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A Review on Herbs Used in Dengue Fever

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ABSTRACT:
Dengue fever causes mortality around the world, especially in the tropics and subtopic regions, which has been of major concern to governments and the world health organization (WHO). As a consequence, the search for new anti-dengue agents from medicinal plants has assumed more urgency than in the past. Medicinal plants have been used widely to treat a variety of vector ailments such asmalaria. the demand for plant-based medicines is growing as they are generally considered to be safer, non-toxic, and less harmful than synthetic drugs. this article reviews potential anti-dengue activities from plants distributed around the worldsixty-nine studies from 1997 to 2012 describe 31 different species from 24 families that are known for their anti-dengue activities. about ten phytochemicals have been isolated from 11 species, among which are compounds with the potential for the development of dengue treatment. crude extracts and essential oils obtained from 31 species showed a broad activity against flavivirus. current studies show that natural products represent a rich potential source of new ant-dengue compounds. further ethnobotanical surveys and laboratory investigations are needed to establish the potential of identified species in contributing to dengue control

keywords: Dengue fever Anti-dengue medicinal plants phytochemical

I. INTRODUCTION

Etiology of dengue fever: Dengue fever is caused by the arthropod-borne flavivirus named dengue virus (DENV)transmitted by the Aedes Aegypti mosquito.[1] to date,four antigenically related but distinct virus serotypes (DENV-1,2,3 and 4) have been identified as belonging to the genus flavivirus in the Flaviviridae family.[2-4] infection with one DENV serotype produces only specific antibodies against that serotype.[6] when antibodies from the first although DENV2 is known to be more lethal than other serotypes, some studies have revealed that primary infection with DENV-1 or DENV-3 always results ina more dangerous disease than infection with DENV-2 or DENV-4.[3-7] In reacts years, the current dengue epidemic has become a focus of international public health awareness. Unlike malaria, which is more prevalent in remote areas, cases of dengue are distributed mostly in urban and suburban areas.[8-9] this has made the epidemic more lethal as an outbreak is difficult to control due to highly populated areas in cities.

Types of DENV infection include mild fever known as dengue fever (DF), which constitutes about 95% of cases, and a more serious type known as dengue hemorrhagic fever and/or dengue shock syndrome (DHS/DSS, 5% of cases). recovery from the first type of infection provides lifelong immunity; however, it affords only half protection from a subsequent viral infection that ultimatelyresults in the risk of DHF. Most dengue infections are characterized by non-specific symptoms including frontal headache, retro-orbital pain, body aches, nausea and vomiting, joint pains, weakness, and rash.[12-13]

Epidemiology of dengue fever:international travel, increasing human population and urbanization create suitable conditions for the mosquito vector Ae. Hegyi, and thus spread the virus to new areas, America, the eastern Mediterranean, Southeast Asia, and the western pacific, with southeast Asia and the western pacific being the regions most affected. the first case of DHF was discovered in the 1950s in Thailand and the Philippineswhere the first two DENV serotypes were identified, followed by the third and fourth serotypes in 1945. since then, DHF has recorded major cases resulting in hospitalization and dealing among children in regions stretching from Asia to Africa and the pacific. Approximately 2.5 billion people, or half the world`s population, are now at risk of dengue and 50 million infections globally occur annually. over 100 million cases of DF and its consequences, the staggering numbers of those affected are increased by the fact that at present here is no specific antiviral treatment or vaccine for DF. early diagnosis and strict hospitalization often save the life of patients with DHF. Efforts to

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combat the vector have been undertaken by regulatory bodies in an attempt to tackle this problem through awareness campaigns and vector control. others strategies include the use of plants with a bioactive substance that have toxic propertiestothe vectoror insecticidal properties. Clearly, the development of antiviral drugs and vaccines is needed in order to support these programs. [14-23]

Global distribution of dengue fever :guangdong province in china has become a major area with reported cases of dengue. from 2000 to 2005, a total of 2,496 cases of dengue was recorded. the epidemic peaked in 2002. in northern Thailand,there were wer13,915, 1,092,6,992and 6,914 DF cases reported during the period 2002-2006. outbreaks of DF and DHF have been reported in India over past decades Dengue Malaysiamalasiya

In Malaysia, with a population of 27.7 million and a population density of 84 per km2 [27], outbreaks of dengue cases are endemic, with increasing cases are endemic, with increasing cases of dengue over the past two decades. the first case was documented in 1902. during the period 1973-1982 12,077 dengue cases were reported, with a fatality rate of 3.38%, the number of cases rose in following decade of 1983-1992 with 13,558 and 15,862 incidence rate, respectively per 100,000 population with an increase of 16.99% of cases a total of 107 deaths. in a pre statement, the director general of healthMalaysiaa, reported a total of 545 cases and 4 death in 5weeks in 20012 as the highestincreases of dengue cases and deaths, with an increases of 57 cases (12%) compared to 488 cases with 2 deaths the previous week. in the period 2009 -2011, the number of dengue cases decreased to 21,602 cases with peak appearing in 2010.

Since early human civilization, plants have been a source of traditional medicine , and demands for herbal and natural product have recently increased . about 70-95% people worldwide now rely on traditional herbs as the primary treatment for various disease. it is estimated that about 25% of modern drugs, including antiviral agent, originate from natural products with over 60% of anti-cancer compounds and 75% of infectious disease drugs derived from natural ingredients, which are more acceptable , less toxic and less expensive that synthetic drugs . several studies have reported potential antiviral agents from plants in the form of crude extracts, essentials oils or purified compounds. recent studies have reported the potential of some flavonoid compounds as antiviral against DENV-2.[24-26]

Pathophysiology of dengue fever: Dengue infection is caused by bites of the female Ae. Aegypti mosquito carrying flavivirus. After a person is bitten, the virus incubation period varies between 3 and 14 days, after which the person may experience early symptoms such as fever, headache,rash,nausea, and joint and musculoskeletal pain. This classic DF records temperatures between 39 and 40 C and usually lasts 5-7 days. During this period, the virus may get into the peripheral bloodstreams and, if left untreated, can damage blood vessels and lymph nodes resulting in DHF with symptoms such as bleeding from the nose, gums, or under the skin. DHF patients also have difficulty breathing and severe development can lead to DSS. DSS can result in death if proper treatment is not provided.

Aedes mosquitoes are small and black with white marking on the body and legs. Female mosquitoes need blood from biting humans or animals to produce live eggs. it takes 2-3 days for egg developmentthe principal vector of dengue (Ae. Aegypti) has adapted well to the urban environment and always breeds in stagnant containers. Eggs need moist condition and mature in 24-72h. Mosquito bites are the only route of DENV spread. The transmission of DENV is often from human to human through domestic mosquitoes. An outbreak starts after a mosquito sucks the blood of a patient with DF/DHF. After being transmitted to a new human host by infected mosquitoes, the virus replicates in the lymph nodes and spreads through the lymph and blood to other tissues. To identify a potential antiviral treatment for DENV, it is necessary to understand the life cycle of the virus. the dengue virion is a small particle with a lipoprotein envelope and an icosahedral nucleocapsid containing a positive single–stranded RNA genome. Virus infection of the cell begins with binding to the host cell surface. it enters the cell by receptor-mediated endocytosis, with the cell membrane forming a sac-like structure known as an endosomein the endosome, the virus penetrates deep into the cell until the endosome membrane acquires a negative charge, which allows it to fuse with the endosomal ton open a port for release of genetic materials. At this point, the virus journey travel plays an important role in its maturation.[23-30]

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Possible mechanisms and pathways in the treatment of dengue.

There are currently no specific treatments for dengue fever Only standard treatment for the management of fever is given, i.e....., nursing care, fluid balance, electrolytes, and blood clotting parameter. Patients with dengue fever will be treated, for example, sponging, acetaminophen, bed rest, and oral rehydration therapy, and if signs of dehydration or bleeding occur the patient is usually hospitalized. Aspirin should be avoided because it may cause bleeding. Platelet count and hematocrit should be measured daily from the suspected day of illness until 1-2 days after defervescence. Current prevention of dengue by potential dengue vaccine and vector control is highly cost-effective. In addition, mosquito control programs are the most important preventive method (6). However, these are difficult to implement and maintain (39). Development of a vaccine for dengue is difficult since there are four closely relatedbut antigenically distinct, serotypes of the virus that can cause disease. Infection by one serotype does not ensure the protection of the patient from infection by the other three serotypes Therefore if a vaccine were produced for only one or two serotypes, the other serotypes would increase the risk of more serious illness. Ribavirin has shown significant in vivo activity against RNA viruses; however, it exhibited only very weak activity against flaviviruses. A possible strategy in the treatment of dengue is to use chimeric tetravalent vaccines that show high neutralizing antibodies against all dengue serotypes. Studies on the development of tetravalent vaccines are ongoing in Thailand and these should be available shortly (6). In addition, recombinant vaccines against capsid, pre membrane and envelope genes of DENV-1,-2, and -3 inserted into a copy of a DNA infection clone of DENV-2 are being developed and are currently undergoing clinical trials.[31-48]

Plants traditionally used to treat dengue

According to a works health organization(WHO) fact sheet dated December 2008,80% of the population in some Asian and African countries depended on traditional medicine as their primary health care due to economic and geographical constraints. Natural products have become the main source of test materials in the development of antiviral drugs based on traditional medical practicesTraditional medicines are based on knowledge and are used to maintain health, and prevent, treat and diagnose physical or mental illness. Traditional medicinal plants have been reported to have antiviral activity and some have been used to treat viral infections in animals and humans.

To date, 31 different species have been found to have the potential to treat dengue; some of these have not yet been investigated scientifically (as indicated in table 1). In the Philippines known locally as “tawa-tawa”. Is used in folk medicine to cure dengue fever by people in rural areas. Practitioners of traditional medicines believe that decoction of tawa-tawa leaves can rreverseviral infection and prevents the fever from moving into critical stages although tare here no scientific studies proving its effectiveness. Sometimes,tawa-tawa is prepared together with papaya leaves since papaya leaf ext has a function as an antibiotic to cure fever. While papaya leaf extract kills the bacterial infection that caused the fever, tawa-tawa is prepared together with papaya leaf extract kills the bacterial infection that caused the fever, and tawa-tawa extract prevents bleeding. In addition, unpublished research has found that psidium guava leaves are a good way to increase platelets, thus helping to avoid bleeding. A water decoction of guava leaves contains quercetin, which acts to inhibit the formation of the enzyme mRNA in the virus.[49-52]

Drugs used as Anti Dengue

Helped Bumi

Synonym:Alternanthera philoxeroides
Family: Amaranthaceae.

A Philoxeroides is also called Alligator Weedand is an immersed aquatic plant. It originated from South America but is currently invading Australia. The effect of A. philoxeroides extracts against the dengue virus was investigated in vitro. An MTT assay was carried out to determine the cytotoxicity of A. philoxeroides on C6/36 cell lines. Coumarin extract of A. philoxeroides showed the lowest toxicity on cells, whereas a petroleum ether extract of A. philoxeroides had the strongest inhibitory effect th on the dengue virus.

Neem

Synonym: Azidarchta India
Family: Meliaceae.

It is a fast-growing tree with a final height in the range of 15-20m. It is native to India and Pakistan and grows throughout tropical and semi-tropical regions.

The in vitro and in vivo inhibitory

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potential of aqueous extract of Azadirachta indica leaves on the replication of DENV-2 was evaluated. Cytotoxicity studies few carried out to determine the MNTD in a virus inhibition assay. The aqueous extract of neem leaves completely inhibited 100-10,000 tissue culture infective dose 50 of the virus as indicated by the absence of cytopathic effect at its maximum non-toxic concentration of 1.897 mg ml -1. An in vivo study on the inhibitory effects ofthe virus of NL aqueous extract in day-old suckling mice was carried out by intracerebral inoculation' It was shown that the aqueous extract inhibited the virus at nontoxic doses in the range of 120-30mg ml -1 as indicated by the absence of 511-bp dengue group specific amplicons upon RT-PCR.

Finger root
Synonym : Boesnbergia rotunda
family : Zingiberaceae.

It is a medicinal and culinary herb known as Chinese ginger. It is found throughout China and Southeast Asia. The activity of some compounds extracted from B.rotunda for the inhibition of dengue virus protease has been tested on DENV-2. The cyclohexenyl chalcone derivation of B.rotunda, 4-hydroxypanduratin A, and pandurate A showed good competitive inhibitory activities towards DENV-2 NS3 protease with Ki values of 21 IM and 25 IM, respectively. The small value of Ki shows the potential of 4-hydroxypanduratin A to inhibit DENV-2 NS3 protease in vitro.

Papaya
Synonym: Carica papaya
family: Caricaceae.

It is an erect, fast-growing, and unbranched tree or shrub indigenous to Central America and cultivated in Mexico and most tropical countries for its edible fruits.

C. papaya leaf has been used traditionally in the treatment of DF. The leaf has been investigated for its potential against DF. The aqueous extract of leaves of this plant exhibited potential activity against DF by increasing the platelet (PLT) count of white blood cells (WBC) and neutrophils (NEUT)in blood samples of a 45-year-old patient bitten by carrier mosquitoes. After 5 days of oral administration of 25ml aqueous extracts of C.papaya leaves to the patient twice daily, the PLT count increased from 55 9 103/IL to 168 9 103/IL, WBC from 3.7 9 103 / IL to 7.7103/IL and NEUT from 46.0 to 78.3%. Increased platelets could lead to reduced bleeding, thus avoiding progression to the severe illness of DHF.

Chettaphangknee
Synonym : Cladogynos orientalis
Family : Euphorbiaceae.

It is a white-stellate-hairy shrub about 2m high found in Southeast Asia, Malaysia, and Thailand. The in vitro activity of Cladogynos Orientalis-a Thai medicinal plant- against dengue virus was evaluated. The dichloromethane ethanol extract of C.orientalis was tested for anti-dengue activities against DENV-2 in Vero cells by the MTT method. The result showed that the ethanol extract of C. Orientalis at a concentration of 12.5 Ig mL exhibited inhibitory activity on DENV-2 with 34.85%. In addition, C. Orientalis at a concentration of 100 Ig mL-1 exhibited an inactivated viral particle activity of 2.9%.

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Brown Seaweed
Synonym: Cladosiphon okamuranus
family: Chordariaceae.

It is a brown seaweed found naturally in Okinawa, Japan. A sulfated polysaccharide, fucoidan from Cladosiphon okamuranus was found to potentially inhibit DENV-2 infection. The virus infection was tested in BHK-21 cells in a focus-forming assay. Fucoidan in which glucuronic acid was converted to glucose attenuated the inhibitory activity of DENV-2 infection.

Lemon grass
Synonym: Cymbopogon citratus
family: Poaceae.

It is a grass species known as lemon grass and is a tropical plant from Southeast Asia. The antiviral activity of Cymbopogoncitratus was determined based on cytopathic effects shown by the degree of inhibitionf DENV-1-infected Vero E6 cells. The methanolic extractof C. citratus showed a slight inhibition effect on DENV-1 this result was further confirmed with an inhibition assay by the MTT method. however,C.citrates showed no significant inhibition.

Tawa Tawa
Synonym: Euphorbia hirta
family Euphorbiaceae.

it is a common weed in garden beds,garden paths, andwastelandsand is found throughoutJava, Sunda, Sumatra, and Vietnam. the water decoction of leavesfrom EUPHORBIA Hirta, locally known as gatas-gatas, is used in the Philippines as folk medicine to treat Df. internal hemorrhaging will stop and dengue fever will be cured after 24 h. However, the mechanism of action is still unknown and the antiviral properties and its abilities and its ability to increase blood plates is currently being investigated. The tea obtained from boiled leaves of E. hirta is used to cure DF.

Whip vine
Synonym: Flagellaria indica
family: Flagellariaceae.

It is a robust perennial climber that grows in many of the tropical and subtropical regions of the old world, India, Southeast Asia, Polynesia, and Australia. Flagellaria Indica was investigated for its anti-dengue properties in Vero cells. The antiviral assay results show that 45.52 % inhibition of DENV-2 was observed in vitro in the presence of 12.5 mg ml-1 of ethanol extract of the plant. By conducting MTT assays, the cytotoxicity of F. Indica was determined. The CC50 of ethanol extract of F. indiceswas 312 mg mL-1. Thus, this study indicates that F. India has a significant potential effect on DENV.

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Red Seaweed
Synonym: Gymnogongrus griffithsiae
family: Phyllophoraceae.

It is a red seaweed found in Ireland, Europe, Atlantic Islands, North America, South America, Caribbean Islands, Southwest, and Southeast Asia, and Australia and New Zealand. The inhibitory properties against DENV-2 of the sulfated polysaccharide from Gymnogongrus griffithsiae and kappa carrageenanwere evaluated in Vero cells. The compound effectively inhibits DENV-2 multiplication at the IC50 value of 0.9 mg mL-1, which is the same as the IC50 value for the commercial polysaccharides DS8000. However, the compound has a lower antiviral effect against DENV-3 and DENV-4 and was inactive against DENV-1.

Red Seaweed
Synonym : Gymnogongrus torulosus

family: Phyllophoraceae. It is a red seaweed found in Australia and New Zealand. Gymnogongrus torulosus was investigated for its in vitro antiviral properties against DENV-2 in Vero cells. Galactan extracted from this plant was active against DENV-2, with IC50 values in the range of 0.19-1.7 mg mL-1.

Sea Buckthorn
Synonym: Hippophae rhamnoides
Family: Elaeagnaceae.

It is a deciduous shrub occurring throughout Europe including Britain, from Norway south and east to Spain, and in Asia to Japan and the Himalayas. The anti-dengue activity of extracts of Hippophae rhamnoides leaves was investigated against dengue virus type-2 in infected blood-derived human macrophages. The findings showed that cells treated with H. rhamnoides leaf extracts were able to maintain cell viability of dengue-infected cells on par with Ribavirin, a commercial anti-viral drug along with a decrease in TNF-a and IFN-c, respectively. Moreover, H. rhamnoides leaf extract proved its anti-dengue activity as indicated by a decrease in plaque numbers after the treatment of infected cells.

Chameleon plant
Synonym : Houttuynia cordata
family: Saururaceae.

It is an herbaceous perennial flowering plant growing between 20 and 80 cm and is native to Japan, Korea, Southern China, and Southeast Asia. Ethanol extract from Houttuynia cordata revealed anti-dengue activity with 35.99% inhibition against DENV-2 in Vero cells at a concentration of 1.56 mg mL-1. Aqueous extract of H. cordata showed effective inhibitory action against DENV-2 through direct inactivation of viral particles before infection of the cells. A

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concentration of 100 mg mL-1 also effectively protects the cells from viral entry and inhibits virus activities after adsorption. HPLC analysis of H. cordata extract indicated that hyperoside was the predominant bioactive compound, and was likely to play a role in this inhibition.

White lead tree
Synonym : Leucaena leucocephala

Leucaena leucocephala belongs to the family Fabaceae. It is species of Mimosoid tree indigenous throughout Southern Mexico and Northern Central America and the West Indies from the Bahamas and Cuba to Trinidad and Tobago. Galactomannans extracted from seeds of Leucaena leucocephala have demonstrated activity against the yellow fever virus and DENV-1 in vitro and in vivo. Galactomannans are polysaccharides consisting of a mannose backbone with galactose side groups, more specifically their structure consists of the main chain of linked protection against dead in 96.5 % of YFV-infected mice. In vitro experiments with DENV-1 in C6/36, cell culture assays showed that the concentration producing a 100-fold decrease in virus titer of DENV-1 was 37mg L-1.

Pronto Alivio
Synonym: Lippia alba and Lippia citriodora
family: Verbenaceae.

They are flowering plants native to Southern Texas, Mexico, the Caribbean, and Central and South America. Essential oils from Lippia alba and Lippia citriodora showed a considerable inhibitory effect on dengue virus serotype replication in Vero celEssentialcial oil of L. alba was observed to produce a 100% reduction of YFV yield at 100 mg mL-1.

Lemon verbena
Synonym : Meristiella gelidium
family : Solieriaceae.

It is a marine species found in Atlantic Islands, North America, Caribbean Islands, and South America. The antiviral activity of kappa-carrageenan in Meristiella delirium was evaluated against DENV-2. The IC50 of carrageenans isolated from M. delirium was in the range of 0.14-1.6 LG mL-1. The results show that the extract and the fraction derived from M. delirium were more effective inhibitors of DENV-2 when compared with reference polysaccharides.

Bracatinga
Synonym: Mimosa cabrilla
Family: Fabaceae.

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It is a fast-growing, 15-20 m high, and up to 50 cm diameter tree native to the cool, subtropical plateaus of Southeastern Brazil. Galactomannans extracted from seeds of Mimosa cabrilla have demonstrated activity against YFV and DENV-1 in vitro and in vivo.

Bitter melon
Synonym : Momordica charantia
family : Cucurbitaceae.

It is also known as bitter melon or peria, a tropical and subtropical vine found throughout Asia, Africa, and the Caribbean. The MNTD of the methanolic extract of Momordica charantia against Vero E6 cells was investigated in vitro.

Karela or Bitter Gourd

Tulsi
Synonym : Ocimum sanctum
Family: Labiatae.

It is an aromatic herb and shrub native to the tropical regions of Asia and the Americas. Tea, which is traditionally prepared by using Ocimum sanctum boiled leaves, acts as a preventive medicament against DF.

Long pipper
Synonym : Piper retrofractum
family: Piperaceae.

It is a flowering vine native to Southeast Asia and cultivated in Indonesia and Thailand mostly for its fruit. In vitro anti-dengue activity of Piper retrofractum in Vero cells was investigated. The inhibitory activity against DENV-2 infected cells was determined on dichloromethane ethanol extract by the MTT method.

Guava
Synonym: psidium guajava
family: Myrtaceae.

It is an evergreen shrub or small tree indigenous to Mexico, the Caribbean, and Central and South America. It is cultivated widely in tropical and subtropical regions around the world. Psidium guajava leaf extract has been tested in vitro and shown to inhibit the growth of the dengue virus.

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Gall oak
Synonym : Quercus lusitanica
family : fagaceae.

It is a species of oak native to Morocco, Portugal, and Spain. Quercus lusitanica extract was found to have a good inhibitory effect on the replication of DENV-2 in C6/36 cells. The methanol extract of the seeds completely inhibited the TCID50 of the virus at its maximum non-toxic concentration of 0.25 mg mL-1 as indicated by the absence of cytopathic effects. A low dose of Q. Lusitania showed 100% inhibition with 10 TCID50 of the virus.

Tephrosia crassifolia, Tephrosia madness, and Tephrosia viridiflora

Tephrosia crassifolia, Tephrosia madness, and Tephrosia viridiflora belong to the family Fabaceae. Genus Tephrosia is an herb, undershrub, or shrub, distributed mainly in tropical and subtropical regions of the world. Methyl-hildgardtol A isolated from T. crassifolia exhibited a moderate to low inhibitory effect, while hildgardtol A isolated from T. crassifolia exhibited a moderate to low inhibitory effect, while hildgargtol A from T. crassfolia and elongating from T. viridiflora did not affect viral growth.

Cats Claw
Synonym: Uncaria tomentosa
Family: Rubiaceae.

It is a woody vine growing in the tropical jungles of Central and South America. Uncaria tomentosa is a large woody vine native to the Amazon and Central American rainforests. The antiviral activity of U. tomentosa was revealed by viral antigen detection in monocytes by flow cytometry in C6/36 cells.

Marine eelgrass
Synonym : Zostera marina
Family: Zosteraceae.

It is an aquatic plant known as eelgrass and is native to North America and Eurasia. A compound from the temperate marine eelgrass Zostera marina has been identified as possessing anti-dengue virus activity in a focus-forming unit assay in LLCMK2 cells.

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Table 1 Plants with reported anti-dengue activity, according to family

Family	Species	Local/common name	Part(s) used	Compound isolated
Acanthaceae	*Andrographis paniculata*	Hempedu Bumi (Malaysia)	Leaves	
Amaranthaceae	*Alternanthera philoxeroides*	Alligator weed	Whole plants	
Caricaceae	*Carica papaya*	Papaya	Leaves	
Chordariaceae	*Cladosiphon okamuranus*	Brown seaweed	Whole plants	Fucoidan (3)
Cucurbitacea	*Momordica charantbia*	Bitter Melon, Peria (Malaysia)	Fruit	
Elaeagnaceae	*Hippophae rhamnoides*	Sea Buckthorn	Leaves	
Euphorbiaceae	*Cladogynos orientalis*	Chettaphangkhee (Thailand)	Whole plants	
	Euphorbia hirta[a]	Gatas-gatas	Leaves	
Fabaceae	*Leucaena leucocephala*	White Leadtree, Petai Belalang (Malaysia)	Seeds	Galactomanan (7)
	Mimosa scabrella	–	Seeds	Galactomanan (7)
	Tephrosia madrensis	–	Leaves and flowers	Glabranine (8), 7-*O*-methylglabranine (9)
	Tephrosia crassifolia	–	Leaves and flowers	
	Tephrosia viridiflora	–	Leaves and flowers	
Fagaceae	*Quercus lusitanica*	Gall Oak	Seeds	
Flagellariaceae	*Flagellaria indica*	Whip Vine	Whole plants	
Halymeniaceae	*Cryptonemia crenulata*	Red seaweed	Whole plants	Galactan (4)
Labiatae	*Ocimum sanctum*	Holy Basil, Tulsi (India)	Leaves	
Meliaceae	*Azidarachta indica*	Neem	Leaves	
Myrtaceae	*Psidium guajava*[a]	Guava, Jambu Batu (Malaysia)	Leaves	
Piperaceae	*Piper retrofractum*	Dipli (Thailand), Long Pepper	Whole plants	
Phyllophoraceae	*Gymnogongrus torulosus*	Red seaweed	Whole plants	Galactan (4)
	Gymnogongrus griffithsiae	Red seaweed	Whole plants	Kappa carrageenan (5)
Poaceae	*Cymbopogon citratus*	Lemon Grass	Whole plants	
Rhizophoraceae	*Rhizophora apiculata*	Bakau (Malaysia)	Whole plants	
Rubiaceae	*Uncaria tomentosa*	Cat's Claw	Stem barks	
Saururaceae	*Houttuynia cordata*	Pak Kan Thong (Thailand), Chameleon Plant	Whole plants, aerial stem and leaves	Hyperoside (6)
Solieriaceae	*Meristiella gelidium*	–	Whole plants	Kappa carrageenan (5)
Verbenaceae	*Lippia alba*	Pronto Alivio (Colombia), Bushy Matgrass	Whole plants	
	Lippia citriodora	Verbena Olorosa (Colombia), Lemon Verbena	Whole plants	
Zingiberaceae	*Boesenbergia rotunda*	Finger Root, Chinese Ginger	Rhizoms	4-hydroxypanduratin A (1), panduratin A (2)
Zosteraceae	*Zostera marina*	Marine eelgrass	Whole plants	Zosteric acid (10)

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II. CONCLUSION

This review has covered only 31 potential plants that could be used in the treatment of dengue and about ten isolated active phytochemicals. The available research highlights the information available for various parts and extracts types of medicinal plants for the treatment of dengue. However, some of the plants that have not yet been fully explored may have a broad range of potential therapeutic applications. Developing new anti-dengue products from bioactive compounds is necessary to find more effective and less toxic anti-dengue drugs. Therefore, any extensive study on the potential of plants with isolated active compounds that have shown anti-dengue activity should go through additional in vitro and in vivo animal testing followed by toxicity and clinical tests. This route may reveal a promising compound to be optimized and thus be suitable for application in the production of new anti-dengue compounds. If pursued from drugs derived from medicinal plants around the continents, this work may prove valuable to the health of individuals and nations.

Moreover, such discovery may lead to the development of highly efficient and safe anti-dengue treatments. However, to identify potential anti-dengue plants or compounds, knowledge of the mechanisms of virus infection needs to be understood to facilitate the search for and development of the most appropriate drugs. Further research is needed to determine how to target the most appropriate stages to prevent the spread of virus infection. Focusing on each phase in the life cycle funds could prevent infection of host cells, the viral maturation process, the synthesis of viral RNA, or the spread of viral particles.

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