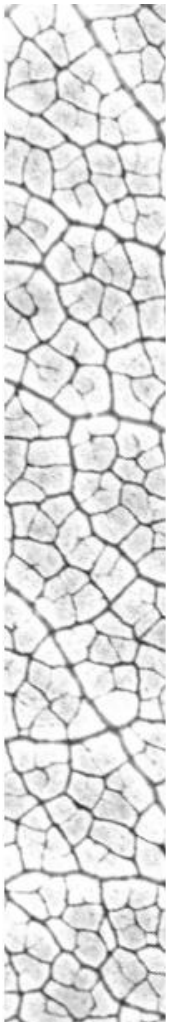

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Study the effect of some plant's powders on adults of rustic flour beetle *Tribolium castaneum*

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Abstract
The study was conducted to determine the efficacy of three plant powders (*Moringa oleifera*, *Mentha arvensis,* and *Syzygium aromaticum*) on red flour beetle *Tribolium castaneum* after 1, 2, 24, and 72 hr. The results showed that the concentration of 6 g of *M. arvensis* leaf powder recorded the highest percentage of insect expulsion reached 90% and the lowest expulsion rate of *Moringa oleifera* plant at a concentration of 2 g was 23.3 after half an hour. While the *Syzygium aromaticum* with the same concentration reached 50% after 24 hours. The results of the percentage of killings calculated after 24 hours showed the highest percentage of *Syzygium aromaticum* powder by 6.00% and the concentration of 6 g and the lowest percentage of *Mentha arvensis* reached 2.33% at the same concentration. The percentage of killings after 72 hours for *Moringa oleifera*, *Mentha arvensis,* and *Syzygium aromaticum* powders showed the highest killing rate of 6g was 8.66% 3.33%, and 9.33% respectively

Keywords: plant powder, *Tribolium castaneum*, repellent, mortality

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INTRODUCTION

Wheat (Triticum spp.) is from cereal crops that belong to the family Poaceae (order Poales). Wheat is an essential source of nutrients for around 40% of the world's population (Giraldo *et al*., 2019). Wheat flour is a powder obtained from the milling of wheat grains, which is the main raw material for cereal-based food products (Lin *etal*., 2019). The red flour beetle, Tribolium castaneum (Herbst) insect beetle belongs to the Tenebrionidae family, Coleoptera order and is one of the most serious secondary pests in stores and warehouses (Adarkwah,*et al*.,2010) that feed on a wide range of durable stored products importantly the flour and grain products. In addition, it is a pest for other stored products such as beans, peas, dried fruits and milk. Dehydrated, ready-made cake mixtures, spices, drugs, chocolate, cocoa and oilseeds, dried flowers, herbs and others (Moore and Aleglet, 2002). The exact place of origin of *T. castaneum* is still subject to debate. It is, believed to have originated from India or Indo-Australian origin (Ridley *et al*., 2011). It is currently a worldwide insect pest of great economic significance in stored product environments (Haines,1991). Damage by this pest is usually manifested by a loss in both quantity and quality (Bachrouch *et al*., 2010) Product attacked by *T. castaneum* usually contains frass, carcasses, and exuviae. It also turns grey in colour with a pungent unacceptable odour due the elicitation of benzoquinones, a defensive chemical material from their prothoracic and abdominal glands; making the product unsuitable for humans (Devi and Devi, 2015) Both larvae and adults feed externally on grains and processed foodstuff causing devastating damage, but the damage by larvae are mostly confined to the germ of the grains in wheat (Obaid, 2010, Khalaf and Omaran, 2016). To reduce the effect of this insect, a lot of techniques were used, including pesticides, chemical. Fumigation with synthetic chemicals, the most widely used fumigants are phosphine and methyl bromide (Gasemzadeh *et al*., 2010). Daglish *et al*. (1992) reported that methacrifos, chlorpyrifos-methyl, deltamethrin, and pirimiphos-methyl have efficiently curtailed the development of the progenies of T. castaneum on the treated peanuts. But by contrast, malathion proved to be very efficacious against both the adults of T. castaneum and their immature stages. However, the control of stored product pests using synthetic pesticides and fumigants had some limitations such as pest resurgence, environmental disturbances, and pest resistance to pesticides, increasing cost of application, lethal effects

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on non-target species, and the poisoning of farmworkers and consumer (Adarkwah *et al*., 2010). This necessitated the exploration and adoption of other suitable alternatives to these synthetic insecticides for the management of insect pest infestation on stored products over the last few decades. Many researchers have conducted studies on the effect of different plants, including cinnamon and coriander, in controlling warehouse insects such as the cowpea beetle, grain weevil and rice (Arther, 2000 Golob,1997 and, Adler *et al.*, 2000). Numerous substances from plant sources have been reported as having deleterious bioactivity against all life stages of T. castaneum and have been used with varying degrees of success for its control on many stored products. For instance, (Ahmed *etal*., 2010) found that the use of Annona squamosa L. powder at an application rate of 7.5g/25g (30% w/w) gave maximum protection of stored millet against T. castaneum infestation. These plants act as insect repellants, repellants, or growth regulators (*Mtunai et al.*,2014). The aim of this study is to investigate pesticides of plant origin from *Moringa oleifera*, *Mentha arvensis,* and *Syzygium aromaticum* hat are good in combating flour beetles, because insects cannot resist them in the long run and also leave no trace in nature.

MATERIALS AND METHODS

Collecting of Tribolium castaneum

Adult of Tribolium castaneum beetle were collected from the flour and stored at 25 ° C and humidity of 70% inside the incubator for a week for the purpose of adapting them to the laboratory conditions before conducting the experiment by weight 250 g of bran then placed in a sterile glass bottle, 8 cm in diameter and 15 cm in height, and 20 pairs of insects aged between 48 h and 24 ‘h after its separation. The bottle was covered with a plastic lid in the middle of the bottle with a diameter of 2 cm for the purpose of ventilation covered with tulle cloth (AL-rahimy and Khalaf,2014).

Preparation of leaf powder

After collecting the leaves of the *Syzygium aromaticum*, *Moringa oleifera* and *Mentha arvensis*, it was washed thoroughly and then dried under shade. The dried leaves were ground to a fine powder with the help of grinding machine. The powder was then sieved and preserve for experiment purpose. 100 g of healthy uninfested broken grains of wheat varieties “Kanchan” was taken in plastic bottle, and then 2 g of each plant powder was mixed. After mixing thoroughly 10 pairs of newly emerged adult were released in a bottle. The mouth of the bottle was covered with muslin cloth and tied with rubber bands. The observations were recorded on adult mortality, adult emergence and per cent weight loss due to insect damage.

Exhausting the effect of plant powders

The Naworth (Naworth,1973) method was adopted with some modifications in estimating the expelling effect of vegetable powders against the rust beetle insect by taking a large dish with a diameter of 14 cm and a height of 5.1 cm and a small dish with a diameter of 5.8 cm and a height of 3.1 cm, and the small dish was installed in the middle of the large dish by adhesive after Put 10 g of flour for each small dish separately, then add the vegetable powders and concentrations 2 g, 4 g, 6 g for each dish. Then put into the small plate 10 adult insects, the nozzle of the large dish was covered with a cloth of the millimeter and attached by a rubber band, then recorded the numbers of insects coming from the small dish to The great dish after an hour and two hours from th Working, and performed the same steps on a plate Alkntrul, calculated the percentage of the expulsion according to the following equation

Expulsion percentage = number of insects exiting a small dish / total number of insects x 100

Test the effect of plant powders on the percentage of adult deaths

The powders of the plants under study were added with concentrations of 2.0g, 4.0 g, 6.0 g (for each concentration of three replicates) to the insect food, which consists of 10.0 g of the environment (clean flour, baking yeast, and powdered milk) for each dish and without mixing the materials, then insert for each dish 10 adult insects. Then the plates were covered with nylon bags and punctured by minute holes for air intake, and the percentage of dead insects were recorded after 24 hours and 72 hours, and the results were corrected according to the Abbott equation (Aboot,1925).

Statistical analysis

The experiment was conducted according to-Completely Randomized Design (C.R.D.) and Results were compared using a Least Singnificant Differences (L.S.D) At a probability level of 0.05 (Alrawyand and Abdulaziz, 2000).

RESULTS

The results of **Table 1** showed that the concentration of 6.0 gm of mint leaves powder has recorded the highest mortality percentage for adult, it reached 90%. Then, other plant powders with a concentration of 6.0 g, was recorded in insect repellent, as it reached 80% for clove powder and 53,3 for leaf morna leaf compared to the comparison treatment recorded 20%.

The results of **Table 2** showed that the mint powder recorded the highest ejection percentage at a concentration of 6 g as it was 96.6%, while the lowest ejection percentage for clove powder was at a concentration of 2% as it reached 50% compared to the comparison treatment of 30%.

The results of **Table 3** showed the corrected percentage of the effect of plant powders used in killing

Table 1. Effect of different concentrations of plant powders on Expulsion rate of adults of flour beetle *T. castaneum* after one an hour

The plant powders	Concentration Weight /gram	Expulsion rate %
Moringa oleifera	2	23.3
	4	30,0
	6	53.3
Syzygium aromaticum	2	30,0
	4	30,0
	6	80,0
Mentha arvensis	2	%80
	4	86,6
	6	90,0
Control	0	%20
LSD	2.25	

Table 2. Effect of different concentrations of plant powders on Expulsion rate of adults of T. castaneum after 2 hours

The plants powder	Concentration Weight / gram	Expulsion rate %
Moringa oleifera	2	53.3
	4	56.6
	6	83.3
Syzygium aromaticum	2	50
	4	73.3
	6	83.3
Mentha arvensis	2	80
	4	90,0
	6	96,6
Control	0	0.00
LSD	2.01	

Table 3. Effect of different concentrations of plant powders on Expulsion rate of adults of T. castaneum Percentage of murder after 24 hours

The plant powders	Concentration Weight gram	Murder rate *%*
Moringa oleifera	2	1.3
	4	3,6
	6	4.66
Syzygium aromaticum	2	1.63
	4	3.33
	6	6.00
Mentha arvensis	2	1.00
	4	1.6
	6	2.33
Control	0	0.00
LSD	1.5	

the insect that was recorded after 24 hours of treatment, as carnation powder recorded the highest percentage of insect mortality at 6.00 at a concentration of 6 g and the lowest percentage of mint powder at a concentration of 6 g amounted to 2.33.

The results of **Table 4** showed that the clove powder and the minka powder recorded the highest percentage of killing at a concentration of 6 g at 8.66 and 9.33 respectively, while the lowest percentage of killing of the mint plant with the three concentrations used in the experiment (2.4.6) was 1.00, 1.33 and 3 33. respectively, The active substances in the plant with an aromatic smell had an effective effect in flushing out the insect the study agrees with the work of (Tolez *et al.,* 2006) in their study on lice of the head of mint, with the highest rate of mint powder being recorded at 75.5% (**Table 2**).

Table 4. Effect of different concentrations of of murder powder on Expulsion rate of adults of *T. castaneum* after 72 hours (mortality)

The plant powders	Concentration Weight / gram	Murder rate *%*
Moringa oleifera	2	4.00
	4	6.33
	6	8.66
Syzygium aromaticum	2	4.33
	4	7.33
	6	9.33
Mentha arvensis	2	1.00
	4	1.33
	6	3.33
Control	0	0.00
LSD	3.28	

DISCUSSION

This results of current study was disagreed with as reported by other authors like (ALjaber, 2006) when using mint powder and mixing with wheat in various concentrations if he recorded the highest murder rate (**Table 4**).

Our results are agreement with (Farman, 2009, Kalaf and Glayan, 2000) that the increase in the mortality of whole beetles flour and the increase in the repellent effect are related to the increase in the concentrations of powders mixed with the grains.

The destruction in the insect may be attributed to the fact that the minute the powder adheres to the body of the insect absorbing water to it, and therefore the insect dries and dies, and that the insect's contact with the particles of the powder causes it to remove the waxy layer of the insect's body wall so that the water evaporates quickly, then it dries and dies (Halawah and EL-kashlan*,* 1998), or the insect's destruction may be suffocating from oils Strong aromatic in powders. Or that the insect is confused when you smell a strange perfume that is free from these plants, which causes it to find food or avoid food, and this confusion is affected by the active substance (Adarkwah *et al.,2010*). The effect of most plant powders on insects is by stimulating the nerve centers and then suddenly inhibiting them from what happens nervous shock and the occurrence of paralysis or toxic effect during contact with the surface of the body and choose chemical compounds for extracts and powders Vegetation of the Q-close by the flexible areas or respiratory openings, causing paralysis and rapid killing, This difference is attributed to what leads to the emergence of trauma in the plant and the insect containing phytophthora of different plants. One of the vital processes causing metabolism stops and then death (Shaban and Nizar,1993).

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