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Andrographis paniculata (AP) or hempedu bumi belonging to family Acanthaceae is traditionally used in China and India to cure skin infection. This herb was also believed to treat common cold, diarrhea, liver diseases, inflammation and also suggested as a new way to treat HIV infection and other related immune disorder. The antimicrobial effects were studied on three parts of the plant which were leaf, stem and root. These parts were extracted using hexane, ethyl acetate and methanol. All extract were screened using discs diffusion method against seven bacteria causing skin disorder. The tested bacteria were: (4 Gram-positive: *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Bacillus subtilis* and *Streptococcus pneumoniae*) and (3 Gram-negative strains: *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*). The penicillin G and Streptomycin Sulfate were used as the positive control, while methanol was used as negative control. The active extracts possessed relative antibacterial activity against the tested microorganisms with the diameter of inhibition zones between ± 7 to 13 mm. The methanol extract of the leaf inhibited *S. epidermidis* growth with inhibition zone diameter around 10 mm, while the methanol extract of the root showed the inhibition toward *K. pneumoniae* with the same size of inhibition zone diameter. The extraction of stem using hexane showed sensitivity towards *B. subtilis* with ± 11 mm. On the other hand, the ethyl acetate extract of the root was susceptible against *S. pneumoniae* (± 9 mm). The stem methanol extract of AP showed the highest inhibitory effects against *S. aureus* with ± 13 mm diameter compared to other bacteria tested. The ethyl acetate extract of the stem and the hexane extract of the leaf showed a significant activity against four bacteria ($\pm 8 - 11$ mm diameter) which were *S. pneumoniae*, *K. pneumoniae*, *P. aeruginosa* and *S. epidermidis*. These results may suggest that the stem of *A. paniculata* possess compounds with antibacterial property which can be used as antibiotic therapy for skin infection treatment.

Keywords: *Andrographis paniculata*, antimicrobial effect, skin, infection, discs diffusion method.

CHAPTER 1

INTRODUCTION

1.1 Overview of *Andrographis paniculata*

Andrographis paniculata or traditionally known as *Hempedu Bumi*, is a herbal plant belonging to the family Acanthaceae, a herb widely distributed in Asia. It is an annual herbaceous plant which is broadly cultivated in southern Asia, Scandinavia, China and some parts of Europe. This herb commonly termed as the ‘King of Bitter’ has been used conventionally to treat a number of ailments including common cold, fever, diarrhoea, liver diseases, and inflammation (Shen *et al.*, 2002). In traditional Chinese medicine, it is widely used to get rid of body heat. Recent studies have revealed some cardiovascular effects of this herb. It is also found to be a promising way for the treatment of HIV, AIDS (Calabrese *et al.*, 2000), and numerous symptoms associated with immune disorders, and commonly as a immune system booster (Iruetagoiena *et al.*, 2005). The juice of fresh leaves is a domestic remedy in the treatment of colic pain, loss of appetite, irregular stools and diarrhea. The pharmacological studies suggest this herb has a antipyretic, anti-viral, potential cancer therapeutic agent (Zhou *et al.*, 2006), anti-hyperglycemic and anti-oxidant properties.

The potential of this herb has made it as a chosen herb for the study of inhibitory effect towards bacterial causing skin infection. Bacterial skin infections are among the common problems in developing countries (Elixhauser *et al.*, 2001). The mechanism of isolating active compounds from this herb is demonstrated to evaluate its capability as a skin infection remedy. A number of evidences reported previously have been accumulated to demonstrate the promising potentials of medicinal plants

used in various traditional, complementary and alternative systems (Kanokwan *et al.*, 2008).

Evidences of its long establish use in tradition related to infections of the skin (Tapsell *et al.*, 2006) have made it a potential herb for further evaluation in order to ascertain its antibacterial potential to treat skin infections caused by some pathogenic bacterial strains. It is considered beneficial to the skin and is used both internally and externally for this purpose (Jain, 1991). Frequency of certain skin infections in developing countries including Malaysia are in a rising manner. Indeed, skin infections are among the most prevalent in the world. Bacterial skin infections are among the common problem in developing countries (Elixhauser *et al.*, 2001). Therapies of bacterial skin infections are a frequent problem due to the emergence of resistant bacterial strains to numerous antibiotics (Marimoto *et al.*, 1999).

Diterpenoids and flavonoids are the main chemical constituents of *A. paniculata* which are believed to be responsible for the most biological activities of this plant (Tang and Eisenbrand, 1992). *A. paniculata* has been used in the treatment of some skin infections in India and China by folkloric medicine practitioners. Evidences on its wide use by the traditional clerics in treating some infections of the skin (Tapsell *et al.*, 2006) have prompted us to choose and confirm this plant for further evaluation in order to ascertain its antibacterial potential to treat skin infection that are caused by some pathogenic bacterial strains. Andrographolide can be easily dissolved in methanol, ethanol, pyridine, acetic acid and acetone, but slightly dissolved in ether and water. Hence, the use of methanol as a solvent for this study.

1.2 Objectives of Research

The objectives of this research are to determine the bacteria those were sensitive towards *Andrographis paniculata* and to compare the most active parts of plant that act as antimicrobial drug for bacterial skin infection.

1.3 Scope of Work

Investigation on the chemical compositions will cover the root, leaf, and stem of *Andrographis paniculata*. All the fresh samples will be extracted by using *n*-hexane, ethyl acetate and methanol.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of *Andrographis paniculata*.

Andrographis paniculata, a member of Acanthaceae family has been used for centuries as a medicinal and multi-potent herb for a myriads of ailments. The leaves and roots have been traditionally used as a folklore remedy for a wide spectrum of disorder or as an herbal supplement for health. Various preparations and compound formulas of the herb have been used to treat infectious and non-infectious diseases for conditions such as epidemic encephalitis B, suppurative otitis media, neonatal subcutaneous annular ulcer, vaginitis, cervical erosion, pelvic inflammation, herpes zoster, chicken pox, mumps, neurodermatitis, eczema, and burns (Chang and But, 1987). This is all may due to its active constituent which believed to be beneficial for many treatments.

Among the constituents being isolated are Andrographolide, a diterpene lactone compound, is believed to be the principal active agent. Leaves of the plant contain several derivatives of diterpene lactones out of which andrographolide (bitter constituent) and neoandrographolide (non bitter constituent) are the significant ones. The concentration of these active ingredients varies within plant parts and with the geographical distributions of the species. The andrographolide being secondary metabolites are often influenced by the environmental, seasonal factors and its distribution in between leaves and whole plant. From the results, it is evident that there is a wide variation in the andrographolide present in leaves and whole plant.