

Review Article

A PHARMACOLOGICAL COMPREHENSIVE REVIEW ON 'RASSBHARY' *PHYSALIS ANGULATA* (L.)

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ABSTRACT

The present review article reveals the importance of species *Physalis angulata* (L.) of the genus *Physalis* (L.) distributed worldwide including India. *Physalis* species are perennial, erect and variously having toothed or lobed leaves. *Physalis angulata* (L.) belongs to the family Solanaceae, includes about 120 species with different and specific herbal characters. On the basis of these herbal characters, the plant is traditionally used as medicine to cure various disorders like asthma, kidney, bladder, jaundice, gout, inflammations, cancer, digestive problems and diabetes etc. *P. angulata* is a source of the variety of phytoconstituents like phytosteroles, withangulatin A, a variety of physalins and flavonol glycoside etc. The plant extracts from the different parts having different pharmacological activities such as anti-cancerous, immunomodulatory, anti-diabetic, diuretic and anti-bacterial. In this article cytomorphological, phytochemical, biological activities and ethnobotanical inputs have been extensively recorded for *P. angulata* (L.).

Keywords: *Physalis angulata* (L.), Cytomorphology, Phytochemistry, Ethnobotany, Biological activities.

INTRODUCTION

From the ancient time plants have been used in preparation of medicines for treatment of various human and animal diseases. Reduced efficacy of synthetic preparations due to various reasons leads the global interest in the preparation of therapeutic medicines from the plants [1]. *Physalis angulata* (L.) is a plant of the family Solanaceae, widely distributed throughout tropical and sub-tropical regions of the world [2]. It is distributed as a weed in gardens, waste

lands, along roads, in the forest along creeks near sea levels and in cultivated fields [3]. All over the world this plant is used for the herbal medicine and for the treatment of various human ailments like malaria, hepatitis, asthma, dermatitis and rheumatism [4]. Plant leaf infusions are being used for earache and to treat postpartum infections. *P. angulata* is reported for CNS depressant action and it also possesses the anti-tumor activity [5-7]. Physalin A, B, D, F and glycosides namely myricetin-3-o-neohesperidoside have been isolated from the plant and shows the anti-tumor activities [8].

Botanical classification		Vernacular name	
Kingdom:	Plantae	Ben:	Ban tipariya
Order:	Solanales	Guj:	Parpoti, Popti, Motipopti
Family:	Solanaceae	Hin:	Rassbhary, Thlatipati, Tipari
Subfamily:	Solanoideae	Kan:	Guddehannu
Tribe:	Physaleae	Mal:	Njodinjotta
Subtribe:	Physalinae	Mar:	Chirboti, Dhanmori
Genus:	<i>Physalis</i> (L.)	Ori:	Phutka
		Tam:	Tholtakkali
		Tel:	Kupanti, Buddabudama, Buddabasara

Trade and common name

Winter cherry, Cape gooseberry, Hogweed, Balloon cherry, Coqueret, Strawberry tomato, Cutleaf ground cherry, Wild tomato, Winter tomato, Winter cherry, Cow pops, Chinese lantern, Mullaca, Koropo, Camapu.

Morphological description

P. angulata (L.) is an annual, erect and branching herb having much branched stems grows up to 1m height. Plant leaves are approximately 9 cm long, ovate to elliptic, having 1-2 nodes with pointed tips. Flower of the plant is up to 6 mm long and white or pale yellow in color, solitary in the leaf axis, produces small, orange edible berries surrounded by an inflated balloon like and ovoid calyx to about 3-5 mm long. Seed is 1.0 to 1.5 mm having the shape of a disc with pale yellow color [9, 10].

Cytological inputs

The second Indian species *P. angulata* (L.) was cytologically well studied and reported 2n=4x=48 [11-15].

Chemical constituents

The different phytosteroles, carbohydrates, vitamins, minerals and lipids are possessed by the species *Physalis* (L.) which leads to form

the Withanolide type structures. Withanolides are first isolated from genus *Withania* (L.) which contains a group of C₂₈ ergostan type steroids with a C-22, 26 δ-lactone group [16, 17].

Various physalins namely B, E, F, G, H, I and withangulatin A are present in *P. angulata* (L.). Withangulatin A and withaferin A, the chemical compounds which are related structurally to one another. A flavonol glycoside viz. myricetin 3-O-neohesperidoside present in the plant [18, 19, 8]. The physalins B and F are responsible to reduce the *Leishmania* infected macrophages and the intracellular parasite number *in-vitro* at low concentrations [20].

Pharmacological and biological activities

Physalis genus is not economically important only as a food supplier, but also very important for its chemical compounds. The tropane alkaloids and physalins are two major groups of chemical compounds which are responsible for the various medicinal properties. The tropanes shows the anti-muscarinic activity by inhibiting the activity of neurotransmitter acetylcholine adhering to muscarinic receptors of the parasympathetic nervous system.

These present chemical compounds are important and useful to treat of gastrointestinal and muscular spasms and Parkinson disease [21-29]. Due to anti-tumor and cytotoxic activities, physalins are under attention. *Physalis* has a broad spectrum of biological

activities viz. anti-bacterial, abortifacient, molluscicidal, anti- protozoal, anti-cancer, anti-septic, and cytotoxic and immunomodulatory activities [30-38]. Unfortunately, these medicinal properties are not used commercially. *P. angulata* is used in traditional and folk medicine as anti-diuretic and cures the

stomach troubles, analgesic and anti-rheumatic. It is also considered as antinociceptive, antipyretic, anti-inflammatory for hepatitis and cervicitis [39]. Few most important and well defined biological activities of the *Physalis angulata* of the genus *Physalis* (L.) are extensively compiled and discussed.

Table 1: Morphological features of *P. angulata* (L.)

Part	Macroscopic features
Herb	An erect and branching herb with branched stems, acquires the height up to 1m.
Leaves	Ovate to elliptic, up to 9 cm long, 1-2 nodes with pointed tips
Flowers	White or pale yellow colored, solitary in the leaf axis, up to 6 mm long
Fruits	Produces small, orange edible berries with balloon-like ovoid calyx, about 3-5 mm long.
Seeds	Disc-shaped pale yellow, 1.0 to 1.5 mm long.

Anti-inflammatory, Anti-arthritis and immuno modulatory activity

The aqueous, ethanolic and methanolic extracts of *P. angulata* (L.) leaves were analyzed against Anti-inflammatory and anti-arthritis activities by various workers. They analyzed the anti-inflammatory and *in-vitro* anti-arthritis activity by HRBC membrane stabilization and protein denaturation method respectively in different concentrations and found a positive response from all used extracts [40]. In another research work *P. angulata* (L.) lyophilized root extract (aqueous) was used to control the inflammatory response induced by 1% carrageenan injection into subcutaneous rat's air pouches. The inflammatory mediators action was evaluated by adenosine deaminase (ADA) activity, nitrite level, and prostaglandin E (2) level. In immuno modulatory response, tumor growth factor-beta level was used as a bio-indicator. Powerful anti-inflammatory and immunomodulatory activities were shown by the aqueous extract [9]. Immunomodulatory activities of physalins B, F or G from *P. angulata* used a reduction in nitric oxide production by macrophages stimulated with lipopolysaccharide and interferon-g. The mice treated with the physalin B had lower levels of serum TNF- α than control mice after lipopolysaccharide challenge. Mice injected with physalins B, F or G survived after a lethal polysaccharide challenge. These results demonstrate that seco-steroids are potent immunomodulatory substances and act through a mechanism distinct from that of dexamethasone [41]. For investigating immunomodulatory activity the different *Physalis angulata* (L.) extracts fraction (PA-VII, PA-VII-A, PA-VII-B and PA-VII-C) prepared [39]. The results obtained were, PA-VII and PA-VII-C strongly enhance sblastogenesis response, PA-VII-B had moderate activity, and PA-VII-A exerted only slight effect on cell proliferation. PA-VII and PA-VII-C possessed stimulatory activity on B-cells and have very little effect on T-cells. The antibody responses were also shown by PA-VII, PA-VII-B and PA-VII-C, but not by PA-VII-A.

Aminociceptive activity

The aminociceptive activities of the *P. angulata* aqueous extract from the roots were analyzed by Bastos and co-workers. Aqueous extract inhibits the abdominal contractions is given by half or an hour before the acetic acid treatment which causes the abdominal contractions. Mice treatment with extract or with morphine produced a significant increase in reaction time in the hot plate test. The results showed the aqueous extract produce marked aminociceptive against the acetic acid induced visceral pain and inflammatory pain responses induced by formalin in mice [33].

Anti-diabetic activity and acute toxicity

In another experiment Sateesh and co-workers reported the anti-diabetic activity (*in-vitro*) on the *P. angulata* fruit. Solvents namely, *n*-hexane, chloroform, ethyl acetate, acetone and methanol were used for the extract preparation of powdered fruit material by the sequential maceration method. The anti-diabetic activity was shown using inhibition of α -amylase and α -glucosidase enzymes. The results showed that the methanol extracts of powdered fruit were more effective in inhibiting both the enzymes *in-vitro* [42]. *P. angulata* aqueous, methanolic extracts and column fraction of whole plant analyzed against the anti-diabetic activity by Abo and Lawal.

The positive significant results were shown by the extract by lowering blood glucose level in the alloxan induced diabetic rats. The fraction shows the significant reduction of the blood glucose level when compared to crude extracts [43]. In another experiment anti-diabetic potential of ethanolic root extract of *P. angulata* using alloxan induced diabetes mellitus in rats was also checked by analyzing their fasting blood glucose and lipid profile. The extract was prepared which shows the significant results by reducing the blood glucose, cholesterol, triglycerides and low density lipoproteins, while increases the high density lipoproteins [44].

Anti-cancerous activity

The researchers concluded that the physalin-F induces cell apoptosis in human carcinoma cells by targeting NF-kappa B cells and generating oxygen species in *P. angulata*. Results showed that physalin-F was very promising anti-cancer agent and useful for further clinical development [45].

Anti-microbial activity

The anti-microbial activity of zinc oxide ointment and *P. angulata* crude extracts against *Pseudomonas aeruginosa* and *Staphylococcus aureus* were checked by Donker and co-workers. The un formulated crude extract showed the highest inhibitory activity against *S. aureus*. Due to these results it has been clear that plant fruit extract is useful against the *S. aureus* infections [46]. The anti-microbial activity of essential oils from aerial and root parts of *P. angulata* studied against various stains viz. on *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia* and *Staphylococcus aureus*. *Candida torulopsis*, *Candida albicans* and *Candida stellatoidea* were the fungal species used in the experiment.

The results showed the minimum inhibitory concentrations ranging between 3.75 mg/ml and 4.0 mg/ml for *Bacillus subtilis*, *Klebsiella pneumoniae* by the aerial and root extracts. The fungal strains were susceptible to the essential oils from the aerial and root part of the plant. This study justified the use of the plant for treatment of cuts, sores, and some skin diseases often reported in folkloric medicine. Leaf and callus extracts prepared in chloroform were found to be more effective against the pathogenic bacteria and fungi [47].

Anti-leishmaniasis activity

In this experiment, the physalins purified from *P. angulata* was evaluated against the anti-leishmanial activity by Elisalva and co-workers. Intracellular amastigotes of *Leishmania amazonensis* (MHOM/BR88/BA-125) and *Leishmania major* (MHOM/RI/-/WR-173) were tested against the physalins B, D and F. The *in-vivo* study was done in the BALB/c mice infected with *Leishmania amazonensis* subcutaneously. The results showed that the physalin-F is significantly potent against the Leishmania and can be used for the development of new therapeutic drugs for cutaneous leishmaniasis [20].

Anti-asthmatic activity

The anti-asthmatic activity of the *P. angulata* alcoholic root extract was checked by the researchers in albino mice. The asthma was induced with ovalbumin in rats. The extract results inhibited ovalbumin induced asthma by decreasing the release of

inflammatory mediators. The anti-asthmatic activity is due to the reduction in inflammatory mediator release [48].

Molluscicidal activity

Santos and co-workers studied the molluscicidal activity of *P. angulata* (L.) extracts, fractions, and the physalin modified steroids present in this plant species. The results showed the ethyl acetate and acetone extract from the whole plant, the ethanolic extracts of roots and the physalins extracted from the stem and leaves were active against *Biomphalaria tenagophila* [49].

Diuretic activity

In this experiment diuretic activity of the *P. angulata* (L.) methanolic extract was tested in rats, using furosemide as a positive control. The diuretic effect was measured by urine volume and extraction of sodium, potassium and chloride ion contents. It had been concluded

from the results that significant diuretic activity shown by *P. angulata* [50].

Anti-malarial activity

Anti-plasmodial and cytotoxic activity of methanolic and dichloromethane extracts of *P. angulata in-vivo* and *in-vitro* against the *Plasmodium berghei* infected mice were checked. The extract showed the significant anti-plasmodial and anti-malarial activity [51].

Anti-oxidant and cytotoxic activities

P. angulata methanolic extracts from stem, leaves, fruit and roots were evaluated using DPPH, superoxide, nitric oxide, hydrogen peroxide and hydroxyl radical. The fruit and leaf extracts were found to be more effective than the stem and root extracts. The total content of phenols and flavonoids were found high in leaves and fruit extracts [52].

Table 2: Part basis details of pharmacological activities of *P. angulata* (L.)

Pharmacological activities	Parts	Extraction/possible chemical constituents	Screening method	Possible mechanism of action/Result
Anti-inflammatory activity, anti-arthritis and immunomodulatory activity	Leaves Roots Whole plant	Methanolic, ethanolic extracts Lyophilized aqueous extract Physalins B, F or G	HRBC membrane stabilization method, protein denaturation activity Carrageenan and Adenosine deaminase (ADA) activity, nitrite level, and prostaglandin E (2) level lipopolysaccharide and interferon-G	Shows the positive results for anti-inflammatory and anti-arthritis activity [40]. Aqueous extracts showed powerful anti-inflammatory and immuno-modulatory activities [9]. Seco-steroids are potent immunomodulatory substances [41].
Aminocceptive activity	Roots	Aqueous extract	Acetic acid treatment	Marked aminocceptive [33].
Anti-diabetic activity and acute toxicity	Fruits Whole plant Roots	Sequential maceration method Aqueous, methanolic extracts Ethanolic extract	Alpha amylase and alpha glucosidase enzymes Alloxan induced diabetes mellitus	Extracts of fruits inhibited both of the enzymes <i>in-vitro</i> [42]. Fraction shows the significant reduction of blood glucose level [43]. Shows the significant results by reducing the blood glucose, cholesterol, triglycerides and low density lipoproteins, while increases the high density lipoproteins [44].
Anti-cancerous activity	Whole plant	Physalin-F		Physalin-F appears to be a very promising anti-cancer agent [45].
Anti-microbial activity	Fruits Aerial and root part	Crude extract Essential oil	Inhibitory activity Minimum inhibitory concentration	The plant fruit extract is useful against the <i>S. aureus</i> infections [46]. Chloroform extracts found effective against bacteria and fungi [47].
Anti-leishmanial activity	Whole plant	Physalins B, D and F	Intracellular amastigotes of <i>Leishmania amazonensis</i> (MHOM/BR88/BA-125) and <i>Leishmania major</i> (MHOM/RI/-/WR-173)	Results showed that the physalin-F is significantly potent against the leishmanial [20].
Anti-asthmatic activity	Roots	Alcoholic extracts	Ovalbumin	Activity is due to the reduction in inflammatory mediator release [48].
Molluscicidal activity	Whole plant	Ethyl acetate, acetone extract (whole plant), ethanolic extracts of roots and the physalins extracted from stem and leaves	Physalins	Active against <i>Biomphalaria tenagophila</i> [49]
Diuretic activity	Whole plant	Methanolic extract	Furosemide	Significant diuretic activity [50].
Antimalarial activity	Whole plant	Methanolic and dichloromethane extracts	<i>In-vivo</i> and <i>in-vitro</i> against the <i>Plasmodium berghei</i> infected	Showed the significant anti-plasmodial and anti-malarial activity [51].
Anti-oxidant and cytotoxic activities	Leaves, stem, fruit and root	Methanol extract	DPPH, superoxide, nitric oxide, hydrogen peroxide and hydroxyl radical	Fruit and leaf extracts were found to be more effective [52].

Ethnobotanical aspects

P. angulata leaves and whole plant used to reduce spleen, liver and bladder inflammations and in baths for inflammatory processes like rheumatism respectively [53]. In Amazon valley the plant juice is

used as sedative, depurative, anti-rheumatic and for earache [10]. A plant used in the medicinal preparation of diabetes, malaria and asthma in Taiwan [54]. The Peruvian Amazon rural people use the leaves for problems related to malaria, liver and hepatitis [55, 56]. In Western Africa the herb is used to treat cancer, traditionally [57].

The aerial parts and fruits of the plant are used in the treatment of boils, sores or wounds, constipation and digestive problems [58].

CONCLUSION

Physalis angulata is widely available as a weed and is cultivated for different purposes like, medicinal, food, forage, ornamental and other usages. The manifestations can be made on the basis of this comprehensive perusal of literature, that the *Physalis angulata* used traditionally, due to immense therapeutic potential to treat/cure various diseases. The plant is a rich source of bioactive compounds like, physalins, secosteroids, and withanolides etc. with a wide range of health benefits. Cytomorphological data reveal that there is an immense need to find out new cytomorphotypes for further germ plasm maintenance and evaluation, because till today no one is working on these important aspects. As per the phyto chemical data, it is concluded that there is a need to identify the chemo types for further herbal and allopathic drugs formations. There is a huge need and possibilities to isolate new active components from this species from India. Many studies demonstrated significant anti-inflammatory, anti-cancer, anti-asthmatic, anti-diabetic and anti-bacterial activities, etc., which are reported in the extracts of different parts and from its phyto-constituents. As per the recorded data it is clear that this species have been extensively studied on different parameters, but needs to do further extensive bioactivities on this species. The various existed therapeutic methods to treat rheumatoid arthritis and other immunological disorders, having lots of future possibilities. Different studies and investigations showed that, these plant species, mainly involved in the immunological effects. Thus, evidences promising drug therapy for immunological disorders. These pharmacological activities and identified compounds provide solid scientific evidence for some of the traditional therapeutic claims. A variety of phytoconstituents have been isolated from different parts of various species. Thus, there remains a very wide scope for further scientific exploration of *Physalis angulata* to establish their therapeutic efficacy and commercial exploitation.

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CONFLICT OF INTERESTS

Declared None

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