

**THESIS**

**EFFECT OF GARLIC (*Allium sativum*) INFUSION ON  
TIME OF DEATH OF *Ascaridia galli***



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**ENDORSEMENT FORM**

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OF *Ascaridia galli***

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## DECLARATION

Hereby, I declare that in this thesis entitled :

### **EFFECT OF GARLIC (*Allium sativum*) INFUSION ON TIME OF DEATH OF *Ascaridia galli***

There is no work ever published to obtain a college degree in a certain college and to my knowledge there is also no work or opinion ever written or published by others, except those in writing referred to in this paper and mentioned in the references.

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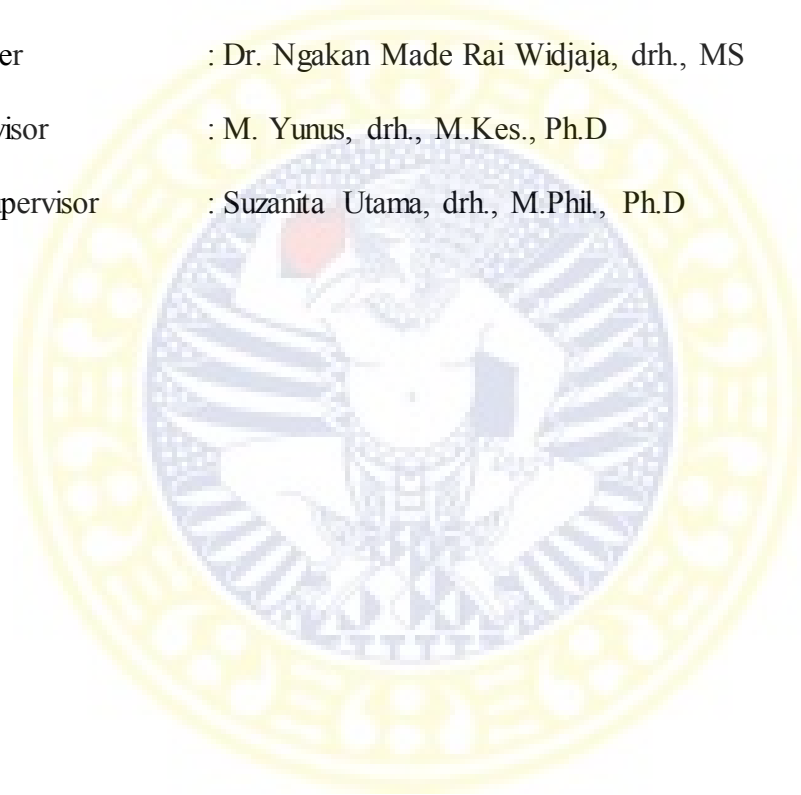
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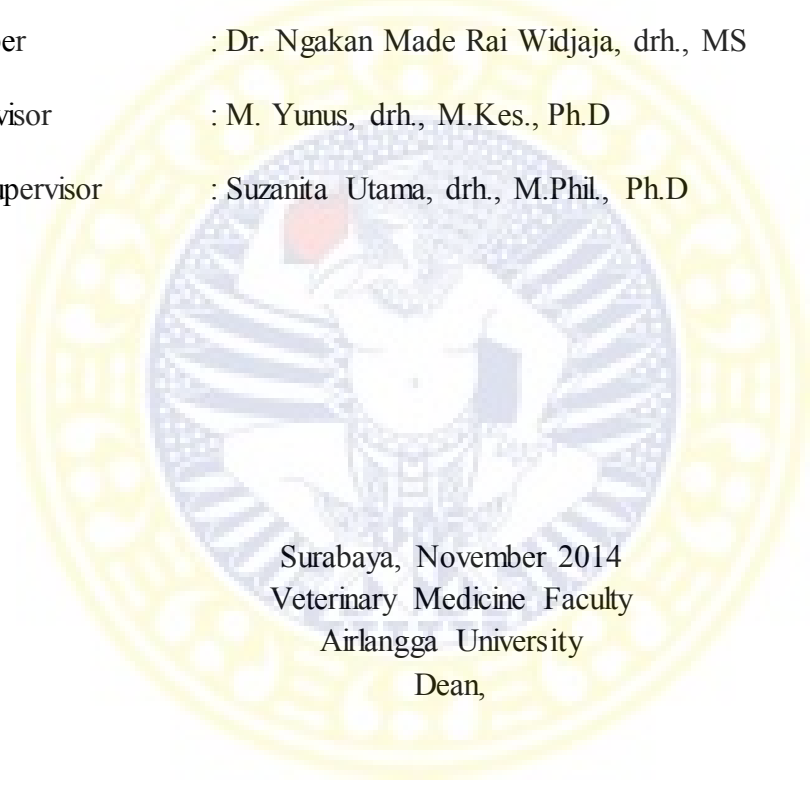
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## **EFFECT OF GARLIC (*Allium sativum*) INFUSION ON TIME OF DEATH OF *Ascaridia galli***

Ida Yuniarti

### **ABSTRACT**

Infectious disease is a major problem for animal husbandry. One of infectious disease is caused by *Ascaridia galli*. This worm attacks small intestine of poultry especially those one on the traditional farm type. Ascariidiasis occurs in either broiler or layer that caused decrease of meat and egg productions. Garlic (*Allium sativum*) contain *alicin* that have the ability to kill parasites. This research was conducted to determine the effect of garlic on time of death of *Ascaridia galli*. In this research used *Ascaridia galli* with length 7-11 cm regardless the sex. The treatment used local, kating and single garlic with concentration of 39.50%, 62.40% and 98.60%. The negative control used NaCl physiology (0.9 %). The result showed that all the treatment group can shortened the time of death of *Ascaridia galli* compared to control. The time of death of *A. galli* on local garlic infusion with 39.50 % concentration (P1) was 6.24 hours, on 62.40 % concentration (P2) was 4.94 hours and on 98.60 % concentration (P3) was 3.97 hours, kating garlic infusion on 39.50 % concentration (P4) was 5.08 hours on 62.40 % concentration (P5) was 3.81 hours, on 98.60 % concentration (P6) was 2.96 hours, single garlic infusion on 39.50 % concentration (P7) was 5.4 hours, on 62.40 % concentration (P8) was 3.86 hours, on 98.60 % concentration (P9) was 3.83 hours. The best treatment was kating garlic on 98.60% concentration (P6) because give shortest time of death.

**Keywords** : Garlic infusion, *Ascaridia galli*, *Allium sativum*, time of death

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Surabaya, 4<sup>th</sup> November 2014

Author



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## ABBREVIATIONS AND SYMBOLICS MEANING

ANOVA	: Analysis of Variance
<i>et al</i>	: <i>et alii</i>
°C	: Degrees Celcius
cm	: centimeter
ml	: mililiter
µm	: micrometer
±	: plusminus
%	: percentage



## CHAPTER 1 INTRODUCTION

### 1.1 Background

Infectious disease is a major problem for animal husbandry. One of infectious disease is caused by *Ascaridia galli*. This worm attacks small intestine of poultry especially those one on the traditional farm type. Ascariidiasis occurs in either broiler or layer that caused decrease of meat and egg productions, of course it make a farmer has financial loss (Subekti *et al.*, 2011).

*A. galli* usually causes a chronic illness with slowly or subclinical symptoms (Permin *et al.*, 1998). Heavy infection by *A. galli* has effect on losing their blood, losing level of blood sugar, hiperurisemia, thymus athropy, growth disorder and increase of mortality (Tabbu, 2002).

Study by Zalizar *et al.* (2007) on *A. galli* worm infection demonstrated lowering egg quality due to the decrease of egg weight (5.35%), thinner egg shell with the percentage decrease in egg shell thickness by 5.55% and a decrease in serum calcium level by 36.26%.

People in the rural areas, especially those work as farmers, preferred to traditional treatment because the modern medicine is relatively expensive (Satrija *et al.*, 2007). In Indonesia there are many traditional medicines used to treat intestinal worms, one of them is garlic (Wijayakusuma, 2002).

In Indonesia there are several garlic varieties are grown, including yellow Lumbu, green Lumbu and white Lumbu. Other varieties is a modification of the three varieties, for example, is a single garlic varieties (Syamsiah dan Tajudin, 2003). Indonesia has also been planting garlic from China that is Kating but its

development is longer and the results are comparatively low compared to local garlic. In the end, Indonesia had to import Kating garlic because its less suitable cultivated in Indonesia (Wibowo, 1998).

Garlic contain many chemical compounds, among others are essential oil 0.2% (primary component of aliin), allicin, ajoene, diallyl sulfide, allyl propyl sulfide, diallyl monosulfide, allyl polysulfide, allyl vinyl sulfide, and vinyl dithiines (Kemper, 2000).

Alliin works antagonizing acetylcholine thereby suppressing smooth muscle contraction caused paralysis in *Ascaris suum* (Amagase, 2010). Allicin disrupt the glycolytic pathway to form energy, so *A. galli* lack of energy and will eventually die (Zuliyannah, 2008).

The alcoholic extract of bulb of *A. sativum* has also shown moderate *in vitro* anthelmintic activity against human *Ascaris lumbricoides*. Oil of *A. sativum* has also been reported to possess anthelmintic activity and discards all parasites in the intestine (Londhe *et al.*, 2011).

Many research had been done about potential of garlic but how long the time of death of *A. galli* in garlic immersion has not been done. Based on the above background, the research entitled anthelmintic effect of garlic infusion on time of death of *A. galli* was conducted.

## 1.2 Theoretical Base

Allicin (thiopropen sulfinic acid allyl ester) is a compound that could be expected to lower blood cholesterol levels and thought to have the power to kill parasites. The content of saponin in garlic powder can cause the cells of worms



hydrolyzed. Diallyl propyl allyl sulfide and sulfide can act as anthelmintic and thrombolic (destroyer blood clots) (Reynold, 1982).

Garlic contains allicin which anthelmintic nutritious ingredients after investigated further comprises dialilsulfida, diallyl disulfide, diallyl trisulfida, propyl allyl disulfide, an enzyme sulfhidril that can penetrate eggs wall and worms. Sulfidril enzyme has a strong ability to bind to the enzyme phosphofructokinase of cells (eggs and worms). Phosphofructokinase enzyme function catalyze changes in fructose-6-phosphate to fructose-1,6-diphosphate on track glycolytic protein and glucose, because it binds to allicin causes changes in fructose-6-phosphate does not occur and ultimately ATP is not produced. No formation of ATP causes cell division in the egg will not take place so that in the end the embryo is not formed. No formation ATP causes shortages of energy and worms will eventually die (Bagus, 2003).

In general, all varieties of garlic have the same active ingredients but different percentages of each content (Wibowo, 1998).

### **1.3 Problem Statements**

1. Is there any effect of garlic infusion on time of death of *A. galli* ?
2. Is there any different time of death of *A. galli* on each types and concentration of garlic ?

### **1.4 Aims of Study**

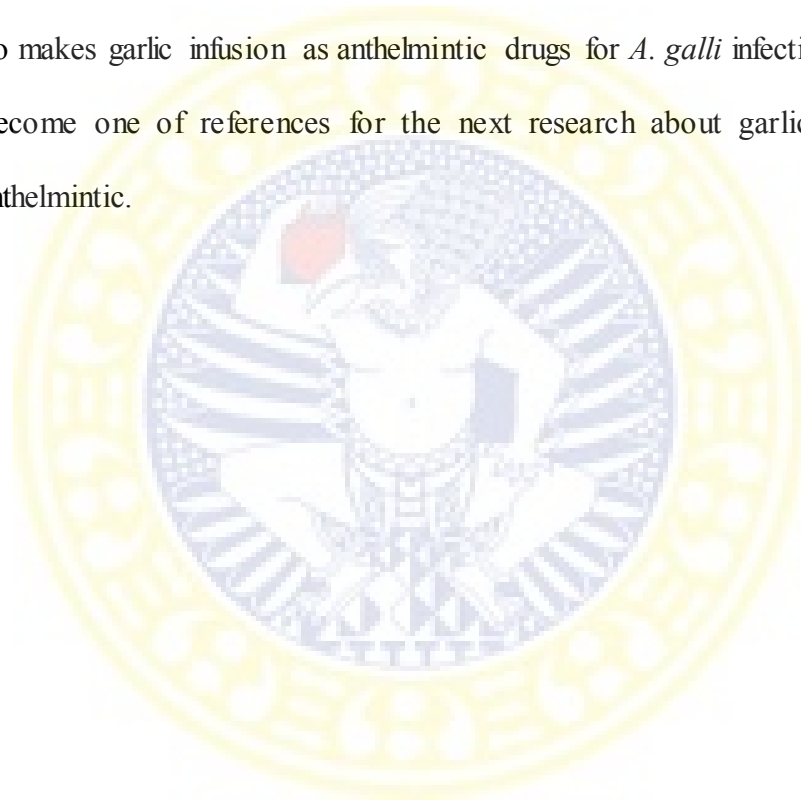
1. To prove the effect of garlic infusion on time of death of *A. galli*.
2. To prove the different time of death on each types and concentration of garlic.

### 1.5 Hypothesis

1. Garlic infusion can shortened the time of death of *A. galli*.
2. There was a different time of death of *A. galli* on garlic infusion each types and concentration.

### 1.6 Outcomes of Research

1. To makes garlic infusion as anthelmintic drugs for *A. galli* infection.
2. Become one of references for the next research about garlic infusion as anthelmintic.



## CHAPTER 2 LITERATURE REVIEW

### 2.1 Garlic

Garlic is probably one of the earliest known medicinal plants, which was used from ancient time to cure different disease conditions. Garlic's principal medicinal uses are to lower blood pressure and cholesterol, fight infections, and prevent cancer. In vitro and animal studies data suggest that garlic may help to prevent some solid tumors. The other proposed uses include the hepatoprotective, anthelmintics, anti-inflammatory, antioxidant, antifungal and wound healing (Londhe *et al.*, 2010).

#### 2.1.1 History of Garlic

Garlic is certainly worth considering. *Allium sativum*, best known for its edible aromatic bulb, is a member of the lily family along with onions, shallots, leeks and chives. This compound bulb composed of individual “cloves” has been favorite food and medicine for at least 4000 years and probably longer (Hulquis, 1996).

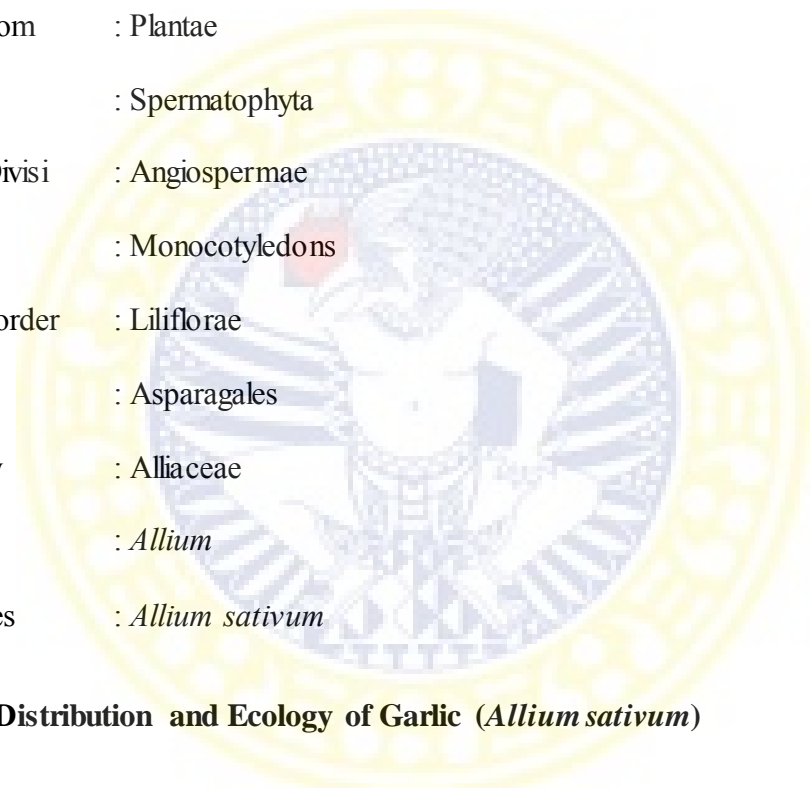
The name “*Allium sativum*” is derived from the Celtic word “all”, meaning burning or stinging, and the Latin “sativum” meaning planted or cultivated. The English word, garlic, is derived from the Anglo-Saxon “gar-leac” or spear plant, referring to its flowering stalk (Kemper, 2000).

In Traditional Chinese Medicine, garlic is known as *da suan*. It is considered a warm, bitter herb with particular effects on the Large Intestine, Spleen and Stomach meridians. It is used to lower blood pressure, to treat

parasitic infections, food poisoning and tumors, and as a mild anticoagulant (Kemper, 2000).

### 2.1.2 Classification of Garlic (*Allium sativum*)

According to Corey (2010) classification of *Allium sativum* taxonomy systematically as :



Kingdom	: Plantae
Divisi	: Spermatophyta
Sub Divisi	: Angiospermae
Class	: Monocotyledons
Superorder	: Liliiflorae
Order	: Asparagales
Family	: Alliaceae
Genus	: <i>Allium</i>
Species	: <i>Allium sativum</i>

### 2.1.3 Distribution and Ecology of Garlic (*Allium sativum*)

Garlic is believed to originate from Central Asia (Kazakhstan, Uzbekistan and western China). This was confirmed by phylogenetic analysis based on molecular and biochemical markers, also indicating a secondary diversity center in the Caucasus. Garlic spread to the Mediterranean in ancient times. It was already grown in Egypt in 1600 BC and is an ancient crop in India and China as well. At present garlic is grown all over the world from the equator to latitudes of

50° in both hemisphere, but is most popular in China, the Mediterranean and Latin America (Messiaen and Rouamba, 2004).

In the tropics garlic growing is possible in the highlands and is restricted in the lowlands to the cool season. Garlic prefers a light loamy soil. It strongly dislikes soil acidity and requires a soil pH of 6-7 or somewhat higher. It is sensitive to aluminium toxicity (Messiaen and Rouamba, 2004).

#### **2.1.4 Parts of Function**

The used part of this plant for medicine is the bulb. Sliced garlic can eradicate worms, parasites and tonic to the system general (Londhe *et al.*, 2011). *Alicin* as anthelmintic against *A. galli* (Zuliyannah, 2008) is found in this part of garlic too.

#### **2.1.5 Chemical Compounds of Garlic (*Allium sativum*)**

Garlic contains at least 33 sulfur compounds, several enzymes, 17 amino acids, and minerals such as selenium. It contains a higher concentration of sulfur compounds than any other *Allium* species. The sulfur compounds are responsible both for garlic's pungent odor and many of its medicinal effects. Dried, powdered garlic contains approximately 1% *alliin* (S-allyl cysteine sulfoxide). One of the most biologically active compounds, *allicin* (diallyl thiosulfinate or diallyl disulfide) does not exist in garlic until it is crushed or cut; injury to the garlic bulb activates the enzyme allinase, which metabolizes alliin to allicin. Allicin is further metabolized to vinyldithiines. This breakdown occurs within hours at room temperature and within minutes during cooking. Allicin, which was first

chemically isolated in the 1940's, has antimicrobial effects against many viruses, bacteria, fungi and parasites (Londhe *et al.*, 2011).

### 2.1.6 Types of Garlic

There are many types of garlic around the world. In Indonesia there are three types of garlic that commonly use, they are local garlic, kating garlic and single garlic (Wibowo, 1998).

#### 2.1.6.1 Local Garlic

Garlic is a bulbous perennial herb closely related to the onion. It has a tall, erect flowering stem that reaches 2-3 feet in height. The plant has pink or purple flowers. The shape of the compound bulb and bulb structure type are seen on Figure 2.1.



Figure 2.1 Bulb Structure of Local Garlic ( Stavelikova, 2008)

#### 2.1.6.2 Single Garlic

Single garlic or known as “Bawang Lanang” in Javanese was first discovered in Magetan, East Java. Single garlic is garlic varieties that can occur

due to environmental influences that do not match the growth of garlic so that the plants only form one bud alone. These buds grow and become dominant and pressed another clove buds to form a whole bulb of garlic, it can be seen on Figure 2.2. Single garlic usually used as traditional medicine for lowering cholesterol level on blood, anthelmintic and haemorhoid (Nadzifa, 2010).



Figure 2.2 Bulb of Single Garlic (Nadzifa, 2010)

### 2.1.6.3 Kating Garlic

Kating Garlic is originally from China. Kating not grow well in Indonesia, but will grow well if planted in an area with a subtropic climate (Wibowo, 1998). Most heads will be quite large, consists of a single layer bulb composed radically. While some will be mild, some will have much stronger and richer flavors. (Wenger, 2009).

## 2.2 Infusion

Indonesia pharmacope standards for traditional medicine is infusion. Infusion is liquid preparation made from vegetable simplicia mix with water at

90° C for 15 minutes (Suranto, 2004). While it is warm, the solution is filtered with a flannel cloth until the required volume is fulfilled (Lazuardi, 2007).

### **2.3 *Ascaridia galli***

*A. galli* has been incriminated as the most common and most important parasite of poultry (Luka and Ndams, 2007). *A. galli* is a common parasite of poultry and has been reported in chicken, turkey, guinea fowl, pigeons, duck, and goose (Kombe *et al.*, 2012).

#### **2.3.1 Ascaridiasis**

Ascaridiasis is a disease caused by genus *Ascaridia*. Ascaridiasis that usually attacks the poultry such as, *A. galli* attacks small intestine of chicken, turkey, goose, jungle fowl and wild bird, *Ascaridia columbae* attacks pigeon, *Ascaridia dissimilis* attacks turkey, *Ascaridia compar* attacks lovely bird, *Ascaridia numidae* attacks jungle fowl, *Ascaridia razia* attacks domestic pigeon (Subekti *et al.*, 2011).

Ascaridiasis is a challenge to poultry breeders, since with other conditions/ diseases, causes reduced egg production, reduced growth rate in broilers and subsequent economic losses to the poultry industry (Kombe *et al.*, 2012).

A chick infected by *A. galli* is more sensitive than a chicken, because less intestinal mucus in a chick. *Ascaridia galli* infection attacks chicken at all ages especially at 1-3 month ages (Subekti *et al.*, 2011).



### 2.3.2 Classification of *Ascaridia galli*

According to Soulsby (1986) classification of *A. galli* taxonomy systematically as :

Kingdom	: Animalia
Sub Kingdom	: Eumetazoa
Phylum	: Nematelminthes
Class	: Nematoda
Subclass	: Secenentea
Order	: Ascaridida
Superfamily	: Ascaridoidea
Family	: Ascaridae
Genus	: <i>Ascaridia</i>
Species	: <i>Ascaridia galli</i>

### 2.3.3 Habitat and Morphology

*A. galli* is the worm that mostly attacks chickens and caused economic losses for poultry breeders. This worm in the small intestine of poultry, such as turkeys, goose, guinea fowl, wild birds, and especially chicken. *A. galli*'s mouth is completed with three lips, one dorsal and two lateroventral. The male worm length are 50-76 mm, meanwhile the females are 72-116 mm. Posterior male worm has a clear alae, and 10 pairs of papil and prekloakal sucker, two long slender spicules equal in length, vulva located slightly anterior to the middle of the body. Eggs are oval, flat-walled, not yet developed when come out with feces, measuring 73-93  $\mu\text{m}$  x 45-57  $\mu\text{m}$  (Subekti *et al.*, 2011).

### 2.3.4 Life Cycle of *Ascaridia galli*

Egg of *A. galli* comes out with host feces and developed outdoor into infective stage in 10 days or more. The egg then contains a fully developed second stage larvae and is fairly resistant to adverse conditions (Subekti *et al.*, 2011). At the second stage, larvae can survive more than 3 months in the shaded place, but it will die if the weather is dry and hot even when the larvae are located about 15 cm deep under the soil surface (Soulsby, 1986).

*A. galli* infection may occur through the consumption of infective eggs with feed or drink. Chickens can also be infected by earthworms that swallow the egg of *A. galli* and than the chickens eat earthworms (automatically the earthworms is transmitted in chickens). Eggs are consumed by the host will hatch into larvae stage III in the small intestine on day 8 after infection, then the larvae lives in the small intestine freely. On day 9-10 stage III larvae penetrates the intestinal mucosa then develops into larval stage IV on days 14-15 after infection. Day 17-18 young worms will come out from the small intestine mucosa into the lumen of the small intestine and become adults in 6-8 weeks. On day  $\pm 100$  *A. galli* eggs is found in the feces of the host (Subekti *et al.*, 2011).

### 2.3.5 Pathogenesis and Clinical Signs of *Ascaridia galli* Infection

The eggs consumed by host will hatch and develop into stage III. Subsequently the larvae penetrate the mucosa of the intestine. Young chicken are more sensitive than the older chicken, because older chicken have more intestine mucous than young chicken, and in this mucous will be formed parasite

antibodies. With an increased number of mucus in the intestine of older chickens, it will be a factor inhibiting the development of the *A. galli* larvae (Subekti *et al.*, 2011).

Development of stage III become stage IV happened in intestine mucose, then stage IV will be young worm and out from mucose to lumen developing into adult worm (Subekti *et al.*, 2011). The most serious infections occur in chickens one to three months of age. Marked lesions may be produced when large number of the young parasites penetrate into the duodenal mucosa. They cause haemorrhage and enteritis and the birds become anaemic and suffer from diarrhea. The birds become unthrifty, markedly emaciated, generally weak and egg production is decreased. In heavy infections intestinal obstruction may occur (Soulsby, 1986).

*A. galli* heavy infection has effect on blood loss, decreasing of blood sugar level, hiperurisemia, thymus atrophy, growth disorder and increase of mortality (Tabbu, 2002). The mortality rate that caused can reach 35% (Subekti *et al.*, 2011).

In productive layer chicken may decrease or stop egg production. In broiler chicken can cause growth disorder and weight loss (Subekti *et al.*, 2011).

### **2.3.6 Resistance of Chicken to *Ascaridia galli* Infection**

Resistance to *A. galli* infections is different among individuals depending on age, gender, genetics, and nutritional condition of livestock (Subekti *et al.*, 2011).

Chickens over three months of age are more resistant to infection. This may be associated with a marked increase in goblet cells in the gut mucosa about this age (Soulsby, 1986).

Hens also more resistant to *A. galli* compared to the rooster. Female sex hormone (estrogen) stimulates the formation of connective tissue in the intestinal wall that can act as a barrier against nematode infection, in addition, estrogen also stimulates RES that responsible for the formation of antibodies that protect against parasitic infections (Subekti *et al.*, 2011).

Dietary deficiencies, such as vitamins A, B and B12, various minerals and proteins, predispose to heavier infection (Soulsby, 1978). Deficiency of vitamin A in feed can decrease intestine mucous, so the development of worm's larvae is uninhibited. Vitamin B12 cause peristaltic of intestine developed well, if feed ration has low vitamin B12 peristaltic of intestine will be disturbed and eliminated of worm from intestine will be decrease (Subekti *et al.*, 2011).

Feed with a low protein content, vitamins and minerals in poultry rations, will significantly impair the immune system of chicken and intensify *A. galli* infection (Subekti *et al.*, 2011).

### **2.3.7 Prevention of *Ascaridia galli* Infection**

Treatment and prevention of *A. galli* infection in the pullet usually given around the age of 5 weeks, then repeated at 4 week intervals until chicken reaches the age of 21 weeks. In the cage with litter system, the frequency of anthelmintic drug usually between 3-5 times in the area of high risk of *A. galli* infection. The

infections repetition usually occurs when chickens ingest embryonated eggs (Tabbu, 2002).

Prevention of infection with *A. galli* can also be done by nursing young chicken and adult one separately, keeping the cages litter as well as cages equipment (food and drink equipment) clean, the floor of the cage should not made of the soil, periodical treatment once a month and give the good feed (contain vitamin A, B 12, enough mineral and protein) (Subekti *et al.*, 2011).

Treatment can use adipate Piperazin 300-400 mg / kg of feed, Piperazin citrate 400 mg / liter of water for 24 hours. Mechanism of action of piperazine is a pathway blockade on neuro-muscular acetylcholin junction, that causes paralysis of worms and worm comes out with feces. Effectiveness of piperazine on ascaridiasis is almost 100%. It also can used Phenotiazin 2200 mg / kg of feed, hygromycin B 8 grams / ton of feed administered for 8 weeks effectively to control the infection *A. galli* and Mebendazol, Tetramizol and Haloxon (Subekti *et al.*, 2011).

#### **2.4 Time of Death**

Time of death is time that used to calculate how much time it takes worms to die calculated from the treatment given (Zuliyannah, 2008).

## CHAPTER 3 MATERIALS AND METHODS

### 3.1 Research Location and Date

The research has been done in Veterinary Parasitology Department, Faculty of Veterinary Medicine, Universitas Airlangga Surabaya from April 29<sup>th</sup> until May 30<sup>th</sup> 2014.

### 3.2 Materials of Research

#### 3.2.1 Research Sampel

This research used *A. galli* with the length of 7-11 cm from small intestine of kampong chicken that purchased in poultry slaughtering house of Wonokromo traditional market.

#### 3.2.2 Research Substance

The materials that used were three types of garlic (local garlic, kating garlic and single garlic) infusion and 0.9 % NaCl.

#### 3.2.3 Research Equipments

The equipments used were blender, glass petridish, scissors, pipette 10 ml, beaker glasses 500 ml, ruler 30 cm, measuring glass 100 ml, scales 1000 g, laboratory thermometer, Incubator, flanel cloth, bowl, stirring tool glass, gas stove and dissecting microscope.

### 3.3 Research Methods

#### 3.3.1 Preparation of *Ascaridia galli*

*A. galli* was collected from small intestine of infected chicken. Worms which selected were the ones with the length of 7-11 cm regardless the sex. Worms were placed in a petridish containing NaCl 0.9 % so the worm can survive

before the treatment. The worm (*Ascaridia galli*) can survive in a petridish containing NaCl 0.9% maximum for 25 – 34 hours (Putri, 2007).

### 3.3.2 Sample Size of *Ascaridia galli*

The research design using completely randomized design (Kusriningrum, 2009). This research conducted in ten treatments. The calculation as follows :

$$t(n-1) \geq 15$$

$$10n - 10 \geq 15$$

$$10n \geq 25$$

$$n \geq 2.5$$

Annotation : t = the number of treatment that used in the research

n = minimum sample that used in each treatment.

The number of repetition in each treatment was five. In this research to obtain optimal results, used 10 samples in each petridish.

### 3.3.3 Concentration Range Determination Garlic (*Allium sativum*) Infusion

Preliminary research was earlier to determine the concentration range of garlic (*Allium sativum*) infusion for originally research. To obtain good distribution data, determined by doses distribution factor of garlic (*Allium sativum*) which gives a response mortality levels of 0 % to 100%. According to Thomson (1985), dose distribution factor calculated by the following formula :

$$F = \sqrt[t]{I}$$

Which was :

F = distribution factor

r = N ( dose rank that used) – 1

$$I = \frac{\text{The highest concentration that causes 100 \% death}}{\text{The lowest concentration that causes 0 \% death}}$$

Distribution factor value used to determine concentration interval in originally research.

### **3.3.4 Determination of The Characteristics of a Dead Worms**

Worm was considered dead if there was no movement in immersion of garlic infusion, the worms was pale and enervate (Zahroh, 2006)

### **3.3.5 Preparation of Garlic (*Allium sativum*) Infusion**

Garlic was peeled then sliced. The slices were put into a blender and finely ground. Ground garlic was used for infusion. Concentration of garlic (*Allium sativum*) infusion used were 39.5 %, %, 62.41 %, 98.6% for each types of garlic. To prepare garlic infusion, 39.5 grams, 62.4 grams and 98.6 grams of each garlic (local garlic, kating garlic and single garlic) were put individually in 9 beaker glasses. Garlic was put in each beaker glass which is contains of 100 ml of 0.9 % NaCl. The beaker glass were put in a water bath (90°C) for 15 minutes and stirred constantly. While it is warm, the solution is filtered with a flannel cloth until a recoverable volumes of 100 ml.



### 3.3.6 Research Procedures

In this researches the volume of infusion for each treatment in a petridish was 10 ml. Each petridish contains 10 *A. galli*. Repetition was performed on each treatment as much as five times.

This study comprised of ten treatments :

- Treatment I (P0) : Immersion the worms in NaCl 0.9%
- Treatment II (P1) : Immersion of the worms in 39.50% local garlic infusion
- Treatment III (P2) : Immersion of the worms in 62.40% local garlic infusion
- Treatment IV (P3) : Immersion of the worms in 98.60% local garlic infusion
- Treatment V (P4) : Immersion of the worms in 39.50% kating garlic infusion
- Treatment VI (P5) : Immersion of the worms in 62.40% kating garlic infusion
- Treatment VII (P6) : Immersion of the worms in 98.60% kating garlic infusion
- Treatment VIII (P7) : Immersion of the worms in 39.50% single garlic infusion
- Treatment IX (P8) : Immersion of the worms in 62.40% single garlic infusion
- Treatment X (P9) : Immersion of the worms in 98.60% single garlic infusion

Incubation of each treatment was 37° C of temperature with an incubator. Observations made to record the dead worms. Observations were done in every hours until 12 hours.

### **3.4 Research Variables**

Variables used in this research were: independent variable, dependent variable, and controlled variables.

#### **3.4.1 Independent Variable :**

Three types of garlic infusion (local garlic, kating garlic and single garlic).

#### **3.4.2 Dependent Variable :**

Time of death.

#### **3.4.3 Controlled Variables :**

Experimental temperature and length of *Ascaridia galli*.

#### **3.4.4 Operational Definition of Variables**

- a. Garlic infusion was liquid preparation made from garlic simplicia mix with 0.9% NaCl at 90° C for 15 minutes.
- b. Experimental temperature was the temperature used in the research study and adjusted for body temperature of chicken (37°C).
- c. *Ascaridia galli* that used was collected from small intestine of infected chicken with length of 7-11 cm regardless the sex.
- d. Time of death was the time that required until the half of *Ascaridia galli* dead that observe from given drug exposure until the worms death with indication no movement when we touched or manipulated.

### 3.5 Experimental Design and Data Analysis

The experiment use completely randomized design with ten treatments and five repetitions for each treatment. The data were analyzed by Probit to determine time of death of *A. galli* and the best treatment. Statistical analyze used the Statistical Program Service and Solution (SPSS) for windows 21.



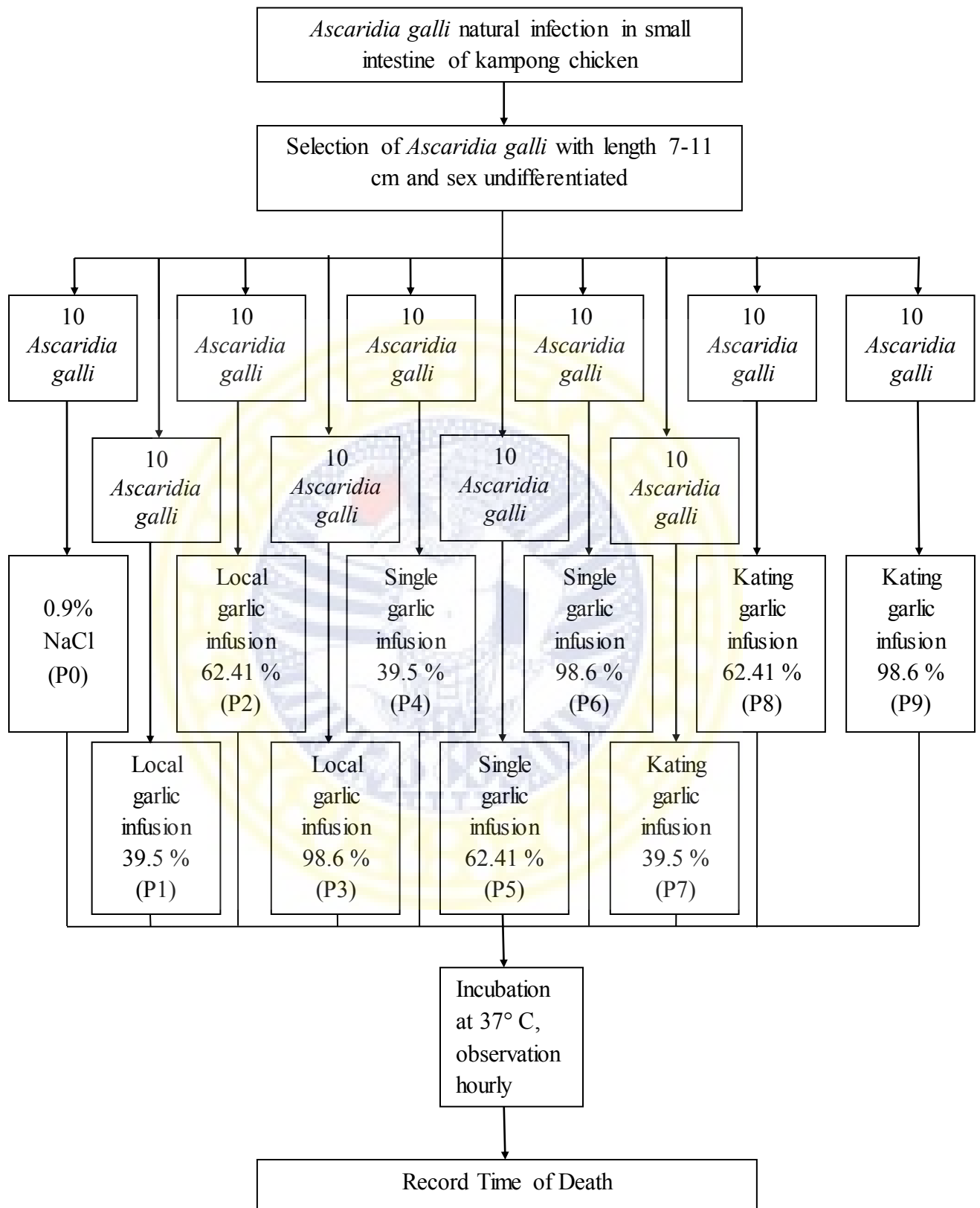


Figure 3.1. Research Flowchart

## CHAPTER 4 RESEARCH RESULTS

This research was conducted in two phases, preliminary research and originally research. Preliminary research was to determine the garlic (*Allium sativum*) infusion range concentration. In preliminary research used local garlic and the concentration were 25 %, 50 %, 75 %, and 100 %. The best result was concentration 100 % because it was kill all of the worms. The maximum observation time in preliminary research was 12 hours. Table 4.1 was demonstrated the death percentage of the worms in preliminary research.

Table 4.1 Death Percentage of *Ascaridia galli* on Garlic (*Allium sativum*) Infusion in Preliminary Research.

Concentration	Quantity	Life	Death	Death Percentage (%)
25%	10	10	0	0%
50%	10	0	4	40%
75%	10	0	6	60%
100%	10	0	10	100%

Based preliminary result, it could be determine the concentration in originally research. The result about determination range concentration were given on Appendix 1. Originally research result were demonstrated in Table 4.2, it was the time of death of *A. galli* on each treatment

Table 4.2 Time of Death of *Ascaridia galli* on Local, Kating and Single Garlic With Different Concentration

<b>Treatment</b>	<b>Time of Death (Hour)</b>
0.9 % NaCl (P0)	29.64
<b>Local Garlic</b>	
39.50% (P1)	6.24
62.41% (P2)	4.94
98.60% (P3)	3.97
<b>Kating Garlic</b>	
39.50% (P4)	5.08
62.41% (P5)	3.81
98.60% (P6)	2.96
<b>Single Garlic</b>	
39.50% (P7)	5.4
62.41% (P8)	3.86
98.60% (P9)	3.83

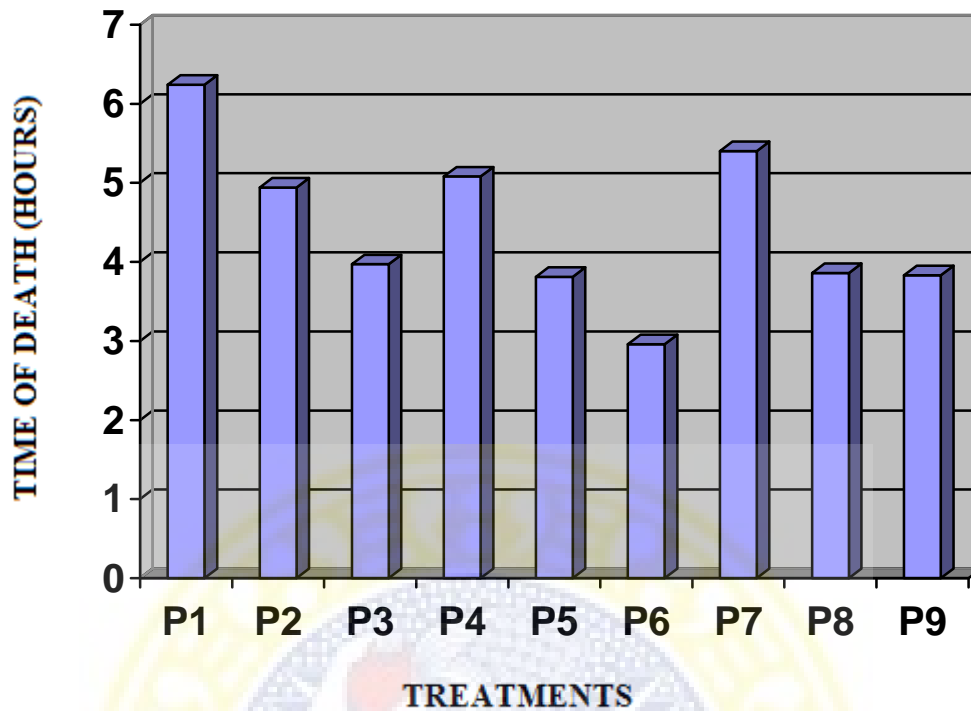


Figure 4.1 The Differences of Time of Death on Each Treatment ; P1: 39.5% Local Garlic, P2 : 62.41% Local Garlic, P3 : 98.6% Local Garlic, P4 : 39.5% Kating Garlic, P5 : 62.41% Kating Garlic, P6 : 98.6% Kating Garlic, P7: 39.5% Single Garlic, P8 : 62.41% Single Garlic, P9 : 98.6% Single Garlic

Figure 4.1 showed the difference effect of garlic infusion in each concentration on time of death of *A. galli*. The time of death of *A. galli* on local garlic infusion with 39.50 % concentration (P1) was 6.24 hours, on 62.40 % concentration (P2) was 4.94 hours and on 98.60 % concentration (P3) was 3.97 hours, kating garlic infusion on 39.50 % concentration (P4) was 5.08 hours on 62.40 % concentration (P5) was 3.81 hours, on 98.60 % concentration (P6) was 2.96 hours, single garlic infusion on 39.50 % concentration (P7) was 5.4 hours, on 62.40 % concentration (P8) was 3.86 hours, on 98.60 % concentration (P9) was 3.83 hours.

Kating garlic infusion with concentration 98.60 % (P6) was the best treatment because their time of death was shorter than the other concentration. It means that the worm in this concentration was dead earlier than the other concentration.





## CHAPTER 5 DISCUSSION

The research for determine the effect of garlic infusion on the time of death of *A. galli* in vitro was conducted with preliminary research, so garlic infusion has anthelmintic potentiality on *A. galli*. The concentration of garlic infusion on preliminary research were 25 %, 50 %, 75 % and 100 %. As a negative control used 0.9 % NaCl with purpose to ensure the freshness of the worms.

Preliminary result demonstrated in 12 hours, local garlic infusion with concentration of 25 %, 50 %, 75 % and 100 % have capability to kill *A. galli*. Concentration 25 % during 10 hours the death percentage was 0%, concentration 50 % was 30 %, on 75 % concentration was 50 % and on 100 % concentration was 100 %. The best concentration in preliminary research was 100 % concentration, it was kill all of the worms in 12 hours. According to research Dyah (2007) the maximum time that used in originally research obtained from the maximum time in preliminary research. The originally research was divides the worms in ten group, local garlic infusion with 39.50 % (P1), 62.40 % (P2) and 98.60 % (P3) concentration; kating garlic infusion with 39.50 % (P4), 62.40 % (P5) and 98.60 % (P6) concentration; single garlic infusion with 39.50 % (P7), 62.40 % (P8), 98.60 % (P9) concentration; and the negative control in 0.9 % NaCl (P0). The difference result between preliminary and originally research because the contain of garlic was not measured accurately.

The time of death of *A. galli* on 0.9 % NaCl was 15.26 hours, longer than other treatment because 0.9% NaCl was a isotonic liquid that not contain any

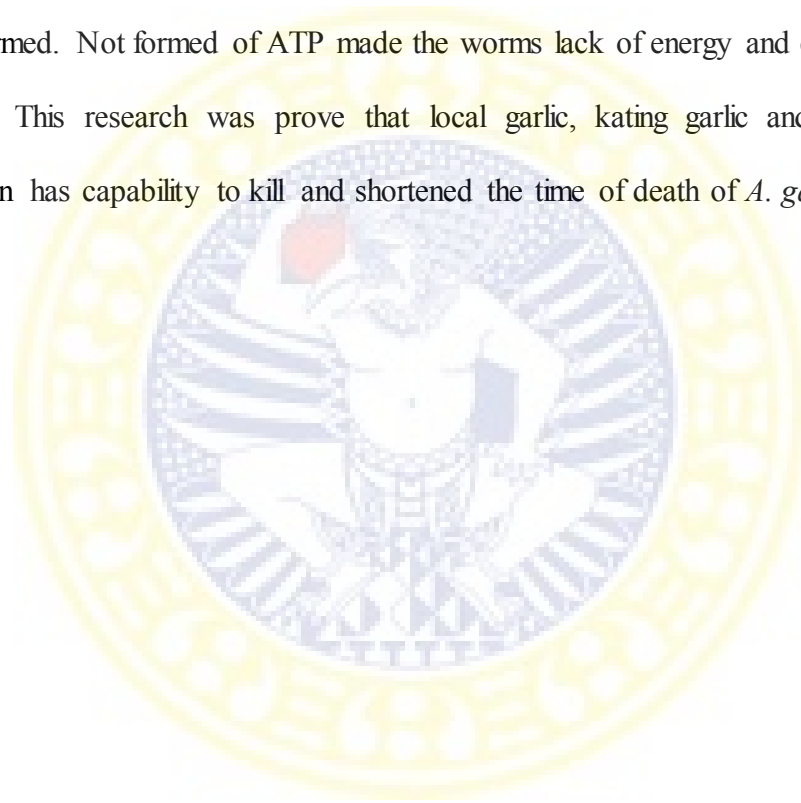
chemical compound that has the capability to kill *A. galli*. P1 until P9 can shortened the time of death of *A. galli* but there were different time of death on each treatment. It caused by active ingredients that contain in each varieties of garlic was similar but has different percentages of each content (Wibowo, 1998). The time of death of local garlic infusion on 39.50 % concentration (P1) was 6.24 hours, on 62.40 % concentration (P2) was 4.94 hours and on 98.60 % concentration (P3) was 3.97 hours, kating garlic infusion on 39.50 % concentration (P4) was 5.08 hours on 62.40 % concentration (P5) was 3.81 hours, on 98.60 % concentration (P6) was 2.96 hours, single garlic infusion on 39.50 % concentration (P7) was 5.4 hours, on 62.40 % concentration (P8) was 3.86 hours, on 98.60 % concentration (P9) was 3.83 hours. The best treatment was kating garlic on 98.60% concentration (P6) because give the shortest time of death than the other concentration.

The immersion of *A. galli* in NaCl 0.9% until 12 hour did not make all of the worm dead because NaCl 0.9% contain substances needed for *A. galli* therefore the worm can be survive more than the observation time (Zahroh, 2006).

The shortened time of death of *A. galli* was caused by allicin that works antagonizely acetylcholine thereby suppressing smooth muscle contraction caused paralysis in worms and also allicin disrupt the glycolytic pathway to form energy, so the worm will lack of energy that ends with death (Amagase, 2010). The signs of the dead worms such as, there was no movement when in immersion of garlic infusion, the worms was enervate and the colour of worms more pale (Zuliyannah, 2008)

Analytical statistic determine this research were appropriate with the other previous research. Zuliyannah (2008) done the research about garlic filtrate has anthelmintic effect on *A. galli* in vitro. The shortened time of death of *A. galli* was caused by allicin that penetrate to the cuticle of worm and covalently bonded with the phosphofructokinase enzyme in the cell of worm. This bond inhibited the changes of fructose-6-phosphate became fructose-1,6-phosphate so the ATP will not formed. Not formed of ATP made the worms lack of energy and cause dead.

This research was prove that local garlic, kating garlic and single garlic infusion has capability to kill and shortened the time of death of *A. galli*.



## CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Conclusions

Based on the research result has done in *A. galli*, be concluded that local garlic, kating garlic and single garlic infusion with concentration of 39.5%, 62.41% and 98.6% has capability to shortened time of death of *A. galli*.

### 6.2 Recommendations

1. Need some continuation researches about effect of garlic infusion for *A. galli* treatment.
2. Need some continuation researches about the dosage, side effect, toxicity from garlic infusion to increase drugs efficiency.
3. Need some continuation researches about amount of *allicin* in each types of garlic.

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## Appendix 1 : Determination of Range Concentration

Preliminary Result :

Concentration	Quantity	Life	Death	Death Percentage (%)
25%	10	10	0	0%
50%	10	0	4	40%
75%	10	0	6	60%
100%	10	0	10	100%

According to Thomson (1985), dose distribution factor can be calculated by the following formula :

$$F = r\sqrt{I}$$

Which was :

F = distribution factor

$$r = N (\text{dose rank that used}) - 1$$

The highest concentration that causes 100 % death

$$I = \frac{\text{The highest concentration that causes 100 \% death}}{\text{The lowest concentration that causes 0 \% death}}$$

The lowest concentration that causes 0 % death

$$F = 4^{-1} \sqrt{100\% / 25\%} = 3\sqrt{4} = 1.58$$

$$I : 25 \% \times 1.58 = 39.5 \quad \text{---} > P1$$

$$II : 39.5\% \times 1.58 = 62.41 \quad \text{---} > P2$$

$$III : 62.41 \times 1.58 = 98.6 \quad \text{---} > P3$$



Appendix 2 : The Range Time of Death *Ascaridia galli* in Three Types of Garlic (*Allium sativum*) on Probit Analyzed.

		Confidence Limits						
	Treatment Probability	95% Confidence Limits for Time			95% Confidence Limits for log(Time) <sup>b</sup>			
		Estimate	Lower Bound	Upper Bound	Estimate	Lower Bound	Upper Bound	
PROBIT <sup>a</sup>	Local Garlic 39.	.010	.574	.417	.756	-.241	-.380	-.122
		.020	.759	.564	.982	-.120	-.249	-.008
		.030	.906	.683	1.160	-.043	-.165	.064
		.040	1.036	.789	1.315	.015	-.103	.119
		.050	1.155	.887	1.457	.062	-.052	.163
		.060	1.266	.979	1.590	.103	-.009	.201
		.070	1.373	1.068	1.717	.138	.028	.235
		.080	1.477	1.154	1.840	.169	.062	.265
		.090	1.577	1.238	1.959	.198	.093	.292
		.100	1.676	1.321	2.076	.224	.121	.317
		.150	2.155	1.724	2.643	.334	.237	.422
		.200	2.632	2.127	3.206	.420	.328	.506
		.250	3.125	2.545	3.789	.495	.406	.579
		.300	3.645	2.986	4.408	.562	.475	.644
		.350	4.204	3.459	5.075	.624	.539	.705
		.400	4.814	3.974	5.807	.682	.599	.764
		.450	5.488	4.540	6.622	.739	.657	.821
		.500	6.243	5.172	7.541	.795	.714	.877
		.550	7.102	5.887	8.596	.851	.770	.934
		.600	8.096	6.709	9.827	.908	.827	.992
.650	9.270	7.672	11.295	.967	.885	1.053		
.700	10.692	8.829	13.092	1.029	.946	1.117		
.750	12.472	10.264	15.370	1.096	1.011	1.187		
.800	14.805	12.123	18.396	1.170	1.084	1.265		
.850	18.080	14.699	22.717	1.257	1.167	1.356		
.900	23.251	18.696	29.677	1.366	1.272	1.472		
.910	24.707	19.809	31.665	1.393	1.297	1.501		

.920	26.392	21.091	33.979	1.421	1.324	1.531
.930	28.378	22.593	36.724	1.453	1.354	1.565
.940	30.774	24.395	40.059	1.488	1.387	1.603
.950	33.754	26.620	44.241	1.528	1.425	1.646
.960	37.625	29.489	49.728	1.575	1.470	1.697
.970	42.999	33.433	57.432	1.633	1.524	1.759
.980	51.348	39.485	69.584	1.711	1.596	1.843
.990	67.919	51.275	94.255	1.832	1.710	1.974
.010	.454	.325	.604	-.343	-.488	-.219
.020	.601	.441	.785	-.221	-.356	-.105
.030	.717	.534	.926	-.144	-.272	-.033
.040	.820	.617	1.050	-.086	-.210	.021
.050	.914	.694	1.163	-.039	-.159	.066
.060	1.002	.766	1.269	.001	-.116	.104
.070	1.087	.836	1.370	.036	-.078	.137
.080	1.169	.904	1.468	.068	-.044	.167
.090	1.249	.970	1.562	.096	-.013	.194
.100	1.327	1.035	1.655	.123	.015	.219
.150	1.706	1.353	2.104	.232	.131	.323
.200	2.084	1.671	2.550	.319	.223	.407
.250	2.474	2.001	3.010	.393	.301	.479
Local Garlic 62. .300	2.885	2.351	3.498	.460	.371	.544
.350	3.328	2.726	4.023	.522	.436	.605
.400	3.811	3.135	4.599	.581	.496	.663
.450	4.344	3.585	5.238	.638	.555	.719
.500	4.942	4.089	5.960	.694	.612	.775
.550	5.622	4.659	6.786	.750	.668	.832
.600	6.409	5.314	7.750	.807	.725	.889
.650	7.338	6.084	8.898	.866	.784	.949
.700	8.463	7.009	10.303	.928	.846	1.013
.750	9.872	8.156	12.083	.994	.911	1.082
.800	11.719	9.645	14.446	1.069	.984	1.160
.850	14.312	11.707	17.818	1.156	1.068	1.251
.900	18.405	14.910	23.248	1.265	1.173	1.366
.910	19.558	15.802	24.799	1.291	1.199	1.394

	.920	20.892	16.829	26.604	1.320	1.226	1.425
	.930	22.464	18.033	28.745	1.351	1.256	1.459
	.940	24.360	19.477	31.345	1.387	1.290	1.496
	.950	26.719	21.261	34.607	1.427	1.328	1.539
	.960	29.784	23.560	38.885	1.474	1.372	1.590
	.970	34.037	26.722	44.891	1.532	1.427	1.652
	.980	40.647	31.574	54.365	1.609	1.499	1.735
	.990	53.764	41.027	73.594	1.730	1.613	1.867
	.010	.366	.258	.492	-.437	-.588	-.308
	.020	.484	.350	.639	-.316	-.456	-.195
	.030	.577	.424	.754	-.238	-.373	-.123
	.040	.660	.490	.854	-.181	-.310	-.068
	.050	.736	.551	.946	-.133	-.259	-.024
	.060	.807	.609	1.032	-.093	-.216	.014
	.070	.875	.664	1.114	-.058	-.178	.047
	.080	.941	.718	1.193	-.027	-.144	.077
	.090	1.005	.771	1.270	.002	-.113	.104
	.100	1.068	.823	1.345	.029	-.085	.129
	.150	1.373	1.076	1.708	.138	.032	.232
	.200	1.677	1.331	2.068	.225	.124	.316
	.250	1.991	1.595	2.439	.299	.203	.387
Local	.300	2.322	1.875	2.832	.366	.273	.452
Garlic 98.	.350	2.678	2.177	3.255	.428	.338	.512
	.400	3.067	2.505	3.717	.487	.399	.570
	.450	3.496	2.868	4.230	.544	.458	.626
	.500	3.977	3.274	4.808	.600	.515	.682
	.550	4.525	3.734	5.469	.656	.572	.738
	.600	5.158	4.263	6.240	.712	.630	.795
	.650	5.906	4.886	7.157	.771	.689	.855
	.700	6.812	5.635	8.278	.833	.751	.918
	.750	7.946	6.565	9.697	.900	.817	.987
	.800	9.432	7.772	11.580	.975	.891	1.064
	.850	11.519	9.446	14.264	1.061	.975	1.154
	.900	14.813	12.048	18.584	1.171	1.081	1.269
	.910	15.741	12.772	19.817	1.197	1.106	1.297

	.920	16.815	13.607	21.253	1.226	1.134	1.327
	.930	18.080	14.586	22.955	1.257	1.164	1.361
	.940	19.606	15.760	25.022	1.292	1.198	1.398
	.950	21.505	17.210	27.615	1.333	1.236	1.441
	.960	23.971	19.080	31.015	1.380	1.281	1.492
	.970	27.395	21.651	35.788	1.438	1.335	1.554
	.980	32.714	25.597	43.314	1.515	1.408	1.637
	.990	43.272	33.287	58.588	1.636	1.522	1.768
	.010	.468	.335	.622	-.330	-.475	-.206
	.020	.619	.454	.808	-.209	-.343	-.093
	.030	.739	.550	.954	-.131	-.259	-.020
	.040	.844	.636	1.082	-.073	-.197	.034
	.050	.941	.715	1.198	-.026	-.146	.078
	.060	1.032	.789	1.307	.014	-.103	.116
	.070	1.120	.861	1.411	.049	-.065	.150
	.080	1.204	.931	1.512	.081	-.031	.179
	.090	1.286	.999	1.609	.109	-.001	.207
	.100	1.366	1.066	1.705	.136	.028	.232
	.150	1.757	1.393	2.168	.245	.144	.336
	.200	2.146	1.720	2.628	.332	.236	.420
	.250	2.547	2.060	3.103	.406	.314	.492
Kating	.300	2.971	2.419	3.605	.473	.384	.557
Garlic 39	.350	3.427	2.805	4.148	.535	.448	.618
	.400	3.924	3.225	4.742	.594	.509	.676
	.450	4.474	3.689	5.402	.651	.567	.733
	.500	5.089	4.206	6.146	.707	.624	.789
	.550	5.789	4.792	6.999	.763	.681	.845
	.600	6.600	5.466	7.993	.820	.738	.903
	.650	7.557	6.257	9.179	.878	.796	.963
	.700	8.716	7.208	10.629	.940	.858	1.026
	.750	10.167	8.387	12.466	1.007	.924	1.096
	.800	12.069	9.917	14.905	1.082	.996	1.173
	.850	14.739	12.037	18.385	1.168	1.081	1.264
	.900	18.954	15.329	23.990	1.278	1.186	1.380
	.910	20.141	16.245	25.590	1.304	1.211	1.408

	.920	21.515	17.301	27.453	1.333	1.238	1.439
	.930	23.134	18.539	29.662	1.364	1.268	1.472
	.940	25.087	20.023	32.346	1.399	1.302	1.510
	.950	27.516	21.857	35.712	1.440	1.340	1.553
	.960	30.673	24.221	40.127	1.487	1.384	1.603
	.970	35.053	27.471	46.325	1.545	1.439	1.666
	.980	41.860	32.458	56.102	1.622	1.511	1.749
	.990	55.369	42.176	75.946	1.743	1.625	1.881
	.010	.351	.247	.473	-.455	-.607	-.325
	.020	.464	.335	.614	-.334	-.475	-.212
	.030	.554	.406	.724	-.256	-.391	-.140
	.040	.633	.469	.821	-.199	-.329	-.086
	.050	.706	.528	.909	-.151	-.278	-.041
	.060	.774	.583	.991	-.111	-.234	-.004
	.070	.839	.636	1.070	-.076	-.196	.029
	.080	.903	.688	1.146	-.045	-.163	.059
	.090	.964	.738	1.219	-.016	-.132	.086
	.100	1.025	.788	1.292	.011	-.103	.111
	.150	1.318	1.031	1.640	.120	.013	.215
	.200	1.609	1.276	1.985	.207	.106	.298
	.250	1.910	1.529	2.341	.281	.184	.369
Kating	.300	2.228	1.798	2.718	.348	.255	.434
Garlic 62	.350	2.570	2.087	3.123	.410	.320	.495
	.400	2.942	2.403	3.565	.469	.381	.552
	.450	3.354	2.751	4.057	.526	.440	.608
	.500	3.816	3.141	4.610	.582	.497	.664
	.550	4.341	3.583	5.243	.638	.554	.720
	.600	4.949	4.092	5.981	.694	.612	.777
	.650	5.666	4.690	6.859	.753	.671	.836
	.700	6.535	5.410	7.932	.815	.733	.899
	.750	7.623	6.305	9.289	.882	.800	.968
	.800	9.050	7.466	11.090	.957	.873	1.045
	.850	11.052	9.076	13.658	1.043	.958	1.135
	.900	14.212	11.579	17.790	1.153	1.064	1.250
	.910	15.102	12.276	18.969	1.179	1.089	1.278

	.920	16.132	13.079	20.342	1.208	1.117	1.308
	.930	17.346	14.020	21.970	1.239	1.147	1.342
	.940	18.811	15.149	23.948	1.274	1.180	1.379
	.950	20.632	16.545	26.427	1.315	1.219	1.422
	.960	22.999	18.343	29.679	1.362	1.263	1.472
	.970	26.283	20.817	34.244	1.420	1.318	1.535
	.980	31.387	24.613	41.442	1.497	1.391	1.617
	.990	41.516	32.011	56.050	1.618	1.505	1.749
	.010	.272	.188	.373	-.565	-.726	-.429
	.020	.360	.255	.484	-.444	-.594	-.316
	.030	.430	.309	.571	-.367	-.510	-.244
	.040	.491	.357	.646	-.309	-.447	-.189
	.050	.547	.402	.716	-.262	-.396	-.145
	.060	.600	.444	.780	-.222	-.352	-.108
	.070	.651	.485	.842	-.186	-.315	-.075
	.080	.700	.524	.902	-.155	-.281	-.045
	.090	.748	.563	.960	-.126	-.250	-.018
	.100	.795	.601	1.016	-.100	-.221	.007
	.150	1.022	.787	1.289	.009	-.104	.110
	.200	1.248	.974	1.560	.096	-.012	.193
	.250	1.482	1.168	1.838	.171	.067	.264
Kating	.300	1.728	1.374	2.132	.238	.138	.329
Garlic 98	.350	1.993	1.597	2.448	.300	.203	.389
	.400	2.282	1.840	2.793	.358	.265	.446
	.450	2.602	2.108	3.175	.415	.324	.502
	.500	2.960	2.409	3.605	.471	.382	.557
	.550	3.367	2.751	4.096	.527	.439	.612
	.600	3.839	3.145	4.667	.584	.498	.669
	.650	4.395	3.609	5.346	.643	.557	.728
	.700	5.070	4.169	6.174	.705	.620	.791
	.750	5.914	4.864	7.221	.772	.687	.859
	.800	7.020	5.768	8.609	.846	.761	.935
	.850	8.573	7.024	10.584	.933	.847	1.025
	.900	11.024	8.978	13.760	1.042	.953	1.139
	.910	11.715	9.523	14.665	1.069	.979	1.166

	.920	12.514	10.151	15.720	1.097	1.007	1.196
	.930	13.456	10.887	16.969	1.129	1.037	1.230
	.940	14.591	11.770	18.487	1.164	1.071	1.267
	.950	16.004	12.862	20.389	1.204	1.109	1.309
	.960	17.840	14.269	22.883	1.251	1.154	1.360
	.970	20.388	16.205	26.382	1.309	1.210	1.421
	.980	24.347	19.178	31.900	1.386	1.283	1.504
	.990	32.204	24.973	43.090	1.508	1.397	1.634
	.010	.497	.357	.659	-.304	-.447	-.181
	.020	.657	.484	.856	-.182	-.315	-.068
	.030	.785	.587	1.011	-.105	-.232	.005
	.040	.897	.678	1.146	-.047	-.169	.059
	.050	1.000	.762	1.269	.000	-.118	.104
	.060	1.097	.841	1.385	.040	-.075	.141
	.070	1.189	.918	1.495	.075	-.037	.175
	.080	1.279	.992	1.602	.107	-.004	.205
	.090	1.366	1.064	1.705	.135	.027	.232
	.100	1.451	1.136	1.807	.162	.055	.257
	.150	1.866	1.484	2.298	.271	.171	.361
	.200	2.279	1.832	2.786	.358	.263	.445
	.250	2.706	2.193	3.290	.432	.341	.517
Single	.300	3.156	2.575	3.824	.499	.411	.583
Garlic 39	.350	3.640	2.985	4.401	.561	.475	.644
	.400	4.168	3.432	5.032	.620	.536	.702
	.450	4.752	3.924	5.734	.677	.594	.758
	.500	5.406	4.473	6.526	.733	.651	.815
	.550	6.150	5.095	7.433	.789	.707	.871
	.600	7.011	5.810	8.492	.846	.764	.929
	.650	8.027	6.649	9.754	.905	.823	.989
	.700	9.258	7.657	11.298	.967	.884	1.053
	.750	10.800	8.907	13.254	1.033	.950	1.122
	.800	12.820	10.528	15.853	1.108	1.022	1.200
	.850	15.656	12.775	19.561	1.195	1.106	1.291
	.900	20.133	16.262	25.533	1.304	1.211	1.407
	.910	21.394	17.234	27.238	1.330	1.236	1.435

	.920	22.854	18.352	29.224	1.359	1.264	1.466
	.930	24.574	19.663	31.579	1.390	1.294	1.499
	.940	26.648	21.236	34.439	1.426	1.327	1.537
	.950	29.228	23.178	38.027	1.466	1.365	1.580
	.960	32.581	25.682	42.732	1.513	1.410	1.631
	.970	37.234	29.124	49.339	1.571	1.464	1.693
	.980	44.464	34.407	59.760	1.648	1.537	1.776
	.990	58.814	44.700	80.914	1.769	1.650	1.908
	.010	.355	.250	.480	-.449	-.602	-.319
	.020	.470	.339	.623	-.328	-.470	-.206
	.030	.562	.411	.735	-.251	-.386	-.134
	.040	.642	.475	.833	-.193	-.323	-.079
	.050	.715	.534	.922	-.145	-.272	-.035
	.060	.785	.590	1.006	-.105	-.229	.003
	.070	.851	.644	1.086	-.070	-.191	.036
	.080	.915	.696	1.162	-.039	-.157	.065
	.090	.977	.748	1.237	-.010	-.126	.092
	.100	1.038	.798	1.310	.016	-.098	.117
	.150	1.335	1.044	1.664	.126	.019	.221
	.200	1.631	1.291	2.015	.212	.111	.304
	.250	1.936	1.548	2.376	.287	.190	.376
Single	.300	2.258	1.820	2.758	.354	.260	.441
Garlic 62	.350	2.605	2.113	3.169	.416	.325	.501
	.400	2.982	2.432	3.619	.475	.386	.559
	.450	3.400	2.785	4.117	.531	.445	.615
	.500	3.868	3.179	4.679	.587	.502	.670
	.550	4.400	3.627	5.322	.643	.559	.726
	.600	5.016	4.142	6.070	.700	.617	.783
	.650	5.743	4.748	6.961	.759	.676	.843
	.700	6.624	5.477	8.050	.821	.739	.906
	.750	7.727	6.382	9.427	.888	.805	.974
	.800	9.172	7.557	11.255	.962	.878	1.051
	.850	11.202	9.188	13.861	1.049	.963	1.142
	.900	14.405	11.722	18.053	1.159	1.069	1.257
	.910	15.307	12.428	19.250	1.185	1.094	1.284

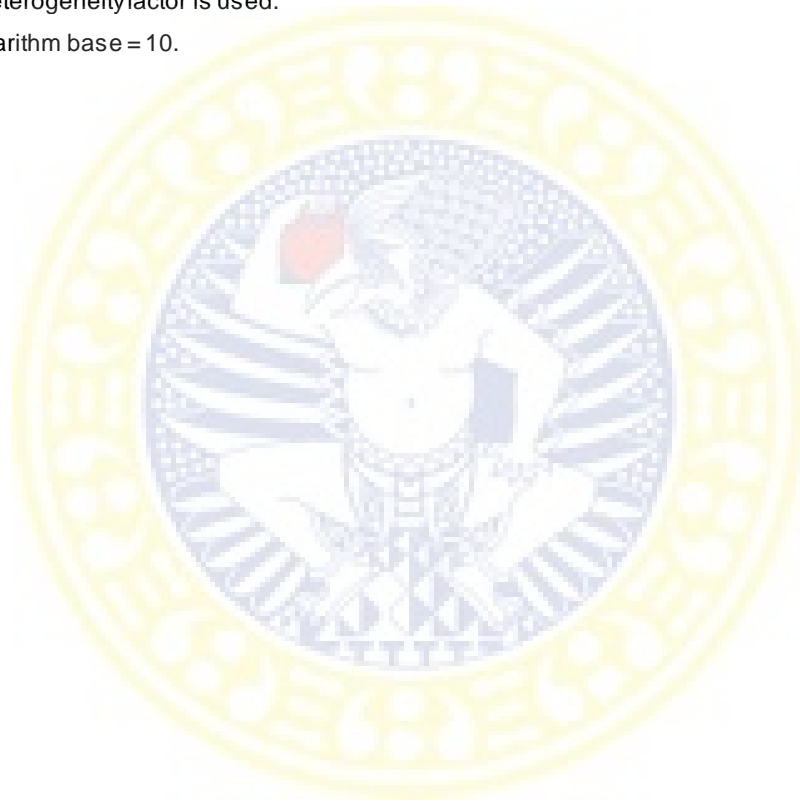


	.920	16.351	13.241	20.642	1.214	1.122	1.315
	.930	17.582	14.195	22.294	1.245	1.152	1.348
	.940	19.066	15.338	24.300	1.280	1.186	1.386
	.950	20.912	16.751	26.815	1.320	1.224	1.428
	.960	23.311	18.573	30.114	1.368	1.269	1.479
	.970	26.640	21.078	34.744	1.426	1.324	1.541
	.980	31.813	24.923	42.046	1.503	1.397	1.624
	.990	42.080	32.416	56.863	1.624	1.511	1.755
	.010	.352	.248	.476	-.453	-.606	-.323
	.020	.466	.336	.617	-.332	-.474	-.209
	.030	.557	.407	.729	-.254	-.390	-.137
	.040	.636	.471	.826	-.197	-.327	-.083
	.050	.709	.529	.914	-.149	-.276	-.039
	.060	.778	.585	.998	-.109	-.233	-.001
	.070	.843	.638	1.077	-.074	-.195	.032
	.080	.907	.690	1.153	-.043	-.161	.062
	.090	.969	.740	1.227	-.014	-.131	.089
	.100	1.029	.790	1.300	.013	-.102	.114
	.150	1.324	1.034	1.651	.122	.015	.218
	.200	1.616	1.279	1.998	.209	.107	.301
	.250	1.919	1.533	2.357	.283	.186	.372
Single	.300	2.238	1.802	2.736	.350	.256	.437
Garlic 98	.350	2.582	2.092	3.143	.412	.321	.497
	.400	2.956	2.409	3.589	.471	.382	.555
	.450	3.370	2.758	4.084	.528	.441	.611
	.500	3.833	3.148	4.641	.584	.498	.667
	.550	4.361	3.591	5.279	.640	.555	.723
	.600	4.971	4.102	6.021	.696	.613	.780
	.650	5.692	4.702	6.905	.755	.672	.839
	.700	6.565	5.424	7.985	.817	.734	.902
	.750	7.658	6.320	9.351	.884	.801	.971
	.800	9.091	7.485	11.163	.959	.874	1.048
	.850	11.102	9.100	13.747	1.045	.959	1.138
	.900	14.277	11.610	17.904	1.155	1.065	1.253
	.910	15.171	12.310	19.090	1.181	1.090	1.281

.920	16.206	13.115	20.471	1.210	1.118	1.311
.930	17.426	14.060	22.108	1.241	1.148	1.345
.940	18.897	15.193	24.097	1.276	1.182	1.382
.950	20.727	16.593	26.591	1.317	1.220	1.425
.960	23.104	18.398	29.862	1.364	1.265	1.475
.970	26.404	20.880	34.452	1.422	1.320	1.537
.980	31.531	24.689	41.691	1.499	1.393	1.620
.990	41.706	32.114	56.380	1.620	1.507	1.751

a. A heterogeneity factor is used.

b. Logarithm base = 10.



## Appendix 3 : Figures of Research



Figure 1. Research Equipment

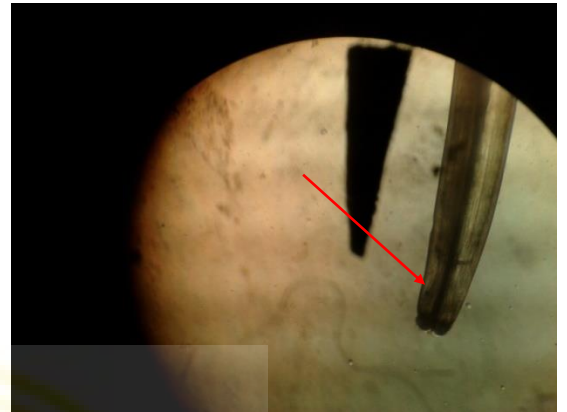
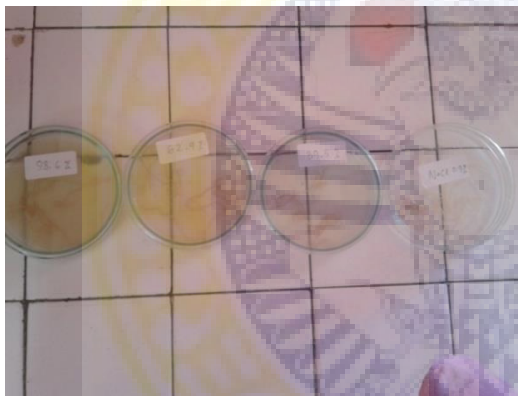
Figure 2. Cheking *Ascaridia galli*

Figure 3. Treatment on Garlic Infusion



Figure 4. Bulb Structure of Local Garlic

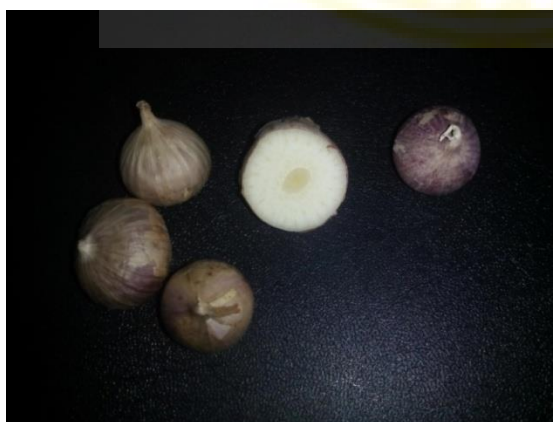


Figure 5. Bulb Structure of Single Garlic



Figure 6. Bulb Structure of Kating Garlic

