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Chemical Compositions and Antimicrobial Properties of Piper Sarmentosum – A Review

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Abstract: *Herbal medicine has emerged as a popular alternative medicine throughout the world due to the unfavorable report on the side effect of a commercial drug. Alternative treatments from nature product have been brought into investigation due to comprehensive traditional uses, low cost and no harmful effects. Piper sarmentosum Roxb. or kaduk (Piperaceae family) is frequently used in local medicine to treat various diseases and ailments. Traditionally, different parts of P. sarmentosum are widely used as a treatment for fever, coughs, diabetes and joint aches. Different types of phytochemical constituents such tannin, phenolics, sarmentine and sarmentosine have been successfully isolated from parts of P. sarmentosum. Furthermore, the antimicrobial activities of P. sarmentosum against pathogenic microorganisms such Pseudomonas aeroginosa, Methicilin Resistant Staphylococcus aureus (MRSA), Mycobacterium tuberculosis, Aspergillus niger and Candida albicans have been reported before. This review aims to summarize the isolated chemical compositions from the different way of extraction and antimicrobial properties of P. sarmentosum reported from the previous studies.*

Keywords: *Piper Sarmentosum, Chemical Composition, Antibacterial, Antifungal, Antivirus*

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I. Introduction

Piper sarmentosum Roxb. is known in Malaysia as 'kaduk' or another name is called as Cha-plu, sirih duduk and Wild Betel, belongs to the family Piperaceae [1-5]. This herb is found easily in the tropical and sub-tropical region of the world [6]. P. sarmentosum is a dioecious plant species, normally grown as small shrub sometimes climbed up to 30cm tall. Its petiole is 1-2.5 cm long and their leaves are variable in shape and size; leaf blade are thin to thick, light to dark green, broadly ovate to elliptic with 7.5-9.5 cm long and 4.5-6 cm wide present with aromatic odour and pungent taste. Spike of the plant grows with male and female flowers, straight up together cylindrically with 1-1.5 cm long, 0.3-0.5 cm in diameter. Fruiting spike of the plant is 1-2 cm long and 0.5-1 cm in diameter [2]. Locally, the P. sarmentosum leaves are extensively used as spices, food additive and also traditionally used to treat fever, joint aches, rheumatism and hypertension [7-8]. This plant also used to cure skin diseases, diarrhea, indigestion and toothache [5]. In addition, the whole plant decoction of P. sarmentosum has been used to treat diabetic and used as the expectorant to treat coughs by promotes the secretion of sputum by the air passages [5,9].

II. Chemical Composition

Previous studies have reported that different parts of P. sarmentosum contain various phytochemical compound. The different type of solvent used in the extraction procedure will take out different active compound [10].Methanol extract of leaves of P. sarmentosum contain Vitamin C, Vitamin E, carotenes, xanthophylls, tannin and phenolics [11], while roots and stems of P. sarmentosum presented langkamide (a new 2-pyrrolinone alkaloid), piplartine, and 3.4.5-trimethoxycinnamic acid [12]. In the aqueous extract of P. sarmentosum leaves, consists of flavonoid, phenolic and ascorbic acid [13]. An ethanol extract of P. sarmentosum root contained sixteen compounds, namely aromatic alkene, (+)-sesamin, horsfieldin, 1-allyl-2-methoxy-4,5-methylenedioxybenzene, β-sitosterol and pyrrole amide, N-(phenyl-propanoyl)-Δ3-2-pyrrolidone (Sarmentamide A), Ncinnamoyl-trans-3,4-diacetoxypyrrolidine (Sarmentamide B), N-(2,4,5-trimethoxycinnamoyl)pyrrolidine (Sarmentamide C), N-(2E,4E-Decadienoyl)pyrrolidine (Sarmentine), N-[9-(3,4-Methylenedioxyphenyl)-2E,4E,8E-nonatrienoyl]pyrrolidine, N-[9-(3,4-Methylenedioxyphenyl)-2E,8E-nonadienoyl]pyrrolidine, N-[7-(3,4-Methylenedioxyphenyl)-2E,6E-hepadienoyl]pyrrolidine (Sarmentosine), N-Isobutyl-2E,4Edecadienamide(Pellitorine),N-Isobutyl-13-(3,4-methylenedioxyphenyl)-

2E,4E,12Etridecatrienamide (Guineensine), N-Isobutyl-15-(3,4-methylenedioxyphenyl)-2E,4E,14Epentadecatrienamide (Brachystamide B) [14]. Meanwhile, the hexane and ethyl acetate extracts of aerial part of P. sarmentosum presence of three amides; 3-(3',4',5'-trimethoxyphenylpropanoyl) pyrrolidine, 3-(4'-methoxyphenylpropanoyl) pyrrole, N-(3-phenylpropanoyl) pyrrole and a sterol; β-sitosterol [3]. In addition, the essential oils of P. sarmentosum leaves contained α-Phellandrene, Piperitone, Cinnamyl alcohol, Eugenol, α-Copaene, Methyl eugenol, α-Lonone, γ-Elemene, β-Bicylogermacrene, α-Humulene, β-Guaiene, Germacrene D, Ethyl laurate, α-Farnesene, Elemicin, Bicylogermacrene, δ-Cadinene, Cadinadiene, Myristicin, γ-Cadinene, Germacrene B, Guaiol, Dehydrocarveol, Spathulenol, T-Muurolol, β-Eudesmol, β-Bisabolol, δ-Cadinol, α-Cadinol, E,Z-Farnesol, E,E-Farnesol [15], benzyl benzoate, benzyl alcohol, 2-hydroxy-benzoic acid phenylmethyl ester, 2-butenyl-benzene [16], Caryophyllene oxide, α- bisabolene, Z-α- bisabolene, Aromadendrene, δ- cadinene, Easarone, Methyl eugenol, α- muurolene, α- copaene, Z- calamine, and Z- pinane [7].

III. Antibacterial Activity

Poly Butylene Succinate (PBS) extracts of P. sarmentosum stem and leaves, revealed the antibacterial activity against Pseudomonas aeroginosa with minimum inhibitory concentration (MIC) value 50mg/ml (14mm) and 100mg/ml (10mm) respectively. However, both extracts are not capable to disrupt the growth of Escherichia coli, Bacillus anthracis and Staphylocuccus aureus [17].

The ethanol extract of P. sarmentosum exhibited an antibacterial activity against Methicilin Resistant Staphylococcus aureus (MRSA), Staphylococcus aureus, and Pseudomonas aeruginosa but not sensitive against Escherichia coli, Klebsiella pneumonia, Vibrio cholera and Streptococcus pneumonia [18-19]. In another study, the methanol extract of P. sarmentosum leaves exhibited antibacterial activities against Mycobacterium tuberculosis, E. coli, Burkholderia sp. and Haemopillus parasuis with MIC values are 800, 502, 1005 and 251μg/mL respectively [20-21]. In another experimental study, methanol extract of P. sarmentosum leaves did not exhibit antibacterial activity against all 15 clinically important strains; Staphylococcus aureus, Staphylococcus aureus, Staphylococcus epidermidis, Micrococcus flavus, Bacillus cereus, Bacillus subtilis, Corynebacterium rubrum, Pseudomonas aeruginosa, Salmonella typhimurium, Proteus Mirabilis, and Proteus vulgaris [22]. Furthermore, the antibacterial study on methanol extract of P. sarmentosum leaves demonstrated the MIC value of 12.5 mg/ml for both major rice pathogen; Pseudomonas fuscovaginae and Xanthonomas oryzae pv. Oryzae and the Minimum Bactericidal Concentration (MBC) value were 25.0 and 12.5 mg/ml respectively [23].

Water and ethanol extraction of all parts of P. sarmentosum exhibited an anti-tuberculosis activity by using MTT assay [24]. Moreover, the maximum antibacterial activity of ethanol extract of P. sarmentosum leaves was observed at concentration 100mg against Pseudomonas aeruginosa (12mm), followed by Staphylococcus aureus (11mm) and Eschericia coli (8mm). The antibacterial activity of this extract failed to inhibit Bacillus subtilis in any concentration of extract [25]. Three amides; 3-(3',4',5'-trimethoxyphenylpropanoyl) pyrrolidine, 3-(4'-methoxyphenylpropanoyl) pyrrole, N-(3-phenylpropanoyl) pyrrole and a sterol; β-sitosterol from an aerial part of P. sarmentosum has been used against Gram negative bacteria; E. coli, Pseudomonas aeruginosa and Gram positive bacteria; Bacillus subtilis, Staphylococcus aureus to investigate the antibacterial activity of specific isolated compounds. The result indicated that isolated compounds were active towards Gram positive but not on Gram negative bacteria. The other compound, 3-(3',4',5'-trimethoxyphenylpropanoyl) pyrrolidine showed significant activity against B. subtilis (MIC 500 μg/ml, MBC 500 μg/ml). S. aureus was found to be sensitive to β-sitosterol (MIC and MBC 500 μg/ml) and N-(3-phenylpropanoyl) pyrrole (MIC and MBC 125 μg/ml). Unfortunately, 3-(4'-methoxyphenylpropanoyl) pyrrole did not exhibit any antibacterial activity against both Gram bacteria [3].

IV. Antifungal Activity

Antifungal activity of P. sarmentosum has been demonstrated by several research studies. The whole plant of P. sarmentosum ethanol extract gives a positive result in inhibiting the growth of Aspergillus niger but not Aspergillus oryzae and Penicilium sp. [26]. The ethanol extract of P. sarmentosum leaves exhibited antifungal activity against Candida albicans [27-28] and Aggregatibactor actinomycetemcomitans but unable to inhibit the growth of Lactobacillus sp., and Streptococcus mutans. In addition, there was no antifungal activity demonstrated by P. sarmentosum leaves oil against C. albicans, A. actinomycetemcomitans and Lactobacillus sp. [28].

P. sarmentosum methanol extract showed an antifungal activity against Aspergillus flaves, Candida albicans, Microsporum canis, Trichophyton mentagrophytes and Trichophyton rubrum [29]. On the other hand, the methanol extract of P. sarmentosum leaves showed a significant antifungal activity against Candida albicans, Rhodotorula rubra and Torulopsis glabrata but not to Cryptococcus neoformans [30]. Furthermore, the Poly

Butylene Succinate (PBS) extracts of stem and leaves of P. sarmentosum did not exhibit any antifungal activity against Candida albicans and Candida neoformans [17].

V. Antiviral Activity

An in vitro study of the antiviral activity of P. sarmentosum has been demonstrated by exposing the whole plants extract with Dengue virus type 2 (DENV-2). Dichloromethane and ethanol extract of P. sarmentosum with a similar concentration (12.5µg/ml) did not exhibit inhibitory activity against DENV2 in Vero cell [31]. Ethanol extract of P. sarmentosum leaves extracts also possessed antiviral activity against Vesicular stomatitis virus (VSV) with MIC value 0.02 mg/ml, but, ethanol leaves extract of P. sarmentosum showed a negative result against Herpes simplex virus type-1 (HSV-1) [32].

VI. Conclusion

The different activity of plants is contributed by the active compounds in the plant itself. However, part of plant, area of plant growth and type of solvent used for extraction are the factors that determine the specific compound to be extracted. P. sarmentosum is a famous herb used specifically in Malay medicinal folklore. It is traditionally used to treat microbial infection which has been supported by previous studies. This review recommends that P. sarmentosum plant have a great potential to be used as one of the sources for alternative antimicrobial drugs. Clinical study on the mechanism of action may elucidate the safety and efficacy of herb and promotes its reputation to be used as one of the candidate in herbal medicine.

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