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The Effect of Some *Quercus* spp. (Oak) Extracts on Adult *Tribolium castaneum* Mortality

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Abstract

Three concentrations (0.5, 1, 2) mg/ ml of hot water extract, alcoholic extract, and phenolic extract of *Quercus* spp. were used as biocontrol of *Tribolium castaneum* adult by Putting 10 grains of clean rice in a petri dish with five adults and sprayed with the previous concentrations of the extracts for three replicates, as well as the control treatment (sprayed with solvent without the plant extract). The results indicated that the alcoholic extract was significantly superior to the aqueous and phenolic extracts. The alcoholic extract caused 100% death after 16 hours of exposure at a concentration 2 mg/ ml, and the aqueous extract caused 100% mortality after 48 hours at a dosage 2 mg/ ml, while the phenolic extract caused 50% mortality after 16 hours at a concentration 2 mg/ ml.

Keywords: *Quercus extract, phenolic extract , biocontrol, Tribolium castaneum.*

1. Introduction

The rusty flour beetle *Tribolium castaneum* belongs to the family Tenebrionidae and order Coleoptera [1]. It is a reddish-brown colored flat-oval-shaped insect, a length of 3.5 mm, has a dots on the thorax and lines engraved on its sheath. This insect differs from its counterpart in that its two antennae enlarged in its last decade. Flour beetle is one of the main warehouse insects that spread in the most regions of the world especially worm parts, both adult and larva lives on infected grains and flour such as this insect affects flour, broken grains, biscuits, cakes and chocolate [2]. This insect causes some damage to the grains and flour as it causes unwanted odor as a result of insect secretions and causes decrease in the degree of consistency of the dough and in elasticity [1] and pollutes it with its residues, molting skins and dead individuals.

Chemical pesticides are used to protect stored materials from infecting insects, many problems related to the negative impact of pesticides on humans, animals and all surrounding environment. Therefore, various alternative measures were studied to resolve pesticide problems, such as used temperature to control the growth of *Triboluim confusum*, and he found that exposure to two hours of cooling was the best in killing of the three phases (adult, larva and pupa) [3]. Whereas [4] tested six types of inert dusts against adult insects of the red flour beetle after treating wheat flour with these powders and insect breeding on them, as it appeared that silica gel powder was the most influential in the rate of adult killing and. Several studies have also indicated the possibility of using plants powders in controlling insects and stored materials. Antifeedant activity of ethanolic extracts of nine plants native from central region of Argentina on *Alphitobius diaperinus* (Panzer) (Coleoptera: Tenebrionidae) was evaluated looking for low environmental impact management alternatives, adults of *A. diaperinus* were exposed to food treated with the extracts to assess whether feeding behavior and survival were altered. None of the extracts affected adult survival. However, the extracts of *Gaillardia megapotamica*, *Vernonanthura nudiflora*, *Baccharis artemisioides*, *Lithraea molleoides*, and *Ambrosia artemisiifolia* had a strong antifeedant effect (92-96%). The other extracts evaluated slightly affected (50-55%) the food consumption [5]. [6] was investigate the insecticidal activity of desert date

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(*Balanites aegyptiaca* [L.] Delile) seed oils against the red flour beetle (*Tribolium castaneum* Herbst). Oils were extracted by chloroform, hexane, and ethanol, and they were tested on the pest by the film residue method at doses of 1.131, 0.566, 0.283, and 0.142 mg cm-2 after 12, 24, 36, and 48 h. Results showed that chloroform extract was the most toxic for T. castaneum compared with the other extracts. The results of the oil analysis revealed that (9Z,12Z)-octadeca-9,12-dienoic acid, hexadecanoic acid, (Z)-octadec-9-enoic acid, and (E)-octadec-6- enoic acid were the main components, but the concentration differed from one extract to another. These results suggest that chloroform and hexane extracts have potent insecticidal activity and could be used in grain storage to control pests.

Quercus spp. (Oak) is one of the plants used in folk medicine, is one of the vast woody trees known for its strength and durability. *Quercus aegilop*, *Q.brantii*, *Q.iibani* and *Q.infectoria* spread throughout the year in northern Iraq. Their medical importance is in bark (young tree veneer) especially in winter, as well as trees dried well in the sun after maturity [7]. Organic extracts of *Quercus* were used to Anopheles sterphensi biocontrol in India, by preparing the ethyl acetate extract [8].

Flavonoids are active compounds in *Quercus*, phenolic compounds containing 15 carbon atoms. Phenols are distinguished by their ability to combine with cell protein, changing its nature and deposition [9]. They degrade live cell membranes and phenols are considered as growth regulators [10]. [11] were isolated two flavonic compounds (quercetin 3-O-α-D arabinopyranoside and quercetin 3-O-β-D-galactopyranoside), and two compounds of tannins (precursors and procyanidin) by ethyl acetate extraction of oak leaf *Quercus aurcheri* , these compounds have inhibitory action for bacteria and fungi Inasmuch of the global economic importance of the rusty flour beetle and the importance of using natural products, such as plant compounds, to control insects and stored materials as alternatives to chemical pesticides in Iraq, the current study came to study the effect of water, alcoholic and phenolic extracts of *Quercus* spp. scales (peat) to find out the most effective and effective ones on the decimation of adult rusty flour beetle.

2. Materials and methods

Quercus sp. (Oak) peels were cleaned from dust by washing with deionized-distilled water. They were left to dry in lab temperature (20ºC), and crushing them by blender, and kept the oak peel powder in the refrigerator at 4°C until use. *T. castaneum* adults of mixed sex and age were randomly collected from stock rice immediately before the test.

Harborne [12] method modified by [10] was followed in the preparation of the aqueous extract by mixed 20 g of powder with 200 ml hot distilled water and left for half an hour, blending for 15 min, and filtration by tissue filters. The extraction solution was dried using rotary evaporator (<50°C).

Ethyl alcohol was selected as a polar solvent [10] in preparing the alcoholic extract. 10 gram of powder in thimbles of soxhlet extractor was taken; 200 ml of ethyl alcohol was used for 24 h. at a temperature of 50 °C. The extraction solution was dried by using rotary evaporator.

Phenolic compounds were extracted according to the [9] method, as 10g of powder was mixed with 40ml of 2% acetic acid, the extraction process was carried out by the reflux condenser using the German heating plate 70°C for 8 hr., after the compilation of the extraction process the solution was left to cool then filtered with Whitman No.1 filter paper, then equal volume of N-propanol and a quantity of Sodium Chloride NaCl were added to it for reaching the saturation status two layers were resulted, the upper layer containing phenolic compounds was isolated using separating funnel and dried with the rotary evaporator and preserved in -20°C temperature until use .

The stock solution was prepared from the extract by dissolving 1 g of dried extracted powder in 5ml of the same solvent which used in its preparation and complete the volume to 100ml of distilled water, then prepared the required concentrations in the experiment (0.5, 1, 2 mg/ml) add to each concentration two drops of the Tween substance (Tween20) as a spreader per 100ml of the concentrations [10, 13].

2.1. Effect of aqueous, alcoholic and phenolic crud extracts on Tribolium castaneum adults

To study the effects of the three types of *Quercus* extractions, Putting 10 grains of clean rice in a petri dish with five adults and sprayed with the previous concentrations of the extracts for three replicates and sprayed with the previous concentrations of

extracts, as well as control treatment (sprayed with solvent without plant matter)[14].

All statistical analyse were conducted by the commercial statistical program SPSS (version18) and by using the ANOVA test to find the least significant L.S.D below the probability level $P \leq 0.05$ to test the significance of the difference between the times and the used concentrations. T-test was also used to compare aqueous and alcoholic extracts.

3. Results

3.1. Effect of the aqueous extract on Tribolium castaneum adults

The results in the Table 1 show that the aqueous extract of *Quercus* affected the mortality of *Tribolium castaneum* adults. The lowest death rate was recorded at 1st hour at a concentration 2 mg/ml and the significant difference with the control group, while the highest death rate was 100% at 24 hour at a concentration 2 mg/ml. The results also showed that 2 mg/ml concentration is the best in achieving the highest percentage of death by a significant difference from the other two concentrations since the first hour of the experiment.

3.2. Effect of the alcoholic extract on Tribolium castaneum adults

The results in the Table 2 show that the alcoholic extract of *Quercus* affected the mortality of *Tribolium castaneum* adults. The lowest death rate was recorded at the 1st hour at a concentration of 1 mg/ml and significant difference compared with the control group, while the highest death rate was 100% at the 16th hour at a concentration 2 mg/ml. The results also showed no significant difference between 1 mg/ml and 2 mg/ml concentrations in achieving the percentage of mortality in *Tribolium castaneum* adult from the first hour of the experiment.

Table 1 Effect of different concentrations of the aqueous extract of the Qurecus spp. on the destruction of adult rusty flour beetle (total number of adults = 5)

Conc. [mg/ml]/ Time	1h.	4h.	8h.	16h.	24h.	48h.
0.5	0.66±0.33	1.66±0.33	2.33±0.33	2.33±0.33	2.33±0.33	2.33±0.33
1	1.33±0.33	2.33±0.33	3±0.00	3±0.00	3.33±0.33	3.33±0.33
2	1.66±0.66	2.66±0.33	3.66±0.33	4±0.00	4.66±0.33	5±0.00
Cont.	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	1.00±0.00

Table 2: Effect of different concentrations of the alcoholic extract of the *Quercus* spp. on the destruction of adult rusty flour beetle (total number of adults = 5)

Conc. [mg/ml]/ Time	1h.	4h.	8h.	16h.	24h.	48h.
0.5	1±0.57	1.33±0.66	2±0.57	3±0.57	4±0.57	4.66±0.33
1	2.6±0.88	3± 0.57	3.33±0.66	4.33±0.33	4.66±0.33	5±0.33
2	3.33±0.66	4±0.33	4.66±0.33	5±0.00	5±0.00	5±0.00
Cont.	0.00±0.00	0.00±0.00	0.00±0.00	0.66±0.33	1.33±0.33	1.66±0.33

3.3. Effect of the alcoholic extract on Tribolium castaneum adults

The results in the Table 3 show that the alcoholic extract of *Quercus* affected the mortality of *Tribolium castaneum* adults. The lowest adults' death rate was recorded at the 1st hour at a concentration 1 mg/ml and significantly differenet from the control group, whereas the highest mortality rate was 50% at 16 hour with 2 mg/ml concentration. The results also showed no significant difference between the 1 mg/ml and 2 mg/ml concentrations in achieving the percentage of mortality in *Tribolium castaneum* adults from the first hour of the experiment.

3.4. Comparison between extracts

Table 4 show that the alcoholic extract achieved a significant difference in the perishing of Tribolium castaneum adults at 48 hours. The alcoholic extract achieved a significant difference in *Tribolium castaneum* adults mortality at 48 hours compared to the aqueous and phenolic extracts.

4. Discussion

Most plants contain several active compounds such as glycosides, tannins, terpenes, alkaloids, soaponen Etc. These materials are found in various parts of the plant such as stems, leaves, roots and flowers [15]. These compounds are environmentally safe when used as alternative sources of pesticides and are biodegradable to non-toxic compounds [16]. [17] Recorded that *Quercus* spp. peels containing resins, soaponen, tannins, alkaloids, glycosides and terpenes compounds.

Hot distilled water was used to obtain the aqueous extract of *Quercus* spp. which plays a major in inhibiting plant enzymes that may dissolve secondary chemical compounds or convert them to other compounds [10]. The reason for choosing water as a solvent is because of water is a good polar solvent that withdraws the similar polar substance that contain the hydroxyl group by the aromatic ring that makes up phenols and alkaloids [18].

Table 3: Effect of different concentrations of the Phenolic extract of the Quercus spp. on the destruction of adult rusty flour beetle (total number of adults = 5)

Conc. [mg/ml] / Time	1h.	4h.	8h.	16h.	24h.	48h.
0.5	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
1	2±1.00	2±1.00	2±1.00	2±1.00	2±1.00	2±1.00
2	2±1.00	2±1.00	2±1.00	2.66±0.33	2.66±0.33	2.66±0.33
Cont.	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	1.00±0.00

Table 4 :Comparison among the effect of the aqueous, alcoholic and phenolic extracts of Quercus spp. on destruction of adult rusty flour beetle

Time / Extract	48h	24h	16h	8h	4h	1h
Water extract	1.6	1.6	1.6	1.3	1.3	1.3
Phenolic extract	3.5	3.3	3.1	3	2.2	1.2
Alcoholic extract	4.9	4.6	4.6	4.3	1.7	2
LSD	2.6 sign alcoholic 48h					

Quercus spp. was extracted with ethyl alcohol as a polar solvent which extract polar compounds such as phenols, salts of alkaloids and glycoside. Ethyl alcohol is also a low-toxic organic solvent and is widely used with dyes and coatings in addition to their medical uses [19].

The superiority of the alcoholic extract over the aqueous and phenolic extracts by a significant difference is due to the extraction of terpenes compounds with alcoholic solvent. These findings concur with those mentioned by [20] suggested that contact toxicity could be attributable to the high quantity and/or good quality of active compounds, and [17] Diagnosed 7 phenolic compounds from *Quercus* extract, and 8 terpenes compound. After comparison with the standard terpenes compounds, their concentrations were calculated, as vinidiflorol was the highest concentration of 550.69 mg/ml followed by epiglobulol 198.73 mg/ml, terpinene-8 is the lowest concentration 24.47 mg/ml. Furthermore, ethanolic extracts had a strong antifeedant effect on Coleoptera but none of the extracts affected adult survival [5].

The combined effect of the compounds is better than that of the individual compounds, due to the support phenomenon. Despite the role of phenols as pesticides, some terpenes compounds affect insects by inhibiting growth, delaying puberty, reducing reproductive capacity and suppressing appetite, causing insect death by starvation or poisoning [21]. [22] Indicated that monoterpenes affect enzymes known as cytochrome P450 obstruction their action in removing the toxic effect of some compounds. [23] Explain the cytotoxicity of terpenes based on their inclusion of phenols, aldehydes, and alcohols within their composition.

5. Conclusions

In the light of the findings of present study, it could be stated that *Quercus* spp. alcoholic extract shown promising effect of seed protection and insecticidal properties so these might be used in *T. castaneum* population managing in stored rice. Moreover, our study can be considered as an approach to future studies about this plant to produce a commercial insecticide.

6. References

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