Bioactivity of Aviprin and Aviprin-3''-O-Glucoside, Two Linear Furanocoumarins from Apiaceae1

Seyed Mehdi Razavi1,2 and Gholamreza Zarrini1

1 Department of Biology, Faculty of Sciences, University of Mohaghegh Ardabili, Ardabil, Iran
2 Department of Animal Sciences, Faculty of Natural Sciences, University of Tabriz, Tabriz, Iran

Received October 20, 2009; in final form, November 19, 2009

Abstract—Furanocoumarins are well-known natural products that occur in the most evolved genera of Apiaceae family. This compounds were found to have cytotoxic, phytotoxic, photosensitizing, insecticidal, antibacterial and high antifungal effects. Aviprin is considered as a linear furanocoumarin substituted at C8 with an oxygenated prenyl residue. In this study we found that aviprin is a bioactive compound that exhibits high antibacterial, antifungal and phytotoxic activity. The compound stunted the germination of lettuce seeds with IC50 value of 0.270 mg/ml. The compound also inhibited the mycelia growth of Sclerotinia sclerotiorum. Aviprin indicated antibacterial activity against tested gram negative and positive bacteria with inhibition zone of 19–23.5 mm. Our results shown that aviprin can play an allelopathic role for plant.

Key words: furanocoumarin, aviprin, allelochemicals, Sclerotinia sclerotiorum

DOI: 10.1134/S1068162010030118

INTRODUCTION

A characteristic feature of plants is their capacity to produce a large variety of low molecular weight compounds, the so-called secondary metabolites or natural products. These compounds were previously thought to be simply functionless end products of metabolism, or metabolic wastes. Over the two last decades, it has become evident that plant secondary metabolites are not just waste products, but also they have an important role in the plants producing them. They serve as chemical defense compounds against herbivorous animals, pathogen fungi and bacteria, and competing plants. They may also play attractant role for pollinators and seed dispersing animals [1]. On the other hand, due to different biological activity, natural products are widely used as drugs for treatment of different human illness. Approximately one-third of the top-selling drugs in the world are natural products or their derivatives with ethnopharmacological background [2].

Furanocoumarins are well-known natural products that occur in the most evolved genera of Apiaceae family such as Angelica, Prangos and Peucedanum. There are many reports on different biological activity of these compounds. Furanocoumarins were found to have cytotoxic, phytotoxic, photosensitizing, insecticidal, antibacterial and high antifungal effects. They are inhibitors of different enzymes and block the synthesis of some metabolites [3]. In this investigation, we will study some biological activity of aviprin and its glucosylated derivative (Fig. 1) that are considered as linear furanocoumarins.

RESULTS AND DISCUSSION

Phytotoxic assays showed that aviprin significantly reduced seed germination of lettuce dose-dependent manner (Fig. 2). In the concentration higher than 1 mg/ml, aviprin entirely stunted the germination of lettuce seeds. The IC50 values for aviprin phytotoxicity were calculated as 0.270 mg/ml for seed germination of lettuce. Our results also showed that aviprin-3''-O-D-glucopyranosid exhibited less phytotoxic activity than aviprin as this activity appeared in high concentrations (> 1 mg/ml). The respected IC50 values for this compound were calculated as 0.575 mg/ml.

The fungitoxic assays approved that aviprin displayed high fungitoxic effects against Sclerotinia sclerotiorum, a common plant pathogen fungus. Addition of 0.01, 0.1 and 1 mg/ml of aviprin to fungus media inhibited the radial mycelia growth to 28, 42 and 100%, respectively (Fig. 3). Aviprin-3''-O-glucoside did not show significant antifungal activity in the test.

Table presents antibacterial effects of aviprin and aviprin-3''-O-glucoside. As it is shown, aviprin at concentration of 200 μg/disk displayed high antibacterial activity on both bacilli and cocci gram positive bacteria with inhibition zone of 19–23.5 mm. The compound also had antibacterial effect on meticillin resistant strain of Staphylococcus aureus (E38) with inhibition zone of 10.5 mm. Aviprin-3''-O-D-glucopyranosid did not
exhibit considerable antibacterial activity. Our finding tend to indicate that aviprin and its derivatives play an allelopatric role for bearing plants. Plants have their own defense mechanism against bioagents by producing allelochemicals. The allelochemicals from plants can be utilized for the purpose of managing weeds, pathogens, diseases and herbivores. In the last decades, in spite of the successful weed and pest control achieved with synthetic toxins, certain weeds, pests and pathogen species ultimately evolved resistance to some of this chemicals occurred very rapidly (2–3 years) and led to cross resistance to entire chemical class. The use of synthetic toxins is also claimed to negatively effect the environment. Therefore, at the recent years, there are many efforts to introduce new natural chemicals and new target sites or development of crop plants genetically engineered to be allelopatric to weeds, pests and pathogens [4].

The literature review showed that aviprin and releated derivatives have been already found in some species of Apiaceae and Rutaceae families [5]. It is assumed that the compounds are released as the plant leaves or roots decompose and act as growth inhibitors on surrounding competing weeds. These compounds may combat pathogenic bacteria and fungi and herbivorous insects.

Our findings revealed that aviprin displayed high antibacterial activity specially on some antibiotic resistant bacteria strains. Some other reports demonstrated that furanocoumarins have antiproliferative, antioxidant, anticonvulsant and anticoagulant activity [6]. The results obtained also revealed that aviprin exhibited more bioactivity than aviprin glucoside that might be attributed to the presence of sugar moiety. Thus, it is proposed that aviprin-3''-O-glucoside should be a conjugated inactive form of aviprin that may also be a storage form of it.