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Supplementary materials

Table S1. Search term table for Scopus, PubMed, and Google Scholar

Database	Search String
Scopus	(Plant* OR Natural product* OR Natural compound* OR Organic product* OR Phytochemical* OR Plants-derived compound* OR Plant secondary compound* OR Plant secondary metabolites OR Medicinal plant* OR Medicinal herb* OR Herb* OR Therapeutic plant* OR botanical drug OR traditional medicine OR Plant extract* OR Herbal extract* OR polyphenol* OR phenolic compound* OR flavonoid* OR Terpenoid*) AND (Autophagy OR Autophagic OR cell degradation OR lysosomal degradation OR mitophagy OR cell turnover OR Autophag*) AND (neuro* OR neuron* OR neurological OR neurodegenerat* OR neuroprotect* OR neurogenesis OR neuroscience OR astrocyte* OR microglial* OR hippocampal* OR neuroblastoma)
PubMed	("Plant*" OR "Natural product*" OR "Natural compound*" OR "Organic product*" OR "Phytochemical*" OR "Plants-derived compound*" OR "Plant secondary compound*" OR "Plant secondary metabolites" OR "Medicinal plant*" OR "Medicinal herb*" OR "Herb*" OR "Therapeutic plant*" OR "botanical drug" OR "traditional medicine" OR "Plant extract*" OR "Herbal extract*" OR "polyphenol*" OR "phenolic compound*" OR "flavonoid*" OR "Terpenoid*") AND ("Autophagy" OR "Autophagic" OR "cell degradation" OR "lysosomal degradation" OR "mitophagy" OR "cell turnover" OR "Autophag*") AND ("neuro*" OR "neuron*" OR "neurological" OR "neurodegenerat*" OR "neuroprotect*" OR "neurogenesis" OR "neuroscience" OR "astrocyte*" OR "microglial*" OR "hippocampal*" OR "neuroblastoma")
Google Scholar	Allintitle: (Plant* OR Natural product* OR Natural compound* OR Organic product* OR Phytochemical* OR Plants-derived compound* OR Plant secondary compound* OR Plant secondary metabolites OR Medicinal plant* OR Medicinal herb* OR Herb* OR Therapeutic plant* OR botanical drug OR traditional medicine OR Plant extract* OR Herbal extract* OR polyphenol* OR phenolic compound* OR flavonoid* OR Terpenoid*) AND (Autophagy OR Autophagic OR cell degradation OR lysosomal degradation OR mitophagy OR cell turnover OR Autophag*) AND (neuro* OR neuron* OR neurological OR neurodegenerat* OR neuroprotect* OR neurogenesis OR neuroscience OR astrocyte* OR microglial* OR hippocampal* OR neuroblastoma)

Explanation:

- **Scopus**: The search string uses wildcards (*) and Boolean operators (AND, OR) to capture a wide range of relevant literature. The search string is designed to be comprehensive, accounting for variations in terminology across different studies.
- **PubMed**: PubMed's search string is similar to Scopus, but formatted for the specifics of PubMed syntax, including quotation marks around phrases.
- **Google Scholar**: The Allintitle: operator is used in Google Scholar to focus on articles where the key terms appear in the title, which typically increases relevance. The rest of the search string follows the same logic as the others, with wildcards and Boolean operators.

Table S2. Search Term Filters for Scopus, PubMed, and Google Scholar

Filters	
Text availability	Limited to free full text and full text
Date of range	Period of the inception of databases until February 28, 2024
Author name	No limitation
Subject Area	No limitation
Document type	Limited to original article and book chapter
Source title	No limitation
Publication stage	No limitation
Keyword	No limitation
Affiliation	No limitation
Funding sponsor	No limitation
Country	No limitation
Source type	No limitation
Language	Limited to English
Open access	No limitation

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Table S3. PRISMA Checklist.

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Line 1, Line 11-13
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Line 7 - 32
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Line 35 - 61
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Line 62 - 74
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. . Data sources and search strategy Inclusion and exclusion criteria Quality assessment	Line 86 – 102, supplementary note Table S1, S2
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Line 77 – 84
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplementary note S1 and S2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Line 114-122
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Line 86-86
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Line 113 - 125
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Not applicable
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation	Not applicable

Section and Topic	Item #	Checklist item	Location where item is reported
		tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Not applicable
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Not applicable
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Not applicable
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Not applicable
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Not applicable
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Not applicable
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Not applicable
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Not applicable
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Not applicable
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Figure 1
Study characteristics	17	Cite each included study and present its characteristics.	Table 1 & 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Not applicable
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Table 1 & 2
Results of	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Results

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Section and Topic	Item #	Checklist item	Location where item is reported
syntheses	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Not applicable
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Not applicable
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not applicable
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Not applicable
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Line 153 – 584
	23b	Discuss any limitations of the evidence included in the review.	Line 585 – 612, Table 3
	23c	Discuss any limitations of the review processes used.	Not applicable
	23d	Discuss implications of the results for practice, policy, and future research.	Line 613 – 661, Table 4
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Not applicable
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Not applicable
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Not applicable
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Line 690-691
Competing interests	26	Declare any competing interests of review authors.	Line 693
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Line 681-684

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Table S4: Neuroprotective and autophagy modulatory activities of natural products.

Plant crude extract studies					
Plant name, common & scientific name, part (root/flower/leave, etc. used), country	**Sample preparation method (solvents used)**	**Chemical compounds/ Chemical composition/ Bioactive compounds identified**	**Human disease (Cell lines/ animal models)**	**Results**	**Reference**
Acorus tatarinowii Schott (roots), China	Dried roots was grinded and extracted using petroleum ether reflux, the essential oil was concentrated at 50-60℃ under pressure	N/A	Alzheimer's disease (*C. elegans*)	Neuroprotective activities: ↓ Aβ-induced paralysis in CL4176 transgenic *C. elegans* ↑ Olfactory learning and serotonin sensitivity in CL4176 Aβ transgenic *C. elegans* ↓ Aβ and polyglutamine deposition in the muscle tissue in CL4176 Aβ transgenic and AM140 *C. elegans* ↓ Intracellular ROS in CL4176 Aβ transgenic *C. elegans* Autophagic enhancement: ↑ *Bwc-1, vps-34, unc-51, lgg-1*, and *1gg-2* autophagic-related gene expressions ↓ P62 protein expression level	[1]
Andrographis paniculata, China	Ethanol extract was prepared by soaking in 95% ethanol, followed by vacuum evaporation	Andrographolide, neoandrographolide and deoxyandrographolide	Neurotoxicity study: Aluminium (male ICR mice and PC-12 cells)	Neuroprotective activities: ↑ Cognitive and memory function of aluminium chloride-treated mice ↓ Oxidative stress levels in aluminium chloride-treated mice ↓ Tau phosphorylation in aluminium chloride-treated mice ↑ Viability of $Al(mal)_3$ treated PC12 cells Autophagic enhancement: ↑ LC3B-II and p62 protein expressions in both *in vitro* and *in vivo* experiments ↑ Number of autophagosomes in $Al(mal)_3$ treated PC12 cells	[2]

Angelica polymorpha Maxim (root), Korea	1 kg of grounded root was boiled in 2 L of 80% ethanol for 2 h. Ethanol was added to remove polysaccharides, then evaporated and filtered.	N/A	Neuroblastoma (human SH-SY5Y neuroblastoma cells)	Antiproliferative activities: ↑ Cell viability, ↓ Akt, GSK-3β and MAPKs activation, ↑ number of apoptotic cells, ↑ MMP depolarization, ↑ BAX proapoptotic marker, ↓ Bcl-2 and Mcl-1 anti-apoptotic markers, and ↑ Caspase-3 activation No autophagic activation: No significances in autophagic vacuoles and LC3 proteins expression level	[3]
Apios americana Medik, China	Water extract was prepared by ultrasonicating 100 g of flower powder with 4 L of deionized water at 50°C	1-O-(4-hydroxybenzoyl)-β-D-glucopyranose, apigenin, and kaempferol-3-O-sophoroside	Neuropathology: oxidative stress (PC-12 cells)	Neuroprotective activities: ↓ Cytotoxicity and DNA damage in H_2O_2-treated PC12 cells ↓ Cellular ROS and ↑ mitochondrial function in H_2O_2-treated PC12 cells ↓ Bax, caspase-3 and Nrf2 pro-apoptotic proteins while ↓ Bcl-2 anti-apoptotic protein expressions in H_2O_2-treated PC12 cells Autophagic enhancement: ↑ Atg4, atg5, Rab5, SIRT1, and FoxO1 autophagy proteins expressions in H_2O_2-treated PC12 cells	[4]
Apocynum venetum (leaves), China	Provided by Department of Integrative Medicine of Zhongshan Hospital, Shanghai, China.	N/A	Neuropathology: oxidative stress (PC-12 cells)	Neuroprotective activities: ↑ Viability of H_2O_2 treated PC12 cells ↓ BAX and activated caspase-3 pro-apoptotic protein levels Autophagic enhancement: ↑ LC3-II autophagic marker ↓ SQSTM1/p62 protein expression	[5]
Arctium lappa L. (roots), China	Extract was prepared using ethyl acetate with own research group protocol	4,5-*O*-dicaffeoyl-1-*O*-[4-malic acid methyl ester]-quinic acid	Cerebral Ischemia (male Sprague Dawley rats and SH-SY5Y cells)	Neuroprotective activities: ↑ Neurological score, cerebral infarction and oedema of post MCAO rats ↓ MDA oxidative level, and ↑ SOD and CAT antioxidant enzymatic activities in the hippocampus post MCAO rats and SH-SY5Y cells ↓ TNF-α, IL-1β, NF-κB and COX-2 neuroinflammatory markers ↓ Neuronal apoptosis and neuronal loss in the hippocampus post MCAO rats and SH-SY5Y cells	[6]

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				Autophagic enhancement: ↑ LC-II and Beclin-1 autophagic markers and ↓SQSTM1/p62 protein expression in OGD/R treated SH-SY5Y cells	
Bacopa monnieri (whole plant), India	Ethanolic extract was prepared by using its dried powder with 50% ethanol under 3 times of reflux. The extract was filtered, dried and concentrated using a rotary evaporator	Bacosides	Neurotoxicity: Benzo[a]pyrene (Primary human fetal astrocytes and *C. elegans*)	Neuroprotective activities: ↓ Number of apoptotic cells and activated caspases level in Benzo[a]pyrene-treated astrocyte cells ↑ Lifespan of Benzo[a]pyrene-induced senescence in *C. elegans* Autophagic enhancement: ↓ TOM20 protein expression to promote mitophagy in Benzo[a]pyrene-treated astrocyte cells ↑ LC[7]3-II/I ratio and ↓ p62 autophagy protein markers	[8]
Boswellia serrata (gum), Korea	Methanol extract was prepared by soaking the gum in methanol with sonication, followed by rotary evaporator concentration	N/A	Parkinson's disease (C57BL/6J mice and SH-SY5Y cells)	Neuroprotective activities: ↓ Behavioural dysfunction and microglial activation in the striatum of rotenone-treated mice ↑ BDNF level in the striatum of rotenone-treated mice ↑ Tyrosine hydroxylase dopaminergic marker in the striatum of rotenone-treated mice ↓ α-synuclein protein expression expression in the striatum of rotenone-treated mice and SH-SY5Y cells Autophagic enhancement: ↑ AMPK activation in the striatum of rotenone-treated mice in SH-SY5Y cells ↑ Beclin-1 protein expression in the striatum of rotenone-treated mice	[7]
Calendula officinalis L. (flowers), China	Aqueous extract was prepared by suspending dried flower powder using ultrapure water in 1:100 ratio, followed by concentration with rotary evaporator.	isorhamnetin-3-O-neohespeidoside (12.8104%), rutin hydrate (9.9114%), di-O-methylquercetin (9.9016%), rutin (8.8155%), quercetin-3'-O-glucoside (7.8508%),	Parkinson's disease (zebrafish)	Neuroprotective activities: ↑ Viability of dopaminergic neuron and ↓ nervous system damage in MPTP-treated zebrafish ↑ Locomotor function of MPTP-treated zebrafish ↑ Neurodevelopment-associated gene expressions Autophagic enhancmenet: ↑ *pink1* and *parkin* mitophagy gene expressions ↑ *atg7, atg12, ulk1b* and *ulk2* gene expressions ↑ Clearance of α-synuclein level	[9]

		isoquercitrin (6.369%), isotrifoliin (5.7853%), spiraeoside (5.3827%), tricin 5-O-hexoside, petunidin 3-O-rutinoside, myricitrin, isomucronulatol-7-O-glucoside, tricin, hyperoside, narcissoside, phloretin, and methylnaringenin c-pentoside			
Green tea polyphenols, *Camellia sinensis*, China	N/A	Epigallocatechin-3-gallate and other catechins	Diabetic neuropathy (male Sprague Dawley rats and PC12 cells)	Neuroprotective activities: ↑ Hippocampal senescence, islet structures, and glucolipid metabolism in type-2 diabetic mellitus rats ↑ Spatial memory and ↓ hippocampal injury and apoptosis in T2DM rats ↓ Endoplasmic reticulum stress marker levels Autophagic enhancement: ↑ Number of autophagosomes and autophagosome-lysosome formation in the hippocampus of T2DM rats ↑ PINK and LC3-II/I protein expressions in the hippocampus of T2DM rats and PC12 diabetic cell model ↓ p62 and activated-mTOR protein expressions in the hippocampus of T2DM rats and PC12 diabetic cell model	[10]
Celosia argentea L. (seeds), China	Ethanol extract was prepared by macerating the seed powder in 50% ethanol, and separated using resin HPD100 column chromatography	N/A	Pathophysiology: Oxidative stress (NSC-34 cell lines)	Neuroprotective activities: ↑ Viability of BHP-treated NSC34 cells ↓ Intracellular ROS level in BHP-treated NSC34 cells ↓ Number of apoptotic cells in BHP-treated NSC34 cells ↓ Activated caspase-3, and -7, and cytochrome C expression level ↑ SOD1 antioxidant enzymatic activity Autophagic enhancement: ↑ Beclin-1 autophagic marker	[11]

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Chaenomeles sinesis, China	Aqueous extract was prepared and applied in this study	N/A	Amyotrophic lateral sclerosis (male hemizygous B6SJ/hSOD1G93A mice)	Neuroprotective activities: ↑ Motoneuron function in ALS mice ↓ Inflammatory protein levels in muscle and spinal cord of ALS mice ↓ Oxidative stress level in the muscles ALS mice Autophagic suppression: ↓ LC3B and p62 protein expressions in the muscles ALS mice ↓ activated-mTOR and SMAD2 in the muscles ALS mice	[12]
Coptis chinesis (rhizome), Taiwan	Aqueous extract was provided by Sun-Ten Pharmaceutical Co., LDT.	Berberine (2.66%), Palmatine (0.78%), and Cotpisine (0.72%)	Parkinson's disease (human Flp-In 293 cells SH-SY5Y neuroblastoma cell)	Neuroprotective activities: ↑ β-glucocerebrosidase (GBA) protein expression in Flp-In 293 cells ↑ Cell viability and neurite outgrowth of A53T α-Syn-GFP transgenic SH-SY5Y cells Autophagic enhancement: ↑ Number of stained LC3-positive autophagic vacuoles in Flp-In 293 cells ↑ LC3-II/I autophagy marker protein expression in Flp-In 293 cells ↑ Clearance of α-synuclein in A53T α-Syn-GFP transgenic SH-SY5Y cells	[13]
Cynanchum otophyllum Schneid (rhizome), China	Purchased from Aktin Chemicals Inc. Chengdu, China. The rhizome was pulverised and 1 kg of the powder was reflux in 95% ethanol and subsequently extracted in chloroform. The fraction was further dissolved in methanol and 5% hydrochloric acid at 90°C for 30 min. The mixture was neutralized with	N/A	Alzheimer's disease (Triple transgenic AD mice and HT22 mouse hippocampal cell)	Neuroprotective activities: ↓ Aβ and Tau proteins aggregation in transgenic human APP expression 7PA2 cell and AD mice brain ↓ Microglial and astrocyte activated neuroinflammation in AD mice brain Autophagic enhancement: ↑ LC3-II, LAMP1, TFEB, PPARα and mature CTSD autophagy proteins expression in transfected P301L-GFP HT22 cells and AD mice brain tissue	[14]

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	sodium hydroxide to pH6-7, concentrated and evaporated. Lastly, the crude extract was diluted with water and extracted by chloroform again, separated and concentrated in vacuo at 40°C.				
Bergamot, *Citrus bergamia*	Essential oil, provided by CAPUA s.r.l., Reggio Calabria, Italy	Limonene, linalyl acetate, γ-terpinen, β-bisabolene, terpinolene, neryl acetate, α-pinene, sabinene,myrene, ß-bisabolene, terpinolene, neryl acetate, α-thujene, geranyl acetate, β-caryophyllene, trans-α-bergamotene, geranial, phellandrene, neral, ρ-cimene, decanal, camphene, o-cimene	Autophagy-associated neurological diseases (human SH-SY5Y neuroblastoma cell)	Antiproliferative effects: ↑ Cell death in both apoptosis and necrosis Autophagic enhancement: ↑ LC3-II/I ratio and p62, and ↓ Beclin-1 autophagic markers by both Bergamot essential oil and Limonene pure compound.	[15]
Wampi, *Clausena lansium* (Lour.) Skeels. (fruit peels)	Aqueous extract was prepared by dissolving grinded fruit peels in Milli-Q water in ratio of 1:5, under boiling condition for 1h	N/A	Neuroblastoma (SH-SY5Y cells)	Antiproliferative activities: ↓ Viability in SH-SY5Y cells ↑ DNA damage in SH-SY5Y cells ↑ Oxidative stress in SH-SY5Y cells ↑ BAX and activated caspase-3 pro-apoptotic proteins and ↓ Bcl-2 anti-apoptotic protein Autophagic enhancement: ↑ Beclin-1, Atg4B, and LC3-II/I ratio autophagic markers	[16]
Clitoria ternatea Linn. (whole plant), India	Whole plant and jaggery were combined (1:1) to	Pyrogallal (1.93%), Kaempferol 3-neohesperioside	Brain ageing (Male albino Wistar rats)	Neuroprotective activities: ↑ Spatial learning and memory of stereotaxic mediated kainite stress rats	[17]

	form Medhya rasayana, they were grinded into fines, then they were mixed with animal feed in (1:1) ratio	(0.91%), Quercetin 3 neohesperioside (0.69%), Clitorin (0.38%), Kaempferol (0.3%), and Kaempferiol 3-glucoside (0.16%)		↑ Catalase, SOD, and GSH antioxidant enzymatic activities Autophagic activities: ↓ Brain autophagic level in stereotaxic mediated kainite stress rats ↓ Numbers of autophagosomes in rats' brain tissue	
Ground green and medium-roasted coffee beans, *Coffea arabica* Burundi, Belgium	Obtained from Beyers Koffee, Belgium.	N/A	Alzheimer's disease (human SH-SY5Y neuroblastoma)	Neuroprotective activities: ↑ Viability of $A\beta_{1-42}$, hydrogen peroxide, and rotenone-treated SH-SY5Y cells Autophagic enhancement: ↑ LC3-II, Beclin-1 and lamp2A autophagic markers in mRNA levels	[18]
Hawthorn, *Crataegus pinnatifida* (leaves), China	Provided by Shanxi Kanglisheng Pharmaceutical Co., Ltd., China.	Flavonoids	Spinal cord injury (Sprague Dawley rats)	Neuroprotective activities: ↑ Motoneuron function and ↓ neuronal injury in SCI rats ↓ Cell apoptosis in SCI rats ↑ Axonal regeneration of injured spinal motor neuron Autophagic enhancement: ↑ Number of autophagosomes in spinal cord tissue ↑ LC3-II/I, Beclin-1 and ↓ p62 and SCG10 protein expression in spinal cord tissue	[19]
Tumeric *Curcuma* longa, Thailand	Cordyceps was provided by Laboratory of Cell-Based Assays and Innovations, Suranaree University of Technology, turmeric extract was purchased from SAND-M Global Co., Ltd., and encapsulated with cordyceps	N/A	Alzheimer's disease (human SH-SY5Y cells)	Neuroprotective activities: ↑ Neuronal maturation and dopamine secretion in SH-SY5Y cells ↓ Expressions of AD-related genes in SH-SY5Y cells Autophagic enhancement: ↑ SIRT1 and LC3 protein expressions in SH-SY5Y cells ↑ Autophagic vacuoles in SH-SY5Y cells	[20]

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Dendrobium nobile Lindl (stems), China	Extracted using boiling in 95% ethanol	Dendrobine (92.6%), dendrobine-N-oxide (3.3%), nobilonine (2.0%), and 6-hydroxy-nobilonine (0.32%)	Alzheimer's disease (rat primary hippocampal cells)	Neuroprotective activities: ↓ Axonal degeneration in $A\beta_{23-25}$ treated cell Autophagic enhancement: ↑ Autophagosome formation and autophagosome-lysosome fusion ↑ LC3-II/I ratio, Beclin-1 and Atg5 autophagic markers	[21]
			Alzheimer's disease (male SAMP8 mice)	Neuroprotective activities: ↑ Cognitive and memory functions in mice ↑ Morphologically improvement in cortex and hippocampus ↓ Aβ deposition in the cortex and hippocampus ↑ IDE and NEP Aβ degrading enzyme activities Autophagic enhancement: ↑ LC3and Beclin-1 autophagic markers and ↓ p62 protein expression	[22]
			Neurotoxicity: D-galactose (primary hippocampal neurons)	Neuroprotective activities: ↑ Viability of D-galactose treated primary hippocampal neurons ↓ Cell senescence biomarkers in primary hippocampal neurons Autophagic enhancement: ↑ LC3-II/I and Beclin-1, ↓ p62 protein expression ↑ Sirt-1 and FoxO1 protein expressions	[23]
	Purchased from Xintian Traditional Chinese Medicine Industry Co., LTD of Guizhou Province		Neurotoxicity: Manganese chloride (PC-12 cells)	Neuroprotective activities: ↑ Cell viability of $MnCl_2$-treated PC12 cells ↓ Cellura ROS production while ↑ mitochondrial respiration level in $MnCl_2$-treated PC12 cells ↓ Apoptotic cells number, ↓ Bax pro-apoptotic protein and ↑ Bcl-2 anti-apoptotic protein expressions in $MnCl_2$-treated PC12 cells Autophagic enhancement: ↓ LC3-II while ↑ p62 autophagy proteins expressions for autophagosome degradation in $MnCl_2$-treated PC12 cells ↑ PINK1 and Parkin mitophagy proteins expressions in $MnCl_2$-treated PC12 cells	[24]

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Eucommia ulmoides Oliver (leaves), China	Aqueous extract was prepared using 50g of leaves powder dissolving in 5 L of ultrapure water under heat reflux, followed by precipitation and freeze-drying process	Aucubin, geniposidic acid, neochlorogenic acid, chlorogenic acid, and cryptochlorogenic acid	Parkinson's disease (Zebrafish embryos)	Neuroprotective activities: ↑ Viability of dopaminergic neurons in the brain of MPTP-treated zebrafish ↓ Number of apoptotic cells in the brain of MPTP-treated zebrafish ↑ Locomotor functions in MPTP induced PD zebrafish ↑ α-synuclein clearance Autophagic enhancement: ↑ *Pink1* and *parkin* mitophagy marker transcript levels ↑ *Beclin-1 ulk1, ulk1b* and *ambra1a* autophagic marker transcript levels	[25]
Euterpe oleracea and *Euterpe precatoria* (pulp), United States	Solubilization of 100 mg whole fruit in 10 mL deionized (water)	Cyanidin-glucoside, cyanidin-rutinoside, delphinidin-glucoside, malvidin-glucoside, peonidin-glucoside, catechin. ferulic acid, quercetin, resveratrol, vanillic acid, and synergic acid	Neuropathology: oxidative stress (mouse hippocampal HT22 cells and primary rat hippocampal cells)	Neuroprotective acitivites: ↓ dopamine-induced calcium dysregulation in primary rat hippocampal neuron Autophagic enhancement: ↓ MDC-stained autophagic vacuoles, ↓ LC3-II/I ratio and p-mTOR autophagic markers, and ↓ p62 selective target for autophagy-mediated proteolysis of bafilomycinA1-induced autophagy dysfunction in HT22 cells.	[26]
Folium *Hibisci mutabilis* (leaves), China	Ethanol extract was prepared by soaking leaves powder in 75% ethanol, followed by vacuum evaporation	N/A	Neuropathophysiology: protein aggregation (*C. elegans,* PC-12 cells and triple transgenic AD mice)	Neuroprotective activities: ↓ AD, PD, and HD pathology in *C. elegans* models ↑ Lifespans and stress resistance in normal N2 worms ↑ Viability of and ↓ clearance of AD-related proteins in Aβ treated PC-12 cells ↑ Cognitive and memory functions in AD mice Autophagic enhancement: ↑ GFP-LGG1 puncta in DA2123 worms ↓ p62/SQST-1-GFP puncta in BC12921 worms ↑ *unc-51 and vps-34* mRNA expression in normal N2 worms ↑ GFP-LC3 puncta, LC3-II/I ratio while ↓ p62 in GFP-RFP-LC3 U87 and PC-12 cells	[27]

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				↑ LC3B and ↓ p62 protein expression in the brain of AD mice	
Gardenia jasminoides, Korea	Provided by Hanpoong Pharmaceutical Co., Jeonju, Korea.	N/A	Brain Tumour (U87MG and U373MG cells, and normal astrocyte cells)	Anti-proliferative activities: ↓ Viability of both human glioblastoma cell lines ↑ Activated caspase-3, -9, and PARP pro-apoptotic proteins ↑ Synergistical anti-proliferative effects on glioblastoma cells when combine with cisplatin ↑ p53, and ↓ activation of Akt and p70S6K protein expressions Autophagic enhacemenet: ↑ LC3-II autophagic marker and ↓ p62 protein expression	[28]
Ginkgo biloba 761, Germany	N/A, extracted using 60% (acetone)	Ginkgo flavone glycosides, terpene lactones, ginkgolides A, B and C, bilobalide, and ginkgolic acids	Alzheimer's disease (TgCRND8 APP-transgenic AD mice)	Neuroprotective activities: ↑ Cognitive function, PSD-95, Munc18-1, and SNAP25 synaptic structure proteins level, BDNF level, ↓ Iba-1-positive inflammatory cells and ↓ TNF-α and CCL-2 pro-inflammatory cytokines in TgCRND8 APP-transgenic AD mice. Autophagic enhancement: ↑ LC3-II, beclin-1 autophagic marker, and p62 autophagic markers, ↓ NLRP3 inflammasome level by autophagy in TgCRND8 APP-transgenic AD mice and primary microglial cells from C57BL/6 mice.	[29]
	Provided by Dr Willmar Schwabe Pharmaceuticals, and extracted using 60% acetone	N/A	Alzheimer's disease (Human SH-SY5Y neuroblastoma and P301S tau mutant-transgenic mice)	Neuroprotective activities: ↑ Cognitive and synaptic functions in tau mutant-transgenic mice ↓ Deposit of phosphorylated tau level in the brain of transgenic mice ↓ Number of Iba-1 and S100 stained inflammatory microglial cells from hippocampus of transgenic mice ↓ il-1β pro-inflammatory, while ↑ arg1 and mcr1 anti-inflammatory transcriptional genes from hippocampus of transgenic mice Autophagic enhancement: ↑ LC3-II autophagic marker in the brain of transgenic mice and normal SH-SY5Y cells	[30]

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				↑ Number of autophagosomes and autolysosomes in SH-SY5Y cells ↑ Atg5 and Beclin-1 autophagic markers in SH-SY5Y cells	
	Provided by Zhonghao International Co. Ltd., China)		Cerebral Ischemia (male Spraque Dawley rats)	Neuroprotective activities: ↓ Neurological deficit and infarct volume the brain of post MCAO rats ↑ Viability of penumbral neuron of post MCAO rats Autophagic enhancement: ↑ LC3-II/I and Beclin-1 protein expressions in penumbra of post MCAO rats ↓ CTSB and CTSD lysosomal proteins in penumbra of post MCAO rats ↑ SQSTM1 protein expressions in penumbra of post MCAO rats	[31]
Ginkgo biloba EGB1212	Provided by Key Laboratory of Traditional Chinese Medicine Pharmaceutical Technology, Zheiang, China.	Flavonoids, terpene lactones (ginkgolides A, B, C and bilobalide), and ginkgolic acids	Cerebral Ischemia (Sprague-Dawley rats)	Neuroprotective activities: ↑ Survival rate of post-reperfusion rats ↑ Visual-spatial learning and memory, and short-term spatial memory in EGB1212-treated rats ↓ Neuronal death in the hippocampal CA1 region of post-reperfusion rats Autophagic suppression: ↓ LC3-II/I ratio autophagic marker in the hippocampal neurons	[32]
Graptopetalum paraguayense (leaves), China	Ethanol extract was prepared by dissolving 15 g lyophilized powder into 100 ml of pure ethanol and fractionized using size exclusion column	N/A	Alzheimer's disease (APPswe/PS1dE9 double transgenic mice, and SH-SY5Y cells, *C. elegans*)	Neuroprotective activities: ↓ Aβ production in APP695 transgenic SH-SY5Y cells ↓ Plaque formation in the brain of transgenic mice ↑ AMPK activation in the brain of transgenic mice Autophagic enhancement: ↑ LC3-II/I ratio autophagic marker and ↓ p62 protein expression in APP695 transgenic SH-SY5Y cells ↑ LGG-1/LC3 puncta in the seam cells of transgenic AD *C. elegans*	[33]

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Herba Rhodiolae, China	Purchased from Beijing Tongrentang	N/A	Depression (male Sprague Dawley rats)	Neuroprotective activities: ↓ Depressive behaviour in CUMS rats ↑ BDNF and TrkB protein expression levels in the hippocampus tissue of CUM rats ↓ Glutamate level in the hippocampus tissue of CUM rats Autophagic suppression: ↓ LC3-II/I ratio and Beclin-1 autophagy protein expressions in the hippocampus tissue of CUM rats ↓ Number of autophagosomes in the hippocampus tissue of CUM rats	[34]
Humulus lupulus L., Italy	Extarcted using boiling water or 10% ethanaol, followed by freeze dyring	Chlorogenic acids, procyanidines, and glycosyl flavanols	Alzheimer's disease (SH-SY5Y cells and *C. elegans*)	Neuroprotective activities: ↑ Viability of Aβ-treated cells ↓ Aggregation of Aβ in Aβ-treated cells ↓ Paralyzed worm in AD transgenic *C. elegans* Autophagic enhancement: ↑ Beclin-1, LC3, p62, and LAMP2A transcription and protein level ↓ Activation of Akt, ERK, and p70S6K protein expression	[35]
Lychee, *Litchi chinensis* Sonn. (seeds), China	N/A	N/A	Alzheimer's diseases (BV-2 and PC-12 cells)	Neuroprotective activities: ↓ NLRP3 inflammatory marker in Aβ-treated BV-2 cells and mutant Aβ transgenic mice ↑ Viability of Aβ-treated PC12 cells ↑ Cognitive function in mutant Aβ transgenic mice Autophagic enhancement: ↑ LRP1 Aβ transport membrane expression level in Aβ-treated BV-2 cells and mutant Aβ transgenic mice ↑ LC3-II/I ratio and Beclin-1 autophagic markers in Aβ-treated BV-2 cells and mutant Aβ transgenic mice ↑ Activation of AMPK, while ↓ protein level in Aβ-treated BV-2 cells and mutant Aβ transgenic mice	[36]
	N/A	N/A	Alzheimer's disease (APP/PS1 double transgenic AD C57BL/6 mice and bEnd.3 muse brain	Neuroprotective activities: ↑ Cognitive function of AD mice ↑ Cell viability of Aβ (25-35)-induced bEnd.3 cells ↓ Monolayer permeability of Aβ (25-35)-induced bEnd.3 cells	[37]

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			capillary endothelial cell line)	↓ NLRP3, caspase-1, ASC, IL-1β and IL-18 neuroinflammatory proteins in brain tissue of AD mice and Aβ (25-35)-induced bEnd.3 cells Autophagic enhancement: ↑ LC3-II and formation of GFP-LC3 puncta in Aβ (25-35)-induced bEnd.3 cells ↑ Activation of AMPK and ↓ mTOR and ULK1 proteins in Aβ (25-35)-induced bEnd.3 cells	
Lonicera japonica (flowers), China	Ethanol extract was prepared by using 95% ethanol under reflux	N/A	Alzheimer's disease (male Kunming mice)	Neuroprotective activities: ↑ Cognitive and memory functions in LPS-treated mice Autophagic enhancement: ↑ Atg5, Vps34, Beclin-1, and LC3-II autophagic marker in the hippocampus of LPS-treated mice	[38]
Lycium barbarum, China	Purchased from Ningxia Agricultural and Forestry College	N/A	Diabetic peripheral neuropathy (male Sprague Dawley rat)	Neuroprotective activities: ↓ Myelin and axonal injury in the sciatic nerves of diabetic rats ↓ Electrophysiological damage in the sciatic nerves of diabetic rats Autophagic enhancement: ↑ LC3-II and Beclin-1 while ↓ p62 autophagy proteins expressions ↓ Activation of mTOR and p70S6K proteins	[39]
	Purchased from Beijing Solarbio Science & Technology Co. Ltd, Beijing, China	N/A	Stroke (Primary hippocampal neuron from C57BL/6 mice)	Neuroprotective activities: ↑ Viability and ↓ LDH release from oxygen glucose deprivation/reoxygenation-induced neuron ↓ Intracellular ROS level ↓ Caspase-3 activation and BAX/Bcl-2 ratio pro-apoptotic marker ↓ Number of apoptotic cells Autophagic suppression: ↓ LC3-II/I ratio and Beclin-1 autophagic markers, ↑p62 protein expression ↑ activation of Akt, mTOR protein expression	[40]

	Aqueous extract of dried fruits was prepared sequential decolouration and delipidation in alcohol, and boiling in distilled water, lastly, followed by freeze-dried into powder, China	N/A	Retinal ganglion degeneration (female Sprague Dawley rats)	Neuroprotective activities: ↓ Degeneration of retinal ganglion cells in the nasal retinas of post-PONT rats ↑ Microglia/macrophages polarization Autophagic enhancement: ↑ CD68 marker for microglia/macrophages activation ↑ LC3-II autophagic marker	[41]
	Purchased from Yuanye Biotechnology Co. Ltd. Shanghaim China.	N/A	Parkinson's disease (Sprague Dawley juvenile rats)	Neuroprotective activities: ↓ Behavioural and locomotor dysfunction in 2,4-dichlorophenoxyacetic acid treated PD rats ↑ Viability of neuronal cells in hippocampus ↑ Microglial activation ↓ Oxidative stress and ↑ antioxidant enzyme activities in rat sera Autophagic enhancement: ↑ LC3-II/I and Beclin-1 autophagic markers mRNA expressions	[42]
Lycium babarum, Hong Kong, China	Purchased from Hong Kong Institute of Biotechnology, Hong Kong, China	35% arabinose, 16% galactose, 10% rhamnose, small fractions of glucose, xylose, mannose, glucuronic acid, and carotenoids	Chronic intermittent hypoxia (Male Sprague Dawley rats)	Show neuroprotective properties without alternation of autophagic activities in brain tissue of rats Autophagic enhancement: ↑ Autophagosome activities in DA2123 *C. elegans*	[43]
Nicandra physaloides (fruits), China	Fruits were extracted using 90% ethanol and partitioned with ethyl acetate	Phenolic amides	Parkinson's disease (human SH-SY5Y neuroblastoma)	Neuroprotective activities: ↑ Viability of MPP^+-treated SH-SY5Y cells ↓ Number of apoptotic cells, ↑ caspase-3 activation and BAX/Bcl-2 ratio apoptotic marker Autophagic enhancement: ↑ LC3-II/I ratio and ↓ p62 autophagic markers	[44]

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Olea europaea L. (extra virgin olive oil), Spain	Cooking oil was purchased that originated from Empeltre cultivar	N/A	Amyotrophic lateral sclerosis ($SOD1^{G93A}$ transgenic mice)	Neuroprotective activities: ↑ Lifespan and motor function of ALS mice ↑ Muscle fiber are in ALS mice Autophagic suppression: ↓ *LC3* and *Beclin-1* autophagic gene expression levels	[45]
Oxalis corniculate (aerial part), Egypt	Methanol extract using 5 g of dried powdered aerial parts through maceration with pure methanol and concentrated by rotary evaporator.	Carbohydrates, glycosides, saponins, tannins, and terpenoids	Alzheimer's disease (Male Sprague-Dawley rats)	Neuroprotective activities: ↑ Cognitive functions of learning and spatial memory of aluminium chloride ($AlCl_3$)-treated AD rats ↑ *Nrf2* and *HO-1* antioxidant gene expressions in brain tissue of $AlCl_3$-treated AD rats ↓ IL-1β, TNF-α neuroinflammatory protein expressions while ↓ *NLRP3* and *caspase-1* neuroinflammatory gene expressions in brain tissue of $AlCl_3$-treated AD rats ↑ *Bcl-2* anti-apoptotic and ↓ *Bax* pro-apoptotic gene expressions in brain tissue of $AlCl_3$-treated AD rats ↓ BACE1 protein expression and ↑ APP, Aβ, p-Tau protein clearance in brain tissue of $AlCl_3$-treated AD rats Autophagic enhancement: ↓ Beclin-1 protein expression in brain tissue of $AlCl_3$-treated AD rats	[46]
Korean ginseng, *Panax* ginseng, ginsenoside SGB121	Purchased from Daedong Korean ginseng Co., Ltd	Ginsenoside Rg1, Rb1, Rc, Rb2, Rb3, and Rd)	High fat diet-induced brain damage (female C57BL/6J mice)	Neuroprotective activities: ↓ Oxidative stress and ↑ antioxidant enzymatic activities in high fat diet mice ↓ Cellular senescent and inflammatory protein markers in high fat diet mice ↓ Neuronal apopotosis and pro-apoptotic proteins in high fat diet mice Autophagic suppression: ↓ Atg12, Beclin-1, and LC3-II and ↑ p62 protein expression	[47]
Guarana, *Paullinia cupana* (seeds), Brazil	Guarana seed powder was extracted in 70% ethanol in a ratio of 300 mg/mL	Caffeine, theobromine, catechins, epicatechins	Alzheimer's and Huntington's diseases	Neuroprotective activities: ↑ Viability of aversive stimuli neurons in Polyglutamine treated Huntington's *C. elegans* ↓ $A\beta_{1-42}$-induced paralysis in Alzheimer's *C. elegans*	[48]

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			(*Caenorhabditis elegans*)	↓ ROS accumulation in CL2006 transgenic *C. elegans* ↑ Expression of antioxidant and heat shock-associated genes Autophagic enhancement: ↑ Proteosomal and lysosomal degradation activity	
Palm date, *Phoenix dactylifera* L. (fruits), Egypt	Aqueous extract was prepared by using 100 g of blended fruits in 1 L of water, followed by evaporation	p-coumaric acid, caffeic acid, ferulic acid, chlorogenic acid, sinapic acid, quercitin-3-o-glycoside, apiginin-c-glycoside, and luteoline-7-o-glycoside	Autism (female Sprague Dawley rats)	Neuroprotective activities: ↑ Cognitive and memory functions of valproic acid-treated rats ↓ Anxiety biomarker and oxidative stress levels of valproic acid-treated rats ↑ Cerebellar and hippocampus morphologically integrity in Autism rats ↓ Pro-apoptotic markers in Autism rats Autophagic enhancement: ↑ Sirt-1 expression in the hippocampus of Autism rats ↑ LC3 expression in the cerebellar cortex of Autism rats	[49]
Kaliningrad amber, *Pinus succinifera*, Russia	Ethanol extract was prepared using 50% ethanol with constant stirring at 40℃, lyophilized and further dissolved in DMSO	N/A	Alzheimer's disease (human SH-SY5Y cells)	Neuroprotective activities: ↓ Viability of Aβ-treated SH-SY5Y cells ↓ BAX/Bcl-2 ratio and activated caspase-3 pro-apoptotic markers at mRNA and protein levels ↓ Intracellular ROS level and ↑ SOD1, SOD2, and CAT antioxidant enzymatic activities at mRNA level Autophagic enhancement: ↑ LC3-II and Beclin-1 autophagic markers at mRNA and protein expression	[50]
		N/A	Parkinson's disease (human SH-SY5Y cells)	Neuroprotective activities: ↑ Viability in 6-OHDA treated cells ↓ Intracellular ROS level and pro-apoptotic proteins in 6-OHDA treated cells Autophagic enhancement: ↑ LC3-II and Beclin-1 autophagic proteins	[51]
Piper Longum L.	Prepared by Laboratory for Chemistry of Chinese	Piperine (54.1%) and piperlonguminine (3.74%)	Parkinson's disease (mouse MN9D dopaminergic neuronal	Neuroprotective activities: ↑ Motor function of rotenone-Wistar rats	[52]

	Material of Chinese Capital Medical University, Beijing ,China		and human SK-N-SH neuroblastoma cell lines, C57BL/6 mouse primary cortical neuron and male Wistar rats)	↑ Viability of rotenone-treated and mitochondrial function on both rotenone-treated cell lines ↑ Mitochondrial mPTP blockage and ↓ cytochrome C release in both cell lines and mice primary cortical cell. ↓ Caspase-3 pro-apoptotic marker in rotenone-treated mice primary cortical cells Autophagic enhancement: ↑ LC3-II/I ratio autophagic marker	
Yuan Zhi, *Polygala tenuifolia* (root), China	Ethanolic extract, 20 g of *Polygala tenuifolia* powder followed by 1 h reflux with 10 times its volume of 75% ethanol. The extract was dried and concentrated using rotary evaporator	Polygalacic acid, senegenin and onjisaponin B	Huntington's disease and Parkinson's disease (PC-12 and mouse embryonic fibroblast cells)	Autophagic enhancement: ↑ LC3II/I ratio autophagic marker in PC-12 cells ↑ LC3 puncta formation in wild type *Atg*7 gene but not in *Atg*7 gene-deficient mouse embryonic fibroblast ↓ AMPK and p70s6k activation Its bioactive compounds, Onjisaponin B showed similar effect Neuroprotective activities: ↑ Clearance of mutant proteins aggregation (Huntingtin and A53T α-synuclein) transfected in PC12 cells	[24]
	Ethanolic extract, extracted in 70% ethanol using spin steaming process with rotary evaporator	N/A	Alzheimer's disease (Chinese hamster ovary CHO and human SH-SY5Y neuroblastoma cells)	Neuroprotective activities: ↓ Aβ1-40 peptides secretion level of transgenic CHO-APP/BACE1 cells Autophagic enhancement: ↑ Autophagic vacuoles and LC3II/I ratio autophagic marker in SH-SY5Y cells ↑ mTOR and p70s6k autophagic markers inhibition in SH-SY5Y cells ↑ AMPK and Raptor proteins activation in SH-SY5Y cells	[53]
	Aqueous extract was prepared by immersing 1 kg of dried roots with 8 L of water under reflux	N/A	Depression (male ICR mice and Wistar rats)	Neuroprotective activities: ↑ Antidepressant effects on behavioral despair mice and CRS-induced rats ↓ Iba-1 and ↑ GFAP microglial activation markers ↓ Neuroinflammatory markers at mRNA expression Autophagic enhancement:	[54]

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				↑ LC3-II and Beclin-1 autophagic markers and ↓ p62 protein expression in CRS rats ↓ Activation of Akt mTOR, and ULK1 and ↑ AMPK activation	
Portulaca oleracea L. (stem and leaves), Egypt	Ethanol extracts was prepared by soaking the dried stem and leaves in 70% ethanol, followed evaporation and freeze-drying process.	Gallic acid, chlorogenic acid, catechin	Diabetic-associated Dementia (Sprague Dawley rats)	Neuroprotective activities: ↑ Cognitive function in diabetic rats ↓ ROS and inflammatory level in the hippocampus of diabetic rats Autophagic enhancement: ↓ AMPK activation ↓ LC3B-II/I and p62 protein expression	[55]
Posidonia oceanica (L.) Delile (leaves), Italy	Ethanol extract was prepared by immersing leaves powder in 70% ethanol, followed by hydrophobic compounds exclusion and vacuum dried.		Neuroblastoma (SH-SY5Y cells)	Antiproliferative activities: ↓ Cancer cell migration in SH-SY5Y cells *via* ↓ gelatinase activity ↑ Cell differentiation in SH-SY5Y cells Autophagic enhancement: ↑ LC3-II autophagic marker, and ↓ p-S6 and p62 protein expressions	[56]
Montmorency tart cherry powder, *Prunus cerasus*, United States	Provided by Cherry Marketing Institute in Freeze-dried	N/A	Aging-associated pathology (male Fischer rats)	Neuroprotective activities: ↑ Cognitive and motor function of Fischer rats ↓ GFAP, NOX-2 and COX-2 proinflammatory markers Autophagic enhancement: ↓ mTOR, p62/SQSTM ratio activation and ↑ Beclin-1 autophagic marker	[57]
Boh-Gol-Zhee, *Psoralea coryfolia* L. (seeds), China	300 g of grounded seeds were used to extract twice using distilled water under reflux	Isopsoralen	Neuropathology: Oxidative stress (rat PC-12 pheochromocytoma cells)	Neuroprotective activities: ↑ Viability of palmitate treated PC12 cells and ↓intracellular ROS level by the extract and Isopsoralen ↓ Number of apoptotic cells, ↓ BAX, activated caspase-3 and PARP apoptotic markers, and ↑ BCl-2 antiapoptotic marker by the extract and Isopsoralen Autophagic enhancement: ↑ Beclin-1 and p62 autophagic markers at both mRNA and protein level by the extract and Isopsoralen	[58]

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Pomegranate, *Punica granatum* (fruit), Oman	Frozen at -40°C and grounded into fine powder to produce 4% pomegranate fruit diet.	N/A	Alzheimer's disease (Tg2576 mice)	Neuroprotective activities: ↑ PSD-95, Munc18-1, SNAP25, synaptophysin, p-CaMKIIα/ CaMKIIα, and pCREB/CREB synaptic structure protein levels in the brain of transgenic APP_{sw}/Tg 2576 mice ↓ TNF-α, IL-1β, iNOS, CCL-2 and IL-10 neuroinflammatory markers in brain tissue Autophagic enhancement: ↑ Beclin-1 and LC3-II autophagic markers in brain tissue ↑ Akt, mTOR and p70S6K activation in brain tissue	[59]
Salvia sahendica (Aerial part), Iran	Maceration in (acetone) and purified Salvigenin with TLC technique	Salvigenin, sclareol, esterterpenoid salvileucolide-6,23-lactone, terpenoid loliolide, triterpenoids, oleanolic acid and maslinic acid, the steroidal compounds β-sitosterol and daucosterol, eupatorin, hispudulin, ladanein, and apigenin	Neuropathology: oxidative stress (human SH-SY5Y neuroblastoma cells)	Neuroprotective activities: ↑ SH-SY5Y cell viability against H_2O_2-induced cell death, ↓ intracellular ROS production, ↑ GSH level, ↑ SOD activity, ↓ calpain and caspase-12 ER stress associated protein markers, ↓ AO/EB-stained apoptotic cells, and ↓ activated caspase-3 and Bax/Bcl-2 ratio apoptotic markers Autophagic enhancement: ↑ AO-stained acidic cytoplasmic vesicles,↑ LC3-II/I ratio, Atg7 and Atg12 autophagic markers in H_2O_2 treated SH-SY5Y	[60]
Scrophularia buergeriana Miquel	Ethanol extract was prepared using dried roots with 70% ethanol, following the Brainon® protocol.	Angoroside C	Alzheimer's disease (male senescence-accelerated mouse prone 8)	Neuroprotective activities: ↑ Cognitive and memory functions of SAMP8 mice ↑ Clearance of $A\beta_{1-42}$ and p-Tau proteins in the brain tissue of SAMP8 mice ↑ Expression of SOD-1, SOD-2, GPx-1, catalase and GR antioxidant enzymes in the brain tissue of SAMP8 mice ↓ Expression of iNOS, TNF-α, and IL-6 pro-inflammatory cytokines in the brain tissue of SAMP8 mice ↑ Bcl-2 anti-apoptotic proteins while ↓ Bax, activated caspase-3, caspase-9 and PARP pro-apoptotic proteins Autophagic enhancement:	[61]

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				↑ PINK1 and Parkin mitophagy protein expressions in the brain tissue of SAMP8 mice ↑ FUNDC1 and LC3B autophagy protein expressions in the brain tissue of SAMP8 mice	
Selaginella tamariscina (aerial parts), Korea	Ethanol extract was prepared by macerating 50g aerial parts into 390 ml 70% ethanol, followed by sample concentration in rotary vacuum evaporator	N/A	Neurotoxicity studies: Glutamate (HT-22 cells)	Neuroprotective activities: ↑ Viability and ↓ intracellular ROS level in glutamate treated HT22 cells ↓ Number of apoptotic cells and pro-apoptotic proteins in glutamate treated HT22 cells ↑ MMP level and mitochondrial function Autophagic suppression: ↓ LC3-II and Beclin-1, and ↑ p62 protein expressions ↑ Activation of PI3K, Akt, and mTOR protein expressions	[62]
Sideritis scardica, (Aerial part), Serbia	Maceration in 70% (v/v) (ethanol) and fractionated using diethyl ether and ethyl acetate	Protocatechuic acid, chlorogenic acid, vanillic acid, caffeic acid, syringic acid, *ρ*-coumarin, ferulic acid, luteolin-7-O-glycoside, apigenin-7-O-glycoside, luteolin, apigenin	Brain tumours (rat C6 glioma cells and primary rat astrocytes)	Anti-glioma activities: ↑ Cytotoxicity in rat C6 glioma cells that was not observed in primary rat astrocytes, ↑ intracellular ROS production, ↑ number of apoptotic cells, ↑ caspase activation, and induce cell cycle proliferation block in rat C6 glioma cells. Autophagic enhancement: ↑ AO-stained acidic cytoplasmic vesicles in C6 glioma cells, ↑ LC3-II and beclin-1 autophagic markers, and ↓ p62 selective target for autophagy-mediated proteolysis	[63]
Tanacetum cinerariefolium (flower), China	Purchased from Sigma Aldrich	N/A	Neuroblastoma (SH-SY5Y human neuroblastoma cells)	Anti-proliferative activities: ↓ Cell viability of SH-SY5Y cells ↓ MMP level in SH-SY5Y cells ↑ DNA damage in SH-SY5Y cells Autophagic enhancement: ↑ LC3-II/I ratio and beclin-1 while ↓ p62 expression of autophagic markers ↑ Autophagosome-lysosome fusion formation ↑ AMPK activation while ↓ mTOR and 70s6k activation	[64]

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Thunbergia laurifolia (leaves), Thailand	Ethanol extract was prepared by mixing 40 g of leaves powder in 400 ml of ethanol using Soxhlet appratus	N/A	Neurotoxicity study Glutamate (HT-22 cells)	Neuroprotective activities: ↑ Viability of glutamate-treated HT22 cells ↓ Intracellular ROS level and ↑ mRNA expressions of SOD1, SOD2, GPx and CAT antioxidant enzymatic activities in glutamate-treated HT22 cells ↑ MMP levels of glutamate-treated HT22 cells Autophagic suppression: ↓ LC3-II/I ratio autophagic marker ↑ Tom20 mitophagy marker	[65]
Urtica dioica (leaves), Northwestern Himalayan, India	The leaves were pulverized and macerated in methanol and water solvent (1:1) ratio for 48 h with constant shaking	N/A	Antidepressant and anxiolytic studies (Male Swiss albino mice)	Behavioural improvement: ↑ Mobility in forced swim and tail suspension tests in streptozotocin induced diabetic mice after treatment ↑ Sucrose preference level in diabetic mice ↓ Performance in elevated plus maze task in treated-diabetic mice Protective activities: ↑ BDNF, TrkB and Cylin D1 expressions at mRNA levels in treated-diabetic mice ↓ iNOS expression at mRNA level in hippocampus tissue ↑ Bcl-2 anti-apoptotic marker at mRNA level in the hippocampus tissue ↓ Neuronal damage in hippocampus region of diabetic mice ↓ DNA fragmentation and number of apoptosis in hippocampus region of diabetic mice Autophagic enhancement: ↑ Atg5 and Atg7 autophagic markers at mRNA level in the hippocampus tissue	[66]
Ugni molinae (fruits), Chile	Ethanolic extract was prepared by using the lyophilized and triturated ripe fruits with maceration in ethanol (in 1% formic acid), then it was dried and concentrated	Phenolic compounds	Huntington disease (HEK293 cells)	Protective activities: ↓ Aggregation of polyQ$_{79}$-EGFP and Huntingtin in transfected HEK293 cells. Potential autophagic enhancement: Show a trend of increasing in LC3-II and p62 autophagy proteins expression but they are not statistically significant	[67]

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	using rotary evaporator				
Blueberry extract, *Vaccinium sect. Cyanococcus*, China	N/A	Anthocyanin	Alzheimer's disease (APP/PS1 transgenic AD mice and primary hippocampal neurons)	Neuroprotective activities: ↓ Neuronal injury in the hippocampus of AD mice ↑ Viability of Aβ-treated primary hippocampal neuron Autophagic enhancement: ↑ Number of autophagosomes in hippocampus of AD mice ↑ Autophagosome-lysosome formation in Aβ-treated primary hippocampal neuron ↑ LC3-II, LAMP1 and Cathepsin D protein expression level	[68]
Ashwagandha/Indian ginseng, *Withania somnifera* (roots), Canada	Ethanol extract was prepared in anhydrous ethanol to achieve final concentration of 200 mg/mL	Withanolides	Parkinson's disease (male Long-Evans hooded rats)	Neuroprotective activities: ↑ Viability of dopaminergic neurons of paraquat-treated mice ↑ Motoneuron function in paraquat-treated mice ↓ 4-HNE oxidative stress and lipid peroxidation level and ↑ CARP1 apoptotic marker in the midbrain of paraquat-treated mice ↓ Iba-1 pro-inflammatory marker for microglial activation ↑ GDNF and pro-BDNF neurotrophic factor levels Autophagic enhancement: ↑ Beclin-1 autophagic marker	[69]
	Provided by Valeant Pharmaceuticals International Inc. QC, Canada	Withanolides and alkaloids	Amyotrophic lateral sclerosis (SOD1^{G93A} transgenic mice)	Neuroprotective activities: ↑ Lifespan and motor performance of transgenic Huntington's mice ↑ Clearance of SOD1 misfolded proteins ↑ Viability of motor neurons ↓ TLR2, CD68 and COX-2 and phosphorylated-p65 NF-κB inflammatory markers in the spinal cord of Huntington's mice Autophagic enhancement: ↑ LC3-II ratio and ↓p62 autophagic markers	[70]

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Others					
Plant name, common & scientific name, part (root/flower/leave, etc. used), country, formulation name	**Sample preparation method (solvents used)**	**Chemical compounds/ Chemical composition/ Bioactive compounds identified**	**Human disease (Cell lines/ animal models)**	**Results**	**Reference**
Angelica sinensis (Oliv.) Diels (root and rhizome) and *Cinnamomum cassia* (L.) J. Presl (stem bark)	Extract was performed by using steam distillation with medicine weight of 1:1 ratio of both Chinese herbs. 5 mg of the concentrated yield was dissolved in 5 ml of 30% ethanol.	Ferulic acid, Senkyunolide and Trans-Cinnamic acid	Cerebral Ischemia (male Sprague-Dawley rats	Neuroprotective activities: ↑ Motor function in the brain of MCAO rats ↓ Iba-1 pro-inflammatory microglial activator while ↑ CD206 anti-inflammatory marker ↓ TLR4, p-IKKβ, p-IκBα, NLRP3, ASC, and caspase-1 neuroinflammatory proteins expressions in brain tissue of MCAO rats ↓ Bax, caspase-8 and activated-caspase-3 pro-apoptotic proteins while ↑ Bcl-2 anti-apoptotic protein Autophagic enhancement: ↑ LC3-II/I ratio and Beclin-1 autophagic proteins expressions in brain tissue of MCAO rats	[71]
Fragaria ananassa and *Vaccinium sect. Cyanococcus*, United States, blueberry and strawberry diets	Homogenization of whole fruits with (water) in 1:1 ratio (w/v)	N/A	Neuropathology: Radioactive exposure neuronal stress (^{56}Fe particles-irradiated rat)	Neuroprotective activities: ↓ PHF-tau neurodegenerative disease-related protein accumulation Autophagic enhancement: ↓ p62 selective target for autophagy-mediated proteolysis and ↑ Beclin-1 autophagic marker in ^{56}Fe particles-irradiated rat	[72]
Rehmannia glutinosa, Cistanche deserticola, Paeonia lactiflora Pall, *Angelica sinensis, Pueraria lobata, Coptis chinensis* Franch, *Scutellaria baicalensis* Georgi, *Cornu Bubali, Glycyrrhiza uralensis* China, Bu Shen Jie Du Fang	All the ingredients were purchased from the Pharmacy Depart-ment of Xuanwu Hospital, Beijing, China. They were soaked with 10 times the mass of water for	N/A	Parkinson's disease (PC-12 cells)	Neuroprotective activities: ↑ Cell viability of MPP+-treated PC12 cells Autophagy enhancement: ↑ Number of autophagosomes ↑ Atg12 and LC3 autophagy protein expressions ↑ *Atg12, LC3* and *Beclin-1* gene expressions	[73]

	30min and decocted twice for 30 mins. The solution was added with final ingredient of Antelope horn powder and kept in 4°C.				
Angelica gigas, Astragalus membranaceus, Atractylodis macrocephala, Bupleurum chinense DC., Cimicifuga heracleifolia Kom, Citri unshiu pericarpium, Panax ginseng, and Glycyrrhiza uralensis, Korea, Bojungikgi-tang	Purchased from Hankookshinyak, and diluted using autoclaved distilled water	N/A	Amyotrophic lateral sclerosis (SOD1^{G93A} transgenic mice)	Neuroprotective activities: ↓ GFAP, Iba-1 and TLR4 neuroinflammatory proteins in the spinal cord of transgenic mice ↑ Viability of motor neurons in spinal cord ↓ HO-1 and transferrin oxidative stress-related proteins ↓ BAX pro-apoptotic proteins Autophagic enhancement: ↓ TGFβ and phosphorylated mTOR expression level	[74]
	Purchased from Hankookshinyak	N/A	Amyotrophic lateral sclerosis (hemizygous hSOD^{G93A} transgenic mice)	Neuroprotective activities: ↓ Microglial activation and inflammatory markers in transgenic ALS mice ↓ Metabolic dysfunction and ↑ Mitochondrial function in ALS mice ↓ Muscle denervation in transgenic ALS mice ↑ Viability of motoneuron and ↓ neuroinflammatory markers Autophagic enhancement: ↓ Activation of Akt and mTOR protein expression	[75]
Radix astragali, *Radix angelicae*	Purchased from Guanzhou Zhixin Chinese Herbal	N/A	Stroke (male Dawley Sprague rats)	Neuroprotective activities: ↓ Brain infarction volume and ↑ neurological score in post MCAO rats	[76]

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sinensis, *Radix paeoniae rubra*, *Rhizoma ligustici chuanxiong*, *Flos carthami*, *Semen persicae* and *Lumbricus*, China, Buyang Huanwu decoction Chinese medicinal formula	Medicine Co. Ltd. China.			↓ MDA oxidative stress marker and ↑ CAT and GSH-PX antioxidant enzymatic activities ↓ Neuronal cell death in the brain of post MCAO rats ↑ Neurogenesis *via* DCX downregulation Autophagic enhancement: ↑ SIRT1, LC3-II, and Beclin-1 autophagic markers, while ↓ p62 protein expression	
	Purchased from Beijing Tongrentang drug store	N/A	Cerebral Ischemia (male Dawley Sprague rats)	Neuroprotective activities: ↓ Cerebral injury and infarct volume in post MCAO rats ↓ Neuronal injury and apoptosis in brain of post MCAO rats Autophagic enhancement: ↓ LC3-II/I ratio and Beclin-1 autophagic markers	[77]
	N/A	N/A	Spinal cord injury (male Sprague Dawley rats)	Neuroprotective activities: ↑ Motoneuron function in SCI rats Autophagic suppression: ↑ mTOR, while ↓ LC3, and Beclin-1 protein and mRNA expressions	[78]
Polygonum Multiflorum Thunb, *Alpinia Oxyphylla Miq*, *Juglans Regia L*, *Panax Ginseng* C. A. *Mey*, *Ligusticum wallichii Franch*, *Salviae Miltiorrhizae* Radix, *Angelicae Sinensis* Radix, and *Curcuma aromatica Salisb*. *Panax Ginseng* C. A. *Mey* China, Bu Shen Huo Xue Chinese medicinal formula	Provided by Yi Ling Medicine Company, Shijiazhuang, China	N/A	Dementia (male Dawley Sprague rats)	Neuroprotective activities: ↑ Cognitive and memory function of VD mice ↓ Neuronal loss and hippocampal damage in VD mice Autophagic suppression: ↓ Number of autophagosomes and autophagosome-lysosome formation ↓ LC3-II/I ratio and Beclin-1 autophagic markers, and ↑ p62 protein expression	[79]
Bupleurum chinese DC, *Fossilia Ossia Mastodi, Scutellaria baicalensis*	Decoction in boiling water for 45 min, and the crude extract	N/A	Epilepsy (Sprague Dawley rats)	Neuroprotective activities: ↓ Seizure frequency in lithium-policarpine-induced epilepsy rat	[80]

Georgi, *Zingiber officinale Roscoe*, *panax ginseng C. A. Mey*, *Cinnamomum cassia, Poriacocos (Schw.) Wolf, Pinellia ternate (Thunb.) Makino, Rheum palmatum* L. *Ostrea gigas Thunberg*, and *Ziziphus jujuba* Mill, China, Chaihu-Longgu-Muli decoction	paste was diluted with distilled water to achieve concentration of 1g/ml			Autophagic suppression: ↓ Number of autophagosomes in the hippocampus of epilepsy rat ↓ LC3-II and Beclin-1 autophagic markers, while ↑ mTOR protein expression in the cytoplasm of hippocampus in epilepsy rat at both mRNA and protein levels	
Combination of *Panax ginseng* C. A. Meyer Rhizama and *Aconitum carnichaeli* Debx, Fuzi, sub roots, China	N/A	Ginsenoside Rg1, Re3, Rb1, and Rd)	Depression (female ICR mice)	Neuroprotective activities: ↑ anti-depressive behaviour and proteins in ICR mice Autophagic suppression: ↓ LC3-II/I ratio and Beclin-1, ↑ p62 protein expressions	[81]
Rhizoma Salviae Miltiorrhizae and *Flos Carthami*, China, Danhong Chinese medicine	N/A	N/A	Stroke: cerebral Ischemia (male Sprague Dawley rats)	Neuroprotective activities: ↑ Neurological function and ischemic pathological changes in the brain of post MCAO rats Autophagic suppression: ↑ activation of PI3K, Akt, and mTOR protein expressions in rat brain tissue ↓ FOXO3A, Atg12, Atg16L, ULK1, and AMPK protein expressions in rat brain tissue expressions ↓ LC3-II/I and Beclin-1 protein expressions expressions in rat brain tissue	[82]
Scutellaria baicalensis Georgi*, Gardeniae fructus* Ellis, *Phellodendron chinense* Schneid*, and Coptis chinensis* Franch, Taiwan, Huang Lian Jie Du Tang Chinese herbal medicine	The Chinese herbal medicine was prepared by the National Research Institute of Chinese Medicine, the ingredients were decocted with 1200	N/A	Parkinson's disease (SH-SY5Y human neuroblastoma cells)	Neuroprotective activities: ↑ Cell viability of paraquat-treated SH-SY5Y cells ↓ Free radical while ↑ mitochondrial function of paraquat-treated SH-SY5Y cells ↓ Activation of Ub-S65 and Parkin-S65 protein levels in paraquat-treated SH-SY5Y cells Autophagic suppression:	[83]

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	ml water to reduce to 400 ml and lyophilized. The extract was further diluted with deionized water and filtered prior to experimental assays.			↓ PINK1 mitophagy protein expression in paraquat-treated SH-SY5Y cells	
Acorus gramineus, Polygala tenuifolia, Panax ginseng, and Wolfiporia cocos, China, Kai-Xin-San	Purchased from Beijing Tongrentang Co., Ltd., Beijing, China, and the aqueous extract was prepared using boiling method and concentrated to 300mg/mL	N/A	Neurotoxicity study: Polyglutamine-mediated neurotoxicity (*C. elegans*)	Neuroprotective activities: ↓ Neurotoxicity and behavioural dysfunction in polyQ mutant expressing *C. elegans* ↓ Oxidative stress level in polyQ mutant expressing *C. elegans* Autophagic enhancement: ↑ *lgg-1* autophagic marker in polyQ mutant expressing *C. elegans*	[84]
	Aqueous extract was prepared by dissolving 50 g of herbal formula in 500 ml water with reflux, followed by vacuum dry process	3,6′ -disinapoyl sucrose, ginsenoside Rg1, β-asarone, and pachymic acid	Depression (male Wistar rats and primary rat astrocytes)	Neuroprotective activities: ↓ *Tnf-α, il-1β, and il-6* mRNA expression of neuroinflammatory markers in CUMS rats and primary rat astrocytes ↓ Activation of inflammasome in CUMS rats and primary rat astrocytes ↓ Oxidative stress and ↑ SOD and GSH antioxidant enzymatic activities in CUMS rats and primary rat astrocytes Autophagic enhancement: ↑ LC3-II and Beclin-1 autophagic markers, and ↓ p62 protein expression in CUMS rats and primary rat astrocytes	[85]
Helianthus annuus seed, Brassica *napus* seed, and *Zea mays* kernels, Belgium, plant-based fats ketogenic diet	N/A	N/A	Autophagy based study (male C57BL/6J mice)	Autophagic enhancement: ↑ Autophagosomes formation in the hippocampus and LC3 puncta ↑ LC3-II/I ratio and Beclin-1 autophagic markers in hippocampal and cortical mRNA level	[86]

Glycyrrhiza uralensis, Atractylodes macrocephala Koidzumi, Panax ginseng, and Astragalus membranaceus, Korea, Korean herbal medicine	Aqueous extract was prepared through maceration for 24 h, and freeze-dried into powder	N/A	Amyotrophic lateral sclerosis (hSOD1^{G93A} transgenic mice)	Neuroprotective activities: ↑ Motoneuron function in mucles ALS transgenic mice ↓ TNF-α, GFAP, CD11b neuroinflammatory markers ↓ Oxidative stress in the muscles of ALD transgenic mice Autophagic suppression: ↓ LC3-II/I autophagic marker and p62 protein expression	[87]
Polygala tenuifolia, *Angelica tenuissima*, and *Dimocarpus longan*, Korea, modified Chungsimyeolda-tang	Ethanol extract was prepared using 15g of each air-dried herb with 1 L of 20% ethanol under boiling condition, followed by freeze dried into powder	N/A	Parkinson's disease (male C57BL/6J mice and SH-SY5Y cells)	Neuroprotective activities: ↓ Motoneuron function, loss of dopaminergic neurons in MPTP-induced PD mice, 6-OHDA-induced PD mice and SH-SY5Y cells Autophagic enhancement: ↑ LC3-II/I ratio beclin-1 autophagic markers, and ↓ p62 protein expression in MPTP-induced PD mice, 6-OHDA-induced PD mice and SH-SY5Y cells	[88]
Bupleurum chinense DC., *Angelica sinensis* (Oliv.) Diels., *Acorus calamus* var. angustatus Besser., *Paeonia lactiflora* Pall., *Polygala tenuifolia* Willd., *Atractylodes macrocephala* Koidz., *Glycyrrhiza uralensis* Fisch., *Mentha haplocalyx* Briq., *Paeonia suffruticosa* Andr., *Gardenia jasminoides* J.Ellis, China, modified Xiaoyao San	Purchased from the Affiliated Nan Fang Hospital of Southern Medical University, resuspended in distilled water	N/A	Major depressive disorder (C57 mice)	Neuroprotective activities: ↓ CUMS and social isolation-induced depressive-like behaviours ↓ Neuronal injury and cell apoptosis in the hippocampus of CUMS and social isolated mice ↓ BAX pro-apoptotic and ↑ Bcl-2 anti-apoptotic proteins ↑ Mitochondrial AIF while ↓ mitochondrial cytochrome *c* levels Autophagic enhancement: ↑ Number of autophagosomes ↑ LC3-II/I ratio, Atg3, Atg5, and Atg16 autophagic markers	[89]
	Decoction prepared by using boiling water at ratio of 1:8, grinded into powder	N/A	Depression (N9 cells and ICR mice)	Neuroprotective activities: ↓ Depressive behaviour in LPS-treated mice ↓ Neuroinflammatory proteins in the brain of LPS-treated mice and N9 cells	[90]

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	for subsequent application.			↓ Microglial activation in the brain of LPS-treated mice ↑ Viability in LPS-treated N9 cells Autophagic enhancement: ↑ Iba-1 and LC3B protein expression in the brain of LPS-treated mice ↓ Activation of PI3K, Akt, and mTOR protein expression in in the brain of LPS-treated mice ↓ CD86 and p62 while ↑ LC3-II/I ratio and Atg5 protein expressions	
Pueraria lobata (Willd.) Ohwi, *Angelica tenuissima* Nakai, *Scutellaria baicalensis* Georgi, *Platycodon grandiflorum* (Jacq), *Angelicae Dahurica, Cimicifuga heracleifolia* Kom, *Raphanus sativa* L., *Polygala tenuifolia* (Willd.), *Acorus gramineus* Soland. *and Dimocarpus longan* Lour, Korea, modified Yeoldahanso-tang	Decoction of 70 g dry MYH in 1000 mL of (distilled water), yield final volume of 100 mL	N/A	Parkinson's disease (NGF-differentiated rat PC-12 pheochromocytoma cells, and MPTP-induced substantia nigra C57BL/6 mice)	Neuroprotective activities: ↑ NGF-differentiated PC-12 cell viability against MPP+ and lactacystin -induced cytotoxicity, partially ↑ LC3-II/I ratio ↑ number of TH-IR cells in SNpc and optical density of TH-IR fibres in ST of MPTP-treated C57BL/6 mice Autophagic enhancement: ↑ LC3-II/I ratio and Beclin 1 autophagic markers in MPP+ and lactacystin treated NGF-differentiated PC-12 cells	[91]
Aucklandia lappa Decne, *Piper nigrum* L, *Euphorbia pekinensis* Rupr, *Callorhinus ursins* Linnaeus *and Asarum heterotropoides Fr. Var. man-dshuricum* (Maxim.) kitag, China, Mu Xiang You Fang	The ingredients were purchased from Anhui Medicinal Materials Co. Ltd. They were extracted using supercritical CO_2 extraction method	6-Dehydrocostuslactone (11.12%) Methylarachidonate (9.08%), Methyleugenol (6.03%), Piperine (5.19%), Caryophyllene (4.76%), Costunolide (3.51%), Myristicin (1.82%) and Sesamin (3.00%)	Stroke (PC-12 cells)	Neuroprotective activities: ↑ Cell viability and cytotoxicity of OGD/R-induced PC12 cells ↑ MMP level and ↓ cytosolic calcium ions in OGD/R-induced PC12 cells Autophagy suppression: ↓ MDC-stain autophagic vacuoles and number of autophagosomes ↓ LC3-II/I and Beclin-1 and ↑ p62 autophagy protein expressions ↑ Activation of mTOR and p-70s6k proteins ↓ Activation of AMPK and ULK1	[92]

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Rheum officinale Baill, *Saposhnikovia divaricata* Schischk,, *Gardenia jasminoides* J. Ellis, *Bovis Calculus* Sativus, *Bambusa te-xtilis* McClure, *Magnolia officinalis* Rehder & E.H. Wilson, *Paeonia veitchii* Lynch and *Polygonum cuspidatum* Siebold & Zucc,China, Tong Shen tablets	Purchased from Dongguan Traditional Chinese Medicine Hospital.	geniposide, paeoniflo-rin, prim-O-glucosylcimifugin, 5-O-methylvisa-mmioside, aloe-emodin, physcion, rhein, mag-nolol, emodin, chrysophanol and polydatin	Ischemic Stroke (male Dawley Sprague rats)	Neuroprotective activities: ↑ Neurological behaviour of post-MCAO rats ↑ Nrf2 and HO-1 antioxidant enzyme expressions ↓ IL-1β and TNF-α neuroinflammatory cytokines in brain tissues of post-MCAO rats ↓ Number of apoptotic cells in brain tissues of post-MCAO rats ↓ Bax and Cytochrome c pro-apoptotic proteins while ↑ Bcl-2 anti-apoptotic protein expressions Autophagic enhancement: ↑ LC3B autophagy protein expression	[93]
Panax notoginseng, *Moschus moschiferus* , Calculus Bovis, and Snake Gall, Pien-Tze-Huang (Chinese medicinal formula)	Purchased from Zhangzhou Pien-Zhe-Huang Pharmaceutical Co., LTD, China, and extracted using methanol under 30 min sonication	Taurine, malic acid, citric acid, cholic acid, hyodeoxycholic acid, ursodeoxycholic acid, chenodeoxycholic acid, taurocholic acid, taurochenodeoxycholic acid, tauroursodeoxycholic acid, glycodeoxycholic acid, glycocholic acid notoginsenoside R1, ginsenosides Rg1, Rb1, Re, Rf, Rd, Rg2, Rg3, Rh1, and muscone	Ischemic stroke (BV-2 cells and male Dawley Sprague rats)	Neuroprotective activities: ↓ IL-1β and IL-18 neuroinflammatory protein, and activation of MLRP3 inflammasome in LPS-treated BV-2 cells ↓ Microglial activation and IL-1β, IL-6, TNF-α, COX-2, iNOS, and MCP-1 neuroinflammatory proteins in the brain of post MCAO rats Autophagic enhancement: ↑ LC3-II and Beclin-1 autophagic markers, and ↓ p62 protein expression in cell line and post MCAO rats ↑ Activation of ULK1 and AMPK protein in cell line ↓ mTOR protein activation in cell line and post MCAO rats	[94]
Panax ginseng, Ophiopogon japonicus (Thunb.), and Fructus schisandrae, China, Shengmai injection	Prepared by SYZZ Group Pharmaceutical Ltd., Jiangsu, China	Ginsenoside Re, Ginsenoside Rb1, Ginsenoside Rc, Ginsenoside Rb2, Ginsenoside Rd, Schizandrol A	Stroke: cerebral Ischemia (male C57BL/6J mice)	Neuroprotective activities: ↓ Infarct volume and neuronal injury in reperfusion mice ↑ neurological scores and brain water content of reperfusion mice Autophagic suppression: ↓ numbers of lysosome and autophagosome	[95]

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Polygonum cuspidatum Sieb. Et Zucc, *Forsythia suspense* (Thunb) Vah1, *Isatis indigotica* Fort., *Bupleurum chinese* DC., *Tlaspi arvense* L., *Verbena officindlis* L., *Phargmites communistrin* Trin, and *Glycyrrhiza uralensis* Fisch, China, Shufengjiedu capsule	Provided by Jiren Pharmaceutical, Anhui, China	N/A	Allergic rhinitis (male Sprague Dawley rats)	↓ LC3-II/I and Beclin-1 autophagic markers in the ischemic cortex ↓ AMPKα, ↑mTOR and ↓JNK protein expressions Protective activities: ↓ Serum IgE and number of mast cells in the olfactory epithelium tissue of ovalbumin-treated rats ↓ Small airways obstruction, and ↑ number of neurons in olfactory epithelium ↓ TNF-α and IL-1β neuroinflammatory protein expression levels in serum, lungs, and olfactory epithelium tissue ↓ Activation of caspase-3 pro-apoptotic marker in lung tissue Autophagic enhancement: ↑ Beclin-1 autophagic marker at protein level in lung tissue	[96]
Bupleurum chinense DC. radix*, Paeonia lactiflora* Alba. radix, *Citrus aurantinum L.*, *Glycyrrhiza uralensis* radix, China, Si-ni-san Chinese medicinal formula	N/A	Stearic acid, Adenosine, Formononetin, Erucamide, Oleamide, Catechin, L-Tyrosine, Hesperidin, Rutin, Vitexin, Naringin, Trigonelline, and Apigenin	Chronic unpredictable mild stress (male C57BL/6 mice)	Neuroprotective activities: ↓ Depressive behaviour in CUMS-induced rats ↑ Dendritic spines regulation and GluR2 protein expression Autophagic suppression: ↑ p62 and FTH protein expressions in the hippocampus of CUMS-induced rats ↓ NCOA4 and LC3-II/I protein expression in the hippocampus of CUMS-induced rats	[97]
Panax ginseng radix, *Astragali, Astragalus propinquus* radix, *herba Cistanche deserticola, Atractylodis macrocephala, Poria Cocos, Glycyrrhiza uralensis* radix*, and Epimedium brevicornu*	Provided by Xu Chongdao Chinese Herbal Pieces Factory of Shanghai Yaofang Co., Ltd., China	N/A	Amyotrophic lateral sclerosis (*Adar2* knockout mice)	Neuroprotective activities: ↑ Behavioural function and ↓ spinal cells injury in ALS mice Autophagic suppression: ↓ Number of autophagosome in the spinal cord of ALS mice	[98]

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Maxim, China, Wen-Shen-Jian-Pi Chinese medicinal formula				
Saposhnikovia divaricata (Turcz. ex Ledeb.) Schischk., *Zingiber officinale* Roscoe, *Ephedra sinica* Stapf, *Paeonia lactiflora* Pall., *Conioselinum anthriscoides, Panax ginseng* C.A.Mey., *Prunus amygdalus* Batsch, *Neolitsea cassia* (L.) Kosterm., *Aconitum carmichaeli* Debeaux, *Stephania tetrandra* S. Moore, *Scutellaria baicalensis* Georgi, and *Glycyrrhiza glabra* L., China, Xiao-Xu-Ming decoction formula	The formulation was purchased from First Affiliated Hospital of Henan University of Chinese Medicine. The drug was decocted for 1 h in distilled water in 1:10 ratio (w/v). The suspension was further soaked in 75% ethanol for 24 h at a concentration of 2 g/ml. The extract was kept in kept in liquid form after removing the undissolved substances.	N/A	Stroke: cerebral Ischemia (male Sprague-Dawley rats)	Neuroprotective activities: ↓ Brain infarcted area and neurological deficits in post MCAO-rats ↓ Neuronal cells injury in the brain tissue of post MCAO-rats ↑ Mitochondrial function of in the brain tissue of post MCAO-rats Autophagic suppression: ↓ Formation of autophagosome-lysosome fusion in the brain tissue of post MCAO-rats ↓ VDAC1, Lamp1 and LC3B autophagic markers in the neuronal cells of the penumbra of the ischemic cortex ↓ LC3B, Beclin1, VDAC1, Lamp1, and p62 autophagic proteins expressions	[99]
Homalomena occulta, Astragalus membranaceus, Angelica dahurica, Callerya nitida, and Angelica sinensis, Yaobishu Chinese medicinal decoction formula	Provided by Traditional Chinese medicine Pharmacy of Hunan Provincial People's Hospital	N/A	Lumbar Disc Herniation (normal DRG neuronal cell and Sprague Dawley rats)	Neuroprotective activities: ↑ Cell proliferation and viability in TNF-α treated DRG cell ↓ Inflammatory and pro-apopototic protein levels in TNF-α treated DRG cell and LDH rats ↓ Siegal neurological score and inflammation in LDH rats Autophagic enhancement: ↑ DCN and LEPR cell autophagy related factors in both TNF-α treated DRG cell and LDH rats	[100]
Astragalus propinquus angelicae sinensis, prunus cerasus, aarthamus tinctorius L., paeonia lactiflora Pall.,	The ingredients were purchased from Beijing Tongrentang, they were soaked 10	N/A	Stroke: Intracerebral haemorrhage (male Sprague Dawley	Neuroprotective activities: ↑ Neurological function while ↓ brain oedema in ICH rats ↓ Neuronal injury in ipsilateral cortex of ICH rats	[101]

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ligusticum chuanxiong, angelica dahurica, asarum heterotropoides, Hirudo, glycyrrhiza glabra, China, Yi-Qi-Huo-Xue Chinese traditional decoction	times the mass of distilled water for 1 h and boiled for 30 min for twice, and then concentrated into final volume of 100 mL.		rats and primary cortex neurons)	↑ BDNF and TrkB protein expression *in vitro* and *in vivo* ↓ Number of apoptotic cells in ipsilateral cortex of ICH rats ↑ Cell viability of hemin-treated primary cortex neruons Autophagy suppression: ↓ LC3II/I and Beclin-1 autophagy protein expression *in vitro* and *in vivo*	
Ginkgo biloba, *Panax* ginseng, *Cistanche deserticola* Y.C.Ma, and *Acorus gramineus*, China, Yi-Zhi-Fang-Dai	Purchased from Shanghai Hongqiao Pharmaceutical Co., Ltd, Shanghai, China.	Bilobalide, ginkgolide A, ginsenoside Rb1, ginsenoside Rg1, castanoside A, and α-asarone	Alzheimer's disease (bEnd3 murine cerebral endothelioma cell line, and male APP/PS1(B6C3-Tg (APP_{swe}, PSEN1dE9)/Nju) double-transgenic mice)	Neuroprotective activities: ↑ Cognitive behaviour in AD transgenic mice ↑ Clearance of Aβ in AD transgenic mice Autophagic suppression: ↓ LC3-II/I ratio autophagic marker and ↑ p62 protein expression in $Aβ_{1-42}$-treated bENd3 cells and AD transgenic mice ↓ RAGE mRNA transcription, ↑ activation of mTOR, CaMKKβ, and AMPK protein expression level in both bENDd3 cells and AD transgenic mice	[102]
Phellodendron Chinensis and *Anemarrhena asphodeloides* Bunge, China, Zhimu-Huangbo Chinese medicinal formula	N/A	Feruloyltyramine, neomangiferin, chlorogenic acid, phellatin, ferulic acid, corypalmine, phellodendrine, quercetin, mangiferin, canadine, 3-feruloylquinic acid, rotudine, afzelin, protopine, 5,5'-dimethoxylariciresinol 4-O-glucoside, paenol, isoplatydesmine, noroxyhydrastinine, oxyberberine, jatrorrhizine,	Neurotoxicity study: D-galactose (HT22 cells)	Neuroprotective activities: ↑ Viability of D-galactose treated HT22 cells ↓ Intracellular ROS and ↑ MMP level in D-galactose treated HT22 cells Autophagic enhancement: ↑ PINK1, Parkin, LC3-II/I ratio while ↓ p62 protein expressions in D-galactose treated HT22 cells	[103]

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		thalifendine, bebrbeine, timosaponin A-III, anemarsaponin E, cis-N-p-coumaroyltyramine, palmiteine, kihadanin b, timosaponin A-I, smilagenin, anemarsaponin B, limonin, anemarrhenasaponin 1a, sarsasapogenone, markogenin, anermarsaponin G, obacunone			
Magnolia officinalis, Coptis chinensis, pinellia ternate, rhizoma zingiberis, Hordeum vulgare L., rhizome atractylodis macrocephalae, *codonopsis pilosula, Glycyrrhiza glabra*, Zhi Shi Xiao Pi tang, Chinese traditional medicine	Designated formulation was prepared by the Department of Pharmacy, the affiliated Hospital to Changchun University of Traditional Chinese Medicine. 61g of the ingredients were decocted with 600 ml water and boiled twice for 1 hour. The aqueous extract was dried and concentrated using rotary evaporator	Synephrine, gallic acid, caffeic acid, epicatechin, liquiritin, neringin, hesperidin, neohesperidin, berberine, baicalein, hyperoside, magnolol, honokiol and isoimperatorin	Dyspepsia (male Sprague Dawley rats and PC-12 cells)	Neuroprotective activities: ↓ Cell cytotoxicity and number of apoptotic cells in cort-treated PC12 cells ↓ Apoptotic cell number in FD-induced depressive rats ↓ Intracellular ROS level while ↑ mitochondrial function in cort-treated PC12 cells Autophagic enhancement: ↑ LC3-II/I, Atg5 and Atg7 autophagy proteins function in cort-treated PC12 cells and FD-induced depressive rats ↓ Activation of mTOR protein in cort-treated PC12 cells And FD-induced depressive rats	[104]