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# EFFECT OF MICROWAVE RADIATION ON THE RED FLOUR BEETLE *TRIBOLIUM CASTANEUM* (HERBST)

**Fatma H Galal[1]*, Afnan F. Alenezy[1], Hadeel S Altalib[1], Hind S Aldakhil[1] and Nedal M Fahmy[2,3]**

[1]Biology Department, College of Science, Jouf University, Sakaka, KSA
[2]Department of Biology, University of Tabuk (Ut), KSA
[3]Pest Physiology Department, Plant Protection Research Institute (PPRI),
Agricultural Research Center (Arc), Giza, Egypt
* Email: Fhgalal@ju.edu.sa (corresponding author): ORCID ID: 0000-0002-6819-3422

**ABSTRACT**

**Approximately 50% of total harvested cereal grains are lost during the post-harvest handling and storage, and insects are the main cause for not only quantity (reductions in weight) but also quality. In the present study the effect of microwave radiation was studied on one of the stored product pest, the flour beetle *Tribolium castaneum* (Hersbt). Adult insects were obtained from infested flour products at stores specialized in selling cereal and stored products from Sakaka. Insects with its food media inside sac were exposed to microwave radiation for 15, 30, 45 and 60 sec for each radiation power. *Tribolium castaneum* beetles were exposed to microwave for 15, 30 and 45 sec. This result revealed that the mortality of immature and adults reached 100% in 15 and 45 sec, respectively.**

**Key words:** *Tribolium castaneum*, microwave radiation, stored products, flour, immature, adults, Sakaka, cereals, mortality, exposure

Cereals are the most prominent source of protein in human food (Shewry, 2007) but approximately equal to 50% of total harvested cereal grains suffer losses during storage (Fornal et al., 2007). Insects are the main cause of quantity (reductions in weight) or quality (commercial value and seed viability) in grains Mohale et al. 2010 concluded that the very serious primary insect pests of stored grains/ products are the coleopterans. Microwave radiation is essentially results from the dielectric heating effect, and when produced in grain, the insects damaging these are heated at a faster rate than the products, that may be possible to reach a lethal temperature for insects (Vadivambal et al., 2006). Thus, the microwave radiation can be used as a control method for stored product insects. This study evaluates the effect of microwave radiation on the *Tribolium castaneum* (Herbst) from the Sakaka stores.

## MATERIALS AND METHODS

Adult insects were obtained from infested stored products at stores specialized in selling cereal and stored products form Sakaka. Insects were recognized and maintained at room conditions (25°C ± 2, 70± 5%RH) in plastic jars. The culture was maintained with sterile food media (wheat flour) and sealed with gauze fixed with rubber band. Insects were identified following keys given in Halstead (1986). To study the effect of microwave radiation, about 75 g of stored product (rearing media represented wheat flour) was put in plastic sacks of size 5x 19 cm, each containing 20 newly emerged adults (1-4 day old). Sacks were sealed off and punctured using a needle for ventilation. All treatments were left for 24 hr in order to ensure random distribution of insects inside rearing media, along with immature stages (egg, larva, and pupa). Insects with its food media inside sac were exposed to microwave radiation at exposure times 15, 30, 45, 60, 90 and 120 sec for each radiation power. Each treatment was replicated three times with three replicates for control treatment (without exposing to microwave radiation). After exposure to microwave radiation, food media with insects were spread from the sealed sacks on a white board, for counting. Insects were considered dead if they do not respond/ move when shaken or stimulating them by brush after 0,2,4,8,12,24,36 and 48 hr of exposure, and mortality data were calculated. The data were subjected to statistical analyses using SPSS ver. 19 (SPSS Inc., Chicago, IL).

## RESULTS AND DISCUSSION

The results revealed that the *T. castaneum* immature stages show 100% mortality after exposure for 15 sec of microwave radiation, while in the % adults mortality was 68.35+11%, 0, 10+0.5%, 15+8.5%, 5+1.5% and 1.65+ 1.65% at intervals after 0,2,4,8,12 and 16 hr

Table 1. Adult and immature mortality in *T. castaneum* after exposure to microwave radiation

| Post exposure time/hours | 0 | 2 | 4 | 8 | 8 | |
|---|---|---|---|---|---|---|
| % . Adult mortality | 68.35± 11% | 0 | 10± 0.5% | 15± 8.5% | 15± 8.5% | 1.65± 1.65% |
| % . of immature mortality | 98.35± 1.65% | 1.65± 1.65% | - | - | - | - |

post exposure for 15 sec microwave radiation; the adult mortality was 98.35+ 1.65% and 1.65+1.65% after 0 and 2 hr post exposure for 30 sec. All the insects were dead after 2 hr post exposure for 30 sec microwave radiation (Table 1). Microwave radiations are considered as one of the powerful methods, as 100 % mortality is observed with *T. castaneum* in both immature and adults- after 15 sec for immature and 45 sec for adult, respectively. Electromagnetic energy/ microwave provides a rapid heating in a short time period. that may be lethal to many stored product pests. The present results agree with those of Sadeghi Nasab et al (2004) who observed the effect of microwave radiation on three stored product pests. Vadivambal et al. (2007) and Singh et al. (2012) who worked on *Callosobruchus chinensis* also got similar results. Saboori et al. (2017) studied the effect of microwave radiation, and observed lethal effects on the adults of *C. maculatus*. Patil et al. (2020) reported that microwave irradiation affects *T. castaneum* stages present in almonds at different power levels (120- 600 W) and durations (30-90 sec). Ayad et al. (2022) reported the effect of microwave energy against adult stages, protonymph and larva of dried fruit mite *Carpoglyphus lactis*, and flour mites *Acarus siro* and *Caloglyphus berlesei*. Raju et al. (2022) reported that the increase of microwave irradiation power results in the increase in mortality of all the lifestages of *T. castaneum*.


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## AUTHOR CONTRIBUTION STATEMENT

FA,NA conceived and designed the research; FG, AA,HA,HA, NF conducted the experiments and analysed the data; FG,NF wrote the manuscript; and all authors read and approved the manuscript.

## CONFLICT OF INTEREST

Authors declared that they have no conflict of interest.

## REFERENCES


Ayad E, Roshdy O, Afifi H. 2022. Effect of microwave energy on some stored product mites. Egyptian Academic Journal of Biological Sciences, B. Zoology 14(2): 145-151.

Fornal J, Jelinski T, Sadowska J, Grunda S, Nawrot J, Niewiada A, Warchalenski J, Blaszczak W. 2007. Detection of granary weevil *Sitophilus granarius* (L.) eggs and internal stage analysis. Journal of Stored Products Research 43: 142-148.

Halstead H. 1986. Keys for the identification of beetles associated with stored products. I-Introduction and key to families. Journal of Stored Products Research 22: 163-203.

Mohale S, Allotey J, Siame A. 2010. Control of *Tribolium confusum* J. Du val by diatomaceous earth (Protect- ITTM) on stored groundnut (*Arachis hypogaea*) and *Aspergillus flavus* link spore dispersal. African Journal of Food, Agriculture, Nutrition and Development 10: 2678-2694.

Patil H, Shejale P, Jabaraj R, Shah N, Kumar G. 2020. Disinfestation of red flour beetle (*Tribolium castaneum*) present in almonds (*Prunus dulcis*) using microwave heating and evaluation of quality and shelf life of almonds. Journal of stored products research 87: 101616. https://doi.org/10.1016/j.jspr.2020.101616.

Raju S, Chellappan, M., Bhaskar H, Sudheer P. 2022. Susceptibility of life stages of *Tribolium castaneum* (Herbst) to microwave radiation. Indian Journal of Entomology. https://doi.org/10.55446/IJE.2022.521

Saboori S, Moravvej G, Sadeghi Namaghi H, Mohebbi M. 2017. The lethal effects of microwave radiation on the adults of cowpea seed beetle, *Callosobruchus Maculatus* Fabricius (Coleoptera: Bruchidae). Iranian Plant Protection Research 31: 20-28.

Sadeghi Nasab F, Shayesteh N, Pourmirza A, Ghobadi C. 2004. Effect of microwave with different powers and times on developmental stages of three species of stored product pests. Iranian Journal of Agricultural Sciences 35: 493-498.

Shewry P. 2007. Improving the protein content and composition of cereal grain. Journal of Cereal Science 46: 239-250.

Vadivambal R, Jayas D, White N. 2007.Wheat disinfestation using microwave energy. Journal of Stored Products Research 43: 508-514.

Vadivambal R, Jayas D, White D. 2006. Disinfestation of life stages of *Tribolium castaneum* in wheat using microwave energy. Proceedings of the CSBE/SCGAB, Annual Conference Edmonton Alberta. pp. 6-120.


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