Section: Review Paper

A REVIEW ON THE PHYTOCHEMICAL, PHARMACOLOGICAL, AND ANALYTICAL STUDIES CONDUCTED ON *SEDUM LINEARE* THUNB

Sunil Kumar*[1], A.K.S. Rawat[2], Akash Ved[3], Peeyush Bhardwaj[4], Gyan Singh[5]

[1,2]Maharishi School of Pharmaceutical Science, Maharishi University of Information Technology, Sitapur road, Lucknow- 226013, Uttar Pradesh, India.
[3]Faculty of Pharmacy, Dr. APJ Abdul Kalam Technical University, Lucknow -226028, Uttar Pradesh, India.
[4]Institute of Pharmacy, Bundelkhand University, Jhansi-284128, Uttar Pradesh, India.
[5]P. K. University, Shivpuri Road, Thanra- Shivpuri-473660, Madhya Pradesh, India.

Corresponding author
Mr. Sunil Kumar
PhD. Research Scholar,
Maharishi School of Pharmaceutical Science,
Maharishi University of Information Technology,
Sitapur road, Lucknow- 226013, Uttar Pradesh, India.
Email-sunilsinghpharmacy@gmail.com

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ABSTRACT:

Within the context of traditional Chinese medicine, the use of the whole *Sedum lineare* Thunb. plant as a therapeutic agent is referred as "*Sedi linearis* Herba." This term originated in China. It was often used as a treatment for a wide range of medical conditions, such as hepatitis, swelling of the neck, dysentery, dermatitis rhus, burns, scalds, traumatic bleeding, and a huge number of other conditions. It has been shown that in addition to being able to modify thyroid hormone, this plant also contains the traits of being antibacterial, anticancer, nephroprotective, analgesic, anti-inflammatory, and anti-diarrheal. The capacity of the plant to shield the kidneys from injury is what's meant by the term "nephroprotective." Active chemical substances such as hyperoside, isoquercetin, astragalin, beta-amyrone, and oleanene triterpenes from *Sedum lineare* Thunb. have been identified from the plant, amongst a great many more. These compounds are what give the plant its medical qualities, and they are accountable for those qualities. In this review, we will be concentrating on the medicinal properties, pharmacological and analytical activities, and phytochemical make-up of *Sedum lineare* Thunb.

Keywords: *Sedum lineare* Thunb., Phytochemistry, δ-Amyrone, Pharmacological activity, Analytical study.

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INTRODUCTION:

Traditional Chinese medicine using the whole *Sedum lineare* Thunb. plant is known as Sedi linearis Herba in China[1]. It was often used as treatment for a wide range of medical issues, such as hepatitis, swelling of the throat, dysentery, dermatitis rhus, burns, scalds, traumatic bleeding, and so on[2, 3]. The potential for *Sedi linearis* Herba to stop the formation of malignant cells has piqued the curiosity of the Tujia minority area in western Hubei, China[4-6]. Pharmacological research on mice with experimental acute liver injury found that *Sedi linearis* Herba protected the liver, reduced alanine amino transferase (ALT) activity, and cleared up their jaundice[7-10]. These results were seen in mice. The content of malondialdehyde (MDA) in the blood and the hepatic tissue was also dramatically reduced, and the activity of the superoxide dismutase enzyme was enhanced[11, 12]. Furthermore, ethyl acetate extracted from the plant was shown to have a significant anticancer effect on many different types of cancer cells[13-14]. As an added bonus, the *Sedi linearis* Herb has a long history of use as a vegetable in some regions of China[15]. As a result, not only did this drug have a wide variety of therapeutic characteristics, but it was also safe to use in its crude medicinal form, arguing that it warranted further investigation and development[16-18].

It's generally known that crude drugs include a wide variety of ingredients. Therefore, traditional quality control approaches, which primarily concentrate on quantifying a single active component, cannot provide a comprehensive evaluation of the raw drug's quality[19, 20].

FIGURE 1: PLANTS OF *SEDUM LINEARE* THUNB.[21]

Culture

Plants need full sunshine and soil that is medium to dry in order to flourish. Ideal for conditions with a considerable quantity of shade[22]. It can withstand very high temperatures as well as arid situations with ease[23]. Sandier-than-gravel soils with a fertility level between medium and low are optimal for plant development[24]. If you want to get satisfactory results, you will need to ensure that the soil drains well enough[25-26]. Allowing plants to flourish in their natural habitat may provide a beautiful ground cover[27]. Locations in the St. Louis area, the northernmost latitude at which this plant may survive the winter, should be chosen with care due to the need for protection[28]. This plant is hardy only in warm climates that never drop below freezing[29, 30].

Noteworthy characteristics

A mat-forming, evergreen stonecrop native to eastern Asia and known by its scientific name, *Sedum lineare* Thunb. It may reach a height of 4–6 inches and a width of 12 inches or more, depending on whether it develops stems that stay erect or fall over. Small, straight or lanceolate (up to 1 1/4 inches long) leaves "long) have a very light green colour. Flowering yellow plants (to 14.5 mm in "bloom cynically from late spring to early summer[31-33].

Most sedums grow in a sitting posture, therefore the name "genus" was derived from the Latin word for "to sit," "sedeo" (they sit and sprawl over rocks)[34].

The linear form of the leaves is reflected in the choice of the specific epithet[35].

The common name "stonecrop" is derived from the fact that many sedum species are found in the wild clinging to the sides of steep cliffs[36].

DISTRIBUTION:

Carpet Sedum, an evergreen succulent that thrives in full sun with no care, may be used in places where other plants die[37]. The Latin words sedeo, meaning "to sit," and lineare, meaning "linear," combine to form the plant's name. Its native range includes parts of eastern Asia. Sedums are more often known as stonecrops[38]. As a result, sedums are often found in their natural habitats on stony or rocky terrain. This tough plant can hold its own in scorching temperatures and dry conditions, and it has the potential to spread out in a low mat-like fashion[39-41]. Its versatility makes it a great choice for a wide variety of planting situations, including shady regions, narrow spaces, shady corners, buried in or flowing over walls, rock gardens, xeriscapes, and hanging baskets[42]. As long as there is enough drainage, the Carpet Sedum may flourish in almost any soil type[43]. In order to thrive, the soil should be sandy or gravelly. Some shade is OK, but the plant will grow more open and leggier as a consequence[44, 45].

Carpet Sedum is a plant that has been proposed as a viable option for green roofs on flat-roofed buildings in Shanghai, China. Carpet sedum has a shallow root system and hence cannot establish itself in a soilless environment[46].

The Carpet Sedum is easily reproduced throughout the year by layering, stem cutting, and division[47].When a leaf is placed on top of dirt, roots develop at the point of contact. The leaf will stay there if you sprinkle a little dirt on top of it[48].You may make your plants larger by dividing them and replanting the cuttings. It is possible to do a stem cut by simply taking off a part of the plant and replanting it[49].Carpet Sedum may spread naturally from plant to plant by means of its own seeds[50].The Carpet Sedum is not only pest-proof but also blooms a little yellow flower from late spring into early summer. Pollinators are attracted to this flower[51].It is recommended to keep a watch out for slugs, snails, and scale, although these insects are not generally considered to be a major problem[52].

Origin and Habitat: The countries of Japan, China (including the provinces of Anhui, Fujian, Gansu, Guangdong, Guizhou, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, and Yunnan), and Eastern Asia[53]. The plant was brought to and eventually naturalised in Eastern Europe and the United States (Georgia). This species was first documented using Japanese specimens, but its origins are unknown. The species was described, however, based on data collected in Japan[54].

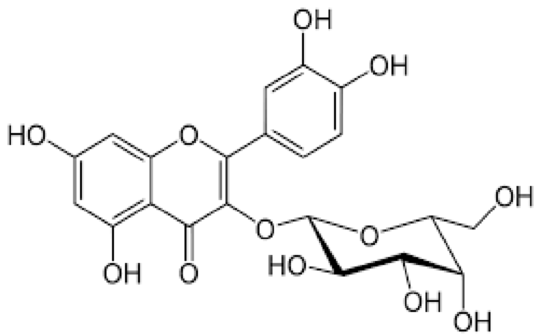
Cultivation and Propagation: *Sedum linerare* Thunb, a kind of moss-like ground cover, is an excellent option for use in rock gardens, stepping-stone containers, and wall niches. Landscape elements that serve as a border, such as rocks or a garden[55]. Use them in bulk or in clusters for the best results. Great as a ground-based scrambler, especially when taught to traverse or circle a nearby rock, so long as the dirt is well drained. Its stems may grow to a length of roughly 30 centimetres, making it a superb plant to use in a hanging basket. Sedums are a kind of succulent that is easy to grow and tolerates a broad range of environmental factors[56]. They do well in full sun or partial shade, wet or dry soil, and many intensities of light. However, they only blossom into their full splendour when given sufficient water and sunshine, and they thrive best when cultivated in the fresh air[57-60]. Due to its ability to withstand cold and drought, minimal soil requirements, and lack of penetrating roots, this plant has been proposed as a good option for "greening" Shanghai, China's flat-roofed skyscrapers[61-62].

MEDICINAL USE OF *SEDUM LINEARE* THUNB:

A fresh plant may be crushed and used to burns and scalds for relief[63].*Sedum lineare* Thunb. a common garden plant, was used historically to treat a broad range of inflammatory skin diseases. Many of the leaves' constituents are used to speed wound recovery and calm irritated skin. Before using the leaves, their protective cuticle is stripped away[64].

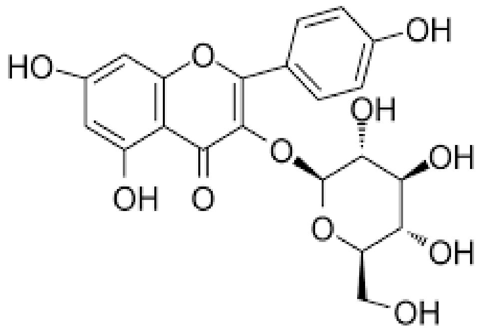
PHYTOCHEMISTRY OF *SEDUM LINEARE* THUNB:

Through the use of phytochemical analysis, it was shown that *Sedum lineare* Thunb. plants contained hyperoside, isoquercetin, and astragalin. In addition to two known oleanene triterpenes, -amyrone (2) and -amyrine acetate, an alcoholic extract of the entire plant of Sedum linear Thunb revealed the presence of one novel olean-13(18)-ene-3,12,19-trione (1). This discovery was made possible by the presence of an additional oleanene triterpene. These findings came from the alcoholic extract's petroleum ether fraction, which was separated out and analysed (3)[65-67].

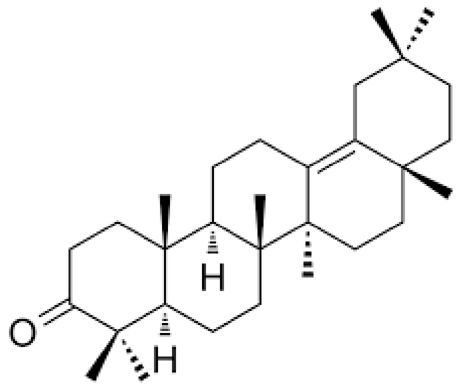


Hyperoside

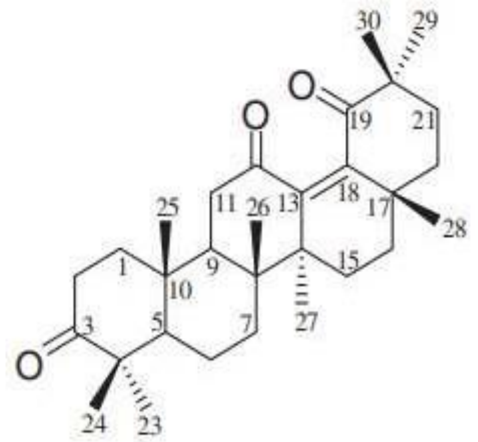
Isoquercetin



Astragalin



δ-Amyrone



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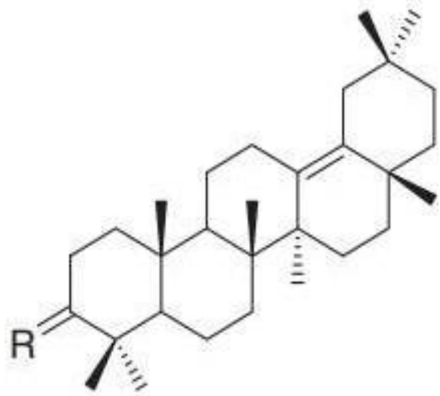

2 R = O
3 R = β-OAc

Triterpene oleanenes derived from *Sedum lineare* Thunb.

PHARMACOLOGICAL AND ANALYTICAL PROPERTIES OF *SEDUM LINEARE* THUNB:

For this chromatography, we used a BDS Hypersil C18 column and a mobile phase of acetonitrile-0.1% acetic acid solution (gradient elution). The results revealed substantial differences in the concentrations of the major active component across samples collected from the same environment throughout each of the four seasons. Samples obtained towards the end of April had a substantially greater ingredient content than those tested in the middle of August. Furthermore, the major active component concentrations varied across samples collected during the same season but from different locations. The sample's concentrations of the most significant elements, for example, were greater in August's rainy climate than in the dry environment. These results, taken together, provided conclusive evidence that the HPLC fingerprint analysis and contents determination technique that had been devised was helpful for analysing and maintaining control over the quality of Sedi linearis Herba[68].

Following the same detection method and a number of collection seasons, HPLC fingerprints of *Sedum lineare* and *Sedum sarmentosum* were produced and compared. *Sedum lineare* has been shown to contain hyperin, isoquercitrin, and astragaloside, all of which were detected in an HPLC analysis of the plant's fingerprint. While fingerprints from *Sedum lineare* grown in the same location but in different environments were nearly indistinguishable, fingerprints from the same plant grown at different times of the year showed striking differences, with the area of the most common peaks shifting from small to large and the number of peaks changing slightly. Despite the fact that they shared four peaks in their HPLC fingerprint, the two Sedum species could be clearly distinguished from one another. These two kinds are best harvested during full bloom. The established method has promise as a standard for recognising and evaluating *Sedum lineare*Thunb[69].

The whole *Sedum lineare* Thunb plant has been utilised as a traditional folk medicine for the treatment of seventeen various conditions, including sore throat, recurring hepatitis, jaundice, and dysentery. In 19 different animal models of inflammation, the pentacyclic triterpene molecule -amyrone (13(18)-oleanen-3-one) isolated from *S. lineare* Thunb was shown to have a potent anti-inflammatory effect. Twenty mice had decreased xylene-induced ear edoema when pretreatment with -Amyrone (intraperitoneally), -amyrone decreased levels of nitric oxide (NO), prostaglandin E2 (PGE2), 21 interleukin-6 (IL-6), and leukocyte counts in acetic acid-induced peritonitis in vivo. The purpose of this study was to investigate the effect of - Amyrone in lipopolysaccharide (LPS)-generated perito- 23 neal macrophages and to determine its possible 22 mechanism. The data indicated that -Amyrone effectively suppressed the production of IL-6, TNF-, and NO. In addition, the results revealed that protein-level regulation of cyclooxygenase-2 is mediated by -amyrone rather than cyclooxygenase-1 (COX-1) (COX-2). Results like these suggest that -amyrone is a bioactive molecule with anti-inflammatory effects that may contribute to COX-2 regulation[70].

Two known oleanene triterpenes, -amyrone (2) and -amyrine acetate (3), and one new olean-13(18)-ene-3,12,19-trione (1) were isolated from a petroleum ether fraction of an alcoholic extract of the whole plant of Sedum linear Thunb (3). X-ray diffraction analysis was used to verify the structure of the unique molecule, and further spectroscopic methods, such as 1D and 2D NMR and HR-ESI-MS, provided more insight into the molecule's composition. NMR analysis allowed for the identification of the proven ones by comparing the compounds' profiles to those of already-identified chemicals. The compounds' anti-TNF- and anti-NO effects were also evaluated *in-vitro*[71].

Important for healthy plant growth, zinc (Zn) might have the opposite effect depending on the concentration. The morphological characteristics and antioxidant capabilities of *Sedum lineare* Thunb. were investigated at varying concentrations of zinc in relation to 24-Epibrassinolide (EBR). 24-Epibrassinolide (EBR) is a well-known steroid phytohormone that regulates plant development and alleviates the damage caused by abiotic stress. Several morphological features were significantly improved by simultaneous foliar treatment with 0.75 M EBR compared to plants exposed to Zn alone, and the benefits of this therapy on plant growth were most pronounced at high Zn concentrations. Increases of 111%, 85%, and 157% in stem length, fresh weight, and internode length were seen in EBR-treated plants compared to Zn alone-treated plants at a toxic 800 M Zn. EBR spray reduced the accumulation of reactive oxygen species (ROS) and lipid peroxidation in plants. In addition, it increased the activities of antioxidant enzymes such as peroxidase (POD), ascorbate peroxidase (APX), and glutathione reductase (GR), as well as the contents of antioxidative agents such as ascorbic acid (AsA) and glutathione. These results suggest that EBR spray may be a useful tool for the (GSH). By demonstrating that EBR helped *S. lineare* Thunb. resist high-zinc stress by strengthening the antioxidant system, the results of this research provided novel insight into how to increase the genetic diversity of Crassulaceae plants cultivated in heavy metal-contaminated soil for phytoremediation. This research was funded by the National Science Foundation[72].

We utilised acetonitrile as the stationary phase and a 0.1% acetic acid solution in acetonitrile as the mobile phase (gradient elution). The results revealed substantial differences in the concentrations of the major active component across samples collected from the same environment throughout each of the four seasons. Samples obtained towards the end of April had a substantially greater ingredient content than those tested in the middle of August. Furthermore, the major active component concentrations varied across samples collected during the same season but from different locations. The sample's concentrations of the most significant elements, for example, were greater in August's rainy climate than in the dry environment. Collectively, these findings proved that the HPLC fingerprint analysis and contents determination approach established was useful for analysing and controlling the quality of *Sedi linearis* Herba[73].

Recent advances notwithstanding, neuropathic pain continues to be a pressing issue in global health. As a result, it is crucial to look into other methods of relieving neuropathic pain. The role of neuroinflammation in the development of neuropathic pain has been well acknowledged. The Chinese herb *Sedum lineare* Thunb. (SLT), which comes from the whole grass of a Crassulaceae plant, is said to have anti-inflammatory effects. However, it is not known how SLT may help with neuropathic pain. In this study, neuropathic pain was induced in rats using spared nerve injury (SNI).

In this study, SLT (p.o.) was administered once a day to SNI rats for a total of 14 days. Pain-related behaviours in the animals were measured using the paw withdrawal threshold (PWT) and the CatWalk gait characteristics. A Western blotting test was used to determine the levels of inflammatory mediators and pain-related signalling molecules that are expressed in the spinal cord. Mechanical hypersensitivity in SNI rats was decreased by SLT treatment in a dose-dependent manner. Doses of SLT (30, 100, and 300 mg/kg, p.o.) were effective. The optimum dose of SLT, 100 mg/kg, successfully suppressed microglial activation, lowered spinal HMGB1, TLR4, MyD88, TRAF6, IL-1, IL-6, and TNF-protein levels, and improved gait parameters in SNI rats.

Protein expression for IB and IL-10 was unquestionably upregulated after SLT treatment, whereas phosphorylation levels for IKK and NF-kappaB p65 were markedly lowered in the spinal cord of SNI rats. Combined, our findings suggest that SLT may work as a therapeutic drug for neuropathic pain by inhibiting the spinal TLR4/NF-B signalling pathway in SNI rats[74].

CONCLUSION:

There has been a significant amount of research conducted on *Sedum lineare* (Thunb.), all of which indicates that it has a massive amount of untapped biological potential. There is reason to be hopeful that the evidence for the use of this plant in medicine may be located in the particulars that are given in this analysis of the phytochemical and other biological characteristics of the extracts. Geographical areas have a role in both the diversity of phytochemical compounds that *Sedum lineare* Thunb has and the efficacy of the therapeutic characteristics that it possesses.

Even in this day and age, the bulk of the world's population relies almost exclusively on plant-based medicines as their sole supply of pharmaceuticals. Because of this, it is still challenging for scientists to deliver medication that is not only inexpensive but also effective and safe, especially for those who live in rural regions. More study has to be done on these species of Sedum as well as their quantification of individual phytoconstituents and their pharmacological profiles, which are based on *in-vitro* research, *in-vivo* research, and clinical trials.

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