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Phytopharmacological review on *Acmella paniculata* of Jorhat district, Assam, India

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Abstract:

Acmella Paniculata is a small annual plant that has been used traditionally across many cultures worldwide as a food and for the treatment of many diseases and illnesses. It is a common toothache plant which belongs to the Asteraceae family growing mainly in nearby streams, rivers, fields and swamps. The herb grows up to a length of 32-60 cm and its identical characteristic of the plant is the discoidal capitula of the flowers. The whole plant is rich in many bioactive compounds that exhibit antioxidant, anti-inflammatory, anti-malarial, antibacterial, anthelmintic and local-anesthetic properties. The current review explores the utility of the plant for nutritional and therapeutic purposes as a natural remedy for day-to-day health issues. It describes the distribution, habitat, chemical composition, ethnomedicinal uses and pharmacological properties of the plant.

Keywords: *Acmella Paniculata*, Asteraceae, ethnomedicine, antioxidant, anti-inflammatory, anti-malarial, antibacterial, anthelmintic.

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1. Introduction:

The plant world has an enormous scope for novel medications for treating and preventing illnesses, which has led researchers to explore this area continually. Although there are plenty of synthetic and conventional medications available, people are constantly searching for naturally derived medications because, as the traditional knowledge of various cultures and communities indicates these medications are likely to be extremely effective, non-invasive, and have few to no negative effects. Pharmacologically active substances come in a wide variety and are widely utilized as effective medications to treat various illnesses, from cancer to the common cold. They additionally provide a model for creating novel synthetic medicine compounds that mimic or even enhance their natural functions. Thus, natural goods have an extraordinary supply of chemical variety and hence the plant extracts in their pure or standardized forms increases the chances of discovering novel drugs are endless.

Even in the present day, the traditional medical system in India is still very vital for patient care. Thus, the objective of modern medicine is also centered upon traditional knowledge of plants and herbal remedies. Over 80,000 plant species have been reported to have medicinal qualities and are utilized for healing in many different cultures worldwide. The plants and their extracts are so utilized for therapeutic and medicinal purposes.

Reportedly, one of the world's oldest and most comprehensive medical systems is the Ayurveda, an Indian system of medicinal knowledge. Since around 5000 BC, the philosophy of Ayurveda has been founded upon the observation that plants had medicinal properties, thus making them a legitimate means of diagnosis and therapy.

Acmella paniculata emerges as a botanical wonder in this regard, which is renowned for its abundant therapeutic properties, serving as a rich reservoir of antioxidants. This plant can be found in almost every region of India and Asia. It grows in nearby streams, rivers, agricultural fields, playgrounds, swamps, and roadside areas. The whole plant is rich in secondary metabolites such as flavonoids, alkaloids, tannins and terpenoids (Salehuddin et al., 2020). The plant is traditionally used by tribal people for dental caries, toothache, and gum infections. It is also known to have medicinal effects on many diseases such as rheumatism, cold, fever etc. (Patel et al., 2019).

2. Plant Description:

Acmella paniculata belongs to the family Asteraceae. It is an annual herb which reaches up to a height of 32-60 cm. It remains erect, ascending and rarely rooting at the nodes can be seen. It is a common toothache plant used widely by tribal people in toothache and gum infections. It is commonly known as “bon narji” or “jati-malkathi” in Assam. The plant has many stems, and they have marigold eye flowers. The stem is very hairy and has a strong bitter taste. The flowers of the plant are chewed by locals and keep them undermouth for

treating common mouth infections caused due to lesions in tongue or cheeks or due to some distinct aspects.

Stems: This is an annual plant, and the stems show branching. It can grow erect or ascending, reaching a height of up to 30 cm or more. Sometimes the stems may even root at the nodes, allowing vegetative propagation. (Rajeshwar & Lalitha, 2013)

Leaves: The petiole or leaf stalk of the plant is 1-2 cm. The leaf blades vary in shape, ranging from ovate to ovate-lanceolate. The leaf blades are 2-4 cm long and 1-2.5 cm wide. It is to be noted that each leaf possesses three veins. The base of the leaf is cuneate, resembling a wedge. Leaf margins can either be entire (smooth) or coarsely or crenately serrate (with tooth-like projections). The apex of the leaf tapers to an acute point (Rajeshwar & Lalitha, 2013).

Flower Heads (Capitula): The capitula are discoid in shape, forming solitary structures. They take place either at the terminal end of the stem or in the leaf axils. These flower heads have dimensions of approximately 8.4-12.5 mm in diameter and 6.9-10 mm in height (Rajeshwar & Lalitha, 2013).

Stalks (Peduncles): The peduncles (flower stalks) extend from 2.5 to 16 cm in length. These stalks are sparsely covered with fine hairs, giving them a pilose appearance (Rajeshwar & Lalitha, 2013).

2.1. Taxonomy of the plant:

Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Asterales
Family	Asteraceae
Genus	Acmella
Species	Acmellapaniculata

2.2. Vernacular Names: The regional names through which people identify this plant are –

S.No.	Language	Local Name
1	Assamese	Bon narji or Jati-malkathi
2	Bengali	Kathuri
3	Hindi	Akaara
4	Manipuri	MithaJambu
5	Malayalam	Mullaangichedi
6	Marathi	Akkalkaro

7	Mizo	Lai Aboo
8	Kannada	Akkugida
9	Sanskrit	Akarkara
10	Tamil	Akaaram

2.3. Botanical Description:

2.3.1. Plant Distribution and Habitat:

Acmella paniculata is widely distributed globally across India, Bangladesh, Sri Lanka, Colombia, Ecuador, Papua, New Guinea, Peru, Solomon Islands, Southern China, Indonesia, Nepal, Malaysia, Taiwan, Philippines, Thailand, and Vietnam (Chung et al., 2008; Patel et al., 2019). It flourishes in environments with partial sunshade, fertile soil, ample humidity, and rainfall, making it abundant in various habitats including wastelands, rivers, streams, agricultural fields, playgrounds, marshes, and swamps. India has vibrant climatic conditions; hence the plant can be seen in almost every part ranging from North-East to South-West. In the Southern and western regions of the country, we can see it thriving in Tamil Nadu, Karnataka, Kerala, Andhra Pradesh and Madhyapradesh. While coming to the North East the plant is vividly seen in Assam, Nagaland, Arunachal Pradesh, Meghalaya, and Manipur (Gupta et al., 2018).

2.3.2. Plant Profile (fruits, leaves, stems):



Figure 1. Plant Habit



Figure 2. Young Plant



Figure 3(a)

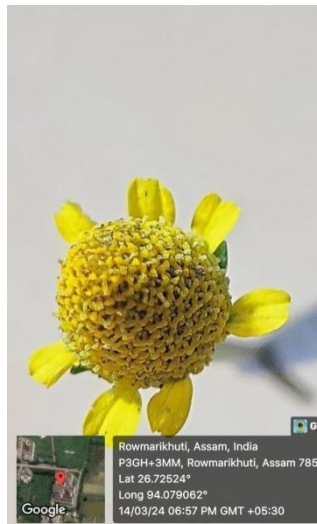


Figure 3(b)



Figure 3(c)

Figure 3(a,b,c). Capitula or Flowers



Figure 4. Anterior side of the Leaf

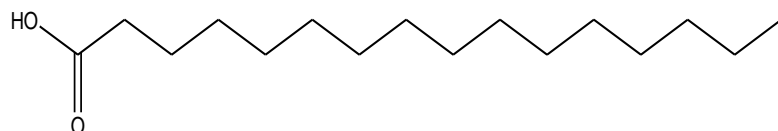
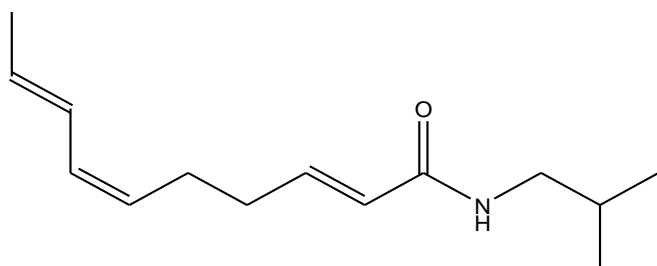


Figure 5. Posterior side of the Leaf

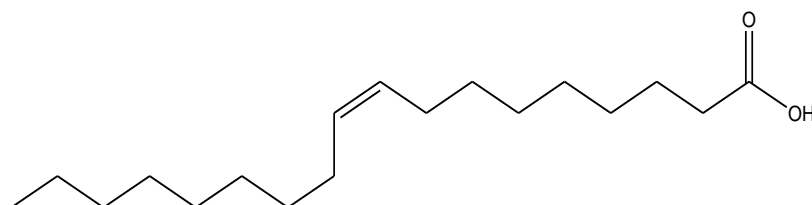
3. Chemical Composition:

A. paniculata is rich source of active metabolites like alkaloids, saponins, flavonoids, tannins and triterpenoids that is concluded from various extracts of the plant namely pet ether extract, chloroform extracts, ethyl acetate extracts and methanol extracts (Mamidala & Gujjeti, 2013). This plant contains a very major pungent compound known as spilanthol. This compound can be effective as an insecticide (Gairola et al., 2021). Along with spilanthol it is also known to possess acmellonate that is said to alleviate the symptoms of toothaches by stimulating saliva secretion and creating an anaesthetic effect. The molecular formula of spilanthol is (2E,6Z,8E)-N-isobutylamide-2,6,8-decatrienamide (Dubey et al., 2013). Through GCMS analysis of the n-hexane and dichloromethane extracts of the plant, major bioactive compounds like linolelaidic, octadecanoic, palmitoleic acids, hexadecanoic and oleic acids are found which are antibacterial in nature. (Abd Ghafar et al., 2022). Essential oils are also found in this plant having analgesic and sedative effect (Gairola et al., 2021).

3.1. Chemical Structures:



Octadecanoic
Acid



Oleic Acid

4. Ethnomedicinal Uses of the Plant:

The plant is a botanical wonder which has been used traditionally as a food and medicine. It is cultivated professionally by the Karen people in Thailand which they use as an ingredient in their cuisine as salads, pickle, and vegetable (Panyadee & Inta, 2022). It is used as a folk medicine by many tribal communities for the treatment of toothache, sore throat, dental caries, and gum infections. The flowers are chewed to relieve toothache while the root decoction is used as a purgative (Leng et al., 2011; Salehuddin et al., 2020). In Cameroon, the leaves are crushed and used for the treatment of articular rheumatism and as an herbal remedy for snakebites (Dubey et al., 2013).

In ancient times, the plant was also believed to treat purgation, gall stones, Urinary Tract Infection, gall stones, pulverization of the kidney (Lithotripsy), and a remedy for stammering in children. Again, in various regions, leaves were believed to treat bacterial and fungal skin diseases (Patel et al., 2019). Minor health conditions like mouth ulcer and leucorrhoea in women can also be treated with this plant. This is due to the presence of various secondary metabolites like phenols, flavonoids, alkaloids, terpenoids, steroids and triterpenoids from various plant extracts, indicating anti-cancer, anti-inflammatory, anti-malarial, anti-microbial and antioxidant bioactivities (Sivaraj et

al., 2023). Also, recent research on this respective plant have verified the anthelmintic activity against intestinal parasitism (Rajeshwar & Lalitha, 2013).

5. Pharmacological Properties of the Plant:

5.1. Anti-inflammatory properties:

The in-vitro anti-inflammatory test is studied through the inhibition of the protein denaturation method. The method was selected because denaturation of proteins is a key factor in causing inflammation. At various concentrations (100ml, 200ml, 300ml, 400ml, and 500ml), the percentage of inhibition of methanolic extract of *Acmella paniculata* in protein denaturation was studied against the inhibition capacity of standard diclofenac sodium. The minimum inhibition capacity of Diclofenac sodium is 28.50% at 100 ug/ml and a maximum inhibition of 49.98% at 500 ug/ml. Test results showed that the methanol extract had a minimum inhibition of 11.22% at 100 ug/ml while the maximum inhibition was recorded to be 46.45% at 500 ug/ml. By comparing the set of data of both the methanolic extract and the diclofenac sodium, the plant is considered to possess extraordinary anti-inflammatory activity and so it can be used as a lead compound for designing new anti-inflammatory phytomedicines (Sailo et al., 2018).

5.2. Antioxidant properties:

The leaf extracts of the *Acmella paniculata* are known to exhibit antioxidant activity due to the presence of bioactive compounds such as steroid, terpenoids and alkaloids (Sivaraj et al., 2023). A cosmetic formulation of the ethanol extract was made in the form of mask cream. DPPH antioxidant testing of three formulas of the mask cream were carried out for study of IC_{50} values against mugwort cream masks. The IC_{50} value of the prepared formulation showed highest antioxidant activity of 21.959 ug/ml as compared to mugwort cream masks which had an antioxidant activity of 28.228 ug/ml (Kholifah et al., 2024).

5.3. Antibacterial properties:

The crude extracts of individual plant parts namely the roots, shoots, and flowers were tested against 6 pathogenic bacteria namely *Bacillus subtilis*, *Salmonella typhi*, *Escherichia coli*, *Vibrio parahaemolyticus*, *Vibrio cholerae*, *Staphylococcus aureus* through well diffusion method. The flowers and leaf showed decent antibacterial activity against all 6 pathogens. The shoot and root extracts showed moderate antibacterial activity against the listed pathogens. However it was noticed that the most resistant strains on *Acmella paniculata* were *Vibrio cholerae* and *Vibrio parahaemolyticus* as they might possess some resistance mechanisms (Krishna et al., 2014). *Streptococcus mutans*, which is an oral bacteria known for breaking down sugar and producing acids in tooth and gums, owes a great deal to dental problems like caries, gingivitis, periodontal disease. Specific extracts of *Acmella paniculata*, comprising n-hexane leaves extract, methanol leaves extract, n-hexane flowers extract, and dichloromethane flowers extract, displayed anti-biofilm activities and bactericidal properties against *Streptococcus mutans* (Salehuddin et al., 2020).

5.4. Anthelmintic properties:

Pet-ether, ethyl acetate, methanol, and chloroform extracts of the plant parts at three concentrations (0.075, 0.15, and 0.22w/v) are used to determine the time of paralysis and time of death on *Pheretimaposthuma* (Indian adult earthworm). *Pheretimaposthuma* was selected for the study due to its resemblance towards intestinal round worm parasites of human beings both anatomically and physiologically. It was observed in the study that at higher concentrations the extracts show remarkable anthelmintic activity. This activity is seen due to the synergistic effect of the active phytoconstituents in the extracts, like alkaloids, saponins, flavonoids, and tannins (Rajeshwar & Lalitha, 2013).

5.5. Local-anesthetic properties:

Acmellapaniculata contains a bioactive phytochemical known by spilanthol((2E,6Z,8E)-N-isobutylamide-2,6,8-decatrienamide) which is responsible for the local anesthetic action. Spilanthol acts by modulating or blocking the Transient Receptor Potential (TRP) channels, mainly TRPV1 and TRPA1 channels which exist near the nerve endings in the mouth. Thus activation of these channels can stimulate saliva secretion and release of neurotransmitters like GABA (gamma-aminobutyric acid) which helps in mediating the nociceptive pain. Also alkylamides are also present in the plant that are proved to exhibit local anesthetic action (S S et al., 2023; Sivaraj et al., 2023).

6. Conclusion:

From this study we can conclude that because of its many uses, *Acmella paniculata* is a very useful plant for both nutritional and therapeutic purposes. Its naturally occurring bioactive chemicals provide a possible substitute for synthetic medicines, treating parasite infestations to bacterial illnesses, along with offering antioxidant advantages that promote general health. Incorporating *Acmella paniculata* into medical procedures and food regimens might enhance patient results and provide long-term, all-natural remedies for contemporary health issues.

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