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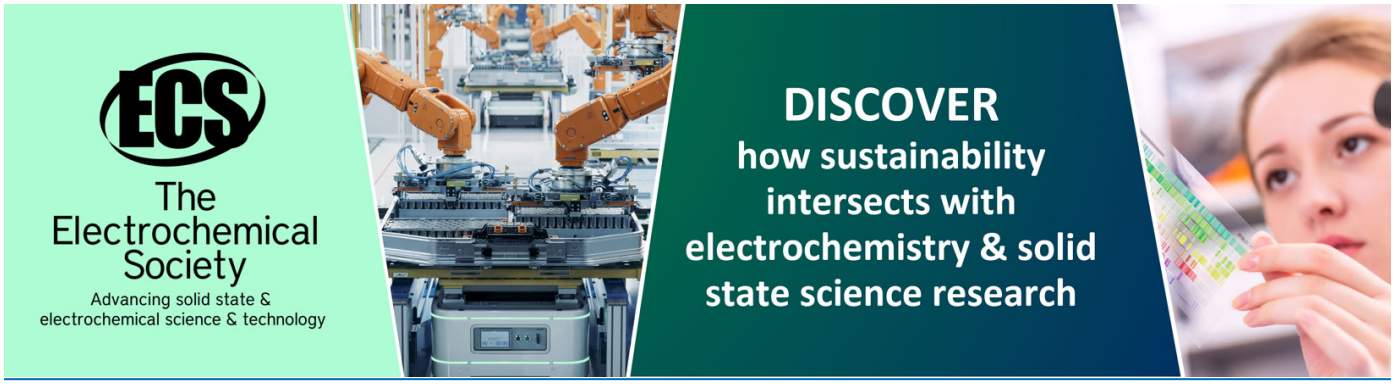

The prevalence and risk factor of gastrointestinal nematode infestation in cattle based on the environmental conditions of the farming locations in Aceh Province

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Abstract. This study was conducted to determine the prevalence and risk factor of gastrointestinal nematode infestation (GIN) in cattle based on environmental conditions, i.e., elevated altitude locations in Aceh Province. Cross-sectional surveys were conducted in the Districts of Gayo Lues and East Aceh, representing high altitude location (HAE) and low altitude location (LAE), respectively. A total of 64 samples (HAE) and 93 (LAE) samples were randomly collected from selected cattle. Fecal samples were examined with the centrifuge technique, and McMaster-counting chamber was used for egg count per gram feces (EPGF). Data obtained were analyzed for GIN infestation prevalence and risk factors based on the calculation of the Odds Ratio (OR). The results revealed that 14 HAE samples (21.9%, CI 13.5-33.43) and 35 LAE samples (37.6%: CI 28.46-47.79) were positive. Then, the number of EPGF in the GIN was significantly lower in the HAE (in average at 567 eggs/grams feces) compared to the LAE (an average at 669 eggs/grams feces) ($P<0.005$). The results of the OR calculation showed that the factor of raising cattle in LAE location significantly increased the risk of GIN infestation which was about 2.16 times higher than that of HAE location (($P<0.05$). In conclusion, the LAE location for raising cattle is a risk factor for higher prevalence of GIN infestation in Aceh Province.
Keywords – cattle, altitude, environment, GI nematodes, risk factor.

1. Introduction

Cattle is one of the most important agricultural commodities as it is considered to be livestock that serve as a source of protein for the life of living things, especially humans, in fulfilling the body's needs in carrying out their lives. According to [1] [2], most sources of animal protein to build human life generally come from livestock and its products.

Cattle are kept and grown by farmers on a small or large scale, both traditionally and intensively. Moreover, they are raised for meat production. However, some of the world's cattle production faces constraints in meeting the mentioned needs, especially health problem leading to low production and productivity. One of the health problems is caused by the presence of worm parasites such as nematode

worm attacking the livestock. This problem is common in the farms of developing countries with low health management. Indeed, poor animal health condition will impact on production.

This aspect was pointed out by [3]. In fact, most of the developing countries in the growing of livestock showed low limits after the investigation demonstrating low production due to high cases of diseases caused by worm parasites, primarily gastrointestinal (GI) nematode that attacks the digestif system of livestock causing large economic losses.

Worm parasitic infections, especially nematode classes found in the digestive (gastrointestinal) system of livestock, are one of the main and biggest causes of production losses [4]. As explained by [5] [6] [7], health problems repeatedly occurred because the GI nematode infestations will cause huge losses for both the government and other actors such as farmers and livestock breeders.

In another study by [8], it was reported that cattle farms in Sri Lanka had an economic loss of up to 230 million rupees/year due to nematode infestations, especially the gastrointestinal types. These losses were also observed in Indonesia. According to reports from [9] [10], the costs incurred for the prevention/ treatment of parasite worms can reach 240 billion rupiahs each year.

According to [11], gastrointestinal nematode (NGI) infection can cause a continuous decrease in livestock production, and if ignored, it can cause tremendous losses in livestock production as a whole. Generally, an increase in gastrointestinal nematode parasites in cattle can be associated with poor maintenance system. For instance, in Indonesia, farmers raise the cattle in traditional or semi-intensive settings by letting the livestock feed themselves, although they are not kept in the shed, leading to a great opportunity for parasite breeding.

Nematodes need an appropriate environment before interacting with the host (animal or human) as explained in some study results in parasitology. Some authors, [12] [13], explained that nematodes are persistent in the environment, and the survival in a host body will last for a long time between 1 and ten years, even though the host immune system continues to react. Because the nematodes can trick the host defense system and repeat infections in the host which may lead to chronic infection with high morbidity in adult animals and contamination of young animals. Furthermore, gastrointestinal nematodes need an environment to survive outside the body of animals, such as topography, temperature, humidity, rainfall, soil conditions or soil pH, because after living the animal or human body, this nematode will continue to live and react with the other host.

[14] [15] explained that an increase in the spread of diseases, especially worm parasites attacking livestock in recent years, could be associated with climate changes, including altitude. This theory is also explained by [16]. Indeed, several main factors increase the spread of diseases, especially those caused by parasites, including the altitude, topography, geographical area, unsuitable climate, different age, unsuitable population, lack of health handling and level of knowledge. According to [17], the relationship between the survival process and the parasite-free life stage of nematode worms in the environment is strongly influenced by temperature, humidity, soil pH, topography and other conditions, including staying alive in extreme conditions such as winter and soil chemical conditions contaminated with disinfectant.

In Aceh Province, the cattle are raised in both high (HAE) and low (LAE) altitudes. The HAE area represents the districts in this province covering an area of 166.06 km^2 with hills and mountainous terrain and an average height between 800-2.000 m asl (above sea level). It includes Mount Leuser which is the highest mountain in Aceh Province (4.446 m asl). An example of HAE is the District of Gayo Lues [18].

LAE is the district with a total area of 6,040.60 Km^2. Generally, a low topographic area is hilly, partly marshy with mangrove forests at an altitude of 0-308 masl. Livestock commodities in the low topographic area, at present, include cattle, buffalo, goats, sheep, and poultry. For example, the districts on the eastern coast of Aceh Province, such as District of East Aceh. Based on reports, the total population of cattle was 64.169 heads, and LAE is one of the regencies in Aceh Province becoming cattle hulls [19]. Therefore, the

purpose of this study was to determine the prevalence and risk factor of gastrointestinal nematode infestation (GIN) in cattle farming in HAE and LAE in Aceh Province.

2. Materials and methods

2.1. Time and location of the study

Cattle fecal collection was conducted from April to June 2018 in two different areas, i.e., HAE in Gayo Lues (>800 mdpl) and LAE in East Aceh (<100 mdpl). A precise position of each location is shown in the map presented in Figure 1.

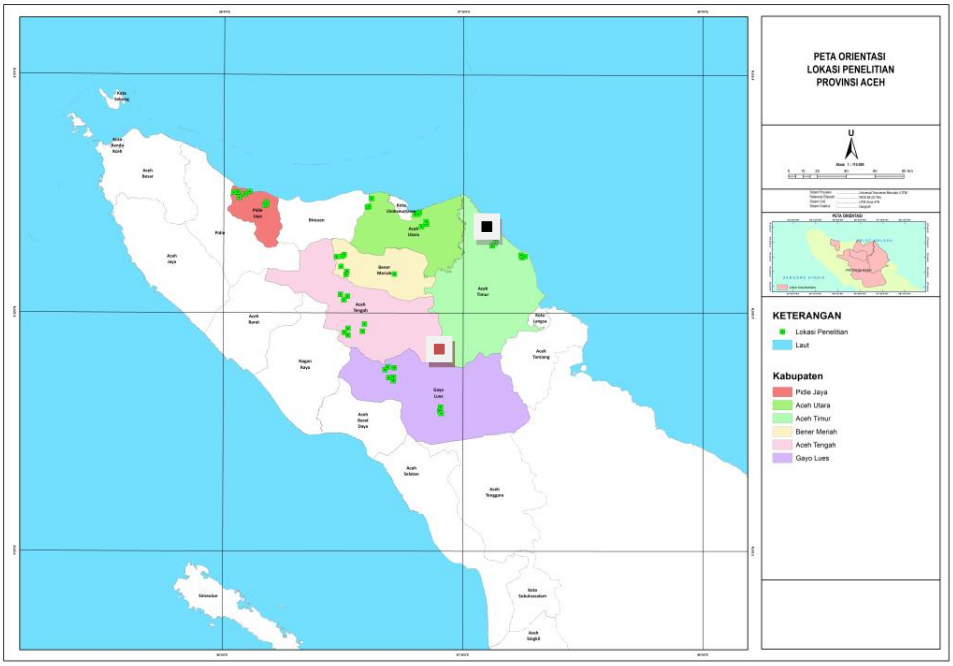

Figure 1. Map of the study locations (black dot: East Aceh District; red dot: Gayo Lues District).

2.2. Materials

The materials used in this study were as follows: spoons, plastic basins, refrigerators, scales, test tubes, Petri dishes, measuring cups, scissors, glass objects, centrifuges, Becker glasses, Pasteur pipes, microscopes, ice boxes, and digital cameras. The feces samples were collected with plastic, connective rubber, cardboard, pens, distilled water, 0.4% formalin, and saturated salt or NaCl Physiology.

2.3. Sample examination method

Fecal sample examination to identify positive and negative gastrointestinal nematode worm eggs were conducted through the centrifuge method. Initially, the samples were added with the saturated salt solution as much as 40 ml so that the total volume becomes 60 ml. The fecal solution was taken/sucked while stirring until even/homogeneous using a special pipette which at the end of the filter has a size of 250 ~ L according to the size of the largest worm eggs with a transverse diameter of 130-200 p [20].

The solution was taken using a pipette and rapidly incorporated into the glass room count tool (Universal Whitlock) with four count rooms. Each room has a volume of 0.5 ml. The number of eggs per gram of feces (EPG) was then counted [21] [22].

2.4. Data analysis

The prevalence was calculated as the number of positive samples from HAE and LAE that were examined. Data analysis was performed as per the EPGF of GI nematodes in each location. The obtained data were analyzed for GIN infestation prevalence and risk factors based on the calculation of the Odds Ratio (OR).

The formula is as shown below:

a. Prevalence:

$$P = \frac{X}{N} \text{ X } 100\%$$

P = Prevalence, X = exposed, N = Total Sample

b. Faecal egg count (EPGF) test:

$$TTGT = n/Bt \times Vt/Vh$$

N = the number of worm eggs in the room,
Vt = total volume of stool samples,
Vh = volume of calculated rooms,
Bt = stool weight.

c. Calculation of odd ratio:

$$OR = ad/bc$$

Notes:
- OR = odd ratio;
- a = cell a positif;
- b = cell b negatif;
- c = cell c positif : and,
- d = cell d negatif

3. Results and discussion

3.1. The percentage of Gastrointestinal Nematodes (NGI) in HAE and LAE

The percentages of gastrointestinal nematodes (NGI) in cattle maintained in both high and low topographic areas are presented in Table 1. High topographic areas showed a smaller percentage gastrointestinal nematodes (NGI) (<21.9%: CI 13.5-33.43) compared to a low topographic area (>37.6%: CI 28.46-47.79). There were significant differences (P<0.005) in the percentages or prevalence of GI nematodes between areas at different altitudes.

Table 1. The percentages of gastrointestinal nematodes (NGI) infection in cattle.

Areas	District	Gastrointestinal Nematodes				
		Total Sample	Sample Positive	Sample Negative	Prev (%)	CI
HAE	Gayo Lues	64	14	50	21,9	13,5-33,43 [a)]
LAE	East Aceh	93	35	58	37,6	28,46-47,79 [b)]

Note: [a) and b)]different superscripts show significant differences (P<0.005).

The results showed that microenvironmental conditions such as altitude (area differences), LAE, high temperatures, high humidity, and low rainfall, are likely to affect the prevalence of gastrointestinal nematodes (NGI) in cattle. These results follow those of [15], explaining that the intensity and distribution of worm parasites, especially gastrointestinal nematodes (NGI) types, have been strongly influenced by changes in environmental conditions such as temperature, climate, and altitude (topography).

[23] stated the high prevalence of gastrointestinal nematodes (NGI) in LAE areas could be caused by the number of adult females producing thousands of eggs per day. Thus, causing rapid larval pastoral contamination associated with the outbreak of hemosiosis due to the influence of hotter temperatures. This result was explained by [24], stating that the climate with high temperature and humidity can be the cause of over hatching in the farming area which occurred as these parasites have high biotic potential increasing their pathogenicity in a hot climate.

3.2. Fecal Egg Counts (FEC) of gastrointestinal nematodes infestation in HAE and LAE.

Fecal Egg Counts (FEC) of gastrointestinal nematodes infestation that appeared in cattle in HAE and LAE are presented in Table 2.

Table 2. Fecal Egg Counts (FEC) of gastrointestinal nematodes infestation in cattle in the different areas.

Area Category	District	Gastrointestinal Nematodes			
		Total Sample	Sample Positive	Sample Negative	Average FEC/gram feces
HAE	Gayo Lues	64	14	50	567[a)]
LAE	East Aceh	93	35	58	669[b)]

Note [a) and b)]different superscripts show significant differences (P<0.005)

Table 2 above showed the number of eggs per gram of feces. Cattle kept in HAE area had lower egg infestation compared to those kept in LAE area. Fourteen positive samples from the HAE obtained GI nematode eggs had an average of 567 eggs/gram feces. Meanwhile, the LAE of 35 positive samples turned out to produce an average of 669 eggs/gram feces. These results showed significant differences in various altitudes (P<0.005). The GI nematode egg infestations were lower in HAE environment compared to the LAE ones. However, the results of the average number of eggs, fecal egg counts (FEC) of gastrointestinal nematode infestation in HAE were categorized as the low category (<500 eggs), they were categorized as the medium category (between 500-1000 eggs) in LAE. The types of gastrointestinal nematode eggs can be seen in Figure 2.

Figure 2. Types of gastrointestinal nematode eggs found in fecal samples.

The number of eggs per gram fecal (EPGF) causing high gastrointestinal nematode (NGI) infections was found in cattle kept in HAE and LAE but was still considered low. This result follows that of [25] [26], stating that the number of egg (1-1000 eggs) is still considered light and medium category. However, the number of eggs, ≥ 1000 eggs, is considered a high category.

3.3. Risk Factor

Risk factors of gastrointestinal nematodes in cattle kept in different environments can be seen in Table 3. The results of OR calculation showed that the factor of raising cattle in LAE locations significantly

increased the risk of gastrointestinal nematodes infestation about 2.16 times higher than that of HAE locations (P<0.05).

Table 3. Analysis of gastrointestinal nematodes infestation risk factors in cattle based on the farming areas.

Areas Category	Nematoda GI					
	Total Sample	Sample Positive	Sample Negative	Prev (%)	OR	P (Value)
HAE	64	14	50	21.9 (95% CI: 13.5-33.43)	2.16 (95% CI: 1.04-4.45)	<0,05
LAE	93	35	58	37.6 (95% CI: 28.46-47.79)		

Note : Prev= prevalence, OR = Odds Ratio, CI = Confidence Interval.

The high level of prevalence and transmission risks of gastrointestinal nematode (NGI) in cattle farming environment in LAE area can be associated with environmental factors such as temperature, humidity and pH, population density, poor house conditions, and poor treatment. The gastrointestinal nematode egg can survive in the farming environment. According to [27], the high infestation in LAE areas can be associated with poor environmental conditions, maintenance management and housing located in densely populated areas with limited land, while cattle are constantly being carried to the same location during both dry and rainy seasons. Furthermore, [28] explained that the high prevalence of gastrointestinal nematode infestation in the environment is caused by exposure occurring due to environmental conditions such as unsuitable humidity and temperature.

4. Conclusion

In conclusion, these results indicated that the number of EPGF of GIN was significantly lower in HAE compared to LAE location. Also, the LAE location for raising cattle is a risk factor for higher GIN infestation prevalence in Aceh Province.

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