

## Strongyloidiasis in Bornean Orangutan: A Case Report

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### Abstract

This study reported the diagnosis and treatment of Strongyloidiasis in two Bornean orangutans (*Pongo pygmaeus*); adult male aged 23 years, weighing 100 kg and an infant female orangutan, 4 years old, weighing 13,6 kg. Samples were physically and laboratory examined for faeces using the Mini–FLOTAC method. Therapy was performed on the adult orangutan using albendazole at a dose of 400 mg individual twice a day for 4 days, orally. The infant orangutan was administered albendazole at a dose of 10 mg/kg BW once a day for 3 days orally. From several physical examinations, both orangutans looked active, body temperature and oral mucosa color were normal, green feces with solid consistency in the adult orangutan and brown with solid consistency in the infant orangutan. Microscopic faeces examination of the adult orangutan showed *Strongyloides sp.* as many as 1005 eggs per gram (EPG) of feces, and the infant orangutan as many as 2490 larvae per gram of feces. Both orangutans were diagnosed with severe Strongyloidiasis based on those examinations. Three days after starting treatment, the adult orangutan's EPG decreased to 890, and a week later, no *Strongyloides sp.* eggs or larvae were discovered. A week following treatment, no *Strongyloides sp.* was discovered in an infant orangutan. In conclusion, albendazole was an effective treatment for severe Strongyloidiasis in adult and infant orangutans. Strongyloidiasis can be a threat to both infant and adult orangutans without distinct clinical symptoms.

Keywords: albendazole, Bornean orangutan, Strongyloidiasis, *Strongyloides sp.*

Received: 8 March 2023

Revised: 15 May 2023

Accepted: 4 July 2023

### INTRODUCTION

IUCN, also known as the International Union for Conservation of Nature and Natural Resources, has classified the Bornean orangutan (*Pongo pygmaeus*), an Indonesian endemic mammal, as critically or extremely endangered (Ancrenaz *et al.*, 2016). Because orangutans are included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2023), they are prohibited from being traded. The population of orangutans is declining due to factors like hunting, selling newborns, deforestation, fires, illegal logging, as well as a number of infectious diseases (Supriadi *et al.*, 2012; Mynáová *et al.*, 2016). Intestinal worms are just one of the many parasitic disorders that affect orangutans

(Nurcahyo *et al.*, 2017). *Strongyloides stercoralis* is one of the gastrointestinal worms that frequently infects orangutans (Panda *et al.*, 2021).

A condition known as strongyloidiasis is brought on by infection with the worm *Strongyloides sp.* According to Zulfikri *et al.* (2018), the size of an embryonated *Strongyloides sp.* egg is 50–63 x 26–35 m. Smith (2020) asserts that compared to adults, infant have a larger risk of suffering from *Strongyloides sp.* infection. Strongyloidiasis in adult orangutans frequently goes unnoticed and exhibits no overt symptoms.

Strongyloidiasis, which develops when the worms in the body are present in large numbers and can cause inflammation as the larvae migrate through the tissue, can cause sudden death in newborns and young orangutans, in contrast to adult orangutans. Lethargy is the most typical



clinical symptom. Coughing is one of the respiratory symptoms that can resemble viral illnesses in some circumstances (Smith, 2020). In this study animal did not exhibit these signs.

Orangutan cases of Strongyloidiasis may be treated with albendazole. The total number of eggs per gram (EPG) of feces can be decreased with administration at the proper dose (Yahaya *et al.*, 2013; Smith, 2020). Albendazole and its metabolites function by binding to beta-tubulin, which damages the dynamic equilibrium of worm microtubulin. Only worms in large concentrations are selectively poisonous to albendazole. Typically, this medication is taken orally. The medication will be absorbed, transported throughout the body, and then transcuticularly diffused to the target parasite. According to Enejoh and Suleiman (2017), albendazole is effective against both larval and adult stages.

*Strongyloides sp.* and other pathogenic gastrointestinal parasite diseases can impair immunity, deplete bodily reserves of nutrients, and potentially pose a threat to people if they are zoonotic. Infection with *Strongyloides sp.* in orangutans This might happen in rehabilitation centers because of the environment's impact and maintenance management's influence (Nurcahyo and Prastowo, 2013; Kleinschmidt *et al.*, 2018). In order to prevent casualties and lower the danger of transmission, *Strongyloides sp.* infection in orangutans needs to be treated with the appropriate treatment. Special conservation organizations having a program dedicated to conserving orangutans include the Borneo Orangutan Survival Foundation Samboja Lestari (BOSF–SL) and the Orangutan Sanctuary Center (PSO–ARSARI). In this paper, Bornean orangutans with Strongyloidiasis were reported along with their treatment.

## MATERIALS AND METHODS

### Ethical Approval

An administration process for licensing this study has been completed. The ARSARI Djohadikusumo Foundation (YAD) and the Borneo Orangutan Survival Foundation Samboja

Lestari (BOSF–SL) confirmed their approval to conduct this study.

### Sample

A male orangutan at PSO–ARSARI in Maridan, Sepaku, Penajam Paser Utara, East Kalimantan, who was around 23 years old, weighed an estimated 100 kg, and was used as the sample for the evaluation. Another example of an orangutan comes from BOSF–SL, Margomulyo, Samboja, Kutai Kartanegara, East Kalimantan. A female infant orangutan was roughly 6 years old, and weighed an estimated 13,6 kg.

### Physical Examination

Orangutans in this study were examined including the consistency and color of feces, condition of the oral mucosa, body temperature and activity (Yahaya *et al.*, 2013). The results of the examination showed that all the animals were in normal condition. The adult orangutan revealed solid green feces, normal oral mucosa, body temperature of 36,4°C, and the animal moved actively. The infant orangutan reported solid brown feces, normal oral mucosa, body temperature of 36,7°C, and the animal was moving actively.

### Fecal Examination

Fecal examination was performed following the Mini–FLOTAC method (University of Naples Federico II, Italy). A total of 2 grams of feces were weighed directly in the "Fill–FLOTAC" container, 38 ml of flotation fluid was added, then homogenized thoroughly. Mini–FLOTAC slides were filled with fecal suspension (2 × 1 ml), allowed to stand for 10 min, the disk was spun, and evaluated using a microscope. The total number of parasites found per gram of feces was obtained by calculating the total number of eggs or larvae found multiplied by 5 in the eggs per gram (EPG) or larvae per gram (LPG) units (Daş *et al.*, 2020).

### Diagnosis

Based on the anamnesis, physical examination and laboratory examination, it can be concluded that all orangutan cases were

diagnosed with sub-clinical strongyloidiasis. Sub-clinical cases are different from clinical cases, where in clinical cases, the agent can cause symptoms in the host.

### Therapy

Albendazole (Albenol-100 orally, Interchemie, Netherlands) was administered to adult orangutans at a total dose of 400 mg for adults, delivered twice daily over a period of four days (Smith, 2020). For three days, albendazole 10 mg/kg BW was administered to orangutan infants. Orally, the pill was dissolved in baby porridge (Sun, PT. Indofood CBP Sukses Makmur Tbk., Indonesia) to mix a bolus with a dose of 3 powder : 1 water, which was then administered.

## RESULTS AND DISCUSSION

The results of physical examination and feces of both orangutans showed normal conditions (Table 1). The results of fecal examination using the Mini-FLOTAC method found eggs and larvae of the worm *Strongyloides sp.* (Figure 1). The sizes of worm eggs and larvae range between  $55\text{--}56 \times 22\text{--}39 \mu\text{m}$  and  $167\text{--}200 \mu\text{m}$  respectively. The results of quantitative fecal examination showed 1005 LPG in adult and 2490 LPG in infant samples respectively.

Based on the results of physical and laboratory examinations, adult and infant orangutans were diagnosed with Strongyloidiasis due to infection with *Strongyloides sp.* Factors that play a role in the occurrence of *Strongyloides sp.* infection include; behavior, physical condition, nutritional conditions, age, gender, body weight, and social status (Nurcahyo and Prastowo, 2013). The cages at PSO-ARSARI are individual. Several wild long-tailed monkeys come to steal food in the form of fruit and vegetables during the orangutans are fed, so these monkeys also have the potential to carry *Strongyloides sp.* (Kurniawati *et al.*, 2020). The parthenogenetic life cycle of *Strongyloides sp.* is also thought to be a factor in causing adult orangutans to become infected. Based on medical

history, adult orangutans have been infected with *Strongyloides sp.* before, so the possibility of autoinfection or reinfection exists (Nosková *et al.*, 2023). Meanwhile, the infant orangutans are cared for at the Baby House facility and play in nature by climbing trees. According to Huffman *et al.* (2013), Selian *et al.* (2013) and Wich *et al.* (2016), potential parasitic infections can be obtained from soil contaminated with infective stages.

The severity of *Strongyloides sp.* worm infection in orangutans can be based on the number of worm eggs found in the host's feces (Harahap and Gultom, 2017). The intensity of worm infection was classified based on EPG (Table 2).

In this case, the adult orangutan's feces contained 1005 LPG of *Strongyloides sp.* worm eggs, while the infant orangutan was infected with 2490 LPG, so it can be concluded that both of them had severe levels of Strongyloidiasis. All case animals did not show clinical symptoms. One factor in the absence of clinical symptoms in orangutans in this study may be due to maintenance management and provision of good nutritional feed. According to Dalimunthe *et al.* (2020), food is a very important factor in orangutan immunity in protecting against infection. These findings differ from those of Kleinschmidt *et al.* (2018) who reported that a 5 month old Sumatran orangutan who was positively infected with *Strongyloides sp.* experienced lethargy, flu, respiratory problems, was inactive, accompanied by bloat and yellow watery feces. Orangutans were diagnosed with pneumonia and jaundice due to *Strongyloides sp.* infection.

Albendazole is the causative treatment that can be administered to animals with Strongyloidiasis cases (Smith, 2020). In order to disrupt the dynamic equilibrium of worm microtubulin, albendazole and its metabolites first bind to beta tubulin (Suroiyah *et al.*, 2018). Transcuticular diffusion is used to deliver the medicine to the target parasite after it has been dispersed (Enejoh and Suleiman, 2017). Oral Ivermectin at a dose of 0,5 mg/kg BW is another medication option for Strongyloidiasis treatment

**Table 1.** Physical examination results

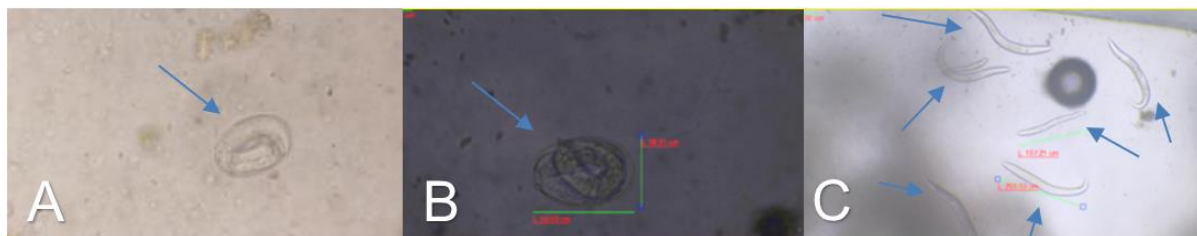
Location	Age	Fecal condition		Color of the oral mucosa	Temperature*
		Consistency	Color		
PSO–ARSARI	Adult	Solid	Green	Normal	36,4°C
BOSF–SL	Infant	Solid	Brown	Normal	36,7°C

**Table 2.** Degree of worm infection based on number of EPG

Total	Unit	Degrees
15–149	Eggs per gram of feces	Light degree
150–275	Eggs per gram of feces	Mild
276–749	Eggs per gram of feces	Moderate
> 750	Eggs per gram of feces	Severe

**Table 3.** Evaluation of the number of larvae during the study

Age	Larvae per gram (LPG)		
	Day 1	Day 3	Day 14
Adult	1005	890	0
Infant	2490	n/a	0



**Figure 1.** Eggs of *Strongyloides sp.* in orangutan feces found using the Mini–FLOTAC method; (A) adult, (B) infant (magnification 40×10), (C) worm larvae (magnification 10×10).

in orangutans (Kleinschmidt *et al.*, 2018). Results of treatment on adult orangutans in this case revealed that 3 days after therapy, the color of the feces changed to brown, there was a drop in the quantity of EPG from 1005 to 890, and no worm eggs or larvae were discovered one week later. The amount of parasites, which was 2490 EPG on the first day of the inspection, was negative a week later (Table 3). Since all of the orangutans in this study were assessed, there were no changes in appetite or stool consistency, clinical conditions, or activity levels during the study of the trial or the first week following therapy. The two orangutans were deemed to be cured on the seventh day based on these circumstances.

**CONCLUSION**

In this case, adult and infant orangutans were infected with *Strongyloides sp.* without showing clinical symptoms. Strongyloidiasis therapy in adult orangutans was administered with 400 mg

of albendazole twice a day for 4 days. Meanwhile, infant orangutans were administered albendazole 10 mg/kg BW once a day for 3 days. Regular monthly fecal investigations are required to monitor cases of strongyloidiasis in orangutans. Routine disinfection is required to keep the environment clean, especially for cage bedding. It is necessary to conduct study by analyzing the feces of wild primates near the enclosure. This test was conducted to look for any potential transfer from wild monkeys to orangutans.

**ACKNOWLEDGEMENTS**

The author would like to thank the East Kalimantan Natural Resources Conservation Center, the ARSARI Djojohadikusumo Foundation, the Orangutan Sanctuary Center (PSO–ARSARI), and the Borneo Orangutan Survival Foundation Samboja Lestari (BOSF–SL) for the permission, assistance and guidance provided during the study.



## REFERENCES

- Ancrenaz, M., Gumal, M., Marshall, A. J., Meijaard, E., Wich, S. A., & Husson, S. (2016). *Pongo pygmaeus* (errata version published in 2018). The IUCN red list of threatened species 2016: e.T17975A123809220. <https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T17975A17966347.en>. Accessed on 4 May 2023.
- CITES. (2023). Appendices I, II and III valid from 4 May 2023. <https://cites.org/sites/default/files/eng/app/2023/E-Appendices-2023-05-04.pdf>. Accessed on 5 May 2023.
- Dalimunthe, N. P., Alikodra, H. S., Iskandar, E., & Atmoko, S. S. U. (2020). Manajemen pakan dan pemenuhan nutrisi orangutan Kalimantan (*Pongo pygmaeus*) di Taman Safari Indonesia dan Taman Margasatwa Ragunan. *Jurnal Biologi Indonesia*, 16(1), 57–66.
- Daş, G., Klauser, S., Stehr, M., Tuchscherer, A., & Metges, C. C. (2020). Accuracy and precision of McMaster and Mini-FLOTAC egg counting techniques using egg-spiked faeces of chickens and two different flotation fluids. *Veterinary Parasitology*, 283, 109158.
- Enejoh, O. S., & Suleiman, M. M. (2017). Anthelmintics and their application in veterinary medicine. *Research Medical Engineering Science*, 2, 118–126.
- Harahap, A. M., & Gultom, E. S. (2017). Derajat infeksi parasit gastrointestinal pada orangutan Sumatera (*Pongo abelii*) dan orangutan Kalimantan (*Pongo pygmaeus*) di Taman Hewan Pematang Siantar Sumatera Utara. *Jurnal Generasi Kampus*, 10(2), 188–194.
- Huffman, M. A., Nahallage, C. A. D., Hasegawa, H., Ekanayake, S., De Silva, L. G. D. D., & Athauda, I. R. K. (2013). Preliminary survey of the distribution of four potentially zoonotic parasite species among primates in Sri Lanka. *Journal of the National Science Foundation of Sri Lanka*, 41(4), 319–326.
- Junardi, Rifanjani, S., & Anwari, M. S. (2019). Prediksi suhu tubuh orangutan (*Pongo Pygmaeus Wurmbeii*) berdasarkan suhu feses di Stasiun Penelitian Cabang Panti Taman Nasional Gunung Palung. *Jurnal Tengawang*, 9(2), 104–111.
- Kleinschmidt, L. M., Kinney, M. E., & Hanley, C. S. (2018). Treatment of disseminated *Strongyloides spp.* infection in an infant Sumatran orangutan (*Pongo abelii*). *Journal Medical Primatology*, 00, 1–4.
- Kurniawati, D. A., Suwanti, L. T., Lastuti, N. D. R., Koesdarto, S., Suprihati, E., Mufasirin, M., & Pratiwi, A. (2020). Identifikasi Molekuler *Blastocystis sp.* pada Monyet Ekor Panjang (*Macaca fascicularis*) di Taman Nasional Baluran, Situbondo, Jawa Timur. *Jurnal Medik Veteriner*, 3(2), 138–144.
- Mynářová, A., Foitová, I., Kváč, M., Květoňová, D., Rost, M., & Morrogh-Bernard, H. (2016). Prevalence of *Cryptosporidium spp.*, *Enterocytozoon bieneusi*, *Encephalitozoon spp.* and *Giardia intestinalis* in wild, semi-wild and captive orangutans (*Pongo abelii* and *Pongo pygmaeus*) on Sumatra and Borneo, Indonesia. *PLoS ONE*, 11(3), e0152771.
- Nosková, E., Modrý, D., Baláž, V., Červená, B., Jirků-Pomajbíková, K., Zechmeisterová, K., Leowski, C., Petrželková, K. J., Pšenková, I., Vodička, R., Kessler, S. E., Ngoubangoye, B., Setchell, J. M., & Pafčo, B. (2023). Identification of potentially zoonotic parasites in captive orangutans and semi-captive mandrills: Phylogeny and

- morphological comparison. *American Journal of Primatology*, 85, e23475.
- Nurcahyo, W., & Prastowo, J. (2013). *Strongyloides spp.* distribution on orangutans in Tanjung Puting National Park, Care Center in Pangkalanbun, and Sebangau National Park. *Jurnal Veteriner*, 14(2), 255–261.
- Nurcahyo, W., Konstanová, V., & Foitová, I. (2017). Parasites of orangutans (primates: ponginae): An overview. *American Journal of Primatology*, 79(6), e22650.
- Panda, A., Djohan, T. S., Artama, W. T., & Priyowidodo, D. (2021). Parasitic load and self-medication of Bornean orangutan (*Pongo pygmaeus ssp.wurmbii*) in Sebangau National Park Central Kalimantan Indonesia. *IOP Conference Series: Earth Environment Science*, 736, 012055.
- Selian, R. M., Hanafian, M., & Erdiansyah, R. (2013). Identifikasi parasit gastrointestinal pada feses orangutan Sumatera (*Pongo abelii*) semi liar di kawasan Cagar Alam Pinus Jantho Kabupaten Aceh Besar, *Jurnal Kedokteran Hewan*, (1), 26–32.
- Smith, J. (2020). Strongyloidiasis review and recommendations: a significant disease of orangutans. *Veterinary Advisor*, AZA's Orangutan SSP.
- Supriadi, Fitria, W. A., & Nurcahyo, R. W. (2012). *Balantidium sp.* infection in faeces samples of orangutan (*Pongo pygmaeus*) from Care Center and Tanjung Puting National Park Area, Central Borneo. *Biology, Medicine, & Natural Product Chemistry*, 1(1), 47–52.
- Suroiyah, F. A., Hastutiek, P., Yudhana, A., Sunarso, A., Purnama, M. T. E., & Praja, R. N. (2018). Prevalensi infeksi *Toxocara cati* pada kucing peliharaan di Kecamatan Banyuwangi. *Jurnal Medik Veteriner*, 1(3), 99-104.
- Wich, S. A., Singleton, I., Nowak, M. G., Atmoko, S. S. U, Nisam, G., Arif, S. M., Putra, R. H., Ardi, R., Fredriksson, G., Usher, G., Gaveau, D. L. A., & Kühn, A. S. (2016). Land-cover changes predict steep declines for the Sumatran orangutan (*Pongo abelii*). *Science Advances*, 2(3), e1500789–e1500789.
- Yahaya, Z. S., Dharmalingam, S. A., & Salleh, N. (2013). Prevalence and antelmintic efficacy studies on gastrointestinal parasites of semi captive orangutans at Orang-Utan Island (OUI), Bukit Merah, Perak. *Journal of Oil Palm & The Environment*, 4, 29–40.
- Zulfikri, M., Ridwan, Y., & Cahyaningsih, U. (2018). Prevalence of intestinal helminth parasites in wild and soft-release Bornean orangutan (*Pongo pygmaeus*) in Lamandau Wildlife reserve, Central Kalimantan. *IOP Conference Series: Material Science Engineering*, 434, 012135.

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