Technical

Nonedible Seed Oils as Insect Repellent

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ABSTRACT

Petroleum ether extracts of seeds at 10-1% concentration were tested for insecticidal activity against stored grain insects, *Tribolium castaneum* Herbst., in the laboratory. About 50 oils were tested, of which ten showed repellent, antifeedant property up to 1% concentration.

INTRODUCTION

Involvement of natural products as pesticides led the way to the discovery of new pesticides including insect repellent or antifeedant chemicals. Repellent property of neem seed and its extracts has been reported by several workers (1-2). Later, Pandey et al. (3) reported four seed powders and their extracts as protection against pulse beetle. Recently, Jacobson and Crystal (4) reported several seed oils rich in polyunsaturated fatty acids as Boll weevil feeding deterrent. The present work is a further step in exploring antifeedant compounds from nonedible seed oils.

EXPERIMENTAL PROCEDURE

The insects used in the test were adult red flour beetles, *Tribolium castaneum* Herbst. Seven- to 14-day old insects were reared on wheat flour with 5% brewers yeast powder at 28 ± 1 C temperature and 75 ± 5% RH in BOD incubator.

EXPOSURE METHOD

In this test, "Schleicher and Schuell" 740 E (1/2 in. diameter) paper discs were used. Treated and control discs were kept on opposite sides of the glass petri dishes of 12 cm diameter. The discs were folded in the form of an inverted "V" to permit the insects to crawl under the discs. The test chemicals were used in acetone solution in four concentrations: 10, 5, 2.5 and 1%. A 0.2-mL test solution was applied to the disc. When all the solvent had evaporated under laboratory conditions, 20 insects were released into the center of the petri dish with a glass funnel, and the dish was covered. Test insects were starved for 36 hr prior to their release into the dish. A count was made for the number of insects on treated and control discs after 1, 5, 10, 20, 30 and 60 min; each disc was replicated thrice. Insects were attracted towards control disc if the compound was repellent, otherwise they were attracted to both discs. The data was analyzed statistically for variance.

RESULTS AND DISCUSSION

Fifty seed oils (Table I) were tested for repellent/antifeedant activity to adult *Tribolium castaneum* Herbst. Only ten oils were found to be repellent. *Glycosmis pentaphylla* and *Cardiospermum canescens* (Table II) were the most powerful repellents. They showed 51 and 50% repellency at 1% concentration, respectively. All three members of the Solanaceae family gave appreciable protective results. *Heliotropium supinum* at 1% concentration was least active; it showed only 20% repellency, while at higher concentration it was moderate. Of five seed oils of the Rutaceae

TABLE I

Seed Oils Tested for Repellent/Antifeedant Activity

Seed	Family	Result
Annona squamosa	Annonaceae	Positive
Polyalthia longifolia	Annonaceae	Positive
Semicarpus anacardium	Anacardiaceae	Positive
Tabernaemontana dichotoma	Apocynaceae	Negative
Bixa orellana	Bixinae	Negative
Bombax malabaricum	Bombacaceae	Negative
Butamopsis lansilata	Butamaceae	Negative
Heliotropium supinum	Boraginaceae	Positive
Calystegia hederaceae	Convolvulaceae	Negative
Celastrus paniculatus	Celastraceae	Negative
Chrysanthemum coronarium	Compositae	Negative
C. Leucanthemum	Compositae	Negative
Grangea maderaspatana	Compositae	Negative
Guizotia abyssinica	Compositae	Negative
Saussurea candicans	Compositae	Negative
Balanites aegyptiaca	Euphorbiaceae	Negative
Croton tiglium	Euphorbiaceae	Negative
Chrozophora rottleri	Euphorbiaceae	Negative
Euphorbia dracunculoides	Euphorbiaceae	Negative
Euphorbia geniculata	Euphorbiaceae	Negative
E. neriifolia	Euphorbiaceae	Negative
Jatropha gossypifolia	Euphorbiaceae	Negative
Phyllanthus reticulatus	Euphorbiaceae	Negative
Putranjiva roxburghii	Euphorbiaceae	Negative
Ricinus communis	Euphorbiaceae	Negative
Aesculus indica	Hippocastanaceae	Negative
Leucas cephalotes	Labiatae	Negative
L. urticifolia	Labiatae	Negative
Barringtonia acutangula	Lecythidaceae	Negative
Canavalia ensiformis	Leguminosae	Negative
Cassia glauca	Leguminosae	Negative
C. pumilla	Leguminosae	Negative
Crotalaria medicaginea	Leguminosae	Negative
Enterolobium seman	Leguminosae	Negative
Asphodelus tenuifolius	Liliaceae	Negative
Hibiscus ficulneus	Malvaceae	Negative
Cocculus pendulus	Menispermaceae	Negative
Mirabilis jalapa	Nyctaginaceae	Negative
Delphinium ajacis	Rutaceae	Negative
Glycosmis pentaphylla	Rutaceae	Positive
Peganum harmala	Rutaceae	Negative
Zanthoxylum alatum	Rutaceae	Negative
Zanthoxylum rhetsa	Rutaceae	Negative
Cardiospermum canescens	Sapindaceae	Positive
C. helicacabum	Sapindaceae	Positive
Mimusop hexandra	Sapotaceae	Negative
Datura alba	Solanaceae	Positive
Solanum indicum	Solanaceae	Positive
S. khasiana	Solanaceae	Positive
Duranta plumieri	Verbenaceae	Negative

TABLE II

Repellency (%) of the Seed Oils at Different Concentrations to Adult *Tribolium castaneum* Herbst

Seed oils	Rate of application repellent (%)			
	10	5	2.5	1
Solanum khasiana	85	70	60	44
Solanum indicum	80	70	58	49
Datura alba	90	80	70	45
Glycosmis pentaphylla	90	75	60	51
Heliotropium supinum	60	47	36.6	20
Semicarpus anacardium	80	70	65	35
Cardiospermum helicacabum	90	80	70	45
Cardiospermum canescens	80	75	60	50
Polyalthia longifolia	80	70	57	40
Annona squamosa	88.8	78.6	60.9	44

$P > 0.05$ in all cases (significant).

family, only *Glycosmis pentaphylla* was found to be active and it had the highest repellent activity. *Polyalthia longifolia* and *Annona squamosa* of Annonaceae family also showed high repellent activity at 1% concentration.

From the above results (Table II), we observe that in all cases there is a gradual fall in the activity of oil with decrease of the concentration ($P > 0.05$). All oils listed in Table II, except *Heliotropium supinum* and *Semicarpus anacardium*, seem to be good repellents to adult *Tribolium castaneum* Herbst, at 1% concentration ($P > 0.05$).

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An ESR Study of Radical Intermediates Formed by γ -Radiolysis of Tripalmitin and Dipalmitoyl Phosphatidylethanolamine

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ABSTRACT

Radicals resulting from the γ-radiolysis at 77 K of neat tripalmitin and neat dipalmitoyl phosphatidylethanolamine were investigated by electron spin resonance spectroscopy (ESR). Analyses of the spectra of these complex lipids were aided by ESR studies of their components phosphorylethanolamine, palmitic acid and hexadecane. Concentrations of various radicals were followed as a function of temperature after γ-irradiation at 77 K. Both tripalmitin and dipalmitoyl phosphatidylethanolamine show anion radicals formed by electron addition to the ester groups (-O-C-) and aliphatic side-chain radicals ($-CH_2-\dot{C}H-CH_2-$) which are thought to be the result of deprotonation of the original positive hole. Computer analyses of the spectra as the temperature increases show loss of the anion radicals with an increase in a new radical produced by the abstraction of a hydrogen atom from the α carbon on an acyl side chain. In the case of dipalmitoyl phosphatidylethanolamine, a radical of the phosphorylethanolamine portion of the molecule is detected as an intermediate. Mechanisms for the formation and decay of the free radical intermediates are discussed.

INTRODUCTION

The investigation of free radical mechanisms of chemical reactions induced by radiolysis of lipids is important to the understanding of radiation damage to biological systems. By identifying radicals produced by irradiation, and by monitoring their decay, predictions of the products formed by radiolysis can be made. This is important to studies of product analyses since many of the low yield products might be overlooked unless a specific search for them is instituted. Due to the complexity of many of the naturally occurring lipids, the best initial approach for their study is to investigate model compounds. In previous work (1-3), we have investigated a number of model compounds such as various esters, carboxylic acids and a small triglyceride triacetin. Since radiation produces anions and cations as primary intermediates, to simplify the systems further, the anionic pathways were investigated separately (2). For example, electron addition to esters was suggested to result in two reactions: (a) β scission of the anion radical in which an alkyl radical and carboxylic acid are formed; (b) hydrogen atom abstraction of a parent molecule by the anion radical producing a hydrogen abstracted radical and an unstable diol.

In this work we apply knowledge gained in these previous investigations by ourselves and other workers to a detailed electron spin resonance (ESR) study of the radicals formed following γ-irradiation of the phospholipid, dipalmitoyl phosphatidylethanolamine (DPPE) and compare these to the radicals present in the triglyceride tripalmitin (TP). The radical reactions resulting from the radiolysis of phospholipids have not been investigated previously, although some product analyses studies have been reported