



UNIVERSITI PUTRA MALAYSIA

**DETECTION OF STRONGYLES IN HORSES
IN KLANG VALLEY AND SELANGOR**

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**DETECTION OF STRONGYLES IN HORSES
IN KLANG VALLEY AND SELANGOR**

NU'MAN BIN NOR SHAHRIN

A project paper submitted to the
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In partial fulfillment of the requirement for the
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It is hereby certified that we have read this project paper entitled “Detection of Strongyles in Horses in Klang Valley and Selangor”, by Nu’man Nor Shahrin and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999 – Final Year Project.

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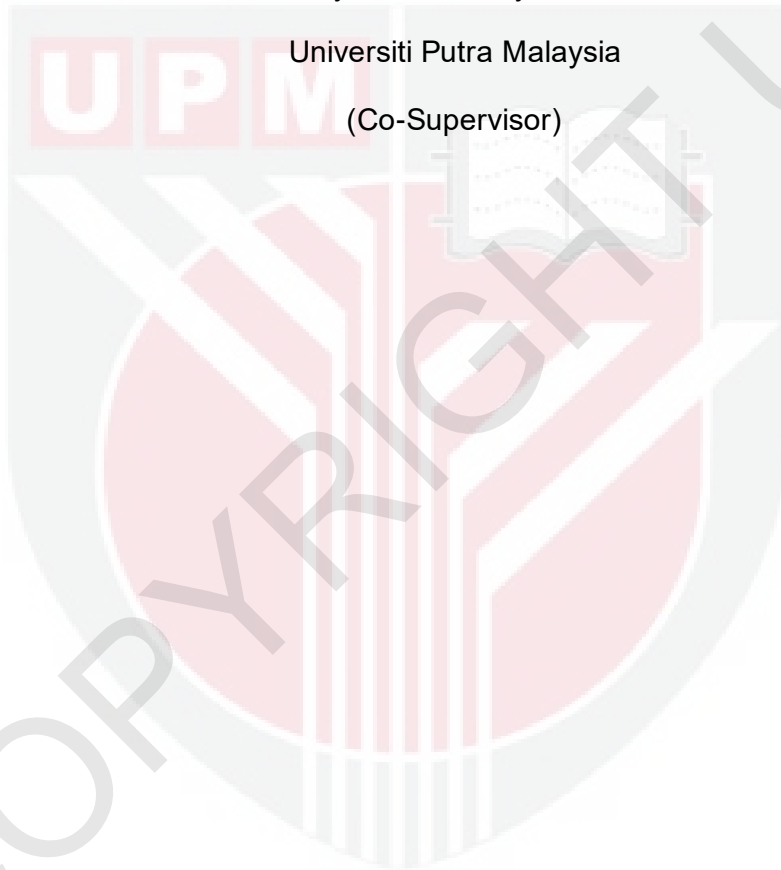
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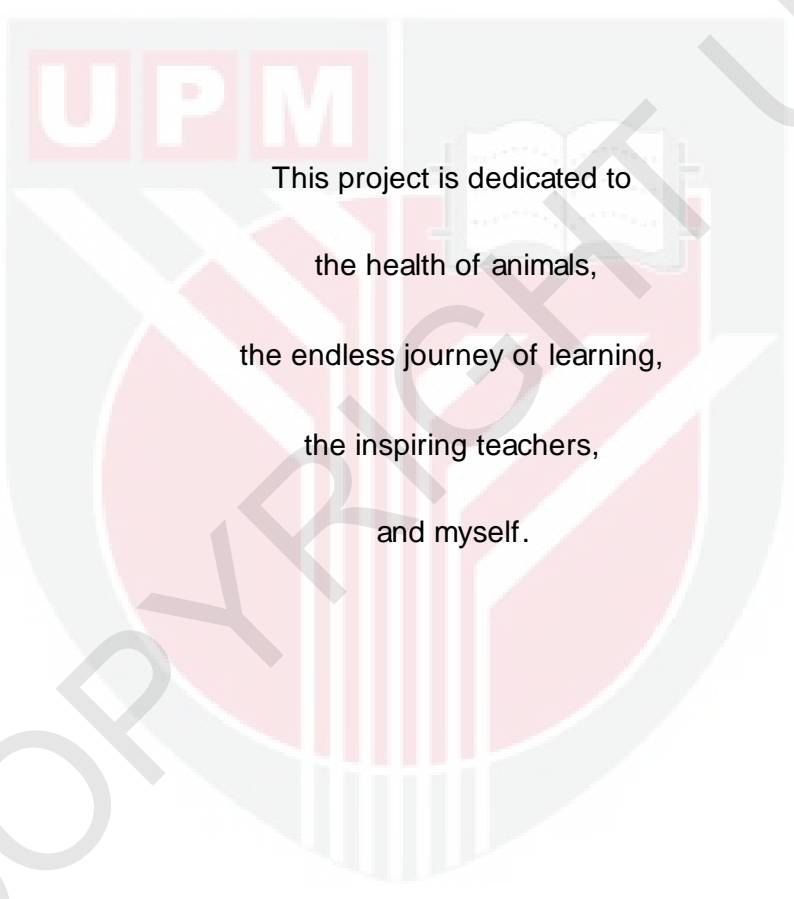
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DEDICATION

The background of the page features a large, semi-transparent watermark of the Universiti Putra Malaysia (UPM) logo. The logo is a shield-shaped emblem with a red and white color scheme. At the top left of the shield, the letters 'UPM' are written in a bold, white, sans-serif font. The central part of the shield contains a stylized white graphic that resembles a book or a set of wings, with a small circular emblem at its base. The shield is set against a light gray background.

This project is dedicated to
the health of animals,
the endless journey of learning,
the inspiring teachers,
and myself.

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ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek Akhir Tahun.

MENGESAN STRONGIL PADA KUDA DI LEMBAH KLANG DAN SELANGOR

Oleh

Nu'man Nor Shahrin

2023

Penyelia: Prof. Madya Dr. Noraniza Mohd Adzahan

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Strongil adalah suatu ancaman biasa dan penting untuk kesihatan kuda yang menyebabkan pelbagai masalah dan menimbulkan kebimbangan pada pemilik kuda dan doktor veterinar, menjadikan rawatan mereka penting sebagai strategi pencegahan. Cacing parasit ini boleh membawa pelbagai masalah, termasuk kolik, penurunan berat badan, dan penurunan prestasi kuda. Objektif kajian ini adalah untuk mengesan kehadiran strongil pada kuda yang lazimnya diberi ubat cacing dan untuk menilai keberkesanan ubat cacing yang digunakan. Sampel najis dikumpul secara rawak daripada 88 ekor kuda dari 8 kandang berbeza di Lembah Klang dan Selangor. Kiraan telur dalam najis (FEC) secara individu ditentukan menggunakan teknik *Modified McMaster* menggunakan larutan tepu natrium klorida (NaCl) pada graviti tentu 1.2 sebagai cecair terapung dengan had pengesanan 50 biji telur setiap gram (EPG). Secara keseluruhan, keputusan menunjukkan 31 (35.2%) daripada 88 kuda positif dengan strongil. Jenis baka ($p < 0.05$), jenis ubat cacing ($p < 0.05$) dan kekerapan penyahcacingan ($p = 0.01$), secara statistik mempunyai kaitan dengan

kehadiran strongil, manakala tiada kaitan bagi umur ($p=0.369$) dan jantina ($p=0.423$). Kuda baka Arab mempunyai prevalen tertinggi (83.33%) berbanding baka lain. Nisbah kemungkinan (OR) 21.33 untuk fenbendazol berbanding dengan ivermektin dan praziquantel menunjukkan bahawa kuda yang dirawat dengan fenbendazol adalah 21.33 kali berkemungkinan positif dengan strongil berbanding dengan kuda yang dirawat dengan ivermektin dan praziquantel. Hasil daripada kajian ini, dapat disimpulkan bahawa jenis baka, jenis ubat cacing, dan kekerapan penyahcacingan didapati menjadi faktor penyumbang yang penting untuk kehadiran strongil dalam kuda. Perkara ini juga penting kerana ia menunjukkan potensi fenbendazol sebagai ubat cacing pilihan dan menekankan keperluan untuk penyiasatan lanjut ke atas aplikasi klinikalnya.

Kata Kunci: *strongil, kuda, ubat cacing, Modified McMaster, kiraan telur dalam najis*

ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD 4999 – Final Year Project.

DETECTION OF STRONGYLES IN HORSES IN KLANG VALLEY AND SELANGOR

By

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2023

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Strongyle is a common and significant threat to equine health, causing various gastrointestinal issues and posing a major concern for horse owners and veterinarians, making their treatment crucial for prevention strategies. These parasitic worms can lead to a range of problems, including colic, weight loss, and decreased performance in horses. The objectives of this study are to detect the presence of strongyles in regularly dewormed horses and to evaluate the efficacy of the anthelmintic used. Faecal samples were randomly collected from a total of 88 horses from 8 different stables in Klang Valley and Selangor. Individual faecal egg count (FEC) was determined using Modified McMaster technique using sodium chloride (NaCl) supersaturated solution of specific gravity 1.2 as floatation fluid with detection limit of 50 eggs per gram (EPG). Overall, the result revealed 31 (35.2%) out of 88 horses were positive with strongyles. Types of breeds ($p < 0.05$), types of anthelmintic ($p < 0.05$) and deworming interval ($p = 0.01$), were statistically associated with the presence of strongyles, while age ($p = 0.369$) and sex ($p = 0.423$) were not.

Arabian breed horses have the highest prevalence (83.33%) compared to other breeds. The odds ratio (OR) of 21.33 for fenbendazole as compared to ivermectin and praziquantel indicates that horses treated with fenbendazole are 21.33 times higher odds of being positive with strongyle compared to those treated with ivermectin and praziquantel. In conclusion, types of breeds, types of anthelmintic, and deworming intervals were found to be significant contributing factors of strongyle presence in horses in this study. It is also significant as they highlight potential limitation of fenbendazole as dewormer of choice and underscoring the need for further investigation into its clinical application.

Keywords: strongyle, horses, anthelmintic, Modified McMaster, faecal egg count

1.0 INTRODUCTION

Endoparasite in horses is of veterinary importance in many countries. One of the most important equine gastrointestinal parasites are strongyle nematodes in the family Strongylidae, living in large intestines of equids, with adults localising in the caecum and colon. Equine strongyles comprise of the large strongyles (three *Strongylus spp.*, including *Strongylus vulgaris*), several *Triodontophorus spp.* and over 51 species of the subfamily cyathostominae, also called “small strongyles” (Cullinane et al., 2006).

Strongylus vulgaris is the most pathogenic of the large strongyles causing damage to the endothelium as a result of the intestinal infarction that larval stages can cause during their migration (Nielsen et al., 2012). Adult worms attaches and feed on the intestinal mucosa. Larval presence in arteries results in thrombosis, sometimes embolism, and ensuing disruption of the blood supply to the intestine and colic (Cullinane et al., 2006).

With the help of anthelmintics, parasitic worm infections in horses can be treated and controlled. However, drug inefficacy reports, despite the proper usage of anthelmintics have accumulated worldwide over the recent years, and resistant cyathostomin isolates are now to be found in Europe (Geurden et al., 2014; Sallé et al., 2017), America (Smith et al., 2015), and Oceania (Scott et al., 2015).

The aims of this study are to describe the prevalence of strongyles through the shedding of parasite eggs in the population of horses in Klang Valley and Selangor and to identify risk factors that are associated with gastrointestinal strongyle infection. It is expected for this study to help veterinarians and stable owners to decide the most effective parasite control programme for their horses.

The objectives of this study are to:

1. detect strongyles in regularly dewormed horses in Klang Valley and Selangor.
2. study the relationship between presence of strongyles and type of anthelmintic used in infected horses.



2.0 LITERATURE REVIEW

2.1 Management and Deworming Programme of Horses

The equine industry in Malaysia is still small and volatile compared to other developed countries such as the United Kingdom, the United States, or Australia as well as other Southeast Asian countries, for instance, the Philippines and Thailand (Hanis et al., 2020). In the urban areas of Malaysia, the horses are usually stabled in equestrian clubs, government stables or individual stable (Darmansah et al., 2017). A study by Razak et al. (2011) mentioned the horses from the stable in their study in Malaysia practices deworming every six months. According to American Association of Equine Practitioners (AAEP), one of the principles in deworming programmes for adult horses are to consist of one- or two-yearly treatments to target large strongyles, tapeworms, bots and spirurid nematodes responsible for causing summer sores.

2.2 Strongylosis in Horses

Strongylosis is an important internal parasitic disease of equines caused by nematodes of strongylidae family affecting more than 80% equids in the world (Khan et al., 2015). Large strongyles show major pathogenesis that encompasses verminous arteritis, damage of visceral organs, embolism or thrombosis leading to death and is attributed to migrating larvae of parasites (Adino et al., 2022). Clinically, small Strongyles (Cyathostominae) infection induces mild signs such as weight loss, anorexia, poor hair coat, intermittent diarrhoea, lethargy, body condition loss, peripheral oedema, and disturbed intestinal motility (McCraw and Slocombe, 1976; Hamed et al., 2019; Zivkovic et al., 2021). Management of these parasites has relied primarily on the use of anthelmintic treatments (Kornas et al., 2015).

2.3 Lifecycle of Strongyle

Strongyles enter the intestine at the third larval stage (L3), which has developed from eggs passed through the faeces onto pastureland (Corning, 2009). Ingested larvae penetrate the mucosa of the large intestine, molt to fourth stage (L4) in the submucosa, and then proceed along arterioles and arteries that supply the intestine to the root of the cranial mesenteric artery (Ogbourne and Duncan, 1985; Swiderski et al., 1999). Once there the larvae molt to immature adults (L5) causing severe arteritis before returning, again via the vasculature, to the large intestine to complete their life cycle (White, 1985; Swiderski et al., 1999). The entire cycle takes up to 6 months or more. Thus, the prepatent period in foals is considerable, and by the time ova appears in the faeces, significant vascular damage may have occurred (Gelberg, 2017).

2.4 Faecal Egg Count (FEC)

According to AAEP, faecal egg count is carried out to evaluate the anthelmintic efficacy using the faecal egg count reduction test (FECRT), to evaluate and monitor the egg reappearance period (ERP) of the most recently administered anthelmintic, to determine the shedding status of the horse at the time of sampling, and to determine whether parasite burdens in foals and weanlings are primarily *Parascaris spp.* or strongyle. Strongyle FEC cut-off values up to the level of 500 EPG yielded significantly higher strongyle worm counts in the treatment group, whereas no differences were found at higher cut-offs (Nielsen et al., 2010). Most studies used the McMaster technique to compare the performance of faecal egg count techniques (FECT) and reported higher estimates of accuracy, precision, and sensitivities for other techniques (Ghafar et al., 2021). One-off FEC cannot be used reliably to indicate disease risk in an individual. However, when used regularly and on a population basis between spring and autumn, FECs are invaluable for

informing the need to treat individuals to reduce egg contamination into the environment (Rendle et al., 2019).

2.5 Types of Anthelmintic and Its Efficacy

Modern equine anthelmintic can be divided to at least seven principal groups based on mode of action, i.e., benzimidazoles, probenzimidazoles, imidothiazoles, tetrahydropyrimidines, organophosphates, piperazines, and avermectins (Wescott, 1987). Fenbendazole, pyrantel, ivermectin and moxidectin are all licensed for reducing patent strongyle numbers and reducing egg excretion during the grazing seasons. Resistance to fenbendazole is ubiquitous, so benzimidazole should not be used unless efficacy has been demonstrated in FECRT (Rendle et al., 2019). Resistance in horses is primarily confined to benzimidazoles and is most reported in cyathostomes. A reduction in egg count of less than 90% is indicative of benzimidazole resistance (Bauer et al., 1986; Coles et al., 1992). Nielsen et al. (2022) mentioned in his study of evidence of ivermectin resistance documented a group of yearling horses in the United States.

3.0 MATERIALS AND METHODS

3.1 Study Design

A cross-sectional study on 88 domestic horses from eight different stables was randomly selected. All 88 horses of various age, sex, breed, management and deworming status were selected.

3.2 Selection of Horses

Domestic horses from nine stables with different deworming practices were selected through convenience sampling. Specifically, horses that defecated after the stables were cleaned were chosen. The management of the horses' establishments are more or less the same. The horses are managed in its stable most of the time and are brought out for work and grazing for a few hours in a day. Information of the age, sex, breed, management, and deworming status of the horses were recorded (Appendix).

3.3 Sample Collection and Transportation

Faecal sample freshly voided from the rectum was collected. After collection, the faecal samples were sealed in sample bag with minimum air and kept in icebox with ice packs and transferred into refrigerator under 4°C. Sample was analysed within seven days.

3.4 Modified McMaster Faecal Egg Count

Modified McMaster Technique was used to determine the number of strongyle eggs per gram (EPG) of faeces. The faecal material was loosened, and the middle portion of faeces was taken into the beaker. Four grams of faecal samples were weighted using electronic scale in a 100ml beaker and added with sodium chloride (NaCl) supersaturated solution with specific gravity of 1.2 until it reached 60 ml

mark. The solution was mixed thoroughly and filtered using tea sieve into another 100 ml beaker and the residues discarded.

The filtrates were stirred and pipetted into the counting chamber of McMaster slides. The slides were allowed to stand for 10 seconds. Under light microscope, the X 100 objective lens was used to visualize and count the eggs in each chamber. EPG was calculated using the formula below:

$$\frac{\text{Number of eggs}}{\text{Weight of faeces (4g)}} \times \frac{\text{Volume of NaCl (60ml)}}{2 (0.15\text{ml McMaster chamber})}$$

= Eggs per gram of faeces

3.5 Statistical Analysis

Chi-square test was used to determine the significant association between the detection of strongyles with age, sex, and breed at 95% confidence level. All statistical analysis was performed using IBM® SPSS® software for Windows.

4.0 RESULTS

4.1 Prevalence of Strongyles

The overall prevalence of strongyles in horses in different stables (labelled A-H) around Selangor and Klang Valley revealed that 31 samples out of 88 samples (35.2%) were positive of strongyles at 95% confidence, $p < 0.05$ (Figure 1). The result shows stable E and F having no prevalence of strongyle, while stable C and G with the highest prevalence.

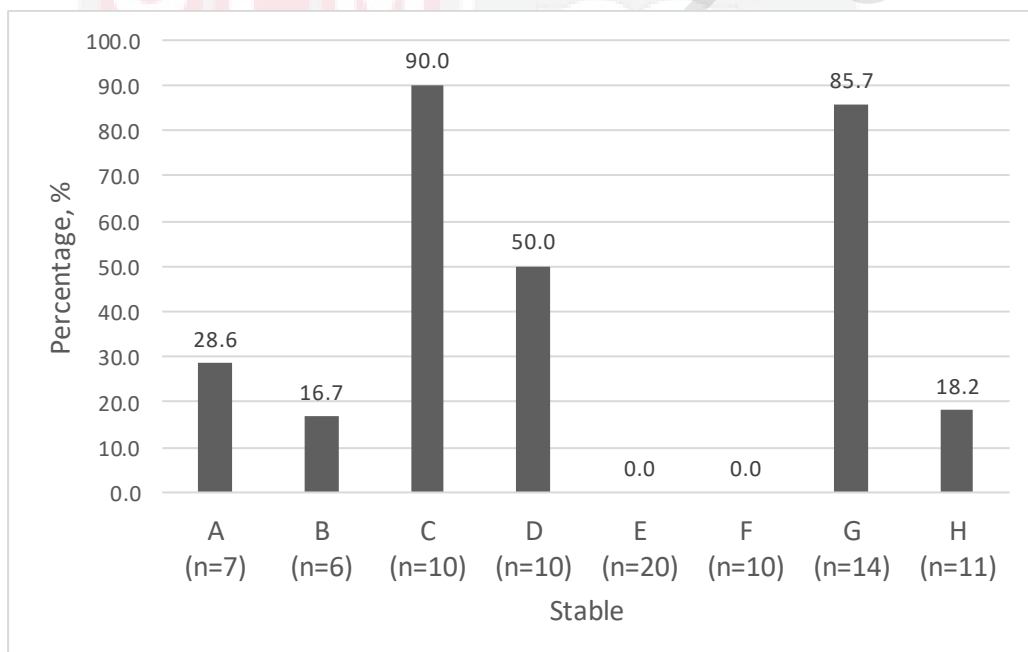


Figure 1: Prevalence based on stables.

4.2 Faecal Egg Count (FEC)

Overall, all the stables, except stable E and F were positive with strongyles with majority of the horses (79.5%) were of low contaminators at 0-200 EPG (Figure 2). Meanwhile, ten horses were high contaminators of >500 EPG, making it 11.4% of the overall sample taken, with the remaining 9.1% being moderate contaminators at 200-500 EPG.

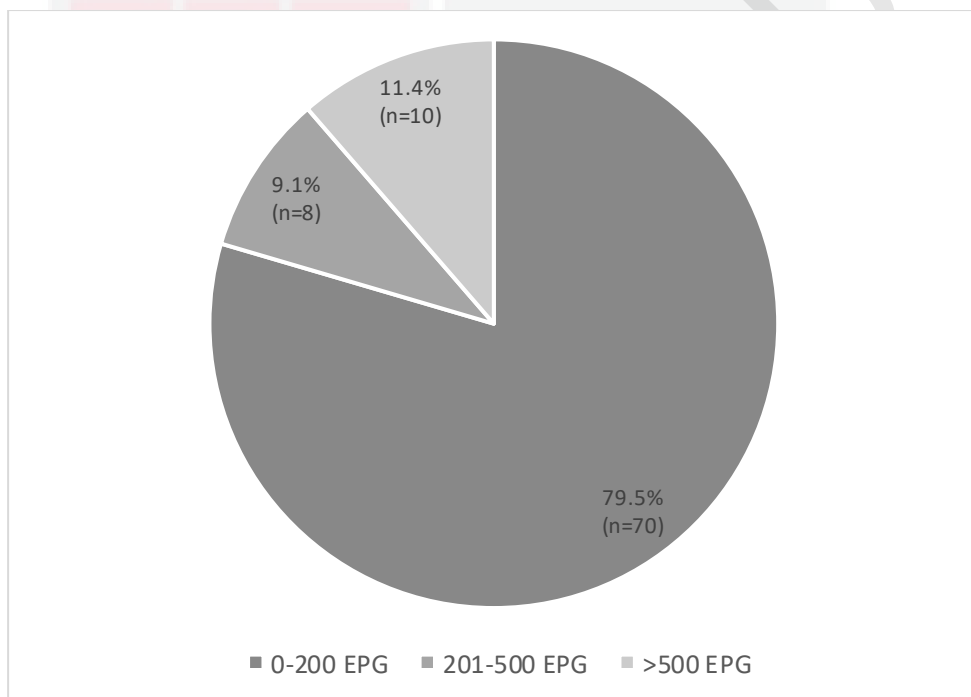


Figure 2: Faecal egg count result.

4.3 Factors of Prevalence

For the prevalence of strongyles related to age group and sex of the horse in Table 1 and 2, there were no significant association found between them ($p > 0.05$). This means that in this study, age and sex does not influence the presence of strongyles. Meanwhile, for the prevalence of strongyles related to breed, it showed significant association ($p = 0.00$) with Arabian breed showing the highest prevalence (83.3%) comparing to Sumbawa Cross breed with the lowest prevalence (0.0%) as shown in Table 3. Next, horses with deworming intervals of more than 6 months have shown a higher prevalence of strongyles (56.0%) compared to less than 6 months (27.0%), with significant association of $p = 0.01$ as presented in Table 4. Similarly, the type of anthelmintic showed significant association with prevalence of strongyles ($p = 0.00$), with horses that was dewormed with fenbendazole having higher prevalence (59.3%) compared to ivermectin and praziquantel (2.8%) as shown in Table 5.

Table 1: Age group in relation to the prevalence of strongyles in horses.

Age Group	Number of Horses Examined	Number of Positive Samples	Positive Sample (%)
1-5	2	1	50.0
6-10	44	19	43.2
11-15	22	4	18.2
15-20	15	5	33.3
20-25	5	2	40.0
Chi-square (P-value)			P = 0.369

Table 2: Sex in relation to the prevalence of strongyles in horses.

Sex	Number of Horses Examined	Number of Positive Samples	Positive Sample (%)
Male	32	12	37.5
Female	56	19	33.9
Chi-square (P-value)			P = 0.423

Table 3: Breed in relation to the prevalence of strongyles in horses.

Breed	Number of Horses Examined	Number of Positive Samples	Positive Sample (%)
Polo Pony	22	15	68.2
Sumbawa Cross	8	0	0.0
Arabian	12	10	83.3
Thoroughbred	13	3	23.1
Warmblood	18	0	0.0
Others	15	3	20.0
Chi-square (P-value)			P = 0.00

Table 4: Deworming interval in relation to the prevalence of strongyles in horses.

Deworming Interval	Number of Horses Examined	Number of Positive Samples	Positive Sample (%)
<6 months	63	17	27.0
>6 months	25	14	56.0
Chi-square (P-value)			P = 0.01

Table 5: Types of anthelmintic in relation to the prevalence of strongyles in horses.

Dewormer Type	Number of Horses Examined	Number of Positive Samples	Positive Sample (%)
Fenbendazole	27	16	59.3
Ivermectin + Praziquantel	36	1	2.8
Chi-square (P-value)			P = 0.00

4.4 Risk Estimation

Risk estimation is the use of odds ratio (OR) is a way to quantify the strength and direction of the relationship between the exposure and outcome. The OR of fenbendazole is 21.33 times more likely to be positive of strongyles compared to when using ivermectin + praziquantel (Table 6). It could also be said that fenbendazole is 2.4 times less likely to be negative of strongyles comparing to ivermectin + praziquantel.

Table 6: The risk estimation table.

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Active Ingredient (Fenbendazole/Ivermectin + Praziquantel)	0.020	0.002	0.165
For cohort Present = Negative	0.419	0.265	0.663
For cohort Present = Positive	21.333	3.012	151.103
N of Valid Cases			63

5.0 DISCUSSION

Studies carried out in Malaysia related to strongyles are usually under the umbrella of gastrointestinal parasites. However, specific study on the prevalence of strongyles in horses has not been done yet. A study in Italy reported that approximately 40% of all horses in Italy shed strongyle eggs and that almost 90% of stables have at least one infected animal (Scala et al., 2020). Meanwhile, in Ethiopia, strongylosis was discovered in 67.19% of the sampled horses (Alemayehu et al., 2022). In this study, the prevalence of strongyles was found to be 35.2% in Selangor and Klang Valley area. The prevalence of strongyles is slightly lower comparing to Italy. However, comparing to Ethiopia, there is a difference of 31.99%, which could be due to the different styles of management. Majority of the horses are used for carriage like riding, carting and packing, with some for ploughing and the rest for races, wedding ceremonies, religious activities and warfare purposes (Alemayehu et al., 2022). In Malaysia, the horses are mainly used for leisure riding, equestrian sport, polo, endurance and patrolling (Hanis et al., 2020).

Eighty per cent of horses in this study were classified to be low contaminators, having 0-200 EPG. When speaking of FEC, the thresholds of >200 EPG are often used and accepted internationally. Horse owners in countries including Denmark, Sweden, the Netherlands, and Finland have widely and successfully used selective anthelmintic therapy (SAT) for several years (Shneider et al., 2014). One study illustrated that if highly effective drugs are used, treating all adult horses exceeding a strongyle FEC of 200 EPG, only leads to treating about 50% of the horse population, but still provides about 95% reduction of the overall egg shedding (Kaplan and Nielsen, 2010).

Based on this study, sex and age of horses had no significant relationship with the prevalence of strongyles. However, in some surveys, females showed a significantly higher prevalence. This is likely due to pregnancy and lactation causing the females to be more sensitive compared to males (Scala et al., 2020). Similarly, studies in Sweden (Lind et al., 1999), Denmark (Larsen et al., 2002), Spain (Francisco et al., 2009) and Australia (Bucknell et al., 1995), indicates that horses from the age of 1-3 years old has more strongyle eggs comparing to older horses. The reason for both of these factors to be found non-significant in this study could be due to the small sample size.

In this study, it was found that Arabian horses have the highest strongyle presence with the prevalence of 83.3%. However, a plausible explanation could be related to the different management of the animals, rather than a potential genetic susceptibility (Scala et al., 2020). In this case, most of the Arabian horses sampled were from the same stable (Stable C), with 100% of their Arabian horses, which is 70% of their population sampled, found to be positive with strongyle presence. It is plausible that the high prevalence of strongyles may be influenced by the stable management.

Regarding deworming intervals, there has been a lack of research in Malaysia to determine the best intervals to deworm horses. However, it is a common practice among stable owners and veterinarian here to deworm horses twice a year. Generally, selective anthelmintic therapy (SAT) has been recommended as a sustainable strategy for cyathostomin control in horse population. This is through the approach of strongyle FEC, with the treatment only recommended for those exceeding a predetermined threshold (Leathwick et al., 2019). According to American Association of Equine Practitioners (AAEP), performing FEC surveillance

is necessary to properly develop and monitor any parasite control programme. A proper FEC survey has not been done in equine practice in Malaysia regularly, and therefore could be suggested in the future studies.

The next step after performing FEC is to treat or to control the parasite through deworming. The choice of anthelmintics is usually dependent on the stable owners. In this study, it was found that 59.3% of the horses using fenbendazole was positive of strongyles, comparing to ivermectin and praziquantel having only 2.8% positive of strongyles. Although the result has been found significant, the proper method to detect resistance of strongyles against anthelmintic is through Faecal Egg Count Reduction Test (FECRT). The anthelmintic efficacy of a chemical is determined by comparing worm egg counts from the animal before and after treatment (Fissiha and Kinde, 2021). In Czech Republic, a study by Napravnikova (2022) found that ivermectin demonstrated excellent efficacy (FECR 99.8–100%) in 45 operations. Fenbendazole, however, was not effective in a single operation (FECR 19.1–77.8%) out of 18. Further research in Malaysia should be done properly to assess for fenbendazole resistance.

6.0 CONCLUSION

In conclusion, this study prompts a re-evaluation of anthelmintic practices, advocating for a more targeted and sustainable approach, considering regional variations, breed-specific vulnerabilities, and potential anthelmintic resistance. These findings lay the groundwork for future research, guiding the development of effective parasite control programmes tailored to the unique equine landscape in Malaysia.

7.0 RECOMMENDATIONS

Key recommendations stemming from the study encompass the urgency for specific investigations into strongyle prevalence among Malaysian horses, with a focus on adapting management practices according to the most suitable option for the stable. Faecal culture might also be an option when studying strongyles, as to accurately assess strongyles commonly found in local horses. The adoption of selective anthelmintic therapy (SAT) is advised, following successful models in other countries, and re-evaluating the practice of biannual deworming considering potential variations in efficacy. Continuous faecal egg count (FEC) surveillance is paramount for effective parasite control, aligning with international guidelines. Additionally, a comprehensive assessment of anthelmintic efficacy, particularly through the Faecal Egg Count Reduction Test (FECRT), is crucial to gauge and address resistance issues.

8.0 REFERENCES

- Adino, A., Girma, A., Hurma, N. (2022). Review on epidemiology of strongylosis. *Journal of Veterinary Science and Technology*, 13(5).
- Alemayehu, M. T., Abebe, B. K., & Haile, S. M. (2022). Investigation of Strongyle Prevalence and Associated Risk Factors in Horses in and around Alage District, Ethiopia. *Journal of parasitology research*, 2022, 3935008. <https://doi.org/10.1155/2022/3935008>
- Clark, A., Sallé, G., Ballan, V., Reigner, F., Meynadier, A., Cortet, J., Koch, C., Riou, M., Blanchard, A., & Mach, N. (2018). Strongyle Infection and Gut Microbiota: Profiling of Resistant and Susceptible Horses Over a Grazing Season. *Frontiers in physiology*, 9, 272. <https://doi.org/10.3389/fphys.2018.00272>
- Coles, G. C., Bauer, C., Borgsteede, F. H. M., Geerts, S., Klei, T. R., Taylor, M. A., & Waller, P. J. (1992). World Association for the Advancement of Veterinary Parasitology (WAAVP) methods for the detection of anthelmintic resistance in nematodes of veterinary importance. *Veterinary parasitology*, 44(1-2), 35-44. [https://doi.org/10.1016/0304-4017\(92\)90141-U](https://doi.org/10.1016/0304-4017(92)90141-U)
- Corning, S. (2009). Equine cyathostomins: a review of biology, clinical significance and therapy. *Parasites & Vectors*, 2(Suppl 2), S1.
- Darmansah, N. F., Misnan, M. S., Sam, A. R. M., & Omar, A. H. (2017). Contribution of Equine Education to the Equine Industry Development in Malaysia. *Advanced Science Letters*, 23(4), 2818-2820. <https://doi.org/10.1166/asl.2017.7685>
- Fissiha, W., & Kinde, M. Z. (2021). Anthelmintic Resistance and Its Mechanism: A Review. *Infection and drug resistance*, 14, 5403–5410. <https://doi.org/10.2147/IDR.S332378>
- Gelberg, H. B. (2017). Chapter 7—Alimentary System and the Peritoneum, Omentum, Mesentery, and Peritoneal Cavity1. *Pathologic Basis of Veterinary Disease, 6th ed.; Zachary, JF, Ed*, 324-411. <https://doi.org/10.1016/B978-0-323-35775-3.00007-2>
- Ghafar, A., Abbas, G., King, J., Jacobson, C., Hughes, K. J., El-Hage, C., ... & Jabbar, A. (2021). Comparative studies on faecal egg counting techniques used for the detection of gastrointestinal parasites of equines: A systematic review. *Current research in parasitology & vector-borne diseases*, 1, 100046. <https://doi.org/10.1016/j.crpvbd.2021.100046>
- Grice, A., Erskine, M., Graves, E., Vaala, W., Tully, R. C., & French, D. D. AAEP Parasite Control Guidelines.
- Hanis, F., Chung, E. L. T., Kamalludin, M. H., & Idrus, Z. (2020). The influence of stable management and feeding practices on the abnormal behaviors among stabled horses in Malaysia. *Journal of equine veterinary science*, 94, 103230. <https://doi.org/10.1016/j.jevs.2020.103230>
- Higgins, A. J., & Snyder, J. R. (Eds.). (2013). *The equine manual*. Elsevier Health Sciences.

- Khan, M. A., Roohi, N., & Rana, M. A. A. (2015). Strongylosis in equines: a review. *JAPS: Journal of Animal & Plant Sciences*, 25(1).
- Kornas, S., Cabaret, J., Skalska, M., & Nowosad B. (2010). Horse infection with intestinal helminths in relation to age, sex, access to grass and farm system. *Veterinary Parasitology*, 174(3–4), 285-291, <https://doi.org/10.1016/j.vetpar.2010.09.007>
- Kornaś, S., Sallé, G., Skalska, M., David, I., Ricard, A., & Cabaret, J. (2015). Estimation of genetic parameters for resistance to gastro-intestinal nematodes in pure blood Arabian horses. *International journal for parasitology*, 45(4), 237-242. <https://doi.org/10.1016/j.ijpara.2014.11.003>
- Leathwick, D. M., Sauermann, C. W., & Nielsen, M. K. (2019). Managing anthelmintic resistance in cyathostomin parasites: Investigating the benefits of refugia-based strategies. *International Journal for Parasitology: Drugs and Drug Resistance*, 10, 118-124. <https://doi.org/10.1016/j.ijpddr.2019.08.008>
- Nápravníková, J., Várady, M., & Vadlejch, J. (2022). Total Failure of Fenbendazole to Control Strongylid Infections in Czech Horse Operations. *Frontiers in veterinary science*, 9, 833204. <https://doi.org/10.3389/fvets.2022.833204>
- Nielsen, M. K., Baptiste, K. E., Tolliver, S. C., Collins, S. S., & Lyons, E. T. (2010). Analysis of multiyear studies in horses in Kentucky to ascertain whether counts of eggs and larvae per gram of feces are reliable indicators of numbers of strongyles and ascarids present. *Veterinary Parasitology*, 174(1-2), 77-84. <https://doi.org/10.1016/j.vetpar.2010.08.007>
- Nielsen, M. K., Littman, B. A., Orzech, S. W., & Ripley, N. E. (2022). Equine strongylids: ivermectin efficacy and fecal egg shedding patterns. *Parasitology Research*, 121(6), 1691-1697.
- Razak, R. A., Ahmad, Bashir., Hassan, L., & Isa, N. M. M. (2011). Field evaluation of ivermectin and mebendazole treatment against gastrointestinal parasite in stable horses. *6th proceedings of the seminar on veterinary science*, 83-90.
- Rendle, D., Austin, C., Bowen, M., Cameron, I., Furtado, T., Hodgkinson, J., ... & Matthews, J. (2019). Equine de-worming: a consensus on current best practice. *UK-Vet Equine*, 3(Sup1), 1-14. <https://doi.org/10.12968/ukve.2019.3.S.3>
- Schneider, S., Pfister, K., Becher, A. M., & Scheuerle, M. C. (2014). Strongyle infections and parasitic control strategies in German horses - a risk assessment. *BMC veterinary research*, 10, 262. <https://doi.org/10.1186/s12917-014-0262-z>
- Scala, A., Tamponi, C., Sanna, G., Predieri, G., Dessì, G., Sedda, G., Buono, F., Cappai, M. G., Veneziano, V., & Varcasia, A. (2020). Gastrointestinal Strongyles Egg Excretion in Relation to Age, Gender, and Management of Horses in Italy. *Animals : an open access journal from MDPI*, 10(12), 2283. <https://doi.org/10.3390/ani10122283>

- Swiderski, C. E., Klei, T. R., Folsom, R. W., Pourciau, S. S., Chapman, A., Chapman, M. R., ... & Horohov, D. W. (1999). Vaccination against *Strongylus vulgaris* in ponies: Comparison of the humoral and cytokine responses of vaccinates and nonvaccinates. *Advances in veterinary medicine*, 41, 389-404. [https://doi.org/10.1016/S0065-3519\(99\)80029-9](https://doi.org/10.1016/S0065-3519(99)80029-9)
- Wescott, R. B. (1987). Anthelmintics for horses. *International Journal for Parasitology*, 17(2), 503-510. [https://doi.org/10.1016/0020-7519\(87\)90126-3](https://doi.org/10.1016/0020-7519(87)90126-3)
- Živković, S., Pavlović, I., Mijatović, B., Trailović, I., & Trailović, D. (2021). Prevalence, intensity and risks involved in helminth infections in domestic mountain pony and Balkan donkey in Nature Park Stara Planina, Serbia. *Iranian Journal of Parasitology*, 16(2), 318. <https://doi.org/10.18502/ijpa.v16i2.6283>

