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Potentiality of plants as source of insecticide principles

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Abstract In the search for alternatives to conventional insecticides, essential oils extracted from aromatic plants have been widely investigated. Their toxicities toward insects were of special interest during the last decade. The purpose of this paper is to provide an overview of the data published mostly in the past 10 years on aromatic plant and plant's essential oils that have been reported to possess insecticidal activity and practical methods and recent techniques for screening these compounds. The review refers to 230 plants, their geographical distribution and the organism tested. Some aspects of recent insecticidal activity directed research on natural products are discussed.

1. Introduction

Chemical control is an effective strategy used extensively in daily life (Pavela, 2009a). However, the widespread use of synthetic insecticides has led to many negative consequences (Pavela, 2008), resulting in increasing attention to natural products (Pirali-Kheirabadi and da Silva, 2010). Among biopesticides, botanical ones are experiencing a revival due to their eco-toxicological properties (Cosimi et al., 2009). Plants play pivotal roles in ecological systems (Garcia et al., 2007). They may provide potential alternatives to currently used insect-control agents because they constitute a rich source of bioactive chemicals (Qin et al., 2010). Essential oils are among the best-known substances tested against insects (Pitasawat et al., 2007). These compounds act as fumigants (Choi et al., 2006), contact insecticides (Tang et al., 2007), repellents (Islam et al., 2009) and antifeedants (Gonzalez-Coloma et al., 2006) and may affect some biological parameters such as growth rate (Nathan et al., 2008), life span and reproduction (Isikber et al., 2006).

Risks and problems associated with the use of chemicals lead to increasingly stringent environmental regulation of pesticides (Pavela et al., 2010). There is therefore an urgent need to develop safer, more environmentally friendly and efficient alternatives that have the potential to replace synthetic pesti-

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Table 1 List of some tested plant essential oils for their insecticidal activity.

Botanical name	Species (References)
Abutilon	*A. indicum* (Abdul Rahuman et al., 2008b)
Acer	*A. campestre*, *A. cissifolium*, *A. negundo*, *A. platanoides*, *A. pseudoplatanus* (Pavela, 2008)
Achillea	*A. millefolium* (Pavela, 2008; Conti et al., 2010)
Aegiphila	*A. lhotskiana* (de Mendonça et al., 2005)
Aegle	*A. marmelos* (Abdul Rahuman et al., 2008b)
Aframomum	*A. melegueta* (Ukeh et al., 2009)
Ageratum	*A. conyzoides* (Bouda et al., 2001; de Mendonça et al., 2005)
Ailanthus	*A. altissima* (Pavela, 2009a)
Ajuga	*A. iva* (Jbilou et al., 2008), *A. reptans* (Pavela, 2008)
Alexitoxicon	*A. scandens* (Pavela, 2009a)
Allium	*A. cepa* (Pyun and Shin, 2006; Khater et al., 2009), *A. sativum* (Yang et al., 2010)
Alpinia	*A. offcinarum* (Choi et al., 2006)
Ammi	*A. visnaga* (Pavela, 2008)
Amygdalae	*A. oleum raffinatum* (Choi et al., 2006)
Amyris	*A. balsamifera* (Pavela, 2009b; Amer and Mehlhorn, 2006a,b,c)
Anacardium	*A. occidentalis* (de Mendonça et al., 2005)
Andira	*A. inermis* (de Mendonça et al., 2005)
Anethum	*A. graveolens* (Choochote et al., 2007; Amer and Mehlhorn, 2006a,b,c)
Angelica	*A. archangelica* (Pavela, 2009a), *A. sinensis* (Choi et al., 2006)
Aniba	*A. rosaeodora* (Amer and Mehlhorn (2006a,c)
Annona	*A. crassiflora* and *A. glabra* (de Mendonça et al., 2005), *A. squamosa* (Senthilkumar et al., 2009)
Anthemis	*A. nobilis* (Pavela, 2009b; Amer and Mehlhorn, 2006a,c), *A. tinctoria* (Pavela, 2009a)
Apium	*A. graveolens* (Pitasawat et al., 2007)
Arctium	*A. lappa* (Pavela, 2009a)
Aristolochia	*A. baetica* (Jbilou et al., 2008) , *A. indica* (Kamaraj et al., 2010)
Arnica	*A. montana* (Choi et al., 2006)
Artemisia	*A. abrotanum* and *A. campestris* (Pavela, 2009a), *A. absinthium* (Squires et al., 2011), *A. annua* (Senthilkumar et al., 2009; Squires et al., 2011), *A. herba-alba* and *A. monosperma* (Abdel-Shafy et al., 2009), *A. judaica* (Abdelgaleil et al., 2008), *A. taurica* (Pavela, 2008), *A. vestita* (Chu et al., 2010)
Astragalus	*A. chinensis* (Pavela, 2009a), *A. excarpus* (Pavela, 2008)
Azadirachta	*A. indica* (Choi et al., 2006; Kebede et al., 2010; Xu et al., 2010)
Balsamita	*B. major* (Pavela, 2009a)
Baptisia	*B. tinctoria* (Choi et al., 2006)
Borago	*B. officinalis* (Pavela, 2009a)
Boswellia	*B. carteri* (Amer and Mehlhorn, 2006a,b,c; Choi et al., 2006)
Bryonia	*B. dioica* (Pavela, 2009a)
Bupleurum	*B. exaltatum* (Pavela, 2008)
Caesalpinia	*C. pyramidalis* (de Mendonça et al., 2005)
Calotropis	*C. procera* (Elimam et al., 2010)
Campanula	*C. longistyla* (Pavela, 2008)
Cananga	*C. odorata* (Choi et al., 2006)
Cannabis	*C. sativa* (Pavela, 2009b)
Carapa	*C. guianensis* (de Mendonça et al., 2005)
Carthamnus	*C. lanatus* (Pavela, 2009a)
Carum	*C. carvi* (Pitasawat et al., 2007; Lopez et al., 2008), *C. copticum* (Sahaf and Moharramipour, 2008)
Cassia	*C. angustifolia* (Kamaraj et al., 2010), *C. fistula* (Senthilkumar et al., 2009)
Cedrela	*C. fissilis* (de Mendonça et al., 2005)
Centaurea	*C. orientalis* (Pavela, 2008)
Centaurium	*C. erythraea* (Jbilou et al., 2008)
Centella	*C. asiatica* (Senthilkumar et al., 2009)
Cestrum	*C. nocturnum* (Patil et al., 2010)
Chamaemelum	*C. nobile* (Amer and Mehlhorn, 2006a,c)
Chromolaena	*C. odorata* (Bouda et al., 2001)
Cichorium	*C. intybus* (Pavela, 2009a)
Cinnamomum	*C. camphora* (Amer and Mehlhorn, 2006a,c), *C. osmophloeum* (Cheng et al., 2009a), *C. zeylanicum* (Prajapati et al., 2005; Amer and Mehlhorn, 2006a,c)
Circium	*C. arvense* (Pavela, 2008)
Citrullus	*C. colocynthis* (Abdul Rahuman et al., 2008c)
Citrus	*C. aurantium* (Choi et al., 2006; Pavela, 2009b), *C. bergamia* (Cosimi et al., 2009), *C. cinesis*, *C. reticulate*, *C. vulgaris* and *C. X paradisi* (Choi et al., 2006), *C. limon* (Amer and Mehlhorn, 2006a,b,c)
Clausena	*C. dentata* (Rajkumar and Jebanesan, 2010)
Clematis	*C. vitalba* (Pavela, 2009a)
Cleome	*C. hirta* (Ndungu et al., 1999)
Commiphora	*C. nolnol* (Choi et al., 2006)