

Pharmacognostic studies of *Polygala senega* L. Root: A homoeopathic drug

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Abstract

Background: *Polygala senega* L. is a small perennial herb belonging to the family Polygalaceae. The roots are used as stimulant and expectorant in bronchitis. In Homoeopathy, it is used for hypopyon, paresis of oculomotor nerve, catarrh of pharynx, sore throat, catarrh of bladder, influenza, asthma, whooping cough, soreness in chest, pleurisy, pneumonia, hydrothorax, pleuropneumonia, pneumonia, hydrothorax and ascites. **Objective:** The objective of the present study deals with morpho-anatomical, powder and physicochemical characteristics of the root of *P. senega* for developing standards for authentication of drug. **Materials and Methods:** The current study includes morpho-anatomical, powder and physicochemical studies of the root of *P. senega*. Physicochemical studies comprise extractive values, ash values, chemical tests, weight/millilitre, total solids, alcohol content and loss on drying. **Results:** The root are yellowish brown to light brown and has as its unique mark a projecting line on its down side. The distinguishing microscopic characteristics of the root included the presence of multilayered phellem, abundant phelloderm interrupted by tracheary elements, acicular crystals, abnormal development of phloem and V-shaped medullary rays. Physicochemical studies of the raw drug and mother tincture are standardised and depicted. **Conclusion:** The pharmacognostic and physicochemical data depicted in this study may serve as pharmacopoeial standards for identification and authentication of the homoeopathic drug *P. senega*.

Keywords: Homoeopathy, Pharmacognosy, *Polygala senega*, Standardisation

INTRODUCTION

Polygala senega L. (syn: *Polygala senegum* L.; *P. rosea* Steud; *Senega officinalis* Spach) is commonly known as snakeroot or milkwort belonging to the family Polygalaceae. Polygala means 'much milk', commence its own secretions and their effect, whereas the 'Senega' word originated from a Seneca tribe belongs to North American Indians. This plant is indigenous to North America and found in Eastern United States, Virginia, South Canada, Western New England to Wisconsin and Kentucky.^[1,2] In India, the plant is generally developed during summer and completes its life period in 4–5 months once self-pollinated.^[3] It is a small perennial herb about 20–50 cm tall. The stems are numerous, unbranched, erect, ascending, and smooth herbaceous to woody along with woody rootstock that spread horizontally. The roots are yellowish brown to light brown, conical, twisted, thick; branched roots and broken pieces thereof together with detached rootlets, 5–15 cm length. The leaves are alternately arranged, sessile, exstipulate, lanceolate or oblong or ovate

lanceolate, bright green, paler underneath, rough margin with a sharp point. Flower is white, cleistogamous, irregular, hermaphrodite and 5 distinct sepals, of 3–5 petals, 8 stamens and a bicarpellate pistil. Fruits are loculicidally dehiscent, two celled capsule, flat broader than long and having barrel shaped pollen grains. Seeds are two in number, oblong ovate, somewhat hairy, and black in colour.^[4-6]

This plant is widely used in herbal and allopathic medicines. The root of *P. senega* has been reported to possess anticancer, anti-inflammatory, anti-hypoglycaemic, antioxidant, antitussive, antiasthmatic, anti-venom and immunological adjuvant activities.^[7-12] The reported chemical constituents of *P. senega* are triterpenoid saponins such as senegin, polygalic acid, senegenin, presenegenin, senegenic acid, fixed oil,

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sterol and senegin II.^[13-15] In Homoeopathy, it is used for hypopyon, paresis of oculomotor nerve, catarrh of pharynx, sore throat, catarrh of bladder, influenza, asthma, whooping cough, soreness in chest, pleurisy, pneumonia, hydrothorax, pleuropneumonia, pneumonia, hydrothorax and ascites.^[16]

In view of the medicinal uses of its root in Homoeopathy, standardisation studies on root of *P. senega* have been undertaken and the data presented in this article would provide correct diagnostic features for identification and authentication of raw drug for preparation of homoeopathic mother tincture and further dilutions.

MATERIALS AND METHODS

Chemicals

All the chemicals used in the studies were of analytical grade.

Plant collection

The roots of plant of *P. senega* were obtained from the Centre for Medicinal Plants Research in Homoeopathy, Ooty, Tamil Nadu, India, and the methods carried out as per the study protocols described in Homoeopathic Pharmacopoeia of India (HPI).^[6] For physicochemical studies, root was dried in shadow. The dried root was ground into coarse powders used for the preparation of mother tincture and other studies.

Macroscopy

Macroscopic characteristics of crude drugs were made on the basis of shape, size, fracture, colour, surface characteristics and texture of cut/broken sides of raw drug materials following the prescribed methods.^[17]

Microscopy

The roots were little boiled, sliced into small pieces, fixed in formaldehyde-acetic acid-alcohol (FAA) and dehydrated all the way through different xylene/alcohol ratio followed by embed in paraffin wax. The cross-sections made were in between 10 and 12 μ m processed for staining in crystal violet and basic fuchsin combination as per the Johansen's method. Permanent slide was prepared with the help of Canada balsam as per the Johansen's method.^[18] Microscopic characteristics and photomicrography were made using Olympus BX 53 Research Trinocular Microscope.

Powder studies

The powder studies were carried out by boiling the powder drug in distilled water, stained in safranin and mounted with glycerine. Photomicrography was done with Olympus CH-2 Trinocular Microscope.

Organoleptic characteristics

A small amount of powdered drug was spread on a white tile and physically examined for general appearance i.e., nature, colour, odour, taste and texture.

Physicochemical studies

The shaded dried sample of senega root was coarsely powdered and determined the physicochemical standards viz., moisture

content or loss on drying, different ash values such as total ash, water-soluble ash and acid-insoluble ash, extractive values, specific gravity, test for saponins, pH, chromatographic profile and ultraviolet (UV) spectroscopy studies. Mother tincture was prepared following percolation method as per HPI.^[6]

Thin-layer chromatography

Mother tincture (25 ml) was evaporated on water bath and removed alcohol. The remaining aqueous part was extracted with 25 ml of chloroform (thrice). All the fractions were combined, concentrated, applied on thin-layer chromatography (TLC) plate and developed using chloroform: ethyl acetate (9:1) as mobile phase. The spots were identified using UV lights of 365 nm and 254 nm.

OBSERVATIONS AND RESULTS

Macroscopy

The root are yellowish brown to light brown, and in size from the width 0.5–1.5 cm. It has unique mark a projecting line, all along its curved in side. It is usually conical, twisted, sometimes almost spiral, rarely straight, thick, tortuous, vertical mostly, branched roots and broken pieces thereof together with detached rootlets, knotty crown, 5–15 cm length, composed largely of short stem bases. Its surface wrinkled longitudinally and short fracture and rather splintery in the centre on breaking. Sharp cutting section of root showed an abnormal appearance having one or two wedge-shaped portions that may reinstate by parenchymatous tissue. The plunges in the root are mainly due to the development of the phloem. The odour is wintergreen and tastes sweet and then becomes acrid [Figure 1].

Microscopy

The transverse section of root shown 4–6 layers of cork or phellem which were made of thin, polygonal, tangentially elongated radially wide cells, few squarish, closely packed, dense with contents, interspersed with acicular crystals in few. Phellem followed single-layered phellogen then by abundant phelloderm interrupted by tracheary elements. Phelloderm cells are polygonal mostly oval to circular, closely packed without



Figure 1: *Polygala senega* root crude drug

intercellular spaces, contents scanty. Some of these cells become collenchymatous and filled with oil ducts. Primary xylem is diarch, present at centre with vessels/tracheids arranged in radial rows, few laterally aligned interrupted by xylem parenchyma. Primary xylem is surrounded by scanty phloem. Phloem consists of sieve cells, sieve tubes and phloem parenchyma. Phloem parenchyma compactly arranged contents scanty. Secondary xylem is arranged in three cycles located in phelloderm region. Outer cycle secondary xylem is made of 3–4 vessels arranged as patches interrupted by phelloderm. Middle and inner cycles of secondary xylem with numerous vessels are arranged as linear rows of vascular bundles interrupted by 3–4 rows of medullary rows. Medullary rays are V-shaped, outer side having oil ducts. Vascular bundles showed conjoint, collateral and exarch condition [Figure 2].

Powder studies

Microscopic studies of *P. senega* root powder have shown the presence of pieces of cork with tangentially elongated cells containing acicular crystals, fragments of phelloderm with polygonal cells and isolated or broken or whole tracheary elements with bordered pits [Figure 3].

Organoleptic characteristics

- Colour: Pale brown-yellowish brown
- Touch: Coarse
- Odour: Like wintergreen
- Taste: Sweet becomes acrid.

Physicochemical studies

The data generated under the physicochemical studies for raw drug of *P. senega* are summarised in Table 1. Formulation and preparation of mother tincture and its standardisation data are summarised in Tables 2 and 3, respectively, and the results of TLC/chromatographic studies are summarised in Table 4 and Figure 4.

CONCLUSION

The described macro- and microscopical characteristics along with powder studies of *P. senega* are unique diagnostic

characteristics which will help in identification and authentication raw drug materials to ensure quality and

Table 1: Physicochemical standards of crude drug *Polygala senega*

Different parameters	Observations
Moisture content (LOD at 105°)	Not >6.65%w/w
Total ash	Not >9.42%w/w
Acid-insoluble ash	Not >2.5%w/w
Water-soluble ash	Not >3.31%w/w
Extractive value in	
Petroleum ether (60°-80°)	Not <0.35%w/w
Chloroform	Not <8.25%w/w
Methanol	Not <9.25%w/w
Alcohol	Not <0.8%w/w
Purified water	Not <15.7%w/w
Foam test	Positive
LOD: Loss on drying	

Table 2: Formulation and preparation of mother tincture (6)

Drug strength	1/10
Alcohol content (%)	51
Percolation technique is used (HPI 1971)	
<i>Polygala senega</i> root in coarse powder (g)	100
Strong alcohol (ml)	536
Purified water (ml)	485

To make 1000 ml of the mother tincture. Potencies: 2X to contain one part mother tincture, three parts purified water and six parts strong alcohol; 3X and higher with dispensing alcohol. HPI: Homoeopathic Pharmacopoeia of India

Table 3: Different tests/parameters for finished product

Parameters/tests	Observations
Organoleptic profile	
Appearance	Clear, nonviscous
Colour	Yellow
Odour	Characteristic
Sediments	Absent
Weight per ml	Not >0.90 g
Specific gravity	0.90 at 25°
Total solids	Not <1.72%w/v
Alcohol content	48-51%v/v
pH at RT	4.4-5.3
λ_{max}	271 and 321 nm
RT: Room Temperature	

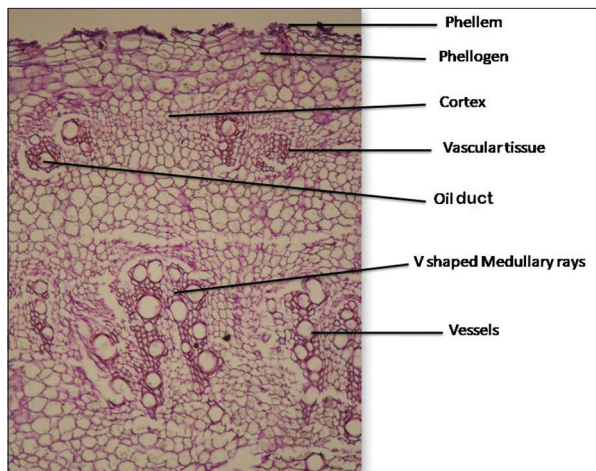


Figure 2: Transverse section of *Polygala senega* root

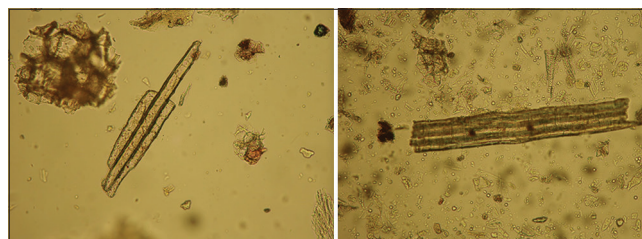


Figure 3: Powder microscopy of *Polygala senega* root

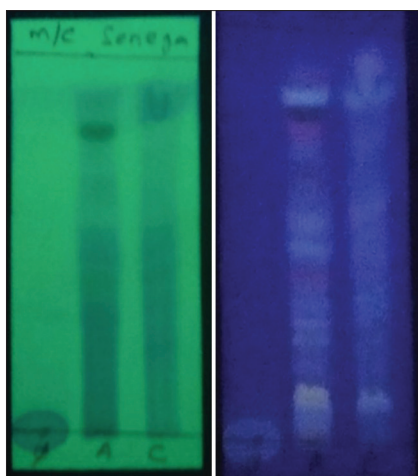


Figure 4: Thin-layer chromatography plates of *Polygala senega* using 90/10 CHCl₃/MeOH. In-house mother tincture, A = In-house Mother Tincture's CHCl₃ extract, C = Commercial Mother Tincture's CHCl₃ extract. Left = 254 nm, Right = 366 nm

Table 4: Chromatographic profile of *Polygala senega*

Solvent system	Detecting agent	Number of spots	R ^f	Colour of spots
Chloroform: methanol (9:1 v/v)	UV 254 nm	13	0.88	Blue
			0.79	Black
			0.66	Blue
			0.54	-do-
			0.50	-do-
			0.46	-do-
			0.40	-do-
			0.32	-do-
			0.28	-do-
			0.24	-do-
			0.20	-do-
			0.16	-do-
			-do-	UV 366 nm
0.85	Blue			
0.80	Black			
0.76	Orange			
0.52	Blue			
0.47	-do-			
0.44	-do-			
0.28	-do-			
0.23	-do-			
0.12	Yellow			

UV: Ultraviolet

efficacy of the drug. Physicochemical data viz., extractive values, ash values, chemical tests, weight per ml, total solids, alcohol content and loss on drying were found to be acceptable limit. The results of TLC studies and UV spectroscopic data

can be used as characteristic standards for *P. senega*. These data may also be treated as pharmacopoeial standards for the homoeopathic drug *P. senega*.

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Conflicts of interest

None declared.

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पॉलीगैला सेनेगा एल.रुट – एक होम्योपैथिक औषधि का भेषज वैज्ञानिक अध्ययन

सार

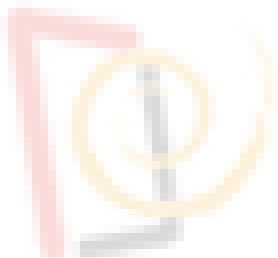
पृष्ठभूमि: पॉलीगैला सेनेगा एल. पॉलीगैलासी परिवार की एक छोटी सी बारहमासी जड़ी बूटी है। इसकी जड़ें ब्रॉन्काइटिस में उत्तेजक व एक्सपोटोरेंट के रूप में उपयोग की जाती हैं। होम्योपैथी में इसका उपयोग हाइपोपियन, ओकुलो-मोटर तंत्रिका के आंशिक पक्षाघात, ग्रसनी की घुटन, गले में खराश, मूत्राशय के श्लैष्मिक ज्वर, श्लैष्मिक ज्वर (इंफ्लूएंजा), दमा, काली खांसी, सीने में दर्द, परिफुफुसशोथ, न्यूमोनिया, हाइड्रोथोराक्स, प्लूरो-न्यूमोनिया में होता है।

उद्देश्य: वर्तमान अध्ययन का उद्देश्य दवाओं के प्रमाणीकरण के लिए मानकों के विकास के लिए पी. सेनेगा की जड़ के मोर्फो-एनाटोमिकल, पाऊंडर और भौतिक रसायन संबंधी लक्षणों से संबंधित है।

सामग्री व विधि – इस अध्ययन में मोर्फो-एनाटोमिकल, पाऊंडर और भौतिक-संबंधी अध्ययन शामिल हैं, जैसे एक्सट्रेक्टिव मूल्य, राख मूल्य, रासायनिक परीक्षण, वजन प्रति मिलीलीटर, कुल ठोस पदार्थ, एल्कोहल की मात्रा और पी. सेनेगा की जड़ें सुखाने पर हानि पर किए गए।

परिणाम: जड़ पीले भूरे रंग से हल्के भूरे रंग की होती है और इसके नीचे की तरफ एक प्रक्षेपण रेखा के रूप में इसका अनोखा निशान होता है। जड़ की विशिष्ट सूक्ष्म विशेषताएं हैं कई स्तरित फ्लोएम का होना, प्रचुर मात्रा में ट्रेकियरी तत्वों से बाधित फेलोडर्म, एसिक्वूलर क्रिस्टल्स, फ्लोएम का असामान्य विकास वी-आकार की मस्तिष्क किरण। कच्ची औषधि और मदर टिंक्चर के भौतिक रसायनिक अध्ययन को मानकीकृत और चित्रित किया गया है।

निष्कर्ष: इस अध्ययन में दर्शाया गया भेषज वैज्ञानिक और भौतिक रसायनिक डाटा होम्योपैथिक औषधि पी.सेनेगा की पहचान और प्रमाणीकरण के लिए फार्माकोपियल मानकों के रूप में कार्य कर सकता है।



Pharmakognostische Studien von *Polygala Senega* L. Wurzel - eine homöopathische Droge

Geblendeter Artikel

ABSTRAKT

Hintergrund: *Polygala senega* L. ist eine kleine mehrjährige Pflanze aus der Familie der Polygalaceae. Die Wurzeln werden bei Bronchitis als Stimulans und Expektorans verwendet. In der Homöopathie wird es für Hypopion, Parese des oculomotorischen Nervs, Katarrh des Pharynx, Halsschmerzen, Blasenkatarrh, Influenza, Asthma, Keuchhusten, Schmerzen in der Brust, Rippenfellentzündung, Lungenentzündung, Hydrothorax, Pleuro-Pneumonie, Lungenentzündung, Hydrothorax und Aszites. **Zielsetzung:** Das Ziel der vorliegenden Studie beschäftigt sich mit morphoanatomischen, pulverförmigen und physikochemischen Eigenschaften der Wurzel von *P. senega* zur Entwicklung von Standards für die Authentifizierung von Arzneimitteln.

Material und Methoden: Die aktuelle Studie umfasst morphoanatomische, pulver- und physikochemische Studien, dh extraktive Werte, Aschewerte, chemische Tests, WT. pro ml, Gesamtfeststoffe, Alkoholgehalt und Verlust beim Trocknen der Wurzel von *P. senega*.

Ergebnisse: Die Wurzel ist gelblich-braun bis hellbraun und hat als einzigartige Markierung eine vorstehende Linie auf ihrer Unterseite. Die unterscheidenden mikroskopischen Merkmale der Wurzel sind das Vorhandensein von vielschichtigem Phellem, reichlich Phelloderm, unterbrochen von Tracheaelementen, nadelförmigen Kristallen, abnormaler Entwicklung von Phloem und V-förmigen Markstrahlen. Physikalisch-chemische Studien der Roharzneimittel- und Urtinktur sind standardisiert und dargestellt.

Fazit: Die in dieser Studie dargestellten pharmakognostischen und physikochemischen Daten können als Arzneibuchstandards zur Identifizierung und Authentifizierung des homöopathischen Arzneimittels *P. senega* dienen.

Estudios farmacognósticos sobre la raíz de *Polygala senega* L. – un medicamento homeopático

RESUMEN

Fundamento: *Polygalasenega* L. es una pequeña hierba perenne perteneciente a la familia Polygalaceae. Sus raíces se utilizan como estimulante y expectorante en la bronquitis. En homeopatía, se administra en casos de hipopion, parésia del nervio oculomotor, catarro faríngeo, dolor de garganta, gripe, asma, tosferina, dolorimiento torácico, pleuresía, hidrotórax, pleuroneumonía y ascitis.

Objetivo: El objetivo del presente estudio fue examinar las características morfoanatómicas, físico-químicas y del polvo de la raíz de *P. senega* para desarrollar estándares para la autenticación del medicamento.

Material y métodos: El presente estudio incluye el análisis morfoanatómico, físico-químico y del polvo, es decir, se examinaron los valores de extracción y los valores de cenizas, se efectuaron pruebas químicas y se analizaron el peso por ml, los sólidos totales, el contenido en alcohol y la pérdida de secado de la raíz de *P. senega*.

Resultados: La raíz es de color amarillo-marrón a marrón y como marca exclusiva presenta una línea de proyección en su cara inferior. Las características microscópicas distintivas de la raíz residen en la presencia de un felema multicapa, un feloderma abundante interrumpido por elementos traquearios, cristales aciculares, desarrollo anormal del floema y rayos medulares en forma de “v”. Se estandarizan y presentan los estudios físico-químicos del medicamento crudo y de la tintura madre.

Conclusiones: Los datos farmacognósticos y físico-químicos obtenidos en este estudio pueden servir como estándar de farmacopea para la identificación y autenticación del medicamento homeopático *P. senega*.



Études pharmacognostiques de la racine *Polygala senega* L. – un médicament homéopathique

RÉSUMÉ

Contexte: *Polygala senega* L. est une petite herbe vivace appartenant à la famille des polygalacées. Les racines sont utilisées comme stimulant et expectorant dans le traitement de la bronchite. En homéopathie, sont utilisées pour traiter l'hypopion, la parésie du nerf oculomoteur, le catarrhe du pharynx, le mal de gorge, le catarrhe de la vessie, la grippe, l'asthme, la coqueluche, la douleur dans la poitrine, la pleurésie, la pneumonie, l'hydrothorax, la pleuropneumonie, la pneumonie, l'hydrothorax et l'ascite.

Objectif: Le but de cette étude est d'examiner les caractéristiques morpho-anatomiques, physicochimiques et de la poudre de la racine de *P. senega* en vue d'élaborer des normes pour l'authentification du médicament.

Matériel et méthodes: Cette étude comprend l'analyse des caractéristiques morpho-anatomiques, physicochimiques et de la poudre, à savoir les valeurs extractives, la valeur des cendres, les tests chimiques, le poids/ml, la teneur en matières solides et alcoolique et la perte lors du séchage de la racine de *P. senega*.

Résultats: La couleur de la racine est d'un brun jaunâtre à un brun clair et sa marque unique est une ligne saillante sur le revers. Les caractères microscopiques distinctives de la racine sont la présence de phellème en multicouches, de nombreux phellodermes entrecoupés de trachées, de cristaux aciculaires, d'un développement anormal du phloème et de rayons médullaires en forme de V. Les études physicochimiques du médicament pur et de la teinture mère sont normalisées et mentionnées.

Conclusion: Les données pharmacognostiques et physicochimiques décrites dans cette étude peuvent servir de normes de la pharmacopée pour identifier et authentifier le médicament homéopathique *P. senega*.

美遠志根部（順勢療法藥物）的生物藥學研究

摘要

背景：美遠志是屬於遠志科細小多年生草本植物。其根部被用作支氣管炎的興奮劑和祛痰劑。在順勢療法中，可用於眼前房積膿、眼運動神經輕癱、咽部黏膜炎、喉嚨痛、膀胱黏膜炎、流感、哮喘、百日咳、胸部疼痛、胸膜炎、肺炎、胸膜積水、胸膜肺炎、肺炎、胸膜積水和腹水。

目的：現在這項研究的目的是涉及美遠志根部的形態解剖學、粉末和物理化學特性，以制定藥物認證標準。

材料和方法：目前的研究包括形態解剖、粉末和物理化學研究，即美遠志根部的提取價值、灰燼價值、化學試驗、每毫升重量、總固形物、酒精含量和在乾燥後的流失。

結果：其根部從黃棕色到淺棕色不等，而且下方有作為其獨特標記的投影線。根部顯著的顯微特徵是其多層細胞質、大量被管狀分子間隔的栓內層、針狀晶體、韌皮部的異常發育和V形髓質射線。原藥物和母酊的物理化學研究被標準化並加以描述。

結論：該研究中生物藥學和物理化學的數據是以藥典標準來描述，並以此作為順勢療法藥物美遠志的識別和認證。

