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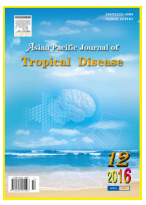

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Rise of mosquito bites in India: A comprehensive study on dengue

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ABSTRACT

Globally, dengue has become one of the major public health concerns. However, the threat of dengue virus (DENV) has been overlooked due to lack of continuous surveillance. The four DENV serotypes are the reason for this serious illness and for its treatment till date no commercial drug is available. The increase in demand of plant based medicine and lack of anti-dengue drug and therapy has triggered to review available literature of potential anti-dengue plants against DENV serotypes. Therefore, the twin objective of this study aims to explore the current dengue data in India (2011–2016) and to review potential anti-dengue plants for their inhibition activity on DENV serotypes. Dengue data from time period 2011–2016 has been reviewed and analysed state, region and year wise in India and studies from 2002–2016 related to potential anti-dengue plant have been reviewed for their inhibition activity on DENV serotypes. It was observed that Tamil Nadu, Kerala, Gujarat, West Bengal, Maharashtra and Karnataka are highly and most consistently affected states. South region of India, most affected by DENV and 2015, 2013 reported the highest number of dengue cases. Moreover, the reviewed potential anti-dengue plants majorly show inhibition activity against DENV 2. Study revealed the current scenario of DENV and identified the largely affected areas and regions in India for development of health initiatives and future studies are encouraged to identify plant species showing inhibition activity against DENV 3, 4.

1. Introduction

Frequency rate of dengue has increased dramatically over the last 5 years. Worldwide, more than 100 countries with 100 million annual dengue cases approximately have reported dengue as a critical re-emerging arboviral disease[1]. It is estimated that billions of people living in Southeast Asia are at threat of dengue infection. India has been identified as endemic for dengue. Earlier, mostly outbreaks occurred in urban and semi-urban region of different states, but recent reports from different parts of the world as well as from India have witnessed numerous severe dengue cases. Major health problems and most researched diseases are malaria, haemoglobinopathies, tuberculosis, fluorosis and hepatitis but dengue outbreak has not been reported, analysed and interpreted clearly from different states of the nation earlier, which leads to the significance of reviewing the current studies in Indian context.

Dengue virus (DENV) is a single stranded RNA virus which belongs to family Flaviviridae of genus *Flavivirus*, having four serotypes (DENV 1, 2, 3 and 4). DENV vectors are mosquitoes of *Aedes* species. *Aedes aegypti* is a principal vector which is a day biting, anthropophilic mosquito and for laying eggs they usually prefers clean water. The importance to study dengue serotypes has risen due to increase in the viral genetic diversity and unavailability of DENV drug. Therefore, this review will provide an updated analysis on the cases and death reported from different Indian states (from 2011 to 2016). In addition, an in depth analysis on potential anti-dengue plants literature has been done for their

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inhibition activity on serotypes of DENV which can help in vaccine development.

1.1. Clinical presentation

Clinically, post infection symptoms are malaise and headache, followed by fever, severe backache and joint pains, primarily in the areas: orbital and periarticular. There is recurrence of fever for a day or two after 24–48 h of interval, which is known as saddleback fever. Antiviral antibodies of the persons, who are previously exposed to dengue virus, possibly will improve the virus uptake into host cells and will cause disseminated intravascular coagulation, shock and death.

1.2. Pathological features

Lymphocytic vasculitis in the dermis is shown in biopsy studies of the skin rash. In serious dengue hemorrhagic fever cases, finding reveals petechial hemorrhages in the skin and hemorrhagic effusions in cavities: pleural, pericardial and abdominal. In many organs, hemorrhage and congestion are seen. Histopathological examination shows hemorrhage, perivascular edema and focal necrosis but no vasculitic or endothelial lesions. Most of the morphologic abnormalities observed are the results from disseminated intravascular coagulation and shock.

2. Dengue current status in India

Dengue is prevalent in India and has witnessed massive loss of life and property. Data were collected from Government of India Statistics. For analysis of data MS Excel has been used. Detailed analysis was carried out state wise, region wise and year wise. Figures 1–6 graphically show the dengue affected states/union territories from 2011 to 2016 (June) which are categorised according to the regions of India that is north, south, east, west, northeast and central. It was observed that in north region highly affected states are Delhi, Punjab, and Haryana. However, Tamil Nadu, Kerala, Karnataka and Andhra Pradesh are more affected in south region. West Bengal and Orissa in east; Maharashtra, Gujarat, Rajasthan in west; Assam and Arunachal Pradesh in northeast and Madhya Pradesh in central region are states which are largely prone to DENV. Figure 7 represents consistent dengue record in south region since 2011. Followed by a large number of cases in west, the second most affected region, and then east and north regions of India. Figure 8 depicts that the highest number of cases reported were in 2015 followed by 2013, 2012 and 2014.

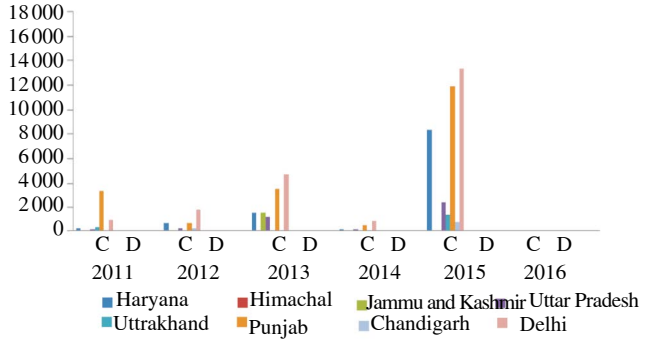

Figure 1. State wise cases and death in North India. C: Case; D: Death.

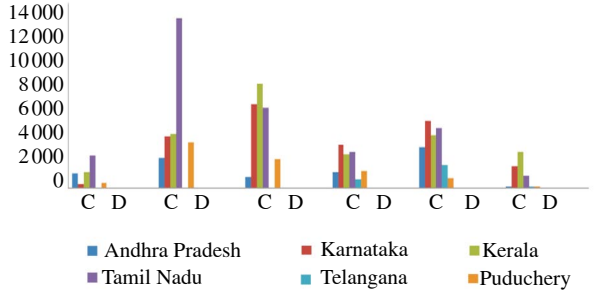

Figure 2. State wise cases and death in South India. C: Case; D: Death.

Table 1
Studies on plants with potential anti-dengue activity.

Scientific name	Family	Common name	Plant part used	DENV
Andrographis paniculata	Acanthaceae	Hempedu Bumi (Malaysia)	Leaves	Type 1
Cladosiphon okamuranus	Chordariaceae	Brown seaweed	Full plant body	Type 2
Carica papaya	Caricaceae	Papaya	Leaves	Against dengue fever
Lippia citriodora	Verbenaceae	Lemon verbena	Full plant body	Type 4
Lippia alba	Verbenaceae	Bushy matgrass	Full plant body	Type 2
Zostera marina	Zosteraceae	Marine eelgrass	Full plant body	Type1, 2, 3, 4
Euphorbia hirta	Euphorbiaceae	Gatas-gatas	Leaves	Dengue fever
Boesenbergia rotunda	Zingiberaceae	Chinese ginger	Rhizomes	Type 2
Quercus lusitanica	Fagaceae	Mazuphal	Full plant body	Type 2
Alternanthera philoxeroides	Amaranthaceae	Alligator weed	Full plant body	Type 1
Ocimum sanctum	Labiatae	Holy Basil, Tulsi (India)	Leaves	Type 1
Leucaena leucocephala	Fabaceae	White Leadtree, Petai Belalang (Malaysia)	Seeds	Type 1
Gymnogongrus torulosus	Phyllophoraceae	Red seaweed	Full plant body	Type 2
Azidarachta indica	Meliaceae	Neem	leaves	Type 2