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Antifeedant activities of terpenoids isolated from tropical Rutales

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Abstract

Terpenes isolated from tropical species of the Rutales were tested for insect antifeedant activity against rice weevil, *Sitophilus oryzae* (L.) using a flour disk bioassay that requires only small amounts of compounds (0, 0.05, 0.25 and 0.50% w/w). At 0.50% (w/w) five compounds isolated from *Lansium domesticum* (iso-onoceratriene, 3-keto-22-hydroxyonoceradiene, onoceradienedione, lansiolic acid and lansiolic acid A) were shown to exhibit significant antifeedant activity. Humilinolide C and D isolated from *Swietenia humilis,* and gedunin from *Cedrela odorata*, were also active at 0.50% (w/w). The most interesting results were obtained from the spirocaracolitones from *Ruptiliocarpon caracolito* which produced total feeding inhibition at 0.50% and potent antifeedant activity at concentrations as low as 0.05%. In conclusion, the antifeedant bioassay provides a rapid and inexpensive method for screening novel compounds available in small quantities to assess their activity as insect antifeedants.

Keywords: Insect control agents; Antifeedants; *Sitophilus oryzae*

1. Introduction

In the New World tropics as well as in Southeast Asia, native trees of the order Rutales are well known for the production of bioactive terpenoids (Isman et al., 1997; Arnason et al., 1993, 1987). In particular, the plant family Meliaceae is noted for the production of useful bitter principles which are insect antifeedant and growth-reducing substances with low mammalian toxicity (Butterworth and Morgan, 1968; Arnason et al., 1985; Schmutterer, 1990; Isman et al., 1997). In recent years, bioactive terpenoids have been isolated from different neotropical species including *Cedrela odorata* L., *Ruptilocarpon caracolito* L. (MacKinnon, 1995), and *Swietenia humilis* Zucc. (Jimenez et al., 1997).

Lansium domesticum Corr. Serr. (Meliaceae) is a tree native to Southeast Asia producing a sweet and aromatic fruit, which is a popular dessert (Wong et al., 1994). The leaves have been used by indigenous people in the Philippines for the control of mosquitoes (Monzon et al., 1994). The peel of this fruit is traditionally known to be toxic to domestic animals. Phytochemical investigations of the peel revealed the presence of triterpene glycosides, and seco-onoceranoids such as lansic acid (Nishizawa et al., 1983). The volatile constituents of the fruit are sesquiterpene hydrocarbons including germacrene-D (Wong et al., 1994). The seed and leaf contain tetranortriterpenoids named dukunolides (Nishizawa et al., 1985, 1989). The major triterpenoid compound of the leaf is lansiolic acid and the minor triterpene is characterized as cycloartanoid type carboxylic acid.

The bark of *L. domesticum* is used traditionally as an antimalarial remedy by the native people of Borneo (Leaman et al., 1995). Despite the importance of such use, there was no published phytochemical investigation on

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the bark until our group successfully isolated six novel triterpenes namely iso-onoceratriene, 3-keto-22-hydroxyonoceradiene, onoceradienedione, lansiolic acid, lansiolic acid A and 3-keto lansiolic acid (unpublished). In this paper, we report the bioactivity of these compounds and related terpenes isolated from neotropical species using a *Sitophilus oryzae* L. antifeedant bioassay well suited to study of small amounts of pure compounds.

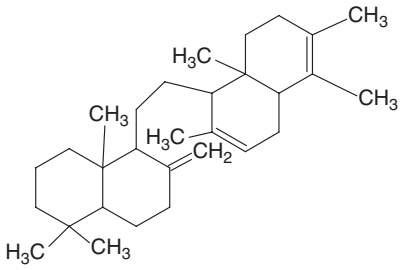
2. Material and methods

2.1. Insect rearing

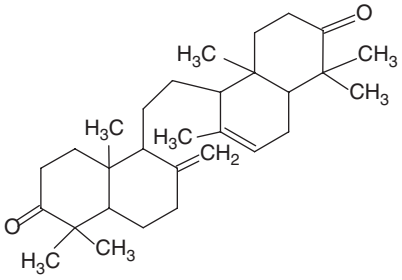
Rice weevils, *S. oryzae* (Coleoptera: Curculionidae), were obtained from Agriculture and Agri-Food Canada, Winnipeg, MB. Insects were reared in a growth chamber (30 °C, 85% r.h. and 18 h light:6 h dark photoperiod) on Western Hard Red Spring wheat at 14% moisture content.

2.2. Bioassay

The bioassay was performed according to a method developed by Xie et al. (1996). Hard red spring wheat flour (200 mg) was added to 1 mL of an aqueous solution containing the test substance at a concentration of 0.5% w/w and mixed using a magnetic stirrer. Ten aliquots (100 μL each) of the stirred suspension were placed in a 100 × 15 mm plastic Petri dish and allowed to dry overnight in air at room temperature. The next day, five of the flour disks were weighed and placed in a new Petri dish with 25 insects. The Petri dish was then sealed with parafilm paper and kept at 30 °C and 85% r.h. for 3 days. Finally, the uneaten parts of the flour disks were weighed. The insect consumption for the different test substances was compared to the control group. As only very small quantities of isolated compounds were available, experiments were done in duplicates.



ONOCERATRIENE



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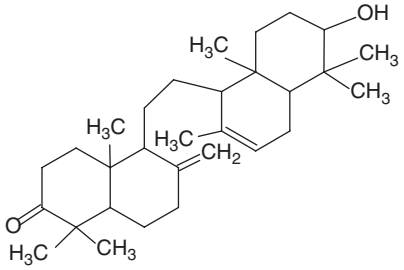
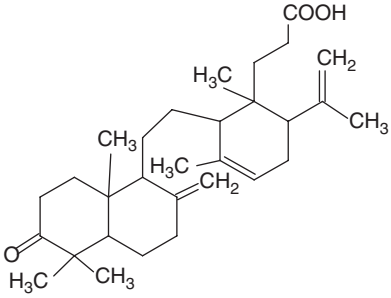
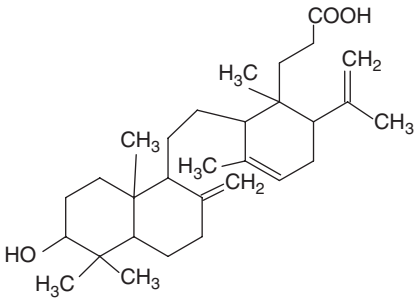


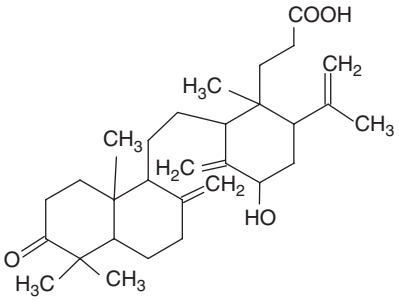
3-KETO-22-HYDROXYONOCERADIENE



3-KETOLANSIOLIC ACID



LANSIOLIC ACID



LANSIOLID ACID A

Fig. 1. Structures of triterpenes isolated from *Lansium domesticum* from Borneo.