## Table 10.0: Summary of Investigations of the Genera *Beilschmiedia* and *Endiandra*

| **Genus: activity** | | |
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| Species (origins) | Investigations and traditional use (if known) | Resources |
| ***Beilschmiedia*** | | |
| **Anti-inflammatory** | | |
| *Beilschmiedia tsangii* (China, Vietnam, Taiwan) | Anti-inflammatory activity: various components, especially endiandric acid M | Huang et al. (2011 & 2012) |
| | Vanillin and 4-hydroxybenzaldehyde: analgesic, anti-inflammatory and antifungal | Pepin (2012) |
| *Beilschmiedia fulva* (Africa: Gabon) | Endiandric acid H derivatives: treatment of allergies and asthma | Oldham et al. (2013); Lenta et al. (2015) |
| *Beilschmiedia pulverulenta* (Malaysia) | Essential oil (45% eugenol): significant anti-inflammatory activity; also anti-tyrosinase and anticholinesterase activity; potential for use in inflammatory disorders and rheumatism | Salleh et al. (2016) |
| **Antimicrobial** | | |
| *Beilschmiedia alloiophylla* (Central and South America) | Numerous bioactive alkaloids present: includes laurelliptine and isoboldine; the latter possesses moderate antifungal activity | Mollataghi et al. (2012b); Lenta et al. (2015) |
| | Extract: antifungal, contains a potent anti-candida aporphine alkaloid (2-hydroxy-9-methoxyaporphine) | |
| *Beilschmiedia acuta* (Africa, Cameroon) | Antibacterial: good activity, including activity against drug resistant bacteria | Tankeo et al. (2016) |
| *Beilschmiedia anacardioides* (Africa, Cameroon) | Traditional use: treatment of uterine tumours, rubella, female genital disorders and rheumatism | Chouna et al. (2009); Pepin (2012) |
| Contains endiandric acid derivatives (beilschmiedic acids) | Beilschmiedic acid C: significant activity against *Bacillus subtilis, Micrococcus luteus, Streptococcus faecalis*; clinical potential for treating Streptococcus arthritis | |
| *Beilschmiedia cinnamomea* (Africa, Cameroon) | Extract: synergistic effect against MDR bacteria in combination with antibiotics i.e. cefepime, norfloxacin, ciprofloxacin, erythromycin | Fankam et al. (2011) |
| *Beilschmiedia cryptocaryoides* (Africa, Madagascar) | Traditionally use: treatment of infectious disorders | |
| | Moderate antibacterial activity: beilschmiedic acid derivatives (cryptobeilic acids A–D) and | Talontsi et al. (2013) |

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| | tsangibeilin B isolated from bark with activity against *E.coli* | |
| *Beilschmiedia erythrophloia* (Taiwan) | Endiandric acid analogues (root extracts): antituberculosis potential | Yang et al. (2009) |
| | Antimycobacterial activity: erythrophloin C and suberosol; also beilschmins A and B. | |
| | Phenolics: oligandrol methyl ether and derivatives, plus farnesylol are also present | Pepin (2012) |
| *Beilschmiedia glabra* (Malaysia) | Essential oil (bark and leaf): antioxidant, anti-inflammatory and antifungal activity; strong activity shown against *Candida glabrata* and *Saccharomyces cervisiae* | Salleh et al. (2015a) |
| *Beilschmiedia madang* (Indonesia, New Guinea) | Essential oil (bark and leaf): antioxidant and moderate antibacterial activity; active against *Klebsiella pneumoniae*, *Enterococcus faecalis*, *Bacillus subtilis* and *Staphylococcus aureus*, also strongly antifungal against *Aspergillus* (bark) | Setzer et al. (2007); Salleh et al. (2015b) |
| *Beilschmiedia mannii* (Ivory Coast, Africa) | Antimicrobial properties of fruit extracts | Ahoua et al. (2015) |
| *Beilschmiedia mearsii* (South America, Chile) | Antimicrobial essential oil: active against plant pathogens (fungi and bacteria) | Carvajal et al. (2016) |
| *Beilschmiedia obscura* (Africa, Cameroon) | Fruit extracts: significant antibacterial activity | Fankam et al. (2014) |
| *Beilschmiedia pulverulenta* (Malaysia) | Essential oil: strong activity against gram-positive bacteria; also moderate antifungal properties | Salleh et al. (2016) |
| *Beilschmiedia sp* (Gabon, Africa) | Beilschmiedic acids: potent antibacterial properties, including anti-MRSA activity | Williams et al. (2012) |
| *Beilschmiedia tovarensis* (Colombia, South America) | Wood extracts: significant antibacterial activity against *Staphylococcus aureus* and *Enterococcus faecalis* | Suarez & Vargas (2005) |
| *Beilschmiedia tsangii* (China, Vietnam, Taiwan) | Anti-tuberculosis: beilschmins A and B show antimycobacterial activity. | Chen et al. (2007) |
| *Beilschmiedia volkii* (Australia) | Lignin: magnolol has antibacterial properties | Lenta et al. (2015) |
| *Beilschmiedia zenkeri* (Africa: Cameroon) | Fruits: spice; medicinal use as an appetite stimulant (*B. gabonensis* used similarly) | Lenta et al. (2009 & 2015); Iwu (2014) |
| | Stem bark extract and flavonoid components: moderately antibacterial, also | Lenta et al. (2009); |

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| | antiplasmodial activity | Pepin (2012) |
| | Stem bark flavonoids: anti-tuberculosis (anti-Mycobacterial) potential | Yasir et al. (2019) |
| **Anticancer studies** | | |
| *Beilschmiedia acuta* (Africa, Cameroon) | Anticancer remedy and anthelmintic (treatment of intestinal worms): leaf and root extracts show significant anticancer properties against a range of cancer cell lines | Kuete et al. (2014); Mbaveng et al. (2017) |
| *Beilschmiedia erythrophloia* (Taiwan, China) | Leaf essential oil: rich in β-caryophyllene (22.6%) and α-humulene (21.9%), with lesser amounts (4–5% each) of terpinene-4-ol, β-ocimene, sabinene and limonene | Su & Ho (2013) |
| | Essential oil: cytotoxic activity against human oral, liver, lung, colon, melanoma and leukaemia cancer cells | |
| *Beilschmiedia ferruginea* (IndoChina: Vietnam) | Leaf and flower extracts: ferrugineic acids with anti-apoptosis potential, notably ferrugineic acids B and C | Apel et al. (2014) |
| *Beilschmiedia kunstleri* (Malaysia) | Numerous alkaloids common to the Lauraceae are present e.g. nornuciferine, isocaryachine, cassythicine, laurotetanine, boldine, noratherosperminine and *N*-demethylphyllocaryptine | Mollataghi et al. (2012a) |
| | Kunstleramide: antioxidant, cytotoxic and moderate antiproliferative potential, active against various cancer cell lines | Mollataghi et al. (2012a); Venkateshwarlu et al. (2016) |
| *Beilschmiedia mannii* (Ivory Coast, Africa) | Chemopreventive potential | Ahoua et al. (2019) |
| *Beilschmiedia tsangii* (China, Vietnam, Taiwan) | Anticancer activity: cytotoxic components: notably α-tocospiro B (a tocospheroid), tsangins A and B | Chen et al. (2006); Lenta et al. (2015); Chen et al. (2021) |
| *Beilschmiedia sp* (Gabon, Africa) | Beilschmiedic acids: cytotoxic activity against lung cancer cell lines | Williams et al. (2012) |
| **Antiparasitic studies** | | |
| *Beilschmiedia alloiophylla* (Central and South America) | Extract: antileishmanial activity | Mollataghi et al. (2012b) |
| *Beilschmiedia cryptocaryoides* (Africa, Madagascar) | Antiplasmodial: cryptobeilic acids (A–D) and tsangibeilin B active against chloroquine resistant *Plasmodium falciparum* | Talontsi et al. (2013) |
| *Beilschmiedia louisii,* | *Trypanosoma*: potent anti-trypanosoma | Waleguele et al. |

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| *Beilschmiedia obscura* (Cameroon, Africa) | activity (beilschmiedols B and C from *B. obscura* stem bark, *B. louisii* roots) | (2020) |
| *Beilschmiedia madang* (Indonesia, New Guinea) | Alkaloid: dehatrine shows antimalarial properties with experimental activity similar to quinine; significant inhibition of chloroquine resistant strain of *Plasmodium falciparum* | Kitagawa et al. (1993) |
| *Beilschmiedia tilaranensis* and *B. brenesii* (Central and South America) | Essential oil: anti-trypanosoma activity (curzain-inhibition) | Setzer et al. (2007) |
| **Neurological properties** | | |
| *Beilschmiedia alloiophylla* (Central and South America) | Alkaloids: laurotetanine, liriodenine and 2-hydroxy-9-methoxyaporphine, all had an inhibitory effect on acetylcholine which suggests potential for use in memory disorders | Mollataghi et al. (2012b) |
| *Beilschmiedia madang* (Indonesia, New Guinea) | Leaf: good inhibitory activity against cholinesterase and tyrosinase | Salleh et al. (2015b) |
| *Beilschmiedia miersii* (South America: Chile) | Leaf oil: sarisan (an isomer of myristicin) is present with insect repellent activity | Kumamoto & Scora (1970); Lenta et al. (2015) |
| | High levels of sarisan (39–46%): excitant (increased sensitivity to stimulation) and CNS depressive; sarisan is also present in the essential oil of *Piper solmsianum* from Brazil | Moreira et al. (2001); Carvajal et al. (2016) |
| **Antidiabetic components** | | |
| *Beilschmiedia alloiophylla* (Central and South America) | Numerous alkaloids: e.g. laurotetanine, liriodenine, boldine, secoboldine, isoboldine, asimilobine etc. | Mollataghi et al. (2012b) |
| | Oreobelline: antidiabetic potential (alpha-glucosidase inhibition) | |
| ***Endiandra*** | | |
| **Antibacterial** | | |
| *Endiandra bessaphila, E. leptodendron, E. monothyra, E. wolfii* (Australia) | | Banfield et al. (1994) |
| **Anticancer studies** | | |

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| *Endiandra anthropophagorum* (Australia) | Dihydroguaiaretic acid (DHGA): cytotoxic against lung cancer cells | Davis et al. (2009) |
| | Endiandrins: moderate cytoxicity | |
| *Endiandra kingiana* (Malaysia) | Endiandric acids and kingianic acids: some are cytotoxic; kingianins and kingianic acid C show anticancer (apoptosis-inducing) activity | Leverrier et al. (2011); Azmi et al. (2014) |
| **Anti-inflammatory, immunomodulatory potential** | | |
| *Endiandra anthropophagorum* (Australia) | Endiandrin A (a lignin), nectandrin B and DHGA: influence glucocorticosteroid activity | Davis et al. (2007); Kuntzsch et al. (2012); Lenta et al. (2015) |

The essential oil analysis of *Beilschmiedia* appears to be fairly limited, as far as species numbers are concerned, with only 10 species being evaluated to date – none of which are of Australian origins. These studies however, do suggest good bioactivity (see Table 10), with various components possessing antimicrobial, anti-inflammatory, antioxidant, analgesic and neuroprotective properties. Some can be present in quite respectable amounts (leaf oil analysis, unless otherwise stated; see also Lenta et al. 2015; Salleh et al. 2015b):

- Germacrene D: *B. alloiophylla* (19%), *B. brenesii* (19%), *B. miersii* (25%) and *B. tilaranensis* (55%)
- β-caryophyllene: *B. erythrophloia* (23%), *B. 'chanco blanco'* (17%), *B. madang* (10%), *B. pendula* (branch: 17%), *B. tilaranensis* (15%)
- (*E*)-caryophyllene: *B. brenesii* (13%)
- α-terpinene: *B. miersii* (10%), *B. pendula* (10%), *B. tarairie* (18%)
- α-pinene: *B. tarairie* (18%), *B. alloiophylla* (12%), *B. 'chanco blanco'* (12%)
- β-pinene: *B. tarairie* (9%, *B. 'chanco blanco'* (8%), *B. pendula* (10%)
- Bicyclogermacrene: *B. 'chanco blanco'* (14%)
- β-ocimene: *B. alloiophylla* (*cis* 19% and *trans* 9%)
- β-selinene: *B. pendula* (branch: 9%)
- δ-cadinene *B. madang* (leaf 17% and bark: 20.5%)
- α-bisabolol: *B. costaricensis* (72%)
- α-humulene: *B. erythrophloia* (22%), *B. brenesii* (8%)
- α-cubebene: *B. brenesii* (13%), *B. madang* (leaf 11% and bark 16%)
- *y*-curcumene: *B. miersii* (10%)
- α-cadinol: *B. madang* (bark: 11%)
- 2-undecanone: *B. brenesii* (13%)

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