



## Effect of Orange Peel (*Citrus sinensis*) (L) extracts and powder on confused flour beetle *Tribolium confusum* (Coleoptera: Teneberionidae)

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### Abstract

This study was carried out to determine the effect of extras of orange peel of (*Citrus sinensis*) in concentrations (1,5, 10) % as well as stomachic effect for the powder of the plant with doses of 5,10 , 15/gm on the biological activities of the adults of *Tribolium confusum* . The effect of powder from the adults has been evaluated using different concentrations of the orange peel. The results showed that the powder have significant effect on the mortality rates of adults. and caused reduction in number of adults after 3 days with 5,10,15/gm killed (30,40, 43.3)% respectively. The use of different doses of *Citrus sinensis* peels powder not impact significantly after just one day. The extract of essential oil also caused growth inhibition in adults and showed that extracts were more effective than the powder. Increasing the essential oil concentration and exposure time lead to increased the mortality rate of adult. The mortality reaches to 100% after 3 days when insect tested with 10% of extract. Generally, the results of this study showed effect of any form of *Citrus sinensis* peel on adult of *Tribolium confusum* compared with control treatment. the effectiveness of orange peel powder is probably due to silica or silica like component, which are abrasive and the ability of the particles to adhere to the grain. *Citrus sinensis* peel oil was superior to untreated and powder using 99.00% reduction in adult emergence at use 0.75g.

**Keywords:** orange peel, *Citrus sinensis*, control of *Tribolium confusum*.

## تأثير خلاصة ومسحوق قشور البرتقال *Citrus sinensis* على بالغات خنفساء الطحين المحيرة *Tribolium confusum* (DUV) (Coleoptera: Teneberionidae) .

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### الخلاصة:

أجريت هذه الدراسة لمعرفة تأثير المستخلص المائي و مسحوق قشر البرتقال *Citrus sinensis* بالتركيز (1, 5, 10) % كذلك تأثير مسحوق هذا النبات 5, 10, 15/غم في الأداء الحياتي لخنفساء الطحين المحيرة *Tribolium confusum* (DUV) . وقد تم تقييم تأثير المسحوق من على البالغات باستخدام تراكيز مختلفة (1, 5, 10) % في 1, 2, 3/يوما وأظهرت النتائج أن مسحوق القشور لها تأثير فعال على معدلات نسب الموت في البالغات ، إذ إن مسحوق القشر تسبب في خفض عدد البالغات بعد 3 أيام باستخدام الأوزان 5, 10, 15 /غم اذ بلغ نسبة الموت في البالغات (40, 30, 43.3)% على التوالي . وان استخدام جرعات مختلفة من مسحوق قشر البرتقال لم يكن مؤثرا بشكل كبير بعد يوم واحد فقط من تعريض البالغات لها . إن

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تأثير المستخلص المائي لقشر البرتقال أدى أيضا إلى تثبيط النمو في البالغات وقد أظهرت النتائج أن المستخلص المائي لقشر البرتقال كان أكثر فعالية وثائيرا من مسحوق القشور . إذ لوحظ إن زيادة تركيز مستخلص قشر البرتقال وبزيادة مدة تعرض الحشرة لها أدى إلى زيادة معدل نسبة موت البالغات إذ وصل إلى 100 % بعد ثلاثة أيام من تعريض البالغات الى تركيز 10 % . وقد أظهرت نتائج هذه الدراسة ان مستخلص قشر البرتقال كان اكثر فعالية في التأثير على البالغات مقارنة مع مسحوق القشر نفسه. وبين إن ذلك قد يعود إلى وجود مادة السليكا أو مشابهات السليكا والتي لها القدرة إلى اختراق الحبوب وبالتالي عدم قدرة الحشرة للتغذي عليها واختراقها . أيضا بين إن مستخلص قشر البرتقال كان أكثر نفوقا بقتل البالغات من معاملات المقارنة ومعاملات مسحوق القشر إذ أدى إلى قتل 99 % من البالغات باستخدام 0.75 غرام.

## Introduction

Confused flour beetles *Tribolium confusum* are one of the most important widely disappare pests in all of the world [1] and causing economic losses to stored products like wheat [2]. The conventional control of insect's pests was the use of insecticides either direct surpy applied to grains or by gas fumigant. [3]. Red and confused flour beetles attack stored grain products such as flour, cereals, meal, beans,...etc. ,and even dried museum specimens [4]. These beetles are two of the most important pests of stored products, have chewing mouth parts. The flour beetle may elicit an allergic response, but is not known to spread disease and does not feed on or damage the structure of a home or furniture [5]. These insects can cause post harvest losses estimated from 9% in developed countries to 20% or more in developing countries [6]. Use of plant products as insecticide is one of the important approaches of insect pest management and it has many advantages and it is alternative to use of synthetic insecticide [7]. Currently, phosphine (From metal phosphide preparations, cylindrized formulations and or site generators) and methyl bromide (available in cylinders and metal cams) are the two common fumigants used for stored product protection world overuse of plant products like orange peel extract as insect pest management and it has many advantages over synthetic pesticides [7]. Some of *Citrus* species have been reported as source of botanical insecticides as variety of these plants contain secondary metabolites that show insecticidal activity against several coleopterans and dipterans [8]. Essential oil derived from orange peels is known to have deterrent to toxic feeding and poor development effects on lesser grain borer *Rhyzoportia domonica* (F) rice weevil , *Sitophilus oryzae* and red flour beetle, *Tribolium castanum*[9]. In higher plants about 3000 essential oils are known some of which 300 are commercially important for pharmaceuticals, cosmetics and perfume industries apart from pesticide potential [9]. Plant that have been reported to repel pest of stored products include *Croton macrostachyus*, *Ricinus communis*, *Datura stramonium* , *Cpsicum frutescons*, *Azadirchata indica*, *Ocimum* sp.and *Eucalyplus* sp[10]. Stored products that agricultural and animal origin are attacked by more than 600 species of beetle pests, 70 species of mouths and about 355 species of mites causing quantitative and qualitative losses and insect contamination in food commodities in an important quality control problem of concern for food industries [10]. Globally a minimum of 10% of cereals and legumes are lost after harvest [11]. Plant materials with insecticidal properties are one of the most important locally available, biological control of pests [12]. Essontial oils are secondary metabolites, characterized by a strong odor and have a generally lower density than that of water [13]. There are 17,500 aromatic plant species [13]. In other studies the essential oil of citrus peels powder to reduce ovipositor or larvae emergence through parental adult mortality. [14,5] and the peel oil has fumigant action against Fleas [15] and *Tribolium confusum* [4]. The peel oil was also reported to have toxicity toward *Culex pipiens* and cowpea weevils *Callosobruchus maculatus* [16]. *Tribolium* spp are the serious insect's pest of stored products feeding on flour, cereals, meals, beans, [10]. Adult stages of *Tribolium* spp is very active and can bread throughout the year in warm areas [1] they live two years or more during which female produce 1000 eggs [17]. Many plants products have been evaluated for their insecticidal properties against different stored grain pests [18]. A number of plants produce Essential oils which have been evaluated for insecticidal property against various insect pests [17]. The present study amid to assaed the repellent activity of essential oils of different plants sources against insect pests. Orange peel at high dosage was also shown to depress progeny development of *Dermestes maculates* [14]. Usages of plant material in pest control become an important alternative to the production of synthetic insecticides [19] Their adverse environmental effect and the need to

maintain a sustainable environment have created the need for environmental – self degradable and target specific insecticidal. Because of this much effort has been focused on plants or their constituents as potential sources of commercial insect control agent [20] d- Limonene can be effectively used to suppress population of stored product beetle. The volatile extracts of *Citrus sinensis* showed greater insecticidal potency while the cockroach, mosquito and housefly were most susceptible to the orange peels powder [16]. Stored product insect can cause post harvest losses estimated from 9% in developed countries to 20% or more in developing countries [2]. The insecticidal activity of many plant derivatives against several stored product pest has been demonstrated [15]. Insect pest cause heavy economic losses to stored grains throughout the world and their impacts are more devastating in poor countries [11]. Use of plant products as insecticide is one of the of the important approaches of insect pest management and it has many advantage over synthetic insecticides [7]. *Chenopodium* sp. Performed very well and resulted in high percentage of adult mortality, reduced progeny emergence and low percentage grain damage [21]. Cow pea beetles treated with powder of orange peels is associated with LD50 of 4% (w/w) for *Callosobruchus maculatus* (F.) exposed to it [20].

### **Material & method**

#### **Insect culture**

Adults of *Tribolium confusum*) DUV was collected from infested wheat obtained From General Company for Grain Trade /Baghdad. Wheat seeds were kept in an oven at 60°C for 6 hours to disinfect the seeds from any prior infestation .Before used it as substrate for insect rearing [22] .In order to prepare the colony of *Tribolium confusum* isolated suitable number of adults (male & female) reared in one liter cans contains wheat seeds ,the cans covered with nylon mesh that was held in place with rubber bands and then the cans kept in unincubator in 24 hours darkness at(22± 2) °C and( 5±32) r.h.

#### **Plant materials**

Orange fruit *Citrus sinensis*(L.) has been collected from local markets during ( 5 /2012) Then peeled was dried naturally at room temperature (30-35)°c. The dried peels were hydro distillation using Clevenger apparatus in order to obtain essential oil. Condition of extraction was 50g ground materials, 500 ml distilled water and distillation for one day, and about 2 ml oil was extract from 50g ground materials. Extract oil was stored in refrigerator at + 4° c until use it.

#### **Essential experiment.**

Filter paper (5 cm diameter) treated with three concentrations of orange peels oil (1, 5, and 10)% Per filter placed in a Petri dish of 7cm diameter, and exposed to open air to all the organic solvent to evaporate. Then 0.5 ml of distilled water was added to entire surface of the each treatment filter papers as a carrier of extracts after treatment, 10 adult of 1-2/ weeks old, were introduced into the treated and control filter paper. Every treatment replicate three times, Mortality of adults insect was counted after 1, 2, 3/ days.

#### **Powder experiment**

20g of wheat seeds mixed with 5, 10, 15/gm of oranges peels powder and 0.5g of talc powder was added as distributed material on the seeds. The control treatment treated with the talc powder only. The material put in Petri dish (7cm diameter) 10 adult of 1-2 week old were introduced in to each Petri dish and control treatment, than introduce into the incubator (23 hours darkness /1 hour light). Every treatment replicate three time, Mortality of adult insect was counted at 1, 2, 3 days after treatment.

#### **Data analysis**

Mortality data were analyzed using analysis of variance (ANOVA) to estimate statistical differences between means.

### **RESULTS**

#### **Extraction experiment**

The data showed that mortality of adult's arranged between 20% - 100% for the three concentrations of orange peel extracts in three days. While it was only 0.33% in control treatments and the results of statistical analysis showed significant difference between the treatments. Orange peel extraction at high concentration 10% caused 100% mortality after three days while mortality was 70% after one day and it was 86.6 %after two days at the same dosage of orange peel extraction that's mean the mortality was increases when we use high dosage of orange peel extraction.

**Table 1-** Effect of orange peel extracts on the mortality of adults of *Tribolium confusum* .

Mean % adult mortality, day after exposure	Orange oil concentration			L.S.D. <sub>0.05</sub>
	10 %	5 %	1 %	
1days	70.0 %	46.6 %	20.0 %	25.75
2days	86.6 %	26.6 %	30.0 %	29.26
3 days	100.0 %	76.6 %	30.0 %	33.74
Control	0.33%	0.33 %	0.33%	

### Powder experiment

All treatments caused significant dead in adults of *Tribolium confusum*) DUV (after two and three days compared with control treatment indicate that the active ingredients of botanical responsible for the toxicity of the plant to kill the adults gradually ,may be the reason of this difference is due to the sensitivity of adults to chemical compounds in orange peel powder or that the dosage that used in experiments were all influential to the adults in this age. The results of this effective experiments showed that all treatments of essential oil of orange peel were relatively toxic to *Tribolium confusum* but not toxic after one day .The current finding are similar to the results of Zewde and Jembere [12] who has also reported effective of orange peel powder against *Zabrotes subfasciatus* . The fumigation toxicity of dried peels showed variable toxicity to adult of test insects depending on dosage and exposure time according to the result of ANOVA, the effect of doses and exposure time Effect of dried peels on beetles .The result showed (table 2) there were positive significant relationships between dose and time exposure within all can concentration level, this indicator that higher dosage is more efficient in management of pests. The uses of 5g of orange peel powder were killed 16.6% of adults after one day while the powder caused the highest mortality in 15g doses at 3days of exposure .In general mortality increase as increasing the doses of powder and exposure period.

**Table 2-** Percentage of *Tribolium confusum* adults mortality by using orange peel powder.

Mean % adult mortality, day after exposure	Orange powder Dosage (g)			L.S.D. <sub>0.05</sub>
	15 g	10 g	5 g	
1day	26.6 %	20.0 %	16.6 %	N.S.
2day	33.3 %	33.3 %	20.0 %	3.00
3 day	63.0 %	40.0 %	30.0 %	6.59
Control	33.3 %	33.3 %	33.3 %	

### Discussion

Different citrus orange peel extracts were subjected to laboratory bioassay against confusum adults, these extracts provided satisfactory results as far as the susceptibility and time is concerned oils from the *citrus varilies* showed strong larvicidal effects over 120 plants and plants products have been showed to have insecticidal or deterrent activity against stored products pests [6] however the number and halite of plants used by farmers is often limited by their viability [23]. Rotaceae is alarge family containiny .130 gener in seven sub furily with many importans fruits and essential oil product lemon essential oil has the highest value of all essential oils import ants to USA [15]. The toxicity of cisinensis peel oil may be attributed to d-1: monene [24]. Tripathia etal [9] repotal the contact toxicily of d-limonene with LD50 74.73, 85.37 and 79.78 for *Rizopertha domanica* , *S. oryae*, and *T.confusum* , Analysis of the toxicity data in present study showed that the essential oil vapors from *citrus* dried peels exhibited a variable toxic ion against the adult of the these beetles. The current findings are similar to the results of morawej and abbar [18] who have also reported fumiganl toxicity of the orange peel oil C. scinensis against stored products pests *Callosobruchus maculates* (F.) , the orange peel oil has been reported to have fumiganl toxicity three times more than the of methyl bromide [9]. The studies also showed that orange peel has strong fumigant toxicity effect against *Z. subfasciatus* [12]. Keita et al [25] reported that the mode of the action of fumigant toxicity of essential oil against

insects might be the inhibition of acetyl cholinesterase. The observed difference between our results and those of mwaiko and savaeli [16] seems to be rentable because of the different species and size of insects of, and methodology of oil extraction [16].

Current findings are similar to the result of Tripathietal [9] who has also reported oviposition reduction effect of orange peel oil against *T.confusum* by 94.5%. Belmain and Stevenson [20] also reported the effective use of effective use of *C. sinensis* powder against legume pests. The effectiveness of orange peel powder is probably due to silica or silica like component, which are abrasive and the ability of the particles to adhere to the grain. *Citrus sinensis* peel oil was superior to untreated and powder using 10.000, 99.uu and 99.00% reduction in adult emergence at 0.75, 0.105 and 0.03g 1250g of haricot been the repellency effect of *C. sinensis* peels oil was relativity lower. This suggests that the active compounds which acted as repellend and fumigant might be chemically different. The species susceptibility of the insect to essential oils has already been noted. Whereas early studies noted are repellent effect from the content of pine needles [19]. The result of the current study suggested that materials derived from *citrus sinensis* may act at small dose. Therefore investigation on incorporating, improving and adopting for the control of stored insets need to be investigated.

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