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Can Achyranthes Aspera Be Used In Dentistry?

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Abstract

Plant kingdom serves the best source of remedy for all sorts of problems of the human body. Microbial species that are found in almost every habitat present in nature accounts for about 60% of the Earth's total biomass. The World Health Organisation (WHO) has stated that more than 80% of the people in the world rely upon traditional medicines for their primary treatment. On that note *Achyranthes aspera* commonly called as chaff flower has got immense therapeutic values. Each and every part of the plant, most importantly it's seeds, roots and shoots possess great medicinal values. *Achyranthes aspera* belongs to the family *Amaranthaceae*. The Plant is a stiff erect annual herb. *Achyranthes aspera* has been used as a folk medicine in Australia, India and Kenya It is useful in treating cough, renal dropsy, fistula, scrofula, skin rash, nasal infection, chronic malaria, impotence, fever, asthma, piles and snake bites. Their stem parts can be used as an emmenagogue, anti arthritic, laxative, ecbolic, abentifacien, anti helminthic, antiviral, anti plasmodic, anti hypertensive, anti coagulant, diuretic and anti tumor agent. The ash from the burnt plant can be mixed with mustard oil and a pinch of salt and the tooth powder obtained is useful in cleaning teeth, treating pyorrhea and tooth ache. Their roots can also be powdered and used as a tooth powder and the roots itself were used as brushes. In India and Terai of Nepal, the juice of the plant is applied to relieve toothache. The stem of the plant was also used as a toothbrush after removing the thorns. The infusion of the twig is also used as a wash for tooth pain. Their usage in dentistry is remarkable as it has got good anti-cariogenic properties and anti inflammatory properties which has been discussed in detail in the current review article.

Keywords: *Achyranthes aspera; Streptococcus mutans; Anti-cariogenic activity; Anti-inflammatory activity*

Introduction

Microbial species that are found in almost every habitat present in nature, accounts for about 60% of the Earth's biomass [1]. Herbal medicines have been used since time immemorial. Plants have got an extraordinary ability to synthesize aromatic substances which are the useful phenols or their oxygen substituted seriatives [2]. The maintenance of good health of the people in most of the developing countries forms the normative basis of the usage of traditional medicines [3]. The World Health Organisation, known for the importance of these valuable medicinal plants, has made an attempt to list all the medicinal plants present globally and has listed more than 20,000 species [4]. It also states that more than 80% of the population worldwide rely upon traditional herbal medicine for their primary health care [5] . The presence of numerous bioactive constituents of immense therapeutic value with no or less side effects make them an exemplary source of alternative medicines [6]. There exists a plethora of knowledge, information and benefits of these plants in our ancient literature. There are about more than 4,00,000 plant species present all over Earth [7]. But only 6% have been studied for their biological properties and only 15% have been phytochemically investigated [8]. This shows that research on plant

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species and their extracts must be greatly increased [9] . On that note, the current study deals with one of such plant species of immense therapeutic values which is *Achyranthes aspera*. Each and every part of the plant, most importantly it's seeds, roots and shoots possess great medicinal values[10]. *Achyranthes aspera* belongs to the family *Amaranthaceae* and is a stiff erect annual herb [11]. *Achyranthes aspera* has been used as folk medicine in Australia, India and Kenya [12]. It is useful in treating cough, renal dropsy, fistula, scrofula, skin rash, nasal infection, chronic malaria, impotence, fever, asthma, piles and snake bites. This review highlights the usage of the traditional herb, *Achyranthes aspera* in dentistry and its anti-cariogenic and anti-inflammatory properties.

Taxonomic Classification [13]:

Kingdom: Plantar

Sub Kingdom: Tracheobinota

Super Division: Spermatophyta

Division: Mangoliophyta

Class: Mangoliophsida

Sub class: Caryophyllidae

Order: Caryophylla

Family: Amaranthaceae

Genus: Achyranthes

Species: aspera

Vernacular Names [14]

Latin: *Achyranthes aspera*

English: Prickly Chaff flower, Rough Chaff tree, Red chaff tree

Sanskrit: Aghata

Hindi: Latjira, Chirchira

Gujarati: Safad, Aghedo

Tamil: Nayuruvi

Telugu: Uttaraene

Malayalam: Kadalad

Punjabi: Kutri

Unani: Chirchitaa

Ayurvedic: Apaamaarga, Chirchitaa, Shikhari, Shaikharika

Geographical Distribution:

Achyranthes aspera is found all over Balochistan, Sri lanka, Tropical Asia, Africa, Australia and America [15]. In India, it is easily found everywhere on roadsides and field edges as a weed throughout up to an altitude of about 2100m [16]. It is also found in plenty in the South Andaman Islands.

Morphological Features [17]

Root: Cylindrical root, 0.1 - 1.0 cm thick, slightly ribbed, gradually tapering, yellowish brown in colour, has got secondary and tertiary roots.

Stem: Yellowish brown, square, branched, hairy, cylindrical, solid, hollow when dry.

Leaf: Simple, subsessile, slightly acuminate, estipulate, obovate, petiolate, opposite, decussate and Pubescent.

Flower: Arranged in long spikes form in inflorescence. Bisexual, Greenish white, numerous, sessile, bracteate with two bracteolates, actinomorphic, hypogynous and syncarpous.

Phytochemical constituents:The major chemical constituents are carbohydrates, protein, glycosides, alkaloids, tannins, saponins, flavoides, lignin.

6. *Achyranthes Aspera* In Dentistry:

Since ancient times, sticks of stems and roots of plants have been widely used by people for brushing. The chewing sticks of the traditional plants possessed anti microbial properties and also cleansed the teeth mechanically [18]. *Achyranthes Aspera Linn* is the scientific name of the Indian prickly chaff flower that was widely seen at road sides and farms throughout tropical and subtropical regions [19]. This is also known as Apamarga. Its Tamil name is Nayuruvi which was described by siddhas as the powerful herbal. All parts of the plants including root, seed, lead and flowers are used as the medicine to cure even dangerous diseases. Their

roots had been powdered and used as a tooth powder and the roots itself were used as brushes [15]. In India and Terai of Nepal, the juice of the plant is applied to relieve toothache[16]. The stem of the plant was also used as a toothbrush after removing the thorns. The infusion of the twig is also used as a wash for tooth pain [17].

It makes teeth brighter, odour free and ensures the maintenance of strong and healthy gums [18]. Only few researchers across the world have tested the anti-cariogenic properties of *Achyranthes aspera* but their other pharmacological properties were widely tested across the globe by many researchers.

Anticariogenic Properties Of *Achyranthes Aspera*:

A study tested the anticariogenic activity of *Achyranthes aspera* against *Streptococcus mutans* [19] The lowest concentration of the extract that had inhibited the growth of the tested microorganisms for both the stem and root extracts is found to be about 2.5% [19]. While for the Gold standard chlorhexidine, the zone of inhibition obtained was 19 mm at 10 µl volume at 2% concentration[19]. *A. aspera* extract has shown statistically significant zones of inhibition. *A. aspera* has shown marked antibacterial activity against *S. mutans*[19] . Another study shows that the leaf extracts of the plant had more significant effects against the salivary microflora than the stem and root extracts of the same plant [20] A study by Murugan K et al., 2013 has recorded the biofilm inhibition percentage against *S.mutans* obtained for methanol, benzene, petroleum ether and aqueous extracts (125 µg/mL) of the plant to be ≤94%, ≤74%, ≤62% ≤42%, respectively. This again proves that *A.aspera* has got great anti cariogenic properties [21].

A study has shown that petroleum ether extract of leaves of *Achyranthes aspera* had shown broad spectrum antibacterial potential predominantly against Gram negative bacteria than Gram positive bacteria[22]. Similarly, Benzene extract of the stem of the plant had also shown good antibacterial activity against gram negative bacteria than gram positive bacteria [23].

The ethanolic extracts of leaves, stem and root parts of *Achyranthes aspera Linn* had been evaluated for antimicrobial activity against salivary microflora by a study [24]. The salivary samples were collected from children who had mixed dentition age group with moderate caries activity. Antibacterial assay was done by agar diffusion method [24]. The results were then evaluated with 0.2% Chlorhexidine which had been used as a standard. The seasonal and less palpated plant, *Achyranthes aspera* showed significant medicinal properties [24]. The crude ethanol leaf extract that was obtained from *Achyranthes aspera* plant was found to be an effective antimicrobial agent against the salivary micro flora having a comparable activity with that of chlorhexidine mouthwash [24]. The study also confirmed the antimicrobial potentials of the plant in its stem and root extract. Thus the study supports the folklore application of the plant as a preventive remedy for various microbial diseases of hard and soft tissues in the oral cavity[24].

A study by Jebashree et al., 2011 had evaluated the anticariogenic activity of ethyl acetate extracts *A. aspera.* The study had shown higher antibacterial activity against *S. mutans* than any other solvent extracts[25]. From these we can infer that *Achyranthes aspera* has got great anti-cariogenic properties. A study by Prabhat et al., 2005, had reported that methanolic extracts of *A.aspera* possessed antimicrobial activity while the study by Khan et al., 2010, had demonstrated that the ethanol and chloroform extracts of the seeds of *A. aspera* had shown mild to moderate antibiotic activity against *Bacillus subtilis*, *E. coli*, and *Pseudomonas aeruginosa* [26 ,27]. Studies by Alam et al., 2009 [28]; Londonkar R et al., 2011 [29]; Naidu et al., 2006 [30]; Elumalai et al., 2009 [31] had demonstrated the potential Antimicrobial activities of *A.aspera.* Further studies on the anti cariogenic properties of the plant can substantiate their potential against the oral pathogens.

***Achyranthes Aspera* Gel In The Management Of Chronic Periodontitis:**

A study by Ramanarayana Boyapati et al., 2017 had conducted an experiment evaluating the usage of *Achyranthes aspera* in the management of chronic periodontitis[32]. The study has concluded that *A. aspera* gel when delivered locally along with scaling and root planing had shown a beneficial effect. *A. aspera* gel as a non-surgical local drug delivery system proved to be without any side effects in the management of periodontitis[32]. *A. aspera* gel has got strong anti-

inflammatory effects in addition to its antioxidant activity which has been discussed in the next paragraph[32].

Anti Inflammatory Properties Of *Achyranthes Aspera*:

There are many studies that show *Achyranthes aspera* has got a good anti inflammatory property An alcohol extract of *A.aspera,* 375 and 500 mg/kg was tested in carrageenan induced hind paw oedema and cotton pellet granuloma models in male albino rats. The alcoholic extract showed a maximum inhibition of rat paw edema of 65.38% and 72.37% after 3 hours [33].

In a chronic test the extract has inhibited 40.03% and 45.32% reduction of the granuloma weight in the sub acute cotton pellet granuloma model[34] Another similar study has also shown that alcohol extract has suppressed granuloma formation in both acute and chronic inflammation [35]. The orally administered ethanolic seed extracts of 100 and 200mg/kg and silver nanoparticles of *Achyranthes aspera* in carrageenan induced paw edema in rats has shown significant inhibition of edema and inflammation [36].

Future Scope:

The review article has explained the anti cariogenic activity of the plant extract. In recent times, the world has shifted towards the herbal cures because of the pronounced cumulative and irreversible reactions of modern therapeutic drugs. The field of nano technology is booming. The *Achyranthes aspera* mediated green synthesis of nanoparticles can enhance the antimicrobial effect of the plant. Especially the green synthesis of silver nanoparticles can be carried out which has got an excellent antimicrobial property[37]. Their quantum effects attribute to their unique mechanical and physicochemical properties[38]. Their increased surface area permits the coordination of various ligands [39]. For these reasons, they are greatly known for their applications in diagnosis, drug delivery and treatment of various diseases[40]. Applications of silver nanoparticles in dentistry is a growing field that has enhanced and stabilized various biomaterials and devices that are already in use in dentistry [38]. However, they cannot be used as such because of it's toxic nature [41]. But green synthesis of nanosilver makes it harmless and also enhances its pharmacological properties [42]. So studies owing to nanotechnology have got a great scope in future.

Conclusion

The article has reviewed the anti cariogenic properties of the plant *A.aspera* in detail. From our article, we can conclude that *A.aspera* has got a lot of uses in dentistry and has got a good anti cariogenic and anti inflammatory property.

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References

1. Ramamoorthi S, Nivedhitha MS, Divyanand MJ. Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial. Aust Endod J. 2015 Aug;41(2):78–87.
2. Ramanathan S, Solete P. Cone-beam Computed Tomography Evaluation of Root Canal Preparation using Various Rotary Instruments: An in vitro Study. J Contemp Dent Pract. 2015 Nov 1;16(11):869–72.
3. Siddique R, Sureshbabu NM, Somasundaram J, Jacob B, Selvam D. Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi. J Conserv Dent. 2019 Jan;22(1):40–7.
4. Rajakeerthi R, Ms N. Natural Product as the Storage medium for an avulsed tooth–A Systematic Review. Cumhuriyet Dental Journal [Internet]. 2019; Available from: https://dergipark.org.tr/en/pub/cumudj/issue/45584/525182
5. Rajendran R, Kunjusankaran RN, Sandhya R, Anilkumar A, Santhosh R, Patil SR. Comparative Evaluation of Remineralizing Potential of a Paste

Containing Bioactive Glass and a Topical Cream Containing Casein Phosphopeptide-Amorphous Calcium Phosphate: An in Vitro Study [Internet]. Vol. 19, Pesquisa Brasileira em Odontopediatria e Clínica Integrada. 2019. p. 1–10. Available from: http://dx.doi.org/10.4034/pboci.2019.191.61

6. Hussainy SN, Nasim I, Thomas T, Ranjan M. Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up. J Conserv Dent. 2018 Sep;21(5):510–5.
7. Kumar D, Antony S. Calcified Canal and Negotiation-A Review. Research Journal of Pharmacy and Technology. 2018;11(8):3727–30.
8. Ravinthar K, Others. Recent Advancements in Laminates and Veneers in Dentistry. Research Journal of Pharmacy and Technology. 2018;11(2):785–7.
9. Noor SSSE, S Syed Shihaab, Pradeep. Chlorhexidine: Its properties and effects [Internet]. Vol. 9, Research Journal of Pharmacy and Technology. 2016. p. 1755. Available from: http://dx.doi.org/10.5958/0974-360x.2016.00353.x
10. Teja KV, Ramesh S, Priya V. Regulation of matrix metalloproteinase-3 gene expression in inflammation: A molecular study. J Conserv Dent. 2018 Nov;21(6):592–6.
11. Janani K, Palanivelu A, Sandhya R. Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality - An in vivo study [Internet]. Vol. 23, Brazilian Dental Science. 2020. Available from: http://dx.doi.org/10.14295/bds.2020.v23i1.1805
12. Jose J, Subbaiyan H. Different Treatment Modalities followed by Dental Practitioners for Ellis Class 2 Fracture–A Questionnaire-based Survey. Open Dent J [Internet]. 2020; Available from: https://opendentistryjournal.com/VOLUME/14/PAGE/59/FULLTEXT/
13. Goel RK, Gawande DY, Lagunin AA, Poroikov VV. Pharmacological repositioning of *Achyranthes aspera* as an antidepressant using pharmacoinformatic tools PASS and PharmaExpert: a case study with wet lab validation. SAR QSAR Environ Res. 2018 Jan;29(1):69–81.
14. Kushwaha U. Evaluation of qualitative phytochemical analysis of water extract of *Achyranthes aspera* and *Achyranthes aspera* 30. 2019; Available from: http://aohindia.in/jspui/handle/123456789/1874
15. Nandakumar M, Nasim I. Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis. J Conserv Dent. 2018 Sep;21(5):516–20.
16. Viswanatha GL, Venkataranganna MV, Prasad NBL, Shylaja H. *Achyranthes aspera Linn.* alleviates cerebral ischemia-reperfusion-induced neurocognitive, biochemical, morphological and histological alterations in Wistar rats. J Ethnopharmacol. 2019 Jan 10;228:58–69.
17. Teja KV, Ramesh S. Shape optimal and clean more. Saudi Endodontic Journal. 2019 Sep 1;9(3):235.
18. Manohar MP, Sharma S. A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists. Indian J Dent Res. 2018 Nov;29(6):716–20.
19. Yadav R, Rai R, Yadav A, Pahuja M, Solanki S, Yadav H. Evaluation of antibacterial activity of *Achyranthes aspera* extract against Streptococcus mutans: An in vitro study. J Adv Pharm Technol Res. 2016 Oct;7(4):149–52.
20. Shep SV, Deshpande RR, Kontham UR, Bagade KK, Dungarwal PP, Gajjar PM. Comparative Evaluation of Antimicrobial Properties of Three Various Extracts of *Achyranthes Aspera* and Chlorhexidine against Streptococcus Mutans. The Journal for Dentistry Photon. 2018;113:284–94.
21. Murugan K, Sekar K, Sangeetha S, Ranjitha S, Sohaibani SA. Antibiofilm and quorum sensing inhibitory activity of *Achyranthes aspera* on cariogenic Streptococcus mutans: an in vitro and in silico study. Pharm Biol. 2013 Jun;51(6):728–36.
22. Y RPS, Pandey Sambasivarao Y R. Antibacterial Activity of Medicinal Plants against Pathogens from Extracts of *Achyranthes Aspera* [Internet]. Vol. 02, Medicinal & Aromatic Plants. 2012. Available from: http://dx.doi.org/10.4172/2167-0412.1000135

23. A FS, Fegade SA, Kolhe R. C. SJVPM'S Rasiklal M Dhariwal College of Pharmacy, Chinchwad, Maharashtra, India. REVIEW ON *ACHYRANTHES ASPERA* (AMARANTHACEAE) [Internet]. Vol. 4, Indian Research Journal of Pharmacy and Science. 2017. p. 1224–31. Available from: http://dx.doi.org/10.21276/irjps.2017.4.4.9
24. Samson S, Research scholar, Singhania University, Pacheribari, Jhunjhunu, (India) R, et al. Pharmacognostic Effects of *Achyranthes aspera* roots and Ocimumsanctumroots and Leaves on Streptococcus mutans Causing Dental Caries [Internet]. Vol. 3, Global Journal For Research Analysis. 2012. p. 92–5. Available from: http://dx.doi.org/10.15373/22778160/july2014/119
25. Jebashree HS, Kingsley SJ, Sathish ES, Devapriya D. Antimicrobial activity of few medicinal plants against clinically isolated human cariogenic pathogens—An in vitro study. ISRN Dent [Internet]. 2011;2011. Available from: http://downloads.hindawi.com/journals/isrn.dentistry/2011/541421.pdf
26. Navneet P, Krishna S. Antimicrobial activity of apamarga (*Achyranthes aspera Linn*.). Natl Acad Sci Lett. 2005;28(11-12):379–81.
27. Khan MTJ, Ahmad K, Alvi MN, Mansoor B, Saeed MA, Khan FZ, et al. Antibacterial and irritant activities of organic solvent extracts of *Agave americana Linn*., Albizzia lebbek Benth. *Achyranthes aspera Linn*. and *Abutilon indicum Linn*-A Preliminary Investigation. Pak J Zool [Internet]. 2010;42(1). Available from: http://search.proquest.com/openview/0fc586cf36ae8065f9beb53fe617315f/1?pq-origsite=gscholar&cbl=616534
28. Alam MT, Karim MM, Khan SN. Antibacterial activity of different organic extracts of *Achyranthes aspera* and *Cassia alata*. Journal of scientific research [Internet]. 2009; Available from: https://www.banglajol.info/index.php/JSR/article/view/2298
29. Londonkar R, Others. Potential Antibacterial and Antifungal Activity of *Achyranthes aspera* L. Recent Research in Science and Technology [Internet]. 2011;3(4). Available from: http://updatepublishing.com/journal/index.php/rrst/article/view/657
30. Naidu PVL, Kumar KK, Kumar CM, Gunesh G, Rao MN. Antimicrobial activity of *Achyranthes aspera*. Biosci Biotechnol Res Asia. 2006;3(1):171–4.
31. Elumalai EK, Chandrasekaran N, Thirumalai T, Sivakumar C, Therasa SV, David E. *Achyranthes aspera* leaf extracts inhibited fungal growth. International Journal of PharmTech Research. 2009;1(4):1576–9.
32. Boyapati R, Gojja P, Chintalapani S, Nagubandi K, Ramisetti A, Salavadhi SS. Efficacy of local drug delivery of *Achyranthes aspera* gel in the management of chronic periodontitis: A clinical study. J Indian Soc Periodontol. 2017 Jan;21(1):46–9.
33. Bhosale UA, Yegnanarayan R, Pophale P, Somani R. Effect of aqueous extracts of *Achyranthes aspera* Linn. on experimental animal model for inflammation. Anc Sci Life. 2012 Apr;31(4):202–6.
34. Ambreen M, Mirza SA. Evaluation of anti-inflammatory and wound healing potential of tannins isolated from leaf callus cultures of *Achyranthes aspera* and *Ocimum basilicum*. Pak J Pharm Sci. 2020 Jan;33(1(Supplementary)):361–9.
35. Vetrichelvan T, Jegadeesan M. Effect of alcohol extract of *Achyranthes aspera Linn.* on acute and subacute inflammation. Phytother Res. 2003 Jan;17(1):77–9.
36. Edwin S, Jarald EE, Deb L, Jain A, Kinger H, Dutt KR, et al. Wound Healing and Antioxidant Activity of *Achyranthes aspera*. Pharm Biol. 2008 Jan 1;46(12):824–8.
37. Aafreen MM, Anitha R, Preethi RC. Anti-Inflammatory Activity of Silver Nanoparticles Prepared from Ginger Oil-An Invitro Approach. Indian Journal of [Internet]. 2019; Availablefrom:https://www.researchgate.net/profile/Kasim_Abass/publication/335236375_Association_between_Socio-economic_Status_and_Breast_Feeding_Practices_in_a_Group_of_Women_Delivered_During_the_Previous_Year_in_Kirkuk_City/links/5de20373299bf10bc3315b05/Association-between-Socio-economic-Status-and-Breast-Feeding-Practices-in-a-Group-of-Women-Delivered-During-the-Previous-Year-in-Kirkuk-

City.pdf#page=175

38. Keerthiga N, Anitha R, Rajeshkumar S, Lakshmi T. Antioxidant activity of cumin oil mediated silver nanoparticles. Pharmacognosy Journal [Internet]. 2019;11(4). Available from: http://www.phcogj.com/article/930
39. Gayathri K, Roy A, Lakshmi T, Rajeshkumar S. Controlling of oral pathogens using ginger oleoresin mediated silver nanoparticles. IJRPS. 2019 Oct 16;10(4):2988–91.
40. A MTAK, Mohamed Thamemul Ansari K, Roy A, Rajeshkumar S. Anti-inflammatory activity of cinnamon oil mediated silver nanoparticles -An in vitro study [Internet]. Vol. 10, International Journal of Research in Pharmaceutical Sciences. 2019. p. 2970–2. Available from: http://dx.doi.org/10.26452/ijrps.v10i4.1579
41. Pranati T, Anitha R, Rajeshkumar S, Lakshmi T. Preparation of Silver nanoparticles using Nutmeg oleoresin and its Antimicrobial activity against Oral pathogens. Research Journal of Pharmacy and Technology. 2019;12(6):2799–803.
42. Jain A, Anitha R, Rajeshkumar S. Anti inflammatory activity of Silver nanoparticles synthesised using Cumin oil. Research Journal of [Internet]. 2019; Available from: http://www.indianjournals.com/ijor.aspx?target= ijor:rjpt& volume=12& issue=6& article=032