**Supplementary Table 1:** Characteristics of the included studies.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Exercise** | **No** | **Author,****Origin** | **Animal model** | **Age of Animal** | **Duration of intervention** | **Intervention** | **Comparator**  | **Outcome measured** | **Improvement on learning and memory** |
| **Neurobeha-vioral Assessment**  | **Biomarker** |
| 1 | Chen Z et al. 2019, China | Mice, C57BL/6  | NA | 7 or 14 days | treadmill exercise - 8–10 m/min for 30 min/day and continued 5 days/week |  | Radial Maze Test | BDNF | Improved |
| 2 | Xu et al. 2022, China | APP/PS1 transgenic mice | 3 months  | 12 weeks | Treadmill – 5 m/min for 5 min, 8 m/min for 5 min (warmingup), 12 m/min for 30 min (main exercise), and 12 m/min for 5 min (recovery) for 5 days per week for 12 weeks |  | MWM |  | Improved |
| **Exercise and Flavonoid** | 3 | Abhijit S et al. 2017, India | Rats, Wistar | 4 & 18 months | 120 days | 400 mg/kg/day grape seed proanthocyanidinextract (GSPE) Swimming Training - 2 h/day and 5 days/week with an intensity of 3% of their body weight tied to their tails as steel washers | sedentary controls (n=11)vs swimming trained (n=11)vsswimming trained and supplemented with GSPE (n=11)vs control supplemented with GSPE (n=11) | T-maze | AChE activity | Improved |
| 4 | Abhijit S et al. 2018, India | Rats, Wistar | 4 & 18 months | 16 weeks | 400 mg/kg/day grape seed proanthocyanidin extract (GSPE)  | sedentary controlsvs sedentary supplemented with GSPEvs swimming trained supplemented with GSPE |  | lipid peroxidation (LPO)GSHGlutathione peroxidase (GPx) activityCAT activityGR activity | Improved |
| 5 | Bhattacharya TK. et al. 2015, USA | Mice, BALB/cJ | 10 weeks | 39 days | 1.49 mg of EGCG per gram of diet3.34 mg of B-ALA per gram of diet23 cm diameter running wheel | Control (n=11 sedentary and 11 runner)vsB-ALA (n=11 sedentary and 12 runner)vsEGCG (n=12 sedentary and 11 runner)vsEGCG and B-ALA (n=12 sedentary and 11 runner) | Contextual fear conditioningCued fear conditioning |  | No Improvement |
| 6**Exercise and Flavonoid** | Gibbons TE. et al. 2015, USA | BALB/cByJ mice | 19 months | 28 days | mice ingested on average 182 mg/kg/day and 417 mg/kg/day, of EGCG and β-ala, respectively.housed in cages with access to a running wheel | Sedentary mice (n=12)vsStandard diet (n=14)vsVWR mice (n=15)vsEGCG and β-ala diet (n=15) | Morris Water MazeContextual Fear Conditioning | BDNF | Improved |
| 7 | Ramis MR et al. 2021, Spain | Rats, Wistar | 18 months | 28 days of catechin 4 weeks rotarod | 20 and 40 mg/kgCatechin5 days/weekRotarod  | Control group (n=7)vsexercise group (n=7)vsrotarod exercise+catechin (n=7) | Radial Maze TestBarnes Holeboard MazeNovel Object Recognition Test | Tryptophan Hydroxylase (TPH)Tyrosine Hydroxylase (TH) | Improved |
| 8**Exercise and Flavonoid** | Zhang Z et al. 2016, China | Mice, APP/PS1 | 8 months | 4 months | 50 mg/kgEpicatechin30 min a day, 13.2 m/min for 5 days/weekTreadmill exercise | nTg group (n=8)vsUntreated‑Tg (n=8)vsepicatechin‑Tg group (n=8)vstreadmill exercise‑Tg group (n=8)vsCOMA group (n=8) | Morris water maze test | GSSG SODGSHLPOCATBDNF expressionsAβ deposition | Morris water maze test – Improved by Exercise alone GSSG, SOD, GSH, LPO, CAT – Improved by Ep aloneBDNF & Aβ – Improved by combination  |
| **Flavonoid** **Flavonoid**  | 9 | Kwon et al. 2022, Korea | ICR mice | 8 weeks old | 3 weeks | 50, 100, and 200 mg/kg/dayTyrosol-Enriched Rhodiola sachalinensisExtracts | Normal (n=12)vsControl (n=12)vsBio-RSE 50 (n=12)vsBio-RSE 100 (n=12)vs Bio-RSE 200 (n=12)vsDNPZ (n=12) | Y mazeMWM PAT | MDAAChE | Improved |
| 10 | Ali et al. 2023, Egypt | Wistar Rat | 6 weeks old | 4 weeks | 50 and 100 mg/kg*Yucca aloifolia L*. extract | group 1- normal control group (n=8)vsgroup 2- rotenone (n=8)vsgroup 3 and 4-Yucca extract (50 and 100 mg/kg) (n=8) | Rotarod TestOFTForced Stress Swim Test | LPOGSHNOSOD | Improved |
| 11 | Hawash et al. 2023, Egypt | Sprague-Dawley |  | 28 days | 500 mg/kg bw Jambolan fruit ethanolic extract  | control group (n=6)vsgroup 2 - Alzheimer’s disease (n=6)vsgroup 3 -jambolan fruit (n=6)vsgroup 4 -Rivastigmine (n=6)vsgroup 5 - choline chloride (n=6)vsgroup6 - jambolan fruit and choline (n=6) | Morris water maze | MDANOCATSOD | Improved |
| 12 | Kim et al. 2023, Korea | ICR mice | 6 weeks | 4 weeks  | 250 mg/kg500 mg/kg*Sesamum indicum* L.  | group 1- normal (n=7)vsgroup 2- control (scopolamine) (n=7)vsgroup 3- positive control (donepezil) (n=7) vsgroup 4 GBE-250 & group 5 GBE-500 (Goenback extract) (n=7)vsgroup 6 GBO-1 & group 7 GBO-2 (Goenback oil) (n=7) vsgroup 8, M74-250 & group 9, M74-500 (M74 extract) (n=7)vsgroup 10 M74-1& group 11 M74-2, (M74 oil) (n=7) | PATMorris Water Maze | BDNF AChE | Improved |
| 13 | Zhong et al. 2023, China | P301s-tau transgenic mouseC57BL/6 | 6 months old | 3 months | 10 µg/mLQuercetagetin drugs | C57BL/6 mice (N=7–10)vsP301S-tau transgenic mice (N=7–10)vsP301S-tau transgenic mice + quercetagitrin (N=7–10) | Y-mazeMorris Water Maze |  | Improved |
| 14 | Lee et al. 2023, Korea | C57BL/6 | 8 weeks old | 12 days | 100 mg/kg The *gastrodia elata‘s* rhizome extract (GER)The *glycyrrhiza uralensis*‘s radix (GUR)mixture of GER and GUR 7:3 = GGW73. | group 1, controlvsgroup 2, scopolamine (SCP)vsgroup 3, SCP + GER vsgroup 4, SCP + GUR vsgroup 5, SCP + GGW73 10 mg/kgvsgroup 6, SCP + GGW73 100 mg/kg vsgroup7, SCP + GGW73 200 mg/kgvsgroup 8, SCP + Donepez | Y-mazePATMorris Water Maze | BDNF | Improved |
| 15 | Jadhav and Kulkarni. 2023, India | Wistar rat | not mentioned | 21 days | 10 mg/kgBaicalein treatment | group 1 normal control (n=6)vsgroup 2 disease control (n=6)vs group 3 memantine (n=6)vsgroup 4 baicalein (n=6)vs group 5 memantine and baicalein (20 + 5 mg/kg) & group 6 memantineand baicalein (20 + 10 mg/kg) (n=6) | MWMElevated Plus MazePAT | MDASODGSHAChEBDNF | Improved |
| 16 | Jadhav and Kulkarni. 2023, India | Wistar rats | not mentioned | 42 days | 25 and 50 mg/kgQuercetin and Memantine treatment | normal control group (n=10)vsdisease control group (n=10)vsmemantine group (n=10)vs group quercetin (n=10)vsgroup memantineand quercetin 25 mg/kg (n=10)vsmemantine and quercetin 50 mg/kg (n=10) | MWMEPMPAT | MDAAChEBDNF | Improved |
| 17 | Mani et al. 2023, Saudi Arabia | Sprague-dawley | 3 months old | 30 days | Methanolic Ajwa Seed Extract treatment (MASE) | control group I (n=6)vsLPS-induced group II (n=6)Vsgroups III and IVMASE 200 mg/kg or 400 mg/kg (n=6) | Elevated Plus MazeNORT | ACh | Improved |
| 18 | Ismail et al. 2023, Pakistan | Sprague-Dawley rats |  | 21 days | 100mg/kg, 200mg/kg,and 400mg/kg*Phoenix dactylifera* extract  | Normal control (n=5)vs diabetes control (n=5)vs diabetes-positive controlGlibenclamide (n=5)vs AD control (n=5)vs Alzheimer’s positive control(Rivastigmine) (n=5)vsPhoenix dactylifera seed extract groups (n=5) | Elevated Plus MazeMorris Water Maze | ACh | Improved |
| 19 | Lee et al. 2023, Korea | Sprague-Dawley | 7 weeks old | not mentioned | *Chrysanthemum boreale* (Makino) extract  | Normal (n=10)vsNC (Sco) (n=10)vsCB extract-low (CBL) (n=10)vsCB extract-high (CBH) (n=10)vsDonepezil (positive control) (n=10) | PAT | BDNF | Improved |
| 20 | Alaqeel et al. 2022, Saudi Arabia  | Albino rats | not mentioned | 140 ±10g | 15 mg/kgQuercetin Nanoemulsion  | negative control group (I) (n=8)vsQC group (n=8)vsAlzheimer’s group (AD) (n=8)vstreated group(I): AlCl3+QC freenanoemulsion (n=8)vstreated group (II): AlCl3+QC (n=8)vstreated group (III): AlCl3+QCNE (n=8) |  | SOD GSHMDA AOPP | Improved |
| 21 | Yeh et al. 2022, Taiwan | C57BL/6 | 8 weeks  | 10 days | 25 and 50 mg/kgTea Seed Kaempferol Triglycoside (KXRG) | group 1, control (n=8)vs group 2, LPS (n=8)vsgroup 3, LPS+25 mg/kg KXRG (n=8)vsgroup 4, LPS+50 mg/kg KXRG (n=8) | Y-maze | SOD | Improved |
| 22 | Pang et al. 2022, Korea | ICR mice | 5 weeks  | 14 days | 50 and 100 mg/kg/day*Cirsium japonicum var*. Maackii extract | sham group (n=7)vscontrol group (n=7)vsECJM50 group (n=7)vsECJM100 (n=7)vsdonepezil group (n=7) | T mazeNORTMWM | MDANO  | Improved |
| 23 | Kang et al. 2022, China | APP/PS1 and C57BL/6J  | 6 months  | 70 days | 1000 mg/kg/dTieguanyin Extracts | control (10 mice, C57BL/6J) vs model (8 mice, APP/PS1)vsDonepezil (8 mice, APP/PS1)vs Tgy-Q (8 mice, APP/PS1, 1000 mg/kg/d),vsTgy-N (8 mice, APP/PS1, 1000 mg/kg/d)vsTgy-C (8 mice, APP/PS1, 1000 mg/kg/d) | MWM NORT | MDANF-κB p65 TNF-αIL-1βIL-6 | Improved |
| 24 | Jajin EM et al. 2021, Iran | Rats, Wistar | 7 weeks | 42 days | 25 mg/kg/day SPION, Quercetin, QT-SPION respectively | control group (n=8)vssham group (n=8)vsAlCl3 group (n=8)vsAlCl3 + SPION group (n=8)vsAlCl3 + QT group (n=8)vsAlCl3 + SPION-QT group (n=8) | Morris Water Maze TestPassive Avoidance Test | AChE  | Improved |
| 25 | Kim CJ et al. 2021, Korea | Mice, C57BL | 9 weeks | 7 weeks | 125, 250, and 500 mg/k HLJG0701 | control group (n=10)vsdonepezil group (n=10)vs scopolamine-induced control group (n=10)vsHLJG0701- groups (n=10) | Morris Water Maze TestY-Maze Task | AChE AChMDA CAT | Improved |
| 26 | Nan S et al. 2013, China | Rats, Sprague-Dawley | NA | 8 weeks | Low dose: 100 mg/kg/d Moderate dose: 250 mg/kg/dHigh dose: 625 mg/kg/dEGCG | sham (n=15)vsAD group (n=15)vs AD + EGCG groups (n=15) | Morris Water Maze Test | GPxT-SOD MDA | Improved |
| 27 | Wen H 2020, China | Rats, Sprague-Dawley | NA | 30 days | 50 mg/kgBlack chokeberry | sham (n=12)vsAβ group (n=12)vsAβ + SMB CAN group (n=12) | Morris Water Maze Test | DPPH ABTS | Improved |
| 28 | Zhang Y et al. 2019, China | Rats, Sprague-Dawley | NA | 28 days | 16.5 and 33 mg/kgSailuotong | control group (n=8)vsmodel group (n=8)vsSLT- group (n=8) | Morris Water Maze Test | IL-6IL-12IL-1α chemokine CXCL10 | Improved |
| 29**Flavonoid**  | Long Jy et al. 2020, China | Rats, Sprague-Dawley | 4–6 weeks | 3 days | low dose - 25 mg/kg middle dose - 50 mg/kg high dose - 100 mg/kg Naringin | control group (n=11)vssham group (n=11)vspositive control group (n=11)vsmodel group (n=11)vsnaringin group (n=11) | Morris Water Maze TestNew object recognition test (NORT) | MDASOD GSH-Px | Improved |
| 30**Flavonoid**  | Kim MJ et al. 2019, Korea | Mice, ICR | 4-week | 3 weeks | 50 and 100 mg/kg Green tea seed oil (GTO) | NC group (n=13) vsAβ group (n=13)vsGTO group (n=13)  | Y-Maze TestPassive Avoidance TestMorris Water Maze Test | MDASOD GSH | Improved |
| 31 | Wang YJ et al. 2019, China | Mice, Kunming | 6-week | 30 days | 100, 200, and 400 mg/kgCentipeda minima | vehicle control (n=10)vsD-gal/AlCl3 + vitamin E (n=10)vsD-gal/AlCl3 group (n=10)vsD − gal/AlCl3 + ECM (n=10) | Morris Water Maze Test | MDAGSH SOD | Improved |
| 32 | Sethiya NK et al. 2019, India | Rats, Sprague-Dawley rats | 2-3 months | 14 days | 400 mg/kgShankhpushpi extract | Group I - vehicle (distilled water) only (n=6)vsGroup II - scopolamine (n=6)vsGroup III - piracetam (n=6)vsGroup IV-VII - CD, CT, CP and EA. (n=6) | Cook and Weidley's pole climbing apparatusMorris Water Maze Test | AchE | Improved |
| 33 | Doungue HT et al. 2018, Cameroon | Rats, Wistar rats | 3-month | 60 days/ 2 months | 200 and 400 mg/ kg bwPassiflora edulis | Group (NC): normal (n=10)vsGroup VE400: AD + Vitamin E (n=10)vsGroup (PC): AD-induced rats (n=10) vsGroup (A.E200) & Group (A.E400) (n=10) | Morris Water Maze Test | AchE | Improved |
| 34 | Sun K et al. 2018, China | mice, ICR | 8 week | 6 weeks | 2 mg/kg and 10 mg/kgMatrine  | control group (n=9)vsVE group(n=9)vsD-gal group (n=9)vsMAT low-dose group and MAT high-dose group | NORY-Maze TestWeight-Loaded Swimming Test | IL-1β IL-6T-SOD MDA | Improved |
| 35**Flavonoid**  | Ma L. et al. 2018, China | Rats, Sprague-Dawley | 7–8 weeks | 14 days | Low dose: 50 mg/kgMedium dose: 150 mg/kgHigh dose: 300 mg/kgVitis vinifera | control group (n=15)vsdonepezil (n=15)vsmodel group (n=15)vslow-dose, medium-dose, high-dose VTF groups (n=15) | Morris water maze task | AChE ChAT | Improved |
| 36**Flavonoid**  | Mostafa N M 2018, Egypt | Rats, Sprague-Dawley |  | 1 week | 200 mg/kg/dayBombax ceiba | Group 1: Control group (n=6)vsGroup 2: distilled water + scopolamine (n=6)vsGroup 3: donepezil (n=6)vsGroup 4: BCLE (n=6) | Morris Water Maze TestPassive Avoidance Test  | Catalase MDAAChE Activity | Improved |
| 37 | Chen Z J et al. 2018, China | mice, SAMP8 and SAMR1 | three months | 9 months | 50 mg/ kg/ dayPsoralea corylifolia | normal control group SAMR1 (n=10)vsSAMP8-RSV group (n=10)vsmodel control group (n=10)vsSAMP8-TPFB group (n=10) | Morris Water Maze Test | TNF-α,IL-1β, IL-6level of Aβ- 42 | Improved |
| 38 | Mundugaru R et al. 2017, India | mice, Swiss albino |  | 45 days | 200 and 400 mg/kg body weightPluchea lanceolata | Group 1: vehicle control (n=6)vsGroup 2: AlCl3 (n=6)vsGroup 3 and 4: HAPL (n=6) | Forced swim testTail suspension test | AchEcatalase, lipid peroxidation, glutathione peroxidase | Forced swim test-improvedTail suspension test & Biomarkers – no improvement  |
| 39**Flavonoid**  | Halawany AME et al. 2017, Egypt | mice, Swiss albino |  | 7 days | 10 and 20 mg/kg/dayGingerol  | Group 1: saline (n=10)vsGroup 2: STZ (n=10)vsGroup A: STZ with celecoxib (n=10)vsGroup B & C: STZ with gingerol (n=10) | Morris Water Maze Test Y-maze | measurement of amyloid β-42COX-2 deposition | Improved |
| 40 | Bhatnagar M et al. 2017, India | mice, BALB/c | 10-14 weeks | 21 days | 40 mg/kg of body weightCentella asiatica and/or Withania somnifera | No Herbal ExtvsCentella ExtvsWithania ExtvsWithania & Centella ExtvsMPTP Centella ExtvsMPTP Withania ExtvsMPTP No Herbal ExtvsMPTP Withania & Centella Ext | AkinesiaCatalepsySwim-test | SODCATGpxGSHLPO | Improved |
| 41 | Choi SY et al. 2017, Korea | mice, ICR | 5 weeks | 14 days | 100 and 200 mg/kg/dayAcer okamotoanum | normal group (n=4)vscontrol group - Ab25–35 (n=4)vsEA groups (n=4) | Morris water maze testNovel object recognition testT-maze test | reduced nitric oxideAChE activity | Improved |
| 42**Flavonoid**  | Koh EJ et al. 2017, Korea | mice, ICR | 5 weeks | 4 weeks | 200 and 400 mg/kg body weight/daySpirulina maxima | control (n=6)vsdonepezil (n=6)vsscopolamine group (n=6)SM70EE groups (n=6) | Passive Avoidance TestMorris Water Maze Test | AChEGSH GPx | Improved |
| 43 | Thangthaeng N et al. 2016, USA | Rats, Fischer 344 | 19 months | 7 weeks | 2% (w/w)Montmorency tart cherry | Control (n=12)vsTart cherry group (n=12) | Morris Water Maze Test | NOX-2, COX-2 | Improved |
| 44 | Prema A et al. 2016, India | Rats, Wistar | 10-12 weeks | 6 weeks | 2.5%, 5% & 10%fenugreek seed powder | Group I - control (n=6)vsGroup II - AlCl3 (n=6)vsGroup III - V (n=6)vsGroup VI - 10% FSP (n=6) | Passive avoidance testMorris Water Maze Test | AChE | Improved |
| 45**Flavonoid**  | Silveira CCSM et al. 2016, Brazil | Rats, Wistar | Three month | 30 min before the assays | 1, 3, and 30mg/kgethanolic extract of the yellow propolis (EEYP) | control group (n=10)vscaffeine group (n=10)vsEEYP groups (n=10) | Open Field (OF) TestElevated Plus Maze (EPM) TestForced Swimming (FS) TestStep-Down Inhibitory Avoidance (IA) Test | MDACAT SOD  | FS showed no improvement All other behavior test and biomarkers showed improvement |
| 46 | Lee HY et al. 2016, Rep of Korea | mice, ICR | 5 weeks | 4 days | 200 and 400mg/kgAronia melanocarpa berries | control group (n=7)vspositive control group (donepezil) (n=7)vsscopolamine group (n=7)vsA. melanocarpa berries groups (n=7) | Morris Water Maze TestPassive Avoidance Test | AChE activity | Improved |
| 47 | Kim MS et al. 2014, Korea | mice, C57BL/6 | 8 weeks | 14 days | 100 and 200mg/kgFructus mume extract | vehicle + vehicle (n=10)vsF. mume (n=10)vsdonepezil + scopolamine (n=10)vsvehicle + scopolamine (n=10)vsF. mume + scopolamine (n=10) | Morris Water Maze Test | AChE ActivityChAT Expression | Improved |
| 48**Flavonoid**  | Zhang Y et al. 2014, China | mice, Chinese Kunming | 6 to 8 weeks | 12 days | 100, 200 and 400 mg/kgZiziphi Spinosae Semen | Control (n=12)vspiacetam (n=12)vsmodel group (n=12)vsWES groups (n=12) | Y‑maze testPassive avoidance test |  | Improved |
| 49 | Baitharu I et al. 2014, India | Rats, Sprague-Dawley  |  | 28 days | 10 mmol kg-1 day-1Withania somnifera  | Normoxia (n=15)vsNormoxia + Withanolide A (n=15)vsHypoxia + Vehicle (n=15)vsHypoxia + Withanolide A (n=15) | Morris Water Maze Test | GSH LPO | Improved |
| 50 | Weon JB et al. 2014, Korea | mice, ICR | 4-week | 120 min | 10, 50, and 100mg/kgLoranthus parasiticus | Control group (n=7)vsDonepezil group (n=7)vs5scopolamine treated group (n=7)vsLoranthus parasiticus groups (n=7) | Morris Water Maze TestPassive Avoidance Test |  | Improved |
| 51 | George A et al. 2014, Malaysia | mice, C57BL/6 | 2-6 months | 14 days | 50 mg/kgGingko biloba50 and 100 mg/kg Polygonum minus | Vehichle (n=12–14)vsDonepezil (n=12–14)vsVehicle + Scopolamine (n=12–14)G. biloba and the P. minus treated groups (n=12–14) | Barnes maze test |  | Improved |
| 52**Flavonoid**  | Hong SW et al. 2013, Rep of Korea | Rats, Sprague Dawley | 8 weeks | 1 week | 5, 10, and 20 mg·kg-1soyasaponin I  | sham group (n=12)vsIBO group (n=12)vssoya-I groups (n=5-6) | Y-Maze taskPassive avoidance taskMorris Water Maze Test |  | Improved |
| 53 | Zhao L et al. 2013, China | mice, APP/PS1 double transgenic | 4 months | 12 weeks | 40 mg/kgApigenin | WT control (n=4)vsWT + apigenin (n=5)vsAPP/PS1 control (n=5)vsAPP/PS1 + apigenin (n=5) | Morris Water Maze Test | Aβ Levels BDNFSOD GSH-Px | Improved |
| 54 | Weon JB et al. 2013, Rep of Korea | mice, ICR | 3 weeks | 90 min | 100, 300 and 500 mg/kgCodonopsis lanceolata | Control (n=7)vsDonepezil (n=7)vsScopolamine (n=7)vsScopolamine + C. lanceolata (n=7)vsScopolamine + fermented C. lanceolata (n=7) | Morris Water Maze TestPassive Avoidance Test |  | Improved |
| 55**Flavonoid**  | Wu KJ et al. 2012, Taiwan | Rats, Sprague–Dawley | 8-9 weeks | 7 days | 30, 100, and 300 mg/kg green tea extract10 mg/kg epigallocatechin gallate | sham group (n=6)vspentoxifylline group (n=6)vsischemia/reperfusion induction group (n=6)vsGTex groups (n=6)vsEGCG group (n=6) | Morris Water Maze Test | MDA SODGSHCOX-2 iNOS | Improved |
| 56 | Cong WH et al. 2012, China | mice, transgenic APP/PS1 | 5 months | 3 months | 44mg/kg/dayWNK(Wei Nao Kang) consisting of P. ginseng, G. biloba, and saffron. | nontransgenic littermates + tap water (n=10)vsEGB761 30 mg/kg/day (n=10)vsAPP/PS1+tap water (n=9)vsAPP/PS1 + WNK (n=10) | Morris Water Maze Test | Aβ-level | Improved |
| 57 | Bihaqi SW et al. 2011, India | rats, Wistar |  | 7 days | 100, 150, and 250 mg/kgConvolvulus pluricaulis | Group I - control (n=6)vsGroup II - scopolamine (n=6)vsGroups III, IV, and V - AE (n=6) | Elevated Plus MazeMorris Water Maze Test | AChE | Improved |
| 58**Flavonoid**  | Biradar SM et al. 2011, India | mice, Swiss albino | 3-4 months | 15 days | 250, 500, 750 mg/kg Ageratum conyzoides | Normal control - NaCl (n=6)vsPiracetam group (n=6)vsVehicle control group (n=6)vsScopolamine control (n=6)vsACEt+scop (n=6) | Elevated plus mazeMorris Water Maze Test | AChE | Improved |
| 59 | Zhoa Q et al 2011 | Mice, SAMP8 and SAMR1 | 6 weeks | 38 days | 750 mg/kgChotosan  | sham-operated controls (n=9-10)vsT2VO control (n=9-10)vsT2VO + CTS (n=9-10) | Elevated plus maze testNobel object recognition test (ORT)Morris Water Maze Test | VEGF | Improved |
| 60 | Peter A.N, Rehab A.A 2021, Egypt**Flavonoid**  | rats, Sprague-Dawley | 8–10 weeks | 8 weeks | 100 mg/kgHesperidin  | Group 1 (control group) (n=15)vsGroup 2 (EMB group) (n=15)vsGroup 3 (HSP group) (n=15)vsGroup 4 (EMB + HSP group) (n=15) | Forced swim test Y-maze testRod walking test | CAT GSH MDA TNF-α IL-1β BDNF  | Rod walking test, TNF-α, IL-1β – significant improvementForced swim test, Y-maze test, CAT, GSH & MDA, BDNF levels – no significant improvement |
| 61 | Oyovwi M O et al 2021, Nigeria | rats, Wistar | 6-8 weeks | 28 days | 20 mg/kg/dayQuercetin  | group 1 - normal (n=5)vsgroup 2 - corn oil (n=5)vsgroup 3 - quercetin (n=5)vsgroups 4 – endosulfan (n=5)vsgroup 5 - quercetin + endosulfan (n=5) |  | MDA GPx SOD CATAChE | Improved |
| 62 | Imran I et al. 2021, Pakistan | Rats, Sprague-Dawley |  | 41 days | 5, 10, 20, and 30% dilutions (v/v in tap water)Grewia asiatica **Flavonoid**  | Group 1 - control (n=6-8)vsGroups 2 to 5 - G. asiatica exudate + Scopolamine (n=6-8)vsGroups 6C - Scopolamine + piracetam (n=6)vsGroups 7 -Scopolamine (n=6) | Open Field TestElevated Plus Maze TestForced Swimming TestPassive Avoidance TestY-Maze TestNovel Object Recognition TestMorris Water Maze Test | AChE MDA SOD GPx  | Improved |
| 63 | Li S et al. 2020, China | Rats, Wistar |  | 8 weeks | 100, 200 mg/(kg·bw)/day – rutin100, 200 mg/(kg·bw)/day – puerarin100, 200 mg/(kg·bw)/day - silymarin | control (n=10)vs AlCl3-toxicity (n=10)vs rutin, puerarin, silymarin (n=10) | Morris Water Maze Test | SODGSH-Px MDA | Improved |
| 64 | Kim J et al. 2020, Korea | mice, CD-1 | 6 weeks | 1 hr | 0.3, 1 or 3 mg/kg casticin  | control group (n=6)vsdonepezil (n=6)vsscopolamine-treated group (n=6)vsV. rotundifolia & casticin (n=6) | Passive avoidance testNovel object recognition testMorris water maze test | AChE BDNF | Improved |
| 65**Flavonoid**  | Kim HJ et al. 2020, Korea | mice, ICR | 6 weeks | 14 days | 10, 20 and 30 mg/kgRibes diacanthum Pall (RDP) | Control (n=6)vsTacrine group (n=6)vsScopolamine group (n=6)vsRDP10; RDP20; RDP30 groups (n=6) | Morris Water Maze TestPassive Avoidance Test |  | Improved |
| 66 | Das J et al. 2020, India | Rats, Wistar | young (6-7 months), aged (18-20 months) | 3 weeks | 20 mg/kg body wt/dayFisetin | Young control (n=10)vsYoung fisetin supplemented (n=10)vsAged control (n=10)vsAged fisetin supplemented (n=10) | MWM testOpen-field test | Lipid Peroxidation | Improved |
| 67 | Gao WL et al. 2020, China | Rats, Sprague-Dawley |  | 7 weeks | 50, 100 and 200 mg/kgGrape seed proanthocyanidin extract (GSPE) | control group (n=9)vsSTZ model group (n=9)vsSTZ plus GSPE groups (n=9) | Morris Water Maze Test | MDASODGSH | Improved |
| 68 | Massaquoi MS et al. 2020, USA | mice, C57BL/6J | 8 weeks | 8 weeks | 5 mg/kg7,8-dihydroxyflavone (DHF) | VEH group (n=17)vsVEH+DHF group (n=18)MPTP group (n=19)vsMPTP+DHF group (n=20) | Grip test analysis | tyrosine hydroxylase (TH) | Improved |
| 69**Flavonoid**  | Keser H et al. 2020, Turkey | mice, C57BL/6 | young (5 months) old (18 months) | 3 weeks | 5 mg/kg7,8-dihydroxyflavone (DHF) | young control (n=10)vsold control (n=10)vsold-DHF (n=7) | Hang wireAdhesive removal | MDASODGSH | Improved |
| 70 | Liu P et al. 2020, China | Rats, Sprague–Dawley |  | 30 days | 25, 50 and 100 mg/kgSilibinin | control group (n=8-10)vsSTZ-injected plus donepezil-treated group (n=8-10)vsSTZ-model group (n=8-10)vsSTZ-injected plus silibinin-treated group (n=8-10) | Open field testY maze testNovel objects recognition testMorris water maze test |  | Improved |
| 71 | Wang GW et al. 2019, China | Rats, Sprague-Dawley | aged rats (21.90±0.22 months); young rats (10 weeks) | 30 days | 25, 50 and 100 mg/kgBidens pilosa L. (BP) | young group (n=10)vsaged control group (n=10)vsEEBP treated aged group (n=10) | Open-field taskPassive avoidance taskMorris water maze test |  | Improved |
| 72 | El-Gazar AA et al. 2019, Egypt | Rats, Sprague-Dawley | 7 days | 7 days | 10 mg/kgMorin | group 1 - normal control (n=19)vsgroup 2 - mTBI control group (n=19)vsgroups 3 and 4 - mRTBI-5 & 7 (n=19)vsgroups 5 and 6 - DMSO (vehicle) (n=19)vsgroup 7 - Morin treated group (n=19)vsgroup 8 - MK-801 treated (n=19)vsgroup 9 - Morin and MK-801 (n=19) | Swimming testConditioned – Avoidance (CA) test | inflammatory mediators - TNF-α, IL-6, p-NF-κB p65apoptotic/anti-apoptotic markers - caspase-3 & Bcl-2dementia markers - Aβ42 & p(thr231)Tau | Improved |
| 73**Flavonoid**  | Liu B et al. 2019, China | Rats, Sprague–Dawley | 8–10 weeks | 45 days | 25, 50, and 100 mg/kgSilibinin | sedentary group (n=10)vsOT plus resveratrol-treated group (n=10)vsovertraining (OT) group (n=10)vsOT plus silibinin-treated groups (n=10) | Morris Water Maze TestNovel Object Recognition Test | MDAT-SODCAT | Improved |
| 74 | Pyrzanowska J et al. 2019, Poland | Rats, Sprague-Dawley | 9 months | 10 weeks | 1:100 n=8), 2:100 (n=8) and 4:100 (n=9)Aspalathus linearis | control (n=8)vsA. linearis infusion pre-treated groups | Morris Water Maze Test | Dopamine level | Improved |
| 75 | Giacomini A et al. 2019, Italy | Mice, Ts65Dn | 4 months | 39 days | 5.0 mg/kg | Euploid+7,8-DHF (n=7)vsEuploid+Vehicle (n=7)vsTs65Dn+Vehicle (n=6)vs7,8-DHF treated group (n=6) | Morris Water Maze Test | levels of TrkB | No improvement |
| 76 | Bax EN et al. 2019, USA | Mice, C57Bl6J | 5 months | 1 month | 10 mg/kg body weight | HFD + vehicle (n=7)vsHFD + S-equol (n=7) | Elevated plus mazeTail suspension test |  | Improved |
| 77 | Chen X et al. 2019, China | Rats, Sprague-Dawley |  | 7 days | 2 μg/kg wtAstragaloside VI | sham control group (n=6)vsMCAO group (n=6)vsAstragaloside VI group (n=6) | Step-through passive avoidance taskMorris Water Maze Test | MDA,protein carbonyl ROS | Improved |
| 78**Flavonoid**  | Zhuang J et al. 2019, China | Mice, ICR | 7 weeks | 20 weeks | 100 mg/kgPurple sweet potato color (PSPC) | control group (n=10)vsPSPC group (n=10)vsHFD group (n=10)vsHFD + PSPC group (n=10) | Step-through passive avoidance taskMorris Water Maze Test | BDNF | Improved |
| 79 | Sun P et al. 2019 | Rats, Sprague Dawley | 8 weeks | 21 days | 100 and 200 mg/kgDihydromyricetin (DHM) | Sham group (n=10)vsAD group (n=10)vsAD + DHM groups (n=10) | Morris Water Maze Test | IL-1βIL-6 TNF-αBcl-2 Bax | Improved |
| 80 | Mallien AS et al. 2019, Germany | Mice, C57BL/6 N Crl | 8 weeks | 21 weeks | soy-containing animal diet | standard diet group (n=12)vssoy-free group (n=12) | Open field–novel object testElevated O-maze testDark–light testNovel object recognition test.Fear conditioningSocial memory testForced swim testHot-plate testPuzzle box test |  | No improvement |
| 81**Flavonoid**  | Khan A et al. 2018, South Korea | Mice, C57BL/6N | 8 weeks | 2 week | 30 mg/kg/dayQuercetin  | Control mice (n=15)vsMice injected with LPS (n=15)vsMice injected with LPS and quercetin (n=15) | Y-Maze TestMorris Water Maze Test | TNF-aCOX-2NOS-2Bax/Bcl-2 | Improved |
| 82 | He L et al. 2018, China | Rats, Sprague-Dawley |  | 20 days | 4, 8, and 16 mg/kgIcariside II (ICS II) | Sham (n=10)vsSham+ICS II-H (n=12)vsIBO+donepezil (n=14)vsModel (IBO) (n=15)vsIBO+ICS II-L, IBO+ICS II-M, and IBO+ICS II-H (n=14) | Morris water maze test |  | Improved |
| 83**Flavonoid**  | Thangarajan S et al. 2018, India | Rats, Wistar |  | 14 days | 40 mg/kg b.wt.Morin | Group I (Control) (n=15)vsGroup II (PbAc) (n=15)vsGroup III (PbAc+Morin) (n=15)vsGroup IV (Morin alone) (n=15) | Rotarod activityMorris water maze test Open field testForced swim testString test for grip strengthAdhesive removal test | SODCATGPxGR, glutathione-S-transferasereduced glutathioneAChELPONO protein carbonyls | String test for grip strength – no improvement  |
| 84 | Mansour SZ et al. 2017, Egypt | Rats, Wistar |  | 21 days | 50 mg/kg b.wt.5, 7-dihydroxyflavone | Group 1 (Control) (n=10)vsGroup 2 (ACR) (n=10)vsGroup 3 (DHF) (n=10)vsGroup 4 (IR) (n=10)vsGroup 5 (DHF+ ACR) (n=10)vsGroup 6 (DHF+ IR) (n=10) |  | MDAAChEcaspase-3BDNF | Improved |
| 85**Flavonoid**  | Parashar A et al. 2017, India | Mice, Swiss albino | 7–8 months | 21 days | 100 mg/kgRutin | group I: control + vehicle (n=8)vsgroup II:control + rutin (n=8)vsgroup III: CUS + vehicle (n=8)vsgroup IV: CUS+ rutin (n=8) | Open fieldBeam walkElevated plus mazeNovel object recognition test |  | Elevated plus maze - no improvement |
| 86 | Gong Y et al. 2017, China | Rats, Sprague-Dawley  | 35–38 days | 34 days | 1 and10 mg/kghyperoside | control group (n=12)vsfluoxetine group (n=12)vsvehicle (equal volume of DMSO) group (n=12)vshyperoside groups (n=12) | Morris water maze testforced swim test | corticosteroneBDNF | Improved |
| 87 | Ay M et al. 2017, USA | Mice, MitoPark transgenic & C57BL6-LC | 12 weeks | 8 weeks | 25 and 175 mg/kgQuercetin  | vehicle (n=8 or 9)vsquercetin groups (n=8 or 9) | open-field apparatusrotarod test |  | Improved |
| 88 | Liu W et al. 2017, China | Mice, C57BL/6 | 10 weeks | 1 week | 183, 550 and 1650 mg/kgPeganum harmala Linn | vehicle-treated group (n=10)vsscopolamine-induced group (n=10)vsEXT-treated groups (n=10) | Morris water maze test | AChE and ACh levelscholine acetyltransferase (ChAT) activity | Improved |
| 89**Flavonoid**  | Chen Q and Hub P, 2017, China | Rats, Sprague-Dawley |  | 8 weeks | 12.5, 25, and 50 mg/kgproanthocyanidins (PAC) | control group (n=8)vsPAC group (n=8)vsethanol group (n=8)vsethanol and PAC groups (n=8) | Morris water maze test | TBARSGSHIL-1β and TNF-α | Improved |
| 90 | Lee Y et al. 2016, Korea | Mice, ICR | 6 weeks | 14 days | 1.25, 2.5, 5 and 10 mg/kgSpinosin | vehicle-treated control (n=9-10)vspiracetam-treated control (n=9-10)vsSpinosin treated groups (n=9-10) | Passive avoidance task | BDNF | Improved |
| 91 | Lee HE et al. 2016, Rep of Korea | Mice, ICR | 6 weeks | 1 hr before acquisition | 1.25, 2.5, 5 and 10 mg/kgSwertisin  | control group (n=8–10)vsdonepezil group (n=8–10)vsscopolamine group (n=8–10)vsSwertisin group (n=8–10) | Passive avoidance taskMorris water maze test Y-maze taskOpen field test |  | Passive avoidance task, Morris water maze task – ImprovedY-maze task, Open field test – No improvement |
| 92 | Ortiz-Lopez L et al.2016, Mexico | Mice, Balb/C | 8–10 weeks | 14 days | 0.625, 1.25, 2.5, 5.0 and 10 mg/kg body weight | control group (n=4–5)vsEGCG groups (n=4–5) |  | Akt protein | Improved |
| 93**Flavonoid**  | Li E. et al. 2016, China | Rats, Wistar |  | 8 – 11 days | 2 μg Apelin-13 | control (n=10)vsVehicle group (n=9)vsImipramine group (n=9–10)vs Apelin group (n=7–9)vsEx 1: FS group (n=10)vsEx 2: FS+apelin group (n=9)vsEx 3: Apelin group (n=9–10)vsEx 4: LY294002 + Apelin group (n=7–9) | Learned helplessness (LH) testNovel object recognition (NOR) testFoot shock sensitivity test | Corticosterone assay | Learned helplessness (LH) test,Novel object recognition (NOR) test – Improved Foot shock sensitivity test, Corticosterone assay - No improvement |
| 94**Flavonoid**  | Jia SL. et al. 2016, China | Rats, Sprague–Dawley | 3 months | 14 days | 25, 50 and 100 mg/kgLiquiritin | sham control (n=12)vsdonepezil (Aβ1–42 + 3 mg/kg donepezil) (n=12)vsmodel (Aβ1–42) (n=12)vsLQ-H, LQ-M, and LQ-L groups (n=12) | Morris water maze test | GSH-Px, SODMDAprotein carbonyl | Improved |
| 95 | Wang S. et al. 2016, China | Mice, Kunming |  | 3 weeks | 20 and 40 mg/kgOrientin  | control group (n=14)vsorientin-H group (n=14)vsnoise group (n=14)vsnoise + orientin-L & H groups (n=14) | Morris water maze testOpen-field testStep-through test | corticosterone (CORT), norepinephrine (NE) dopamine (DA) levelsMDASODGSHCATBDNF | Improved |
| 96 | Souza LC. et al. 2015, Brazil | Mice, Swiss Albino | 3 months | 60 days | 1 and 10 mg/kgChrysin | Young/Vehicle (n=8–10)vsAged/Vehicle (n=8–10)vsAged/Chrysin groups (n=8–10) | Open-field test (OFT)Morris water maze test | BDNFSODCATGPx | OFT - No improvement |
| 97 | Moreno-Ulloa AM. et al. 2014, Brazil | Mice, C57BL/6 | 6 and 26 months | 2 weeks | 1 mg/kg of body weightepicatechin (Epi) | Group one, Y mice (6-month-old) (n=5)vs group two-Senile (26-month-old) (n=5)vsgroup three-S mice treated with Epi (n=5) |  | GSH GSSGCatalase ActivityProtein Carbonylation | Improved |
| 98**Flavonoid**  | Subramanian P. et al. 2015, India | Rats, Wistar |  | 8 weeks | 50 mg/kg b.w.Fisetin | group I – untreated control (n=6)vsgroup II – treated with fisetin (n=6)vsgroup III – injected with AC (n=6)vsgroup IV – administered with AC and fisetin (n=6) |  | Lipid hydroperoxideSODCATGSHNO level | Improved |
| 99 | Li R. et al. 2014, China | Rats, Wistar |  | 26 days | 30 and 100 mg/kgChrysin (CH) | Control group (n=10)vsVehicle group (DM) (n=10)vsCH groups (n=10) | Morris water maze test | MDACATSOD GSHTNF-aIL-1b IL-6 levelscaspase-3 activity | Improved |
| 100 | Jung IH. et al. 2014, Korea | Mice, ICR | 6 weeks | 1 hr | 2.5, 5, 10 and 20 mg/kgSpinosin | control group (n=8–10)vsdonepezil group (n=8–10)vsvehicle-treated control (n=8–10)vsspinosin groups (n=8–10) | Passive avoidance taskY-maze taskMorris water maze test Open field test |  | Improved |
| 101**Flavonoid**  | Nassiri-Asl MN. et al. 2013, Iran | Rats, Wistar |  | 16 days | 25, 50, and 100 mg/kgQuercetin | control group (n=10)vsPTZ control (n=10)vsQuercetin groups (n=10) | Passive avoidance apparatus | TBARS measurementTotal sulfhydryl groups assay | Passive avoidance apparatus – ImprovedTBARS measurement, Total sulfhydryl groups assay – no improvement |
| 102 | Wang Y. et al. 2012, China | Mice, C57BL/6 | 2 months | 60 days | 20 mg/kgEpigallocatechin-3-gallate (EGCG) | Group I - control (n=5–6)vsGroup II - EGCG (n=5–6)vsGroups III EGCG + cyclopamine (n=5–6)vsGroup IV EGCG + 2-hydropropyl-cyclodextrin (n=5–6) | Morris water maze test |  | Improved |
| 103**Flavonoid**  | Zhang L et al. 2020, China | Rats, Sprague–Dawley |  | 14 days | 10, 30 and 100 mg/kg/dayEriodictyol | Vehicle Group (n=10)vsFluoxetine group (n=9)vsLPS group (n=10)vs30 mg/kg eriodictyol+LPS group (n=9) vs100 mg/kg eriodictyol+LPS group (n=10). | Open field testForced swim testNovel object recognition |  | Improved |
| 104 | Ben-Azu B et al. 2018, Nigeria | Mice, Swiss | 5–6 weeks | 30 minutes | 2.5, 5 and 10 mg/kgNaringin | group 1 - control (n=6)vsgroups 2-4 - NARIN (n=6)vsgroup 5 - Diazepam (n=6) | hole-board apparatusElevated-plus maze testtail suspension testforced swim testnovelty-induced rearingopen field testlight and dark box testsocial interaction testY-maze test |  | Improved |
| 105**Flavonoid**  | Das J et al. 2017, India | Rats, Wistar | 3 months | 12 weeks | 20 mg/kgFisetin | Group I - sham controls (n=5)vsGroup II - iron-induced epileptic rats (n=5)vsGroup III - vehicle (DMSO) (n=5)vsGroup IV - pre-treated iron induced rats (n=5) | Morris water maze test Open-field test | MDA | Improved |
| 106 | Akpa AR et al. 2020, Nigeria | Mice, albino |  | 7 weeks | 15 mg/kgFisetin  | Group 1(S/OIL): control (n=8)vsGroup 2 (CPF): Chlorpyrifos (n=8)vsGroup 3 (FIS): fsetin (n=8)vsGroup 4: FIS + CPF (n=8) | forepaw grip | MDAGPxSODCATAChE | Improved |
|  | 107 | Wei P et al. 2022, China | C57 mice |  | 3 weeks | 100 and 200 mg/kgSilibinin, | sham group (n=5)vsFA 2mM group (n=5)vsFA 2mM+ silibinin 100 mg/kg group (n=5)vsFA2mM+ silibinin 200 mg/kg group (n=5)vsmemantine group (n=5) | Y -Maze MWM  | GSH  | Improved |
|  | 108 | Soubh AA et al. 2021, Egypt  | Sprague-Dawley (SD) rat |  | 7 days | 10 mg/kg Morin  | normal controlvsmTBI control groupvsgroups 3 and 4(killed 24 hrs later and after 1 week)vsgroup 5 – Morinvs group 6 - MK-801vs group 7 - Morin + MK-801 | Swimming test Fear-Conditioned (FC) test  | caspase-3 Bcl-2 | Improved |