

ORIGINAL RESEARCH ARTICLE

Substantiation of Medicinal Properties of *Ulatakambal* (*Abroma augusta* Linn.) through Ethnomedicine, Phytochemical, Experimental and Clinical studies

Author: Aparna Dixit¹

Co Authors: Anil Kumar Singh²

^{1,2}Department of Dravyaguna, Faculty of Ayurveda, IMS, BHU, Varanasi, UP, India

ABSTRACT

Since traditional knowledge is developed through a long process of trial and error, this could guide search for new drugs. *Abroma augusta* Linn. is one of such plants which have medicinal property in greater extent. The plant used mostly by folklore healers to treat various ailments in Indian subcontinent and South-East Asia. In this article, ethnobotanical surveys; and phytochemical, experimental and clinical research articles from authentic source are reviewed to summarize available data about plant. This plant is used to treat menstrual disorders, Diabetes mellitus, bone fracture, wound healing, arthritis, headache, skin disorders; and have shown anti-inflammatory and anti-oxidant activities. Abromine, taraxerol, β -sitosterol, stigmasterol are the main chemical constituents are found till date from different parts of plant. The present review is expected to produce a better understanding of the characteristics, bioactivities and mechanistic aspect of this plant and to provide new leads for future research.

Key Words *Abroma augusta*, Ethnomedicinal, Phytochemical

Received 25th June 22 Accepted 08th August 22 Published 10th September 2022

INTRODUCTION

Since time immemorial, human has been dependent on nature for basic needs as well as for treatment of ailments. Plants available in surroundings have become his nectar to treat the diseases as well as to maintain health of humans; and form the basis of traditional medicinal system, specific for a specific area. India has a vast Materia medica of traditional medicinal system termed as Ayurveda which is meant not

only for curing the disease but also for preventing their occurrence¹. Over the past decades, the modern world of science shows interest in traditional medicinal system to explore the formulation of novel Phyto therapeutic agents². The plant *Ulatakambal* (*Abroma augusta* Linn) found in area between Bhutan, India, Bangladesh, Myanmar till Indonesia and Thailand, used for treating different ailments by folklore healers in these places. This makes *A. augusta* valuable and

ORIGINAL RESEARCH ARTICLE

yet to be explore plant. *A. augusta*, belongs to Family Sterculiaceae, is also one of the plants having numerous medicinal properties. In India, this plant is known by various names in different places like: Hindi: kumal, ulatkambal, sanukapashi; Assam: Gunakhiakarai; Bengal: olatkambol; Tamil: sivapputtutti; Orrisa: pisachogonjai; Nepal: sanukapasi; English: Devil's cotton, Perennial Indian Hemp. This is a shrub or small tree with velvety branches, having leaves 10-15 by 10-12 cm., repand- denticulate, base 3-7 nerved, upper smaller, narrower, entire, glabrescent above, tomentose below; petiole 12-25 mm. stipules linear, deciduous, as long as the petiole; peduncle about 4 cm. long axillary. Its flowers are of 5cm diameter, dark red, scarcely exceeding the sepals, imbricate in bud, deciduous. Capsule almost 4 cm. long, obpyramidal, finally glabrous, thrice as long as the persistent calyx. Seeds enveloped in light cottony wool giving its name as Devil's cotton³.

Ulatakambal is one of such drugs which possess enormous medicinal properties. Although ancient scripts do not mention this herb but it is recognized in books of 20th century i.e. Adarsh Nighantu, Bhava Prakash nighantu and Dravyaguna Vigyan specially for treatment of menstrual disorders⁴.

There are many ethnomedicinal surveys carried out which has been mentioned this herb as used by tribal population in many ailments; its leaves, stem bark, seed and rootbark are to be mentioned as useful in many diseases. Recently, there are many researches conducted over this plant to

prove its medicinal properties *in vitro* and *in vivo* conditions. To summarize a scientific material available about this herb; the review is needed to collect different work from different research institutes for collective documentation of medicinal properties of *A. augusta*. In this article, authenticated research papers, surveys and books are reviewed.

METHODOLOGY

The literature available in hard copies and online scientific records from google scholar, PubMed, EMBASE, Wiley library, DHARA, research gate is searched for review of authenticated research works of *Abroma augusta* Linn. restricted in English language. The time period of research papers since 2001 till date. Duplicate and unauthentic records are excluded. The literature available in Ayurvedic classical texts are also considered.

ETHNO-MEDICINAL SURVEYS: There are much more data regarding ethnomedicinal surveys present on web. Phyto therapeutic practices of various parts of this plant by folklore practitioners done in many human ailments. In Meghalaya, its root-bark is used emmenagogue and uterine tonic, powdered root is used as abortifacient and used in other gynecological disorder⁵. In Tripura, traditional healers used its root along with other herbs in treating bone fracture⁶. In Assam, it is reported as used in irregular menstruation and headache^{7,8,9}. In West Bengal, dry seeds of this plant is used in piles,

ORIGINAL RESEARCH ARTICLE

anal fissure and flowers in urethral discharge¹⁰; leaves along with other plants in arthritis¹¹; root in leucorrhoea¹². In Arunachala Pradesh, its bark and root are used in urine disorders¹³; stem-bark decoction used as antidysentery and anti-emetic drug¹⁴. In some district of Uttarakhand, its leaves are used in skin disorder and ring worm¹⁵. Outside India, in many southeast Asian countries, it is used by traditional healers to treat various disorders. In Bangladesh, its root is used in leucorrhoea and bone fracture¹⁶; leaves as anti-diarrheal agent¹⁷; in Philippines decoction of its leaves and bark is used to wash cuts and wounds¹⁸. In Malaysia, it is reported to use in menstrual disorder and skin disorders¹⁹.

PHYTOCHEMICAL DESCRIPTION: The plant was reported to contain steroids/ terpenoids, alkaloids, flavonoids and saponins. The seed oil obtained in a yield of 20% was found to contain mainly palmitic, hexadecenoic, stearic, oleic, and linoleic acids. It has traces of arachidic and behenic acid. Preliminary chemical examination of the seeds revealed the presence of steroids/terpenoids, tannins and phenolics and saponins. The fruits were found to contain steroids/ terpenoids, alkaloids and flavonoids while tannins and phenolics were found to be absent. The leaves were reported to yield taraxeryl acetate, taraxerol and β -sitosterol. Isolation of lupeol was also reported from the leaves. Gas liquid chromatography of the leaves revealed the presence of fatty acids viz laceric, myristic, palmitic, paimitoleic, stearic, oleic, linoleic and linolenic acids. The stem bark

revealed the presence of β -sitosterol and friedelin; and heart wood was reported to yield β -sitosterol and octacosane-1, 28- diol. Carbohydrates identified in the aqueous extract of stem are: glucose, mannose, myo-inositol, glycerol, erythritol, threitol, fucitol, glucitol, mannitol and sucrose. A polysachharide, primarily composed of rhamnose and glucuronic acid was also isolated. In a preliminary chemical examination, the root was found to contain alkaloidal bases, reducing sugars and Phyto-sterols. Glycosides were found to absent, isolation of an alkaloid named abromine and a phytosterol was reported. Abromine later shown to be a betain. Choline was also detected along with beta-sitosterol and stigmasterol from the non-saponifiable fraction of the petroleum ether of the root. The root was also reported to yield a new oleanane derivative, augustic acid and a stigmasterlol glycoside whose structures were established as olean-12-en-2beta-3 beta-diol- 28-oic acid and stigmast-5,22-dien-3-O-alpha-D-glucopyranoside, respectively. The root bark was reported to contain fixed oil, resins and water-soluble bases^{20,21}.

PHARMACOLOGICAL PROPERTIES:

Various studies regarding medicinal values of plant *A. augusta* are done to establish and to explore the reliability of plant. Studies available on web portals are categorized as below:

Anti-Diabetic activity: Different parts of *Abroma augusta* like leaves, stem, roots are used in treatment of Diabetes mellitus. Also in homeopathic treatment, there is an article [September 10th 2022](#) Volume 17, Issue 2 **Page 3**

ORIGINAL RESEARCH ARTICLE

regarding significant effect of its mother tincture in Diabetes mellitus²².

There are various studies came to know about the different activities of leaves of *A. augusta* in Diabetes mellitus either in vitro or in vivo. The methanolic extract of *A. augusta* leaves have anti-hyperglycemic potential which was evaluated through oral glucose tolerance tests in glucose loaded Swiss-albino mice^{23,10}. Also, aqueous extract of fresh leaves of *A. augusta* has significant capacity to reduce the diffusion of glucose from different water-soluble fraction – glucose system²⁴. The study has notified that water-soluble fraction of fresh leaves of *A. augusta* significantly reduced the absorption of glucose administered orally in fasted rats. The result is suggested that this may be beneficial in Diabetic patients to improve glycemic control but should not be co administered with metformin HCL for management of T2DM²⁵. So it may be potentially useful in controlling the post-prandial blood glucose level in T2DM patients. In other studies, it is showed that methanolic and hydro methanolic extracts of leaves of *A. augusta* has protective effects on diabetes induced complication. The study to investigate protective effect of hydro methanolic extract of leaf of *A. augusta* was conducted in streptozotocin induced diabetic male albino rat for 28 days. Blood glucose level, serum insulin, glycated hemoglobin levels along with activities of hepatic carbohydrate metabolic enzyme activities, conjugated diene and thiobarbituric acid reactive substance levels in liver were measured. All these

parameters were shifted towards the control level after the treatment of hydro methanolic extract. Pancreatic islet diameter, count of islets, number of cells in islets also decreased in diabetic animals²⁶. Oral administration of methanolic extract of leaves of *A. augusta* at the dose of 100 and 200 mg/ kg body weight per day could reduce hyperglycemia, hyper lipidemia, membrane disintegration, oxidative stress, vascular inflammation and prevented the activation of oxidative stress induced signaling cascades leading to cell death. Result suggests that *A. augusta* could offer prophylactic role against T2DM and its associated reno- and cardio toxicity²⁷.

The hypoglycemic effect of the aqueous extract of root of *A. augusta* was studied in normal as well as alloxane diabetic rats showing that the water extract of root of *A. augusta* has both hypoglycemic and hypocholesterolemic effects²⁸. the other study was carried out to investigate α - d- glucosidase inhibitory activity of root extract of *A. augusta* through screening of different extracts of root of *A. augusta* in streptozotocin-nicotinamide induced T2DM animals. The results showed that petroleum ether extract exhibited the most significant effect in STZ-NA induced T2DM. These results provide that the root extracts of *A. augusta* might be a potential source of antidiabetic agent for a the treatment of T2DM and its α - d- glucosidase inhibitory potential could be one of the possible mechanism for its Anti diabetic effect²⁹.

ORIGINAL RESEARCH ARTICLE

Combined effect of *A. augusta* and *Coccinea Indica* known to be useful for the treatment of diabetes in Ayurveda on the fasting blood sugar, glucose tolerance and lipid profile of STZ induced albino rats³⁰. Another study was to investigate the combined effect of oral administration (300 mg per kg) of the aqueous extract of turmeric whose active ingredient is Curcumin and of *A. augusta* as a hypo glycaemic agent mixed with diet. The effect of this extract on blood glucose, lipid per-oxidation and the antioxidant defense system in STZ induced diabetic rats. The study resulted in a significant reduction in blood glucose and increase in total hemoglobin and also decreased free radical formation in the tissues. The decrease in thiobarbituric acid reactive substances and increase in reduced glutathione superoxide dismutase and catalase clearly showed the antioxidant property of the mixture. It is suggested that the mixture of the two plants have shown Anti diabetic activity and also reduced oxidative stress in diabetes³¹. Another combination (1:1) of water extract of dried powder of root and leaves (200mg/kg body wt) of *A. augusta* and *Azadirachta Indica* respectively was administered orally to alloxan diabetic rats. This treatment caused significant lowering of blood sugar as estimated by glucose tolerance test. And reduction in serum lipids. Aqueous extract also decreased the formation of lipid peroxides estimated as thiobarbituric acid reactive substance and increased antioxidants (superoxide dismutase, catalase, glutathione

peroxidase and glutathione transferase) in erythrocytes³².

Anti-inflammatory activity: The ethyl acetate extracts of *A. augusta* leaves have anti-inflammatory activity. The decrease in % edema started from 30th min and then optimized at 60th min. The extracts possibly exerted their anti-inflammatory action by influencing the second phase of inflammation, namely the cyclooxygenase pathways rather than the lipoxygenase pathway³³. An isolate of n-hexane extract of leaf of *A. augusta* with dose 10 mg/kg body weight was able to decrease size of edema in mice leg after 90 minutes. The result obtained was better than treated with sodium diclofenac³⁴. An isolate named as squalene enhanced expression levels of anti-inflammatory enzymes (HO-1) and transcription factors (Nrf2 and PPAR γ)³⁵. The anti-inflammatory effect of taraxerol isolated from the methanol extract of *A. augusta* leaf in carrageenan induced paw edema. The treatment significantly attenuates carrageenan mediated upregulation in the levels of IL1B, IL6, IL12 and TNF ALPHA in paw tissues. In search of molecular mechanism, taraxerol could significantly reinstate carrageenan provoked NF- κ B signaling and caused significant down regulation in the expressions of COX-2 and iNOS³⁶.

The probable mechanism of anti-inflammatory action of extract of *A. augusta* may be due to its influence on the second phase of inflammation, cyclooxygenase pathway rather than the lipoxygenase pathway. This is noticeable by the

ORIGINAL RESEARCH ARTICLE

maximal inhibition of inflammation at the end of the third hour after the treatment with carrageenan. different parts of methanolic extracts of *A. augusta* showed significant anti-inflammatory activity. This effect may be due to the inhibition of any inflammatory mediators by the alkaloids and flavonoids present in extract³⁷. Petroleum ether extract of roots of *A. augusta* exhibited inhibitory activity against COX-1 to a greater extent than COX- 2, while weak inhibitory action on LOX activity at the same concentrations resulted that anti-inflammatory of plant extracts could be due to inhibition of COX and LOX enzymes³⁸.

Thrombolytic activity: The methanolic extract of leaves if *A. augusta* were studied for thrombolytic activity with standard of streptokinase. Treatment of clots with 100 µl of extracts of leaves if *A. augusta*, clot lysis 50.1%, 42.9%, 41.6% respectively was obtained which shows significant thrombolytic activity of plant³⁹.

Anti-fungal activity: the study results indicated that the seed oil of *A. augusta* possess a moderate activity against human and animal pathogen but no significant activity of the extract was observed against the plant pathogens. The highest inhibition effects were found for *Trichophyton schoenleinii* and *Microsporum canis*⁴⁰. In another study, the antifungal activity test, the dia-ion raisin adsorbed fractions showed the highest antifungal activity with the zone inhibition of 15 mm against *C. albicans*⁴¹.

Anti-microbial activity: The anti-microbial, antifungal and cytotoxic properties of *A. augusta*

leaf extract has been evaluated on *S. aureus*, *E. coli*. Among four fractionates Dia-ions resin absorbed fraction showed the activity with the zone inhibition of 12-13 mm that was comparable with the standard Kanamycin⁴¹.

Antioxidant activity: In vivo anti-oxidant activity of petroleum ether and aqueous extracts of plant root was assessed by measuring SOD, CAT and LPO in the blood of T2DM animal. The result of the study revealed the significant effect on SOD, CAT and LPO level in animals treated with petroleum ether extract followed by aqueous extract of *A. augusta*. The result of the study suggested the anti-oxidant activity of plant extract which prevents from oxidative stress and provide protection to vital tissues like liver, kidney etc⁴². Antioxidant potential of the methanolic extract of *A. augusta* bark was evaluated in vitro by DPPH scavenging essay method. The extract showed prominent scavenging activity with IC50 value of 38.65 µg/ml⁴³. The DPPH assay of ethanolic extract of *A. augusta* leaf showed considerable IC50 value of 790+3.6 µg as compared to quercetin 34.5+2.1 µg, which is a well-known anti-oxidant¹⁹. Methanolic extract of *A. augusta* exhibited potential antioxidant activity the extract scavenged 50% DPPH free radical at the lowest 40 microgram per ml inhibitory concentration. The methanol extract can be admitted to be a powerful inhibitor of hydroxyl radicals from the results obtained in the present investigation³⁹. The fruit of *A. augusta* also possess potential free radical scavenging activity. In DP PH free radical

September 10th 2022 Volume 17, Issue 2 Page 6

ORIGINAL RESEARCH ARTICLE

scavenging activity ethanolic extract is found most active then others with IV50 of 12.6 microgram per ml. The order of antioxidant activity was like this CME>AQF>PEF>CIF. For hydroxyl and nitric oxide free radical scavenging activity ethanolic extract founds better activity in studies⁴⁴.

Anticancer activity: Cytotoxicity and anti-cancer activities were observed on Ehrlich ascites carcinoma (EAC) cells. In addition, the bark showed significant cytotoxic activity with IC50 value of 329.41 µg/ml and the study indicated that the extract was capable of inhibiting EAC cell growth by 75.5% when administered at 100 mg per KG per day body weight intraperitoneal for 5 consecutive days to Swiss albino mice⁴³.

Anti-Alzheimer activity: A number of factors have been identified oxidative stress and cholinergic dysfunction are the major contributor factor of AD. Finding suggested that the fruit of *A. augusta* also possess ACHE and BuCHE inhibitory activity. Study showed that inhibition of ACHE by CME and its subtraction were occurred by those dependent manner and the highest activity was found in ethanolic extract compared to other fractions. Also, lipid peroxidation in AD patients is more dangerous than others while fruit of *A. augusta* found active in lipid peroxidation inhibition. Ethanolic extract found most active among all⁴⁴.

Anti-obesity/ Lipase inhibitory action: Lipase inhibitory activity by methanol extract of whole plant was tested by mixing 100 micro litter of each concentration of methanol extract, 8 ml of

oil emulsion and 1 ml of chicken pancreatic lipase followed by incubation 60 minutes. The reaction was stopped by adding 1.5 ml of a mixture solution containing acetone and 95% ethanol. The liberated fatty acids were measured by titrating the solution against 0.02M NaOH using an indicator i.e. phenolphthalein an indicator. Olive oil used as substrate. It was found that the activity of lipase was affected when incubated with the methanol extract dose dependent inhibition of lipase was found to be 88.6%. This study indicates its protective role of against prevention of obesity by decreasing the gastro intestinal absorption of fat, unlock an access for isolation and characterization of compounds responsible for it⁴⁵.

Wound healing activity: Squalene, an isolate from ethyl acetate extract of *A. augusta* leaves, could be a useful natural product in managing wound healing by its immunomodulation of macrophages, the main innate cells involve in wound healing. Squalene play role in reducing free radical oxidative stress and reduced intracellular levels of ROS, nitrites, pro-inflammatory enzymes (Inos, cox-2 and MPO) and cytokines (TNF- α, IL-1β, IL-6 and IFN-γ). Besides squalene enhanced expression levels of anti-inflammatory enzymes (HO-1) and transcription factors (Nrf2 and PPARγ).³⁵ Ethanolic extract of root of *A. augusta* is used for another study to determine wound healing property. In this study hydroxyproline content and dry weight of granulation tissue were not significantly altered. Therefore it might not have

September 10th 2022 Volume 17, Issue 2 Page 7

ORIGINAL RESEARCH ARTICLE

increase collagen content but probably altered the maturation process by enhancing cross linking of collagen which may have resulted an increase in wound breaking strength⁴⁶.

Prebiotic & Probiotic activity: The mucilaginous polysaccharide from *A. augusta* stem promoted growth of probiotic strains with positive prebiotic course for *Lactobacillus acidophilus* and *Lactobacillus casei*. It could protect probiotic bacteria in simulated gastrointestinal conditions establishing its potential career capabilities for probiotic bacteria with thickening and prebiotic activity⁴⁷.

Emmenagogue activity: Although there are very few clinical studies are available on web portals regarding its role in dysmenorrhea, the ethnomedicinal surveys provide the reliable basis for its use in menstrual disorders^{48, 5-19}.

DISCUSSION: The review from ethnomedicinal surveys of different places and articles regarding experimental and clinical studies on *A. augusta* provide a reliable base for further valuable research. *A. augusta* is found having various active chemical constituents like Abromine, taraxerol, β -sitosterol, stigmasterlol in various parts of plant. *In vivo* and *in vitro* studies have been shown various possible mechanism of action of plant constituents to be effective in various disorders like menstrual disorders, diabetes mellitus, bone fracture, wound healing, arthritis, headache, skin disorders. Anti-inflammatory, anti-oxidative, lipase inhibitory activities are some established actions of this plant make it useful in different metabolic

ailments. Although, there are very few clinical studies are found regarding *A. augusta* on web portals. This makes the plant important for further analysis in future researches to make it well established natural source of medicine.

CONCLUSION

For further researches, this review article provides a reliable source regarding *A. augusta*. As the plant is easily available in the Indian subcontinent, the plant can be easily available, cost effective and reliable source for medicinal purpose to treat different ailments.

ORIGINAL RESEARCH ARTICLE

REFERENCES

1. Karunamoorthi K, Phil M, Jegajeevanram K, Vijayalakshmi J, Mengistie E. Traditional Medicinal Plants: A Source of Phytotherapeutic Modality in Resource-Constrained Health Care Settings. *J Evid Based Complementary Altern Med.* 18(1):67-74. doi:10.1177/2156587212460241
2. Vedavathy S. Scope and importance of traditional medicine. *Indian J Tradit Knowl.* 2003;2(3):236-239.
3. Kirtikar KR, Basu BD. *Indian Medicinal Plants.*, Bishen Singh Mahendra pal singh, 23-A, New Connaught place, Dehradun 248001; 2008.
4. Upadhyay DBM. ULAT KAMBAL (Pishach Karpas)- *Abroma augusta*: A Study on its Pharmacological Actions from an Ayurvedic Perspective. *Int J Res Appl Sci Eng Technol.* 2020;8(9):1140-1144. doi:10.22214/IJRASET.2020.31703
5. PARKASH V. Floristic and ethnic perspective on wild forest plant species of Nongkhyllam Reserve Forest, Nongpoh, Meghalaya, India. *Asian J Ethnobiol.* 2021;4(2). doi:10.13057/asianjethnobiol/y040204
6. Das G, Kumar Sarma A, Das N, Bhagawati P, Sharma RK. Indigenous Medicinal Plants of Tripura used by the Folklore Practitioners for the Treatment of Bone Fractures. *Int J Life Sci Pharma Res.* 2021;(3):17-22. doi:10.22376/ijpbs/lpr.2021.11.3.L17-22
7. Adhikari PP, Talukdar S, Borah A. Ethnomedicobotanical study of indigenous knowledge on medicinal plants used for the treatment of reproductive problems in Nalbari district, Assam, India. *J Ethnopharmacol.* 2018;210:386-407. doi:10.1016/J.JEP.2017.07.024
8. Kr Das Assistant Professor J. ETHNO-MEDICINAL PLANTS USED BY ETHNIC TRIBES OF FRINGE VILLAGES IN GREATER MANAS LANDSCAPE, BAKSA DISTRICT OF ASSAM, INDIA. *Int J Adv Res.* 8(03):459-464. doi:10.21474/IJAR01/10649
9. Gogoi J, Singh V, Bhattacharjya DK. Phytomedicines for female infertility in Barpeta District of Assam, India. *Pleione.* 2019;13(1). doi:10.26679/Pleione.13.1.2019.082-089
10. Basak GK, Chowdhury T, Jana AK, Saha S, Mandal A. An ethnobotanical study of the indigenous knowledge by the Rajbangshi community of Raiganj Block, Uttar Dinajpur district, West Bengal, India. *Acta Ecol Sin.* Published online March 11, 2022. doi:10.1016/J.CHNAES.2022.02.005
11. Chanda S, Mukherjee A. *Phytoremedies Used against Arthritis by Tribals in Ayodhya Hills, Purulia District, West Bengal.*; 2011. Accessed June 9, 2022. <https://go.gale.com/ps/i.do?id=GALE%7CA277874729&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=09762876&p=AONE&sw=w&userGroupName=anon~408051f8>
12. Mandal A, Roy R, Roy K, Choudhury A, Islam J. ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS USED BY THE

ORIGINAL RESEARCH ARTICLE

ETHNIC COMMUNITIES OF ALIPURDUAR DISTRICT OF WEST BENGAL, INDIA. plantarchives.org.

doi:10.51470/PLANTARCHIVES.2021.v21.no1.032

13. Das AK, Tag H. Ethnomedicinal studies of the Khamti tribe of Arunachal Pradesh. *Indian J Tradit Knowl*. 2006;5(3):317-322.

14. Kagyung R, Gajurel PR, Rethy P, Singh B. Ethnomedicinal plants used for gastro-intestinal diseases by Adi tribes of Dehang-Debang Biosphere Reserve in Arunachal Pradesh. *Indian J Tradit Knowl*. 2010;9(3):496-501.

15. Arora A. Ethnobotanical information of medicinal plants in Haridwar District. *Environ Conserv J*. 2009;10(3):67-71.

16. Shah R, Islam M, Shova A, et al. Phytotherapeutic practices of a folk medicinal practitioner in Dinajpur district, Bangladesh. *J Appl Pharm Sci*. 2017;7(05):161-165. doi:10.7324/JAPS.2017.70528

17. Abu AH, Hoque MA, Akter T, Afroz A, Momin MAM. Pharmacological investigation of selected medicinal plants of Bangladesh. *Trop J Pharm Res*. 2014;13(11):1925-1931. doi:10.4314/tjpr.v13i11.22

18. Dapar MLG, Meve U, Liede-Schumann S, Alejandro GJD. Ethnomedicinal plants used for the treatment of cuts and wounds by the Agusan Manobo of Sibagat, Agusan del Sur, Philippines. *Ethnobot Res Appl*. 2020;19(0):1-18. Accessed June 9, 2022. <https://ethnobotanyjournal.org/index.php/era/article/view/1777>

19. Sunitha P, Sathyanarayana N, Suresh VC, Sreeramanan S, Xavier R. Phytochemical and Antioxidant analysis of the leaf extract of Malaysian Medicinal Plant *Abroma augusta* L. *Indian J Pharm Sci*. 2018;80(1):192-198. doi:10.4172/PHARMACEUTICAL-

SCIENCES.1000344

20. Gupta AK, Tondon N, eds. *Review on Indian Medicinal Plants*. Indian Council of Medical Research; 2004.

21. Anonymous. *The Wealth of India, A Dictionary of Indian Raw Materials & Industrial Products*. Third. National Institute of Science Communication and Information Resources, Council of Scientific and Industrial Researches, New Delhi, India; 2009.

22. E SRR, Sharma PK, Raj P. Effect of abroma augusta mother tincture in type 2 diabetes mellitus by assessing blood glucose levels - a clinical study. *Int J Recent Sci Res*. 2018;9(03):24687-24691. doi:10.24327/IJRSR.2018.0903.1707

23. Akter L, Sultana A, Mosaddeque F, Mahjabeen C, Rahmatullah M. Methanol extract of *Abroma augusta* L. leaves lower serum glucose levels in mice: Evaluation through oral glucose tolerance tests. *Adv Nat Appl Sci*. 2013;7(5):484-489. Accessed December 23, 2021.

<https://go.gale.com/ps/i.do?p=AONE&sw=w&issn=19950772&v=2.1&it=r&id=GALE%7CA365687690&sid=googleScholar&linkaccess=fulltext>

24. Islam MT, Rahman MA, Islam MA-U. In vitro Effect of Aqueous Extract of Fresh Leaves
September 10th 2022 Volume 17, Issue 2 **Page 10**

ORIGINAL RESEARCH ARTICLE

- of *Abroma augusta* L on the Diffusion of Glucose. *Bangladesh Pharm J.* 2013;16(1):21-26. doi:10.3329/BPJ.V16I1.14486
25. Islam T, Rahman A, Islam AU. Effects of Aqueous Extract of Fresh Leaves of *Abroma augusta* L. on Oral Absorption of Glucose and Metformin Hydrochloride in Experimental Rats. *ISRN Pharm.* 2012;2012:1-5. doi:10.5402/2012/472586
26. Saha U, Ghosh C, Mallick C. ANTIHYPERGLYCEMIC AND ANTIOXIDATIVE EFFECT OF HYDRO-METHANOLIC EXTRACT OF LEAF OF *ABROMA AUGUSTA* IN STREPTOZOTOCIN INDUCED DIABETIC MALE ALBINO RAT. *Int J Pharm Sci Res.* Published online 2018:3788-3794. doi:10.13040/IJPSR.0975-8232.9(9).3788-94
27. Khanra R, Dewanjee S, K Dua T, et al. *Abroma augusta* L. (Malvaceae) leaf extract attenuates diabetes induced nephropathy and cardiomyopathy via inhibition of oxidative stress and inflammatory response. *J Transl Med.* 2015;13(1):1-14. doi:10.1186/S12967-014-0364-1/FIGURES/7
28. Eshrat H, Hussain MA, Jamil K, Rao M. Preliminary studies on the hypoglycaemic effect of *Abroma augusta* in alloxan diabetic rats. *Indian J Clin Biochem.* 2001;16(1):77-80. Accessed December 21, 2021. https://www.academia.edu/4020082/Preliminary_studies_on_the_hypoglycaemic_effect_of_Abroma_augusta_in_alloxan_diabetic_rats
29. Bisht R, Bhattacharya S, Ya J. Evaluating the use of root extract of *Abroma augusta* as alpha glucosidase inhibitor for Type-II diabetes. *Annals Plant Sci.* 2014;3(4):2-7.
30. Eshrat MH. Effect of *Coccinia indica* (L.) and *Abroma augusta* (L.) on glycemia, lipid profile and on indicators of end-organ damage in streptozotocin induced diabetic rats. *Indian J Clin Biochem* 2003 182. 2003;18(2):54-63. doi:10.1007/BF02867368
31. Ali Hussain HEM. Hypoglycemic, hypolipidemic and antioxidant properties of combination of Curcumin from *Curcuma longa*, Linn, and partially purified product from *Abroma augusta*, Linn. in streptozotocin induced diabetes. *Indian J Clin Biochem* 2002 172. 2002;17(2):33-43. doi:10.1007/BF02867969
32. Halim M E. Lowering of blood sugar by water extract of *Azadirachta indica* and *Abroma augusta* in diabetes rats. *Indian J Exp Biol.* 2003;41(6):636-640. Accessed December 21, 2021. <https://europepmc.org/article/med/15266913>
33. Latief M, Tarigan IL, Muhaimin M, Amanda H, Yulianti ND. Isolation and Characterization of Ethyl Acetate Fraction from *Abroma augusta* L as an Anti-Inflammatory Agent. *Makara J Sci.* 2021;25(2):6. doi:10.7454/mss.v25i2.1173
34. Latief M, Amanda H, Utami A, Muhaimin, Nurhayati. Isolation of active compounds from the leaf extract of patah kemudi (*Abroma augusta* L.) and its anti-inflammatory activity. *J Phys Conf Ser.* 2019;1282(1):012064. doi:10.1088/1742-6596/1282/1/012064

ORIGINAL RESEARCH ARTICLE

35. Latief M, Muhaimin M, Amanda H, Prahandika G, Lasmana Tarigan I, Kimia J. Anti-inflammatory activities of squalene compound of methanol extract of *Abroma augusta* L. *J Teknol Lab.* 2020;9(2):176-185. doi:10.29238/TEKNOLABJOURNAL.V9I2.228
36. Khanra R, Dewanjee S, Dua TK, Bhattacharjee N. Taraxerol, a pentacyclic triterpene from *Abroma augusta* leaf, attenuates acute inflammation via inhibition of NF- κ B signaling. *Biomed Pharmacother.* 2017;88:918-923. doi:10.1016/J.BIOPHA.2017.01.132
37. Das S, Datta R, Nandy S. Phytochemical screening and evaluation of anti-inflammatory activity of methanolic extract of *Abroma augusta* Linn. *Asian Pacific J Trop Dis.* 2012;2(SUPPL.1):S114-S117. doi:10.1016/S2222-1808(12)60135-2
38. Bisht R, Bhattacharya S, Jaliwala YA, Jaliwala A. COX and LOX inhibitory potential of *Abroma augusta* and *Desmodium gangeticum*. *J Phytopharm.* 2014;3(3):168-175. Accessed December 22, 2021. www.phytopharmajournal.com
39. Bhuiya MAM, Talukedar B, Ajrin M, Akter S, Sen R. In Vitro Thrombolytic and Anti-Oxidant Activity Study of *Abroma Augusta* (Ulatkambal). *Exp Int J Sci Technol.* 2013;14(2):888-893. Accessed December 23, 2021. <http://www.experimentjournal.com/article/vitro-thrombolytic-and-anti-oxidant-activity-study-abroma-augusta-ulatkambal>
40. Khan T, . WA, . SB, et al. Biological and Pharmacological Properties of *Abroma augusta* Linn. Seed Oil. *Pakistan J Biol Sci.* 2003;6(13):1142-1144. doi:10.3923/PJBS.2003.1142.1144
41. Mannan A, Islam Z, Hossen J. Evaluation of Antimicrobial , Antifungal and Cytotoxic Properties of *Abroma augusta* Linn . *Asian J Chem Sci.* 2017;3(2):1-7. doi:10.9734/AJOCS/2017/35638
42. Bisht R. IN-VIVO ANTIOXIDANT EFFECT OF *ABROMA AUGUSTA* IN DIABETES INDUCED OXIDATIVE STRESS. *J Drug Deliv Ther.* 2017;7(7):226-228. doi:10.22270/JDDT.V7I7.1646
43. Miah M, Shimu AS, Mahmud S, et al. Methanolic Bark Extract of *Abroma augusta* (L.) Induces Apoptosis in EAC Cells through Altered Expression of Apoptosis Regulatory Genes. *Evidence-based Complement Altern Med.* 2020;2020. doi:10.1155/2020/9145626
44. Begum MM, Biswas K, Sarker A, et al. Anticholinesterase and Antioxidant Potentials of a Medicinal Plant *Abroma* Deficits in Alzheimer ' s disease Clinical Pharmacology Anticholinesterase and Antioxidant Potentials of a Medicinal Plant *Abroma augusta* : Implications for the Alternative Treatmen. *Clin Pharmacol Biopharm.* 2015;(December). doi:10.4172/2167-065X.1000148
45. Gupta N, Ganeshpurkar A, Jatav N, Bansal D, Dubey N. In vitro prevention of chick pancreatic lipase activity by *Abroma augusta* extract. *Asian Pac J Trop Biomed.* 2012;2(2):S712-S715. doi:10.1016/S2221-September 10th 2022 Volume 17, Issue 2 **Page 12**

ORIGINAL RESEARCH ARTICLE

1691(12)60301-3

46. Shenoy S, Bairy L k. Wound healing activity of *Abroma augusta* in Wistar rats. *Indian J Pharmacol*. Published online 2008. Accessed June 8, 2022.

https://www.researchgate.net/publication/298006847_Wound_healing_activity_of_Abroma_augusta_in_Wistar_rats

47. Roy A, Patra M, Sarkhel S, et al. Fucose-containing *Abroma augusta* mucilage hydrogel as a potential probiotic carrier with prebiotic function. *Food Chem*. 2022;387:132941. doi:10.1016/J.FOODCHEM.2022.132941

48. Minaxi A, Bal Krishan K, Brinda S. COMPARATIVE STUDY OF ALOE VERA AND ABROMA AUGUSTA WITH SPECIAL REFERENCE TO DYSMENORRHOEA. *Int J Phyther Res*. 2014;4. Accessed December 22, 2021. www.earthjournals.org