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A review on pharmacognostic and phytochemical study of a plant *Spilanthes acmella* Murr.

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Abstract

Genus *Spilanthes* is widely distributed in tropical and subtropical regions of the world. *Spilanthes acmella* Murr. Is potent medicinal plant, belongs to the family Asteraceae. The plant is used in traditional system of medicine for healing various diseases. This study comprises morphological, macroscopy, microscopical, pharmacodynamics and pharmacognostic investigations of the plant. It's multiple traditional Use and pharmacological responses allow us to write a review of *Spilanthes acmella*. This review will give all the scientific information in a brief manner to the scientific community.

Keywords: *Spilanthes acmella*, macroscopy, microscopical, phytochemical and pharmacognostic

1. Introduction

1.1 Role of herbal medicine

The world health organization (WHO) estimates that 80% of the population of some Asian and African countries presently uses herbal medicine for primary health care. Medicinal plants play an important role in the development of potent therapeutic agents. Currently herbal medicine is in very much in demand and their popularity is increasing day by day. Herbal drugs referred as plant materials or herbals, involves the use of plants, to treat injuries or illness. A medicinal plant is any plant which, in one or more of its organ, contains substances that can be used for therapeutic purposes, or which are precursors for chemical, pharmaceutical and semi-synthetic purpose^[1].

Herbal medicines are the oldest remedies known to mankind. Herbs had been used by all culture throughout associated with the use of medicinal plant. In the present scenario, the demand for herbal product is growing experimentally throughout the world and major pharmaceutical companies are currently conducting extensive research on plant materials for their potential medicinal values. Standardization of herbal formulation is essential in order to access of quality drugs, based on the concentration of this active principle, physical, chemical, hypo-chemical, standardization and in-vitro, in-vivo parameters.

1.2 Advantages of herbal drugs

- Cost effective
- Easy accessibility
- Less side effects
- Safe^[1].

2. Plant introduction

Genus *Spilanthes* belongs to family Asteraceae which is widely distributed in tropical and subtropical regions of the world. The plants of this genus are reported in some regions of India such as South India, Chhattisgarh and Jharkhand. The plant grows naturally in damp areas, near sewage discharge areas, near lakes or ponds. It is commonly known as toothache plant, eyeball plant, paracress and spot plant. There are around 60 species of genus *Spilanthes* which have been reported from different areas and regions of the world. From all of these 5 species occur in India namely *S. acmella* Murr., *S. acmella* L. var. *oleraceae* Clarke, *S. calva* L., *S. calva*, *S. paniculata*, and *S. mauritiana* L. from all these species *S. acmella* is an acutely threatened species. In some of literature survey genus *Spilanthes* also mentioned as *Acmella*^[2].

Spilanthes acmella is a vital medicinal plant commonly known as akarkara plant with rich source of therapeutic constituents. By chewing the leaves or flowers, it produces a numbing

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effect to the tongue and gums so it is called as toothache plant. Flower heads and roots are used in treatment of scabies, psoriasis, scurvy, and toothache, infection of gums and throats and paralysis of tongue [2]. The leaves contain important phytoconstituents such as alkaloids (Spilanthol), which is responsible for the trigeminal and saliva inducing effects of

products, isobutylamide derivatives, α - and β -amyrin esters, amino acids, stigmasterol, triterpenoid saponins, and alkaloids. The plant has been used as anti-inflammatory and analgesic, anesthetic and antipyretic, bio-insecticides and as remedy for rheumatism, and infection of gums and as immunostimulant [3].



Fig 1: Figure depicting the plant in flowering stage, a single flower, and a plant in its natural habitat, crude powder form and seeds of the plant *Spilanthes acmella*.

2.1 History


Spilanthes having two species was first described by Jacquin (1760), *Spilanthes insipida* and *S. urens*. Richard (1807) described *Spilanthes* in having ray florets and lack of pappus which differ *Acmella* as a genus of five species. Cassini (1822) suggested that *Acmella* might be treated better as a section within *Spilanthes*. De Candolle (1836) followed Cassini's suggestion and recognized two sections, namely

sect. *Salivaria* DC. Still some of the Indian treatises Ramsewak *et al.* 1999, Saraf & Dixit 2002, Shefali Arora *et al.* 2011, Kishan *et al.* 2011, Veda *et al.* 2012, Anuradha Sharma *et al.* 2012) have followed the broader concept of the genus *Spilanthes* [4].

3. Pharmacognostic Profile

3.1 Taxonomical classification [5]

Table 1: Taxonomical classification

| | | |
|----------------|----------------|--|
| Kingdom | Plantae |  |
| Subkingdom | Tracheobionta | |
| Phylum | Tracheophyta | |
| Division | Magnoliophyta | |
| Superdivision | Spermatophyte | |
| Class | Magnoliopsida | |
| Sub Class | Asteridae | |
| Order | Asterales | |
| Family | Asteraceae | |
| Subfamily | Mimosoideae | |
| Genus | Spilanthes | |
| Species | Acmella | |

3.2 Local names [5, 6]

Table 2: Local name

| Language | Synonym | Language | Synonym |
|-----------|---|----------|------------------------|
| India | Akarkara | Japanese | Supirentesu panikurata |
| Indonesia | Jotang, jocong and Dung getang | Malaysai | Subhang nenek |
| Chinese | San lu cao, Xiao tong chui, Tian wen cao, Bian di hong. | Thai | Raan |

3.3 Pharmacognostic evaluation

3.3.1 Macroscopy

It is an annual herb and is short lived that is 40-60 centimeters tall. Mainly grown in damp area and has low rate of germination and poor vegetative propagation. Its flowers and leaves have pungent taste but when cooked, the plants lose their strong flavor and may be used as a green leafy vegetable. *Spilanthes acmella* is synonym with *Spilanthes oleracea*. *Spilanthes acmella* is a very beautiful, erect or ascending stout herb, and can be grown as an annual plant in most climates of the world. A small, erect herb grows swiftly and flourishes with gold and red floral inflorescences. It can be grown in the

ground or as a potted herb. A rich soil with compost is suitable the temperature of about 70 °F is suitable [6].

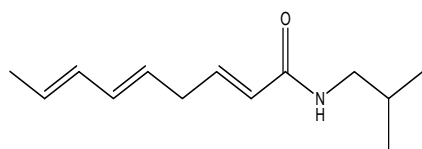
Leaves are opposite, acute or obtuse at apex, petiolete, broadly ovate, narrowed at base, flowering and fruiting in March-April. *Spilanthes acmella* L [7].

3.3.2 Chemical constituents [6, 7]

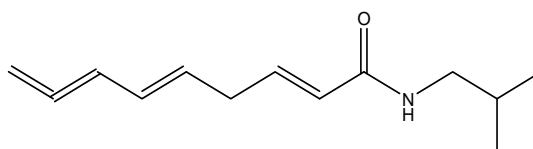
The major pungent constituent reported in this plant *S. acmella* is "spilanthol," which is an isobutylamide having insecticidal properties. Spilanthol is chemically N-isobutylamide which is bitter in taste and could stimulate salivation.

Table 3: Phytochemical compounds in plant of *Spilanthes acmella*

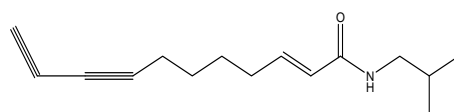
| S. No. | Type of nucleus | Name of the compound | Part used | Solvent |
|--------|-------------------------|---|--------------|----------------------------|
| 1. | Alkamide | Spilanthol and Undeca-2E-7Z-9E-trienoic acid isobutylamide. | Flower buds | Hexane |
| 2. | Alkamide | 8E-trienamide Q α and β -myrin esters stitosterol-O-D-glucoside. | Whole plant | Hexane |
| 3. | Aliphatic compound | Lauric, myristic, plamitic and linolenic acid. | Whole plant | Ethylacetate |
| 4. | Sterols coumarin | B-sitosterone and mixture of stigmasteryl and β -sitosteryl-3-O- β -D-glucopyranoside | Aerial parts | Hexane and petroleum ether |
| 5. | Triterpenoid saponins | Olean-12-en-3-O-beta-D-galactopyranosyl-(1-4)-O-alpha-1-rhamopyranoside | Root | Hexane |
| 6. | Long chain 2-keto ester | AcmellonateN-isobutyl-dedeca-2E,4E,8Z,10,E-tetraen amide | whole plant | Chloroform |



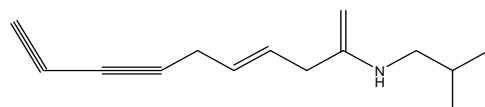
Spilanthol



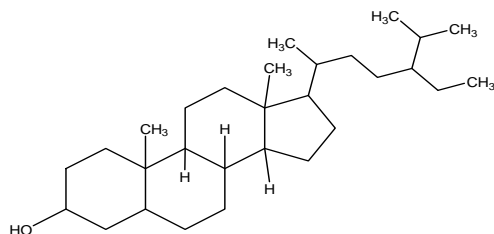
Undeca-2E-en-8, 10-diyonic acid isobutylamide



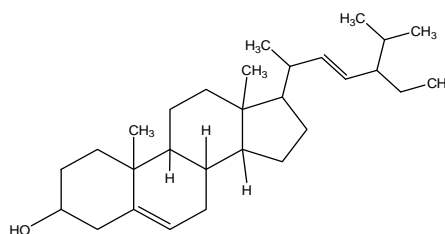
Undeca-2E-7Z-9Etrienoic acid isobutylamide



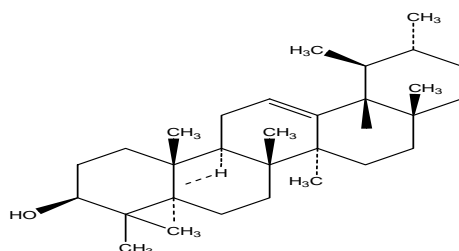
2E-N-(2-methylbutyl)-2-undecene-8,10-diyamide



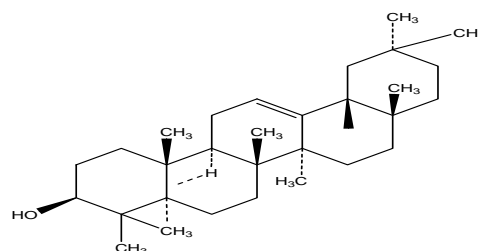
β -Sitosterol



Stigmasterol



α -Amyrin



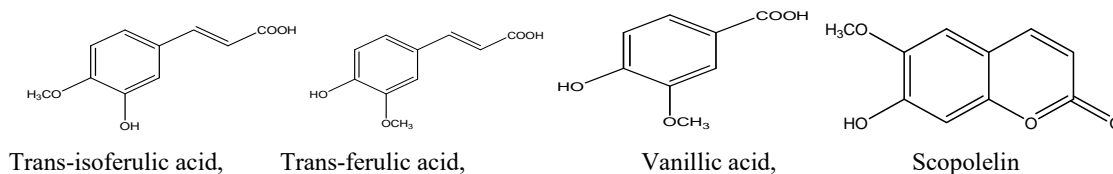
β -Amyrin

Structure 1: Structure of Spilanthol and derivatives [8]

3.3.3 Bioactive metabolites

Major isolates were lipophilic alkylamides or alkamides bearing different number of unsaturated hydrocarbons (alkenes and alkynes), such as spilanthol or affinin (*2E*, *6Z*,

8E)-*N*-isobutyl-2, 6, 8-decatrienamamide and amide derivatives. Alkamides are structurally related to animal endo cannabinoids and is highly active in the central nervous system [9].



Trans-isoferulic acid,

Trans-ferulic acid,

Vanillic acid,

Scopoletin

Structure 2: Bioactive metabolite isolated from *S. acmella* [10]

4. Uses

Table 4: Reported uses of genus *Spilanthes* in ethnopharmacological surveys

| S. No. | Type of use | Population or geographic zone | Part used and method |
|--------|---|-----------------------------------|----------------------------|
| 1. | Toothache and throat complaints, insecticidal, colic, GI disorders. | India | Flowers and leaves [1] |
| 2. | Headache, toothache, muscle pain, cough, head infections accompanied by tchiness. | Bangladesh | Flowers and leaves [2] |
| 3. | Cough, as an insecticides and toothache. | Jamalpur district, Hasanur Hills. | Whole plants [3] |
| 4. | Anticancer agent. | Indonesia | Entire plant Indonesia [6] |
| 5. | Sialagogue. | Sri Lanka | Flowers tincture |
| 6. | Diuretic activity and the ability to dissolve urinary calculi Uva Province and Fortifier for infants. | Madagascar | Leaves Soup [8] |
| 7. | Soup and as a fortifier for infants. | Madagascar | Leaves |
| 8. | Get rid of unpleasant symptoms of the alcoholic hangover. | Brazil | Leaves [9] |

5. Pharmacological Activity

| S. No. | Plant part used | Therapeutic activity | Effect | Author name/Year |
|--------|-----------------------|--|--|--------------------------------------|
| 1. | Aerial parts | Neuroprotective | <i>S. acmella</i> Murr extracts exerted neuroprotective effect, alteration of calcium homeostasis, against pirimicarb induced neurotoxicity [14]. | Suwanjang W <i>et al.</i> (2016) |
| 2. | Whole plant | Antimicrobial activity | Antimicrobial activity of the different extracts of entire plant including flower heads of <i>Spilanthes acmella</i> was evaluated. ¹⁵ | Thakur H.R. and Bhamare M.R. (2015) |
| 3. | Dried roots | Improvement of virility. | Crude extracts of plants, which have been useful in sexual disorders, have potential for improving sexual behaviour and performance, and are helpful in spermatogenesis and reproduction [16]. | Chauhan NS (2014) |
| 4. | Aerial parts | Antifungal | <i>Spilanthes acmella</i> contain good antifungal activity and as alternative medicine in the treatment of various life threatening fungal infections in immune compromised patients [17]. | Khatoon R. <i>et al.</i> (2014) |
| 5. | Root | Antioxidant | Different concentrations of methanolic extract of roots showed radical scavenging activity with an IC ₅₀ value 16.3 ug/ml using DPPH [18]. | Sana H. <i>et al.</i> (2014) |
| 6. | Leaves | Anthelmintic and antioxidant | The significance of callus cultures as a source of high-value metabolites and will help to move a step forward in the search for antioxidant and anthelmintic agents of plant origin [19]. | Singh M. <i>et al.</i> (2014) |
| 7. | Flower head | Anti-tooth ache activity | It is also known as eyeball plant due to its characteristic appearance of the flower head and also known as anti-toothache plant [6]. | Srinath J and Laksmi T (2014) |
| 8. | Stems | Antibacterial | Antibacterial activity of <i>S. acmella</i> through <i>in vitro</i> callus and also its potential against gram negative bacteria harbouring <i>bla</i> genes [20]. | Jaha N. <i>et al.</i> (2013) |
| 9. | Whole plant | Analgesics, anti-inflammatory and antioxidant. | Justify the ancient and pre-clinical findings about medicinal applications of <i>Spilanthes</i> herbal agents in oral hygiene. This review explores extracts, phytochemicals & formulations of <i>Spilanthes</i> evaluated for possible analgesic, anti-inflammatory, antioxidant activity [21]. | Urankar M. <i>et al.</i> (2013) |
| 10. | Seeds | Insecticidal | Shows potent insecticidal toxicity for the management of <i>P. xylostella</i> and other insects of agricultural importance [22]. | Sharma A. <i>et al.</i> (2012) |
| 11. | Shoot tips and callus | Antifungal | The <i>in vitro</i> raised part of plants and calli shows efficient antifungal activity [23]. | Sharma S. <i>et al.</i> (2012) |
| 12. | Leaves | Antimicrobial activity | The methanol and standard of ethyl acetate extract against bacterial strain <i>Klebsiella pneumoniae</i> as it showed more inhibition zone than the standard drug Doxycycline [24]. | Arora S. <i>et al.</i> (2011) |
| 13. | Whole plant | Local anaesthetic and antipyretic | The plant shows significant local anaesthetic and antipyretic activity [25]. | Charkraborty A. <i>et al.</i> (2011) |

| | | | | |
|-----|--------------|---------------------------|--|--|
| 14. | Flowers | Diuretics | The highest dose of flowers tested possesses strong diuretic activity when given orally in single dose. The urine was slightly acidified and strongly suggests that the CWE is acting as a loop diuretic [26]. | Kumar B.N.S <i>et al</i> (2010) |
| 15. | Leaves | Immunomodulatory activity | The extract exhibit significant peritoneal macrophage stimulation and 25-50% mortality as compared to control mice, indicating its prominent immunostimulant activity [27]. | RV Savadi <i>et al.</i> (2010) |
| | Whole plant | Laxative | <i>Spilanthes acmella</i> appear to contain substance(s) that possess significant laxative activity. Bisacodyl is widely used stimulant laxative in the management of constipation, which effectively antagonized constipation induced by atropine [28]. | Das M. <i>et al.</i> (2009) |
| | Flower heads | Larvicidal compound | Spilanthal, a major constituent of ethanolic extract of flower heads of <i>Spilanthes acmella</i> Murr. is having potent pupicidal activity, ovicidal and larvicidal [29]. | Saraf D.K. and Dixit V.K. (2002) |

6. Marketed preparation

| S. no. | Trade name of the preparation containing Akarkara | Product name | Uses for | Pharmaceutical company |
|--------|---|-------------------|-----------------------------|------------------------|
| 1 | Akarkara dant manjan | Dant kanti manjan | Dantal care | Patanjali |
| 2 | Akarkara | Payodhii | Anticholestrolic | XO Herbs |
| 3 | Akarkara | Kumaryasav | Gastric irritation symptoms | Dabur |

7. Conclusion

Spilanthes acmella is a plant of choice for many health related disorders. It is used traditionally in many diseases. There are many phytoconstituents which shows vital pharmacological activity, the active ingredient spilanthal is proposed to be responsible for most of its biological activities. There are many alkaloids and secondary compounds reported from the plants. The review shows the activity of various parts of the plant and its pharmacognostic profile. Extracts and phytoconstituents isolated from this plant have shown to produce different pharmacological response, which includes diuretic, analgesic, anticonvulsant, vasodilation, anti-inflammatory and antimalarial effects. The most traditional use of this plant is to reduce toothache all over India as well as South America. Other traditional uses of *Spilanthes acmella* are as anti-diarrhoeal used rarely against tuberculosis, stomachic and stimulant.

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