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Medicinal property of *Callistemon viminalis*

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Abstract
Callistemon viminalis (weeping bottlebrush), belongs to the family myrtaceae, is thought to have scientific importance. A decorative plant stands for its several attributes together with antioxidant, moluscicidal, antibacterial, antifungal, allelopathic, anti-platelet aggregation, anti-quorum sensing, anti-infective, anti-helminthic and has additionally been determined as a powerful insecticidal activity. This plant possesses an extensive variety of secondary metabolites such as triterpenoid, monoterpenes, steroid, glycoside, phenolic, tetra decahedron xanthene diones, pyrrole derivatives, flavonoids and important oils. An impact has been taken from preceding studies that the foremost ingredients of C. viminalis are monoterpenes which can be in particular liable for exceptional organic sports of C. viminalis. This overview consists of the facts regarding the cultivation, morphology, microscopic studies, physiochemical, and phytochemistry, so that it will take advantage of it similarly for the human welfare.

Keywords: *Callistemon viminalis*, phytochemistry, monoterpenes, C. viminalis

Introduction
Herbal medicines have historically shown to help humans, and have shown exponential development in their use in the past several years due to their varied characteristics. Herbal medicine is often utilized in many poor nations, and indigenous people in distant locations have employed it since antiquity, Synthetic chemical usage has a tremendous influence on all kinds of life, resulting in an increase in the amplification of all forms of life (Kavitha and Satish. 2013). Complex nature of their chemical compositions can lead to mild to severe adverse effects, making well-planned scientific research to prove safety for herbal medicines by evaluating toxicity studies and standard protocols (Binishan *et al.*, 2014, Oyedeji *et al.* 2009) [1].

There are 122 general and around 3800 species of shrubs and 5800 species of trees are included in the family Myrtaceae, which are found all across the world in tropical and subtropical areas (Stefanello *et al.*, 2011), Callirtemon (the genus), often known as bottlebrushes, is a part of Myrtaceae famity, which includes 34 species, which includes genus Metrosideros. M, viminalis (Sol, ex Gaertn.) G. Don. Melalenca viminalis, C. viminalis (Salem *et al.*, 2017b). C. uiminalis, a woody fragrant tree found throughout most of the wet tropics, notably Australia, South America, and Southeast Asia. This is mostly utilised as a decorative plant, but it is also used to manage pesky weeds (Brophy *et al.*, 1997) [2, 3].

Fig 1: *Callistemon viminalis*

Taxonomy of C. viminalis
Scientific name: *Callistemon viminalis* Common names): Weeping Bottlebrush
Kingdom: Plantac
Subkingdom: Tracheobionta
Superdivision: Spermatophyta
Division: Magnoliophyta Class- Magnoliopsida
Order: Myrtales.
Genus: Callisternon
Family: Myrtaceae
Height: 15 to 20 feet.
Spread: 15 to 20 feet
Crown uniformity: Inegular outline or silhouette
Crown shape: round: weeping
Crown density: open
Growth rate: medium
Texture: fine

Cultivation and Morphology
Ciminalis is a common omamental plant that is found worldwide. In locations that are exceedingly cold and dry, this plant is not found. It may be found in many locations. Including on the streets and in the botanical gardens (Wheeler, 2005; Zubair *et al.*, 2013), C viminalis prefers running water, but does well in cultivation where there is a stable water source, Plants thrive in medium to beavy soil conditions, and may tolerate an improper drainage condition, although they may suffer in the event of light to moderate frost. Once it flowers, it has to be fertilised on a yearly basis. In the early stages, it is more resistant to lengthy periods of drought (Brophy *et al.*, 1997). However, while the plant reacts ty trimming, it is not possible to disguise weeping features with it. In comparison with other bottlebrushes, they can withstand partial shade and blossom the same. Although somewhat restricted in range. C. viminalis can tolente varying soil conditions and can thrive with minimal care (Sheat 19951). In terms of propagation. C. viminalis is made simple with the method of using seeds and cuttings. Callistemon cultivar may yield viable seed, which, if planted, is capable of germinating readily. Though seedling variation is always there, any plant that is the result of this seed will not be exactly the same as the parent plant (Zubair of al. 2013). Plants resulting from cuttings are genetically identical to the original plant. This species produces some of the most gorgeous stumen in the genus, due to a long, flexible stalk (Shem 1995). Also known as Red C. viminalis, this flower has gorgeous scarfer flowers. during the blossoming season. Also, the nectar-producing species, C. viminalis, generates. Huge quantities of nectar (Kamal and Fareeda, 2017; Srivastava *et al.*, 2003) [4, 5, 6].
It is also a medium-sized tree with a wide-spreading crown and minimal branching. It is common for mature trees to grow to 8-9 m tall after 30 years, although most trees usually grow to between 5-6 m in height and 8-9 m in width. A weeping appearance is created as a result of the three to four-inch-long, thin, light green leaves growing exclusively at the extremities of the long hanging branches. C. viminalis leaves are lanceolate, measuring 03 em to 06 cm broad and 4 to 7 cm long Flowers on spikes, often in the month of February, are around 14-15 cm long and have conspicuous red stumens, which are 15-25 cm long Multiple, long, bristle-like filaments form the red, cylindrical, brilliant crimson flowers. Which are typically three to five inches long and one inch broad. The flowers are light or greenish, have small petals, and are inconspicuous. Additionally, the bloces are followed by woody capsules that remain concealed unless you are standing really next to the tree (Brophy *et al.*, 1997: Kamal and Fareeda, 2017) [7, 8, 9].

Microscopic Study of *Callistemon viminalis*
Myrtaceae family's stomata are present on the leaf, revealing unomocytic stomata, Cross slice visualises the epidermis (dermis), cuticle (epidermis, periderm, and epidermal appendages), vascular handles (xylem and phloem), pericyclic fibres, collenchyma, and trichomes (single celled). This stem has the epidermis, cork tissues, 2-3 layers of cortical tissue, 7-8 layers of medullary tissue, ray emissaries, endodermis, oil glands, sclerides in the cure area, and pith in the middle (Kamal and Fareeda, 2017) [10, 11, 12].

Table 1: Physiochemical parameter [13, 14]

Parameter	C. viminalis (leaves) Value %	C. viminalis (stems) %
Ash value		
Total ash	4.66 in leaf(%w/w)	10.5 in stem (%w/w)
Acid insoluble ash	2.5 in leaf (%w/w)	4.5 in stem
Water soluble ash	2.45(%w/w)	3.6%
Extractive value		
Alcohol soluble	11.5(%w/w)	13.4(%w/w)
Water soluble	14.4(%w/w)	12.5(%w/w)
Moisture Content	3.4(%w/w)	4(%w/w)

Essential oil constituents
Flowering tops of this plant include abundant phenolic, triterpenoid, flavonoid, saponin, steroid, alkaloid, tannin, carbohydrate, amino acid, and protein components. For around forty-two different chemical classes, among which are acids, alcohols, aldehydes, esters, hydrocarbons, and ketones, chemical components such as these were isolated from the leaves of the plant. There are three main components to this list, and they are 18-cineole, a-pinene. and menthyl acetate, together with their respective minor elements, u-thujene, B-pinene, and myreene. Among these aromatics, the ones ending in "ciruj" inchide (Peymene), (y terpinene), (terpinolene). (linalool), (transpinocarveoli, (bomeol), talloaromadendrene), (spachulenol), and (globulol) (Olivera *et al.*, 2015; Wngley and Fagg, 1993) [15, 16]. Instead of making tea, its leaves are used to provide a unique flavour (Bhushan *et al.*, 2014: Oyedeji *et al.*, 2009) Latitude, regional dispersion, and other environmental variables are thought to be factors behind the C. viminalis essential oil composition (Quijano-Célis *et al.*, 2010, Simmons and Panons, 1999). At different geographical locations, the main murker identified as cineole and predominator in the Callistemon gemas as well as the Myrtaceae family was found to be 18 cincole (Gobar *et al.*,

2014: Kamal and Fareeda, 2017) [17, 18]. From all across the world, literature has shown that the plant possesses a wide range ofdistinct chemical compositions in its various sections (leaves, flower, fruits, wood, bark), s followed below are some isolated chemicals that are derived from different sections of the plant and that are extracted from distinct extracts (Fareeda and Kamal, 2017) Aerial Viminatione A and B (Tetra decahydro xanthene dianes derivative) such as apples, peaches, and walnuts [19, 20, 21].

Fruits and backs

Triterpenes (Triterpenoid). a-Octacosano, Stosterol-3-0-B-D Glucopyranoside, methyl gallate, and f-sitosterol (Stemsid), Uriolic acid Ellagic acid (Phenolic), 3.4 dihydro-2-phenyl-Ellagic acid (Phenolic), 34-dihydn-2-phenyl-acetic acid (hydroxymethyl) 2-Chloro-4-methyl-2H-pyrrole-2-carhaldehyde (Pyroles derivative) Barks: O- acetylsalic acid from. 3 (Triterpenoid) Leaves: Pinene. Phellandrene, D-Limonene, 1.8-Cincole, P-Cymene, Terpineol, and Menthyl acetate (Flavnoids) [22, 23].

In decorative horticulture, essential oil manufacturing, forestry, windbreak plantings, and land reclamation, C. viminalis is utilised extensively (Salem *et al.*, 2013). It is a kind of medicinal plam belonging to the Myrtaceae family, which is used for traditional treatment, and it is found in many countries worldwide. The beneficial use of viminalis was also demonstrated in treating hemorrhoids (Islam *et al.*, 2010: I. X009). Due to its astringent nature, this plant has a hemostatic characteristic which means it can help to constrict blood vessels, such in ulcers, and therefore stop internal bleeding (Wheeler, 2005). Bottle brush was shown to be a molluscicide, a bio-repellent for land leeches, and an insecticide (Nath *et al.* 2002: Ndomo *et al.*, 2010) [24, 25, 26]. However, the usage of this therapeutic plant has not been well publicized, and the components of this herb are being researched for herbicidal characteristics and in the search for possible medical applications, Like many tea substitutes, including kumquats, lemongrass, and the herb St. John's wort, it is rich in flavonoids and has a pleasant. Soothing taste and smell. While most tea served in Jamaica is made from C. viminalis, C. viminalis tea locally called "tea" is also useful in gastroenteritis, diarrhoea, skin infections, and respiratory issues (Afrah 2012: Cowan, 1999) [27, 28]. In terms in terms of sharpness antimicrobial, food conservation, pain relieving, and tomic. Terpenoid compounds isolated from C. viminalis were characterised by sharp flavour, antimicrobial, food conserved, analgesic for pain, and tomics (Jawad AM. 20081) [29, 30]. Gram-positive bacteria, including staphylococci, Streptococci, and Listeria, were inhibited by extracts from flowers. and leaves of C. viminali (Cowan. 1999: Spencer and Lamley, 1991). the antibacterial. antifungal, antioxidant, hepatoprotective, and anti-thrombin properties of several solvent extracts and essential oils from C. viminalis cultivated in various locations across the world. are demonstrated. Based on preliminary evidence, it was found to be effective against skin pathogen. No significant difference was seen between gastrointestinal pathogens (Shigella omnes, Salmonella enteritidis, and E. coli) and intestinal pathogen (Saccharomyces cerevisiae, Bacillus subtilis, Bacillus cereas, and Staphylococcus aureus) (Mukherjee, 2002: Salem *et al.*, 2017). Other notable attributes of C. ciminalis include in-vitro activities that inhibit helminthes, tapeworms, and hookworms (Garg and Kavera, 1982) [31, 32]. Moreover, it has been shown to bolster the immune system and ward off chronic diseases such as heart disease, brain disease, and other life-threatening disorders of major organs such as the heart. Brain, and other organs of the body (Eldib and Elshenawy, 2008). It also had an anticancer impact on human liver cancer cells, HepG2, and was shown to be non-toxic to normal cells Ibrahim and Moussa, 2020) [33, 34].

Pharmacological and biological activities

Antibacterial and antifungal activities

Disc diffusion and broth microdilution were used to determine the *in vitro* bactericidal activity of the essential oils (C citrimes and C viminalis). Despite their effectiveness against some bacteria, the nils demonstrated a strong zone of inhibitions against bacteria such as S.faecalls, both. S. aureus strains. B. cereus, and S. macrcesens. Be prepared for Pseudomonas seraginosa aeruginosa and Staphylococcus macruri (Oyedeji *et al.*, 2009)

Bacteria and some bacteria strains were susceptible to certain extracts of C. iminalis. For example, nhexane extract had significant action against methicillin-resistant S. aureus, but non methicillin-resistant S. aureus was only sensitive to the MeOH extract (Delahaye McKenzie *et al.*, 2009), S. aureus, Streptococcus Pneumonia, Staphylococcus epidermidis, Klebsilla pneumonia Kiebrietla oxytaci, Proteus vulgaricas, and E. coli can be combined using Aq and alcoholic extracts from leaves, however watery extract is more effective than ethanel extract. The essential oil from C. riminalls was evaluated in terms of its ability ty inhibit the growth of E. coli and S. aureus bacteria. While Ecoli was quite vulnerable to the essential oil. S. aureux did not appear to be greatly affected (Salem *et al.*, 2017a). Ag flowerAg flower and leaf extracts were shown to have antimicrobial properties. Methanol leaf extract has good to moderate antibacterial activity (Abdullah, 2011: Srivastava *et al.*, 2003), Bitter, fermented leaf water with microorganisms P. aeruginosa, P. pseudomelli, S. aureus, K. pneumonia, K oxytaci, P. vulgaris, S. pocumonia. S. epidermidis, E. coli, E. cloacae, and Streptococcus pneumonia isolated from the urinary tract the watery extract of C. vmmalis was less effective in reducing pathogenic germs than the alcoholic extract. According to the results, C. viminalis's alcoholic extract was more effective against S. pneumonia pathogen, therefore a direct injection of the extract intraperitoneally was employed as an experimental infection in animals (*in vivo*). Fewer improvements were observed in the levels of calcium, creatinine, creatinine kinase, and uric acid, but more in the levels of blood urea nitrogen, creatinine, and creatinine kinase (Kamal and Fareeda, 2017) [35, 36].

Haemolytic activity

This investigation was conducted to examine the haemolytic activity of C. viminalis extracts against human blood erythrocytes (RBCS) and to discover what proportion of RBCs may potentially yield therapeutic medicines (Saleem *et al.*, 2015). In the order of percent hemolysis of different extracts, chloroform was ranked fint, in the range of 1, 79% - 4.95% (Zubair *et al.*, 2013). These C. viminalis leaf altered the levels of blood urea nitrogen, creatinine, creatinine kinase, and uric acid in infected rabbits that were tested for Streptococcus pneumonia (Salem *et al.*, 2017) [37, 38].

Anti-infective activity

C. viminalis, Conocarpus erectus, and flacida buceras were screened for P. aeruginosa inhibition, and reductions in toxins and mortality were detected, which indicated potential anti-infective properties (Adonizio *et al.*, 2008) [39, 40].

Activity of Insects

When trying to eradicate stored-grain insects. C. viminalis shown moderate activity. In particular, the grain posts, such as Sitophifo oryzae, Tribotium castone, and Rhycopertha dominica, were killed (Lee *et al.*, 2004). Studies show that essential oils from C. viminalis are toxic to Ephestia kuchniella and impair its immunological cells in a dose-dependent concentration, there was a reduction in the total hemocyte count in treated larvae at intervals following treatment with C. viminalis oils (Ghasemi *et al.* 2014).

In adults, essential oils from C. viminalis were employed as a fumigant against the entomopathogenic nematode Sinophiles oryzae (Lee *et al.*, 2004). *Acanthoscelides* obtectus and Callosabru hus maculatus. 72.6% and 80% mortality rate were found for the insects, which are a common pest of stored beans in Cameroon, when dried leaves from the highest concentration (0.40 ml/g) or filter paper dises (0.251 ml/cm2) were applied to the grains, while powder and acetonie extracts had no effect on the insects at the tested concentration (Salem *et al.*, 2017) [41].

Anti-quorum Sensing have

Bacterial cell-to-cell communication for Quorum Sensing) is believed to govern the pathogenicity of many different kinds of bacteria. In two different bio-monitor strains, *Chromobacterium violaceum* and Agrobacterium numefaciens, the Criminalis leaf extract was shown to have anti-quorum sensing activity by inhibiting quorum sensing gene (las and "" have an thl) and QS-controlled factors (Adonizio *et al.*, 2000: Kamal and Fareeda, 2017) [42].

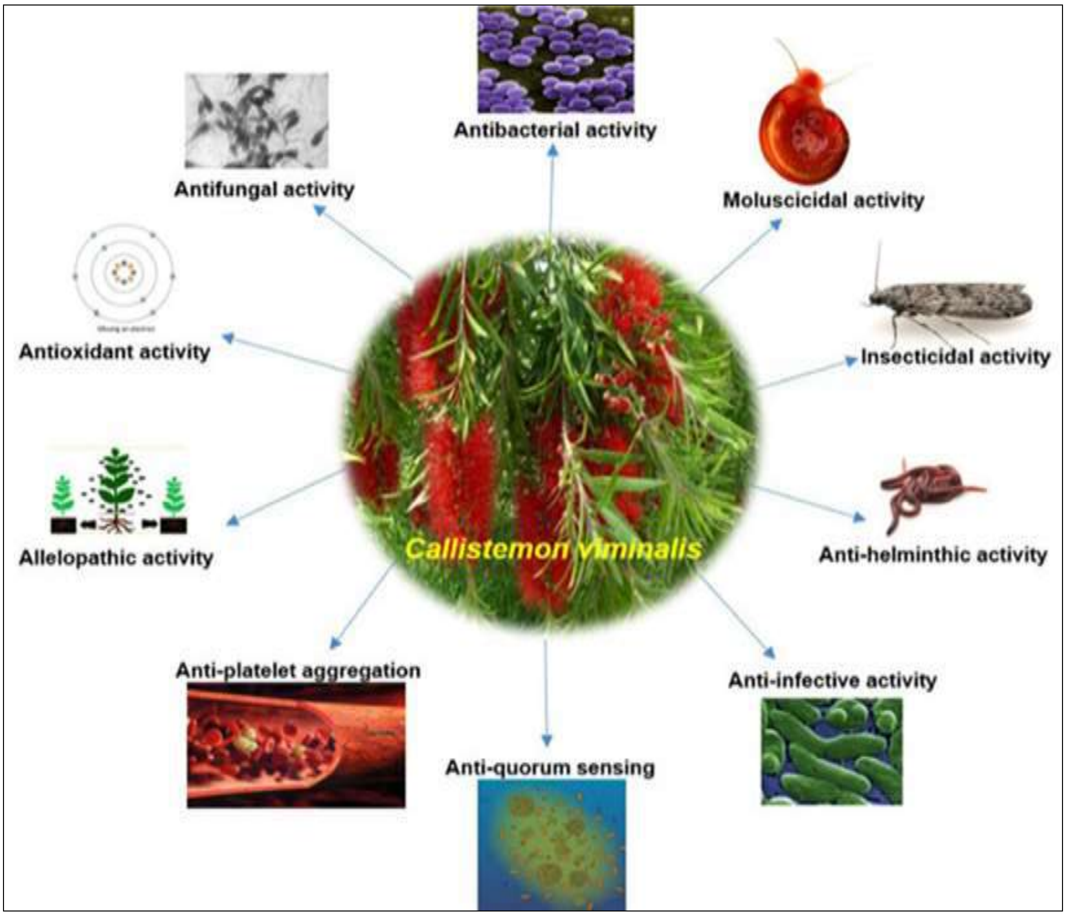

Fig 2: Pharmacological application of *callistemon viminalis*

Anti-platelet Aggregation

Epi. adenosine diphosphate (ADP), and thrombin were used to induce rat platelet aggregation. Oleanolic acid (OA), Ursolic acid (UA), Betulinic acid (BA), and Maslinic acid (MA) isolated from C. viminalis leaves were evaluated *in vitro* for anti-platelet aggregation activity on thrombin. ADP, and epinephrine-induced platelet aggregation. When measured on thrombin-induced platelet aggregation, it was found that the compounds displayed the greatest activity with OA (IC50 of 0.84 mg/ml) and the mixture of BA/OA (IC50 of 261 mg/ml) exhibited the highest activity. There were several reports showing that 2.57 mg/ml of BAOA had a substantial effect on epinephrine-induced platelet aggregation (Rahalola *et al.* 2013) [43].

Allelopathic Activity

Many hiological compounds affect the development of other species by promoting allelopathy. In addition, the results of the study revealed that essential oils from the flowers of C. viminals had allelopathic activity as a function of varying concentrations of the essential oil (0.2 10.5.0 LmL-1), which corresponds to the Germination Speed Index (GST) of lettuce seeds, which results in inhibited germination and growth (Garg, 2008).

Anti helmintic action

Pheretima posthuma and Taenia softum Linn. Demonstrated effective anthelmintic action *in Vitro*, whereas the activity against hookworms (Bunostom trigonocephalum was equal to that of hexylresorcinol (Garg and Kasera, 1982: Srivastava *et al.*, 2011; Veerakumari, 2015).

Toxicity to mollusks

C. viminalisis claimed to have molluscicidal action. To prevent human schistosomiasis, extracted barks, fruits, and leaves were stored in methanol, after which the methanol was used as a molluscicide in tests to disrupt the fatty acid profile of intermediate host snails, the Biompladaria alexandrina. Residues extracted from many species of mollusks shown. Antiparasitic efficacy against the vectors of schistosomiasis, which causes the liver disease bilharzia. The LC50 valse for C. viminalis bark, fraits, and leaves was 6.2 ppm, but the LC50 value for the essential oil extracted from the leaves was 32 ppm. The C. viminalis truit extract demonstrated the strongest impact against the tested snails, which was about 10 times stronger than the other tested fruit extracts. Hermaphrodite gland is where all tested extracts have their target location, according to histopathological investigations (Golur *et al.*, 2014) [44].

Anti-infective

Aqueous extracts of plants C viminalis, Conocarpus erectus and Bucida buceras were screened for inhibition of opportunistic human pathogen Pseudomonas aeruginosa that were found reduction in toxin production 50-90% and mortality 60%, indicative of their potential for anti-infective development [45].

Anti-platelet Aggregation

Oleanolic Acid (OA), Ursolic Acid (UA), Betulinic Acid (BA) and Maslinic Acid (MA) isolated from leaves of C. viminalis were evaluated *in vitro* for anti-platelet aggregation activity on thrombin, Adenosine Diphosphate (ADP), and epinephrine-induced rat platelet aggregation. It was reported that the compounds exhibited highest activity by OA (IC50 of 0.84 mg/ml) and mixture of BA/OA (IC50 of 2.61 mg/ml) was observed on thrombin-induced platelet aggregation. It was known that BA/OA (IC50 of 2.57 mg/ml) also showed a significant platelet aggregation inhibitory activity on epinephrine-induced platelet aggregation [46].

Antioxidant Activity

Essential oil of C. viminalis (88.60±1.51%) showed highest antioxidant activity as compared to gallic acid, which is a standard compound (80.00±2.12%). Ethyl acetate leaf extract of C. viminalis (85.12±1.42%) showed antioxidant activity comparable to standard antioxidants such as gallic acid (80.00±2.12%) [5]. Antioxidant potential of petroleum extract of C. viminalis leaves showed better IC50 value 56.2 ± 0.54 µg/ml as compared to the standard compounds *viz.* butylated hydroxy toluene. The total extracts, petroleum ether, Methylene chloride and Ethyl acetate fractions of the fruits and bark of C viminalis along with the compounds methyl gallate, gallic acid, catechin and ellagic acid showed highest antioxidant activity comparable with that of the standard antioxidant, ascorbic acid [47].

Conclusion

According to the WHO, 80% of the world's population commonly the ones of growing nations depend upon plant derived drug treatments for fitness care. It is discovered that nearly 60% of medicine authorized for acute illnesses remedy are of herbal origin. The international scenario is converting their belief in the direction of the usage of natural drug treatments because of much less facet impact and therefore are getting used to expand a contemporary-day drug to therapy many acute illnesses. C. viminalis is an important medicinal plant having traditional importance and this is proven by various experiments and scientific studies. Although biological and medicinal applications have been explored, still many pharmacological applications are needed to be explored. The plant has numerous therapeutic applications *viz.* antioxidant, moluscicidal, antibacterial, antifungal, allelopathic, anti-platelet aggregation, anti-quorum sensing, anti-infective, and anti-helminthic activities on insects. The major studies were reported using extracts of the plant; still the active principle involved behind these activities is needed to be worked on. As the value of medicinal plants depends on the active principle present in them, so the uniformity in quality as well as the quantity of planting material is of paramount importance.

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