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CAMPHOR AS A PROMISING INSECTICIDE FOR CONTROL OF *Callosobruchus chinensis* (L.)[1]

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ABSTRACT

Studies on camphor insecticidal activities were conducted in a room with the temperature of 32±1°C and the relative humidity of 40±5(%), using *C. chinensis* (L.) as a test insect. According to the data obtained, camphor with a concentration of 12 ppm gave a one-hundred percent control of this insect, and inhibited its oviposition in closed jars. No significant effects were obtained when camphor was used in open containers. Lack of performance in these containers suggested that the chemical acts as a fumigant insecticide. Males and females did not respond differently to the concentrations of camphor used under the conditions of this study.

Considering the price, low mammalian toxicity, and high insecticidal activities in closed containers, camphor is considered to be a promising candidate insecticide. More studies are required on its possible application in controlling stored-product insects.

INTRODUCTION

The use of chemicals toxic to insects is one of the most widely used measures in control of infestations of stored products, and the literature relating to it is extensive. In spite of the high insecticidal efficiency of modern insecticides, the problem of insect resistance is becoming more important.

According to West and Hardy (26), Dethier has provided an excellent review on insect repellents, and pointed out that with the inevitable development of increased resistance of insects to insecticides the use of repellents is likely to remain an important measure.

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In addition, due to toxic residue of insecticides, search for finding materials with low mammalian toxicity is necessary. Among the candidate chemicals, studies on well-known materials with low human toxicity are recommended. Camphor is one of these substances which may be considered for possible application in insect control.

Camphor is a white crystal obtained by steam distillation from camphor trees, *Cinnamomum camphora* (L.), growing in Japan, Formosa, Java, Sumatra, China, and Brazil or produced by diene synthesis (20, 21, 23, 27). It is relatively stable at room temperature, with low solubility in water (about 1200 ppm); and highly soluble in most organic solvents (1, 20, 23). At 25°C one gram of the crystals dissolve in about 0.4 cc benzene, 0.4 cc acetone, 0.5 cc chloroform, 0.5 cc glacial acetic acid, and 1.5 cc oil of turpentine (23). It boils at 204°C, and has a specific gravity of 0.990 at 20°C (25). The median subcuteneous mammalian toxicity (LD50) of camphor is 2.2 g/kg for rat (23); therefore, it is classed as a safe chemical. Camphor taken as a medicine is detoxified by the liver (1).

An early application of camphor is found among the old-time preventives of plaque (20). More information on its medical uses has been given by Wright and Montag (27), Sollmann (21), Adriani (1) and Strecher (23).

Although the camphor tree is attacked by many pests (18), the extracted or synthetic material known as camphor ($C_{10}H_{16}O$) has been extensively used as an insect repellent and to protect woolens from clothes-moth attack (9, 13, 20).

Insecticidal properties of camphor have been studied by many investigators (2-7, 9-17,-19,20, 22, 24,28). According to the literature cited, this chemical has been mainly active when tested in closed containers. Therefore, it was of interest to study the insecticidal properties of camphor on insects of stored products which are usually confined to relatively close environment. For this purpose, *Callosobruchus chinensis* (L.) was used as a test animal. This paper reports the effect of camphor on mortality and oviposition of the insect.

MATERIALS AND METHODS

Adults of *Callosobruchus chinensis* (L.) were used throughout this work, using three males and three females for each replicate. This ratio was determined by statistical sampling of naturally infested chickpeas (*Cicer arietinum* L.) from which one newly mated female was obtained. The mated female was transferred to a 1-liter jar, containing about 100 grams of chickpeas, covered by a cheese cloth for oviposition. The eggs resulted in a F_1 generation. The mated females of this generation were used for infestation of other seeds of chickpeas with the same procedure described above. Members of the F_2 generation were used in this experiment.

One-day old adults which were obtained from well-developed pupae, were exposed to different doses of camphor crystals ranging from 1.8 to 5.6 mg per jars of about 450 cc capacity (corresponding to 3-12 ppm), each containing twenty seeds of chickpeas (weighing about two grams) as an oviposition site. Untreated seeds and also the seeds treated by 5.6 mg chickpeas powder (equivalent to maximum dosage of camphor) were included as checks. The latter was used for evaluation of physical effects of powder, if any, on mortality and oviposition of the insects.

To study comparative effects of the chemicals in open and closed conditions, the experiment was conducted both in open and closed jars. The open containers were covered by 50 mesh cheese cloths and fastened with rubber bands, and in closed containers the bottles were fitted with self-sealing glass lids containing rubber bands. Camphor was introduced into the jars as crystals and deposited on the bottom.

Mortality of the insects was recorded after 24 hours, and egg counts were made when all insects were dead.

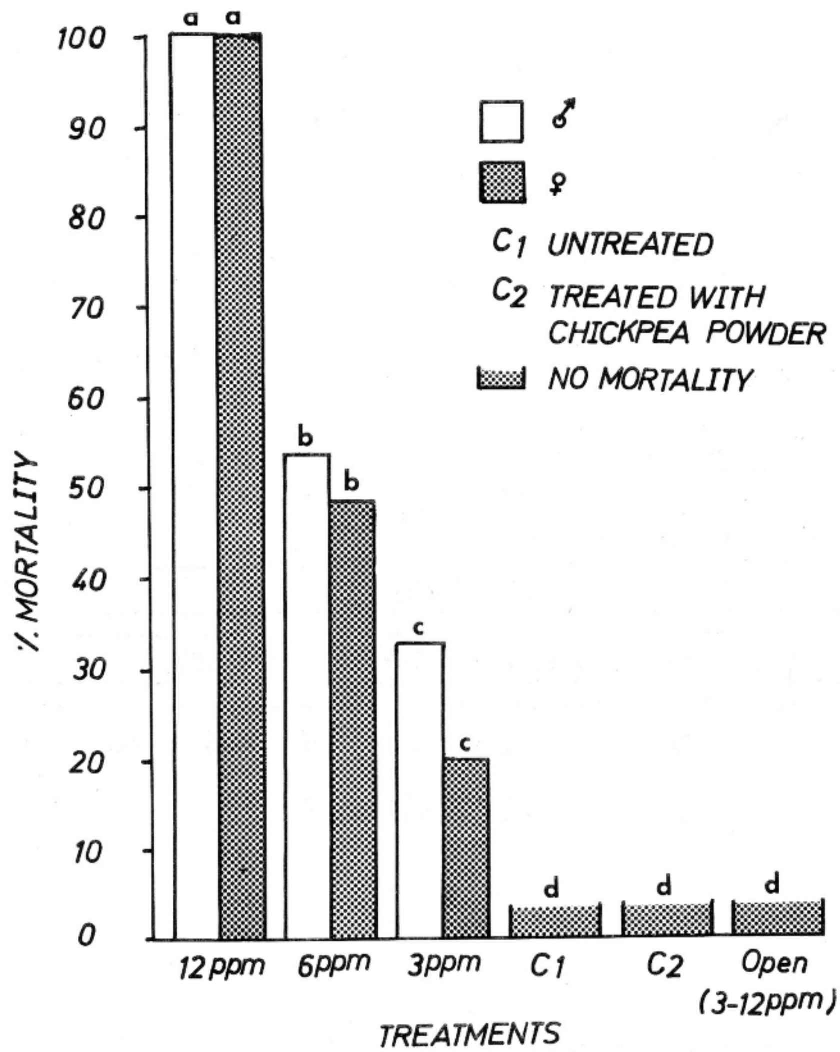
The experiment was conducted with a completely randomized design with five replications per treatment. Temperature and relative humidity throughout this study were 22 C ± 1 and 40 (%) ± 5, respectively.

RESULTS AND DISCUSSION

Results illustrated in Figure 1 indicated that camphor at 12 ppm concentration, in closed containers, killed one-hundred percent of adult weevils after 24 hours. No significant mortality was obtained, when it was introduced to open containers. This is believed to be due to high volatility of this chemical which is considered to be the reason for its failure in the past (5-7, 14-16, 19,28). The lower dosage of camphor (6ppm), in closed containers, resulted in a highly significant control of this insect. There was no significant difference between mortality of the males and the females. The chickpea powder did not affect natural mortality.

According to Figure 2, oviposition of the females was almost inhibited by their exposure to 12 ppm of camphor, while the lower doses, and the chickpea powder failed to show any significant difference with the check. No egg was laid on the interior surface of the jars, in all treatments. As mating is required for egg production

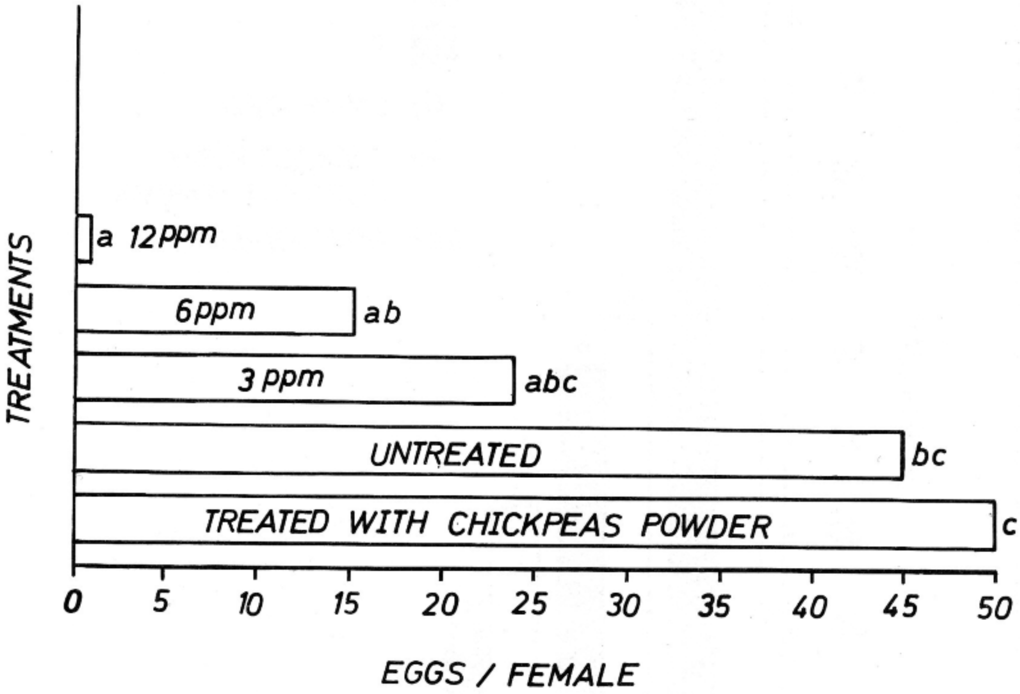
Fig. 1. Effect of three concentrations of camphor on mortality of *C. chinesis* (L) adults, in open and closed containers.[1,2]



1 Mean of Five replicates.

2 Means followed by the same letter are not significant at the 1% level ; determined by Duncan's Multiple Range Test (8).

Fig. 2. Effect of three concentrations of camphor on oviposition of *C. chinensis* (L.) females, in closed containers.[1,2]



[1] Mean of five replicates.

[2] Means followed by the same letter are not significant at the 5% level; determined by Duncan's Multiple Range Test (8).

in the females, inhibition of oviposition may partly be attributed to the loss of mating ability in the males which were hardly walking, several hours after exposure to the highest dosage. However, the possible effect of camphor on oviposition mechanism of the females, cannot be negated. For, according to our observations, oviposition also was inhibited when mated females were exposed to camphor at a concentration of 12 ppm.

Considering price, effective dosage, effectiveness, and the low mammalian toxicity, camphor is considered as a promising candidate insecticide for possible application in controlling stored-product insects. Extensive studies on other aspects of its insecticidal properties are underway. No recommendation of camphor application should be made, before obtaining a thorough information about its behavior.

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