CONCENTRATION DEPENDENT OVICIDAL EFFECTS OF THREE BOTANICALS ON EGGS OF *Ephestia cautella*

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A PROJECT SUBMITTED TO THE DEPARTMENT OF ANIMAL AND ENVIRONMENTAL BIOLOGY, FACULTY OF LIFE SCIENCES UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA IN PARTIAL FULFILLMENT FOR THE AWARD OF BACHELOR OF SCIENCE B.Sc. (Hons), ANIMAL AND ENVIRONMENTAL BIOLOGY.

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CERTIFICATION

This is to certify that this project work was carried out by **Karim Mercy OBOSE (Miss)** in the Department of Animal and Environmental Biology, Faculty of Life Sciences, University of Benin, Benin City, under the supervision of DR. I. N. EGBON.

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PROF. A. A. IMASUEN (Head of Department)	**DATE**
EXTERNAL EXAMINER	**DATE**

DEDICATION

This work is dedicated to Almighty God and my parents.

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I want to thank God almighty the giver of life for his guidance and protection. Special thanks goes to my supervisor, Dr, I. N. Egbon who gave me maximum audience in the supervision of my work and made this project become a reality.

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Special thanks goes to my beloved parents, Mr and Mrs Karim Ebehi for their prayers, encouragements and most especially financial support all through my quest for knowledge in the university of Benin and also my sister shade Karim, I will forever be grateful to you for being the best sister I could have asked for and thank you for everything because you made these four years journey easy.

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ABSTRACT

In this study, the concentration dependent ovicidal effects of three botanicals were investigated on the eggs of *Ephestia cautella.* Three plants were selected for the experimental process, these include bitter leaf (*Vernonia amygdalina*), Neem leaf (*Azadirachta indica*) and Siam weed (*Chromolaena odorata*). Aqueous, alcohol and acetone extracts of the selected botanicals were prepared. Eggs of the insect *Ephestia cautella* were also collected and treated with the various extracts. The ovicidal activity of the various extract o the eggs of *E. cautella* was investigated after 96h and the percentage mortalities were estimated for the various extracts. Findings from the study revealed that for aqueous extract treatments, the highest percentage mortality 55.81% was recorded for treatments with aqueous extract of Siam weed while the lowest percentage mortality 6.97% was recorded for treatments with aqueous extract of Bitter leaf. For alcohol extracts treatments, the highest percentage mortality 20.00% was recorded for treatments with alcohol extract of Bitter leaf while the lowest percentage mortality 8% was recorded for treatments with alcohol extract of Neem leaf. Ovicidal effect of acetone extract on eggs of *Ephestia cautella* revealed that the highest percentage mortality 20.00% was recorded for treatments with acetone extract of Bitter leaf and Neem leaf. Aqueous extract of the botanicals were most effective in inhibiting the egg development of *E. cautella*. The study proved the efficacy of botanicals in preventing the growth and development of destructive plant pests such as *Ephestia cautella.*

CHAPTER ONE INTRODUCTION

Ephestia cautella (Walker) which is also sometimes called *Cadra cautella* (Hb) (Abeysinghe *et al*., 2020) ranks second only after *Tribolium castaneum* (Herbst) for the amount of damage caused to stored products (Sedlacek *et al*., 1995). *Ephestia cautella* (Walker) is a lepidoteran pest belonging to the family pyralidae (Karuppaiah *et al*., 2018; Oyedokun and Omoloye, 2019). It is commonly referred to as the almond moth or tropical warehouse moth (Oyewo and Amo, 2020). The complete life cycle of *E. cautella* under laboratory conditions takes about 50 days on stored cocoa beans and its life cycle tend to differ with the food or food product it infests. For example, on maize, the life cycle was completed in about 30 days (Oyewo and Amo, 2020). It lays an average of 100 eggs over its average four days life span. The incubation period of the egg is four days, the larval period is 38 days and the pupal stage is eight days (Oyewo and Amo, 2020).

E. cautella is a small, stored-product pest that infests flour, bran, oats, and other grains, as well as dried fruits or nuts (Aldawood *et al*., 2013; Oyewo and Amo, 2020; Sedlacek *et al*., 1995). *E. cautella* moths are serious pests of dried plant materials and have been recorded from cereal grains (maize) and their products (grain flour), dried fruit, nuts (palm kernels, walnuts, hazelnuts and peanuts), oilseeds (groundnut), pulses (cowpea), cocoa beans, confectioneries, dried figs, apricots, apples, sultanas, chocolate, dates, stored garlic (Aldawood *et al*., 2013; Sammani *et al*., 2020). All these food crops appear to be more suitable than cocoa for the development of the insect, because the life cycle on them took a much shorter period. *E. cautella* can cause almost 29 % damage to fermented stored cocoa beans over a period of four months (Oyewo and Amo, 2020).

E. cautella can be controlled using traditional methods (removal infested grains or cons), physical methods (use of gamma rays and UV rays), chemical methods (fumigants)and biological control methods (use of natural enemies to eliminate insect) (Ibrahim *et al.,* 2012; Qader, 2020; Nazir *et al.,*2020).

1.1 Justification

Crop damage and loss caused by insects is a serious problem to final crop yield and harvest. Their feeding habits leads to crop loss worth billions of dollars annually. The development of an efficient and effective control measures for such pest is very paramount for the sustenance of crop growth and development. This study thus addresses this issue and seeks to answer the questions as regards the control of the crop pest *Ephestia cautella* known to be a destructive pest of grains (maize, palm kernels, walnuts, peanuts etc.)

1.2 Aim

The aim of this study was to evaluate the efficacy of three botanicals against the eggs of *Ephestia cautella.*

Specific objectives are to:

(i) To evaluate the effect of the selected botanicals on the oval mortality rate of *Ephestia cautella.*

(ii) To evaluate the role of extraction medium on the biocidal properties of the different botanicals.

CHAPTER TWO LITERATURE REVIEW

Insects are the most diverse species of animals living on earth. Apart from the open ocean, insects can be found in all habitats; swamps, jungles, deserts, even in highly harsh environments such as pools of crude petroleum (Jankielsohn, 2018; Hikal *et al*., 2017). Insects are the most diverse species of animals living on earth. Apart from the open ocean, insects can be found in all habitats; swamps, jungles, deserts, even in highly harsh environments such as pools of crude petroleum. Insects are undoubtedly the most adaptable form of life as their total numbers far exceed that of any other animal category (Samways, 1993). The majority of insects are directly important to humans and the environment. For example, several insect species are predators or parasitoids on other harmful pests, others are pollinators, decomposers of organic matter or producers of valuable products such as honey or silk.

Insect infestation spares no part of the plant or life stage of the plant. They can affect stored seeds, seedlings, developing plants and matured crops with already formed fruits. They are capable of causing losses before cultivation of plants and even postharvest of said cultivated crop (Gahukar and Reddy, 2019). Insect pests inflict their damage on stored products mainly by direct feeding. Some species feed on the endosperm causing loss of weight and quality, while other species feed on the germ, resulting in poor seed germination and less viability. Thus, due to damage done by insects, grains lose value for marketing, consumption or planting.

Ephestia cautella also called almond moth or tropical warehouse moth is a small, stored product pest. Almond moths infest flour, bran, oats, and other grains, as well as dried fruits. It belongs to the family of snout moths (Pyralidae), and more specifically to the tribe Phycitini of the huge snout moth subfamily Phycitinae. This species may be confused with the related Indian mealmoth (*Plodia interpunctella*) or the Mediterranean flour moth (*E. kuehniella)*, which are also common pantry pests in the same subfamily (Tetsuhiko and Hajime, 1999). It can also sometimes called *Cadra cautella* in literature. Other common names, particularly in nonbiological literature, are dried currant moth and fig moth. Like the raisin moth, the almond moth has achieved an essentially cosmopolitan distribution due to inadvertent transport with food products in its larval form.

The insect is widely distributed across the globe. Due to this, it has become known under a number of junior synonyms *Cadra defectella* (Walker), *Cryptoblabes formosella* (Wileman and South), *Ephestia cautella* (Walker), *Cadra cautella* (Hb), *Ephestia irakella* (Amsel), *Ephestia passulella* (Barrett) and *Ephestia pelopis* (Turner) to name a few (Wikipedia, 2021). Almond moths are found around the world. Although it thrives best in tropical climates, it has spread to many regions around the globe due to its tendency to infest dry goods that are shipped internationally (Bhadriraju and David, 1996). For example, it has been transported across Polynesia with copra shipments (BioNET-International, 2021).

The insect eggs are translucent yellow with a sculpted surface. The larvae range from 1.5-15 mm in length and are light brown, mostly gray, with dark brown spots with a sparse covering of hair. The heads of the larvae are usually darker. The pupae are darkbrown and found within a relatively light pupal case. Adult almond months are predominantly light brown in color, with smaller hind wings that are typically gray. When extended, its wingspan ranges from 14-22 mm. The back edges of the wings are lined with a short fringe (Francia, 2021; Wikipedia, 2021).

The larval stage (caterpillar) is the destructive stage of the life circle of *E. cautella*. The tropical warehouse moth is a major pest of a range of stored foods, especially cereals (maize, rice, wheat, sorghum, millet, oats) flours and other cereal products, dried cassava, groundnuts, cocoa beans, dried mango, dates, nutmeg, mace, cowpeas and other dried stored products (Aldawood *et al*., 2013; Sammani *et al*., 2020).

Adults live for about 10 days after eclosion and do not eat, but may drink if water is available. The mating system is polygamous; however, many females will only mate once (Aldawood *et al*., 2013; Sammani *et al*., 2020). Adult almond moths do not eat during their short lifespan but will drink water if they have access to it (Kathryn *et al*., 2009). Larval almond moths are hatched onto a variety of dry food products, which then serve as their primary food source. Although the moth infests several different kinds of food, the larvae develop most rapidly on wheat-based products (Oyewo and Amo, 2020). Moreover, cracked or ground seed and grain products are more ideal for larvae than whole seeds or grains because the almond moth larva larvae are unable to penetrate shells or hulls, which makes feeding more difficult (Sammani *et al*., 2020) The caterpillars are cannibalistic; larvae will also eat eggs and other smaller larvae (Francia, 2021; Wikipedia, 2021).

Generally, adult female moths will oviposit around 200 eggs at a time. The timing and number of eggs oviposited has been shown to vary based on several factors, including temperature, humidity, access to water, and type of food source. Low temperatures delay oviposition, and low humidity or lack of access to water seems to reduce the number of eggs oviposited by any given female. Preferred food source upon which to oviposit may vary with the strain of almond moth. Typically, females will oviposit at night (Bhadriraju and David, 1996; Oyewo and Amo, 2020).

Adult females of *E. cautella* lay somewhat of 300 small round sticky eggs within the substrate through holes in bags. A temperature range of 32-33^{0}C and a relative humidity of 70 percentage is optimum for its infestation. Larvae of *E. cautella* feeds on the seed germ and are fairly mobile within the produce. The larval stage of *E. cautella* is the most damaging and causes considerable losses by feeding gregariously on stored harvest (Alwaneen *et al*., 2019). The larvae is as an internal feeder which cause damage to the inner parts of the beans, however, it can also cause external damage, that can be easily observed by the presence of holes on beans, faeces, silk webbing and dead bodies (Oyewo and Amo, 2018). The production of silk results in considerable amount of damage in grains and on the surface of storage bags forming large lumps making food to no longer be fit for consumption once infested. Pupation takes place in crevices or between bags. Adult moths spread the infestation in the warehouse through egg laying (Alwaneen *et al*., 2019).

The following practices has been employed in curbing the destructive habits and economic losses (Francia, 2021) brought about by *E. cautella*;

Monitoring: Pheromone traps and water traps attract the pest. The latter is considerably more efficient, catching moths of both genders.

Cultural practices: Maintaining good hygiene, such as cleaning the store between harvests, removing any commodity spillages, immersing grain sacks in boiling water and fixing storehouse cracks and crevices.

Modified atmospheres: Provided that the grains are stored in closed structures, low oxygen and carbon dioxide-enriched atmospheres can be used to control the pest.

Mating disruption: This is combined with water traps eliminated large moths from a confectionary factory, acting together as an integrated pest management system.

Chemical control: Fumigation with phosphine is often used to control the moth. Another option was fogging with pyrethrins.

Biological control: Several species of *Trichogramma* parasitize the eggs of the pest. *Habrobracon hebetor* and *Venturia canescens* attack the larvae. The mesostigmid mite *Blattisocius tarsalis* is an important predator. Some of the pest's populations have become resistant to *Bacillus thuringiensis*.

Botanicals: these involes the practice of using natural sources against pests (Suleiman and Rugumamu, 2017). Plant parts and plant products have insecticidal, repellent or ant feeding and development inhibiting effects on insect pests (Issa *et al*., 2011).

CHAPTER THREE MATERIALS AND METHODS

3.1 Study Area

This study was carried out in Entomology laboratory under room temperature.

3.2 Preparation of Plant Extracts

Three plants materials (leaves) were selected for this study. These plants bitter leaf (*Vernonia amygdalina*), Neem leaf (*Azadirachta indica*) and Siam weed (*Chromolaena odorata*). To obtain the crude extract, 5g of each leaves was squashed in 2ml of water. The liquid was sieved through a fine mesh. Using a camel hair brush, the eggs of *E. cautella* were treated with the crude extract through apical application.

Eggs of insect: The eggs of test insect pest was obtained from the laboratory.

3.3 Sample Preparation

A total of 60 petri dishes were used in the experiment. They were labelled using a masking tape and indelible marker. Each treatment was replicated five times after 10 eggs were introduced into each petri dishes and exposed to the plant extracts. Thereafter, little amount of water pulverised chocolate was added to the petri dishes to serve as food for the hatchling prior to assessing their post-harvest survivability.

3.4 Preparation of Plant extracts

Bitter leaf Aqueous extract: Two (2ml) milliliter of water was added to 5g of bitter leaf. The liquid extract was used to treat the eggs within this group.

Neem leaf aqueous extract was prepared by adding two (2ml) milliliter of water to 5g of neem leaf. The liquid extract was used to treat the eggs within this group. The bitter leaf alcohol extract was prepared by adding five (5g) grammes of bitter leaf to alcohol and the liquid extracted was used to treat the eggs. The neem leaf alcohol extract was prepared by adding five (5g) grammes of neem leaf to alcohol and the liquid extracted was used to treat the eggs. The Siam weed alcohol extract was prepared by adding two (2ml) milliliters of water to 5g of Siam weed. The liquid extracted was used to treat the eggs. All plant parts were locally sources from the botanical garden in the University of Benin, Benin City. The control setup was prepared using only water which was used for treating the eggs without the addition of botanicals. The treatments prepared using only alcohol involved treatment of eggs with only alcohol and without the addition of botanicals.

3.5 Ovicidal activity

Each experiment was replicated five times along with appropriate control. The numbers of unhatched eggs were counted after 96 h and the rate of mortality was calculated. Percent mortality was calculated according to Abbot (1925):

$$\text{Abbot corrected mortality (\%)} = \frac{\text{\% unhatched eggs in treatment} - \text{\% unhatched eggs in control} \times}{100\ \text{\% unhatched eggs in control}} \frac{100}{1}$$

Plate 1: Locally sourced Chocolate

Plate 2: Labelled Petri dishes used for the experiment

CHAPTER FOUR RESULTS

The result obtained for effect of aqueous extract on the eggs of *Ephestia cautella* is shown in Table 1.

Result reveals that after treatment with aqueous extract of Bitter leaf (*Vernonia amygdalina*), the only eight out of a total of ten eggs successfully hatched into larva. Treatment with aqueous extract of Neem leaf (*Azadirachta indica*), showed that only four out of a total of ten eggs successfully hatched into larva. Treatment with aqueous extract of Siam weed (*Chromolaena odorata*), showed that an average of 3.80 eggs successfully hatched into larva. Control egg samples showed an average of 8.60 eggs which successfully hatched into larva. Ovicidal impact of the botanical aqueous extract on eggs of *Ephestia cautella* revealed that the highest percentage mortality 55.81% was recorded for treatments with aqueous extract of Siam weed while the lowest percentage mortality 6.97% was recorded for treatments with aqueous extract of Bitter leaf.

Table 1: Ovicidal effect of Aqueous extract of botanicals on eggs of *Ephestia cautella*

Treatment	Total number of Eggs introduced	Mean Number of Eggs Introduced Mean	S.E	Total number of Larva_Present	Mean Data of Larva_Present Mean	S.E	Number of unhatched eggs	% Mortality
1	50	10.00	±0.00	40	8.00	±0.45	10	6.97
2	50	10.00	±0.00	20	4.00	±0.32	30	53.49
3	50	10.00	±0.00	19	3.80	±0.49	31	55.81
4	50	10.00	±0.00	43	8.60	±0.24	7	-

Key:
1= Aqueous extract of Bitter leaf (*Vernonia amygdalina*)
2= Aqueous extract of Neem leaf (*Azadirachta indica*)
3= Aqueous extract of Siam weed (*Chromolaena odorata*)
4 = Control water

The result obtained for effect of alcohol extract on the eggs of *Ephestia cautella* is shown in Table 2.

Result reveals that after treatment with alcohol extract of Bitter leaf (*Vernonia amygdalina*), that average of 4.00 eggs successfully hatched into larva. Treatment with alcohol extract of Neem leaf (*Azadirachta indica*), showed that an average of 4.60 eggs successfully hatched into larva. Treatment with alcohol extract of Siam weed (*Chromolaena odorata*), showed that an average of 5.00 eggs successfully hatched into larva. Control egg samples showed an average of 5.00 eggs which successfully hatched into larva.

Ovicidal impact of the botanical alcohol extracts on eggs of *Ephestia cautella* revealed that the highest percentage mortality 20.00% was recorded for treatments with alcohol extract of Bitter leaf while the lowest percentage mortality 8% was recorded for treatments with alcohol extract of Neem leaf.

Table 2: Ovicidal effect of Alcohol extract of botanicals on eggs of *Ephestia cautella*

Treatment	Total number of Eggs introduced	Mean Number of Eggs Introduced Mean ±S.E	Total number of Larva_Present	Mean Data of Larva_Present Mean ±S.E	Number of unhatched eggs	% Mortality
1	50	10.00 ±0.00	20	4.00 ±0.45	30	20
2	50	10.00 ±0.00	23	4.60 ±0.40	27	8
3	50	10.00 ±0.00	25	5.00 ±0.55	25	0
4	50	10.00 ±0.00	25	5.00 ±0.55	25	-

Key:
1= Alcohol extract of Bitter leaf (*Vernonia amygdalina*)
2= Alcohol extract of Neem leaf (*Azadirachta indica*)
3= Alcohol extract of Siam weed (*Chromolaena odorata*)
4 = Control Alcohol

The result obtained for effect of acetone extract on the eggs of *Ephestia cautella* is shown in Table 3.

Result reveals that after treatment with acetone extract of Bitter leaf (*Vernonia amygdalina*), that average of 2.40 eggs successfully hatched into larva. Treatment with acetone extract of Neem leaf (*Azadirachta indica*), showed that an average of 2.40 eggs successfully hatched into larva. Treatment with acetone extract of Siam weed (*Chromolaena odorata*), showed that an average of 3.20 eggs successfully hatched into larva. Control egg samples showed an average of 3.00 eggs which successfully hatched into larva.

Ovicidal effect of the botanical acetone extracts on eggs of *Ephestia cautella* revealed that the highest percentage mortality 20.00% was recorded for treatments with acetone extract of Bitter leaf and Neem leaf.

Table 3: Ovicidal effect of Acetone extract of botanicals on eggs of *Ephestia cautella*

Treatment	Total number of Eggs introduced	Mean Number of Eggs Introduced		Total number of Larva_Present	Mean Data of Larva_Present		Number of unhatched eggs	% Mortality
		Mean	±S.E		Mean	±S.E		
1	50	10	±0.00	12	2.40	±0.40	38	20
2	50	10	±0.00	12	2.40	±0.24	38	20
3	50	10	±0.00	16	3.20	±0.20	34	N.D
4	50	10	±0.00	15	3.00	±0.00	35	-

Key:
1= Acetone extract of Bitter leaf (*Vernonia amygdalina*)
2= Acetone extract of Neem leaf (*Azadirachta indica*)
3= Acetone extract of Siam weed (*Chromolaena odorata*)
4 = Control Acetone
N.D = not determined

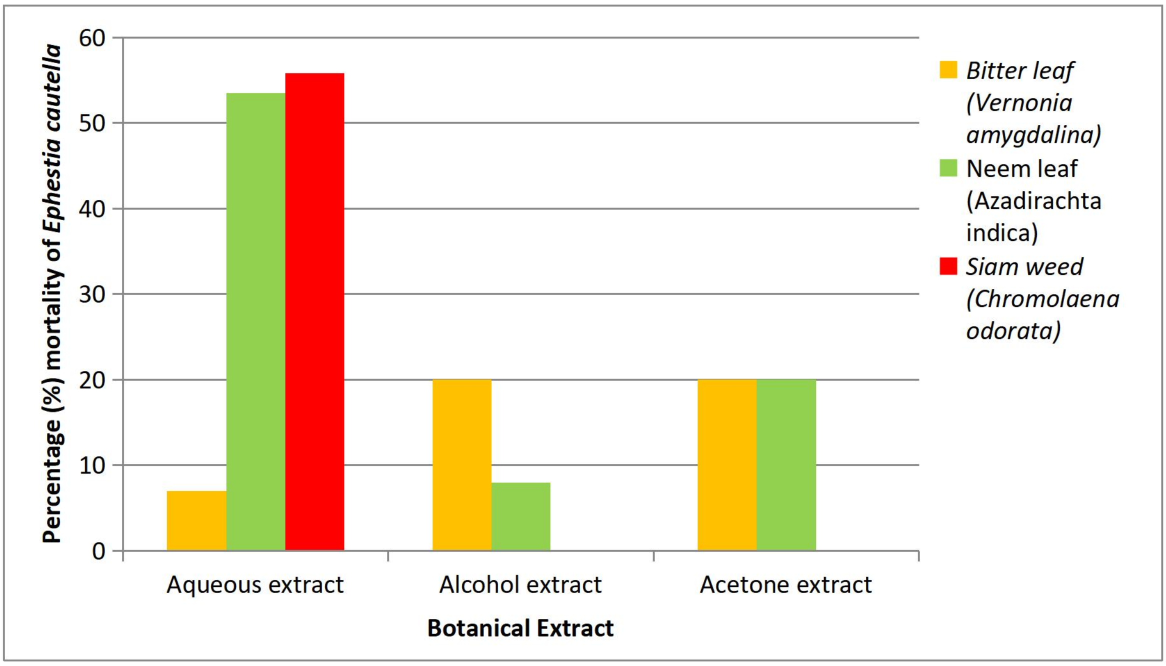

Figure 1: Percentage mortality of botanicals extracts on eggs of *Ephestia cautella*

CHAPTER FIVE DISCUSSION

E. cautella is a serious insect pest of dates either in the field or in the form of stored product. Also, this insect pest infests other stored products and causes high loss in all these fruits and cereal grains and their products (El-Khayat *et al.,* 2017). The conditional control of *E. cautella* in storage systems mainly depends on fumigants such as methyl bromide or phosphine. However, methyl bromide was banned in many countries starting in 2004, because of its ozone depleting properties (Hansen and Jensen, 2002). Many alternatives have been tested to replace methyl bromide fumigation for stored-product and quarantine uses. Plant-based insecticides are friendly and safe alternative in managing pests and they can be incorporated in pest management programs (Ashamo and Akinneye, 2004; Ashamo, 2005). There is an increasing interest for natural pesticides derived from plants and microorganisms due to they are assumed being safer than the synthetic pesticides (Isman *et al.,* 2007; Shukla and Tiwari 2011). These concerns have resulted in a renewed interest in search for alternative control measures (Jbilou *et al*., 2006).

This study was carried out to investigate the ovicidal effects of three selected botanicals against the development of on eggs of *Ephestia cautella.* Findings revealed that the selected botanicals exhibited varying effects on the hatchability of the eggs of *Ephestia cautella.* When eggs of *Ephestia cautella* were treated with aqueous extract of the botanicals, results showed that highest impact was exhibited by the aqueous extract of Siam weed (*Chromolaena odorata*) for which 31 eggs were unhatched while lowest activity was exhibited by aqueous extract of Bitter leaf (*Vernonia amygdalina*) for which 10 eggs were unhatched. Highest Percentage mortality (55.81%) was exhibited by aqueous extract of Siam weed (*Chromolaena odorata*) while lowest percentage mortality (6.97%) was exhibited by aqueous extract of Bitter leaf (*Vernonia amygdalina*).

Insect repellents work by providing a vapor barrier deterring the arthropod from coming into contact with the surface (Ayvaz *et al.*, 2008). Among them, essential oils, complex mixtures of volatile compounds isolated from a large number of plants, have been found to have these properties against various haematophagous arthropods, some of them being the basis of commercial repellent formulations (Choochote *et al.,* 2007). Therefore, there has been an increase in search efforts for natural and eco-friendly repellents. Some plant-based repellents are comparable to, or even better than synthetics; however, essential oil repellents tend to being short-lived in their effectiveness, which depends on their volatility (El-Khyat *et al.,* 2017).

Further investigation in this study revealed that when eggs of *E. cautella* were treated with alcohol extract of the botanicals, results showed that highest impact was exhibited by the alcohol extract of Bitter leaf (*Vernonia amygdalina*) for which 30 eggs were unhatched while lowest activity was exhibited by alcohol extract of Neem leaf (*Azadirachta indica*) for which 27 eggs were unhatched. Highest Percentage mortality (20.00%) was exhibited by alcohol extract of Bitter leaf (*Vernonia amygdalina*) while lowest percentage mortality (8.00%) was exhibited by alcohol extract of Neem leaf (*Azadirachta indica*).

Dwivedi and Garg (2003) reported ovicidal activity of flower extract of turmeric and *Lantana camara* against *C. cephalonica* eggs. They observed that ovicidal effect was dose dependent which may be due to its easy penetration through delicate covering of vitellin and chorion membrane thereby increasing the mortality rate. High percentage of egg mortality caused by the extract is assumed to be caused by the active ingredients present in them which might have disrupted blastokinesis and induced impaired larval hatching.

In this study the percentage mortality of acetone extract of Bitter leaf (*Vernonia amygdalina*) and Neem leaf (*Azadirachta indica*) was 20% recording a total of 38 unhatched eggs respectively after treatment were applied. This study revealed the aqueous extract of Neem leaf (*Azadirachta indica*) and Siam weed (*Chromolaena odorata*) were most effectively in control or inhibiting growth and development of eggs of *E. cautella.*

Similar case study was carried out by El-Khyat *et al.* (2017) on the insecticidal activity of some essential oils from different plants against the *Ephestia cautella.* Their findings revealed that the highest toxic essential oil was that of Bitter orange after 72 h exposure, but the most repellent one was that of German chamomile. The higher toxicity in the form of fumigation was in the right of essential oil of Bitter orange. The LC50 value against moths and larvae was the least (22.45 and 52.46mg/l, respectively) in the case of Bitter orange essential oil.

Sabbour (2003) also investigated the effect of two microbial entomopathogens (*Bacillus thuringiensis* and *Beauveria bassiana*) and three botanical extracts; methanolic extract of *Taxodium distichum* leaves, volatile oil (V.O) of *Taxodium distichum* leaves and (V.O) *Boswella carterii* (gum resin) on *Plodia interpunctella*, *Ephestia cautella* and *Ephestia küehniella*. At 5% concentration level to the botanical extract, *T. distichum* leaves (methanolic extract), scored the highest potential effects against the target insects (88-90% mortalities). The other botanical extracts at this concentration caused also high effects (75-81 mortalities). The different stages of the target insects were affected by a lower concentration at 0.5%. The treatments, beside inducing reasonable larval mortality, caused increase in the malformed pupae and deformed adults.

Many authors recommended the traditional use of a number of plant materials as protectants of stored products (El-Khyat *et al.,* 2017). Findings obtained in this study has proved the efficacy of botanicals in preventing the growth and development of destructive plant pests such as *Ephestia cautella.*

Conclusion

Results of the current study conclude that, the tested aqueous botanicals were most effective in controlling the hatchability and development of eggs of *E. cautella* thus might be useful for managing the destructive feeding habits of the insect in warehouses. Further analysis to isolate the active compounds in all three botanicals is essential to elucidate their ovicidal activity. Identification of these active compounds could be used to control other insect pest species in the future.

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APPENDIX

Overall Summary Table of Ovicidal effect of Botanicals on eggs of *Ephestia cautella*

Treatment	Number of Eggs Introduced		Data of Larva_Present	
	Mean	S.E	Mean	S.E
Vernonia water extraction	10.00	±0.00	8.00	±0.45
Azadirachta water extraction	10.00	±0.00	4.00	±0.32
Chromolaena water extraction	10.00	±0.00	3.80	±0.49
Vernonia alcohol extraction	10.00	±0.00	4.00	±0.45
Azadirachta alcohol extraction	10.00	±0.00	4.60	±0.40
Chromolaena alcohol extraction	10.00	±0.00	5.00	±0.55
Vernonia acetone extraction	10.00	±0.00	2.40	±0.40
Azadirachta acetone extraction	10.00	±0.00	2.40	±0.24
Chromolaena acetone extraction	10.00	±0.00	3.20	±0.20
Control water	10.00	±0.00	8.60	±0.24
Control alcohol	10.00	±0.00	5.00	±0.55
Control acetone	10.00	±0.00	3.00	±0.00