

# INSECTICIDAL EFFECT OF THREE ESSENTIAL OILS LOADED ON NANO AGAINST TRIBOLIUM CASTANEUM (COLEOPTERA: TENBRIONIDEA)

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## Abstract

The present study evaluates the probable insecticidal effect of spearmint, camphor and marjoram essential oils loaded on Nano on *Tribolium castaneum*. Nano oils were characterized by transmission electron microscopy (TEM). Spearmint and marjoram Nano oils showed a similar effect on pupa stage and caused 59% mortality percentage and 55.07% for camphor Nano oil. Camphor and marjoram Nano oil significantly affect *Tribolium castaneum* adults with mortality rate reached to 90% at the concentration (0.625 and 1.25)% and showed greater effect compared with spearmint Nano oil that reached to (26.54 and 33.00)% respectively. *Keyword: Tribolium castaneum*; Chitosan; Nano essential oils

#### Introduction

Cereal craps still to be central to the world food source for people in different countries (Alonso-Amelot and Avila-Núñez 2011). The red flour beetle Tribolium castaneum (Herbst) is one of the most widespread destructive primary insects of stored grains (Hagstrum and Subramanyam 2009), fruit and nut products (Fedina 2007). Moreover, they infest structures including mills, food warehouse, retail stored, and urban homes (Abdelghany et al., 2010), and caused a serious agricultural economic loss because of their rapid reproduction, strong adaptation and wide distribution (Turner 1994) also the red flour beetle T. castaneum can produce a large number of toxic substances which are harmful to warm-blooded animals (Ashworth 1993). Such as carcinogenic chemical known as quinines (Hodges, Robinson, and Hall 1996). In most of strong control system, the use of chemical tool for managing stored grain insect pest including T. Castaneum (Boyer, Zhang, and Lempérière 2012), methyl bromide and phosphine fumigation widely used to control Τ. castaneum but they limited in use due the ozonedepleting properties and to toxicity to the warm blooded animals (Napal et al., 2010). Resistance of stored grain insect to chemical pesticides and fumigants has been discovered in many countries (Opit et al., 2012). As a result, in this study we investigable the insecticidal activities of three essential oils loaded on Nano against T. castaneum to find a new materials with low toxicity and easy biodegradation as they botanical alternative with is easy to use and reduces health and environ mental impacts to minimize levels compared with chemical pesticides (Isman 2006).

#### **Material and Methods**

1. Insect : T. castaneum culture was established for a several generations a way of any insecticidal

contamination in the laboratory of Department of plant protection, Agriculture faculty, University of Kufa. The insect reared on wheat flour in a glass jars covered by muslin cloth held with rubber bands. The culture was maintained in incubate set as  $28\pm2$  °C and  $68\pm2\%$  r.h at 12:12 light: dark photoperiod.

- 2. Preparation of essential oils loaded on Nano : Three Nano oils loaded on chitosan supplied from international research center Cairo/Egypt by Professor Doctor Manal M. Adel. Nano Spearmint oil, Nano camphor oil and Nano Marjoram oil loaded on chitos with 5% concentration. The concentration (1.25, 0.625, 0.312 and 0.125) % were prepared by mixing with distilled sterilized water and used in the experiments, while control treatment carried out by using distilled sterilized water only.
- **3. Transmission Electron Microscopy :** Transmission Electron Microscopy (TEM) in Al-Razi center / republic of Iran characterized Nano oils.
- **4. Bioassays :** Experiments were carried out to examine the effect of three essential oils loaded on Nano on pupal stage and adults. Effect of each oil against *T. castaneum* stage was determined by direct contact application by spraying the individuals, the result were registered of death rate and growth period for pupal stage, and death rate only for adults.
- **5. Data Analysis :** Mortality data were corrected for control mortality according to Abbott's formula (Abbott 1925). The value of Least Significant Differences (L.S.D) used to compare the means of treatment under 0.05 probability level. Analysis done by Genestat program (ver:12).

# Results

1. Transmission Electron Microscopy : Transmission Electron Microscopy (TEM) was used to investigate of chitosan Nano particles in three essential oils. Spearmint Nano oil (Figure 1), camphor Nano oil (Figure 2) and Marjoran Nano oil (Figure 3)



Fig. 1 : TEM photo to spearmint Nano oil



Fig. 2 : TEM photo to Camphor Nano oil



Fig. 3 : TEM photo to Marjoram Nano oil

2. Insecticidal activity on pupal stage : Significant differences (0.05) in the percentage of pupa mortality were observed for different Nano oils concentrations (Table 1, 2 and 3). Pupa treated with Spearmint, Camphor and Marjoram Nano oil reached to (59.00, 55.07, 59.00)% respectively in mortality rate at 1.25% concentration, there is no significant differences observed in pupal growth period at all Nano oils concentrations.

Growth period	Mortality %	Concentration
(day)	rate	%
7.33		Con.
6.33	15.00	0.156
5.67	37.14	0.312
5.33	36.93	0.625
5.33	59.00	1.25
4.119	17.24	L.S.D <sub>(0.05)</sub>

Table 1 : Effect of spearmint Nano oil on pupal stage

Table 2 : Effect of Camphor Nano oil on pupal stage

Growth period (day)	Mortality % rate	Concentration %
7.33		Con.
6.67	12.29	0.156
7.33	23.86	0.312
6.67	43.08	0.625
5.00	55.07	1.25
5.59	14.39	L.S.D <sub>(0.05)</sub>

Table 3 : Effect of Marjoran Nano oil on pupal stage

Growth period	Mortality %	Concentration
(day)	rate	%
7.67		Con.
6.33	15.00	0.156
7.33	32.71	0.312
7.00	48.93	0.625
6.67	59.00	1.25
1.336	17.85	L.S.D <sub>(0.05)</sub>

**3.** Insecticidal activity on adults : The contact effect of the essential Nano oils against *T. castaneum* adults were listed in (Table 4). The result showed that Camphor and Marjoram Nano oils was significant effect reach to 90% at 0.625 and 1.25 concentrations, while Spearmint Nano oil reached (26.54, 33.00)% mortality respectively at the same concentration. Both Camphor and Marjoram Nano oil were more effective than Spearmint Nano oil, and the concentration (0.652and 1.25) were more effective compare with (1.156 and 0.312)%.

 Table 4 : Effect of three Nano oil on T. castaneum adults

Avg.	Mortality rate Spearmint Nano oil	Mortality rate Camphor Nano oil	Mortality rate Marjoram Nano oil	Concentration %
15.24	12.29	18.43	15.00	0.156
6.14	6.14	12.29	0.00	0.312
68.86	26.54	90.00	90.00	0.625
71.00	33.00	90.00	9.00	1.25
	19.50	52.68	48.75	Average
<b>conc</b> =6.68 <b>Treatment</b> = <b>5.78</b> <b>overlap</b> = 11.57			L.S.D <sub>(0.05)</sub>	

## Conclusion

Essential oils loaded on chitosan considered as an enzymes inhibitors and gave those oils stability towards light, air, humidity and high temperature that caused degradable of essential oils. A conclusion Nano essential oils in this study is potent to be used as supplement of other control methods in sustainable agriculture practices.

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