB2 receptors in neuroprotective effects of cannabinoids. Mol Cell Endocrinol 286:S91–S96. https://doi.org/10.1016/j.mce.2008.01.001 (https://doi.org/10.1016/j.mce.2008.01.001)
CrossRef (https://doi.org/10.1016/j.mce.2008.01.001)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=18291574)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Role%20of%20CB2%20receptors%20in%20neuroprotective%20effects%20of%20cannabinoids&author=J.%20Fern%C3%A1ndez-Ruiz&author=MR.%20Pazos&author=M.%20Garc%C3%ADa-Arencibia&author=O.%20Sagredo&author=JA.%20Ramos&journal=Mol%20Cell%20Endocrinol&volume=286&pages=S91-S96&publication_year=2008&doi=10.1016%2Fj.mce.2008.01.001)

Ferreiro E, Eufrásio A, Pereira C, Oliveira CR, Rego AC (2007) Bcl-2 overexpression protects against amyloid-beta and prion toxicity in GT1-7 neural cells. J Alzheimers Dis 12:223–228. https://doi.org/10.3233/JAD-2007-12303 (https://doi.org/10.3233/JAD-2007-12303)
CrossRef (https://doi.org/10.3233/JAD-2007-12303)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=18057555)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Bcl-2%20overexpression%20protects%20against%20amyloid-beta%20and%20prion%20toxicity%20in%20GT1-7%20neural%20cells&author=E.%20Ferreiro&author=A.%20Eufr%C3%A1sio&author=C.%20Pereira&author=CR.%20Oliveira&author=AC.%20Rego&journal=J%20Alzheimers%20Dis&volume=12&pages=223-228&publication_year=2007&doi=10.3233%2FJAD-2007-12303)

Ferrer I, Blanco R, Carmona M, Puig B (2001) Phosphorylated mitogen-activated protein kinase (MAPK/ERK-P), protein kinase of 38kDa (p38-P), stress-activated protein kinase (SAPK/JNK-P), and calcium/calmodulin-dependent kinase II (CaM kinase II) are differentially expressed in tau deposits in neurons. J Neural Transm 108:1397–1415. https://doi.org/10.1007/s007020100016 (https://doi.org/10.1007/s007020100016)
CrossRef (https://doi.org/10.1007/s007020100016)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=11810404)
Google Scholar (http://scholar.google.com/scholar_lookup?

Frölich L, Blum-Degen D, Bernstein HG, Engelsberger S, Humrich J, Laufer S, Muschner D, Thalheimer A, Türk A, Hoyer S, Zöchling R, Boissl KW, Jellinger K, Riederer P (1998) Brain insulin and insulin receptors in aging and sporadic Alzheimer's disease. J Neural Transm 105:423–438. https://doi.org/10.1007/s007020050068 (https://doi.org/10.1007/s007020050068)
CrossRef (https://doi.org/10.1007/s007020050068)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=9720972)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Brain%20insulin%20and%20insulin%20receptors%20in%20aging%20and%20sporadic%20Alzheimer%E2%80%99s%20disease&author=L.%20Fr%C3%B6lich&author=D.%20Blum-Degen&author=HG.%20Bernstein&author=S.%20Engelsberger&author=J.%20Humrich&author=S.%20Laufer&author=D.%20Muschner&author=A.%20Thalheimer&author=A.%20T%C3%BCrk&author=S.%20Hoyer&author=R.%20Z%C3%B6chling&author=KW.%20Boissl&author=K.%20Jellinger&author=P.%20Riederer&journal=J%20Neural%20Transm&volume=105&pages=423-438&publication_year=1998&doi=10.1007%2Fs007020050068)

Gilbert GL, Kim HJ, Waataja JJ, Thayer S (2007) Δ9-Tetrahydrocannabinol protects hippocampal neurons from excitotoxicity. Brain Res 1128:61–69. https://doi.org/10.1016/j.brainres.2006.03.011 (https://doi.org/10.1016/j.brainres.2006.03.011)
CrossRef (https://doi.org/10.1016/j.brainres.2006.03.011)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=17140550)
Google Scholar (http://scholar.google.com/scholar_lookup?title=%CE%949-Tetrahydrocannabinol%20protects%20hippocampal%20neurons%20from%20excitotoxicity&author=GL.%20Gilbert&author=HJ.%20Kim&author=JJ.%20Waataja&author=S.%20Thayer&journal=Brain%20Res&volume=1128&pages=61-69&publication_year=2007&doi=10.1016%2Fj.brainres.2006.03.011)

Goodman J, Packard MG (2015) The influence of cannabinoids on learning and memory processes of the dorsal striatum. Neurobiol Learn Mem 125:1–14. https://doi.org/10.1016/j.nlm.2015.06.008 (https://doi.org/10.1016/j.nlm.2015.06.008)
CrossRef (https://doi.org/10.1016/j.nlm.2015.06.008)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=26092091)
Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20influence%20of%20cannabinoids%20on%20learning%20and%20memory%20processes%20of%20the%20dorsal%20striatum&author=J.%20Goodman&author=MG.%20Packard&journal=Neurobiol%20Learn%20Mem&volume=125&pages=1-14&publication_year=2015&doi=10.1016%2Fj.nlm.2015.06.008)

Granado-Serrano AB, Martín MA, Bravo L, Goya L, Ramos S (2006) Quercetin induces apoptosis via caspase activation, regulation of Bcl-2, and inhibition of PI-3-kinase/Akt and

Serrano&author=MA.%20Mart%C3%ADn&author=L.%20Bravo&author=L.%20Goya&author=S.%20Ramos&journal=J%20Nutr&volume=136&pages=2715-2721&publication_year=2006)

Green LC, Wagner DA, Glogowski J, Skipper PL, Wishnok JS, Tannenbaum SR (1982) Analysis of nitrate, nitrite, and [15N]nitrate in biological fluids. Anal Biochem 126:131–138. https://doi.org/10.1016/0003-2697(82)90118-X (https://doi.org/10.1016/0003-2697(82)90118-X)
CrossRef (https://doi.org/10.1016/0003-2697(82)90118-X)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=7181105)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Analysis%20of%20nitrate%2C%20nitrite%2C%20and%20%5B15N%5Dnitrate%20in%20biological%20fluids&author=LC.%20Green&author=DA.%20Wagner&author=J.%20Glogowski&author=PL.%20Skipper&author=JS.%20Wishnok&author=SR.%20Tannenbaum&journal=Anal%20Biochem&volume=126&pages=131-138&publication_year=1982&doi=10.1016%2F0003-2697%2882%2990118-X)

Gupta A, Bisht B, Dey CS (2011) Peripheral insulin-sensitizer drug metformin ameliorates neuronal insulin resistance and Alzheimer's-like changes. Neuropharmacology 60:910–920. https://doi.org/10.1016/j.neuropharm.2011.01.033 (https://doi.org/10.1016/j.neuropharm.2011.01.033)
CrossRef (https://doi.org/10.1016/j.neuropharm.2011.01.033)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=21277873)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Peripheral%20insulin-sensitizer%20drug%20metformin%20ameliorates%20neuronal%20insulin%20resistance%20and%20Alzheimer%E2%80%99s-like%20changes&author=A.%20Gupta&author=B.%20Bisht&author=CS.%20Dey&journal=Neuropharmacology&volume=60&pages=910-920&publication_year=2011&doi=10.1016%2Fj.neuropharm.2011.01.033)

Harvey BS, Ohlsson KS, Mååg JLV, Musgrave IF, Smid SD (2012) Contrasting protective effects of cannabinoids against oxidative stress and amyloid-β evoked neurotoxicity in vitro. Neurotoxicology 33:138–146. https://doi.org/10.1016/j.neuro.2011.12.015 (https://doi.org/10.1016/j.neuro.2011.12.015)
CrossRef (https://doi.org/10.1016/j.neuro.2011.12.015)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=22233683)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Contrasting%20protective%20effects%20of%20cannabinoids%20against%20oxidative%20stress%20and%20amyloid-%CE%B2%20evoked%20neurotoxicity%20in%20vitro&author=BS.%20Harvey&author=KS.%20Ohlsson&author=JLV.%20M%C3%A5%C3%A5g&author=IF.%20Musgrave&author=SD.%20Smid&journal=Neurotoxicology&volume=33&pages=138-

%20Hashimotodani&author=T.%20Ohno-Shosaku&author=M.%20Kano&journal=Neuroscientist&volume=13&pages=127-137&publication_year=2007&doi=10.1177%2F1073858406296716)

Henneberg N, Hoyer S (1995) Desensitization of the neuronal insulin receptor: a new approach in the etiopathogenesis of late-onset sporadic dementia of the Alzheimer type (SDAT)? Arch Gerontol Geriatr 21:63–74. https://doi.org/10.1016/0167-4943(95)00646-3 (https://doi.org/10.1016/0167-4943(95)00646-3)
CrossRef (https://doi.org/10.1016/0167-4943(95)00646-3)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=15374226)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Desensitization%20of%20the%20neuronal%20insulin%20receptor%3A%20a%20new%20approach%20in%20the%20etiopathogenesis%20of%20late-onset%20sporadic%20dementia%20of%20the%20Alzheimer%20type%20%28SDAT%29%3F&author=N.%20Henneberg&author=S.%20Hoyer&journal=Arch%20Gerontol%20Geriatr&volume=21&pages=63-74&publication_year=1995&doi=10.1016%2F0167-4943%2895%2900646-3)

Hillard CJ, Manna S, Greenberg MJ, DiCamelli R, Ross RA, Stevenson LA, Murphy V, Pertwee RG, Campbell WB (1999) Synthesis and characterization of potent and selective agonists of the neuronal cannabinoid receptor (CB1). J Pharmacol Exp Ther 289:1427–1433
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=10336536)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Synthesis%20and%20characterization%20of%20potent%20and%20selective%20agonists%20of%20the%20neuronal%20cannabinoid%20receptor%20%28CB1%29&author=CJ.%20Hillard&author=S.%20Manna&author=MJ.%20Greenberg&author=R.%20DiCamelli&author=RA.%20Ross&author=LA.%20Stevenson&author=V.%20Murphy&author=RG.%20Pertwee&author=WB.%20Campbell&journal=J%20Pharmacol%20Exp%20Ther&volume=289&pages=1427-1433&publication_year=1999)

Hooper C, Killick R, Lovestone S (2008) The GSK3 hypothesis of Alzheimer's disease. J Neurochem 104:1433–1439. https://doi.org/10.1111/j.1471-4159.2007.05194.x (https://doi.org/10.1111/j.1471-4159.2007.05194.x)
CrossRef (https://doi.org/10.1111/j.1471-4159.2007.05194.x)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=18088381)
PubMedCentral (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3073119)
Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20GSK3%20hypothesis%20of%20Alzheimer%E2%80%99s%20disease&author=C.%20Hooper&author=R.%20Killick&author=S.%20Lovestone&journal=J%20Neurochem&volume=104&pages=1433-1439&publication_year=2008&doi=10.1111%2Fj.1471-4159.2007.05194.x)

Hoyer S (2002) The brain insulin signal transduction system and sporadic (type II) Alzheimer

&journal=J%20Neural%20Transm&volume=109&pages=341-360&publication_year=2002&doi=10.1007%2Fs007020200028)

Hoyer S, Muller D, Plaschke K (1994) Desensitization of brain insulin receptor. Effect on glucose/energy and related metabolism. J Neural Transm Suppl 44:259–268
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=7897397)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Desensitization%20of%20brain%20insulin%20receptor.%20Effect%20on%20glucose%2Fenergy%20and%20related%20metabolism&author=S.%20Hoyer&author=D.%20Muller&author=K.%20Plaschke&journal=J%20Neural%20Transm%20Suppl&volume=44&pages=259-268&publication_year=1994)

Ishiguro K, Shiratsuchi A, Sato S, Omori A, Arioka M, Kobayashi S, Uchida T, Imahori K (1993) Glycogen synthase kinase 3 beta is identical to tau protein kinase I generating several epitopes of paired helical filaments. FEBS Lett 325:167–172
CrossRef (https://doi.org/10.1016/0014-5793(93)81066-9)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=7686508)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Glycogen%20synthase%20kinase%203%20beta%20is%20identical%20to%20tau%20protein%20kinase%20I%20generating%20several%20epitopes%20of%20paired%20helical%20filaments&author=K.%20Ishiguro&author=A.%20Shiratsuchi&author=S.%20Sato&author=A.%20Omori&author=M.%20Arioka&author=S.%20Kobayashi&author=T.%20Uchida&author=K.%20Imahori&journal=FEBS%20Lett&volume=325&pages=167-172&publication_year=1993)

Jordan JD, He JC, Eungdamrong NJ, Gomes I, Ali W, Nguyen T, Bivona TG, Philips MR, Devi LA, Iyengar R (2005) Cannabinoid receptor-induced neurite outgrowth is mediated by Rap1 activation through Gαo/i-triggered proteasomal degradation of Rap1GAPII. J Biol Chem 280:11413–11421. https://doi.org/10.1074/jbc.M411521200 (https://doi.org/10.1074/jbc.M411521200)
CrossRef (https://doi.org/10.1074/jbc.M411521200)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=15657046)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Cannabinoid%20receptor-induced%20neurite%20outgrowth%20is%20mediated%20by%20Rap1%20activation%20through%20G%CE%B1o%2Fi-triggered%20proteasomal%20degradation%20of%20Rap1GAPII&author=JD.%20Jordan&author=JC.%20He&author=NJ.%20Eungdamrong&author=I.%20Gomes&author=W.%20Ali&author=T.%20Nguyen&author=TG.%20Bivona&author=MR.%20Philips&author=LA.%20Devi&author=R.%20Iyengar&journal=J%20Biol%20Chem&volume=280&pages=11413-11421&publication_year=2005&doi=10.1074%2Fjbc.M411521200)

Kamat PK, Kalani A, Rai S, Tota SK, Kumar A, Ahmad AS (2016) Streptozotocin intracerebroventricular-induced neurotoxicity and brain insulin resistance: a therapeutic

tic%20intervention%20for%20treatment%20of%20sporadic%20Alzheimer%E2%80%99s%20disease%20%28sAD%29-like%20pathology&author=PK.%20Kamat&author=A.%20Kalani&author=S.%20Rai&author=SK.%20Tota&author=A.%20Kumar&author=AS.%20Ahmad&journal=Mol%20Neurobiol&volume=53&pages=4548-4562&publication_year=2016&doi=10.1007%2Fs12035-015-9384-y)

Kang J, Lemaire H-G, Unterbeck A, Salbaum JM, Masters CL, Grzeschik KH, Multhaup G, Beyreuther K, Müller-Hill B (1987) The precursor of Alzheimer's disease amyloid A4 protein resembles a cell-surface receptor. Nature 325:733–736. https://doi.org/10.1038/325733a0 (https://doi.org/10.1038/325733a0)
CrossRef (https://doi.org/10.1038/325733a0)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=2881207)
Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20precursor%20of%20Alzheimer%E2%80%99s%20disease%20amyloid%20A4%20protein%20resembles%20a%20cell-surface%20receptor&author=J.%20Kang&author=H-G.%20Lemaire&author=A.%20Unterbeck&author=JM.%20Salbaum&author=CL.%20Masters&author=KH.%20Grzeschik&author=G.%20Multhaup&author=K.%20Beyreuther&author=B.%20M%C3%BCller-Hill&journal=Nature&volume=325&pages=733-736&publication_year=1987&doi=10.1038%2F325733a0)

Kar S, Slowikowski SPM, Westaway D, Mount HTJ (2004) Interactions between beta-amyloid and central cholinergic neurons: implications for Alzheimer's disease. J Psychiatry Neurosci 29:427–441
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=15644984)
PubMedCentral (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC524960)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Interactions%20between%20beta-amyloid%20and%20central%20cholinergic%20neurons%3A%20implications%20for%20Alzheimer%E2%80%99s%20disease&author=S.%20Kar&author=SPM.%20Slowikowski&author=D.%20Westaway&author=HTJ.%20Mount&journal=J%20Psychiatry%20Neurosci&volume=29&pages=427-441&publication_year=2004)

Karanian DA (2005) Dual modulation of endocannabinoid transport and fatty acid amide hydrolase protects against excitotoxicity. J Neurosci 25:7813–7820. https://doi.org/10.1523/JNEUROSCI.2347-05.2005 (https://doi.org/10.1523/JNEUROSCI.2347-05.2005)
CrossRef (https://doi.org/10.1523/JNEUROSCI.2347-05.2005)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=16120783)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Dual%20modulation%20of%20endocannabinoid%20transport%20and%20fatty%20acid%20amide%20hydrolase%20protects%20against%20excitotoxicity&author=DA.%20Karanian&journal=J%20Neurosci&volume=25&pages=7813-

Google Scholar (http://scholar.google.com/scholar_lookup?title=Synthetic%20and%20endogenous%20cannabinoids%20protect%20retinal%20neurons%20from%20AMPA%20excitotoxicity%20in%20vivo%2C%20via%20activation%20of%20CB1%20receptors%3A%20involvement%20of%20PI3K%2FAkt%20and%20MEK%2FERK%20signaling%20pathways&author=D.%20Kokona&author=K.%20Thermos&journal=Exp%20Eye%20Res&volume=136&pages=45-58&publication_year=2015&doi=10.1016%2Fj.exer.2015.05.007)

Kosik K, Joachim C, Selkoe D (1987) Microtubule-associated protein tau (tau) is a major antigenic component of paired helical filaments in Alzheimer disease. Alzheimer Dis Assoc Disord 1:203. https://doi.org/10.1097/00002093-198701030-00022 (https://doi.org/10.1097/00002093-198701030-00022)
CrossRef (https://doi.org/10.1097/00002093-198701030-00022)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Microtubule-associated%20protein%20tau%20%28tau%29%20is%20a%20major%20antigenic%20component%20of%20paired%20helical%20filaments%20in%20Alzheimer%20disease&author=K.%20Kosik&author=C.%20Joachim&author=D.%20Selkoe&journal=Alzheimer%20Dis%20Assoc%20Disord&volume=1&pages=203&publication_year=1987&doi=10.1097%2F00002093-198701030-00022)

Laezza C, Malfitano AM, Proto MC, Esposito I, Gazzerro P, Formisano P, Pisanti S, Santoro A, Caruso MG, Bifulco M (2010) Inhibition of 3-hydroxy-3-methylglutarylcoenzyme a reductase activity and of Ras farnesylation mediate antitumor effects of anandamide in human breast cancer cells. Endocr Relat Cancer 17:495–503. https://doi.org/10.1677/ERC-10-0009 (https://doi.org/10.1677/ERC-10-0009)
CrossRef (https://doi.org/10.1677/ERC-10-0009)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=20304978)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Inhibition%20of%203-hydroxy-3-methylglutarylcoenzyme%20a%20reductase%20activity%20and%20of%20Ras%20farnesylation%20mediate%20antitumor%20effects%20of%20anandamide%20in%20human%20breast%20cancer%20cells&author=C.%20Laezza&author=AM.%20Malfitano&author=MC.%20Proto&author=I.%20Esposito&author=P.%20Gazzerro&author=P.%20Formisano&author=S.%20Pisanti&author=A.%20Santoro&author=MG.%20Caruso&author=M.%20Bifulco&journal=Endocr%20Relat%20Cancer&volume=17&pages=495-503&publication_year=2010&doi=10.1677%2FERC-10-0009)

Lannert H, Hoyer S (1998) Intracerebroventricular administration of streptozotocin causes long- term diminutions in learning and memory abilities and in cerebral energy metabolism in adult rats. Behav Neurosci 112:1199–1208. https://doi.org/10.1037//0735-7044.112.5.1199 (https://doi.org/10.1037//0735-7044.112.5.1199)
CrossRef (https://doi.org/10.1037/0735-7044.112.5.1199)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=9829797)

disease. J Alzheimers Dis 9:13–33. https://doi.org/10.3233/JAD-2006-9102 (https://doi.org/10.3233/JAD-2006-9102)
CrossRef (https://doi.org/10.3233/JAD-2006-9102)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=16627931)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Intracerebral%20streptozotocin%20model%20of%20type%203%20diabetes%3A%20relevance%20to%20sporadic%20Alzheimer%E2%80%99s%20disease&author=N.%20Lester-Coll&author=EJ.%20Rivera&author=SJ.%20Soscia&author=K.%20Doiron&author=JR.%20Wands&author=SM.%20Monte&journal=J%20Alzheimers%20Dis&volume=9&pages=13-33&publication_year=2006&doi=10.3233%2FJAD-2006-9102)

Lipina C, Hundal HS (2017) The endocannabinoid system: “NO” longer anonymous in the control of nitrergic signalling? J Mol Cell Biol 9:91–103. https://doi.org/10.1093/jmcb/mjx008 (https://doi.org/10.1093/jmcb/mjx008)
CrossRef (https://doi.org/10.1093/jmcb/mjx008)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=28130308)
PubMedCentral (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5439392)
Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20endocannabinoid%20system%3A%20%E2%80%9CNO%E2%80%9D%20longer%20anonymous%20in%20the%20control%20of%20nitrergic%20signalling%3F&author=C.%20Lipina&author=HS.%20Hundal&journal=J%20Mol%20Cell%20Biol&volume=9&pages=91-103&publication_year=2017&doi=10.1093%2Fjmcb%2Fmjx008)

Marsicano G, Moosmann B, Hermann H, Lutz B, Behl C (2002) Neuroprotective properties of cannabinoids against oxidative stress: role of the cannabinoid receptor CB1. J Neurochem 80:448–456. https://doi.org/10.1046/j.0022-3042.2001.00716.x (https://doi.org/10.1046/j.0022-3042.2001.00716.x)
CrossRef (https://doi.org/10.1046/j.0022-3042.2001.00716.x)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=11905991)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Neuroprotective%20properties%20of%20cannabinoids%20against%20oxidative%20stress%3A%20role%20of%20the%20cannabinoid%20receptor%20CB1&author=G.%20Marsicano&author=B.%20Moosmann&author=H.%20Hermann&author=B.%20Lutz&author=C.%20Behl&journal=J%20Neurochem&volume=80&pages=448-456&publication_year=2002&doi=10.1046%2Fj.0022-3042.2001.00716.x)

Martín-Moreno AM, Brera B, Spuch C, Carro E, García-García L, Delgado M, Pozo MA, Innamorato NG, Cuadrado A, de Ceballos ML (2012) Prolonged oral cannabinoid administration prevents neuroinflammation, lowers β-amyloid levels and improves cognitive performance in Tg APP 2576 mice. J Neuroinflammation 9:8. https://doi.org/10.1186/1742-2094-9-8 (https://doi.org/10.1186/1742-2094-9-8)
CrossRef (https://doi.org/10.1186/1742-2094-9-8)

rc%C3%ADa-Garc%C3%ADa&author=M.%20Delgado&author=MA.%20Pozo&author=NG.%20Innamorato&author=A.%20Cuadrado&author=ML.%20Ceballos&journal=J%20Neuroinflammation&volume=9&pages=8&publication_year=2012&doi=10.1186%2F1742-2094-9-8)

Matsuda LA, Lolait SJ, Brownstein MJ, Young AC, Bonner TI (1990) Structure of a cannabinoid receptor and functional expression of the cloned cDNA. Nature 346:561–564. https://doi.org/10.1038/346561a0 (https://doi.org/10.1038/346561a0)
CrossRef (https://doi.org/10.1038/346561a0)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=2165569)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Structure%20of%20a%20cannabinoid%20receptor%20and%20functional%20expression%20of%20the%20cloned%20cDNA&author=LA.%20Matsuda&author=SJ.%20Lolait&author=MJ.%20Brownstein&author=AC.%20Young&author=TI.%20Bonner&journal=Nature&volume=346&pages=561-564&publication_year=1990&doi=10.1038%2F346561a0)

Milton NGN (2002) Anandamide and noladin ether prevent neurotoxicity of the human amyloid-β peptide. Neurosci Lett 332:127–130. https://doi.org/10.1016/S0304-3940(02)00936-9 (https://doi.org/10.1016/S0304-3940(02)00936-9)
CrossRef (https://doi.org/10.1016/S0304-3940(02)00936-9)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=12384227)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Anandamide%20and%20noladin%20ether%20prevent%20neurotoxicity%20of%20the%20human%20amyloid-%CE%B2%20peptide&author=NGN.%20Milton&journal=Neurosci%20Lett&volume=332&pages=127-130&publication_year=2002&doi=10.1016%2FS0304-3940%2802%2900936-9)

Mosmann T (1983) Rapid colorimetric assay for cellular growth and survival: application to proliferation and cytotoxicity assays. J Immunol Methods 65:55–63. https://doi.org/10.1016/0022-1759(83)90303-4 (https://doi.org/10.1016/0022-1759(83)90303-4)
CrossRef (https://doi.org/10.1016/0022-1759(83)90303-4)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=6606682)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Rapid%20colorimetric%20assay%20for%20cellular%20growth%20and%20survival%3A%20application%20to%20proliferation%20and%20cytotoxicity%20assays&author=T.%20Mosmann&journal=J%20Immunol%20Methods&volume=65&pages=55-63&publication_year=1983&doi=10.1016%2F0022-1759%2883%2990303-4)

Mumby DG (2002) Hippocampal damage and exploratory preferences in rats: memory for objects, places, and contexts. Learn Mem 9:49–57. https://doi.org/10.1101/lm.41302 (https://doi.org/10.1101/lm.41302)
CrossRef (https://doi.org/10.1101/lm.41302)

Munro S, Thomas KL, Abu-Shaar M (1993) Molecular characterization of a peripheral receptor for cannabinoids. Nature 365:61–65. https://doi.org/10.1038/365061a0 (https://doi.org/10.1038/365061a0)
CrossRef (https://doi.org/10.1038/365061a0)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=7689702)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Molecular%20characterization%20of%20a%20peripheral%20receptor%20for%20cannabinoids&author=S.%20Munro&author=KL.%20Thomas&author=M.%20Abu-Shaar&journal=Nature&volume=365&pages=61-65&publication_year=1993&doi=10.1038%2F365061a0)

Nicolas O, Gavin R, Braun N, Ureña JM, Fontana X, Soriano E, Aguzzi A, del Río JA (2007) Bcl-2 overexpression delays caspase-3 activation and rescues cerebellar degeneration in prion-deficient mice that overexpress amino-terminally truncated prion. FASEB J 21:3107–3117. https://doi.org/10.1096/fj.06-7827com (https://doi.org/10.1096/fj.06-7827com)
CrossRef (https://doi.org/10.1096/fj.06-7827com)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=17494993)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Bcl-2%20overexpression%20delays%20caspase-3%20activation%20and%20rescues%20cerebellar%20degeneration%20in%20prion-deficient%20mice%20that%20overexpress%20amino-terminally%20truncated%20prion&author=O.%20Nicolas&author=R.%20Gavin&author=N.%20Braun&author=JM.%20Ure%C3%B1a&author=X.%20Fontana&author=E.%20Soriano&author=A.%20Aguzzi&author=JA.%20R%C3%ADo&journal=FASEB%20J&volume=21&pages=3107-3117&publication_year=2007&doi=10.1096%2Ffj.06-7827com)

Nitsch R, Hoyer S (1991) Local action of the diabetogenic drug, streptozotocin, on glucose and energy metabolism in rat brain cortex. Neurosci Lett 128:199–202. https://doi.org/10.1016/0304-3940(91)90260-Z (https://doi.org/10.1016/0304-3940(91)90260-Z)
CrossRef (https://doi.org/10.1016/0304-3940(91)90260-Z)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=1834965)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Local%20action%20of%20the%20diabetogenic%20drug%2C%20streptozotocin%2C%20on%20glucose%20and%20energy%20metabolism%20in%20rat%20brain%20cortex&author=R.%20Nitsch&author=S.%20Hoyer&journal=Neurosci%20Lett&volume=128&pages=199-202&publication_year=1991&doi=10.1016%2F0304-3940%2891%2990260-Z)

Numajiri N, Takasawa K, Nishiya T, Tanaka H, Ohno K, Hayakawa W, Asada M, Matsuda H, Azumi K, Kamata H, Nakamura T, Hara H, Minami M, Lipton SA, Uehara T (2011) On-off system for PI3-kinase-Akt signaling through S-nitrosylation of phosphatase with sequence homology to tensin (PTEN). Proc Natl Acad Sci U S A 108:10349–10354.

author=H.%20Tanaka&author=K.%20Ohno&author=W.%20Hayakawa&author=M.%20Asada&author=H.%20Matsuda&author=K.%20Azumi&author=H.%20Kamata&author=T.%20Nakamura&author=H.%20Hara&author=M.%20Minami&author=SA.%20Lipton&author=T.%20Uehara&journal=Proc%20Natl%20Acad%20Sci%20U%20S%20A&volume=108&pages=10349-10354&publication_year=2011&doi=10.1073%2Fpnas.1103503108)

Osmanovic Barilar J, Knezovic A, Grünblatt E, Riederer P, Salkovic-Petrisic M (2015) Nine-month follow-up of the insulin receptor signalling cascade in the brain of streptozotocin rat model of sporadic Alzheimer's disease. J Neural Transm 122:565–576. https://doi.org/10.1007/s00702-014-1323-y (https://doi.org/10.1007/s00702-014-1323-y)
CrossRef (https://doi.org/10.1007/s00702-014-1323-y)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=25503661)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Nine-month%20follow-up%20of%20the%20insulin%20receptor%20signalling%20cascade%20in%20the%20brain%20of%20streptozotocin%20rat%20model%20of%20sporadic%20Alzheimer%E2%80%99s%20disease&author=J.%20Osmanovic%20Barilar&author=A.%20Knezovic&author=E.%20Gr%C3%BCnblatt&author=P.%20Riederer&author=M.%20Salkovic-Petrisic&journal=J%20Neural%20Transm&volume=122&pages=565-576&publication_year=2015&doi=10.1007%2Fs00702-014-1323-y)

Paradis E, Koutroumanis M, Goodyer C (1996) Amyloid Beta peptide of Alzheimer ' s disease downregulates Bcl-2 and upregulates Bax expression in human neurons. J Neurosci 16:7533–7539
CrossRef (https://doi.org/10.1523/JNEUROSCI.16-23-07533.1996)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=8922409)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Amyloid%20Beta%20peptide%20of%20Alzheimer%20%E2%80%99s%20disease%20downregulates%20Bcl-2%20and%20upregulates%20Bax%20expression%20in%20human%20neurons&author=E.%20Paradis&author=M.%20Koutroumanis&author=C.%20Goodyer&journal=J%20Neurosci&volume=16&pages=7533-7539&publication_year=1996)

Paxinos G, Watson C (2007) The Rat Brain in Stereotaxic Coordinates. 6th Edition, Academic Press, San Diego
Google Scholar (https://scholar.google.com/scholar?q=Paxinos%20G%2C%20Watson%20C%20%282007%29%20The%20Rat%20Brain%20in%20Stereotaxic%20Coordinates.%206th%20Edition%2C%20Academic%20Press%2C%20San%20Diego)

Pazos MR, Núñez E, Benito C, Tolón RM, Romero J (2004) Role of the endocannabinoid system in Alzheimer's disease: new perspectives. Life Sci 75:1907–1915. https://doi.org/10.1016/j.lfs.2004.03.026 (https://doi.org/10.1016/j.lfs.2004.03.026)
CrossRef (https://doi.org/10.1016/j.lfs.2004.03.026)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?

https://doi.org/10.1038/nature01640 (https://doi.org/10.1038/nature01640)
CrossRef (https://doi.org/10.1038/nature01640)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=12761548)
Google Scholar (http://scholar.google.com/scholar_lookup?title=GSK-3alpha%20regulates%20production%20of%20Alzheimer%E2%80%99s%20disease%20amyloid-beta%20peptides&author=CJ.%20Phiel&author=CA.%20Wilson&author=VM.%20Lee&author=PS.%20Klein&journal=Nature&volume=423&pages=435-439&publication_year=2003&doi=10.1038%2Fnature01640)

Pilchova I, Klacanova K, Chomova M, Tatarkova Z, Dobrota D, Racay P (2014) Possible contribution of proteins of Bcl-2 family in neuronal death following transient global brain ischemia. Cell Mol Neurobiol 35:23–31. https://doi.org/10.1007/s10571-014-0104-3 (https://doi.org/10.1007/s10571-014-0104-3)
CrossRef (https://doi.org/10.1007/s10571-014-0104-3)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=25187358)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Possible%20contribution%20of%20proteins%20of%20Bcl-2%20family%20in%20neuronal%20death%20following%20transient%20global%20brain%20ischemia&author=I.%20Pilchova&author=K.%20Klacanova&author=M.%20Chomova&author=Z.%20Tatarkova&author=D.%20Dobrota&author=P.%20Racay&journal=Cell%20Mol%20Neurobiol&volume=35&pages=23-31&publication_year=2014&doi=10.1007%2Fs10571-014-0104-3)

Puighermanal E, Busquets-Garcia A, Maldonado R, Ozaita A (2012) Cellular and intracellular mechanisms involved in the cognitive impairment of cannabinoids. Philos Trans R Soc B Biol Sci 367:3254–3263. https://doi.org/10.1098/rstb.2011.0384 (https://doi.org/10.1098/rstb.2011.0384)
CrossRef (https://doi.org/10.1098/rstb.2011.0384)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Cellular%20and%20intracellular%20mechanisms%20involved%20in%20the%20cognitive%20impairment%20of%20cannabinoids&author=E.%20Puighermanal&author=A.%20Busquets-Garcia&author=R.%20Maldonado&author=A.%20Ozaita&journal=Philos%20Trans%20R%20Soc%20B%20Biol%20Sci&volume=367&pages=3254-3263&publication_year=2012&doi=10.1098%2Frstb.2011.0384)

Puighermanal E, Marsicano G, Busquets-Garcia A, Lutz B, Maldonado R, Ozaita A (2009) Cannabinoid modulation of hippocampal long-term memory is mediated by mTOR signaling. Nat Neurosci 12:1152–1158. https://doi.org/10.1038/nn.2369 (https://doi.org/10.1038/nn.2369)
CrossRef (https://doi.org/10.1038/nn.2369)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?

Rai S, Kamat PK, Nath C, Shukla R (2014) Glial activation and post-synaptic neurotoxicity: the key events in Streptozotocin (ICV) induced memory impairment in rats. Pharmacol Biochem Behav 117:104–117. https://doi.org/10.1016/j.pbb.2013.11.035 (https://doi.org/10.1016/j.pbb.2013.11.035)
CrossRef (https://doi.org/10.1016/j.pbb.2013.11.035)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=24333387)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Glial%20activation%20and%20post-synaptic%20neurotoxicity%3A%20the%20key%20events%20in%20Streptozotocin%20%28ICV%29%20induced%20memory%20impairment%20in%20rats&author=S.%20Rai&author=PK.%20Kamat&author=C.%20Nath&author=R.%20Shukla&journal=Pharmacol%20Biochem%20Behav&volume=117&pages=104-117&publication_year=2014&doi=10.1016%2Fj.pbb.2013.11.035)

Ramalingam M, Kim S (2014) Insulin involved Akt / ERK and Bcl-2 / Bax pathways against oxidative damages in C6 glial cells. 9893:1–7. https://doi.org/10.3109/10799893.2014.970276 (https://doi.org/10.3109/10799893.2014.970276)

Ramírez BG, Blázquez C, Gómez del Pulgar T, Guzmán M, de Ceballos ML (2005) Prevention of Alzheimer's disease pathology by cannabinoids: neuroprotection mediated by blockade of microglial activation. J Neurosci 25:1904–1913. https://doi.org/10.1523/JNEUROSCI.4540-04.2005 (https://doi.org/10.1523/JNEUROSCI.4540-04.2005)
CrossRef (https://doi.org/10.1523/JNEUROSCI.4540-04.2005)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=15728830)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Prevention%20of%20Alzheimer%E2%80%99s%20disease%20pathology%20by%20cannabinoids%3A%20neuroprotection%20mediated%20by%20blockade%20of%20microglial%20activation&author=BG.%20Ram%C3%ADrez&author=C.%20Bl%C3%A1zquez&author=T.%20G%C3%B3mez%20del%20Pulgar&author=M.%20Guzm%C3%A1n&author=ML.%20Ceballos&journal=J%20Neurosci&volume=25&pages=1904-1913&publication_year=2005&doi=10.1523%2FJNEUROSCI.4540-04.2005)

Rohn TT, Vyas V, Hernandez-Estrada T, Nichol KE, Christie LA, Head E (2008) Lack of pathology in a triple transgenic mouse model of Alzheimer's disease after overexpression of the anti-apoptotic protein Bcl-2. J Neurosci 28:3051–3059. https://doi.org/10.1523/JNEUROSCI.5620-07.2008 (https://doi.org/10.1523/JNEUROSCI.5620-07.2008)
CrossRef (https://doi.org/10.1523/JNEUROSCI.5620-07.2008)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=18354008)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Lack%20of%20pathology%20in%20a%20triple%20transgenic%20mouse%20model%2

https://doi.org/10.1016/j.expneurol.2010.03.024 (https://doi.org/10.1016/j.expneurol.2010.03.024)
CrossRef (https://doi.org/10.1016/j.expneurol.2010.03.024)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=20353781)
Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20endocannabinoid%20system%20and%20amyloid-related%20diseases&author=L.%20Ruiz-Valdepe%C3%B1as&author=C.%20Benito&author=RM.%20Tol%C3%B3n&author=JA.%20Mart%C3%ADnez%20Orgado&author=J.%20Romero&journal=Exp%20Neurol&volume=224&pages=66-73&publication_year=2010&doi=10.1016%2Fj.expneurol.2010.03.024)

Rutkowska M, Gliniak H (2009) The influence of ACEA: a selective cannabinoid CB1 receptor agonist on whole blood and platelet-poor plasma serotonin concentrations. Pharmazie 64:598–601
Google Scholar (https://scholar.google.com/scholar?q=Rutkowska%20M%2C%20Gliniak%20H%20%282009%29%20The%20influence%20of%20ACEA%3A%20a%20selective%20cannabinoid%20CB1%20receptor%20agonist%20on%20whole%20blood%20and%20platelet-poor%20plasma%20serotonin%20concentrations.%20Pharmazie%2064%3A598%E2%80%93601)

Ryu BR, Ko HW, Jou I, Noh JS, Gwag BJ (1999) Phosphatidylinositol 3-kinase-mediated regulation of neuronal apoptosis and necrosis by insulin and IGF-I. J Neurobiol 39:536–546. https://doi.org/10.1002/(SICI)1097-4695(19990615)39:4<536::AID-NEU7>3.0.CO;2-J (https://doi.org/10.1002/(SICI)1097-4695(19990615)39%3A4<536%3A%3AAID-NEU7>3.0.CO%3B2-J)
CrossRef (https://doi.org/10.1002/(SICI)1097-4695(19990615)39%3A4<536%3A%3AAID-NEU7>3.0.CO%3B2-J)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=10380075)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Phosphatidylinositol%203-kinase-mediated%20regulation%20of%20neuronal%20apoptosis%20and%20necrosis%20by%20insulin%20and%20IGF-I&author=BR.%20Ryu&author=HW.%20Ko&author=I.%20Jou&author=JS.%20Noh&author=BJ.%20Gwag&journal=J%20Neurobiol&volume=39&pages=536-546&publication_year=1999&doi=10.1002%2F%28SICI%291097-4695%2819990615%2939%3A4%3C536%3A%3AAID-NEU7%3E3.0.CO%3B2-J)

Salkovic-Petrisic M, Hoyer S (2007) Central insulin resistance as a trigger for sporadic Alzheimer-like pathology: an experimental approach. J Neural Transm Suppl:217–233. https://doi.org/10.1007/978-3-211-73574-9-28 (https://doi.org/10.1007/978-3-211-73574-9-28)

Salkovic-Petrisic M, Knezovic A, Hoyer S, Riederer P (2013) What have we learned from the

C%20about%20the%20therapeutic%20strategies%20in%20Alzheimer%E2%80%99s%20research&author=M.%20Salkovic-Petrisic&author=A.%20Knezovic&author=S.%20Hoyer&author=P.%20Riederer&journal=J%20Neural%20Transm&volume=120&pages=233-252&publication_year=2013&doi=10.1007%2Fs00702-012-0877-9)

Salkovic-Petrisic M, Osmanovic J, Grünblatt E, Riederer P, Hoyer S (2009) Modeling sporadic Alzheimer's disease: the insulin resistant brain state generates multiple long-term morphobiological abnormalities including hyperphosphorylated tau protein and amyloid-β. J Alzheimers Dis 18:729–750. https://doi.org/10.3233/JAD-2009-1184 (https://doi.org/10.3233/JAD-2009-1184)
CrossRef (https://doi.org/10.3233/JAD-2009-1184)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=19661616)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Modeling%20sporadic%20Alzheimer%E2%80%99s%20disease%3A%20the%20insulin%20resistant%20brain%20state%20generates%20multiple%20long-term%20morphobiological%20abnormalities%20including%20hyperphosphorylated%20tau%20protein%20and%20amyloid-%CE%B2&author=M.%20Salkovic-Petrisic&author=J.%20Osmanovic&author=E.%20Gr%C3%BCnblatt&author=P.%20Riederer&author=S.%20Hoyer&journal=J%20Alzheimers%20Dis&volume=18&pages=729-750&publication_year=2009&doi=10.3233%2FJAD-2009-1184)

Salkovic-Petrisic M, Tribl F, Schmidt M, Hoyer S, Riederer P (2006) Alzheimer-like changes in protein kinase B and glycogen synthase kinase-3 in rat frontal cortex and hippocampus after damage to the insulin signalling pathway. J Neurochem 96:1005–1015. https://doi.org/10.1111/j.1471-4159.2005.03637.x (https://doi.org/10.1111/j.1471-4159.2005.03637.x)
CrossRef (https://doi.org/10.1111/j.1471-4159.2005.03637.x)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=16412093)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Alzheimer-like%20changes%20in%20protein%20kinase%20B%20and%20glycogen%20synthase%20kinase-3%20in%20rat%20frontal%20cortex%20and%20hippocampus%20after%20damage%20to%20the%20insulin%20signalling%20pathway&author=M.%20Salkovic-Petrisic&author=F.%20Tribl&author=M.%20Schmidt&author=S.%20Hoyer&author=P.%20Riederer&journal=J%20Neurochem&volume=96&pages=1005-1015&publication_year=2006&doi=10.1111%2Fj.1471-4159.2005.03637.x)

Sánchez AJ, García-Merino A (2012) Neuroprotective agents: cannabinoids. Clin Immunol 142:57–67. https://doi.org/10.1016/j.clim.2011.02.010 (https://doi.org/10.1016/j.clim.2011.02.010)
CrossRef (https://doi.org/10.1016/j.clim.2011.02.010)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?

CrossRef (https://doi.org/10.1016/j.physbeh.2012.06.019)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=22921433)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Early%20and%20late%20neurodegeneration%20and%20memory%20disruption%20after%20intracerebroventricular%20streptozotocin&author=CHY.%20Mazucanti&author=GF.%20Xavier&author=AS.%20Torr%C3%A3o&journal=Physiol%20Behav&volume=107&pages=401-413&publication_year=2012&doi=10.1016%2Fj.physbeh.2012.06.019)

Sarker KP, Maruyama I (2003) Anandamide induces cell death independently of cannabinoid receptors or vanilloid receptor 1: possible involvement of lipid rafts. Cell Mol Life Sci 60:1200–1208. https://doi.org/10.1007/s00018-003-3055-2 (https://doi.org/10.1007/s00018-003-3055-2)
CrossRef (https://doi.org/10.1007/s00018-003-3055-2)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=12861385)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Anandamide%20induces%20cell%20death%20independently%20of%20cannabinoid%20receptors%20or%20vanilloid%20receptor%201%3A%20possible%20involvement%20of%20lipid%20rafts&author=KP.%20Sarker&author=I.%20Maruyama&journal=Cell%20Mol%20Life%20Sci&volume=60&pages=1200-1208&publication_year=2003&doi=10.1007%2Fs00018-003-3055-2)

Shen J, Wu Y, Xu JY, Zhang J, Sinclair SH, Yanoff M, Xu G, Li W, Xu GT (2010) ERK- and Akt-dependent neuroprotection by erythropoietin (EPO) against glyoxal-AGEs via modulation of Bcl-xL, Bax, and BAD. Investig Ophthalmol Vis Sci 51:35–46. https://doi.org/10.1167/iovs.09-3544 (https://doi.org/10.1167/iovs.09-3544)
CrossRef (https://doi.org/10.1167/iovs.09-3544)
Google Scholar (http://scholar.google.com/scholar_lookup?title=ERK-%20and%20Akt-dependent%20neuroprotection%20by%20erythropoietin%20%28EPO%29%20against%20glyoxal-AGEs%20via%20modulation%20of%20Bcl-xL%2C%20Bax%2C%20and%20BAD&author=J.%20Shen&author=Y.%20Wu&author=JY.%20Xu&author=J.%20Zhang&author=SH.%20Sinclair&author=M.%20Yanoff&author=G.%20Xu&author=W.%20Li&author=GT.%20Xu&journal=Investig%20Ophthalmol%20Vis%20Sci&volume=51&pages=35-46&publication_year=2010&doi=10.1167%2Fiovs.09-3544)

Shoham S, Bejar C, Kovalev E, Schorer-Apelbaum D, Weinstock M (2007) Ladostigil prevents gliosis, oxidative-nitrative stress and memory deficits induced by intracerebroventricular injection of streptozotocin in rats. Neuropharmacology 52:836–843. https://doi.org/10.1016/j.neuropharm.2006.10.005 (https://doi.org/10.1016/j.neuropharm.2006.10.005)
CrossRef (https://doi.org/10.1016/j.neuropharm.2006.10.005)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=17123555)
Google Scholar (http://scholar.google.com/scholar_lookup?

Alzheimer rat model. Yonsei Med J 55:689–699. https://doi.org/10.3349/ymj.2014.55.3.689 (https://doi.org/10.3349/ymj.2014.55.3.689)
CrossRef (https://doi.org/10.3349/ymj.2014.55.3.689)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=24719136)
PubMedCentral (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3990080)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Agmatine%20improves%20cognitive%20dysfunction%20and%20prevents%20cell%20death%20in%20a%20streptozotocin-induced%20Alzheimer%20rat%20model&author=J.%20Song&author=BE.%20Hur&author=KK.%20Bokara&author=W.%20Yang&author=HJ.%20Cho&author=KA.%20Park&author=WT.%20Lee&author=KM.%20Lee&author=JE.%20Lee&journal=Yonsei%20Med%20J&volume=55&pages=689-699&publication_year=2014&doi=10.3349%2Fymj.2014.55.3.689)

Steen E, Terry BM, Rivera EJ, Cannon JL, Neely TR, Tavares R, Xu XJ, Wands JR, De la Monte SM (2005) Impaired insulin and insulin-like growth factor expression and signaling mechanisms in Alzheimer's disease-is this type 3 diabetes? J Alzheimers Dis 7:63–80
CrossRef (https://doi.org/10.3233/JAD-2005-7107)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=15750215)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Impaired%20insulin%20and%20insulin-like%20growth%20factor%20expression%20and%20signaling%20mechanisms%20in%20Alzheimer%E2%80%99s%20disease-is%20this%20type%203%20diabetes%3F&author=E.%20Steen&author=BM.%20Terry&author=EJ.%20Rivera&author=JL.%20Cannon&author=TR.%20Neely&author=R.%20Tavares&author=XJ.%20Xu&author=JR.%20Wands&author=SM.%20Monte&journal=J%20Alzheimers%20Dis&volume=7&pages=63-80&publication_year=2005)

Stygelbout V, Leroy K, Pouillon V, Ando K, D'Amico E, Jia Y, Luo HR, Duyckaerts C, Erneux C, Schurmans S, Brion JP (2014) Inositol trisphosphate 3-kinase B is increased in human Alzheimer brain and exacerbates mouse Alzheimer pathology. Brain 137:537–552. https://doi.org/10.1093/brain/awt344 (https://doi.org/10.1093/brain/awt344)
CrossRef (https://doi.org/10.1093/brain/awt344)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=24401760)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Inositol%20trisphosphate%203-kinase%20B%20is%20increased%20in%20human%20Alzheimer%20brain%20and%20exacerbates%20mouse%20Alzheimer%20pathology&author=V.%20Stygelbout&author=K.%20Leroy&author=V.%20Pouillon&author=K.%20Ando&author=E.%20D%27Amico&author=Y.%20Jia&author=HR.%20Luo&author=C.%20Duyckaerts&author=C.%20Erneux&author=S.%20Schurmans&author=JP.%20Brion&journal=Brain&volume=137&pages=537-552&publication_year=2014&doi=10.1093%2Fbrain%2Fawt344)

through%20plasma%20membrane%20damage%20and%20independently%20of%20caspase-3&journal=J%20Cell%20Biol&volume=165&pages=357-369&publication_year=2004&doi=10.1083%2Fjcb.200403028)

Terranova JP, Storme JJ, Lafon N, Péŕio A, Rinaldi-Carmona M, Le Fur G, Soubrié P (1996) Improvement of memory in rodents by the selective CB1 cannabinoid receptor antagonist R141716. Psychopharmacology 126(2):165–172
CrossRef (https://doi.org/10.1007/BF02246352)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=8856836)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Improvement%20of%20memory%20in%20rodents%20by%20the%20selective%20CB1%20cannabinoid%20receptor%20antagonist%20R141716&author=JP.%20Terranova&author=JJ.%20Storme&author=N.%20Lafon&author=A.%20P%C3%A9%C5%95io&author=M.%20Rinaldi-Carmona&author=G.%20Fur&author=P.%20Soubri%C3%A9&journal=Psychopharmacology&volume=126&issue=2&pages=165-172&publication_year=1996)

Tsvetanova E, Kessiova M, Alexandrova A, Petrov L, Kirkova M, Todorov S (2006) In vivo effects of CB1 receptor ligands on lipid peroxidation and antioxidant defense systems in the rat brain of healthy and ethanol-treated rats. Pharmacol Rep 58:876–883
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=17220545)
Google Scholar (http://scholar.google.com/scholar_lookup?title=In%20vivo%20effects%20of%20CB1%20receptor%20ligands%20on%20lipid%20peroxidation%20and%20antioxidant%20defense%20systems%20in%20the%20rat%20brain%20of%20healthy%20and%20ethanol-treated%20rats&author=E.%20Tsvetanova&author=M.%20Kessiova&author=A.%20Alexandrova&author=L.%20Petrov&author=M.%20Kirkova&author=S.%20Todorov&journal=Pharmacol%20Rep&volume=58&pages=876-883&publication_year=2006)

Van Der Stelt M, Mazzola C, Esposito G, Matias I, Petrosino S, De Filippis D, Micale V, Steardo L, Drago F, Iuvone T, Di Marzo V (2006) Endocannabinoids and β-amyloid-induced neurotoxicity in vivo: effect of pharmacological elevation of endocannabinoid levels. Cell Mol Life Sci 63:1410–1424. https://doi.org/10.1007/s00018-006-6037-3 (https://doi.org/10.1007/s00018-006-6037-3)
CrossRef (https://doi.org/10.1007/s00018-006-6037-3)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=16732431)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Endocannabinoids%20and%20%CE%B2-amyloid-induced%20neurotoxicity%20in%20vivo%3A%20effect%20of%20pharmacological%20elevation%20of%20endocannabinoid%20levels&author=M.%20Stelt&author=C.%20Mazzola&author=G.%20Esposito&author=I.%20Matias&author=S.%20Petrosino&author=D.%20Filippis&author=V.%20Micale&author=L.%20Steardo&author=F.%20Drago&author=T.%20Iuvone&a

CrossRef (https://doi.org/10.1074/jbc.M111704200)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=11882652)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Signaling%20events%20in%20amyloid%20%CE%B2-peptide-induced%20neuronal%20death%20and%20insulin-like%20growth%20factor%20I%20protection&author=W.%20Wei&author=X.%20Wang&author=JW.%20Kusiak&journal=J%20Biol%20Chem&volume=277&pages=17649-17656&publication_year=2002&doi=10.1074%2Fjbc.M111704200)

Weksler ME, Gouras G, Relkin NR, Szabo P (2005) The immune system, amyloid-beta peptide, and Alzheimer's disease. Immunol Rev 205:244–256. https://doi.org/10.1111/j.0105-2896.2005.00264.x (https://doi.org/10.1111/j.0105-2896.2005.00264.x)
CrossRef (https://doi.org/10.1111/j.0105-2896.2005.00264.x)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=15882358)
Google Scholar (http://scholar.google.com/scholar_lookup?title=The%20immune%20system%2C%20amyloid-beta%20peptide%2C%20and%20Alzheimer%E2%80%99s%20disease&author=ME.%20Weksler&author=G.%20Gouras&author=NR.%20Relkin&author=P.%20Szabo&journal=Immunol%20Rev&volume=205&pages=244-256&publication_year=2005&doi=10.1111%2Fj.0105-2896.2005.00264.x)

Wilson RI, Nicoll RA (2002) Endocannabinoid signaling in the brain. Science 296:678–682. https://doi.org/10.1126/science.1063545 (https://doi.org/10.1126/science.1063545)
CrossRef (https://doi.org/10.1126/science.1063545)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=11976437)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Endocannabinoid%20signaling%20in%20the%20brain&author=RI.%20Wilson&author=RA.%20Nicoll&journal=Science&volume=296&pages=678-682&publication_year=2002&doi=10.1126%2Fscience.1063545)

Winter C, Weiss C, Martin-Villalba A, Zimmermann M, Schenkel J (2002) JunB and Bcl-2 overexpression results in protection against cell death of nigral neurons following axotomy. Brain Res Mol Brain Res 104:194–202. https://doi.org/10.1016/S0169-328X(02)00378-9 (https://doi.org/10.1016/S0169-328X(02)00378-9)
CrossRef (https://doi.org/10.1016/S0169-328X(02)00378-9)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=12225874)
Google Scholar (http://scholar.google.com/scholar_lookup?title=JunB%20and%20Bcl-2%20overexpression%20results%20in%20protection%20against%20cell%20death%20of%20nigral%20neurons%20following%20axotomy&author=C.%20Winter&author=C.%20Weiss&author=A.%20Martin-

PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=15229237)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Double%20dissociation%20between%20the%20effects%20of%20peri-postrhinal%20cortex%20and%20hippocampal%20lesions%20on%20tests%20of%20object%20recognition%20and%20spatial%20memory%3A%20heterogeneity%20of%20function%20within%20the%20temporal%20lobe&author=BD.%20Winters&author=SE.%20Forwood&author=RA.%20Cowell&author=LM.%20Saksida&author=TJ.%20Bussey&journal=J%20Neurosci&volume=24&pages=5901-5908&publication_year=2004&doi=10.1523%2FJNEUROSCI.1346-04.2004)

Yu HY, Kim SO, Jin CY, Kim GY, Kim WJ, Yoo YH, Choi YH (2014) β-Lapachone-induced apoptosis of human gastric carcinoma AGS cells is caspase-dependent and regulated by the PI3K/Akt pathway. Biomol Ther 22:184–192. https://doi.org/10.4062/biomolther.2014.026 (https://doi.org/10.4062/biomolther.2014.026)
CrossRef (https://doi.org/10.4062/biomolther.2014.026)
Google Scholar (http://scholar.google.com/scholar_lookup?title=%CE%B2-Lapachone-induced%20apoptosis%20of%20human%20gastric%20carcinoma%20AGS%20cells%20is%20caspase-dependent%20and%20regulated%20by%20the%20PI3K%2FAkt%20pathway&author=HY.%20Yu&author=SO.%20Kim&author=CY.%20Jin&author=GY.%20Kim&author=WJ.%20Kim&author=YH.%20Yoo&author=YH.%20Choi&journal=Biomol%20Ther&volume=22&pages=184-192&publication_year=2014&doi=10.4062%2Fbiomolther.2014.026)

Zhu X, Raina AK, Lee H-G, Chao M, Nunomura A, Tabaton M, Petersen RB, Perry G, Smith MA (2003) Oxidative stress and neuronal adaptation in Alzheimer disease: the role of SAPK pathways. Antioxid Redox Signal 5:571–576. https://doi.org/10.1089/152308603770310220 (https://doi.org/10.1089/152308603770310220)
CrossRef (https://doi.org/10.1089/152308603770310220)
PubMed (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Abstract&list_uids=14580312)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Oxidative%20stress%20and%20neuronal%20adaptation%20in%20Alzheimer%20disease%3A%20the%20role%20of%20SAPK%20pathways&author=X.%20Zhu&author=AK.%20Raina&author=H-G.%20Lee&author=M.%20Chao&author=A.%20Nunomura&author=M.%20Tabaton&author=RB.%20Petersen&author=G.%20Perry&author=MA.%20Smith&journal=Antioxid%20Redox%20Signal&volume=5&pages=571-576&publication_year=2003&doi=10.1089%2F152308603770310220)

Zou S, Kumar U (2018) Cannabinoid receptors and the endocannabinoid system: signaling and function in the central nervous system. Int J Mol Sci 19. https://doi.org/10.3390/ijms19030833 (https://doi.org/10.3390/ijms19030833)

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