The Journal of Basic & Applied Zoology (2012) 65, 88–93

The Egyptian German Society for Zoology

The Journal of Basic & Applied Zoology

www.egsz.org
www.sciencedirect.com

Insecticidal and biochemical effect of some dried plants against *Oryzaephilus surinamensis* (Coleoptera-Silvanidae)

A.M. Al Qahtani [a], Z.M. Al-Dhafar [a], M.H. Rady [b,*]

[a] *Faculty of Science, Dammam University, Saudi Arabia*
[b] *Faculty of Science, Ain-Shams University, Egypt*

Received 26 June 2012; accepted 23 August 2012
Available online 17 November 2012

KEYWORDS

Botanical insecticides;
Pests of date palm;
Toxicity;
Protein configuration

Abstract Dry powders of three plants, namely ginger (*Zingiber afficinale*), hail (*Elettaria cardamomum*) and shammar (*Foeniculum vulgare*) were tested, for their toxicity, against the adult beetle *Oryzaephilus surinamensis*, as date pest threatens the date product in Saudi Arabia. All the tested plants showed insecticidal activity against *O. surinamensis*. Ginger is the most potent plant, recording the lowest LC_{50} value (0.14 mg/g) followed by hail and shammar (LC_{50} = 0.4 and 0.7 mg/g) respectively. Tested plants alter the protein configuration of *O. surinamensis* after using PAGE for protein analysis. Ginger and shammar increased the insect protein subfractions than normal; while hail reduced separated bands, especially proteins of moderate molecular weight.

1. Introduction

Over the past 20 years, botanical insecticides threw attention as new approaches to insect control. Now many natural products are known to have a range of useful biological properties against insect pests (Isman, 2000). The effectiveness of many botanical oils against stored grain insect pests have already been demonstrated (Shaaya et al., 1991; Kim et al., 2003; Lee et al., 2003; Aslan et al., 2005; Cetin and Yanikoglu, 2006; Negahban et al., 2007; Ayvaz et al., 2009; Al Qahtani et al., 2010).

Date palm is an important crop that provides a primary article of food and commerce in many countries of the world. There are more than one hundred million date palm trees all over the world producing between 2.5 and 4 million tons of fruit (tamar) per year (Djerbi, 1995). In KSA, date palm trees are distributed in Hijaz, Al Hasaa and Medina. In Hasaa, storing date is by pressing it with some dried plants (or flavor) as cardamom, ginger, sweet fennel or sesame seeds. Date fruits suffer from attacking by different insect pests like *Ephestia calidella* (Pyralidae); *Ephestia cautella* walk. (Pyralidae); *Ectomyelois ceratonia* Zell. (Pyralidae); *Arenipses sabella* (Pyralidae); *Stathmopoda auriferella* (Heliodinidae) and *Oryzaephilus surinamensis* (Silvanidae) (Hussain, 2007).

In stored grain mill, insect damage may account for 10–40% yield loss worldwide (Matthews, 1993). *Oryzaephilus surinamensis* (sawtoothed grain beetle) is the most common

* Corresponding author. Tel.: +20 01222322850.
E-mail address: drmagdaradi@yahoo.com (M.H. Rady).
Peer review under responsibility of the Egyptian German Society for Zoology.

ELSEVIER Production and hosting by Elsevier

2090-9896
http://dx.doi.org/10.1016/j.jobaz.2012.10.008

pest attacking stored grain and other products. It is a secondary pest on stored grains due to its inability to damage the whole fruit (Hussain, 2007); however, its status has changed due mainly to the mechanical damage during harvesting and drying, which results in broking and damaging fruit going to storage facilities, causing very high infestation problems. *Oryzaephilus surinamensis*, due to its small size has the ability to hide in many places within the storage houses, making it difficult to be controlled by insecticides, besides it has built up resistance to several insecticides (Wallbank and Collins, 2003; Al-Jabr, 2006; Beckel et al., 2007).

Insect control in stored product houses relies heavily on the use of gaseous fumigants and residual insecticides, both of which can pose serious hazards to worm-blooded animals and environment; (Isman, 2000). Botanical insecticides are good alternatives to chemical insecticides and proved their efficiency to control insect pests (Viñuela et al., 2000; Isman 2000; Rehman et al., 2009). Plant biocides have adverse effect on insect pest physiology and biochemistry (El-Bermawy and Abdel Fattah, 2000; Renuga and Sahayaraj, 2009). This study was initiated to evaluate the toxicity of some natural endogenous plants namely ginger, hail and shammar, against the adult pest *O. surinamensis*. The mode of action was highlighted through studying the effect on insect total proteins.

2. Materials and methods

2.1. Tested insect

Adult stages of *Oryzaephilus surinamensis* were collected from stored date houses in AL Hasaa, and were kept on the wheat flour media with 5% Brower's yeast at room temperature 25 ± 2 °C and 70 ± 2 R.H., in our laboratories of Dammam University-Faculty of Science, KSA, and used for further studies.

2.2. Tested plants

Three common plants namely ginger (*Zingiber officinale*-Zingiberaceae), hail (*Elettaria cardamomum*-Zingiberaceae) and shammar (*Foeniculum vulgare*-Apiaceae) were tested against adult *O. surinamensis*.

Ginger is received as rhizomes, and left to dry in our laboratory then grinding as powder. Hail and shammar were obtained as dry fruits and seeds which were ground directly before use for bioassays.

2.3. Bioassay tests

Three dry powders of the tested plants were used to prepare serial dilutions for each (dry powder/g flour). Twenty-five adults (1–2 weeks age) were sieved (mesh 30, aperture 600 mm) and introduced to specific jars containing the feeding media (flour) mixed with the tested plant powder dilutions. The jar containing only flour was used as the control. All tested jars were kept at 25 ± 2 °C and 70 ± 2 RH with equal periods of the dark and light. After 48 h, mortality readings were calculated, and corrected using Abbott's formula (1925) and used to draw the regression line LC_{50} values according to Finney (1952). The results were statistically analyzed using the program SPSS version 15.

2.4. Protein electrophoresis

Polyacrylamide gel electrophoresis technique (PAGE) was followed to study the effect of plant powder on body proteins of adult *O. surinamensis* according to the method of Laemmli (1970), and was carried out in the Genetic Engineering Center, El-Azhar University, the separated polypeptides were stained with bromophenol blue, photographed and its molecular weights were calculated comparing with the standard proteins of high and low molecular weights.

3. Results

3.1. Insecticidal activity of the tested plant powders

All the tested plant powders proved to have insecticidal activity against *O. surinamensis*. The recorded insect mortalities, after treatment with ginger, were 66.6%, 63.2%, 61.4%, 59.5% and 49.15% corresponding to the gradual plant powder concentrations 4%, 2%, 0.5%, 0.25% and 0.125%. Recorded mortality readings were 68.4%, 63.2%, 50.9%, 42.1% and 40.3% after treatment with hail at same concentrations. The least effect was recorded after treatment of the insect with gradual concentrations of shammar; mortality readings were 63.2%, 54.4%, 47.4%, 45.6% and 26.3%. Ginger was the most potent plant, recording the lowest LC_{50} = 0.14 g/100 g flour followed by hail which killed half of insect population at concentration 0.4 g/100 g flour; finally shammar showed the least activity recording LC_{50} = 0.7 g/l00 g flour. The differences between adult mortality readings were statistically significant ($P < 0.001$). The slope and chi^2 data reflected homogenicity between insect individuals (Table 1).

3.2. Effect of treatment on insect protein profile

SDS PAGE analysis of whole, untreated body proteins of *O. surinamensis* (Fig. 1, Table 2) separates 37 protein bands which can be divided into 3 groups according to their molecular weights, the first group of high molecular weight, ranged from (57.5–45.5 kD) (G1), the second group (G2) of mol. weight (44.5–33 kD), and the third group (G3) represents the low mol. weight group (28.2–16.5 kD).

Treatment with ginger (*Z. officinale*) had an obvious biochemical effect on body proteins (Fig. 1, Table 3), 53 polypeptide bands were separated. G1 group (of high mol. weight) contained thirteen bands instead of ten comparing with the control experiments and was characterized by the bands of MW 56.8. and 51 (kD) and G2 group, after treatment with ginger there appeared an increase in polypeptide fractions; 20 bands were separated (the control had 16 bands). Bands of mol. weights 41, 40.5, 38.5, and 38 kD were new bands that appeared after treatment with ginger. Proteins of low MW also showed an increase in number, 20 bands were separated instead of 11 in the control experiment. Polypeptide profile showed 27, 26.5, 25, 23, 21, 20.5, 19.5, 19, 17.5, 17, 15, 14.5,11, 10.5 and 9.5 kD protein fractions. Fractions of mol. weight 15, 14.5, 12.5, 11, 10.5 and 9.5 kD were specific to the treatment with ginger.

On the contrary, treatment with hail (Fig. 1 and Table 5) decreased the number of protein fractions. Many polypeptides