Pharmacognostic, Phytochemical and Pharmacological Review of “Phog” - *Calligonum polygonoides* L.

**Swarnkar SK**, Khunteta A*, Gupta MK, Jain P, Paliwal S

1. LBS College of Pharmacy, Jaipur, Rajasthan, India
2. Jaipur College of Pharmacy, Jaipur, Rajasthan, India
3. Banasthali Vidyapith, Newai, Rajasthan, India

**ABSTRACT**

*Calligonum polygonoides* (Phog) belongs to family Polygonaceae. It is a geographically widely distributed shrub seen from the arctic to the tropics. This endangered plant (included in Red data book of IUCN) is morphologically having stem with nodes and internodes, white flowers in spike inflorescence and needle like leaves. It is traditionally used to stabilize sand dunes, as fuel, and in treatment of heat-stroke by mixing with curd or “Rayata”. It is also reported as antidote for opium poisoning. Various phytochemicals present include butanolides - calligonolides A and B, various flavanoids like kaempferol, quercetin and their derivatives. Various steroidal compounds are reported in roots. Pharmacologically, its cytotoxic, anti-inflammatory, antioxidant, antifungal and biosorbent potentials are reported by various researchers. Therefore, an attempt has been made to accumulate properties of this potential herb.

**Keywords:** *Calligonum*, phog, biosorbent, heat-stroke, calligonolides, kaempferol

**INTRODUCTION**

*Calligonum* is commonly known as ‘Phog’ or ‘Phogla’ in deserts of Rajasthan. Small shrub of “Phog” belongs to family Polygonaceae. It is found in Southern Trans-Indus plains, Baluchistan, Thar and Cholistan desert areas. It is about 1 to 2 m high, with a girth of 30 to 60 cm. It may even grow in adverse conditions of moisture and soil, but grows commonly on dry sandy soils and on sand dunes.

Floral buds are used as vegetable and are consumed with buttermilk and salt. For this purpose, they are picked during February and March. It enriches sandy soil with nutrients. It is known to increase the fertility of the soils by alteration of microclimate in soil.

**TAXONOMIC POSITION**

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td>Caryophyllales</td>
</tr>
<tr>
<td>Family</td>
<td>Polygonaceae</td>
</tr>
<tr>
<td>Sub-family</td>
<td>polygonoideae</td>
</tr>
<tr>
<td>Genus</td>
<td>Calligonum</td>
</tr>
<tr>
<td>Species</td>
<td>polygonoides</td>
</tr>
</tbody>
</table>

*Address for Correspondence:*

Khunteta A, LBS College of Pharmacy, Jaipur, Rajasthan, India
DISTRIBUTION

It is a geographically widely distributed shrub seen from the Arctic to the tropics. Major concentrations are gained in Northern temperate region by most of the species (Heywood, 1978). Worldwide its distribution is found throughout the North Africa, Southern Europe, Central and Western Asia as main diversity centre. In western Asia, its distribution is found in the desert region which extends to the Western Rajasthan and Southern Punjab in India, Northeast Afghanistan, Boogtee Hill in Pakistan, Armenia, Persia and Syria.

According to Shetty and Singh (1991), *Calligonum* (one species) is out of four genera of Polygonaceae which are distributed in Thar desert of Rajasthan naturally. Arid region of Rajasthan covers from 24°N to 35.5°N and 70.7°E to 76.2°E and *C. polygonoides* shows its presence in Jaipur, Barmer, Churu, Jodhpur and Jaisalmer districts. Shankamarayan (1998) reported its growth on sand dunes as a psammophytic vegetation of Barmer, Bikaner, Churu, Jaisalmer, Jhunjhunu, Nagaur, Sikar and Shri Ganganagar. Shanti reported its distribution in the desert region with a particular focus on the Bikaner district of Rajasthan.

PHARMACOGNOSTIC FEATURES

A. Morphological features

*C. polygonoides* is a small shrub (Figure 1). Sandy soil area is its natural habitat. IUCN has incorporated it in his Red Data Book being an endangered plant species. **Stem:** Stem is having nodes and internodes which joints stem and branches conspicuously; **Roots:** shown as deeply branched, tapped; **Inflorescence** - spike; **Flower** - are white, small, bisexual and regular. Fruit are oblong and nut like; small and rounded seeds. May-June is the flowering and fruiting season. Small prostrate shrub with branched roots; leaves simple, needle like, stipulate and reduced to scale.

B. Anatomical characteristics

Wahid et al (2005) reported in their study that plant bears long needle like leaves, while Al-Khalifa reported leaves as reducing. Temperature variations lead to difference in structures of leaves. With rise in temperature, leaf surface gets shorten to reduce the loss of water.

PHYTO-CHEMICAL REVIEW

Two new butanolides - Calligonolides A (1) and B (2) were isolated by Yawer (2001) which might be the reason of high diversity at chemical as well as molecular levels. Bewal and coworkers, analysed RAPD marker of *C. polygonoides* and reported that plant showing diverse accessions of spreading and occupying geographic niches in arid regions is due to predominantly obligate out breeding behavior.
Ahmed isolated a new flavonoid, kaempferol-3-O-β-D-(6"-n-buty glucuronide), quercetin-3-O-β-D-(6"-methyl glucuronide), quercetin-3-O-glucuronide, astragalin, quercetin-3-O-gluco-pyranoside, taxifolin, dehydro-dicatechin A were also isolated from the aerial parts. Selected isolates were also examined for their cytotoxic activity against MCF-7 and HepG2.19

Muhammed et al analyzed chemical composition of essential oil from fruit and stem of C. polygonoides by using GC-MS. (Z,Z)-9,12-octadecadienoic acid, hexadecanoic acid, nonacosane, tetradecanoic acid, heptacosane, hentriacontane, dodecanoic acid and pentacosane were found as the major components in essential oil of fruit; while hexadecanoic acid, (Z,Z)-9,12-octadecadienoicacid, dodecanoic acid, (R)-massoia lactone, nonanoic acid and pentadecanoic acid were found as the major components of the stem oil.20

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Compound</th>
<th>Structure reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>quercetin 3-O-β-D-(6&quot;-n-buty glucuronide)</td>
<td>Lin et al. 2011</td>
</tr>
<tr>
<td>2</td>
<td>kaempferol-3-O-β-D-(6&quot;-0-0-methyl glucuronide)</td>
<td>Al Sayed et al. 2010</td>
</tr>
<tr>
<td>3</td>
<td>quercetin-3-O-β-D-(6-0-0-methyl glucuronide)</td>
<td>Lin et al. 2009</td>
</tr>
<tr>
<td>4</td>
<td>quercetin-3-O-gluconide (mequilianin)</td>
<td>Badria et al. 2007</td>
</tr>
<tr>
<td>5</td>
<td>kaempferol-3-O-glucuronide</td>
<td>Badria et al. 2007</td>
</tr>
<tr>
<td>6</td>
<td>quercetin-3-O-α-rhamnopyranoside (quercitrin)</td>
<td>Badria et al. 2007</td>
</tr>
<tr>
<td>7</td>
<td>astragalin</td>
<td>Markham &amp; Ternai 1976</td>
</tr>
<tr>
<td>8</td>
<td>quercetin-3-O-glucopyranoside (isoquerctin)</td>
<td>Badria et al. 2007</td>
</tr>
<tr>
<td>9</td>
<td>taxifolin</td>
<td>Kim et al. 2009</td>
</tr>
<tr>
<td>10</td>
<td>(+)-catechin</td>
<td>Badria et al. 2007</td>
</tr>
<tr>
<td>11</td>
<td>dehydrodicatechin A,</td>
<td>Badria et al. 2007</td>
</tr>
<tr>
<td>12</td>
<td>quercetin</td>
<td>Badria et al. 2007</td>
</tr>
<tr>
<td>13</td>
<td>kaempferol</td>
<td>Badria et al. 2007</td>
</tr>
</tbody>
</table>
Ahmed et al (2016) compiled the isolated flavonoids. Presence of dehydro catechin A, kaempferol, kaempferol-3-O-rhamnopyanoside, quercetin, quercitrin, (+)-catechin, isoquercitrin, quercetin-3-O-glucorunicide, kaempferol-3-O-glucorunicide, pro-cyanidines, violaxanthin carotenoids, β-sitosterol-3-O-glucoside and neoxanthin carotenoids was reported.\(^{21,19}\)

Samejo et al (2013) isolated steroidal compounds from methanolic extract of roots, identified as campesterol (1), stigmasterol (2), 3b,5a,24(3)-stigmastan-3-ol (3) and stigmast-4-ene-3-one (4).\(^{22}\)

The major constituents of the buds oil identified are ethyl homovanillate (11.79%), R-massoa lactone (8.79%), 4-(2,6,6-trimethylcyclohexa-1,3-dienyl)but-3-en-2-one (5.12%), (ZZZ)-9,12,15-octadecatrienic acid (4.08%), heptacosane (3.28%), neophytadiene (3.26%) and phytol (2.50%). Whereas, the main components of the roots oil are (-)-drimenol (29.42%), heptacosane (14.14%), 2-nonadecanone (8.04%), mono (2-ethylhexyl) ester 1,2-benzenedicarboxylic acid (7.67%), squalene (7.25%), nonacosane (5.52%), pentacosane (4.01%), tricosane (2.48%) and tetracosane (2.15%). Thus, from these results, it has been inferred that the composition of volatile oils extracted from the buds and roots is different.\(^{20,23}\)

The plant contains calligonoids, steroidal ester, beta-sitosterol glucoside, teracosan-4-olide and ursolic acid.\(^{18}\) Drimenol (29.42%) was isolated from roots.\(^{9,22}\)

**PHARMACOLOGY**

Cytotoxic potential of isolated flavonoids was examined against MCP-7 and HepG2.\(^{19}\)

Yawer isolated calligonolides A and B, two new butanolides, and a new steroidal ester and observed their moderate inhibitory activity against soybean lipoygenase. In addition, few known compounds were also isolated.\(^{18}\)

Another species of *Calligonum* viz. *Calligonum comosum*, have been reported by Liu et al (2001) as efficacious in inflammation, by Handa et al (2006) against stomach ailments and toothache.\(^{24,25}\)

Khan et al (2015) reported antioxidant, antifungal and cytotoxic potential against brine shrimps. They evaluated methanolic extract of whole plant.\(^{26}\)

Biosorbent potential of *C. polygonoides* was illustrated by Nasrullah et al (2015) and demonstrated that its ash is an effective benign biosorbent for methylene blue to remove it from aqueous solutions. The mechanism behind this was demonstrated with the presence of multiple –OH groups which are available to interact mechanically with dye ions being more exposed because of easy penetration of dye ions to the microstructure of adsorbent.\(^{27}\)

**ETHNO-PHARMACOLOGICAL USES**

Bewal reported use of its roots and thick branching stems as fuel. Aqueous paste has been utilized for the management of opium poisoning (as antidote) and also reported as effective antidote against various symptoms of poisoning of various herbs.\(^{4}\) Traditionally, plant extract is given to animals to treat colic.\(^{28}\)

Historically, it is the dominant woody perennial shrub in active sand dunes and stabilize sand fields in most of the desert area.\(^{2,29}\)

In deserts, Phog is used as a fuel especially in winters. During severe draught, animals feed on it. Decoction of roots mixed with catechu is used as gargle in sour gums. Seeds being rich in energy (360 kcal %), protein (6.05 %), iron (3.52 mg %), calcium (211 mg %), fibre (15.70 %) and phosphorous (427 mg %) are dried and consumed with curd based preparation like "Rayata". The same has also reported by Suresh et al (2008) for treatment of sun-stroke. In deserts of Arabian countries also, the same use was reported for flower buds (locally called as "Lasson") by mixing with butter milk (whey) and salt during summers.\(^{30}\) Delicious local preparations in Arabians are reported to be made with bread and flowers with or without cooking in clarified butter or coconut oil.\(^{5,11}\) Aqueous oral paste is also reported as antidote for heavy opium intake.\(^{31}\)

Being a shrubby plant, it binds soil and is used to prevent erosion and thus help in stabilizing sand dunes. The wood is used in building huts and coal prepared from the plant is used by iron and gold-smiths.\(^{32,33}\)

Extract is used in cases of typhoid, whereas gargles of plant decoction are used to cure sore gums by Bhil and Garasia (Bhandari, 1978; Singh and Pandey, 1998). Ethno-veterinary uses are also reported for treatment of colic (extract) and dysuria (decoction).\(^{34}\)

The possible ways of utilization of Phog are described in terms of: food value, fodder value, medicinal value, fuelwood, agricultural uses, live hedge, social and religious aspects, material for huts and for rehabilitation of degraded lands.\(^{35}\)

**CONCLUSION**

*C. polygonoides* is a very less explored desert plant. There is a need to explore it as it is having a wide range of traditional uses.

**REFERENCES**