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Experimental Study on the Effect of Ozone Gas and High Temperature on the Insect Tribolium Castaneum Found in Grain Stores

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ABSTRACT

Stored grains are one of the most abundant sources of food for people and animals. Insects found in grain stockpiles provide one of the most significant issues for researchers and others concerned with global food security. This study investigates the impact of ozone gas and temperature variations on the behavior and survival of the Tribolium castaneum insect, a common pest found in grain storage facilities. Ozone, a reactive gas, is examined for its potential as a pest control agent, The experiment includes the direct application of ozone to wheat and chickpeas infested with insects at different concentrations of 250, 300, and 750 ppm. At a high temperature (T = 50 °C), our focus is on knowing the effectiveness of ozone in eliminating insects present in wheat, and the results obtained indicate Obtaining the remarkable effectiveness of ozone in eliminating insects The findings of this study contribute valuable insights into developing sustainable and effective methods for pest management in grain storage, with potential implications for improving food safety and security.

Keywords: Ozone; Tribolium castaneum; dielectric barrier discharge; wheat and chickpeas; Food Safety

1 Introduction

Rising concerns about the environmental and health effects of traditional insecticides have driven the search for sustainable alternatives in pest management [1] ,Ozone is a powerful oxidizing and antimicrobial agent that is known to destroy certain bacteria and As an alternative to synthetic pesticides, ozone has been used to combat insects in stored grain[2]. In this context, our research delves into the realm of experimental studies exploring the use of ozone as a substitute for conventional insecticides in wheat and chickpeas storage facilities.and at the high temperature Suboptimal high temperatures (35–45°C) are the maximum temperatures for reproduction of most species. Lethal temperatures (above 45°C) cause the cessation of movement, arrest development [3]. These findings clearly highlight the and ozone's ability to act quickly and effectively at higher concentrations and high temperature, offering promising prospects as a viable alternative to conventional insecticides in the context of wheat storage.

2 Experimental

Experimental Device

The experimental system shown in Figure 1 for treating wheat wheat and chickpeas infested with insects uses ozone produced by surface Dielectric Barrier Discharge (DBD).

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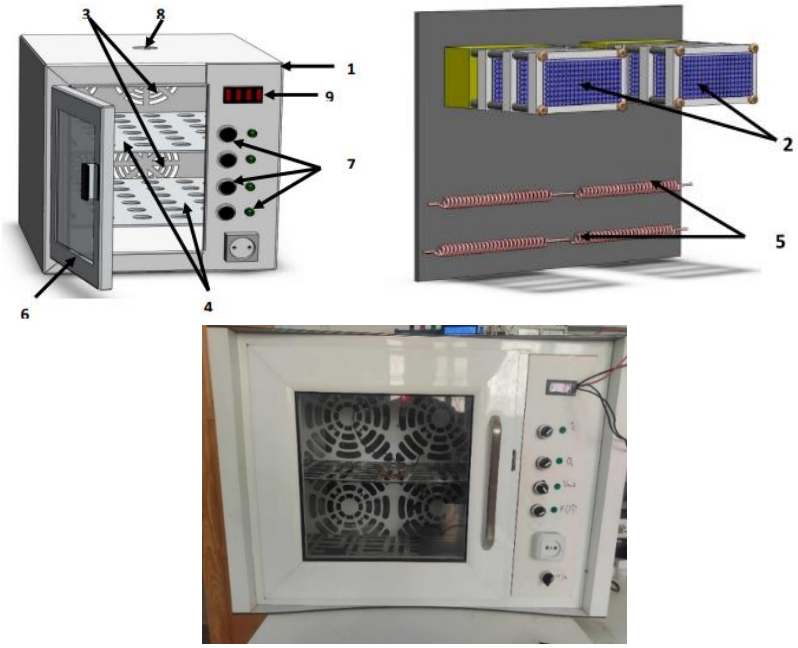

Figure1: The experimental set-up

The treatment chamber (1) is designed to accommodate the wheat and chickpeas to be treated, includes an ozone production chamber located in the rear part of the device , inside which are fixed two ozone ceramic plate modules (2) and two fans (3) with opposing air flows to circulate the ozone produced in the ozonation chamber to the entire volume of the enclosure. The Device has two horizontal perforated aluminum shelves (4) for deposing samples and materials to be treated. Moreover, the ozone destruction is carried out by using electric heating resistors (5) of power 500 W each, located at the bottom of the ozonation chamber. The closure of the sterilizer is ensured by a door (6) fitted with a PVC seal with an electric lock system

For the adjustment of the treatment duration, the operation sequencing control of the three accessories (ozone plates, fans, heating resistors) is carried out manually using switches (7)which control them separately. An ozone concentration meter is placed on the upper wall of the enclosure in an opening through which the detector of the device is introduced(8)

In our study, the experimental device was employed to investigate its effectiveness in eliminating insects from whea , The results demonstrated the remarkable capabilities of the device for these purposes

- In the initial phase, a specified amount of wheat infested with insects is introduced into the ozone treatment chamber for the purpose of purification
- In the first stage, the mortality of insects is observed at intervals. After each interval, the insects are separated from the wheat, and the mortality rate of the insects is calculated. This process is repeated until reaching a 100% mortality rate

3 Results and Discussion

Total Insect Elimination After the initial 120 , 210, and 300 min ozone treatments at 750, 300, and 250 ppm, the presence of insects in the wheat was totally eliminated. This verified the excellent efficiency of the treatment with ozone in eliminating insect infestations in wheat.

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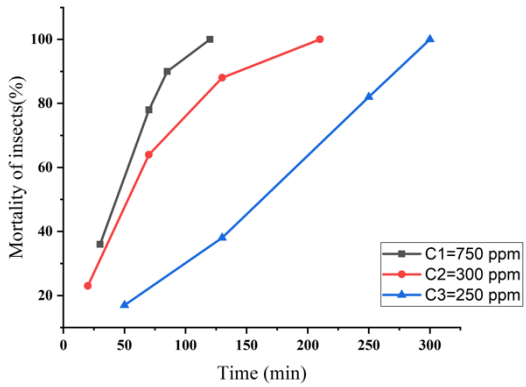

Figure2: Variation of the mortality rate of Tribolium castaneum (%) according to the treatment duration

Through Figure 2, we observe the mortality rate of Tribolium castaneum over time. Elevated temperatures impede insect movement, while ozone gas targets the respiratory system, leading to the demise of the insect.

Table1*: A comparative study between ozone gas and phosphine gas (ph3)*

	Ozone	**Ph3**
Cost	"Cost-effective"	"Very expensive
Gas Production	"easy to produce"	"more complex"
Environmental Impact	"environmentally friendly"	"air pollution"
Toxicity	"harmful to hmans "	"less toxic"

4 Conclusions

ozone demonstrates considerable potential as an alternative to traditional insecticides in wheat storage facilities. Its effectiveness lies in its ability to act as a powerful oxidizing agent, targeting and eliminating pests without leaving chemical residues. The environmental friendliness of ozone, marked by the absence of persistent residues and reduced toxicity compared to conventional pesticides, makes it an attractive choice for sustainable pest managemen

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