THE EFFECT OF CAMPHOR (*Cinnamomum camphora*) AS A REPELLENT ON HOUSE FLY (*Musca domestica sp)*

FINAL ASSIGNMENT

TO FULFILL THE REQUIREMENT FOR BACHELOR OF MEDICINE DEGREE

by :

YOGESWARY A/P RAMACHANDRAN

NIM : 0910714020

FACULTY OF MEDICINE

BRAWIJAYA UNIVERSITY

MALANG

2012

APPROVAL LETTER

The Effect of Camphor (*Cinnamomum camphora sp*) As a Repellent for House fly (*Musca domestica sp*)

FINAL THESIS

AS PREREQUISITE TO OBTAIN THE BACHELOR OF MEDICINE DEGREE

By

YOGESWARY RAMACHANDRAN

NIM :0910714020

Pembimbing 1:	Pembimbing 2:
Dr.dr.Loeki Enggar Fitri, M.Kes,Sp.ParK	drg.R.Setyohadi,MS
NIP : 19641013 199103 2001	NIP:195802121985031001

ACKNOWLEDGEMENT

First of all, I would like to extend my grace to God for allowing me to complete my final assignment in order to fulfil the pre-requisite to obtain the Medical Degree in Faculty of Medicine. The title of my Final Assignment is “The Effect of Camphor (*Cinnamomum camphora*) as a Repellent for house fly (*Musca domestica sp)*. I take this opportunity to express my sincere gratitude to all those who supported me and encouraged me until the completion of my final assignment. My heartfelt thanks is addressed to:

1. Dr.dr Karyono Mintaroem, SpPA as the Dean of The Faculty of Medicine, Brawijaya University for providing the facilities to carry out my final assignment in the Faculty of Medicine,Brawijaya University.
2. Dr.dr.Loeki Enggar Fitri, M.Kes,Sp.ParK as my first supervisor who always supported, advised and gave me ideas to make my assignment a success.
3. dr.R.Setyohadi,MS as my second supervisor who always encouraged me to make this final assignment good and substantial.
4. I also want to thanks all my family and friends Sivaneswary, Vysnavi, Vivek Shukashiny, Adrian, Mithela Losine, Nur, Niva, Jess, Izzul, Tanisha, Diana for assisted me directly or indirectly.

.

ABSTRACT

Yogeswary, 2011. The effect of *Camphor (Cinnamomum camphora)* as a repellent for house fly (*Musca domestica sp).* Final Assignment, Faculty of Medicine, Brawijaya University. Supervisors Dr.dr.Loeki Enggar Fitri, M.Kes, Sp.ParK and dr.R.Setyohadi, MS

House fly or also known as *Musca domestica sp* has become a health hazard to human beings due to its ability to causes transmit several pathogen. There are many ways to kill or repel these pests but most of the products are harmful and have side effects .The common repellent that is used against housefly is naphthalene. Exposure to large amounts of naphthalene may damage or destroy erythrocytes besides causing vomiting, diarrhea, blood in the urine and many more. Therefore, alternative substance from the surroundings is being searched to eradicate these pests. A research on the effect of different concentrations of camphor (*Cinnamomum camphora)* as a repellent towards *Musca domestica sp* has been done. This research was an experimental laboratory research using three different concentrations of camphor (20%, 30% and 40%) to repel the flies for a period of 6 hours. The obtained data was analysed using the parametric method and simple linear regression method. Based from the analysis, different camphor concentrations give different repelling effect 40% camphor (99.6%) and 30% camphor (95.2%) has the higher repelling potential compared to 20%camphor (86.2%).Based on that, 40% camphor has been taken as the best concentration. From this research, we can conclude that camphor (*Cinnamomum camphora*) does have sufficient repellence effect towards *Musca domestica sp*.

Keyword:*Musca domestica sp*, camphor (*Cinnamomum camphora*) , repellent

ABSTRAK

Ramachandran, Yogeswary 2011. Efek camphor (*Cinnamomum camphora*) sebagai pengusir lalat (*Musca domestica sp*). Tugas Akhir. Program Studi Pendidikan Dokter, Fakultas Kedokteran Universitas Brawijaya. Pembimbing: Supervisors Dr.dr.Loeki Enggar Fitri, M.Kes, Sp.ParK and dr.R.Setyohadi, MS

Lalat rumah atau juga dikenal sebagai *Musca domestica sp* dapat menyebabkan gangguan kesehatan kepada umat manusia karena merupakan vektor yang dapat mentransmisikan bermacam pathogen. Ada banyak cara untuk membunuh atau mengusir hewan ini tetapi kebanyakan produk ini mempunyai efek samping terhadap alam.Repelent umum digunakan terhadap lalat adalah naftalena..Paparan dalam jumlah besar naftalen dapat merusak atau menghancurkan eritrosit selain menyebabkan muntah,diare,darah dalam urin dan banyak lagi. Oleh karena itu,zat alternative alami sedang dicari secara besar-besaran untuk membasmi lalat berbahaya ini.Sebuah penelitian tentang pengaruh berbagai konsentrasi camphor (*Cinnamomum camphora*) sebagai penolak terhadap *Musca domestica sp* telah dilakukan. Penelitian ini adalah penelitian eksperimental laboratorium yang berbeda menggunakan tiga konsentrasi camphor (20%, 30% dan 40%) untuk mengusir lalat dalam periode 6 jam. Data yang diperoleh dianalisis dengan metode parametric dan metode regresi linear. Berdasarkan dari analisis,konsentrasi camphor yang berbeda memberikan pengaruh yang berbeda terhadap efek pengusiran lalat rumah. 30 %(95.2%) camphor dan 40%(99.6%) camphor memiliki potensi pengusir yang lebih baik berbanding camphor 20%.(86.2%) Oleh itu, camphor 40% diambil sebagai konsentrasi terbaik. Dari penelitian ini,kita dapat menyimpulkan bahwa camphor (*cinnamomum camphora*) memiliki potensi sebagai pengusir terhadap *Musca domestica sp*

Kata Kunci: *Musca domestica sp*, camphor (*Cinnamomum camphora*) pengusir

CONTENT

Title i

Approval Letter ii

Acknowledgement iii

Abstract iv

Abstrak v

Table of Contents vi

List of Figures x

List of Tables xi

List of Graphs xii

CHAPTER 1: INTRODUCTION

1.1 Background 1

1.2 Statement of Problem 4

1.3 Research Objective 4

1.3.1 General Objective 4

1.3.2 Specific Objective 4

1.4 Benefit of Research 5

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 Fly 6

2.2 *Musca domestica* 6

2.2.1 Taxonomy 6
2.2.2 Life style and morphology 7
2.2.2.1 Adult 8
2.2.2.2 Egg 9
2.2.2.3 Larva 10
2.2.2.4 Pupa 11
2.2.3 Breeding place 12
2.2.4 Habits 13
2.2.5 Medical Importance 13
2.2.5.1 Diarrhoea 14
2.2.5.2 Thyroid fever 14
2.2.5.3 Tuberculosis 15
2.2.5.4 Anthrax 15
2.2.6 Camphor (*Cinnamomum camphora sp* 16
2.2.6.1 Taxonomy and Morphology 16
2.2.6.2 Morphology 17
2.2.6.3 Chemical compounds in *Cinnamomum camphora sp* 18
2.2.6.4 Chemical properties in extract *Cinnamomum camphora sp* 19
2.2.6.5 Chemical structure of camphor 20
2.2.7 Physical properties of Camphor 21
2.2.7.1 Traditional uses of Camphor 23
2.2.8 Effect of camphor (oil form) as repellent 24
2.3 Repellent 25

CHAPTER 3: CONCEPTUAL FRAMEWORK AND RESEARCH HYPOTHESIS

4.1 Conceptual framework 28

4.2 Research Hypothesis 30

CHAPTER 4: METHODOLOGY

4.1 Research design 31

4.2 Location of Experiment and Time 31

4.3 Population and Sample 31

4.3.1 Experimental population 31

4.3.2 Preparation of adult flies 32

4.3.3 Group and number of samples 32

4.4 Variables of identification 33

4.4.1 Dependent Variables 33

4.4.2 Independent Variables 34

4.5 Tools and Research materials 34

4.5.1 Tools to manufacture camphor extract 34

4.5.2 Material in Research 34

4.6 Operational definition 34

4.7 Research Preparation 36

4.7.1 Camphor extracts preparation 36

4.8 Procedures 37

4.9 Processing and analysis data 41

CHAPTER 5: RESULT

5.1 Data Observation Result 42

5.2 Data Analysis 45

CHAPTER 6: DISCUSSION 49

CHAPTER 7: CONCLUSION

7.1 Conclusion 52

7.2 Suggestions 52

REFERENCES xiii

APPENDIX xv

LIST OF ABBREVATION xvii

LIST OF FIGURES

Figure 2.1 Life cycle of the house fly 7

Figure 2.1 Adult *Musca domestica sp* 8

Figure 2.3 Adult and eggs of the house fly,*Musca domestica sp* 10

Figure 2.4 The staging of *Musca domestica sp* 12

Figure 2.5 *Cinnamomum camphora* tree 18

Figure 2.6 *The Cinnamomum camphora* 20

LIST OF TABLES

Table 5.1 Data on number of flies landed 41

Table 5.2 Percentage of repellent potential..... 43

Table 5.3 Magnitude of maximal concentration of camphor..... 48
concentration within 6 hours

LIST OF GRAPH

Graph 5.1 Compare of repellent potential 46

CHAPTER 1

INTRODUCTION

1.1 Background

Flies are a group of insect that can be found widely all over the world. The house fly, *Musca domestica* is a well-known cosmopolitan pest of both farm and home. This species is always found in close association with humans or activities of humans. *Musca* is a latin word meaning “a fly”. domestica means pertaining to the house shows the synanthropic nature of the housefly. *Musca domestica* is classified in the family of muscidae ,order of diptera, a group of insects whose members other than flies are mosquitoes ,maggots, gnats and midges. Flies are not only nuisance, but they also can transport disease-causing organisms. Excessive fly populations are obnoxious to farm workers, and when there are nearby human habitations a public health problem is possible.(Shriniwas,1992)

One of the *Musca domestica* dominant strains that causes of nuisance in human life is *Musca domestica Linnaeus*. *Musca domestica Linnaeus* has a reddish eye, sponging mouthpart, dorsum of thorax with four narrow black stripes, sharp longitudinal wing or four longitudinal vein, and gray or yellowish abdomen with dark midline and irregular dark markings on sides. Its body length size ranges 6-7mm in adult, female larger than male,3-12mm in larva and 8mm in pupa. The synanthropic nature of the housefly, *Musca domestica* illustrates its potential for spreading diseases from animals to man and animal to animal. More than

100 pathogens associated with the *Musca Domestica Linnaeus* may cause disease in humans and animals. (Campbell et al, 2005).

Based on these problems brought by *Musca domestica*, many insecticides are developed to help human killing housefly. The most widely used are chemical insecticides. Even though the insecticides are useful, they bring negative effects to human. It is well known that the use of persistent organochlorines like DDT and of the acute toxic organo-phosphorous compounds have had hazardous effects on environment and human beings (J.R Coats, 2004). Naphthalene was known as an insecticide which was widely used all over the world. Naphthalene now is found to be less effective (Chen, 1981)

Nowadays many people are aware of the side effect caused by chemical products and they are much more preferable in choosing their anti insecticides. They interested in alternative control strategies and usage of anti insecticides which are safer, cheaper, environmental safe and quality. Anti insecticides made from plants are much safer and cheaper too. It contains less or no chemicals and not harmful for human.

There are many other alternative way in choosing an insecticides. There are many plants or herbs that can be used as a repellent or insecticides for insects. Camphor or its scientific name is known as *Cinnamomum camphora* is suggested to be used as a repellent for *Musca Domestica*. Camphor or Kapur is a waxy, white or transparent substance extracted from the wood of the *Camphor Laurel* tree found in Asia. It can be get easily and it is much cheaper compare to other anti insecticides

products in market. Camphor is used widely everywhere and it has many purpose. In the past, man would light diyas and burn camphor on a regular basis as a part of daily puja in Indian tradition. These helped to purify the air and keep harmful bacteria, viruses and mosquitos away. We can definitely have a better and healthy environment with the use of camphor. Furthermore camphor is used in medicine internally for its calming influence in hysteria, nervousness and neuralgia, and for serious diarrhoea, and externally as a counter-irritant in rheumatisms, sprains bronchitis, and in inflammatory conditions, and sometimes in conjunction with menthol and phenol for heart failure. (Grieve, 1995).

Camphor (*Cinnamamum camphora*) is found to be a repellent for moth. It contains *2-Bornanone* which can distract moth away. Insects don't like the smells of the volatile oils (vapors) in the camphor. This *2-bornanone* is proven as a moth repellent. (Zasshi. 2001).

In this study, camphor (*Cinnamomum camphora*) will be use as a repellent toward *Musca domestica* because 2-bornanone chemical compound in camphor can act as a repellent effect on the housefly (*Musca Domestica Linneaus*) Moreover, this study also want to show how much concentration of camphor is needed to be effective as a repellent and also its relationship between duration of action with the potential camphor (*Cinnamamum camphora*) as a repellent for *Musca Domestica*

1.2 Statement of Problem

Based on the background, the problems of this research are:

1. Does Camphor (*Cinnamamum camphora*) has a repellent effect on housefly *Musca domestica Sp?*

1.3 Research Objective

1.3.1 General Objective

To prove the effect of Camphor (*Cinnamamum camphora*) as a repellent on. housefly *Musca domestica Sp*

1.3.2 Specific Objective

1 . To identify the concentration of Camphor needed to use as a repellent towards *Musca Domestica sp.*

2. To reveal the relationship between duration of action and the concentration of camphor with the potential of camphor as a repellent towards *Musca Domestica sp.*

1.4 Benefits Of Research

1. To give awareness and help the community to get rid of housefly in their respective residence which can cause secondary infection.

2. To provide information and knowledge to community on using safest, cheapest and effective methods of anti insecticides / repellent .

3. To provide more information on the benefits of camphor (*Cinnamamum camphora*) as a repellent towards housefly *Musca domestica sp*

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Fly

Fly is a dipterous or two-winged insect that is often acts as the vector of organisms causing disease. It is one of the major insect orders both in terms of ecological and human (medical and economic) importance. Most toxonomic keys to identify flies are based on morphological characters (Ralph, 2010).

2.2 *Musca domestica*

2.2.1 Taxonomy (Nasif, 2006)

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Diptera

Suborder: Cyclorrhapha

Family: Muscidae

Genus: Musca

Species: *Musca domestica*

2.2.2 Life cycle and morphology

The house fly has a complete metamorphosis with distinct egg, larva or maggot, pupa and adult stages. The house fly overwinters in either the larval or pupa stage under manure piles or in other protected locations. Warm summer conditions are ally optimum for the development of

the house fly, and it can complete its life cycle in as little as seven to ten days. However, under suboptimal conditions the life cycle may require up to two months. As many as 10 to 12 generations may occur annually in temperate regions, while more than 20 generations may occur in subtropical and tropical regions, (John , 2008)

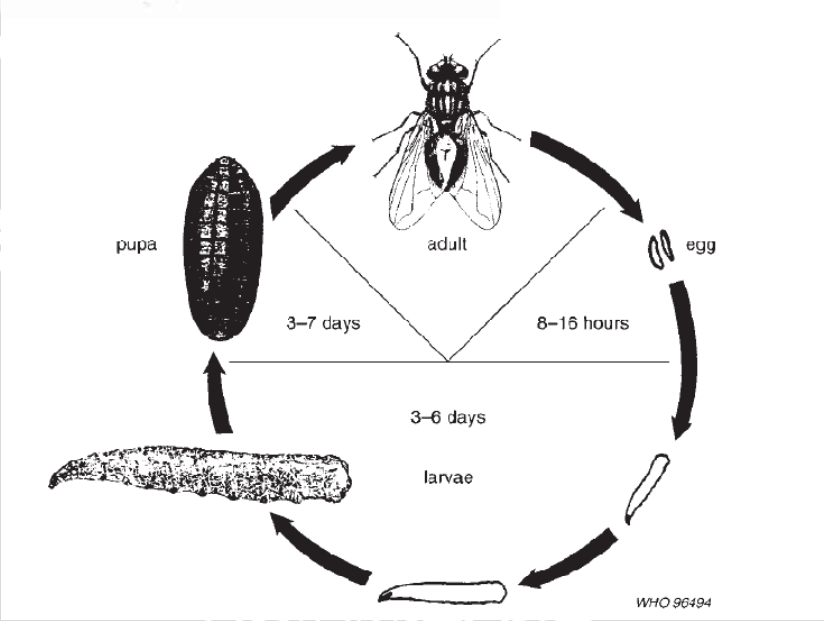


Figure 2.1: Life cycle of the house fly, (Keiding , 1986)

2.2.2.1 Adult

Musca domestica is 6 to 7 mm long, with the female usually larger than the male. The female can be distinguished from the male by the relatively wide space between the eyes (in males, the eyes almost touch). The head of the adult fly has reddish-eyes and sponging mouthparts. The thorax bears four narrow black stripes and there is a sharp upward bend in the fourth longitudinal wing vein. The abdomen is gray or yellowish with

dark midline and irregular dark markings on the sides. The underside of the male is yellowish (figure 2.2). The house fly is often confused with the stable fly, *Stomoxys calcitrans* (Linnaeus), and the false stable fly, *Muscina stabulans* (Germar). All three are in the same family (John, 2008).

Figure 2.2: Adult *Musca domestica sp.* (John, 2008)

Adults usually live 15 to 25 days, but may live up to two months. Without food, they survive only about two to three days. Longevity is enhanced by availability of suitable food, especially sugar. Access to animal manure does not lengthen adult life and they live longer at cooler temperatures. They require food before they will copulate, and copulation is completed in as few as two minutes or as long as 15 minutes. Ovipositor commences four to 20 days after copulation. Female flies need access to suitable food (protein) to allow them to produce eggs, and manure alone is not adequate. The potential reproductive capacity of flies is tremendous, but fortunately can never be realized. The flies are inactive at night, with ceilings, beams and overhead wires within buildings, trees, and shrubs, various kinds of outdoor wires, and grasses

reported as overnight resting sites. In poultry ranches, the nighttime, outdoor aggregations of flies are found mainly in the branches, and shrubs, whereas almost all of the indoor populations generally aggregated in the ceiling area of poultry houses (MacKean, 2004)

2.2.2.2 Egg

The white egg, about 1.2 mm in length, is laid singly but eggs are piled in small groups. Each female fly can lay up to 500 eggs in several batches of 75 to 150 eggs over a three to four day period. The number of eggs produced is a function of female size which, itself, is principally a result of larval nutrition. Maximum egg production occurs at intermediate temperatures, 25 to 30°C (MacKean, 2004). Often, several flies will deposit their eggs in close proximity, leading to large masses of larvae and pupae. Eggs must remain moist or they will not hatch. (John, 2008)

Figure 2.3: Adult and eggs of the house fly, *Musca domestica* sp (Butler, 2008)

2.2.2.3 Larva

Early in stage larvae are 3 to 9 mm long, typical creamy whitish in color, cylindrical but tapering toward the head. The head contains one pair of dark hooks. The posterior spiracles are slightly raised and the spiracular openings are sinuous slits which are completely surrounded by an oval black border. The legless maggot emerges from the egg in warm weather within eight to 20 hours, and immediately feeds on and develops in the material in which the egg was laid (Sanchez, 2008).

The larva goes through three instars and a full-grown maggot, 7 to 12 mm long, has a greasy, cream-colored appearance. High-moisture manure favors the survival of the house fly larva. The optimal temperature for larval development is 35 to 38°C, though larval survival is greatest at 17 to 32°C. Larvae complete their development in four to 13 days at optimal temperatures, but require 14 to 30 days at temperatures of 12 to 17°C (MacKean, 2004).

Nutrient-rich substrates such as animal manure provide an excellent developmental substrate. Very little manure is needed for larval development, and sand or soil containing small amounts of degraded manure allows for successful belowground development. When the maggot is full-grown, it can crawl up to 50 feet to a dried, cool place near breeding material and transform to the pupa stage (MacKean, 2004).

2.2.2.4 Pupa

The pupa stage, about 8 mm long, is passed in a pupa case formed from the last larval skin which varies in color from yellow, red, brown, to

black as the pupa ages. The shape of the pupa is quite different from the larva, being bluntly rounded at both ends. Pupae complete their development in two to six days at 32 to 37°C, but require 17 to 27 days at about 14°C). The emerging fly escapes from the pupa case through the use of an alternately swelling and shrinking sac, called the ptilinum, on the front of its head which it uses like a pneumatic hammer to break through the case (MacKean, 2004).

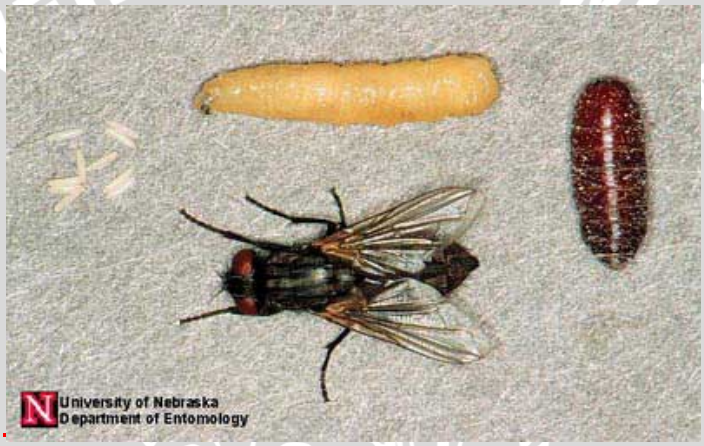


Figure 2.4: The staging of *Musca domestica* fly (WHO, 2006) *Musca domestica sp.*Clockwise from upper left: eggs, larva, pupa, adult (Jim, 2007)

2.2.3 Breeding place

Musca domestica is world-wide in distribution and lives in close association with human dwellings. Breeding continues throughout the year in warm parts of the country. In colder climates the larvae or pupae over winters and adults enter a resting state (diapause) in sheltered situations. According to a study conducted in Texas, USA, breeding site suitability (in descending order), was horse manure, human excrement, cow manure, fermenting vegetable, and kitchen waste. However, another study found that structures containing swine, horse, sheep, cattle, and

poultry varied in fly abundance, with swine facilities containing the most and poultry the least. Fruit and vegetable cull piles, partially incinerated garbage, and incompletely composted manure also are highly favored sites for breeding (Keiding, 2001).

2.2.4 Habits

Musca domestica feeds on feces, open sores, sputum, and moist decaying organic matter such as spoiled food, eggs and flesh (MacKean, 2004). Houseflies can take in only liquid foods. They spit out saliva on solid foods to predigest it, and then suck it back in. They also regurgitate partly digested matter and pass it again to the abdomen (Robert , 2006).

2.2.5 Medical importance

Although this fly species does not bite, the control of *Musca domestica* is vital to human health and comfort in many areas of the world. The most important damage related with this insect is the annoyance and the indirect damage produced by the potential transmission of pathogens (viruses, bacteria, fungi, protozoa, and nematodes) associated with this fly. Pathogenic organisms are picked up by flies from garbage, sewage and other sources of filth, and then transferred on their mouthparts, through their vomits, feces and contaminated external body parts to human and animal food. Of particular concern is the movement of flies from animal or human feces to food that will be eaten uncooked by humans. Also, when consumed by flies, some pathogens can be harbored in the mouthparts or alimentary canal for

several days, and then be transmitted when flies defecate or regurgitate. In situations where plumbing is lacking, such as open latrines, serious health problems can develop, especially if there are outdoor food markets, hospitals, or slaughter houses nearby. Among the pathogens commonly transmitted by house flies are *Salmonella, Shigella, Campylobacter, Escherichia, Enterococcus, Chlamydia*, and many other species that cause illness. These flies are most commonly linked to outbreaks of diarrhea and shigellosis, but also are implicated in transmission of food poisoning and diarrhea, typhoid fever, tuberculosis and anthrax (Campbell et al, 2005).

2.2.5.1 Diarrhea

Diarrhea is the condition of having three or more loose or liquid bowel movements per day. It is a common cause of death in developing countries and the second most common cause of infant deaths worldwide. The loss of fluids through diarrhea can cause dehydration and electrolyte imbalances. The disease is spread throughout mostly rural areas of Asia by transmitting bacteria from the decayed materials which is adhered to its hairs on legs and body, to the foods. Apart from that, the bacteria may remain in the pseudo tracheae or esophagus and readily to be flushed out on to food with the next salivary flow (MacKean, 2004).

2.2.5.2 Typhoid fever

Typhoid fever is a common worldwide illness, transmitted by the ingestion of food or water contaminated with the feces of an infected

person, which contain the bacterium *Salmonella enterica enterica*, serovar Typhi (Keiding, 2001). This disease is spread through the transmission of the bacterial-causing—typhoid fever of an infected person to the human's foods and drinks by the housefly. The bacteria then perforate through the intestinal wall and are phagocytosed by macrophages .With this, symptoms such as slowly progressive high fever, profuse sweating, gastroenteritis and bloody dysentery can occur (MacKean, 2004)

2.2.5.3 Tuberculosis

Tuberculosis is a common and often deadly infectious disease caused by various strains of mycobacteria, usually *Mycobacterium tuberculosis* in humans. Tuberculosis usually attacks the lungs but can also affect other parts of the body. It is spread through the air when people who have the disease cough, sneeze, or spit. As in typhoid fever, these bacilli bacteria may be transmitted from an infected person's fluids such as sputum and also sneeze which is carried on the hairs of *Musca domestica*. Systemic symptoms include fever, chills, night sweats, appetite loss, weight loss, pallor, and often a tendency to fatigue very easily, can occur due to the outbreak of this disease. These symptoms include chest pain, coughing up blood, and a productive, prolonged cough for more than three weeks. (WHO, 2007)

2.2.5.4 Anthrax

Anthrax is an acute disease caused by the bacteria *Bacillus anthracis*. Most forms of the disease are lethal, and it affects both humans and other

animals. Experiments in which flies have been allowed to walk over culture media in sterile dishes have resulted in the growth of over 100 bacterial and fungal colonies from bacteria and fungal spores which the fly deposited (MacKean, 2004). Many of these bacteria are harmless to humans but others may cause serious disease. In this context, the infection of herbivores (and occasionally humans) via the inhalational route normally proceeds as follows: once the spores are inhaled, they are transported through the air passages into the tiny air particles sacs (alveoli) in the lungs. The spores are then picked up by scavenger cells (macrophages) in the lungs and are transported through small vessels (lymphatic) to the lymph nodes in the central chest cavity (mediastinum). Damage caused by the anthrax spores and bacilli to the central chest cavity can cause chest pain and difficulty breathing. Once in the lymph nodes, the spores germinate into active bacilli which multiply and eventually burst the macrophages, releasing many more bacilli into the bloodstream to be transferred to the entire body. Once in the blood stream these bacilli release three proteins named lethal factor, edema factor and protective antigen. All three are non-toxic by themselves, but the combination is incredibly lethal to humans (Guillemin, 2001)

2.2.6 Camphor (*Cinnamomun camphora*)

2.2.6.1 Taxonomy and Morpholgy

Taxonomy of camphor that is used in the research is:

Kingdom : Plantae
Division : Magnoliophyta

Class : Magnoliopsida

Order : Laurales

Family : Lauraceae

Genus : Cinnamomum

Species: *Cinnamomum camphora* (Ayushveda, 2010)

Other names

English name : Camphor

Hindi name : Kapoor

Sanskrit name : Karpoor

Gujrati name : Kapoor

Spanish : Alcanfor, Plumajillo

2.2.6.2 Morphology

Camphor plant is native of Taiwan, southern Japan, eastern China and India. Nowdays it is cultivated. According to ayurveda it has been classified into three categories based on region. (a) Barus camphor, (b) Chinese camphor and (c) Indian camphor. Camphor has a tree that can reach up to the height of 100 feet and have a diameter of 6 to 7 feet. It evergreen tree. Its leaves are alternative, simple, 2 to 4 inch in length, evergreen. It has dark green and shiny dorsal surface and pale on the other surface having three prominent veins. Flowers are of whitish - yellow in color having pleasant aroma and is borne on three inch panicles. Fruits is dark textured having dark green to black color. Fruits appear in bunches, when fruit is young it is of green color but when it matures its color changes to black. Fruits mature in early winters. Bark is rough on outside but is smooth on the inner surface. It is of reddish brown in color (Friend, 2002)

Figure 2.5 The *Cinnamomum camphora* tree (Linda ,2004)

2.2.6.3 Chemical compounds in *Cinnamomum camphora*

Camphor laurel contains volatile chemical compounds in all plant parts, and the wood and leaves are steam distilled for the essential oils. Camphor laurel has six different chemical variants called chemo types, which are camphor, linalool, 1,8-cineole, nerolidol, safrole, or borneol. In China field workers avoid mixing chemo types when harvesting by their odour. The cineole fraction of camphor laurel is used in China to manufacture fake "Eucalyptus oil". The chemical variants or chemotypes seem dependent upon the country of origin of the tree. The tree is native to China, Japan, and Taiwan. It has been introduced to the other countries where it has been found, and the chemical variants are identifiable by country. i.e., *Cinnamomum camphora* grown in Taiwan and Japan, often commonly called "Ho Wood" is normally very high in Linalool, often between 80 and 85%. In India and Sri Lanka the high camphor variety/chemotype remains dominant. The *Cinnamomum camphora* grown in Madagascar, on the other hand, is high in 1,8 Cineole

averaging between 40 and 50%. The essential oil from the Madagascar trees is commercially known as Ravintsara. (Ravinchandran, 2003)

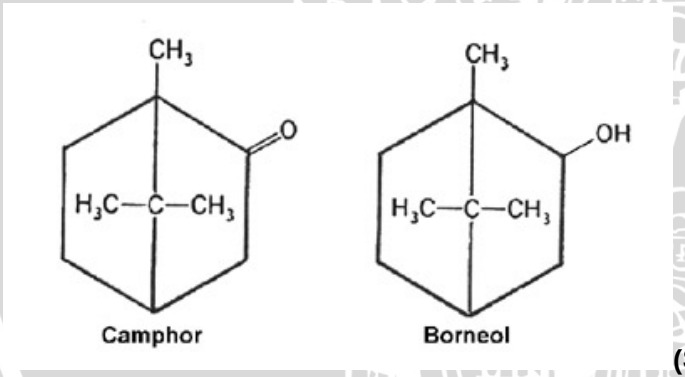
2.2.6.4 Chemical properties in extract *Cinnamomum camphora* (Camphor)

Extract of *Cinnamomum camphora* is camphor. Camphor is a white transparent waxy crystalline solid with a strong penetrating pungent aromatic odor. It is found in wood of the camphor laurel, *Cinnamonum camphora*, which is a large evergreen tree found in Asia (particularly in Borneo, hence its alternate name); it can also be synthetically produced from oil of turpentine.It has a chemical property known as *2-bornanone*, 2-*Camphanone ,and 1,7,7-Trimethylbicyclo(2.2.1) heptan-2-one*.2-bornanone is parent compound for camphor toxicity and can be potent for repellent. Camphor may be natural or synthetic. It occurs naturally in the wood of the camphor tree (*Cinnamonum camphora*), and is extracted by steam distillation and crystallization. Natural camphor is dextrorotatory. Synthetic camphor may be made from pinene which is converted into camphene by treatment with acetic acid and nitrobenzene. Synthetic camphor is optically inactive (Subhuti, 1998)

It is used for its scent, as an embalming fluid and for medicinal purposes. It has calming properties. Modern uses include as a plasticizer for cellulose nitrate, as a moth repellent, in embalming, and in fireworks. Formal Chemical Name (IUPAC) 1, 7, 7-trimethyl-bicyclo (2, 2, 1) heptan-2-one. (NIST, 2011)

Figure 2.6 The *Cinnamomum camphora* (Deane,2007)

2.2.6.5 Chemical Structure of camphor



(Subhuthi, 1998)

C10H16O Molecular Weight = 152.2

2.2.7 Physical Properties of Camphor

Properties of the substance

Camphor is a white solid crystalline bicycles saturated terpene ketone with a characteristic pungent odor and taste, that is flammable and volatile; melting at 176 C to 180 C, boiling at 204°C and specific gravity 0.992.Normal state at room temperature. It is insoluble in water but

soluble in alcohol, ether, chloroform, benzene, carbon disulphide ethanol, ethylether, turpentine, and essential oil and other solvents. Sublimes appreciably at room temperature and are normal. Camphor has flash point 65°C, Autoignition temperature 466°C ,relative density 0.99 (specific gravity) , relative vapor density are 5.2.Vapour pressure is 20 PA at 20°C and camphor solubility in water is 0.125 g/100 m1 (25 °C).

Camphor was formerly obtained from the wood of the Taiwanese camphor laurel tree (*Cinnamomum camphora*), but now is synthesized from pinene which is obtained by refining crude turpentine oil. It is used as a plasticizer in the manufacture of celluloid film and some lacquers. It is used as an insect repellent and in pyrotechnics. It provides cooling effect when applied to the skin. It is applied topically to the skin as well as in pharmaceuticals as an antipruritic and anti-infective. (**IPCS**, 1999)

Uses of camphor

It is used for rubefacient preparations in medicine to relieve mild pain and itching. Other rubefacients include benzyl nicotinate, methyl and ethyl salicylate, glycol salicylate, methyl nicotinate, capsaicin and capsicum oleoresin. Camphor is also an ingredient in cough remedies, ear drops, and preparations for the removal of corns and verrucas. There are dangers associated with the vapour, its dispersion, and possible ignition. There is a moderate risk of fire if camphor is exposed to heat or flame, but spontaneous combustion does not occur. Camphor can use as a plasticizer for cellulose esters and ethers in the manufacture of plastics, in lacquers and varnishes, explosives and pyrotechnics ,in the

manufacture of cymene ,moth repellent and as a preservative in pharmaceuticals and cosmetics. (**IPCS**,1999)

When camphor is applied on the skin, it is analgesic. It is also used in liniments as a counter-irritant in fibrositis, neuralgia, and similar conditions. In dermatology, when it is applied as lotion (0.1 to 3%), it is an anti-pruritic and surface anaesthetic (when applied gently, it creates a feeling of coolness). In dentistry, it is prepared with parachlorophenol 35% (and 65% camphor) and used as an antibacterial for infected root canals. (Reynolds, 1982).

Taken internally, it is an irritant and carminative. It has been used as a mild expectorant and to relieve griping (abdominal discomfort) (this use is now discouraged because of toxicity). Camphor was formerly administered as a solution in oil by subcutaneous or intramuscular injection to act as a circulatory and respiratory stimulant, but there is no evidence of its value for this purpose (Reynolds, 1982). According to the Dutch Information Medicamentorum (1986), camphor s used for pruritus, lotion muscular pains, for colds, chest liniment.

2.2.7.1 Traditional uses of camphor

Camphor is most commonly used externally to relieve arthritic and rheumatic pains, neuralgia, and back pain. It may also be applied to such skin problems as cold sores and chilblains and as a chest rub for bronchitis and other chest infections. It is often used in steam vapourizors to help control coughs by producing a local anesthetic action to the throat and to loosen congestion due to colds. When a cream or ointment

containing camphor is rubbed onto the chest, throat, or back, body heat helps release camphor vapors that, when inhaled, help loosen mucus and relieve airway congestion. *Cinnamomum cassia* is a variety used in China to treat diarrhea. Ayurvedic medicine includes uses for muscle pain, cardiac insufficiency, and asthma. **(**Grieve, 1995)

In Mexico, the sap has slight antiseptic properties and used to relieve aches and pains. Camphor can also be used to soften chapped lips, ease the itchiness of such minor skin irritations as eczema and insect bites, promote the healing of minor burns and skin wounds, and to repel moths and other insects. When camphor is applied to the skin as a salve or linament, it acts as a counterirritant that stimulates nerve endings, helping to reduce the number of pain messages that reach the brain.In Latin America, a solution of camphor in wine is used as a liniment for tumors and to treat respiratory problems. It is sold in Latin American markets in small, semisolid, translucent blocks. In Mexico, a mixture of camphor and olive oil is a popular treatment for bruises and neuralgia. (Grieve, 1995)

2.2.8 Effect of camphor (oil form) as repellent

Camphor contains 2-borbanone which can distract the moth away. It has a sharp aroma that dislikes by the moth. These compounds are volatile oil compounds, so that when oil is applied, in addition to smell (to humans) also can be used as insect repellents (Zasshi. 2001). As a repellent, the bound between the camphor with OBPs (Odorant-Binding Proteins) at the moth antenna could stimulate a respond of evasion of moth toward the smell. Aroma of the camphor initiate stimulus received by

the chemical receptor (chemoreceptor) at the antenna of moth that contains one or some bipolar nerves of the smell receptor or was known as ORNs (Olfactory Receptor Neurons). ORNs is at the end dendrite in the liquid lymph antenna that has function of detecting chemical (smell) at the axon of the nerve impulse , then delivers the impulse to the antenna lobus .In the liquid lymph antenna ,there was a bond of camphor with OBPs (Odorant Binding Proteins).When complex smell OBPs arrives in membrane dendrite, it get bounded with the receptor transmembrane which is known as Ors (Olfactory receptors).Ors transfers the message of chemical substance which would cause cascade and triggers the nerve activation. Then the electric impulse will be sent to the centre of higher brain and will be integrated to bring on the behaviour response such as moving far from the smell.

2.3 Repellent

Repellent is material that has the ability to repel insects. Repellent can be either chemical or natural materials.Repellent in the form of a chemical used in a way the body rub or spray on your clothes / region desired. DEET (*N, Nm-dyethyl-toluamide*) is one example of a chemical repellent. Another example of a repellent is ethyl hexanediol which has properties such as DEET, but the effect does not last long (Catherine, 1997).

Repellent can be made from natural; there are two mosquito repellent plants. The first group is a living plant mosquito repellent. In the form of intact and still alive, this group of plants can create a mosquito

does not feel at home in the vicinity. This effect is caused by essential oils out of the plant leaves or flowers. Examples of this class are zodia (*Evodia suaveolens, Scheff*), geranium (*Geranium homeanum, Turez*), rosemary (*Rosmarinus officinalis)*, lavender (*Lavendula angustifolia*), and sweet basil (*Ocimum spp*) (Gist, 2005. The second group is the plant that produces anti-mosquito material. Like the first group, this group of plants also produces essential oils that do not like mosquitoes. Differences in living conditions, oil aromatic relatively difficult to get out. To remove it, this plant should be cut, chopped and then distilled. Distillate of these essential oils can make mosquitoes fly away. Examples of this class are citronella (*Cymbopogon nardus*), most of lavender, vetiver (*Andropoghon zizaniodes* [L] Urb.), Eucalyptus (*Melaleuce leucadendron, Linn*), clove (*Eugenia aromatice*), and mambas (*Azadirachta indica A. Juss*) (Catherine,1997).

On the basis of a natural insect repellent "made of this, the authors take the same concept to run experiment made of natural mosquito to repel fire ants or flies. DEET (N, Nm-dietyhl-toluamide) is one example of a chemical repellent that has no smell, but can cause a burning sensation when the eyes or skin wounds. In addition, DEET can also damage objects made of plastic and other synthetic materials. The concentration of DEET also gives the effectiveness of different purposes, such as DEET 23.8% survived for at least 5 hours, 20% DEET can last for at least 4 hours, 6.65% DEET can last for at least 2 hours, and 4.75% DEET able to survive for at least 1 hour. Another example of a repellent is ethyl hexanediol which has properties such as DEET, but the effect does

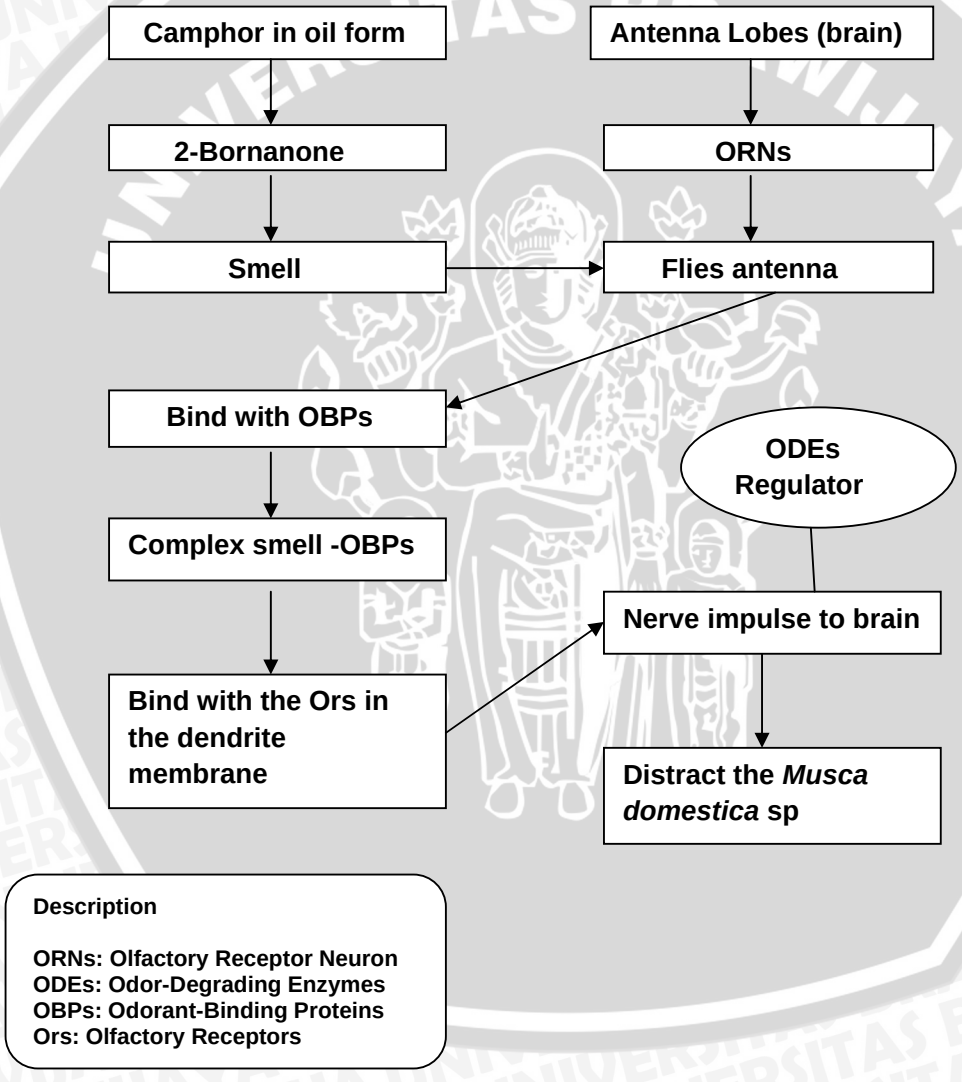
not last long. DEET also can be used in children older than 2 months. Terms of use DEET not be used on irritated skin, only used on the body part that is not covered by clothing, clothing materials exposed to DEET should be washed with water and soap, and do not use DEET material repeatedly. *Azadirachta indica A. Juss*) (Catherine, 1997).

Naphthalene is a white solid that evaporates easily. 1-Methylnaphthalene is a naphthalene-related compound which is also called alpha methylnaphthalene. It is a clear liquid. Naphthalene enters the environment from industrial uses, from its use as a moth repellent, from the burning of wood or tobacco, and from accidental spills. Naphthalene at hazardous waste sites and landfills can dissolve in water. Naphthalene can become weakly attached to soil or pass through the soil into underground water. Naphthalene evaporates easily. Hemolytic anemia (a condition involving the breakdown of red blood cells) is the primary health concern for humans exposed to naphthalene for either short or long periods of time. Other effects commonly found include nausea, vomiting, diarrhea, kidney damage, jaundice (yellowish skin or eyes) and liver damage. These effects can occur from either breathing or eating naphthalene. Cataracts (cloudy spots) might also occur in the eyes of persons who eat or breathe naphthalene.(NCBI,2010)

CHAPTER 3

CONCEPTUAL FRAMEWORK AND RESEARCH HYPOTHESIS

3.1 Conceptual Framework



Camphor (*Cinnamomum camphora*) contains 2-bornanone which can act as a repellent on flies (*Musca domestica sp*). The aroma or smell of the camphor ((*Cinnamomum camphora*) causes to flies distracted and avoid the area. As a repellent, the bound between the camphor with OBPs (Odorant-Binding Proteins) at the flies' antenna could stimulate a respond of evasion of flies toward the smell. Aroma of the camphor initiate stimulus received by the chemical receptor (chemoreceptor) at the antenna of flies that contain one or some bipolar nerves of the smell receptor or was known as ORNs (Olfactory Receptor Neurons). ORNs is at the end dendrite in the liquid lymph antenna that has function of detecting chemical (smell) at the axon of the nerve impulse , then delivers the impulse to the antenna lobus .In the liquid lymph antenna ,there was a bond of camphor with OBPs (Odorant Binding Proteins).When complex smell OBPs arrives in membrane dendrite, it get bounded with the receptor transmembrane which is known as Ors (Olfactory receptors).Ors transfers the message of chemical substance which would cause cascade and triggers the nerve activation. Then the electric impulse will be sent to the centre of higher brain and will be integrated to bring on the behaviour response such as moving far from the smell.

3.2 Research Hypothesis

1. Camphor (*Cinnamomum camphora*) has potential as a repellent for flies (*Musca domestica sp)* .The more the concentration of camphor, the higher the effect potential of camphor as a repellent for *Musca Domestica sp*.

Specific hypothesis

2. The longer the usage duration of repellent as Camphor (*Cinnamomum camphora*), the lesser the effect potential of camphor as a repellent for *Musca Domestica sp*.

CHAPTER 4

METHODOLOGY

4.1. Research design

The research design was a true-experimental post test control group design to know and compare camphor (*Cinnamamum camphora*) extract potential as a repellent on fly *Musca domestica sp.*

4.2. Location of Experiment and Time

The experiment was conducted in Parasitology Laboratory of Faculty of Medicine of Brawijaya University in May 2012.

4.3. Population and Sample

4.3.1 Experimental population

The research populations are 50 female flies of *Musca domestica.sp*

The inclusion criteria for this research:

1. All flies of *Musca domestica* alive
2. Active movement of the *Musca domestica*
3. Has been in starvation condition minimal 4 hours

An exclusion criterion of this research is all flies of *Musca domestica sp* that not included in inclusion criteria.

4.3.2 Preparation of adult flies

As many as 50 flies are captured and included in the stable fly which is covered by wire kasa. Then the flies are feed with glucose solution. Before conducting the experiment, the flies are starved for 4 or more hours.

4.3.3 Group and number of samples

The samples are divided into five groups experiment, namely the control group that given a 20% sugar solution, positive comparison/control groups that given with naphthalene, and three groups that given with 20%, 30% and 40% camphor extract respectively .This experiment is done for 6 hours. Extract concentration was determined by early studies. Each concentration is repeated 4 times with the same stock solution.

The detail of experimental groups are described below

Experiment 1/control negative : cup contains cotton wool with 2,5cc glucose 20%+2,5cc aquades

Experiment 2/control positive : cup contains cotton wool with 2,5cc glucose 20% +2,5cc naphthalene

Experiment 3/extract 20% : cup contain cotton wool with 2,5cc glucose 20%+2,5cc 20%camphor extract

Experiment 4/extract 30% : cup contain cotton wool with 2,5cc glucose 20%+2,5cc 30% camphor extract

Experiment 5/extract 40% : cup contain cotton wool with 2,5cc glucose 20%+2,5cc 40% camphor extract

Number of experiment for each group followed by using the following formula (Loekito, 1998):

$$(3n-1)+(p-1)\geq 16$$

$$(3n-1)+(5-1)\geq 16$$

$$(3n-1)+(4)\geq 16$$

$$(3n-1)\geq 12$$

$$(3n)\geq 13$$

$$n \geq 4$$

n= number of times of repetition for each group

p=number of group

Based on the results of calculation of the formula, so in this study each group is repeated 4 times

4.4 Variables of Identification

4.4.1 Dependent Variables

Dependent variable for this study is the total number of adult housefly *Musca domestica sp.* that land on each cups.

4.4.2 Independent Variables

Independent variable for this study is the dosage or the concentration of camphor extract

4.5 Tools and research materials

4.5.1 Tool to manufacture camphor extract

Blender,Sieve, Sieve paper, extraction bottle, Analytical balance, Static Clamp, Oven, Scale, Percolator, and Set of tools for vacuum evaporation**.**

Tools to test effect of camphor as repellent on *Musca domestica sp.*

Fly box, cup, cotton wool, test tube, Center

4.5.2 Materials in research

Materials that are used in this research are camphor,aquades, etanol 96% and sieve paper

Materials to test repellent ability*: Musca domestica sp.* flies, Camphor paste with 3 different concentration (20%, 30%,40%), cotton, napthalene, Sugary food source 20%, Aquades

4.6 Operational Definition

- Camphor paste which was been made by evaporation and extraction from camphor extract which first dried with using ethanol.
- Flies are *Musca domestica sp with* gray colour with four longitudinal dark lines on the back bought from Parasitology laboratory Faculty of Medicine, Brawijaya University**.**
- .Effect of repellent will known when number flies of flies land on each cup as negative control group, positive control group or treatment group.
- Naphthalene is used as repellent, bought from Malaysia manufacture of Shantha manufacture.

- Sugar or any sugary source to attract the flies is bought from Parasitology laboratory Faculty of Medicine, Brawijaya University.
- Fly box is a box of square shaped which close by casa in its whole surface. At the side of the box, a hole is made so that hand can go into the box; the hole is closed by cloth to avoid flies to fly away.
- The number of flies land during experiment in each cup was recorded in 5 minute in hour to 0,1,2,4 and 6 Hour

4.7 Research Preparation

4.7.1 Camphor extraction process

Camphor extraction process is done by maceration with 96% ethanol solvent Process is as follows

- Dried camphor is put into the oven with a temperature of 60-89°C for 12 hours. If oven is not available, camhor can be dried under the sun for 2 days for 5-6hours. Drying process is carried out until the camphor is completely dry.
- Once dried camphor is blended and then weighed using an analytical balance to obtain as much 250gram.Balance can be kept or thrown.
- 250 grams of dried camphor wrapped in filter paper is inserted into a bottle and then soak it with ethanol.
- 1 liter ethanol solvent inserted into the bottle until the camphor wrapped in filter paper soaked in solvent ethanol. Let it until it turn light yellow.(+/- two days)

- During immersion, ethanol replaced twice, that is on the 3rd and 5th day as much as 1 liter so the active ingredient in the camphor can come out and dissolved in ethanol.
- Stop the extraction if the ethanol in place to accommodate the camphor is clear(+/- one week)
- After that extract in ethanol result evaporated to separe camphor extarctand ethanol solvent.
- To separate camphor extract and ethanol solvent, evaporation container is filled with the extraction result, and then assembled again. Rotary evaporator, chilled water circulation pump equipment and vacuum pump is turned on.
- Distilled water heater turned on until extraction result in evaporation container boiled and ethanol solvent evaporates.
- Ethanol evaporation result is condensed and proceeds into ethanol container so it is not mixed with the evaporation result, while other steam sucked by pump vacuum.
- The process is waited until the extraction of the evaporated volume is reduced and becomes thick, once it become thick, the process is stopped and evaporation result is taken.
- The result is then transfer to an evaporation cup and put into the oven for 50 °C for 1-2 hours to evaporate the rest of the solvent,thus obtain a 100% camphor extract.Camhor extract weighted by analytical scale.

4.8 Prosedures

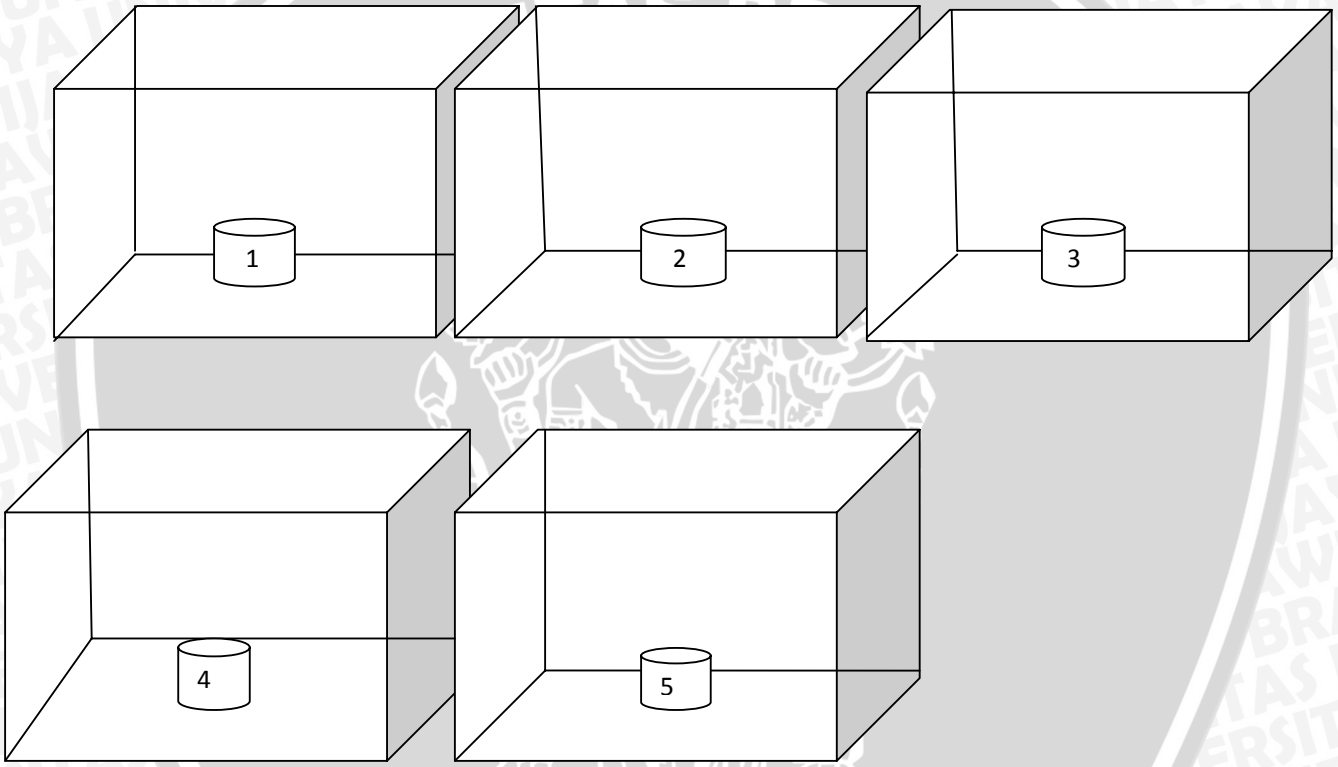
1. Experiment performed using box which have the same temperature with the room temperature 27±2 °C with humidity level between 60-70%.
2. Camphor extract be prepared.
3. 5 Square shaped box which is covered by a fabric filled with 10 flies each of female *Musca domestica sp.*
4. Each cup filled with cotton wool soaked in sugar water 20% which are placed in center of the box
5. First cup contain cotton wool which is soaked with 2,5cc glucose solution 20% + aquades 2,5cc (negative control). Second cup is given well known naphthalene control positive).Third, fourth, and fifth cup is given cotton wool soaked with 2,5cc glucose solution 20% and camphor extract with different concentration.
6. All cups is inserted into the boxes for 5 minute on the clock to the 0,1,2,4, and to-6 hour .In each time interval between hour ,the cup is take out of the box.
7. Number of flies that land on each cup in during observation is recorded.
8. This test is done by repeated 4 times for each observation.
9. Percentage of capacity of camphor extract as repellent is counted using formula as follows:

$$\frac{nc - r}{nc} \times 100\%$$

Explanation:

nc= number of flies land on negative control

r= number of flies land on cotton wool soaked with sugar water and camphor extract.



Explanation:

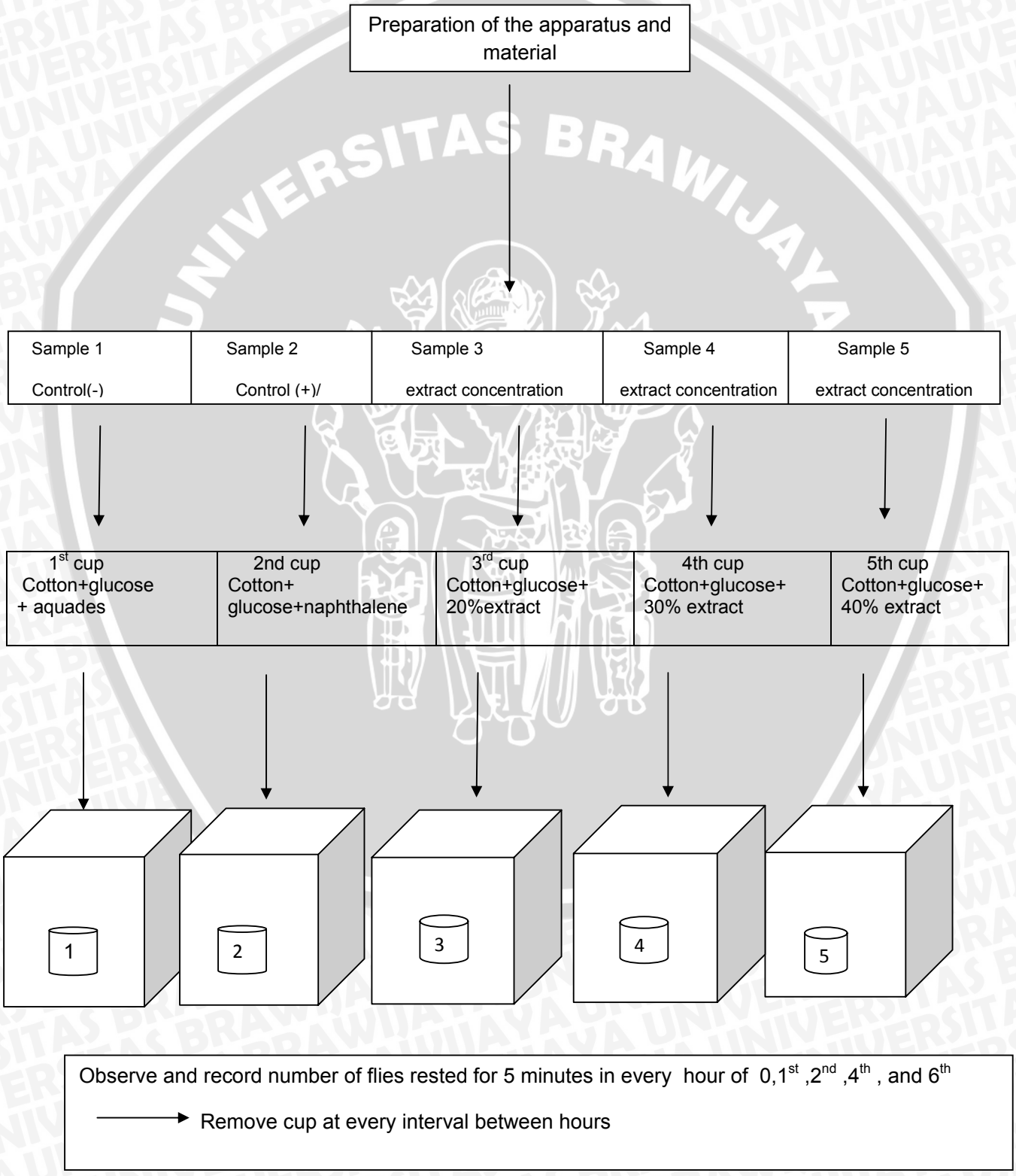
1st cup contain cotton which dipped 2,55cc glucose solution 20% + 2,55cc aquades

2nd cup contain cotton which dipped 2,5cc glucose solution 20% + 2,55cc naphthalene

3rd cup contain cotton which dipped 2,5cc glucose solution 20% + 2,55cc extract camphor 20 %

4th cup contain cotton which dipped 2,5cc glucose solution 20% + 2,55cc extract camphor 30 %

5th cup contain cotton which dipped 2,5cc glucose solution 20% + 2,55cc extract camphor 40 %



4.9 Processing and Analysis Data.

4.9 Processing and data analysis

Processing and data analysis was based on the number of flies *Musca Domestica* sp is landed for each concentration of camphor extract after 6 hours observation.

Data analysis is performed with SPSS 15.0 with One-way ANOVA test to find out if there is difference in number of flies landing which observed in more than 2 samples. In One-way ANOVA test, there are several conditions, which are:

1. ANOVA requirement for more than two unpaired groups must be met in that the data must be normal, the data must be normal Varian.
2. If the condition is not fulfilled, then attempted to transform the data so that the distribution becomes normal and the same variant.
3. If the transformation is not normally distributed or variance remains not same, alternatively choose Kruskall-Wallis test.
4. If ANOVA test or Kruskall Wallis test results in value $P<0.05$,then continued with Post hoc test which is with Mann-Whitney (Dahlan,2004)

BAB 5

RESULT

5.1 Data Observation Result

Potential test of camphor extract as a repellent towards fly *Musca Domestica sp* been used three kind of preparation which is 20% extract, 30% extract and 40% extract. Counting of number of flies landed is done for five minutes on the hour of 0,1,2,4, and 6. The results of the study are as shown in the following table:

Table 5.1 Data on Number of Flies Landed

Time	Repetition	Extract 20%	Extract 30%	Extract 40%	Control (+)	Control (-)
0	1	1	0	0	0	2
	2	2	0	0	0	3
	3	0	0	0	0	2
	4	0	0	0	0	1
Mean		0.75	0.00	0.00	0.00	2.00
SD		0.96	0.00	0.00	0.00	0.82
1	1	1	0	0	0	2
	2	2	0	0	0	4
	3	1	0	0	0	2
	4	2	1	0	0	3
Mean		1.50	0.25	0.00	0.00	2.75
SD		0.58	0.50	0.00	0.00	0.96
2	1	2	1	0	0	3
	2	2	1	0	0	2
	3	1	0	0	0	3
	4	1	0	0	0	2
Mean		1.50	0.50	0.00	0.00	2.50
SD		0.58	0.58	0.00	0.00	0.58
4	1	1	1	0	0	2
	2	1	1	0	0	4
	3	1	1	0	0	3
	4	2	0	0	0	4
Mean		1.25	0.75	0.00	0.00	3.25
SD		0.50	0.50	0.00	0.00	0.96
6	1	2	1	0	0	4
	2	1	1	0	0	4
	3	2	1	1	0	3
	4	3	1	0	0	5
Mean		2.00	1.00	0.25	0.00	4.00
SD		0.82	0.00	0.50	0.00	0.82

Explanation:

Experiment 1/control (-)

Experiment 2/control (+)/naphthalene

Experiment 3/extract 20% :

Experiment 4/extract 30%

From the above table illustrates that the differences preparations give a different effect on the number of flies which landed. There is no flies that settle on the comparative and camphor extracts 40%.While on three other experiment show result of different effect.

Data on the number flies landing on different experiment and different observation time interval analyzed for the repellent potential on each experiment according to the formula:

$$\frac{(nc-r) \times 100}{nc}$$

Explanation

nc=number of flies land on negative control

r= number of flies land on cotton which dipped into glucose solution and camphor extract.

Table 5.2 Percentage of Repellent Potential

Hour		Extract 20%	Extract 30%	Extract 40%	Control (+)	Control(-)
0	Mean	93%	100%	100%	100%	80%
	SD	0.10	0.00	0.00	0.00	0.08
1	Mean	85%	98%	100%	100%	70%
	SD	0.06	0.05	0.00	0.00	0.10
2	Mean	85%	95%	100%	100%	75%
	SD	0.06	0.06	0.00	0.00	0.06
4	Mean	88%	93%	100%	100%	68%
	SD	0.05	0.05	0.00	0.00	0.10
6	Mean	80%	90%	98%	100%	60%
	SD	0.08	0.00	0.05	0.00	0.08

Explanations:

From the above table illustrates that the differences preparations give a different potential percentage depend on the number of flies which landed. There are no flies that settle on the comparative and camphor extracts 40%.While on three other experiment show result of different effect.

5.2 Data Analysis

Data analysis was done with SPSS 15.0. Data from this study according to the terms in the ANOVA test first tested for normality using Kolmogrov-smirnov methods test. This method is used to analyze whether the data have a normal distribution or not. In the test for normality, hypothesis of the data is determined by the significant value obtained, where Ho is the normal distributed data and Hi is data distributed abnormally. Ho is accepted if significant value is >0.05 and Hi is accepted id significant value is <0.05. From the study result shows significant value of 0.063 which means because the significant value >0.05, thus Ho is accepted and the data is normally distributed.

Because the data was normally distributed thus test whether there was any heterogeneity of the data subset, the Levene test homogeneity of variances was ruled out The significant value,p which is 0.062 (p>0.05), thus this can be concluded that variance of the data obtained was homogenous.

Methods One-way ANOVA was used to analyze whether the effect of camphor extract as a repellent against the fly *Musca Domestica* sp .By looking at the value of significance. Hypothesis determined by Ho accepted when the value gained significance> 0.05, while Ho is rejected if the significance value obtained <0.05. Ho of the study was the average results showed 4 kinds of treatment showed no effect of treatment was significantly different to the potential repellent. While Hi is a treatment effect shows the difference between the variation of the concentration with camphor and control were tested against potential repellent. From the table of Oneway Anova test shows potential , significant value at 0, 1, 2, 4 and 6 hour is <0.05 ,thus there is a difference between the treatments tested

on repellence potential. To know which treatment has difference, post hoc test analysis is done

Post hoc test, if p value <0.05, thus can conclude that there is a significant difference in treatment tested .This method will do a comparison between each group that were tested. Result of post hoc analysis between concentration on hour of 0, 1, 2, 4 and 6 is attached in attachment.

To see the difference in potential between the treatment to the time difference we can see in the figure below.

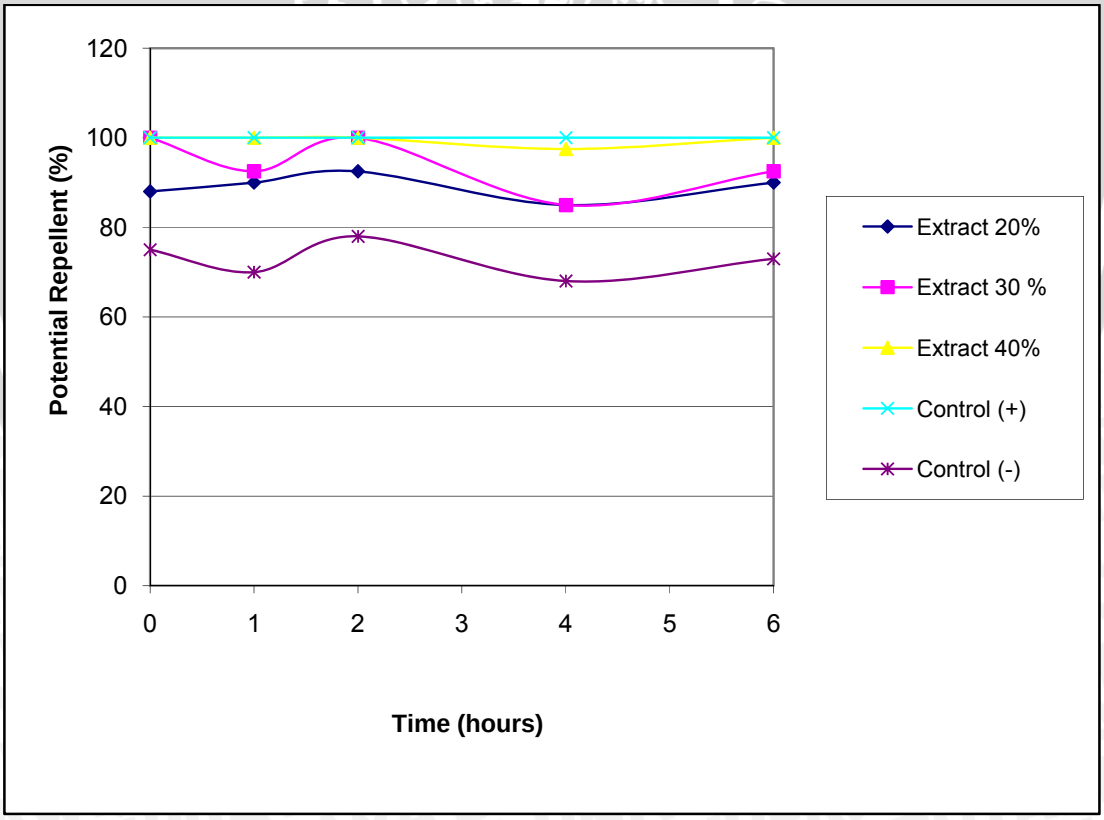


Figure 5.1: Comparation of repellent potential with 5 different treatment.control (+), control (-),20% camphor extract,30%camphor extract and 40%camphor extract

Based on the above graph is known that the experiments were conducted at 5 time interval, namely 0, 1,2,4,6 hours. At the hour of 0, average repellent potential camphor extract 20% is 93%, hour of 1 is 85%, hour of 2 is 85%, hour of 4 is 88% and hour of 6 is 70%. At the hour of 0, average repellent potential camphor extract 30% is 100%, hour of 1 is 98%, hour of 2 is 95%, hour of 4 is 100% and hour of 6 is 90%. At the hour of 0, average repellent potential camphor extract 40% is 100%, hour of 1 is 100%, hour of 2 is 100%, hour of 4 is 100% and hour of 6 is 98%.

Correlation test to determine whether there is a relationship between the effects that occur with the provision of the materials used. In correlation test, if the significant value obtained is <0.01 shows there is relationship between material provision and effect, whereas if the significant value show > 0.01 means there is no relationship between material provision and effect. Coefficient correlation 0-0.2 show very weak relationship, 0.2-0.4 weak, 0.4-0.6 moderate, 0.6-0.8 strong and 0.8-1 very strong.

Correlation test is to know relationship on different extract concentration with repellent potential and to know effect on time on repellent potential. From the correlation test between concentration and potential result, shows significant value p=0.000 which means it is very significant. Pearson correlation coefficient (r value) describes the strength of correlation .Correlation test value of 0.715 shows positive correlation direction with strong repellency.

The correlation test between times of treatment on concentration shows negative value where it shows the repellency and camphor extract have inversely proportional correlation. As the time increases, repellent potential decreases.

Regression test is a kind of statistical analysis test that was performed to investigate the influenced of independent variable (dose and time) and dependent variable (repellency). Based on the R square value, the influence of dose and timing factor in repellency are 61.2% (R2 x 100%). The regression model (Appendix 6) of the effect of camphor (*Cinnamomum camphora*) concentration of repellent potency is $y = 76.201 - 1.135\ X_1 + 0.675\ X_2$, mean that without being affected by the administration of camphor (*Cinnamomum camphora)* extract concentration, the potential repellent camphor *(Cinnamomum camphora)* extract will keep increasing constantly 76.201%. However, when considering the effect of administration of camphor (*cinnamomum camphora*) extract concentration, where any increase in concentrations of camphor *(cinnamomum camphora)* extract 1% will cause a potential repellent camphor (*cinnamomum camphora)* extract increased by 0.675%. While the influence of long-time observation showed that every 1 hours of observation time it lowers the potential repellent camphor (*cinnamomum camphora)* extract up to 1.135%.

Table 5.3: Magnitude of maximal concentrations of camphor concentration within 6 hours

Calculation of the regression equation	Results
$Y = 76.201 - 1.135\ X_1 + 0.675\ X_2$ where $Y=100$, $X_1=6$	((100-(76.201)-(6x-1.135))/ 0.675 = 45.35%

Description:

Y = Potential repellent Camphor

X_1 = Time of observation

X_2 = Concentration

Based on the above calculation, it can be seen that the magnitude of minimal concentrations of camphor (*Cinnamomum camphora*) concentration within 6 hours that can resist house fly up to 100% is a cinnamon extract at concentrations of 45.35%.

CHAPTER 6

DISCUSSION

This experiment was aimed to investigate the effect of the camphor (*cinnamomum camphora*), as a repellent towards house fly *Musca domestica* sp. Camphor oil consists mainly of 2-Bornanone, particularly a-pinene, camphene, b-pinene and also bornyl-acetate and safrole. Benefit of Camphor Oil in a theoretical way is an effective stimulant. It stimulates circulation, metabolism, digestion, secretions and excretion, thereby treating problems and ailments associated with improper circulation, digestion, sluggish or hyper metabolic rates, obstructed secretions .Internally, camphor is given hypodermically as an injection, in substance, or in capsules Camphor treats many ailments and medical conditions. These conditions include chills, cholera, cold, colic, constipation, depression, diarrhea, fever, flatulence, and gout. (VanNostrand 1968) For heart disorders, oil of camphor acts as a stimulant on the heart In practical Camphor Oil is an excellent disinfectant, insecticide and germicide. Camphor Oil can be added to drinking water, particularly in summer and rainy seasons when there is more chance of water getting infected, to disinfect it. A bottle or container of Camphor Oil, if kept open, or a piece of cloth soaked in it, if burnt, drives away insects and kills germs. A drop or two of Camphor Oil, mixed with large quantity of food grains, keep it safe from insects. Indian Ayurvedic medicine has used camphor as an antibacterial agent for over 5,000 years, and Africans have used camphor bark to fight fever and malaria and as an antiseptic .Camphor has a chemical property known as 2-bornanone, 2-Camphanone ,and 1,7,7-Trimethylbicyclo(2.2.1) heptan-2-one.2-bornanone The main active ingredient of camphor (*Cinnamomun camphora*) contents the

compound 2-Bornanone that has the sharp aroma that was not liked by insects. (Zasshi, 2001)

Results from this experiment shows 40% of camphor (*Cinnamomum camphora)* has the best repellence effect on house fly (*Musca domestica* sp) (R square= 61.2%) compare to the other 2 concentrations. According to the above equation (Table 5.2.3), the best concentration which can repel the house fly 100% is 45.35%, but this concentration is not advisable because it may contain high percentage of chemicals and can act as an insecticide.

Correlation test is to know relationship on different extract concentration with repellent potential and to know effect on time on repellent potential. From the correlation test between concentration and potential result, shows significant value p=0.000 which means it is very significant. Pearson correlation coefficient (r value) describes the strength of correlation .Correlation test value of 0.715 shows positive correlation direction with strong repellency.

The correlation test between times of treatment on concentration shows negative value where it shows the repellency and camphor extract have inversely proportional correlation. As the time increases, repellent potential decreases. Unfortunately this repellence effect does not work effectively for the through out a day due to the evaporation of the camphor molecules.

The camphor (*Cinnamomum camphora*) is being used as a repellent in natural. As a repellent, the bound between the 2-Bornanone with OBPs (Odorant-Binding Proteins) at the fly antenna could stimulate a respond of evasion of a flies towards the smell. The smell of the camphor that was the beginning stimulus received by the chemical receptor (chemoreceptors) at antenna of fly

(sensilia) that contained one or some bipolar nerves of the smell receptor or was known as ORNs (Olfactory Receptor Neurons). ORNs is at the end dendrite in the liquid lymph sensilia that had a function of detecting chemicals (smell) at the end axon for the nerves impulse, then delivers the impulse to the antenna lobus. At the liquid lymph sensilia, there was a bond of camphor extract with OBP protein (Odorant-Binding Proteins). Apart being a helper bound to deliver the impulse, OBPs also dissolves baud an acted in the selection of smell information. When the complex smell-OBPs arrives in membrane dendrite, it gets bounded with the receptor transmembrane, which is known as Ors (Olfactory receptors). Ors transfers the message of chemical substance which would caused cascade and triggers the nerve activation. Then the electric impulse will be sent to the centre of the higher brain and will be integrated to bring on the behaviour response such as moving far from the smell. (Subhuthi,1998)

There is a study conducted by another researcher on Camphor as a moth repellent. Camphor crystals of refined camphor are hard and colourless. It is effective for insecticide and prevents moisture. It is widely used by governments and the military. The chemical laurel used as insecticide is Safrole. Safrole is a colorless or slightly yellow oily liquid .It removes bad smell to protect against infectious diseases. It is the principal component of brown camphor oil, and is found in small amounts in a wide variety of plants, where it functions as a natural pesticide. (Akira Hattori, 2004)

In this experiment, there are several limitations from the researcher because of the limitations of the equipment and the reference that were used; we could not know the mechanism of active substances from the camphor (*Cinnamomum Camphora*). The other limitations were on the stability of the

temperature and room humidity of the place while the experiment being carried out which could influence on the number of flies that passes by.

CHAPTER 7

CONCLUSION

7.1 Conclusion

- Camphor (*Cinnamomum camphora*) has a repellent effect on *Musca domestica* sp. All concentrations showed a repelling potential.
- It was also proven that if the concentration of camphor is *Cinnamomum camphora),*is higher the potential of repellence towards *Musca domestica Sp* is bigger.
- The best repellency concentration determined was 40% of camphor (*cinnamomum camphora)* .The optimal concentration is 45.3%

7.2 Suggestions

The research could be carried forward:

a. To know the mechanism of the active ingredient in the camphor (*Cinnamomum camphora*) as a insecticide towards the fly or other pest .

b. To know the side effect that could occur out of the usage of camphor (*Cinnamomum camphora*) repellent so that it can be efficient to the whole society.

c. To know the potential of the other part of the camphor (*Cinnamomum camphora)* such as its leaf or its seed as a repellent.

d. The effectiveness of the camphor (*Cinnamomum camphora*) as an insecticide towards the fire ant because there are possibility to form irritation on the ant's chitin.

REFERENCES

Ayusheda, (2010) Cinnamomum camphora. accesed (online)www.ayusheda.com/herbs/cinnamomum camphora .html

Bloomquist (2004),Neurotoxin Insecticide Inhibit GABA –dependent chloride uptake by brain vessel, Department of Entomology, Lowa State University Ames 50011-3140

Campbelll, (2005).Biology .8th Edition.London: Pearson-Benjamin Cummings, page 350

Chen Tiachi,(1981)Researches on Certain Triphosphate Insecticide contains Naphthalene ring. accessed (online) http://www.cjucc.jllu.edu.cn/EN.

Catherine Regnault-Roger(1997),The Potential of Botanical Essential oil for insect pest control. accessed (online) www.botanicalpesticide.IPM.pdf

Friend .J.A (2001), Camphor, Laurel Trees Invade Coastal N.S.W.Australia

Gulliemin (2001). The Investigation of a Deathly Outbreak, Anthropology.accessed (online) www.ucpress.edu/book.php.

Grieve M(1995). A Modern Herbal , accessed (online) http://botanical.com/botanical/mgmh/c/cinnam69.html

Green Deane(2007).Camphor-Trees. Herbs, Medicinal Miscellanous Plants, Space/Seasoning Trees accessed (online) www.earthweeds.com

IPCS (1999), INCHEM Home-Camphor accessed online www.camphor ipcs.com.

John L Capinera,(2008).Featured Creatures Department Of Entomlogy & Elematology ,accessed online http://entnem.dept.ufl.edu/creatures/urban/flies/house_fly.html.

Jerry Butler (2008) Adult and Eggs of Housefly Musca domestica Linnaeus, University Of Florida.

Jim Kalisch (2007).The Staging of Musca domestica fly, University of Nebraska, Department of Entomology accessed online http://extension.psu.edu.

Keiding J, (1986), The Housefly-biology& control. Health Organization WHO/UBC 64pp accessed (online) www.who.int/entity/water_sanitation_healthresources vector 302-303 pdf

Loekito (1998), Minimal Influential Attributes that Capture Class and Groups Contrast Behavior, University of Melbourne, Australia.

Linda Conway,Duever (2004),Floridata:Cinnamomum amphora, accessed online www.floridata.com.

Mackean D.G (2004), Biology Teaching Resources-The housefly,educational material accessed (online) www.biology-resources,com/housefly-0.1html

NIST (2011) National Institute of Standard & Technology-Material Measurement Laboratory, accessed (online) www.(+)-2-Bornanone.com

NCBI, (2010) ,Pub Chem Compound Naphtalene, Oregon State University. accessed (online) npic.orst.edu/factsheets/naphgen.pdf

Nasif Nahle(2006),Biology Cabinet Research edu. Saryon Biology ,accessed (online) www.biovab.org/Musca_domestica_class.html.

Ravichandran P.N, (2003). Cinnamom/Cassia, The Genus Cinnamomum.

Robert, L. 2006. How Houseflies Work (online) accessed (http:www//animals.howstuffworks.com/insects/housefly.htm

Ralph E.Taggart (2010).Toxonomic,accesed (online) taggart.gly.msu.edu/isb200/classif.html

Reynold (1982),The Extra Pharmacopedia, 28th edition p351, London Pharmaceutical Press.

Sanchez H-Arroyo (2008).Housefly Musca domestica Linnaeus,University of Florida accessed (online) www.edis.ifas.ufl.edu/in205

Shriniwas, (1992) .The Housefly as a Carrier of Pathogenic Microorganism in a Hospital Environment volume 20 pg 209-215

Subhuthi Dharmmanda (1998),phd Borneol, Artemisia & Noxa Phd. Institute For Traditional Medicine, Portland Oregon. accessed (online) www.borneol.artemisia.com

VanNostrand's Scientific Encyclopedia, 4th Ed. D. VanNostrand Company, INC. Princeton, NJ. 1968. Pages 269.

WHO Media Centre, 2007. Fly Morphology –Feeding http://www.WHO.media.centre.net.my/modules/news/print.php? storyid=790

Zasshi,Yakussaki.,2001.Fujisawa Camphor (2) manufacture of borneol,(online) http://www.ncbi.nlm.nih.gov/pubmed/11968216

LIST OF ABBREVATION

ANOVA-Analysis of variance

cc -cubic centimeter

Dr -Doctor

DDT -Dichlorodiphenyltrichloroethane

g/ml -Gram per millimeter

H -Hipothesis

i.e. - Example

IUPAC - International Union of Pure and Applied Chemistry

L -Litre

Mm -Millimeter

ml -mililiter

OBPs -Olfactory binding proteins

ODEs -Odour degrading enzymes

ORNs -Olfactory receptor neurons

Ors -Olfactory reseptors

PA -Pascal unit

P -P values

R^2 -Coefficient of determination

Sp -Species

SPSS -Statistical Product and Service Solutions

SD -Standard deviation

USA -United State of America

WHO -World Health Organization

APPENDIX

Appendix 1: Homogenity test

Dependent Variable:potensi

F	df1	df2	Sig.
1.518	24	75	.062

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + waktu + perlak + waktu * perlak

Levene's Test of Equality of Error Variances[a]

Appendix 2: Normality Test

NPar Tests

One-Sample Kolmogorov-Smirnov Test

		Residual for potensi
N		100
Normal Parameters[a,,b]	Mean	.0000
	Std. Deviation	4.63300
Most Extreme Differences	Absolute	.270
	Positive	.230
	Negative	-.270
Kolmogorov-Smirnov Z		1.700
Asymp. Sig. (2-tailed)		.063

a. Test distribution is Normal.

b. Calculated from data.

Appendix 3: One way ANOVA Test

ANOVA

0 jam

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1220.000	4	305.000	9.632	.000
Within Groups	475.000	15	31.667		
Total	1695.000	19			

Post Hoc Tests

Multiple Comparisons

0 jam
Tukey HSD

(I) Perlakuan	(J) Perlakuan	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Ekstrak 20%	Ekstrak 30%	-7.50000	3.97911	.366	-19.7872	4.7872
	Ekstrak 40%	-7.50000	3.97911	.366	-19.7872	4.7872
	Kontrol (+)	-7.50000	3.97911	.366	-19.7872	4.7872
	Kontrol (-)	12.50000*	3.97911	.045	.2128	24.7872
Ekstrak 30%	Ekstrak 20%	7.50000	3.97911	.366	-4.7872	19.7872
	Ekstrak 40%	.00000	3.97911	1.000	-12.2872	12.2872
	Kontrol (+)	.00000	3.97911	1.000	-12.2872	12.2872
	Kontrol (-)	20.00000*	3.97911	.001	7.7128	32.2872
Ekstrak 40%	Ekstrak 20%	7.50000	3.97911	.366	-4.7872	19.7872
	Ekstrak 30%	.00000	3.97911	1.000	-12.2872	12.2872
	Kontrol (+)	.00000	3.97911	1.000	-12.2872	12.2872
	Kontrol (-)	20.00000*	3.97911	.001	7.7128	32.2872
Kontrol (+)	Ekstrak 20%	7.50000	3.97911	.366	-4.7872	19.7872
	Ekstrak 30%	.00000	3.97911	1.000	-12.2872	12.2872
	Ekstrak 40%	.00000	3.97911	1.000	-12.2872	12.2872
	Kontrol (-)	20.00000*	3.97911	.001	7.7128	32.2872
Kontrol (-)	Ekstrak 20%	-12.50000*	3.97911	.045	-24.7872	-.2128
	Ekstrak 30%	-20.00000*	3.97911	.001	-32.2872	-7.7128
	Ekstrak 40%	-20.00000*	3.97911	.001	-32.2872	-7.7128
	Kontrol (+)	-20.00000*	3.97911	.001	-32.2872	-7.7128

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

0 jam

Tukey HSD[a]

Perlakuan	N	Subset for alpha = 0.05	
		1	2
Kontrol (-)	4	80.0000	
Ekstrak 20%	4		92.5000
Ekstrak 30%	4		100.0000
Ekstrak 40%	4		100.0000
Kontrol (+)	4		100.0000
Sig.		1.000	.366

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 4.000.

Oneway

ANOVA

1 jam

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2330.000	4	582.500	19.417	.000
Within Groups	450.000	15	30.000		
Total	2780.000	19			

Post Hoc Tests

Multiple Comparisons

1 jam

Tukey HSD

(I) Perlakuan	(J) Perlakuan	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Ekstrak 20%	Ekstrak 30%	-12.50000*	3.87298	.038	-24.4595	-.5405
	Ekstrak 40%	-15.00000*	3.87298	.011	-26.9595	-3.0405
	Kontrol (+)	-15.00000*	3.87298	.011	-26.9595	-3.0405
	Kontrol (-)	12.50000*	3.87298	.038	.5405	24.4595
Ekstrak 30%	Ekstrak 20%	12.50000*	3.87298	.038	.5405	24.4595
	Ekstrak 40%	-2.50000	3.87298	.965	-14.4595	9.4595
	Kontrol (+)	-2.50000	3.87298	.965	-14.4595	9.4595
	Kontrol (-)	25.00000*	3.87298	.000	13.0405	36.9595

Ekstrak 40%	Ekstrak 20%	15.00000*	3.87298	.011	3.0405	26.9595
	Ekstrak 30%	2.50000	3.87298	.965	-9.4595	14.4595
	Kontrol (+)	.00000	3.87298	1.000	-11.9595	11.9595
	Kontrol (-)	27.50000*	3.87298	.000	15.5405	39.4595
Kontrol (+)	Ekstrak 20%	15.00000*	3.87298	.011	3.0405	26.9595
	Ekstrak 30%	2.50000	3.87298	.965	-9.4595	14.4595
	Ekstrak 40%	.00000	3.87298	1.000	-11.9595	11.9595
	Kontrol (-)	27.50000*	3.87298	.000	15.5405	39.4595
Kontrol (-)	Ekstrak 20%	-12.50000*	3.87298	.038	-24.4595	-.5405
	Ekstrak 30%	-25.00000*	3.87298	.000	-36.9595	-13.0405
	Ekstrak 40%	-27.50000*	3.87298	.000	-39.4595	-15.5405
	Kontrol (+)	-27.50000*	3.87298	.000	-39.4595	-15.5405

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

1 jam

Tukey HSD[a]

Perlakuan	N	Subset for alpha = 0.05		
		1	2	3
Kontrol (-)	4	72.5000		
Ekstrak 20%	4		85.0000	
Ekstrak 30%	4			97.5000
Ekstrak 40%	4			100.0000
Kontrol (+)	4			100.0000
Sig.		1.000	1.000	.965

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 4.000.

Oneway

ANOVA

2 jam

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1880.000	4	470.000	23.500	.000
Within Groups	300.000	15	20.000		
Total	2180.000	19			

Post Hoc Tests

Multiple Comparisons

2 jam
Tukey HSD

(I) Perlakuan	(J) Perlakuan	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Ekstrak 20%	Ekstrak 30%	-10.00000*	3.16228	.044	-19.7649	-.2351
	Ekstrak 40%	-15.00000*	3.16228	.002	-24.7649	-5.2351
	Kontrol (+)	-15.00000*	3.16228	.002	-24.7649	-5.2351
	Kontrol (-)	10.00000*	3.16228	.044	.2351	19.7649
Ekstrak 30%	Ekstrak 20%	10.00000*	3.16228	.044	.2351	19.7649
	Ekstrak 40%	-5.00000	3.16228	.530	-14.7649	4.7649
	Kontrol (+)	-5.00000	3.16228	.530	-14.7649	4.7649
	Kontrol (-)	20.00000*	3.16228	.000	10.2351	29.7649
Ekstrak 40%	Ekstrak 20%	15.00000*	3.16228	.002	5.2351	24.7649
	Ekstrak 30%	5.00000	3.16228	.530	-4.7649	14.7649
	Kontrol (+)	.00000	3.16228	1.000	-9.7649	9.7649
	Kontrol (-)	25.00000*	3.16228	.000	15.2351	34.7649
Kontrol (+)	Ekstrak 20%	15.00000*	3.16228	.002	5.2351	24.7649
	Ekstrak 30%	5.00000	3.16228	.530	-4.7649	14.7649
	Ekstrak 40%	.00000	3.16228	1.000	-9.7649	9.7649
	Kontrol (-)	25.00000*	3.16228	.000	15.2351	34.7649
Kontrol (-)	Ekstrak 20%	-10.00000*	3.16228	.044	-19.7649	-.2351
	Ekstrak 30%	-20.00000*	3.16228	.000	-29.7649	-10.2351
	Ekstrak 40%	-25.00000*	3.16228	.000	-34.7649	-15.2351
	Kontrol (+)	-25.00000*	3.16228	.000	-34.7649	-15.2351

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

2 jam

Tukey HSD[a]

Perlakuan	N	Subset for alpha = 0.05		
		1	2	3
Kontrol (-)	4	75.0000		
Ekstrak 20%	4		85.0000	
Ekstrak 30%	4			95.0000
Ekstrak 40%	4			100.0000
Kontrol (+)	4			100.0000
Sig.		1.000	1.000	.530

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 4.000.

Oneway

ANOVA

4 jam

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2870.000	4	717.500	25.324	.000
Within Groups	425.000	15	28.333		
Total	3295.000	19			

Post Hoc Tests

Multiple Comparisons

4 jam
Tukey HSD

(I) Perlakuan	(J) Perlakuan	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Ekstrak 20%	Ekstrak 30%	-5.00000	3.76386	.679	-16.6225	6.6225
	Ekstrak 40%	-12.50000*	3.76386	.032	-24.1225	-.8775
	Kontrol (+)	-12.50000*	3.76386	.032	-24.1225	-.8775
	Kontrol (-)	20.00000*	3.76386	.001	8.3775	31.6225
Ekstrak 30%	Ekstrak 20%	5.00000	3.76386	.679	-6.6225	16.6225
	Ekstrak 40%	-7.50000	3.76386	.315	-19.1225	4.1225
	Kontrol (+)	-7.50000	3.76386	.315	-19.1225	4.1225
	Kontrol (-)	25.00000*	3.76386	.000	13.3775	36.6225
Ekstrak 40%	Ekstrak 20%	12.50000*	3.76386	.032	.8775	24.1225
	Ekstrak 30%	7.50000	3.76386	.315	-4.1225	19.1225
	Kontrol (+)	.00000	3.76386	1.000	-11.6225	11.6225
	Kontrol (-)	32.50000*	3.76386	.000	20.8775	44.1225
Kontrol (+)	Ekstrak 20%	12.50000*	3.76386	.032	.8775	24.1225
	Ekstrak 30%	7.50000	3.76386	.315	-4.1225	19.1225
	Ekstrak 40%	.00000	3.76386	1.000	-11.6225	11.6225
	Kontrol (-)	32.50000*	3.76386	.000	20.8775	44.1225
Kontrol (-)	Ekstrak 20%	-20.00000*	3.76386	.001	-31.6225	-8.3775
	Ekstrak 30%	-25.00000*	3.76386	.000	-36.6225	-13.3775
	Ekstrak 40%	-32.50000*	3.76386	.000	-44.1225	-20.8775
	Kontrol (+)	-32.50000*	3.76386	.000	-44.1225	-20.8775

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

4 jam

Tukey HSD[a]

Perlakuan	N	Subset for alpha = 0.05		
		1	2	3
Kontrol (-)	4	67.5000		
Ekstrak 20%	4		87.5000	
Ekstrak 30%	4		92.5000	92.5000
Ekstrak 40%	4			100.0000
Kontrol (+)	4			100.0000
Sig.		1.000	.679	.315

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 4.000.

Oneway

ANOVA

6 jam

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4220.000	4	1055.000	33.316	.000
Within Groups	475.000	15	31.667		
Total	4695.000	19			

Post Hoc Tests

Multiple Comparisons

6 jam
Tukey HSD

(I) Perlakuan	(J) Perlakuan	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Ekstrak 20%	Ekstrak 30%	-10.00000	3.97911	.140	-22.2872	2.2872
	Ekstrak 40%	-17.50000*	3.97911	.004	-29.7872	-5.2128
	Kontrol (+)	-20.00000*	3.97911	.001	-32.2872	-7.7128
	Kontrol (-)	20.00000*	3.97911	.001	7.7128	32.2872
Ekstrak 30%	Ekstrak 20%	10.00000	3.97911	.140	-2.2872	22.2872
	Ekstrak 40%	-7.50000	3.97911	.366	-19.7872	4.7872
	Kontrol (+)	-10.00000	3.97911	.140	-22.2872	2.2872
	Kontrol (-)	30.00000*	3.97911	.000	17.7128	42.2872
Ekstrak 40%	Ekstrak 20%	17.50000*	3.97911	.004	5.2128	29.7872
	Ekstrak 30%	7.50000	3.97911	.366	-4.7872	19.7872
	Kontrol (+)	-2.50000	3.97911	.968	-14.7872	9.7872
	Kontrol (-)	37.50000*	3.97911	.000	25.2128	49.7872
Kontrol (+)	Ekstrak 20%	20.00000*	3.97911	.001	7.7128	32.2872
	Ekstrak 30%	10.00000	3.97911	.140	-2.2872	22.2872
	Ekstrak 40%	2.50000	3.97911	.968	-9.7872	14.7872
	Kontrol (-)	40.00000*	3.97911	.000	27.7128	52.2872
Kontrol (-)	Ekstrak 20%	-20.00000*	3.97911	.001	-32.2872	-7.7128
	Ekstrak 30%	-30.00000*	3.97911	.000	-42.2872	-17.7128
	Ekstrak 40%	-37.50000*	3.97911	.000	-49.7872	-25.2128
	Kontrol (+)	-40.00000*	3.97911	.000	-52.2872	-27.7128

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

6 jam

Tukey HSD[a]

Perlakuan	N	Subset for alpha = 0.05		
		1	2	3
Kontrol (-)	4	60.0000		
Ekstrak 20%	4		80.0000	
Ekstrak 30%	4		90.0000	90.0000
Ekstrak 40%	4			97.5000
Kontrol (+)	4			100.0000
Sig.		1.000	.140	.140

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 4.000.

Appendix 4: Regression Test

Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Konsentrasi, Waktu[a]	.	Enter

a. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.782[a]	.612	.598	4.92723

a. Predictors: (Constant), Konsentrasi, Waktu

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	76.201	2.541		29.989	.000
	Waktu	-1.135	.295	-.317	-3.844	.000
	Konsentrasi	.675	.078	.715	8.664	.000

Appendix 4: Correlation Test

Correlations

		waktu	Konsentrasi	Potensi
waktu	Pearson Correlation	1	.200	-.159
	Sig. (2-tailed)		.125	.225
	N	100	60	60
Konsentrasi	Pearson Correlation	.200	1	.715**
	Sig. (2-tailed)	.125		.000
	N	60	60	60
Potensi	Pearson Correlation	-.159	.715**	1
	Sig. (2-tailed)	.225	.000	
	N	60	60	60

**. Correlation is significant at the 0.01 level (2-tailed).

Picture 1: Tools used for experiment

Picture 2: 50 flies that been captured

Picture 3: Box used for flies

Picture 4: Preparing camphor extract concentration

:

Picture 5: Flies that land on the cup