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A Potent Medicinal Plant: Polygala Tenuifolia

Anvi RANA[1]

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Abstract

Polygala Tenuifolia, also described as Yuan Zhi, is a conventional botanic plant found in Korea and China. It's most well-known promise is to improve cognition and guard against mental disorders, cure sputum, anxiety, and sleeplessness, and keep the central nervous system health. The pharmacological aspects of Polygala Tenuifolia's genesis and component compounds reveal the neuroprotective potential in connection to Alzheimer's disease. It contains three herbs: Bokshin, Sukchangpo, and Wongi. P. Tenuifolia's primary ingredients are Xanthone glycosides, Triterpenoid saponins, and Oligosaccharides. Polygalasaponins and Etrahydrocolumbamine are the major components, and they've been widely used for more than a century to relieve mood and psychological illnesses, particularly in North Asian countries such as Korea, China, Japan, and Taiwan. P. Tenuifolia extract eliminates allergic illnesses such as eczema and contact dermatitis by modulating Protein kinase-A and Mitogen-protein kinase-38. In vitro and in vivo studies linking P. tenuifolia root ingredients to a variety of pharmacological effects pertinent to AD show that this species' isolates may function through polyvalency. In great health, people can take up to 250-300 mg per day. It was given in peer-reviewed studies at dosages of 100-150 mg many times each day. There is minimal evidence that it improves verbal memory in experimental animals.

Keywords: Health benefits, Memory cognitive impairment, Alzheimer's diseases

Major Classification Code: Health Science, Public Health

1. Introduction

Polygala Tenuifolia has been found throughout East Asia. Commonly it is known as Wonji (원지) in Korean and Yuanzhi in Chinese (原值), and it commonly belongs to the family of Polygalaceae. It has shown wide distribution throughout East Asia. Traditionally, Chinese and Korean medicine has been using this extract as a treatment for insomnia, brain fag, depression, memory impairment, and other diseases. Its roots and fruits have been shown to help boost cognitive performance and alleviate inflammation (Deng et al., 2020). Saponins (triterpenoid components) have several pharmacological, anti-inflammatory, and anti-diabetic characteristics (Li et al., 2008).

In the Chinese medicine system, uncooked Polygala Tenuifolia must always be processed prior to intake because it causes unwanted side effects such as gastrointestinal toxicity and throat irritation. The auxiliary materials have also evolved, while Polygala Tenuifolia processing processes have moved from simple to complex. Some common contemporary RPT (Raw Polygala Tenuifolia) processing processes include heartwood removal, licorice boiling,

1 First & Corresponding Author, M.Sc. student, Department of Food Technology and Nutrition, Lovely Professional University, India.
Email: anvirana001@gmail.com

licorice simmering, and honey stir-baking (Gao et al., 2020). Computation licorice (Licorice - a black, chewy, sweet substance that would be both appetising and medicinally effective that is generated by evaporating root juice) might mitigate RPT's detrimental effects on pharyngeal irritation and gastrointestinal stimulation while promoting mental clarity and intellectual advancement. PT (Polygala Tenuifolia) has modest suppressive activities on gastrointestinal motility and digestive function after being treated with licorice. RPT has been found in recent pharmacological investigations to effectively decrease gastrointestinal motility and gastrointestinal system (Wang et al., 2006).

Polygala Tenuifolia bioactive components may change through processing, including the degree of correlation of specific components and the creation of new components (Wang et al., 1994). Additionally, there is little evidence on how boiling licorice affects Polygala Tenuifolia's chemical composition or digestive tract. Chemical characteristics were evaluated in this framework for creating principal component analysis (PCA) and bioactive component abundance estimation. To investigate the effect of LPT and RPT on rat gastrointestinal function, researchers looked at gastrointestinal hormone levels, inflammatory cytokine levels, and histology. The research is intended to provide a sound scientific foundation for the effectiveness and safety of using Polygala Tenuifolia in group therapy.

1.1 Habitat

P. Tenuifolia is found in cool temperatures, in both tropical and subtropical regions of East Asia. It is widely found throughout Korea, China, and Japan. P. Tenuifolia grows well in wet, soil with good drainage that is somewhat nutritious. On the other hand, it is commonly found among agricultural plants, sides of roads, and overgrazed pastures (Pu et al., 2017).

1.2 Botanical description

Polygala Tenuifolia is a plant with simple and wide leaves of dark green and a height of 0.2m (20cm). It has 5-8 pairs of leaflets that are parallel to each other and vary in form. It has little dark purplish-blue petals that are 7-14 inches tall and contain hermaphrodites (has both female and male organs). Polygala Tenuifolia roots are mostly drier roots gathered in the late spring and early autumn months. The roots are boiled in a series of liquid changes. The connected front sepals whose margins correspond to more than one-third of the height, easily identify this subspecies. The plant's fruit might be a samara (flattened wing), or indehiscent (Park et al., 2002).

Table 1: Taxonomical classification

Kingdom	Plantae
Division	Tracheophyte – Vascular plants
Class	Dicots (Dicotyledons)
Order	Legumes, Milkworts
Family	Milkwort
Genus	Milkworts
Species	Yuan Zhi (原值)

Table 2: Common classification

Common name	Chinese senega-root, Siberian milkwort, Thinleaf milkwort
Local name	Yuan Zhi (原值)
Botanical name	Polygala Tenuifolia
Parts used	Roots and flowers
Hazards	No particular reference to this species has been found.
Dosage	Average – 150-250mg (3 times a day)
Early age Intake	19 years and up

2. Chemical composition and Active constituents

Saponins, oligosaccharides, ketones, alkaloids, polysaccharides, and flavonoids contribute to the chemical composition of unprocessed polygala. It is sedative, anticonvulsant, antidepressant, anti-myocardial ischemia, and memory enhancement (Xu et al., 2018). Sapogenin, Mangiferin, Salicaceae, and oligosaccharide ester compounds were all found in various phytoconstituents analyses. Researchers are increasingly interested in these preparations and active chemicals due to their neuroprotective effects on nerve cells, which include antidepressant properties and improvements in memory and learning abilities. Based on the research, saponin sharing in Polygala tenuifolia fluctuates (Cheng et al., 2021). Essential intermediates containing a range of active compounds have been discovered as steroidal saponins and polyphenols (Nagajyothi et al., 2015). Polygala Tenuifolia has been shown to have a total of 15 triterpenoid phytoconstituents. Component formulations from Polygala Tenuifolia exhibit substantial diabetic and anti-inflammatory capabilities (Li et al., 2008).

2.1 Polygala Saponins

Pure Polygala roots and stems are particularly rich in

polygala saponins, which constitute the active components. The aerial portions (stem and leaf) of P. tenuifolia Wild contain up to 2.46% of the total saponin content, whereas the root contains 3.29%. The majority of ginsenosides and saponins are found within the roots of P. sibirica L., with cumulative saponin concentration in the stems and leaves being 1.50 and 1.61%, significantly. Ginsenosides and Polygalasaponins (Senegenin) have diverse chemical structures, with the polygala saponin basic nucleus being an oleanolic acid-type pentacyclic triterpenoid. The bacosides, also known as tetracyclic triterpenoid saponin that belongs to the dammarane form and the pentacyclic triterpe that belongs to the oleanolic characteristic are the two types of techniques of producing polygala saponins (Lv et al., 2014). Senegenin is described as the main component of the polygala saponins and may be connected to a variety of sites, particularly sugars like onjisaponin B and tenuifolia (Yang et al., 2017).

2.2 Polygalaxanthone

Polygalaxanthone III is a representative of the polygalactones subclass of phenolic compounds, which exhibits biological activities such as diuretic, antibacterial, anticancer, and antidepressant amongst many others. Corresponding to this, N-formyl halo, 1-butoxycarbonyl-carboline, 1-ethoxycarbonyl-carboline, and 1-methoxycarbonyl-porphyrin were all reported using Polygala. Alkaloids on the central nervous system (CNS) have been found to provide limited beneficial properties (Xu et al., 2017).

Additionally, to achieve maximum advantages in the therapeutics of Neuroleptics disorders, systematic evidence should emphasize on modification of the natural sources of active pharmaceutical ingredient (API). Chemical alterations additionally performance well-targeted modernisation, strengthen binding sites, increase accessibility, and promote tissue selectivity on the basis of already effective natural chemicals, achieve offering significant potential for the production of psychotropic drugs.

2.3 Oligosaccharide Esters

A distinctive substance found in Polygala varieties that is principally concentrated in the root is called polygala oligosaccharide ester (Miyase et al., 1999). The bulk of the nucleus within the cell is composed of dextrose, table sugar, or other oligosaccharides linked to dextrose by a glycosidic linkage to build oligosaccharides. These oligosaccharides are subsequently joined with organic acid components (like acetic acid, benzoic acid, and cinnamic acid) to form ester molecules (Zhou et al., 2021).

3. Alternatives and Compositions of Polygala Tenuifolia:

A controlled root variety of Polygala tenuifolia known as BT-11 was used in human standardized tests because BT-11 is a balanced ethanolic root infusion used in randomized trials (Park et al., 2002).

However, Polygala Tenuifolia is a component of Kampo (漢方) plant compositions, which are considered traditional Japanese treatment including the roots of certain traditional medicinal plants like polygala Tenuifolia, Angelica acutiloba (also known as Toki in Japanese), Danggui-Shao Yao-san (Chinese traditional medicine), cape jasmine (primarily grown in China and Japan), Chinese figwort, and Panax ginseng (commonly known as Asian ginseng) to cure mental distress like insomnia, and anxiety, a method called as kami-kihi-to in Japan (カミキヒト) (Yabe et al., 2003).

4. Neuro-properties of Polygala Tenuifolia

Polygala Tenuifolia has the ability to cure inflammation, insomnia, depression, bronchial asthma, pertussis, loss of memories, brain fag, Alzheimer’s disease (AD), major neurocognitive disorder (Dementia), protection of neurons, and mental confusion (disorientation) (Hu et al., 2010).

Perhaps significantly, it has been shown that polygala Tenuifolia contributes to the improvement of memory and intelligence by reducing decreases in brain neurotransmitter levels throughout norepinephrine (Cheong et al., 2011).

Methanol extract's anti-inflammatory properties and the occurrence of antioxidant activity like Senegenin and Polygalacic Acid in addition to other age-related cognitive impairments example frontotemporal degenerative changes and dementia with Lewy diseases assist in avoiding the development of Alzheimer's disease (AD), primary Parkinsonism, and some other similar circumstances (Xin et al., 2012). One of the most toxic materials seen in the hippocampus of Dementia sufferers, amyloid beta peptide, has been associated with the onset of the condition (Wang et al., 2020). Tenuigenin, an extraction from the Polygala tenuifolia root, inhibits the production of amyloid beta polypeptide and safeguards the body's cells from oxidation stressors that can cause an imbalance between free radicals and antioxidants in the body and cause Parkinson's (Sun et al., 2007).

Jiang et al. did one study in which they gathered multiple samples of the Polygala plant from various locations in South Korea and China. Following collection, the samples were subjected to both short and long-term light irradiation using the multi-elemental ENAA approach (Epithermal Neutral Activation Analysis). The researchers discovered that provides valuable information for neuroprotective

properties that the herb can enhance the stages of compounds like anti-Tau protein (Tau is a protein that aids in the maintenance of the inner neurons in the brain), antioxidant, and anti-neuronal are responsible for brain growth (Jiang et al., 2016).

The extract and other polygala Tenuifolia constituents possess a significant effect known as an Amyloid beta peptide, which is the degenerative characteristic of Alzheimer's disease (AD) (Deng et al., 2020). The imbalance of Tau protein and phosphatase can lead to a neurodegenerative and decreased microtubule-linked protein that is Tau protein. However, Polygala Tenuifolia has been observed to aid in the management of tau protein kinase and phosphatase imbalances (Ikeya et al., 2004).

4.1. Neuroplasticity properties of Polygala tenuifolia

Polygala Tenuifolia is treated medicinally in its entirety including its roots and leaves (Shin et al., 2014). The contents are presented in Polygala leaves acts as Polygala Tenuifolia can cure inflammation, insomnia, and depression, loss of memories, brain fag, and Alzheimer's disease (AD). It is also hypothesized that Tenuifolia is mainly accountable for the Polygala Tenuifolia root's building a positive impact (Yang et al., 2021).

The unhappy emotion has been related to a reduction in the brain's middle temporal lobes, but it appears that cognitive connections, including Polygala Tenuifolia, could assist modify the temporal lobe (Chen et al., 2004). Such brain connections have been demonstrated to strengthen by modifying the medial temporal to assist boost a proactive mood. The NMDA (N-methyl-D-aspartate) transmitter is known to decrease the performance of cognitive illnesses mainly such as depression and anxiety (Ikeya et al., 2004). The dried root extract of Polygala Tenuifolia can significantly inhibit N-methyl-D-aspartate receptor activation (Jun et al., 2014).

According to Xue et al. The trial was carried out in mice, and the results showed that the polygala plant extract decreased fat production by inhibiting the expression of transcriptional underpinning components in adipocyte development (Xue et al., 2009).

4.2. Anti-depressant properties of Polygala Tenuifolia

Considering the western age, melancholy has a significant role in both death and disability. Its defining characteristics include anorexia, hypothermia, pessimism, and other depressive characteristics (Palazidou 2012).

Given the adverse reactions of currently available antidepressant drugs and the patients' systematic errors to current therapy, it is imperative to find innovative antidepressant compounds for the therapy of depression. The subsequent in vivo investigations' goals are to compare treated mice to standards and measure the impact on mood in mammals using practical functional tests connected to melancholy, for example, the conventional tail suspension trial and the enforced swimming experiment.

The leaf extracts of P tenuifolia have been investigated at 30 mg/kg while fluoxetine, a potent therapeutic 5-HT reuptake inhibitor, served as the control treatment at 3 mg/kg. The observations showed that the ingredient reversed the damage in hippocampal neurogenesis caused by prolonged pressure and greatly decreased depressive-like symptoms in a model of depressive disorder caused by persistent constraints. It was demonstrated that the extract's antiapoptotic effect on the emerging neurons was linked to the improvement in proliferation through triggering Bcl-2 and phophoErk1/2 (extracellular signal-regulated kinase) (Zhou et al., 2018). Such results suggest that P. japonica could reduce melancholy by reversing the reduced hippocampal neurogenesis induced by chronic anxiety. It was feasible to detect 14 distinct metabolites in this preparation employing UPLC-QTOFMS (positive charges technique), featuring quercetin and 7-hydroxy-1,3-dimethoxy xanthone acting as the main components. The bulk of these chemicals were xanthones, flavonoids, and triterpenes.

Polygala Tenuifolia functions both as relaxing and energizing. This allows for maximum concentration since it helps to guide and self-control the brain even while supporting brain abilities. The concentration of the extract in Polygala roots functions as a Monoamine oxidase inhibitor (MOI), which aids in the production of Noradrenaline (which serves a vital role in the body as a fighting or fleeing reaction) and happy hormone, also known as Dopamine. Additionally, it also blocks the production of steroid hormones, resulting in an anti-anxiety effect (Hu et al., 2011).

Predicated on the California Learning And understanding Test's Korean translation, a study was conducted on people with dementia 45-50 years old in which 100 mg of polygala extract was treated three times a day for two months (six weeks), and it was observed that there was a significant rise in self-hypnosis (Lee et al., 2009).

4.3. Effects of Sedatives and Anxiety

Experimental models were used to scrutinize the outcome of P. tenuifolia root abstract, polygalasaponins, and tenuifolin on anxiety-like behaviour, monoamine concentrations, and excessive daytime sleepiness. Modern data reports that the RP extract and/or its active components have anxiolytic-like and anticonvulsant characteristics. Their anticonvulsant and anxiolytic-like effects may be due to undiscovered pathways (Cao et al., 2016). The isolated polygalasaponins definitely possess sedative-hypnotic,

anxiolytic, and have a dose range that is relatively safe. In the broad demonstration project, Polygalasaponins (50–170 mg/kg) considerably decreased movement and incontinence rates despite dramatically increasing central trying to cross and the proportion of central/total ambulation (Yao et al., 2010).

Management with tenuifolia (50 and 170 mg/kg) substantially lengthened the frequency of sessions of occurrences and the quantity of non-rapid visual acuity and fast eye movement sleep. Authentic adenosine A1 transmitter antagonists 8-cyclopentyl-1,3-dimethylxanthine and all oxazine are discovered in P. tenuifolia root, which might be the reason PTE can decrease the substantial adverse cocaine's effects (Shin et al., 2004).

4.4. Advances in Memory and Performance

Animals that are ageing are widely used as paradigms for memory deficits even though they display several age-related pathways that induce learning and memory problems. Across several Asian countries, RP is being used more and more frequently for this purpose because it has been demonstrated to enhance memory in numerous animal models. Several chemicals and/or active components in P. tenuifolia preparation are effective in memory-related animal studies. Senegenin, a particulate fraction (PTB) from Raw Polygala, and P. tenuifolia crude extract can significantly suppress the mRNA and protein expression levels of numerous important pro-inflammatory cytokines in elderly mice, reducing quantities of TNF, IL-1, IL-6, and IL-8 in hippocampus tissues (Li et al., 2014).

Furthermore, when a saponin-rich fraction of P. Tenuifolia's aqueous extracts was cleansed, all beginning to learn and memory tests, along with the Morris water maze (MWM), step-down passive avoidance tests, and the eight-arm radial maze challenge, decided to show impressive increased performance in rodents and 5xFAD transgenic rodents. Each of these characteristics might influence how the TLR4/MyD88/NF-B and TLR4/TRIF/NF-B regulatory proteins are altered. (Sun et al., 2007). Finally, Senegenin, an active component of P. tenuifolia root extraction, considerably lowered TNF-, IL-1, IL-6, and IL-8 levels in hippocampal tissues in an elderly rat splenectomy postoperatively cognitive impairment paradigm. This was accomplished primarily modulating TLR4/MyD88/NF-B and TLR4/TRIF/NF-B-dependent aggravation (Yu et al., 2014). Of that kind, findings suggest that RP may significantly increase learning and memory, which would be transmitted in proportion with cholinergic activity and neuro-inflammation regulation.

4.5. Antioxidant Impacts

Polygala (RP) extracts and its active components enhance neurogenesis, neural plasticity, nerve development, and neurotransmitter release in addition to being neuroprotective toward oxidative stress and apoptosis. (Jia et al., 2017).

Tenifoliside and DISS, two oligosaccharide esters of RP, were demonstrated to improve neuron survival in glutamate- and H2O2-damaged SH-SY5Y cells in a dose-dependent manner. Formulated esters boosted BDNF synthesis and CREB phosphorylation through regulating the CREB-BDNF pathway upstream MAPK/ERK1/2 and PI3K. (Liu et al., 2016). Multiple therapeutic potential has been revealed in in vivo rat models as a consequence of regulating the expression of BDNF and CREB via DISS. Upstream activation of ERK1/2 and CaMKII was implicated in the regulation of CREB-BDNF in the study on H89, LY294002, U0126, KN93, and K252a, and these drugs verified this notion (Hu et al., 2014).

4.6. Impacts of anti-inflammatory

Knowledge for the significance of inflammation in the onset of psychotic illnesses is growing (Lenart et al., 2016). The maintaining homeostasis functions of serotonin (5-HT) and the HPA axis, which are stimulated by a range of internal and external stress stressors, are likely what cause anxiety and depression. According to studies, P. tenuifolia root extract clearly possesses anti-inflammatory characteristics that can raise cytokine levels, regulate inflammation-related pathways, and perhaps treat psychosis (Cheong et al., 2011). Tenuigenin appears to have antioxidant and anti-inflammatory capabilities, according to mounting research.

To establish the anti-inflammatory effects and method of action of Polygala species crude extracts and pure compounds, numerous cellular models were used in vitro. Because macrophages are important immune cells in the genesis of chronic diseases, inflammation is assumed to be a major risk factor. Tenifoliside, a phenyl propanoid glycoside isolated from P. tenuifolia, can be used to treat neurasthenia, dementia, forgetfulness, and inflammation (Nagajyothi et al., 2015).

4.7. Analgesic Effects

It has been shown that the hydroalcoholic extract of P. molluginifolia (10-1000 mg/kg intragastrically) and the isoflavone Isolate (5,3′,4′-trihydroxy-6′,6″-dimethylpyrano [2′,3″:7,6] ISO, 10-100 mg/kg, intranastrically) have antinociceptive properties in vivo in behavioral animal models of acute pain, including formalin-induced postoperative pain and plantar incision-induced postoperative (Nucci-Martins et al., 2016). These drugs suppress the nociceptive behavioural response in animal models of agony in a dose-dependent manner without causing drowsiness or impairment of locomotion. Both endogenous opioid receptors and/or the transient receptor

potential ankyrin 1 (TRPA1) and transient receptor potential vanilloid 1 (TRPV1) channels may contribute to this antinociceptive action, at least in part. Naloxone was also shown to reverse antinociception when preadministration (1 mg/kg, i.p.) was given. Phytomedicines based on P. tenuifolia should be further tested using positive controls, like commercial analgesics, and pharmacokinetic studies before concluding that it uses can provide analgesic properties.

5. Contraindications and Pharmacological implications of Polygala Tenuifolia

Polygala is contraindicated in people with gastritis or ulcers and shouldn't be taken for an extended period of time since it might induce diarrhoea and irritate the stomach. Women who are expecting or nursing should also avoid using it. There are no documented medication interactions involving polygala at the time of writing.

It is believed that Polygala tenuifolia and its active ingredients exhibit multiple neuroprotective properties associated with Alzheimer's disease as well as other illnesses such as cardiovascular disease, cancer, and Xanthine oxidase inhibition, including anti-A aggregation, anti-Tau protein, anti-inflammation, antioxidant, anti-neuronal apoptosis, enhancement of the central cholinergic system, and increase in neuronal proliferation.

5.1. Effects on Cardiovascular System

Cardiovascular illnesses including myocardial infarction and stroke include atherosclerosis (AS), which is associated with persistent inflammation of the arterial vessel walls, as a major contributor to their pathogenesis (Benjamin et al., 2018). Increased oxidative stress, lipoprotein alteration, immunological reactivity, and inflammation are some of the mechanisms causing atherosclerosis. These variables eventually cause endothelial dysfunction, which is the first step in atherogenesis. Basically, (ox-LDL)-induced cell damage causes endothelial dysfunction. Although this study examined several factors meticulously, more in vivo trials comparing euxanthone with an antiatherosclerotic agent are needed before touting euxanthone as a potential drug against AS.

5.2. Effects on Cancer

The in vitro activity (cytotoxicity or growth inhibition) of chemotherapeutic drugs, as well as their anticancer efficacy on transplanted tumors in animals, are useful test systems for identifying possible medicines. This enzyme converts pyruvate into lactate at the end of glycolysis, which is crucial for cancer cells' metabolism. Human isoform 5 of lactate deshydrogenase (hLDH5) is overexpressed in many types of invasive cancers (De Leo et al., 2017).

A study was conducted to assess the viability of cancer cells exposed to euxanthone isolated from P. Tenuifolia at concentrations of 2.5, 5, 10, and 20 M. At 24h, it had an IC50 of 20.38 5.23 to 61.35 M and at 48h, from 13.66 2.96 to 36.92 4.06 M, depending on the cell type. Based on the CCK-8 assay (HT-29, HCT 116, SW480, SW 630, LOVO), it significantly inhibited the growth and survival of cancer cell lines while not affecting colon viability NCM460. HT-29 and SW480 were the most responsive cell lines to this medication (Lin et al., 2005). Tunnel and annexin V tests showed that euxanthone enhanced apoptosis in CRC cells through all activation of caspase-dependent apoptotic pathways and involvement of mitochondrial intrinsic apoptotic pathways.

5.3. Effects on Xanthine oxidase inhibitory effect

A significant biological source of superoxide radicals is thought to be xanthine oxidase. These and ROS are implicated in numerous pathological processes, including inflammation, atherosclerosis, cancer, and ageing, and they add to the oxidative stress on the body.

According to the increasing absorbance at 290 nm, xanthine oxidase catalyzes the oxidation of xanthine to uric acid. A reduction in uric acid production may help cure gout by inhibiting xanthine oxidase. One megastigmane glycoside isolated from P. sibirica L. variety. As with allopurinol (IC50 4.34 M), megalopha has comparable effects in a concentration-dependent manner at 6.48 M. Two novel flavonol glycosides isolated from this species, polygalin H (26), and I (27), were shown to inhibit xanthine oxidase at IC50s of 9.48 and 8.31 M, respectively (Huang et al., 2015).

5.4. Other pharmaceutical processes

In this study, the anti-obesity properties of P. tenuifolia's aqueous extract (PTE) were examined, as well as the effect of these properties on gut microbiota and liver gene expression. A high-fat diet-induced obese mouse model and 3T3-L1 adipocytes were used to investigate the effects of PTE on lipid accumulation (Wang et al., 2017). After PTE therapy, liver gene expression patterns and gut microbiota patterns were examined in order to clarify potential pathways. Based on the authors' observations, PTE (5 g/ml over four days) was highly effective in reducing fat accumulation in 3T3-L1 cells without causing cytotoxicity, reducing lipid synthesis and serum triglycerides, with no hepatotoxicity or nephrotoxicity, and enhancing lipase activity. During the four-week study, mice were given a high fat diet (HFD) to make them obese, so that PTE could be studied in vivo.

High-fat diet-induced obese mice exhibited an increase in their weight, a rise in their blood triglyceride levels, and hepatic steatosis after treatment with PTE (250 mg/kg, daily for five weeks). Moreover, they demonstrated that PTE alters the composition of mouse gut microbiota and the expression of hepatic genes, which contribute to the anti-obesity effects of PTE (Wang et al., 2017).

PTE was used in one dosage and as a negative control in this study. Research should be conducted before determining if PTE might be useful in treating obesity. PTE is examined at various doses, compared to a positive control (for instance, orlistat or metformin), isolated and characterised in order to determine which compounds may be responsible for the observed effects, and additional toxicological and clinical research will be conducted.

According to Jee et al., when tested in a rat's model, it was discovered that polygala Tenuifolia extracts activate the anti-lipogenic transcription factor and have been demonstrated to induce lipid accumulation in liver cells. Furthermore, it has been demonstrated that polygala root extracts have antineoplastic activity in numerous cell lines, signifying that they could contribute to the treatment of some cancer forms.

The aggregation of aqueous extracts through the roots of polygala seems to have a direct influence on the formation of sperm to overcome the spermicidal consequences (Jee et al., 2021). However, no studies have been conducted so far to assess the effects of direct oral intake on fertility.

6. Medication suggestion for Polygala Tenuifolia

Polygala Tenuifolia extracts can be utilized in a wide range of ways due to their agreeable taste and low quantity dosage. The correct dosage of 150 mg Polygala Tenuifolia extract pills produced the best results.

Polygala Tenuifolia provides a great impression for persons with high-intensity professions or academic routines. Polygala Tenuifolia extraction is available in supplement form as well as powerful herbal extracts. Polygala Tenuifolia is thought to be non-poisonous and acceptable to consume. Intake was associated with Polygala Tenuifolia at the elder dose and has also been shown to be helpful in kids and young people prior to the age of 19. Polygala Tenuifolia concentrations of 150-250 mg should always be taken up to three times per day, thus according to Nootropic specialists.

Polygala Tenuifolia is highly good for people suffering from generalized anxiety disorder (GAD) and physical tension, and it is also reported to assist with insomnia. Since the extract is water soluble, the root powder of Polygala Tenuifolia can be consumed with a drinking glass of water.

7. Case study

The investigation was concluded on adolescents ranging from 9 to 19 years old using the dry root powder of Polygala Tenuifolia to check the effectiveness of anti-inflammatory medications. Every patient was administered 300mg of root powder supplemented with polygala twice a day for two months to see whether there were any negative responses. As a consequence, there were no differences found in the prevalence of undesirable responses among young individuals, just since there were no abnormalities in the recurrence of anti-inflammatory illnesses (Park et al., 2009).

8. Conclusion

Traditional Korean East Traditional Medicine employs a root called Polygala Tenuifolia, often referred to as Yuan Zhi. Its benefits for the brain's protection have been extensively considered. According to preliminary animal research, rats may benefit from the antidepressant impact of Polygala Tenuifolia. Although further study is required to validate this effectiveness, Polygala Tenuifolia may enhance cognition. The effects of Polygala Tenuifolia on rodents are comparable to those of ketamine, which also interacts with N-methyl-D-aspartic acid and its receptors, in terms of mechanism and efficacy. Trials on rodents reveal that Polygala Tenuifolia has adaptogen-like and anti-amnesic characteristics. These studies also suggest that the herb may be able to boost levels of substances essential for brain growth, such as nerve growth factor (NGF) and brain-derived neurotrophic factor (BDNF). Although taking Polygala Tenuifolia supplements may marginally improve cognitive function in older individuals, these effects are minimal in healthy persons. Polygala Tenuifolia supplementation can enhance spatial pattern and recognition, but it has no positive impact on the development of short- or long-term memories as determined by free or cued recall. To evaluate if Polygala Tenuifolia classifies as a general tonic, much more study is required.

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