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ORIGINAL ARTICLE

Chemical composition and antibacterial properties of the essential oils and crude extracts of *Merremia borneensis*

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Neopentane;
2-Methyl-2-nitropropane;
α-Humulene;
MIC;
Antibacterial activity

Abstract The hydro distilled essential leaves and stems oils of *Merremia borneensis* were analysed by GC–MS. Sixty-nine compounds representing 96.81% and 89.89% of the leaves and stems oils, respectively, were identified, of which chloromethyl propanoate (3.29% and 3.54%), methylcyclopropanemethanol (1.29% and 1.03%), oxirane (1.41% and 1.05%), 1-penten-3-ol (1.33% and 1.12%), 1-(2-propenyloxy)-heptane (3.44% and 2.98%), camphene (4.11% and 3.65%), l-octen-3-ol (1.56% and 1.08%), α-pinene (2.98% and 2.12%), β-pinene (2.19% and 1.93%), 2-methyl-2-nitropropane (11.91% and 10.51%), bis(1,1-dimethylethyl)-diazene (1.25% and 1.71%), *p*-cymene (2.23% and 2.11%), limonene (1.28% and 1.11%), neopentane (12.02% and 11.95%), cyclopropyl methyl carbinol (2.19% and 1.99%), *cis*-2-octenal (1.29% and 1.13%), 4-undecanone (4.11% and 3.99%), menthone (1.99% and 1.73%), isomenthone (1.01% and 0.93%), methylchavicol (1.57% and 2.22%), dodecane (1.01% and 0.72%), eugenol (3.12% and 3.09%), β-elemene (1.99% and 1.89%), methyleugenol (1.42% and 1.13%), β-carryophyllene (1.12% and 1.05%), α-humulene (6.54% and 6.32%), tridecane (1.16% and 1.08%) were the major compounds. Thus, different types of monoterpenes and sesquiterpenes were the predominant portions of the oils. Essential oils and methanol extract of *M. borneensis* and the derived fractions of hexane, chloroform, and ethyl acetate were tested for antibacterial activity, which was determined by disc diffusion and minimum inhibitory concentration (MIC) determination methods. The oils, methanol extract and derived fractions of methanol extract did not display any potential of antibacterial activity against the tested 10 phytopathogenic bacterial such as *Enterobacter cloacae*, *Staphylococcus aureus*, *Escherichia coli*,

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Bacillus cereus, *Salmonella typhimurium*, *Salmonella biafra*, *Klebsiella pneumoniae*, *Vibrio cholerae* and *Vibrio parahaemolyticus*, in the range of 0% and minimum inhibitory concentration ranging from 25 to 100 μg/ml.

1. Introduction

Plants have great potential sources for producing new drugs of benefit to mankind. There are many approaches in the search for new biologically active principles in higher plants (Abramowize, 1990). Many efforts have been scientifically expended to discover new antimicrobial compounds from various kinds of sources such as soil, microorganisms, animals and plants. One such resource is folk medicine and systematic screening of these traditional herbs may result in the discovery of novel effective compounds (Ahmad et al., 1998; Aswal et al., 1996; Bauer et al., 1966).

Antibacterial properties of different parts of plant like roots, stems, leaves, flowers, fruit and seeds have been well documented for some of the medicinal plants for the past two decades (Aswal et al., 1996; Mitscher et al., 1987; Mourey and Canillac, 2002; Olah et al., 2003). Most of the medicinal and aromatic plants and essences are rich sources in antibacterial compounds which can be an alternative to combat bacterial diseases (Bauer et al., 1966; Benson, 1990; Fong, 1973; Fransworth and Loub, 1983; Janovska et al., 2003; Laven et al., 1979; Nelson, 2007). In recent years antimicrobial properties of Bangladeshi medicinal plants have been increasingly reported (Nelson, 2007; Samy et al., 1998; Schumutterer, 1990).

Chemical bactericides are known to be highly effective to control the postharvest diseases in various vegetables and fruits. Due to the health concerns associated with exposure risks such as health and environmental hazards, residue persistence, and development of tolerance they are not able to consider as long-term solutions (Lingk, 1991; Radja Commare et al., 2002). For the search of synthetic chemical bacteriocidal alternatives, the increasing recognition and importance of bacterial infections and the difficulties encountered in their treatment have stimulated. Recently, researchers have been very much interested in biologically active compounds isolated from plant species for the elimination of pathogenic microorganisms because of the resistance that they have developed to antibiotics (Hunter and Reeves, 2002). Essential oils are made up of many different types of volatile compounds and have been shown to possess antimicrobial and antibacterial properties (Karmen et al., 2003; Ahmet et al., 2005). Essential oils and organic plant extracts are gaining increasing interest because of their relatively safe status, their wide acceptance by consumers, and their exploitation for potential multi-purpose functional uses (Sawamura, 2000; Ormancey et al., 2001). So, essential oils and organic plant extracts are one of the most promising groups of natural compounds for the development of safer antibacterial agents.

Merremia borneensis is applied as a medicinal plant because of the diuretic, antifungal and bacteriostatic properties of its leaves (Prieto et al., 1999). Most of the scientific and academic papers dealing with this subject refer these effects to the content of potassium, inositol and lipophilic flavones in *M. borneensis* leaves (Schut and Zwaving, 1993; Schneider and Tan, 1973). In addition to the above-mentioned components, saponins, sterols, polyphenols, rosmarinic acid and ursolic acid and essential oil have been also detected (Stecher, 1976; Tezuka et al., 2000; Hossain et al., 2006; Guillen and Manzanos, 1998; Haznedaroglu et al., 2001; Jovanovic et al., 2005). The leaves are suitable to be used as wrapper to the famous fermented rice or fermented tapioca known in Malaysia as 'Tapai'. The medicinal plant creeps well and is very productive in shady areas as well as open areas and are known to blanket a wholesome tree or on any objects that it chooses to make its habitat. The stem contains latex that is highly sticky and the flowers are white in color. The Bilaran leaves, according to natives in Sarawak, Malaysia, are used to relieve breast cancer (Prieto et al., 1999). In some cases, the essential oil is the reason for diuretic effects of plant drugs, which has not yet been described in detail. Based on preliminary analyses, however, there is no report available in the literature on the detailed analyses of essential oil of *M. borneensis* and its antibacterial property.

Therefore, the aim of this present study is (a) to examine the chemical composition of the essential oils isolated from the leaves and stems of *M. borneensis* by GC–MS; and (b) to evaluate the anti-bacterial activity of essential oils and methanolic extract of *M. borneensis* and its derived fractions of hexane, chloroform and ethyl acetate against certain important phytopathogens causing severe diseases in the plants.

2. Materials and methods

2.1. Plant material

The leaves and stems of *M. borneensis* were collected from the campus area at University Malaysia Sabah in Malaysia, in November 2010 and initially identified by morphological features and data base present in the library, School of Biology, University Malaysia Sabah.

2.2. Sample collection

The fresh green leaves and stems of *M. borneensis* were collected from the campus of Universiti Malaysia Sabah, Malaysia. The leaves of this plant were harvested during the month of September 2010. The leaves and stems sample were collected at 2:00 pm–3:00 pm on September 2, 2010 and packed in polyethylene bags and stored at 4 °C until required. The plant samples were initially identified by morphological features and data base present in the library, School of Biology, University Malaysia Sabah, Malaysia. About 50 g of leaves were ground using a grinder (Blender 80115) for 20 s. The unfermented *M. borneensis* leaves and stems were kept in the oven at 40 °C and put in a desiccator for at least 24 h prior to analysis.