ISSN: 2287-688X

Annals of
Plant Sciences

Volume 14, Issue 08 (2025) pp. 6913-6921

Review Article

Medicinal and Aromatic Plant Genetic Resources of Bangladesh with Anti-Chikungunya Properties

A. K. M. Golam Sarwar

Laboratory of Plant Systematics, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

Abstract

The resurgence of the chikungunya virus has become a global health issue. Presently, there is no approved treatment or vaccine for many viral diseases, including chikungunya. Furthermore, due to viral resistance, antiviral drugs are often costly, ineffective, and may cause adverse effects, indicating that natural pharmacotherapy could be a viable alternative. This research aims to investigate the valuable genetic resources of medicinal and aromatic plants (MAPs) in Bangladesh to identify those with anti-chikungunya properties. Bangladesh has 62 MAPs suitable for treating chikungunya, covering 39 families and 59 genera. Many of these plants are also effective against dengue, with some showing efficacy against both dengue and COVID-19. Further research into the specific identification of active compounds and mechanisms of phytochemicals in combating viruses will support the development of targeted medication delivery systems and more effective treatments for chikungunya.

Keywords: *Flavonoids, alkaloids, tannins, terpenes, glycosides, polyphenols, chikungunya.*

Introduction

The chikungunya virus (CHIKV), an arbovirus (arthropod-borne virus) member of the *Alphavirus* genus in the *Togaviridae* family, is the cause of the mosquito-borne illness chikungunya <https://www.who.int/news-room/fact-sheets/detail/chikungunya>. It is a positive-sense, icosahedral capsid-enveloped, 12 kb long single-stranded RNA virus (Martins *et al*., 2020). In the southern Tanzanian Kimakonde language, chikungunya means "that which bends up" and describes the twisted posture of individuals infected with the disease, who suffer from excruciating joint pain. After being discovered for the first time in Tanzania in 1952, the CHIKV subsequently expanded throughout Asia and Africa. The disease was first described in Tanzania, and urban epidemics were first noted in Thailand in 1967 and India in the 1970s (Amin *et al*., 2017). Three distinct genotypic and antigenic lineages of CHIKV have been identified, two from Africa and one from Asia (CDC 2017). This virus causes deadly outbreaks worldwide, and millions of chikungunya cases have been documented in over 60 countries (Wahid *et al*., 2017). This year, around 220,000 CHIKV disease cases and 80 deaths have already been reported in 14 countries/territories, including the Americas, Africa, and Asia (ECDPC 2025). Outbreaks are ongoing in Réunion and Mayotte, the outermost regions of the European Union. The first incidence of chikungunya was reported in Bangladesh in 2008 (Paba, Rajshahi), with 32 cases, and in 2009, it occurred in Shathiya Upazilla of Pabna <https://cch.icddrb.org/chikungunya>. The worst CHIKV outbreak occurred in Bangladesh in 2017, when 13,176 cases were reported in 17 of 64 districts. Since then, CHIKV has essentially vanished; however, there was a fresh outbreak in Dhaka and the surrounding areas in late 2024 (Nasif *et al.,* 2025). Chikungunya fever presents a clinical diagnosis dilemma due to similarities with dengue fever, leading to confusion in the diagnosis and management of its causes (Shahid, 2019). Symptoms include sudden fever, severe joint pain, headache, muscle aches, joint swelling, and a rash.

***Corresponding Author:**
A. K. M. Golam Sarwar;
DOI: 10.5281/zenodo.17011873

The joint pain can be intense and may last for months or even years.

The CHIKV is mainly transmitted by *Aedes* mosquitoes, *A. aegypti* and *A. albopictus*, which are also known vectors for dengue and Zika. These mosquitoes acquire the virus by biting an infected person and transmit it during subsequent bites. Other species such as *A. dalzieli*, *A. vigilax*, *A. camptorhynchites*, *A. vittatus*, *A. fulgens*, and *Mansonia* spp. have been involved in some cases (Burt *et al*., 2012). *Aedes* mosquitoes breed in natural habitats like tree holes and plantations, as well as in clean water collections found in tanks, containers, and abandoned objects in urban and peri-urban areas. Like dengue, the spread of this disease is influenced by temperature and precipitation (Amin *et al*., 2017). In recent years, cases have increased during the monsoon and post-monsoon seasons due to fluctuations in vector populations and life spans, which are influenced by temperature and humidity. Increased vector density after the monsoon season boosts virus transmission. *Aedes aegypti* is the primary vector for the transmission of chikungunya in Bangladesh, with *A. albopictus* also found in some regions (Amin *et al*., 2017).

The emerging (disease-causing) CHIKV poses significant global health risks due to its socioeconomic impact and high morbidity rates, yet its treatment remains challenging. Current treatment for CHIKV focuses on symptom relief and is difficult because of the lack of a specialized vaccine or therapy (Millsapps *et al*., 2022). RNA viruses like CHIKV present major threats due to their transmissibility and the difficulty of control measures, making vaccine development challenging or nearly impossible because of their highly mutable nature (Paul *et al*., 2023). Therefore, preventing CHIKV transmission may be one of the best strategies and depends heavily on integrated control methods, including epidemiological surveillance and environmental management to eliminate mosquito breeding sites. Controlling mosquito populations is also difficult due to insecticide resistance, environmental concerns over chemical use, and their ability to adapt to diverse habitats. Traditional medicine has long utilised medicinal plants, herbal products, and compounds for disease treatment and prevention (Mukhtar *et al.,* 2008). These plants are now being researched as potential natural antiviral agents for managing chronic CHIKV symptoms (Alagarasu *et al*., 2022; Arora *et al*., 2020; Chan *et al*., 2016, 2021; Firuj *et al*., 2023; Joshi *et al*., 2021). Bangladesh is abundant in medicinal and aromatic plants (MAPs), with over 1000 species used for primary healthcare (Sarwar, 2020). Firuj *et al*. (2023) enlisted only two MAPs, *Cynodon dactylon* L. and *Vitex negundo* L., in their publication with anti-CHIKV activity. Recently, we reported that several Bangladeshi MAPs could be effective against various viral diseases, such as COVID-19 (Sarwar *et al*., 2022) and dengue viruses (Sarwar *et al*., 2025). This research aims to identify and compile Bangladeshi MAPs, including parts used and active ingredients that may be effective in treating chikungunya.

Materials and Methods

This review was based on preceding academic publications in English. A variety of internet resources, including PubMed, SpringerLink, MDPI link, ResearchGate, Scopus, Google Scholar, and others, were searched for reviews and research relevant to the goal of this work. Bangladeshi publications were searched in the BanglaJol database, which solely contains Bangladeshi journals. A variety of keywords, such as "chikungunya," "antiviral," "medicinal plants," "Bangladesh," and others, were used. We used Plants of the World Online (https://powo.science.kew.org/), the International Plant Names Index (https://www.ipni.org/), and World Flora Online (https://www.worldfloraonline.org/) to research current nomenclature and family delimitations.

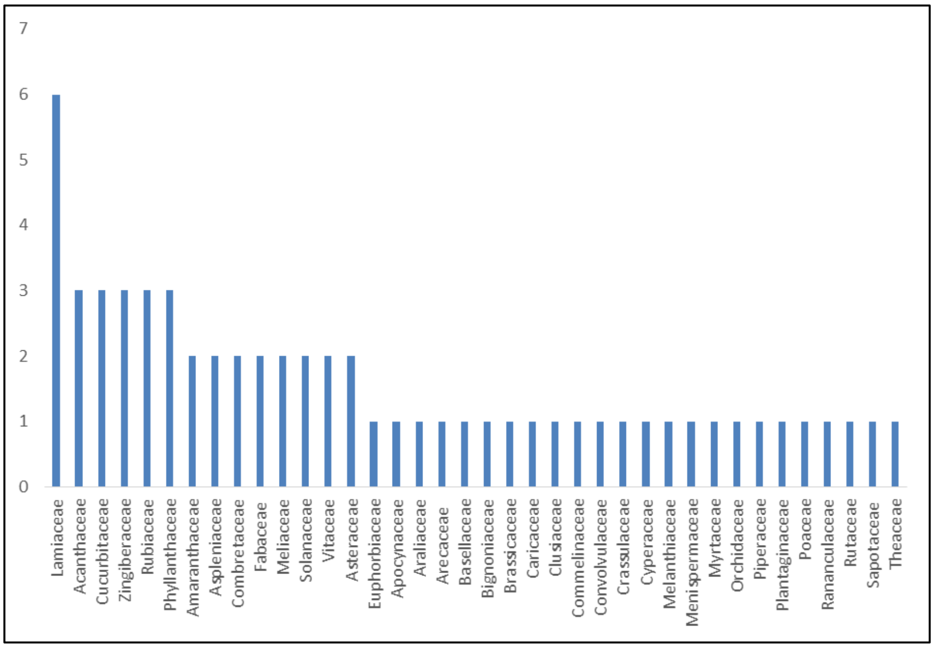

Figure 1: Family-wise distribution of medicinal and aromatic plants in Bar diagram.

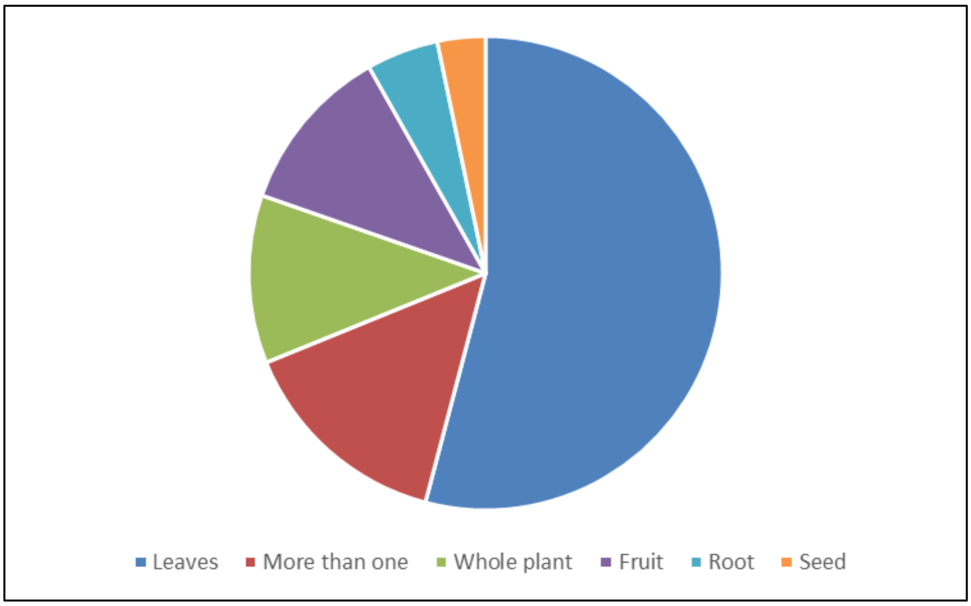

Figure 2: Use of plant parts of medicinal and aromatic plants in Pie graph.

Results and Discussion

A total of 62 MAPs from Bangladesh could be utilised for treating chikungunya disease. These plants belong to 39 families and 59 genera (Table 1). Lamiaceae became the leading source of anti-chikungunya herbs (6 species), followed by Acanthaceae, Cucurbitaceae, Phyllanthaceae, Rubiaceae and Zingiberaceae, each with 3 species, while 25 families were represented by a single species each (Figure 1). The family Lamiaceae has become a repository of plants containing compounds that effectively combat viral infections by targeting different stages of the viral life cycle (Duque-Soto *et al*., 2022; Mishra *et al*., 2025; Sarwar *et al*., 2025). Substances such as β-sitosterol, rosmarinic acid, and oleanolic acid target early attachment phases during viral infections (Mishra *et al*., 2025). Other compounds, including hesperetin, luteolin, caffeic acid, and others, disrupt viral replication, transcription, multiplication, and assembly processes. The Lamiaceae family also has considerable potential as a source of bioactive compounds, especially as preservatives in the food industry (Duque-Soto *et al*., 2022). Furthermore, 18 species, namely *Andrographis paniculata*, *Alternanthera sessilis*, *Plumeria alba*, *Carica papaya*, *Cucurbita maxima*, *Glycyrrhiza glabra*, *Ocimum tenuiflorum*, *Rotheca serrata*, *Vitex negundo*, *Azadirachta indica*, *Tinospora cordifolia*, *Psidium guajava*, *Phyllanthus amarus*, *Piper retrofractum*, *Tarenna asiatica, Bacopa monnieri*, *Curcuma longa*, and *Zingiber officinale*, have been identified as effective against both CHIKV and dengue virus (Alagarasu *et al*., 2022; Sarwar *et al*., 2025). Some of them, such as *Andrographis paniculata*, *Glycyrrhiza glabra*, *Ocimum tenuiflorum*, *Tinospora cordifolia*, and others, could be used against CHIKV, dengue, and COVID-19 viruses (Table 1; Sarwar, 2022; Paul *et al*., 2023; Sarwar *et al*., 2025).

Plant parts, such as leaves, roots, bark, fruit, seeds, and flowers, have medicinal properties due to their active compounds, with some parts being hazardous while others have beneficial effects. In general, leaves are the most commonly used part, followed by roots, fruits, and bark (Uddin, 2006). Among the plant parts used, the leaf possessed the top position (31 species), followed by more than one part used (8 species) (Figure 2).

MAP extracts contain active ingredients such as alkaloids, terpenes, flavonoids, glycosides, polysaccharides, tannins, saponins, proteins, and peptides (Table 1; Raghavendhar *et al*., 2019; Ben-Shabat *et al*., 2020). These substances, known for their non-harmful properties, can inhibit viral attachment, replication, and protease activities, showing a dose-dependent response in the virus replication inhibition assay (Raghavendhar *et al*., 2019). The method for preventing viral infections is unique and specific to each compound (Figure 3; Ben-Shabat *et al*., 2020; Jennings and Parks, 2020; Martins *et al*., 2020). For instance, Curcumin, a phytochemical found in plants, has been shown to inhibit dengue virus entry and replication by affecting actin filament organization and cell lipogenesis; human immunodeficiency virus replication through anti-oxidation and anti-inflammation; and CHIKV attachment by altering the conformation of viral and cellular surface proteins (Jennings and Parks, 2020).

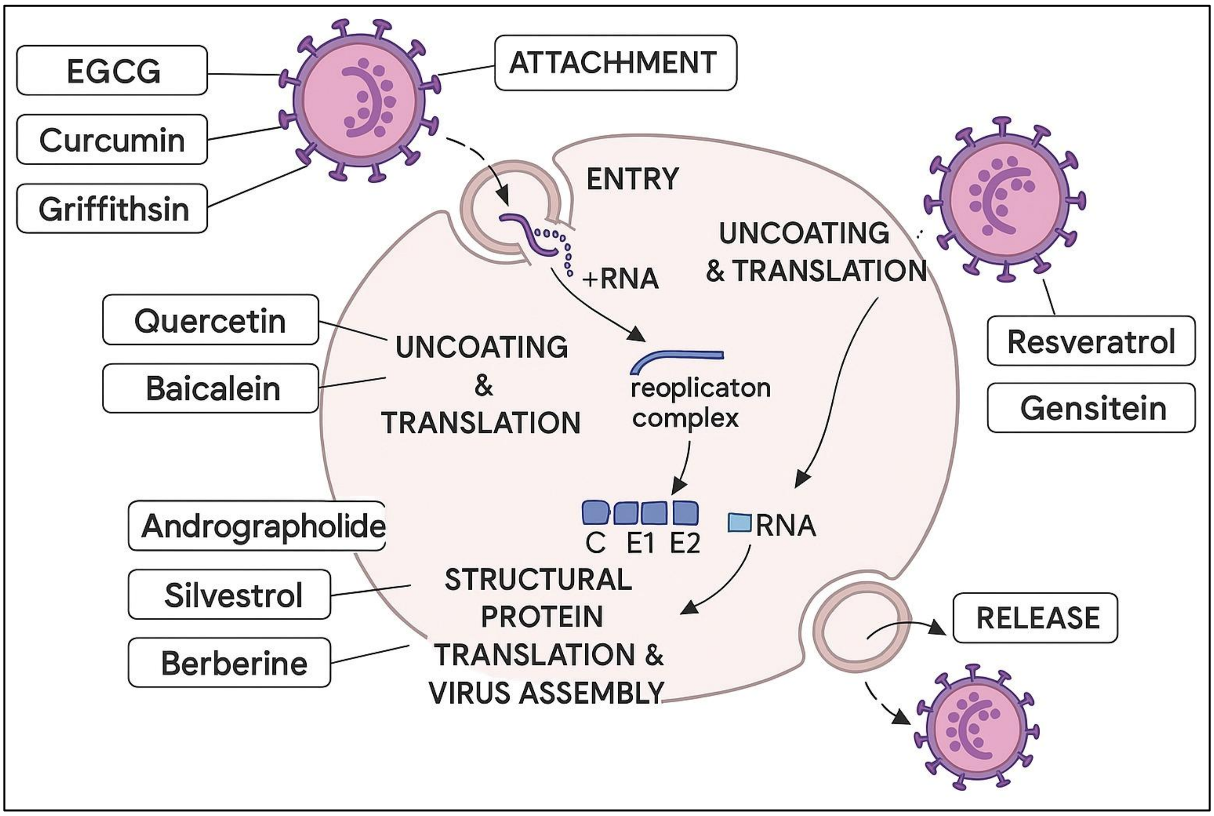

Figure 3: Mode of action of natural compounds with antiviral activity against CHIKV (AI simplified from Martins *et al.,* 2020)

Table 1: List of medicinal and aromatic plants used against chikungunya.

Sl. No.	Bangla/Common Name	Scientific name	Family	Part used	Active constituents	Reference
1.	Kalmegh	*Andrographis paniculata* (Burm.f.) Wall. *ex* Nees*	Acanthaceae	Whole plant	Diterpneoid, Andrographolides	Arora *et al.*, 2020
2.	Chinese Violet	*Asystasia gangetica* (L.) T.Anderson	Acanthaceae	Leaves	Polyphenols, Flavonoids, Tannins	Chan *et al.*, 2016
3.	Jagatmadan	*Justicia gendarussa* Burm.f.	Acanthaceae	leaves	Auranamide, Lupeol, Certain lignans	Rafe *et al.*, 2020
4.	Shalinche/Carpet Weed	*Alternanthera sessilis* (L.) DC.*	Amaranthaceae	Leaves	Flavonoids, Alkaloids, Terpenoids, Tannins	Chan *et al.*, 2016
5.	Beet root	*Beta vulgaris* L.	Amaranthaceae	Root	Betalains, Phenolic compounds	Chan *et al.*, 2021
6.	Kathgolap	*Plumeria alba* L.	Apocynaceae	Bark, Leaves	Methyl gallate (MG-S)	Alagarasu *et al.*, 2022
7.	Lawn marsh pennywort	*Hydrocotyle sibthorpoides* Lam.	Araliaceae	Whole plant	Ethyl palmitate	Chan *et al.*, 2021
8.	Salak	*Salacca zalacca* (Gaertn.) Voss	Arecaceae	Fruit	Chlorogenic acid, Flavonoids	Chan *et al.*, 2021
9.	Bird's Nest Fern	*Asplenium nidus* L.	Aspleniaceae	Leaves	Flavonoids apigenin and luteolin	Chan *et al.*, 2016
10.	Dheki shak	*Diplazium esculentum* (Retz.) Sw.**	Aspleniaceae	Leaves, stems	Flavonoids, Polyphenols, Steroids	Chan *et al.*, 2021
11.	Okinawa spinach	*Gynura bicolor* (Roxb. *ex* Willd.) DC.	Asteraceae	Leaves	Quercetin	Chan *et al.*, 2021
12.	Marigold	*Calendula officinalis* L.*	Asteraceae	Leaves	Saponins, Flavonoids, Triterpenoids	Kumar *et al.*, 2024
13.	Pui shak/Malabar spinach	*Basella alba* L.	Basellaceae	Leaves	-	Chan *et al.*, 2021
14.	Kanaidinga	*Oroxylum indicum* (L.) Kurz*	Bignoniaceae	Leaves	Flavonoids	Kumar *et al.*, 2021
15.	Garden cress	*Lepidium sativum* L.	Brassicaceae	Leaves	Alkaloids, Saponins, Anthracene, Glycosides	Arora *et al.*, 2020
16.	Papaya	*Carica papaya* L.	Caricaceae	Leaves, Fruit	Citrophen, Quercetin	Mishra *et al.*, 2020
17.	Mangosteen	*Garcinia mangostana* L.	Clusiaceae	Fruit (peel)	α-Mangostin	Alagarasu *et al.*, 2022
18.	Bahera	*Terminalia bellirica* (Gaertn.) Roxb.	Combretaceae	Fruit	Tannins, Flavonol glycosides, Terpenoids, Saponin, Sterols	Arora *et al.*, 2020
19.	Haritaki	*Terminalia chebula* Retz.	Combretaceae	Fruit	Magnoflorine, Berberine	Kumar *et al.*, 2021
20.	Oyster plant/Boat lily	*Tradescantia spathacea* Sw.	Commelinaceae	Leaves	Alkaloids, Flavonoids, Glycosides, Saponins, Tannins	Kumar *et al.*, 2021
21.	Kalmi shak/Water spinach	*Ipomoea aquatica* Forssk.*	Convolvulaceae	Leaves	Flavonoids Nicotiflorin and Ramnazin-3-O-rutinoside	Kumar *et al.*, 2021
22.	Patharkuchi/	*Kalanchoe pinnata* (Lam.) Pers.	Crassulaceae	Leaves	Flavonoids	Joshi *et al.*, 2020
23.	Sweet gourd	*Cucurbita maxima* Duchesne	Cucurbitaceae	Seed	Gallic acid, Ellagic acid, Naringin	Alagarasu *et al.*, 2022
24.	Telakucha/Jiaogulan	*Gynostemma pentaphyllum* (Thunb.) Makino	Cucurbitaceae	Leaves	-	Chan *et al.*, 2016
25.	Chayote	*Sechium edule* (Jacq.) Sw.	Cucurbitaceae	Leaf and stem	Apigenin, Luteolin	Chan *et al.*, 2021
26.	Mutha/Nut sedge	*Cyperus rotundus* L.	Cyperaceae	Whole plant	FF72 (a type of triterpenoid saponin)	Arora *et al.*, 2020

27.	Rang Chiat	*Euphorbia tithymaloides* L.	Euphorbiaceae	Leaves	Diterpenes, Jatrophane, Lathyrane	Joshi *et al.,* 2020
28.	Jering	*Archidendron jiringa* (Jack) I.C.Nielsen	Fabaceae	Seed	Jujubogenin triglycoside, Methyl gallate	Chan *et al.,* 2021
29.	Licorice	*Glycyrrhiza glabra* L.	Fabaceae	Root	Glycyrrhizin	Arora *et al.,* 2020
30.	Bilati Tulsi	*Mesosphaerum suaveolens* (L.) Kuntze*	Lamiaceae	Leaves	β-caryophyllene, 1,8-cineole, Diterpenoids	Sangeetha & Rajarajan, 2015
31.	Hoary basil	*Ocimum americanum* L.	Lamiaceae	Leaves	Rosmarinic acid, Oleanolic acid	Chan *et al.,* 2021
32.	Tulsi/Holy Basil	*Ocimum tenuiflorum* L.	Lamiaceae	Leaves	Methyl eugenol, other terpenoids	Arora *et al.,* 2020
33.	Blue Fountain Bush	*Rotheca serrata* (L.) Steane & Mabb.	Lamiaceae	Whole plant	Flavonoids, Terpenoids	Paul *et al.,* 2023
34.	Teak	*Tectona grandis* L.f.	Lamiaceae	Leaves	benzene-1-carboxylic acid-2-hexadeconate	Kumar *et al.,* 2021
35.	Nishinda	*Vitex negundo* L.*	Lamiaceae	Leaves	Flavonoids, Essential oils	Firuj *et al.,* 2023
36.	Satuwa	*Paris polyphylla* Sm.	Melanthiaceae	Leaves	Polyphyllin D, Dioscin	Joshi *et al.,* 2020
37.	Neem	*Azadirachta indica* A.Juss.*	Meliaceae	Leaves	Azadirachtin, Nimbolide, Nimbin	Biswas *et al.,* 2002
38.	Chinaberry	*Melia azedarach* L.	Meliaceae	Leaves	Limonoids	Kumar et al. 2021
39.	Gulancha/Heart-leaved moonseed	*Tinospora cordifolia* (Willd.) Hook.f. & Thomson	Menispermaceae	Leaves, Stem, Root	Magnoflorine, Berberine	Mishra *et al.,* 2020
40.	Guava	*Psidium guajava* L.*	Myrtaceae	Leaves	Quercetin, Longifolene	Kumar *et al.,* 2021
41.	Bamboo orchid	*Arundina graminifolia* (D.Don) Hochr.	Orchidaceae	Leaves	Stilbenoids, Phenanthrenes	Chan *et al.,* 2021
42.	Bhumi amla	*Phyllanthus amarus* Schumach. & Thonn.	Phyllanthaceae	Leaves, Fruit	Phyllanthin	Prusty *et al.,* 2020
43.	Pata Bahaar	*Phyllanthus androgynus* (L.) Chakrab. & N.P.Balakr.	Phyllanthaceae	Leaves	-	Chan *et al.,* 2016
44.	Amla	*Phyllanthus emblica* L.	Phyllanthaceae	Leaves, Fruit	Alkaloids, Tannins, Polyphenols	Arora *et al.,* 2020
45.	Chuijhal/Long pepper	*Piper retrofractum* Vahl	Piperaceae	Fruit	-	Kumar *et al.,* 2024
46.	Luchipata/Pepper Elder	*Peperomia pellucida* (L.) Kunth	Piperaceae	Leaves	Flavonoids, Tannins, Terpenoids	Chan *et al.,* 2016
47.	Brahmi	*Bacopa monnieri* (L.) Wettst.	Plantaginaceae	Whole plant	Methyl gallate	Alagarasu *et al.,* 2022
48.	Durba	*Cynodon dactylon* (L.) Pers.*	Poaceae	Whole plant	Flavonoids luteolin and apigenin	Firuj *et al.,* 2023
49.	Black cumin	*Nigella sativa* L.	Rananculaceae	Leaves, Fruit	Kaempferol, (-)-Epicatechin, (+)-Catechin, Apigenin	Arora *et al.* 2020
50.	Thankuni/Asiatic Tarenna	*Tarenna asiatica* (L.) Kuntze *ex* K.Schum.	Rubiaceae	Leaves bud	Corymbosin	Ramabharathi *et al.,* 2014
51.	Mainphal/False Guava	*Catunaregam spinosa* (Thunb.) Tirveng.	Rubiaceae	Leaves	Catunarosides, Randianin	Chan *et al.,* 2016
52.	Common or Indian Madder	*Rubia cordifolia* L.	Rubiaceae	Whole plant	Anthraquinones, Terpenes	Arora *et al.,* 2020
53.	Mandarin Orange	*Citrus reticulata* Blanco	Rutaceae	Fruit	Nobiletin, Resveratrol	Kumar *et al.,* 2021

54.	Safeda	*Manilkara zapota* (L.) P.Royen	Sapotaceae	Fruit	Flavonoids, Tannins, Terpenoids	Chan *et al.,* 2021
55.	Bon Tepari	*Physalis angulata* L.	Solanaceae	Leaves	Withanolides, Saponins	Chan *et al.,* 2016
56.	Ashwagandha	*Withania somnifera* (L.) Dunal	Solanaceae	Leaves	Withafarin A	Arora *et al.,* 2020
57.	Tea (green tea)	*Camellia sinensis* (L.) O.Kunze*	Theaceae	Leaves	Epigallocatechin gallate	Weber *et al.,* 2015
58.	Hairy Wild Grape	*Ampelocissus tomentosa* (Roth) Planch.	Vitaceae	Root	-	Joshi *et al.,* 2020
59.	Harajora/Veldt Grape	*Cissus quadrangularis* L.	Vitaceae	Leaves	Flavonoids, Triterpenoids	Chan *et al.,* 2016
60.	Thai ginger	*Alpinia galanga* (L.) Willd.***	Zingiberaceae	Rhizomes	Diarylheptanoids, 1'-acetoxychavicol acetate	Sangeetha & Rajarajan, 2015
61.	Holud/Curcuma	*Curcuma longa* L.*	Zingiberaceae	Rhizomes. Leaves	Curcumin	Ichsyani *et al.,* 2017
62.	Ada/Ginger	*Zingiber officinale* L.**	Zingiberaceae	Rhizomes. Leaves	[6]-Gingerol, Shogaol	Hayati *et al.,* 2021

Plants with insecticidal properties against *Aedes* spp.; ** insecticidal properties against *Culex quinquefasciatus*; *** insecticidal properties against *Aedes*, *Anopheles* and *Culex* spp.

Some of these plants possess insecticidal properties against the vector *Aedes* spp. (Table 1; Hossen *et al.,* 2025). More notably, *Zingiber officinale* is effective against both *Aedes* spp. and *Culex quinquefasciatus* mosquitoes (Hossen *et al.,* 2025), while *Alpinia galanga* is active against all three disease-transmitting mosquito genera: *Aedes*, *Anopheles*, and *Culex* (Poonsri *et al.,* 2019). In addition to their larvicidal, pupicidal, ovicidal, and adulticidal activities, MAP extracts can also repel, poison, feed, delay, and protect against bites (Sarwar *et al.,* 2025). Bioinsecticides derived from plants are cost-effective, biodegradable, safe for non-target organisms, and eco-friendly. Their multiple modes of action and synergistic properties make them suitable for use in integrated mosquito management programmes, which can help prevent resistance development (Demirak and Canpolat, 2022).

Conclusion

MAPs show promising therapeutic potential in herbal medicines against CHIKV infection, as medicinal herbs contain anti-infective compounds, particularly antiviral agents. Screening programmes for these agents have potential for pharmaceutical development. A few of these MAPs demonstrated effectiveness against the dengue and COVID-19 viruses. Further research into phytochemicals' mechanisms could lead to targeted medication delivery systems and more effective treatments for chikungunya disease.

References

1. Alagarasu, K., Patil, P., Kaushik, M., Chowdhury, D., Joshi, R. K., Hegde, H. V., Kakade, M. B., Hoti, S. L., Cherian, S., & Parashar, D. "In vitro antiviral activity of potential medicinal plant extracts against dengue and chikungunya viruses." *Frontiers in Cellular and Infection Microbiology* 12 (2022): 866452. doi:10.3389/fcimb.2022.866452.
2. Amin, M. R., Rahman, M. M., & Islam, Q. T. "Chikungunya." *Journal of Medicine* 18 (2017): 92–108.
3. Arora, K., Tomar, P. C., Kumari, P., & Kumari, A. "Medicinal alternative for chikungunya cure: a herbal approach." *Journal of Microbiology, Biotechnology and Food Sciences* 9.5 (2020): 970–978. doi:10.15414/jmbfs.2020.9.5.970-978.
4. Ben-Shabat, S., Yarmolinsky, L., Porat, D., & Dahan, A. "Antiviral effect of phytochemicals from medicinal plants: Applications and drug delivery strategies." *Drug Delivery and Translational Research* 10 (2020): 354–367. doi:10.1007/s13346-019-00691-6.
5. Biswas, K., Chattopadhyay, I., Banerjee, R. K., & Bandyopadhyay, U. "Biological activities and medicinal properties of neem (*Azadirachta indica*)." *Current Science* 82 (2002).
6. Burt, F. J., Rolph, M. S., Rulli, N. E., Mahalingam, S., & Heise, M. T. "Chikungunya: a re-emerging virus." *The Lancet* 379.9816 (2012): 662–671. doi:10.1016/S0140-6736(11)60281-X.
7. CDC (Communicable Disease Control). *National Guideline on Clinical Management of*

Chikungunya Fever. Dhaka: Disease Control Unit, Directorate General of Health Services, Bangladesh, 2017.
8. Chan, S. M., Khoo, K. S., Sekaran, S. D., & Sit, N. W. "Mode-dependent antiviral activity of medicinal plant extracts against the mosquito-borne chikungunya virus." *Plants* 10 (2021): 1658. doi:10.3390/plants10081658.
9. Chan, Y. S., Khoo, K. S., & Sit, N. W. "Investigation of twenty selected medicinal plants from Malaysia for anti-chikungunya virus activity." *International Microbiology* 19.3 (2016): 175–182. doi:10.2436/20.1501.01.275.
10. Demirak, M. Ş. Ş., & Canpolat, E. "Plant-based bioinsecticides for mosquito control: Impact on insecticide resistance and disease transmission." *Insects* 13 (2022): 162. Doi:10.3390/insects13020162.
11. Duque-Soto, C., Borrás-Linares, I., Quirantes-Piné, R., Falcó, I., Sánchez, G., Segura-Carretero, A., & Lozano-Sánchez, J. "Potential antioxidant and antiviral activities of hydroethanolic extracts of selected Lamiaceae species." *Foods* 11 (2022): 1862. doi:10.3390/foods11131862.
12. ECDPC (European Centre for Disease Prevention and Control). *Chikungunya virus disease worldwide overview.* (2025). Available at: https://www.ecdc.europa.eu/en/chikungunya-monthly. Accessed 12 July 2025.
13. Firuj, A., Aktar, F., Akter, T., Chowdhury, J. A., Chowdhury, A. A., Kabir, S., Büyüker, S. M., & Amran, M. S. "Anti-viral activity of 62 medicinal plants, herbs and spices available in Bangladesh: A mini review." *Dhaka University Journal of Pharmaceutical Sciences* 22.2 (2023): 213–232. doi:10.3329/dujps.v22i2.67408.
14. Hayati, R. F., Better, C. D., Denis, D., Komarudin, A. G., Bowolaksono, A., Yohan, B., & Sasmono, R. T. "[6]-Gingerol inhibits Chikungunya virus infection by suppressing viral replication." *BioMed Research International* (2021): 1–7. doi:10.1155/2021/6623400.
15. Hossen, M. S., Islam, S., Ismail, M., Evan, K. A., Rahman, M. K. R., Hossain, M. A., Faruque, M. O. "Larvicidal activities of 215 medicinal plant extracts against *Aedes aegypti* from Bangladesh." *Bangladesh Journal of Botany* 54.1 (2025): 54–60. doi:10.3329/bjb.v54i1.80737.
16. Jennings, M. R., & Parks, R. J. "Curcumin as an antiviral agent." *Viruses* 12.11 (2020): 1242. doi:10.3390/v12111242.
17. Joshi, B., Panda, S. K., Jouneghani, R. S., Liu, M., Parajuli, N., Leyssen, P., Neyts, J., & Luyten, W. "Antibacterial, antifungal, antiviral, and anthelmintic activities of medicinal plants of Nepal selected based on ethnobotanical evidence." *Evidence-Based Complementary and Alternative Medicine* (2020): 1043471. doi:10.1155/2020/1043471.
18. Kumar, S., Garg, C., Kaushik, S., Buttar, H. S., & Garg, M. "Demystifying therapeutic potential of medicinal plants against chikungunya virus." *Indian Journal of Pharmacology* 53 (2021): 403–411. doi:10.4103/ijp.IJP_81_19.
19. Kumar, S., Kaushik, S., & Garg, C. "Cell culture and molecular docking analysis to determine the antiviral activity of folklore medicinal plants against chikungunya virus." *Current Drug Delivery* (2024). doi:10.2174/0115672018307676240827103052.
20. Martins, D. O. S., Santos, I. de A., de Oliveira, D. M., Grosche, V. R., & Jardim, A. C. G. "Antivirals against chikungunya virus: Is the solution in nature?" *Viruses* 12 (2020): 272. doi:10.3390/v12030272.
21. Millsapps, E. M., Underwood, E. C., & Barr, K. L. "Development and application of treatment for chikungunya fever." *Research Reports in Tropical Medicine* 13 (2022): 55–66. doi:10.2147/RRTM.S370046.
22. Mishra, P., Sohrab, S., Tripathi, V., & Mishra, S. K. "Invigorating the antiviral arsenal: Family Lamiaceae as a promising treasure-trove of antiviral compounds." *Journal of Herbal Medicine* 49 (2025): 100980. doi:10.1016/j.hermed.2024.100980.
23. Mounce, B. C., Cesaro, T., Carrau, L., Vallet, T., & Vignuzzi, M. "Curcumin inhibits Zika and chikungunya virus infection by inhibiting cell binding." *Antiviral Research* 142 (2017): 148–157. doi:10.1016/j.antiviral.2017.03.014.
24. Mukhtar, M., Arshad, M., Ahmad, M., Pomerantz, R. J., Wigdahl, B., & Parveen, Z. "Antiviral potentials of medicinal plants." *Virus Research* 131 (2008): 111–120. doi:10.1016/j.virusres.2007.09.008.
25. Nasif, M. A. O., Haider, N., Muntasir, I., Qayum, M. O., Hasan, M. N., Hassan, M. R., Khan, M. H., Sultana, S., Ferdous, J., Prince, K. T. P., Rudra, M., Rahman, M., Alam, A. N., & Shirin, T. "The reappearance of chikungunya virus in Bangladesh, 2024." *IJID Regions* 16 (2025): 100664. doi:10.1016/j.ijregi.2025.100664.

26. Paul, A., Chakraborty, N., Sarkar, A., Acharya, K., Ranjan, A., Chauhan, A., Srivastava, S., Singh, A., Rai, A. K., Mubeen, I., and Prasad, R. "Ethnopharmacological potential of phytochemicals and phytogenic products against human RNA viral diseases as preventive therapeutics." *BioMed Research International* 2023 (2023): 1977602. doi: 10.1155/2023/1977602
27. Poonsri, W., Pengsook, A., Pluempanupat, W., Yooboon, T., and Bullangpoti, V. "Evaluation of *Alpinia galanga* (Zingiberaceae) extracts and isolated trans-cinnamic acid on some mosquitoes larvae." *Chemical and Biological Technologies in Agriculture* 6 (2019): 17. doi: 10.1186/s40538-019-0157-0
28. Prusty, D., Swain, S. N., Panda, B. P., Nayak, A. K., and Padhy, R. N. "In silico and in vitro analysis of *Phyllanthus amarus* phytochemicals as potential inhibitors against chikungunya virus nsP2 protease." *Computers in Biology and Medicine* 121 (2020): 103816. doi: 10.1016/j.compbiomed.2020.103816
29. Rafe, M. R., Salam, R., Ahmed, S. N., Ahmed, Z., and Chowdhury, S. M. "A pharmacological review of four widely used traditional medicinal plants for wound healing in Bangladesh." *Current Traditional Medicine* 6 (2020): 65-74. doi: 10.2174/2215083805666190820120523
30. Raghavendhar, S., Tripati, P. K., Ray, P., and Patel, A. K. "Evaluation of medicinal herbs for anti-CHIKV activity." *Virology* 533 (2019): 45-49. doi:10.1016/j.virol.2019.04.007
31. Ramabharathi, V., Saigopal, D. V. R., and Rajitha, G. "Antiviral activity of leaf-bud gum-resin of *Tarenna asiatica*." *Bangladesh Journal of Pharmacology* 9.3 (2014): 398-405. doi: 10.3329/bjp.v9i3.19707
32. Sarwar, A. K. M. Golam, Ashrafuzzaman, M., and Pramanik, M. H. R. "COVID-19 pandemic: minor fruits and medicinal plants." *Abstracts of the 6th International Symposium on Minor Fruits and Medicinal and Aromatic Plants*, Cooch Behar, India, November 24-26 (2022).
33. Sarwar, A. K. M. Golam, Hasan, M., Farhan-Ul-Islam, Hossain, T. I., and Ashrafuzzaman, M. "Medicinal plant genetic resources of Bangladesh exhibiting anti-dengue activity: A review." *International Journal of Minor Fruits, Medicinal and Aromatic Plants* 11 (2025): 29-40. doi: 10.53552/ijmfmap.11.1.2025.29-40
34. Sarwar, A. K. M. Golam. "Medicinal and aromatic plant genetic resources of Bangladesh and their conservation at the Botanical Garden, Bangladesh Agricultural University." *International Journal of Minor Fruits, Medicinal and Aromatic Plants* 6 (2020): 13-19.
35. Shahid, S. B. "Chikungunya fever and its impact: Bangladesh perspective." *Bangladesh Journal of Infectious Diseases* 6.2 (2019): 28.
36. Uddin, S. N. *Traditional Uses of Ethnomedicinal Plants of the Chittagong Hill Tracts.* Edited by M. M. Rahman. Bangladesh National Herbarium, Mirpur, Dhaka, 2006.
37. Wahid, B., Ali, A., Rafique, S., and Idrees, M. "Global expansion of chikungunya virus: mapping the 64-year history." *International Journal of Infectious Diseases* 58 (2017): 69-76. doi: 10.1016/j.ijid.2017.03.006
38. Weber, C., Sliva, K., von Rhein, C., Kümmerer, B. M., and Schnierle, B. S. "The green tea catechin, epigallocatechin gallate inhibits chikungunya virus infection." *Antiviral Research* 113 (2015): 1-3. doi: 10.1016/j.antiviral.2014.11.001

Source of support: Nil;
Conflict of interest: The authors declare no conflict of interests.

Cite this article as:

Sarwar, A. K. M. Golam. "Floral Biology and Interspecific Crossability of *Litsea Salicifolia*, a Host Plant of the Muga Silkworm." *Annals of Plant Sciences.* 14.08 (2025): pp. 6913-6921.