

# POPULATION OF *Ascaridia galli* ACCORDING TO ITS PREDILECTION AFTER BEING TREATED WITH ARECA NUT INFUSION AND ITS ECONOMIC ANALYSIS

Bambang Sudarmanto<sup>1</sup>, Muzizat Akbarrizki<sup>1</sup>, and Wida Wahidah Mubarakah<sup>1\*</sup>

<sup>1</sup>Polytechnics of Agricultural Development Yogyakarta Magelang, Ministry of Agriculture, Republic of Indonesia, Magelang, Indonesia

\*Corresponding author: [wida\\_wahidah02@yahoo.co.id](mailto:wida_wahidah02@yahoo.co.id)

## ABSTRACT

This study aims to determine the effectiveness of *Areca catechu* crude aqueous extract (ACCAE) as an anthelmintic, the number of *Ascaridia galli* worms in the duodenum, jejunum, and ileum after treatment, and an economic analysis. In this study, 50 female chickens were used. The chickens were divided into 5 groups: treatment 1, negative control (P1), which was given aquadestylates; treatment 2 (P2), which was given infusion of ACCAE at a dose of 26 mg/mL; treatment 3 (P3), which was given infusion of ACCAE at a dose of 53 mg/mL; treatment 4 (P4), which was given ACCAE with a dose of 79 mg/mL; and treatment 5 (P5) (positive control with pyrantel pamoat). Each group consisted of 10 chickens. An examination was carried out that included weighing the population of adult worms according to their predilection 14 days after treatment. Weighing was carried out at the beginning before treatment, on the 7<sup>th</sup> day after treatment and on the 14<sup>th</sup> day after treatment. The chickens were then euthenized, the intestinal worms were counted, and the economic analysis was calculated. Based on the results of the study, it can be concluded that the best dose for removing *Ascaridia galli* worms is 79 mg/mL, and the location of the predilection of the intestine where the most worms are found is the jejunum and the least is in the ileum. Economically, the highest income in treatment 4 is with infusion of areca nut at a dose of 79 mg/mL.

Key words: *Areca catechu* crude aqueous extract, *Ascaridia galli*, economic analysis, ileum, jejunum

## ABSTRAK

Penelitian ini bertujuan mengetahui efektifitas infusa biji pinang sebagai antelmintik, jumlah cacing *Ascaridia galli* di duodenum, jejunum, dan ileum setelah perlakuan serta analisis ekonominya. Dalam penelitian ini digunakan 50 ekor ayam kampung betina dan dibagi dalam 5 kelompok. Perlakuan 1 (P1), kontrol negatif diberi aquadestilata, perlakuan 2 (P2) dengan pemberian infusa biji pinang dosis 26 mg/ml, perlakuan 3 (P3) pemberian infusa biji pinang dosis 53 mg/ml, perlakuan 4 (P4) pemberian infusa biji pinang dosis 79 mg/ml, dan perlakuan 5 (P5) (kontrol positif dengan pyrantel pamoat) dengan masing-masing kelompok 10 ekor ayam. Pemeriksaan yang dilakukan meliputi penimbangan berat badan, populasi cacing dewasa sesuai predileksinya setelah perlakuan 14 hari setelah pengobatan. Penimbangan berat badan dilakukan pada awal sebelum perlakuan, hari ke-7 setelah perlakuan dan hari ke-14 setelah perlakuan, lalu ayam dipotong dan dihitung cacing di bagian usus serta dihitung analisis ekonominya. Dari hasil penelitian dapat disimpulkan bahwa dosis paling baik untuk menghilangkan cacing *Ascaridia galli* 79 mg/ml dan lokasi predileksi dari usus yang paling banyak ditemukan cacing di jejunum, paling sedikit di ileum. Secara perhitungan ekonomi pendapatan tertinggi pada perlakuan 4 yaitu dengan infusa biji pinang dosis 79 mg/ml.

Kata kunci: analisa ekonomi; *Ascaridia galli*; ileum; infusa biji pinang; jejunum

## INTRODUCTION

Free-range chickens play an important role in the provision of meat and eggs, and are a vital source of income for local communities. Poultry farming is an important part of the national development of Indonesia due to the fact that poultry is one of the main sources of animal protein for millions of people. In addition, the poultry industry is able to create jobs and provide additional income for most people, especially those living in rural areas (Suprijatna 2010). *Ascaridia galli* is a parasitic nematode that is often found in poultry such as chickens (Susanti and Prabowo 2014). These parasites cause high economic losses and negatively affect animals in the form of weight loss, stunted growth, and decreased egg quality and production. This is because in addition to absorbing food substances, worms also cause damage to villous epithelial cells by reducing the surface area of the intestinal villi which play a role in the process of digestion and absorption of food (Zalazar *et al.* 2007).

Intensive use of anthelmintics has led to resistance problems. Resistance occurs to all currently available broad-spectrum anthelmintics, such as benzimidazole,

imidothiazole-tetrahydropyridine, and macrocyclic lactones. The increasing incidences of resistance and increasing consumer awareness of animal products that are free of drug residues make research on new anthelmintics the best approach in controlling helminthiasis. Plants with anthelmintic properties have been widely used throughout the world for quite some time, but little research has been done on them especially in regards to veterinary medicine (Kaplan 2004). One of the plants that has anthelmintic properties is *Areca catechu* or areca nut. Traditionally, areca nut is used as a remedy for anorexia, skin disorders, back pain, and helminthiasis. *Areca catechu* contains active substances such as flavonoids, tannins, saponins, monoterpenes, sesquiterpenes, phenols, quinones, and alkaloids (arecoline and arecaine) (Amudhan *et al.* 2012; Febriani *et al.* 2014). Tannins are generally derived from polyphenolic compounds which have the ability to precipitate proteins by forming water-insoluble copolymers. Tannins also have ovicidal properties, which means they can bind to worm eggs so that cell division in the eggs will not take place and in the end larvae can not form (Tiwow *et al.* 2013). Saponin compounds work by increasing the

permeability and pore formation of the worm body wall which causes vacuolization and disintegration of the cuticle (Parvathy *et al.* 2012).

Sujarno (2008) explains, income is the difference between total revenue (TR) and total cost (TC), where revenue is the multiplication between the production obtained/quantity (Q) with the selling price (P) and the total costs are generally classified into two, namely fixed costs (FC) and variable costs (VC). Fixed costs are costs that are relatively fixed in number and continue to be issued regardless of the amount of production produced, while variable costs are costs whose size is influenced by the amount of production produced. According to Sukirno and Sadono (2006) income is the amount of income received by residents for their work performance during a certain period, either daily, weekly, monthly or yearly. Sofyan (2002) adds that income is a gross increase in assets and a gross decrease in liabilities which are assessed based on accounting principles derived from profit-seeking activities. A company's income comes from sales, where the sales value is determined by the number of units sold (quantity) and the selling price (price), and small industry income is defined as the results obtained by entrepreneurs in organizing the production factors they manage. In determining the level of production, a business engaged in the formal and informal sectors will take into account the level of income that will be generated in a production.

Based on the description above, it is strongly suspected that areca nut infusion has the ability as an anthelmintic agent against adult worms of *Ascaridia galli in vivo*, because the performance and productivity of free-range chickens is strongly influenced by the presence of *Ascaridia galli* worm infestations in the chicken intestine. The number of worms is the main parameter to determine the effectiveness of anthelmintics, and this has an impact on profits. It is important to conduct research on herbal plants which are a form of traditional medicine as an anthelmintic alternative, and analyze their economic aspects.

## MATERIALS AND METHODS

### Experimental Animals

The experimental animals used in this study were 50 female free-range chickens, aged 1.5-2 months which weighed between 250-400 g. Stool samples were examined directly from the cloaca using the Mc.Master method. Chickens were adapted to the study cage for two weeks, and were raised in a bamboo cage with a battery system and fed with rice bran, rice and ad libitum water. The cage temperature was set to room temperature.

### Experimental Group

This *in vivo* study was divided into 5 groups, namely: treatment (P1) (negative control), which was given aquadestylates; treatment 2 (P2), which was given infusion of areca nut at a dose of 26 mg/mL; treatment 3 (P3), which was given infusion of areca nut

at a dose of 53 mg/mL; treatment 4 (P4), which was given infusion of areca nut at a dose of 79 mg/mL; and treatment 5 (P5) (positive control with pyrantel pamoat). Each group consisted of 10 female free-range chickens.

### The Preparation of Areca Seed Infusion

The infusion was made by cutting or chopping areca nuts into softer or smaller pieces. The slices of areca nut were weighed according to the desired weight or concentration, which was 2.6 g. The chunks were put into a beaker. The beaker glass that has been filled with betel nut is then filled with 100 mL of distilled water. The beaker placed in the oven at 90° C for 15 minutes. The remaining liquid in the beaker was taken and filtered to obtain a 26 mg/mL betel nut infusion (Daryatmo, 2010)

### Research Examination

An examination was carried out that included weighing the population of adult worms according to their predilection 14 days after treatment. Weighing was carried out at the beginning before treatment, on the 7<sup>th</sup> day after treatment and on the 14<sup>th</sup> day after treatment. The chickens were then euthenized, the intestinal worms were counted, and the economic analysis was calculated.

### Data Analysis

To find out which places have the most worms and the number of worms, statistical analysis of the analysis of variance (ANOVA) data was carried out. As for the economic analysis, the following formula was used:

$$TR = Q \times Pq$$

Notes:

TR = Total Revenue (Rp)

Q = Quantity/Product obtained

Pq = Selling price (Rp)

Total revenue is the product obtained multiplied by the selling price, production is negatively related to the price, meaning that the price will fall when production is excessive. Income is the difference between Total Revenue (TR) and Total Cost (TC), where revenue is the product obtained (Q) and selling price (Pq), and Total Cost is the sum of Fixed Costs (FC) and Variable Costs (VC).

$$\pi = TR - TC$$

Notes:

$\pi$  = Income (Rp)

TR = Total revenue (Rp)

TC = Total cost (Rp)

## RESULTS AND DISCUSSION

The highest worm population based on location (duodenum, jejunum and ileum) was found in the negative control group. In treatment 2, worms were still found in all locations, namely the duodenum, jejunum

and ileum. In treatment 3, the presence of worms was only found in the duodenum and jejunum. In treatments 4 and 5 (positive control) no worms were found in any of the locations (Table 1). In addition to a dose of 26 mg/mL, all doses of areca nut infusion showed potential anthelmintic activity. The results of the analysis of variance showed that the treatment and location had a very significant effect ( $P < 0.01$ ) on the number of worms. There was a very significant interaction ( $P < 0.01$ ) between treatment and location on the number of worms. The results of this study are in accordance with the results of research by Akter *et al.* (2016) who reported that an 87.5% mortality rate of *Ascaridia galli* worms resulted from the use of pineapple leaf water extract. Herawati *et al.* (2018), stated that jambe powder was able to eliminate *Ascaridia galli* worms in the small intestine of chickens by 80%. This is in accordance with the research conducted by Mubarokah *et al.* (2019a) which stated that the use of betel nut infusion at a dose of 79 mg/mL in vivo reduced eggs per gram (EPG) from  $1485 \pm 386.62$  to  $0 \pm 0.00$  in eggs of *Ascaridia galli* worms in chickens. In in vitro studies, the best concentration for killing *Ascaridia galli* worm is a 25% concentration of betel nut infusion (Mubarokah *et al.* 2019b) with a lethal concentration of 21.18% (Mubarokah *et al.* 2018). Based on in vitro tests, *Areca catechu* infusion against *Haemonchus contortus* can cause mortality in worms, with the calculation result of the lethal concentration 50 being 7.50% (Mubarokah *et al.* 2021a). This is due to the presence of tannins in the infusion of areca nut which is believed to cause damage to the protein in the cuticle of the worms which results in the death of the worms. In accordance with a study on the protein profile of worms using the sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) test, it was found that *Ascaridia galli* worms treated with betel nut infusion produced fewer protein bands than the negative control (without treatment) (Mubarokah *et al.* 2019c) and that upon scanning with electron microscopy, it was found that shrinkage, cracking, and damage to the surface of the egg wall had occurred. In addition, the anterior tegument of the larva (L2) shrank and the cuticle ruptured on administration of 25% betel nut infusion (Mubarokah *et al.* 2021b).

Death of adult worms in this study is believed to be influenced by the presence of tannins in the infusion of areca nut. Various simple phenolics including gallic acid, caffeic acid, and flavonoids, which increase tannins, are known to be anthelmintic (Mondal *et al.* 2015). Tannins may react directly on the surface of the

worm's body causing damage, or indirectly by increasing protein nutrition and the immune system of the host (Min *et al.* 2003). Tannins inhibit fumarate reductase and succinate dehydrogenase enzymes so that adenosine triphosphate (ATP) synthesis in mitochondria is inhibited. Inhibition of fumarate reductase and succinate dehydrogenase causes obstruction of the terminal electron acceptor. The formation of succinate is inhibited so that less ATP is formed, thus resulting in the death of the worms (Dhanraj and Verakumari 2016). Damage to the worm membrane due to tannins causes paralysis and then death. In addition, tannins from the polyphenol group are also able to precipitate proteins in the form of copolymers that are insoluble in water (Tangalin 2011; Susanti and Prabowo 2014). Saponin compounds work by increasing the permeability and pore formation of the worm body wall which causes vacuolization and disintegration of the cuticle (Parvathy *et al.* 2012).

The highest number of *Ascaridia galli* worms was found in the jejunum and the smallest number was found in the intestinal ileum. Based on the location, the results of this study are in accordance with the statement of Ferdushy *et al.* (2012), which stated that the location of the most *Ascaridia galli* worms was in the anterior part of the jejunoileum. Prastowo *et al.* (2017) added that the highest population of adult *Ascaridia galli* worms treated with jambe and binahong powder was in the jejunum. The location of these worms depends on the age of infection and the presence or absence of other infections, both from other types of worms and bacterial infections (Roepstorff *et al.* 1997; Ferdushy *et al.* 2012).

The number of free-range chickens that became the raw material was 50 which were divided into 5 treatments, so that each treatment consisted of 10 free-range chickens. The price for each 1 month old free-range chicken was Rp. 15,000/head, so the cost of raw materials for free-range chickens for each treatment containing 10 chickens was Rp. 150,000/treatment.

Fixed costs were calculated for each period, where each period lasted for 2 months. Fixed costs consisted of the cost of depreciation of the cage, the cost of depreciation of the feeder, the cost of depreciation of the drinking place, and the cost of depreciation of the 3 cc syringe. The total fixed cost for 50 birds was Rp. 7,083 and for each treatment the fixed cost was Rp. 1,417/period.

Variable costs included the cost of infusion of areca nut, pyrantel pamoat deworming medicine, labor costs, and the cost of feed consisting of white

**Table 1.** Population of adult worms according to their predilection after treatment

Treatment	Duodenum	Jejunum	Ileum
(P1) Control- (Aquadestillata)	27.6±3.98 <sup>a</sup>	52.3±9.31 <sup>a</sup>	3.4±1.51 <sup>a</sup>
(P2) dose of 26 mg/mL	19.4±11.99 <sup>b</sup>	37±21.79 <sup>b</sup>	2.4±0.95 <sup>a</sup>
(P3) dose of 53 mg/mL	0.7±1.16 <sup>c</sup>	1.3±2.21 <sup>c</sup>	0±0.00 <sup>b</sup>
(P4) dose of 79 mg/mL	0±0.00 <sup>d</sup>	0±0.00 <sup>d</sup>	0±0.00 <sup>b</sup>
(P5) Control+	0±0.00 <sup>d</sup>	0±0.00 <sup>d</sup>	0±0.00 <sup>b</sup>
(Pyrantel pamoat 50 mg/mL)			

<sup>a,b,c,d</sup> Different superscripts within the same column indicate significant differences ( $P < 0.01$ )

**Table 2.** Cost of production for each treatment

No	Description	Raw material (Rp)	Fixed cost (Rp)	Variable cost (Rp)	HPP full costing/treatment (Rp)
1	(P1)	150,000	1417	62,875	214,292
2	(P2)	150,000	1417	71,875	223,292
3	(P3)	150,000	1417	80,875	223,292
4	(P4)	150,000	1417	89,875	241,292
5	(P5)	150,000	1417	102,875	254,292

**Table 3.** Total revenue and income for each treatment

No	Description	Initial weight/treatment (Kg)	Final weight/treatment (Kg)	Difference in weight/treatment (Kg)	Price/Kg of free-range chicken (Rp)	Revenue of the difference in weight/treatment (Rp)	Revenue of initial weight/treatment (Rp)	Total revenue (Rp)	Income/treatment (Rp)
1	(P1)	11.32	11.24	0.08	40,000	3,200	452,800	449,600	235,308
2	(P2)	11.30	11.34	0.04	40,000	1,600	452,000	453,600	230,308
3	(P3)	11.40	11.72	0.32	40,000	12,800	456,000	468,800	236,508
4	(P4)	11.42	12.68	1.26	40,000	50,400	456,800	507,200	265,908
5	(P5)	11.14	12.80	1.66	40,000	66,400	445,600	512,000	257,708

rice, rice bran and water. The variable cost in treatment 1 was Rp. 62,875, treatment 2 Rp. 71,875, treatment 3 Rp. 80,875, treat 4 for Rp. 89,875, and treatment 5 (the highest) Rp. 102,875. The difference between the treatments was the dose of deworming medication and the type of deworming medication. Both of these factors affected the total fixed costs. Based on Table 2, it is known that the largest total cost was in treatment 5, which was Rp. 254,292. This is because the price was relatively more expensive compared to areca nut infusion.

Based on Table 3, it can be concluded that in treatment 1, the weight of chickens did not increase but in fact decreased in weight at harvest. The group that experienced the highest increase in weight was treatment 5. However, with the fairly high price of deworming medicine it can be seen that the highest total income was from treatment 4, which used the infusion of areca nut infusion at a dose of 79 mg/mL and cost Rp. 265,908. According to Noor and Faizal (2007) production cost efficiency will achieve maximum profit/profit because profit is one of the most important goals in business. In a business, in general, income/business profit is the main goal. Operating income is the amount of money received by the company from its activities, which are generally obtained from the sale of products or services to customers. Istikomah (2018) explains that the income earned is different. This is caused, among other things, by the different scales of livestock business and the type of feed provided, where the potential of the surrounding environment when utilized can reduce the amount of variable costs incurred.

### CONCLUSION

The best dosage to remove *Ascaridia galli* worms was 79 mg/mL and the location of predilection was found the most in the jejunum and the least in the ileum. Economically, the highest income was from treatment 4, which was given an infusion of areca nut with a dose of 79 mg/mL was Rp. 265,908.

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