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Guest editorial:

NEUROPROTECTIVE EFFECTS OF MEDICINAL PLANTS

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As human life expectancy has increased, so too has the incidence of age-related neurodegenerative disorders such as Alzheimer's disease, Parkinson's disease, and Huntington's disease (Borgesius et al., 2011). Plant extracts have a wide range of medicinal actions, and throughout history, they have been used to treat many different types of diseases. More recently, however, scientists have begun investigating the biological activities of medicinal plants, including their neuroprotective actions. For example *Lycium chinense* Miller, which is a traditional herbal medicine used in China, Korea, and Japan, has been shown to have hypotensive, hypoglycemic, and antipyretic effects in animal studies following treatment with the fruit and root bark of the plant (Potterat, 2010; Lee et al., 2004). Furthermore, this plant has been used as an anti-aging therapy and a treatment for neurodegenerative diseases (Ho et al., 2010; Potterat, 2010), and recent research has confirmed neuroprotective effects of the fruit of the plant in a rat model of trimethyltin-induced learning and memory impairment (Park et al., 2011a). Other plants have also shown neuroprotective effects. In separate studies, extracts of *Camellia sinensis* and *Erigeron breviscapus* demonstrated neuroprotective effects against hydrogen peroxide-induced toxicity in PC12 cells (López and Calvo, 2011; Hong and Liu, 2004), and *Smilacis chinae* Rhizome exhibited a neuroprotective effect in an *in vitro* model of *N*-methyl-d-aspartate-induced neurotoxicity; it showed a similar effect in an *in vivo* model of focal cerebral ischemia. Studies investigating the neuroprotective actions of various medicinal plants are shown in Table 1.

Table 1: Studies investigating the neuroprotective effects of medicinal plants

Key message	Reference
Ginkgo biloba extract (EGb 761) protected hippocampal neurons from toxicity induced by Abeta fragments in a concentration-dependent manner (10–100 µg/mL), with complete protection occurring at the maximum concentration investigated.	Bastianetto et al., 2000
Pretreatment of cells with an aqueous extract of *Curcuma longa* L. (0.5–10 µg/mL) prior to hydrogen peroxide (H2O2) exposure significantly prolonged cell survival, increased antioxidant enzyme activity, and decreased malondialdehyde (MDA) concentration.	Koo et al., 2004a

Table 1 (cont.): Studies investigating the neuroprotective effects of medicinal plants

Key message	Reference
Pretreatment of cells with PJBH (a dried decoctum consisting of 18 medicinal herbs: *Semen biotae*, *Fructus torilis* seu cnidii, *Fructus rubi*, *Herba dendrobii*, *Radix morindae officinalis*, *Cortex eucommiae*, *Radix espragi*, *Radix polygalae*, *Radix dipsaci*, *Ramulus cinnamomi*, *Rhizoma acori graminei*, *Rhizoma alismatis*, *Rhizoma dioscoreae*, *Radix ginseng*, *Radix rehmanniae preparata*, *Fructus corni*, *Fructus schisandrae* and *Herba cistanches*) prior to H2O2 exposure significantly prolonged cell survival, increased antioxidant enzyme activity, and decreased MDA concentration.	Koo et al., 2004b
Pretreatment with an extract of *Lycium barbarum* significantly reduced lactate dehydrogenase (LDH) release and Abeta peptide-activated caspase-3 activity.	Yu et al., 2005
Pretreatment of PC12 cells with either the traditional Chinese medicine Bak Foong Pills (BFP), or its main ingredients (*Panax ginseng*, *Angelica sinensis*, *Glycyrrhiza uralensis*, and *Ligusticum chuanxiong*), protected against cell toxicity and inhibited the activation of caspase-3.	Jia et al., 2005
Extracts of both green tea and black tea (5–25 µg/mL) showed a neuroprotective action against Abeta-induced toxicity. The constituent epigallocatechin gallate was considered a candidate for an inhibitory action against Abeta fibril/oligomer formation. These findings support the hypothesis that black tea as well as green tea may reduce the risk of age-related neurodegenerative diseases such as Alzheimer's disease.	Bastianetto et al., 2006
Pretreatment with *Lycium barbarum* significantly reduced LDH release and caspase-3 activity following Abeta exposure.	Ho et al., 2007
Treatment with Palmul-Chongmyeong-Tang *(PMCMT)*, a 10-herb formulation consisting of *Ginseng Radix, Atractylodis Macrocephalae Rhizoma, Poria, Glycyrrhizae Radix, Angelicae Gigantis Radix, Ligusticum Rhizoma, Rehmanniae Radix, Paeoniae Radix, Acori Graminei Rhizoma, and Polygalae Radix*, reduced the cerebral ischemia-induced loss of cholinergic immunoreactivity in the hippocampus.	Yun et al., 2007
Resveratrol and oxyresveratrol isolated from the rhizome of *Smilacis chinae* demonstrated neuroprotective effects on ischemia-induced brain damage *in vivo*, and *N*-methyl-d-aspartate-induced neurotoxicity *in vitro*.	Ban et al., 2008
An extract of *Uncaria rhynchophylla* significantly reduced cell death and the generation of reactive oxygen species (ROS) in PC12 cells. It also increased GSH concentrations, and inhibited caspase-3 activity induced by 6-hydroxydopamine (6-OHDA).	Shim et al., 2009
An extract of the *Morus alba* L. fruit significantly protected SH-SY5Y cells stressed with 6-OHDA from neurotoxicity in a dose-dependent manner.	Kim et al., 2010
An extract of *Polygalae radix* significantly inhibited 6-OHDA-induced cell damage at doses of 0.05–1 µg/ml, having a maximum effect at 0.1 µg/ml.	Choi et al., 2011
White tea extract demonstrated a significant protective effect against H_2O_2 exposure in PC12 cells: cell survival was significantly improved and radical scavenging properties were observed, along with a reduction in intracellular oxidative stress.	López and Calvo, 2011
Treatment with the fruit of *Lycium chinense* showed a reduction in the loss of hippocampal choline acetyltransferase (ChAT) and cyclic adenosine monophosphate (cAMP).	Park et al., 2011b

Table 1 (cont.): Studies investigating the neuroprotective effects of medicinal plants

Key message	Reference
Pretreatment with GJ (a decoction consisting of 5 herbs: Ginseng, *Acori Graminei Rhizoma, Uncariae Ramulus et Uncus, Polygalae Radic*) and *FE* showed a reduction in the loss of cholinergic immunoreactivity in the hippocampus. These results show that *GJ* and *FE* have protective effects against ischemia-induced neuronal and cognitive impairment.	Lee et al., 2011
Compared to ISC treatment, black ginseng showed a reduction in the loss of both cholinergic immunoreactivity and nicotinamide adenine dinucleotide phosphate diaphorase (NADPH-d)-positive neurons in the hippocampus.	Park et al., 2011b
An extract of *Lycium barbarum* protected against MPP(+)-induced loss of viability and DA neurodegeneration in *Caenorhabditis elegans* in a dose-dependent manner. The extract reduced MPP(+)-induced intracellular ROS accumulation and loss of mitochondrial membrane potential, and restored total glutathione (GSH) levels in PCl2 cells.	Yao et al., 2011
Extract from indigenous plants (n = 69) in Cambodia were evaluated for their cytoprotective effects against glutamate-activated neurotoxicity in HT22 cells at concentrations of 100 and 300 µg/ml. Of the plant extracts investigated, 8 ethanolic extracts showed significant cytoprotective effects. These extracts were from the following plant materials: the bark of *Anacardium occidentale*, the bark and sapwood of *Bauhinia pulla*, the flowers of *Borassus flabellifer*, the stems and leaves of *Coix lacryma-jobi*, the bark and sapwood of *Diospyros nitida*, the sapwood of *Dipterocarpus obtusifolius*, the stems of *Oryza rufipogon*, and the fruits of *Phyllanthus emblica*.	Keo et al., 2012

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