



Comprehensive Preclinical Evaluation of a Taste-Masked Praziquantel Formulation as a Feline Anthelmintic

Mawar Subangkit^{1*}, Elpita Tarigan², Yusa Irarang², Sindi Farhana², Hamdika Yendri Putra², and Sabhina Rona Djuwita³

¹Division of Pathology, Department of Clinical, Reproduction and Pathology, School of Veterinary Medicine and Biomedical Science, Bogor, Indonesia

²iRATco Laboratory Services, Bogor, Indonesia

³Undergraduate Program, School of Veterinary Medicine and Biomedical Science, Bogor, Indonesia

*Corresponding author's Email: bangkit@apps.ipb.ac.id

ABSTRACT

Helminthiasis is common in domestic cats, compromising their welfare and posing a zoonotic risk. Praziquantel is a highly effective agent against cestodes; however, its bitter taste may cause hypersalivation and resistance to oral administration. The present randomized, controlled trial aimed to evaluate the pharmaceutical qualities, anthelmintic efficacy, tolerability, and systemic exposure to praziquantel (Anthel Cat), formulated with taste-masking and solubilizing excipients, compared with a commercially available product. A total of 30 domestic short-haired cats (*Felis catus*), aged 1-3 years and weighing 3.5 ± 1.1 kilograms (kg), comprising 20 males and 10 females, all of which had naturally acquired gastrointestinal helminth infection confirmed by fecal examination, were randomly allocated into three groups of ten. The control group received distilled water, the commercial group received a commercially available product, and the Anthel group received Anthel Cat tablets. Both active treatments contained 20 mg of praziquantel and 230 mg of pyrantel pamoate per tablet and were administered at the recommended dose of 1 tablet per 4 kg of body weight, as a single oral dose. Cats were monitored for 14 days. Active ingredient content, disintegration time, fecal egg counts determined by flotation and sedimentation, hematology, serum biochemistry, taste acceptance, and plasma praziquantel concentration were assessed. Anthel Cat active ingredient contents were 107.88% of pyrantel pamoate and 99.17% of praziquantel, both within pharmacopoeial limits, with a mean disintegration time of 7 minutes 22 seconds. By day 14, fecal egg counts in both treated groups declined to near zero by sedimentation, whereas flotation did not demonstrate a difference among groups. Hematological and serum biochemical parameters remained within reference ranges and did not differ among groups, which indicated no hepatic or renal toxicity. Peak plasma praziquantel levels occurred 1 hour after dosing in both treated groups, and Anthel Cat did not differ from the commercial product. For taste acceptance, Anthel Cat produced no measurable saliva volume. Salivation duration was elevated in both treated groups. The result demonstrated that Anthel Cat has the same quality as the commercial product in pharmaceutical quality, anthelmintic efficacy, tolerability, and systemic exposure. However, limiting the salivary aversion response, particularly saliva volume.

Keywords: Anthelmintic, Cat, Efficacy, Praziquantel, Pyrantel pamoate

INTRODUCTION

Gastrointestinal helminth infections are prevalent among domestic cats, with reported prevalence rates that differ considerably across geographic regions, environmental conditions, and husbandry practices (Symeonidou et al., 2025). *Toxocara cati* is consistently the most common endoparasite of owned cats, with a prevalence of 19.7% in a multicenter European survey of 1,519 cats (Beugnet et al., 2014). In Indonesia, a retrospective study of 171 pet cats in Bogor detected *Toxocara* spp. in 38.0% and *Dipylidium caninum* in 4.7% of the animals (Ridwan et al., 2023). Several feline helminths are zoonotic; therefore, effective parasite control is crucial for animal welfare and public health (FAO/OIE/WHO, 2021). Praziquantel is widely used as a cestocidal agent in felines, and its anthelmintic efficacy has been linked to the activation of transient receptor potential channels in parasites. This activation leads to calcium influx, prolonged muscle contractions, and damage to the tegument, potentially increasing exposure of parasitic antigens to the host's immune system (Park et al., 2021; Waechtler et al., 2023).

Despite the efficacy of praziquantel, its significant bitter taste can complicate oral administration (Kuevi et al., 2023). Interaction of the medicine with lingual bitter-taste receptors can trigger hypersalivation, foaming, and dose rejection (Waechtler et al., 2023). Incomplete or unsuccessful dose administration may reduce medicine exposure and compromise treatment efficacy (Waechtler et al., 2023). Administering medication orally can be especially challenging in cats, a species in which owners often struggle to administer medication reliably (Papich, 2020).

ORIGINAL ARTICLE
Received: June 16, 2026
Revised: July 19, 2026
Accepted: August 18, 2026
Published: September 30, 2026



Several pharmaceutical strategies have been investigated to reduce the bitterness of praziquantel (Kuevi *et al.*, 2023). Microencapsulation of praziquantel in polymer matrices, such as the gastro-soluble polymethacrylate, limits drug release in saliva and hence its contact with taste receptors, while allowing rapid dissolution in gastric and intestinal fluids (Münster *et al.*, 2017; Machado *et al.*, 2018). Forming complexes with cyclodextrins or maltodextrin can also decrease the amount of unbound praziquantel dissolved in saliva (Münster *et al.*, 2017). Studies using electronic tongue and rodent taste-aversion methodologies confirm that taste masking effectively reduces the bitterness of praziquantel liquids (Münster *et al.*, 2017; Kuevi *et al.*, 2023). Nevertheless, excipients used for taste masking may influence medicine release and absorption (D'Abbrunzo *et al.*, 2024). Praziquantel is a compound with low water solubility and high permeability, where dissolution could limit its systemic absorption (Waechtler *et al.*, 2023; D'Abbrunzo *et al.*, 2024). Coating materials and complexing agents designed to reduce oral exposure to medicines can delay or alter drug release, potentially affecting overall systemic exposure and therapeutic effectiveness (Ahmad *et al.*, 2021; D'Abbrunzo *et al.*, 2024). Conversely, appropriately selected solubilizing excipients may improve medicine dissolution (D'Abbrunzo *et al.*, 2024). To properly assess a taste-masking formulation, its impact on pharmaceutical quality and *in vivo* therapeutic performance should be evaluated concurrently in the target species (Gupta *et al.*, 2021).

Taste-masking excipients are not completely inert in drug delivery (Waechtler *et al.*, 2023). Coating layers and complexing agents, which prevent the medicine from interacting with lingual receptors, also slow the release of taste-masking excipients. For compounds where absorption is limited by dissolution rather than permeability, this delayed release could reduce systemic exposure and potentially decrease efficacy of the active compounds (Waechtler *et al.*, 2023; D'Abbrunzo *et al.*, 2024). Therefore, the efficacy of a taste-masked formulation should be tested in the target species before replacing an existing product to ensure it performs comparably. Anthel Cat is an Indonesian-approved tablet for cats, containing 20 mg of praziquantel and 230 mg of pyrantel pamoate. Anthel Cat uses a new milk-flavor masking to reduce the bitterness of the active ingredients. The use of Praziquantel combined with Pyrantel pamoate is common in feline veterinary treatments, but it lacks extra taste-masking and solubilizing excipients (Papich, 2020). The present study aimed to assess whether the taste-masked formulation of Anthel Cat was equivalent to the commercial product in terms of quality, palatability, efficacy, tolerability, and praziquantel exposure in naturally infected cats.

MATERIALS AND METHODS

Ethical approval

The present study was conducted in accordance with institutional guidelines for the care and use of animals in research. Ethical approval was obtained from the Animal Ethics Committee of the School of Veterinary Medicine and Biomedical Sciences, IPB University, Bogor, Indonesia, prior to the commencement of all experimental procedures (Approval No. 290A/KEH/SKE/I/2025).

Animals and housing

A total of 30 domestic short-haired cats (*Felis catus*) of local origin were obtained from iRATco Laboratory Services in Bogor, Indonesia. Animals were aged 1 to 3 years, weighed 3.5 to 4 kg, and comprised 20 males and 10 females. All cats underwent a 7-day acclimatization period before treatment. The present study was conducted as a controlled comparative trial focusing on efficacy and tolerability, rather than detecting a specific effect size. The number of cats was minimized in accordance with the 3Rs principles and in accordance with institutional approval for animal use. A group of 10 cats exceeded the minimum requirement of six adequately infected animals per group, as recommended by the World Association for the Advancement of Veterinary Parasitology for controlled anthelmintic efficacy studies (Beugnet *et al.*, 2022).

Cats were housed individually in cages that met laboratory animal welfare standards and had free access to commercial feed and water. Eligibility was determined through clinical examination and quantitative fecal analysis conducted on two consecutive days prior to treatment. Cats qualified when their average fecal egg count reached at least 80 eggs per gram. Cats with no detectable helminth eggs and those treated with any anthelmintic in the past three months were excluded. Selected cats were allocated to three groups of 10 using simple randomization. Allocation was not stratified by age, sex, or body weight, and since all animals were domestic short-haired cats, breed was homogeneous by the inclusion criterion. Cats in the control group received distilled water orally as a vehicle, cats in the second group received the commercially available antiparasitic product, and cats in the third group received the Anthel Cat tablets. The trade name of the commercial product was withheld for commercial reasons; consequently, the product was identified throughout by its composition, strength, and regulatory status. Both antiparasitic products contained 20 mg of praziquantel and 230 mg of pyrantel pamoate per tablet, with a similar dosage of one tablet per 4 kg of body weight, equivalent to 5 mg/kg of praziquantel and 57.5 mg/kg of pyrantel pamoate. Regarding the dosing procedure, each tablet

was dissolved in physiological saline (0.9% NaCl) at a 1:1 (w/v) ratio and administered orally via syringe to ensure the complete delivery of the intended dose to each cat. Any immediate signs of taste aversion, such as hypersalivation, head-shaking, or spitting, were observed during daily clinical observations. All treatments were administered as a single dose at the start of the study, and the animals were monitored for 14 days.

Test material

Anthel Cat (PT Agroveta Husada Dharma, a subsidiary of PT Kalbe Farma Tbk in East Jakarta, Indonesia) is a solid oral tablet containing 20 mg of praziquantel and 230 mg of pyrantel pamoate. Anthel Cat is officially registered with the Indonesian Ministry of Agriculture under registration number D.22037309 PKM and is indicated for the treatment of gastrointestinal nematode and cestode infections in feline patients. The tablet was divided into sections, and its distinguishing feature relative to existing combination products was the addition of a milk flavoring to reduce bitterness. The commercial film-coated tablet contained 20 mg of praziquantel and 230 mg of pyrantel pamoate, approved for use in cats in Indonesia and prescribed for *Toxocara cati*, *Ancylostoma tubaeforme*, *Dipylidium caninum*, and *Taenia taeniaeformis*. Since the two products were identical in active ingredients, potency, and dosing schedule, and differed only in taste-masking excipients, any differences in performance were attributed to formulation rather than dosage.

Taste acceptance assessment

Both antiparasitic products were administered as solutions. Taste acceptance was objectively assessed by monitoring the salivary aversion response during dosing in a subset of five cats per group. Immediately after each syringe-administered dose, salivation duration was recorded with a stopwatch, and the saliva produced was collected by allowing it to drip into a one mL microtube; its volume was then measured with a micropipette. All recordings were performed by a single observer who was blinded to the treatment groups. The duration of salivation and saliva volume were subsequently compared among the control, commercial, and Anthel Cat groups.

Active ingredient content and disintegration time analyses

The amounts of pyrantel pamoate and praziquantel were measured using a validated in-house reversed-phase high-performance liquid chromatography (HPLC) method, which was developed based on established protocols for their simultaneous analysis in solid dosage forms (Tatar et al., 2015; Rajesh and James, 2019) and validated for accuracy, precision, and reproducibility according to the International Council for Harmonization Q2(R2) guideline. Standards and sample solutions were prepared using gravimetric methods on a calibrated analytical balance, then homogenized and filtered through a 0.45 µm nylon membrane filter. Separation was performed on a Phenomenex Luna C18 column (250 × 4.6 mm, 5 µm) with water and acetonitrile (20:80, v/v) as the mobile phase, delivered isocratically at one mL/minute, with an injection volume of 20 µL and ultraviolet detection at 220 nm. Analyses were carried out on a Shimadzu Prominence liquid chromatograph (Shimadzu Corporation, Japan) comprising an LC-20AT pump, SIL-20A autosampler, SPD-20A ultraviolet-visible detector, and CTO-20A column oven. Peak areas for each analyte were quantified against a standard calibration curve, and results were assessed against the acceptance limits for tablet content stated in the Indonesian Pharmacopeia (Ministry of Health of the Republic of Indonesia, 2020).

Disintegration time was determined using an ED-2L disintegration test apparatus (Electrolab, India) in 700 mL of demineralized water maintained at 37 ± 2°C, following the tablet disintegration analysis described in the Indonesian Pharmacopeia (Ministry of Health of the Republic of Indonesia, 2020). Disintegration was considered complete when there was no solid residue on the mesh and all particles had dispersed into the medium. Three replicates were performed for each product.

Efficacy and safety analysis

Fecal samples were collected on days 0, 7, and 14. Egg counts were determined in parallel by flotation and sedimentation and expressed as the mean number of helminth eggs per microscopic field, counted across 5 fields per sample at 400x magnification. For flotation, 1 g of feces was homogenized in saturated sugar-salt solution, transferred to a 15 mL tube until a convex meniscus formed, and covered with a coverslip for 10 minutes before microscopic examination. For sedimentation, one g of feces was homogenized in sodium chloride solution, strained, centrifuged at 3,000 rpm for 10 minutes, and the resuspended sediment was examined under a light microscope (ZEISS, Germany). The primary efficacy endpoint was the percentage reduction in egg count on day 14 relative to day 0, calculated using Formula 1.

$$\text{Primary efficacy endpoint} = ([\text{day 0 count} - \text{day 14 count}] / \text{day 0 count}) \times 100 \quad (\text{Formula 1})$$

Complete clearance was characterized by the absence of detectable eggs in all examined fields. Endpoint definitions followed the World Association for the Advancement of Veterinary Parasitology guidelines for the evaluation of

anthelmintic efficacy in dogs and cats (Beugnet *et al.*, 2022). Clinical observations concerning activity, appetite, response to stimuli, salivation, and overall condition were documented daily throughout the 14-day period. Blood samples were obtained from the brachial vein on days 0, 7, and 14. A total volume of 1.5 mL was divided between an EDTA tube for hematological analysis, including erythrocyte count, leukocyte count, hemoglobin levels, hematocrit, and differential leukocyte count, while the remaining volume was collected into a plain tube for serum biochemistry analysis. Hematological analyses were performed by a BC-5000 Vet Auto Hematology Analyzer (China). Serum glutamic pyruvic transaminase (SGPT) and serum glutamic oxaloacetic transaminase (SGOT) were determined by the optimized IFCC method, blood urea nitrogen (BUN) by the kinetic ultraviolet glutamate dehydrogenase method, and creatinine by an enzymatic method, using Glory Diagnostics reagent kits (Linear Chemicals S.L.U., Spain) according to the manufacturer's instructions, on an RT-6100 microplate reader (Rayto Life and Analytical Sciences, China)

Bioavailability measurement

Plasma praziquantel levels were measured primarily to qualitatively confirm systemic absorption of the active ingredient, rather than to detail its pharmacokinetics; therefore, the sampling schedule was designed accordingly. Plasma praziquantel was measured by competitive enzyme-linked immunosorbent assay (ELISA) with the ECALBIO praziquantel ELISA kit (Cat. No. PZQ-ELISA-96; Wuhan Ecalbio, China), following the provided assay protocol. The blood sampling timetable and the approach to describing plasma praziquantel disposition were based on the published characterization of oral praziquantel pharmacokinetics in cats (Xie *et al.*, 2023). Blood was collected at 0, 1, 2, 4, 8, 10, and 12 hours after dosing on day zero. These samples were centrifuged at 4,000 rpm for five minutes. From each sample, 50 μ L of supernatant was diluted with 950 μ L of redissolving solution before analysis. Blood samples and standards were measured in duplicate, and absorbance was read at 450 nm using an RT-6100 microplate reader (Rayto Life and Analytical Sciences, China). Concentrations were measured using the established curve as a reference.

Statistical analysis

Baseline comparability of age, sex, body weight, and fecal egg count on the first day among the three groups was assessed prior to the primary analysis. Data were presented as mean $\pm$ standard deviation. Distributions were assessed using the Shapiro–Wilk test, and homogeneity of variance was assessed using Levene's test. Fecal egg counts, hematological and serum biochemical parameters were analyzed using repeated-measures ANOVA, considering group as the between-subject factor and day as the within-subject factor. For the comparisons between groups on days 7 and 14, day 0 values were used as a covariate in an analysis of covariance. No prior sample-size or power calculation was conducted. Statistical significance was set at p less than 0.05. Analyses were performed in R version 4.6.1 (R Core Team, 2026).

RESULTS AND DISCUSSION

The antiparasitic treatment groups exhibited a higher salivary response than the control group; however, the taste-masked formulation demonstrated greater tolerability, as reflected in the volumetric measurements (Table 1). Salivation duration was significantly longer in the commercial product (10.60 ± 1.67 seconds; $p < 0.05$) and Anthel Cat (7.80 ± 2.68 seconds; $p < 0.05$) than in the control group. The commercial product significantly increased saliva volume (0.46 ± 0.11 mL; $p < 0.05$), while Anthel Cat did not cause a significant change (0.00 ± 0.00 mL), which did not differ significantly from the control group ($p > 0.05$). Anthel Cat did not produce a measurable volume of saliva, whereas the commercial product produced a measurable volume of saliva. This contrast indicated that the taste-masking strategy successfully limited the salivary aversion response.

The pyrantel pamoate content was 107.88% in Anthel Cat and 108.49% in the commercial product, while praziquantel was 99.17% and 97.18%, respectively (Table 2). Both products were within the Indonesian Pharmacopeia acceptance range of 90.0–110.0% and the United States Pharmacopeia acceptance range. Since both products contained 20 mg of praziquantel per tablet, the actual doses were 19.83 mg for Anthel Cat and 19.44 mg for the commercial product, representing about a 2% difference. Since both products delivered equivalent praziquantel doses, any difference in systemic exposure could be attributed to formulations rather than dosages (Papich, 2020). Content uniformity within pharmacopoeial limits indicated a homogeneous distribution of active substances during blending and compression, demonstrating effective control of granulation, binder addition, and lubrication steps (Cutolo *et al.*, 2022). Maintaining consistent active ingredient levels is clinically crucial, as subtherapeutic exposure may lead to anthelmintic resistance (Gupta *et al.*, 2021). The slight variation in praziquantel content between the two products was due to differences in excipient composition or the medicine's physicochemical properties during granulation and drying. Interactions between active ingredients and excipients can influence the stability of poorly soluble compounds, especially those susceptible to

polymorphism (Papich, 2020). The mean disintegration time was 7 minutes and 22 seconds for Anthel Cat, compared to 5 minutes and 42 seconds for the commercial product (Table 2). Disintegration time was influenced by excipient composition, tablet hardness, particle size, and porosity. It is important to note that a longer disintegration time did not necessarily correlate with reduced absorption, as praziquantel absorption is primarily limited by dissolution rather than membrane permeability. Furthermore, exceptionally rapid disintegration may lead to the release of the medicine at a rate faster than its dissolution rate (Waechtler et al., 2023; D'Abbrunzo et al., 2024). Consequently, the disintegration profile of Anthel Cat was consistent with the active ingredient's effective release.

Table 1. Salivation duration and saliva volume in domestic short-haired cats

Parameter	Control	Commercial	Anthel Cat
Salivation duration (seconds)	0.00 ± 0.00 ^a	10.60 ± 1.67 ^b	7.80 ± 2.68 ^b
Saliva volume (mL)	0.00 ± 0.00 ^a	0.46 ± 0.11 ^b	0.00 ± 0.00 ^a

^{a,b} Means within a row with different superscript letters differ significantly ($p < 0.05$).

Table 2. Active ingredient content and disintegration time of Anthel Cat and the commercial product

Product	Content		Disintegration time		
	Pyrantel pamoate	Praziquantel	1	2	3
Anthel Cat	107.88%	99.17%	0:07:15	0:07:22	0:07:30
Commercial	108.49%	97.18%	0:05:15	0:05:54	0:05:58

Anthelmintic efficacy

Using sedimentation, the fecal egg counts in both treatment groups decreased significantly by day 7 and nearly reached zero by day 14, whereas the Fecal egg counts in the untreated control group remained elevated throughout the study period (Figure 1; $p < 0.05$). Through flotation, counts in the treated groups declined over the same interval; however, the differences among the groups were not statistically significant ($p > 0.05$). The flotation findings were not significant across the treatment groups compared to the control groups. The difference between the two techniques was probably due to their unique egg-recovery properties rather than any biological impact. Sedimentation tended to recover eggs with higher specific gravity more effectively, whereas the sugar-salt flotation technique used in the present study did not float all helminth eggs with equal efficiency (Beugnet et al., 2022). The reduction in fecal egg excretion to near-zero levels within two weeks indicated substantial clearance of gastrointestinal helminths and was considered an established marker of effective anthelmintic therapy. Based on sedimentation results, both Anthel Cat and the commercial product demonstrated comparable reductions in fecal egg counts. These findings are consistent with the high efficacy reported for praziquantel-based combinations against feline gastrointestinal helminths (Gupta et al., 2021; Tielemans et al., 2021).

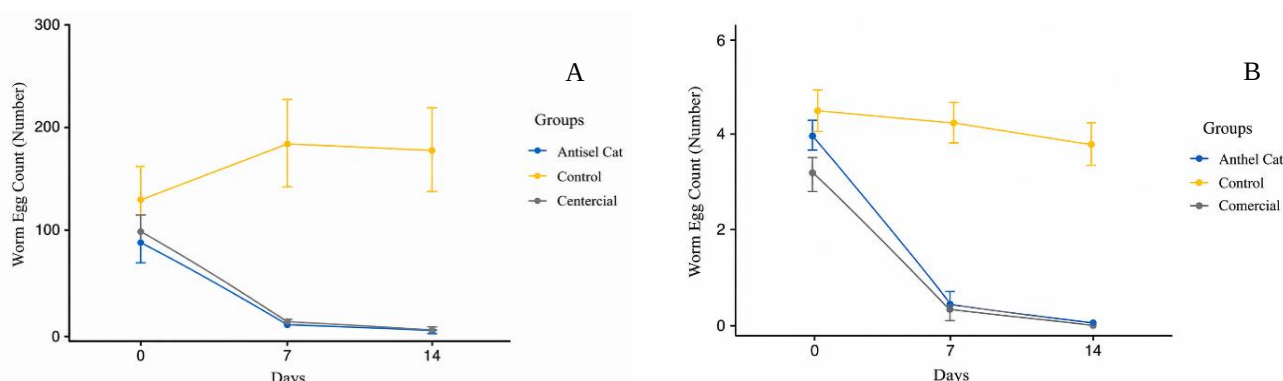


Figure 1. Fecal egg counts in domestic short-haired cats after receiving a single oral dose of distilled water (control), a commercial anthelmintic, and Anthel Cat on days 0, 7, and 14. **A:** Counts determined by the flotation method, **B:** Counts determined by the sedimentation method. Values are mean ± standard deviation

Tolerability

No clinical sign of toxicity was recorded in any group during the 14-day observation period. Hematological parameters did not differ significantly among the control, commercial, and Anthel Cat groups at any time point (Table 3; $p > 0.05$), and all values remained within published commercial ranges for the domestic cat (Brooks et al., 2022). Leukocyte counts declined gradually in both treated groups over the observation period, while the remaining hematological parameters were within commercial limits.

Table 3. Hematological parameters of domestic short-haired cats after receiving a single oral dose of distilled water (control), a commercial anthelmintic, and Anthel Cat on days 0, 7, and 14

Groups Parameters	Control			Commercial			Anthel Cat		
	Days								
	0	7	14	0	7	14	0	7	14
WBC (10 ⁹ /L)	20.62 ± 11.3 ^{ns}	19.3 ± 9.4 ^{ns}	19.35 ± 8.0 ^{ns}	18.49 ± 7.7 ^{ns}	15.86 ± 5.9 ^{ns}	14.39 ± 6.0 ^{ns}	23.0 ± 5.0 ^{ns}	18.52 ± 5.1 ^{ns}	15.63 ± 4.9 ^{ns}
Neu (10 ⁹ /L)	12.8 ± 8.3 ^{ns}	12.4 ± 7.5 ^{ns}	12.19 ± 5.9 ^{ns}	12.7 ± 6.4 ^{ns}	11.2 ± 5.2 ^{ns}	9.6 ± 4.6 ^{ns}	8.35 ± 5.2 ^{ns}	7.57 ± 4.3 ^{ns}	6.61 ± 3.9 ^{ns}
Lym (10 ⁹ /L)	5.2 ± 2.9 ^{ns}	4.3 ± 2.4 ^{ns}	4.38 ± 1.9 ^{ns}	3.5 ± 1.1 ^{ns}	3.02 ± 1.2 ^{ns}	3.56 ± 1.6 ^{ns}	10.65 ± 4.5 ^{ns}	8.2 ± 2.9 ^{ns}	7.67 ± 3.0 ^{ns}
Mon (10 ⁹ /L)	1.16 ± 1.8 ^{ns}	0.91 ± 1.0 ^{ns}	0.98 ± 0.9 ^{ns}	0.88 ± 1.2 ^{ns}	0.53 ± 0.4 ^{ns}	0.54 ± 0.3 ^{ns}	0.93 ± 0.3 ^{ns}	0.86 ± 0.4 ^{ns}	0.89 ± 0.3 ^{ns}
Eos (10 ⁹ /L)	1.46 ± 1.0 ^{ns}	1.69 ± 0.8 ^{ns}	1.81 ± 0.9 ^{ns}	1.41 ± 0.4 ^{ns}	1.1 ± 0.5 ^{ns}	0.7 ± 0.3 ^{ns}	3.06 ± 0.4 ^{ns}	1.9 ± 0.7 ^{ns}	0.47 ± 0.2 ^{ns}
Bas (10 ⁹ /L)	0.0 ± 0.0 ^{ns}	0.0 ± 0.0 ^{ns}	0.0 ± 0.0 ^{ns}	0.0 ± 0.0 ^{ns}	0.0 ± 0.0 ^{ns}	0.0 ± 0.0 ^{ns}	0.01 ± 0.0 ^{ns}	0.0 ± 0.0 ^{ns}	0.0 ± 0.0 ^{ns}
RBC (10 ¹² /L)	5.43 ± 2.1 ^{ns}	6.77 ± 1.2 ^{ns}	5.23 ± 2.5 ^{ns}	6.12 ± 1.4 ^{ns}	6.75 ± 2.1 ^{ns}	4.13 ± 1.2 ^{ns}	8.18 ± 1.7 ^{ns}	6.95 ± 2.0 ^{ns}	7.01 ± 1.8 ^{ns}
HGB (g/L)	92.7 ± 31.5 ^{ns}	105.9 ± 18.3 ^{ns}	84.2 ± 39.0 ^{ns}	101.5 ± 21.6 ^{ns}	100.2 ± 2.1 ^{ns}	70.0 ± 18.0 ^{ns}	140.1 ± 30.9 ^{ns}	114.9 ± 9.6 ^{ns}	127.7 ± 30.5 ^{ns}

ns: Non-significant, meaning there was no statistically significant difference in each parameter (p > 0.05). WBC: White blood cells, Neu: Neutrophils, Lym: Lymphocytes, Mon: Monocytes, Eos: Eosinophils, Bas: Basophils, RBC: Red blood cells, HGB: Hemoglobin

Table 4. Serum biochemical parameters of domestic short-haired cats after receiving a single oral dose of distilled water (control), a commercial anthelmintic, and Anthel Cat on days 0, 7, and 14

Groups Parameters	Control			Commercial			Anthel Cat		
	Days								
	0	7	14	0	7	14	0	7	14
SGPT	30.12 ± 11.27 ^{ns}	37.48 ± 9.11 ^{ns}	36.51 ± 18.67 ^{ns}	34.16 ± 7.83 ^{ns}	43.04 ± 12.77 ^{ns}	61.96 ± 31.13 ^{ns}	39.17 ± 18.62 ^{ns}	32.33 ± 8.91 ^{ns}	32.33 ± 8.91 ^{ns}
SGOT	22.52 ± 16.97 ^{ns}	22.73 ± 17.91 ^{ns}	35.47 ± 35.74 ^{ns}	19.29 ± 17.13 ^{ns}	20.84 ± 19.4 ^{ns}	30.05 ± 14.77 ^{ns}	19.93 ± 13.26 ^{ns}	21.01 ± 12.72 ^{ns}	21.01 ± 12.72 ^{ns}
BUN	18.04 ± 2.43 ^{ns}	19.11 ± 3.22 ^{ns}	20.8 ± 3.38 ^{ns}	18.58 ± 3.06 ^{ns}	21.6 ± 3.54 ^{ns}	18.78 ± 4.67 ^{ns}	17.83 ± 3.27 ^{ns}	18.72 ± 5.23 ^{ns}	16.5 ± 4.24 ^{ns}
Creatinine	2.71 ± 0.96 ^{ns}	2.49 ± 1.08 ^{ns}	2.61 ± 1.01 ^{ns}	3.07 ± 1.25 ^{ns}	3.01 ± 1.25 ^{ns}	2.61 ± 0.79 ^{ns}	2.76 ± 0.87 ^{ns}	2.41 ± 0.82 ^{ns}	2.4 ± 0.61 ^{ns}

ns: Non-significant, meaning there was no statistically significant difference in each parameter (p > 0.05). SGPT: Serum glutamic pyruvic transaminase, SGOT: Serum glutamic oxaloacetic transaminase, BUN: Blood urea nitrogen

The observed trends aligned with reduced immune stimulation following parasite clearance. However, the differences were not statistically significant. Eosinophil counts demonstrated the greatest alterations, decreasing in both treated groups from day 0 to day 14, with a slight increase in the control group. Considering the role of eosinophils in the antiparasitic response, the observed pattern was consistent with successful parasite clearance; however, the change was not statistically significant ($p > 0.05$). Erythrocyte and hemoglobin levels remained stable across all groups.

Serum biochemical parameters did not differ significantly among groups at any time point (Table 4; $p > 0.05$). The SGPT, SGOT, BUN, and creatinine levels remained within the published reference ranges for domestic shorthair cats (Reynolds et al., 2008). Furthermore, no progressive elevation was observed in any group, indicating that neither product caused detectable hepatocellular injury nor impairment of glomerular filtration throughout the study period. The absence of clinicopathological changes aligns with the established safety profile of praziquantel in cats. Target animal safety investigations involving praziquantel-based formulations have documented no significant changes in BUN, creatinine, SGPT, and SGOT levels following single or repeated administration of praziquantel at doses up to 5 times the recommended label dose. Additionally, histopathological examinations revealed no hepatic or renal lesions (Gupta et al., 2021; Tielemans et al., 2021). The considerable safety margin was attributable to the mechanism of action, given that the transient receptor potential channels targeted by praziquantel are specific to parasites and lack mammalian counterparts (Park et al., 2021).

Systemic praziquantel exposure

In both treated groups, plasma praziquantel concentrations increased rapidly following administration compared with the control group, reaching their maximum at approximately one hour, then gradually declining and remaining detectable at 12 hours (Figure 2). The peak observed in the Anthel Cat group surpassed 200 ng/mL.

The plasma concentration-time profile exhibited rapid gastrointestinal absorption followed by first-order elimination, consistent with the pharmacokinetic characteristics reported for praziquantel in felines following oral administration (Xie et al., 2023). Peak concentration was regarded as the pharmacologically important metric because the cestocidal efficacy of praziquantel depends on reaching a sufficient level at the parasite's tegument rather than on maintaining prolonged low-level exposure (Waechter et al., 2023). Praziquantel is a poorly soluble, highly permeable compound where absorption depends mainly on dissolution rather than membrane permeability. Therefore, any excipient that slows down release might decrease systemic exposure (D'Abbrunzo et al., 2024). Overall, the taste-masked formulation demonstrated a plasma concentration time profile similar to the commercial product, indicating that its taste-masking excipients did not significantly hinder absorption or affect therapeutic levels.

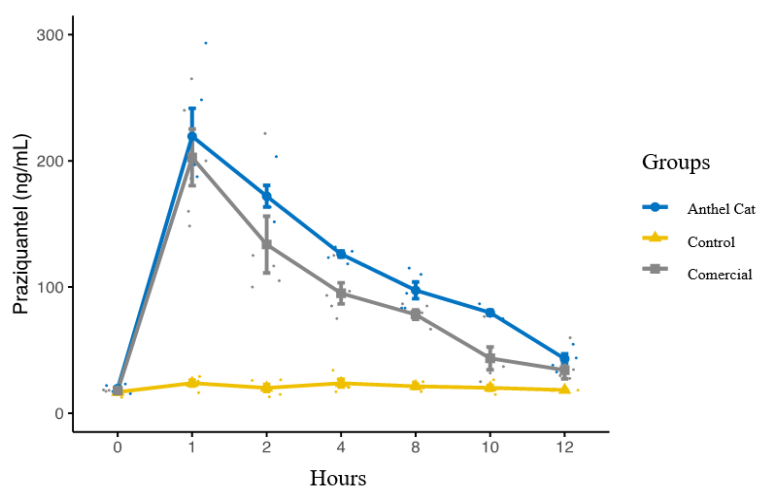


Figure 2. Plasma praziquantel concentration in domestic short-haired cats at 0, 1, 2, 4, 8, 10, and 12 hours after a single oral dose of distilled water (control), a commercial anthelmintic, and Anthel Cat. Values are mean $\pm$ standard deviation, n: 10 per group

CONCLUSION

Anthel Cat complied with pharmacopoeial specifications for active ingredient content and disintegration time. In naturally infected domestic cats, a single oral dose resulted in fecal egg counts decreasing to near zero by day 14, as evidenced by sedimentation examination, a result comparable to that of the commercial product. However, the flotation data did not reveal a significant difference among the groups. Hematological and serum biochemical parameters did not differ among groups over 14 days, indicating no detectable hepatotoxicity or nephrotoxicity. Plasma praziquantel

concentration peaked one hour after administration at a level at least comparable to that of the commercial product, indicating that the taste-masking excipients did not significantly delay absorption. The addition of taste-masking excipients did not compromise the formulation's pharmaceutical quality, anthelmintic efficacy, tolerability, or systemic exposure. The current findings were limited by the modest sample size, the absence of quantitative palatability and pharmacokinetic measurements, and the identification of helminths only to genus level. Future studies ought to incorporate an adequately powered efficacy trial alongside species-level parasite identification, a formal assessment of palatability, and chromatographic measurement of plasma praziquantel accompanied by comprehensive pharmacokinetic characterization.

DECLARATIONS

Acknowledgments

The authors wish to express their gratitude to all personnel at iRATco Laboratory Services, Bogor, Indonesia, for their technical assistance throughout the present study.

Authors' contributions

Mawar Subangkit conceived and designed the study, supervised its execution, and critically revised the manuscript. Elpita Tarigan conducted the laboratory analyses and contributed to data interpretation. Yusa Iarang performed the parasitological examinations and contributed to data analysis. Sindi Farhana carried out the animal procedures and sample collection. Hamdika Yendri Putra performed the statistical analysis and drafted the manuscript. Sabhina Rona Djuwita provided the test materials and contributed to the interpretation of formulation data. All authors have read and approved the final edition of the manuscript prior to publication in the present journal.

Availability of data and materials

The datasets generated and analyzed during the present study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no competing interests in relation to the processing of this manuscript.

Ethical considerations

All authors have reviewed and addressed ethical considerations, including plagiarism, consent for publication, misconduct, data fabrication and falsification, double publication or submission, and redundancy. AI-assisted tools (Claude version Opus 4.8) were employed solely for linguistic editing. The entirety of the data, analyses, and scientific content is authored by the present authors themselves. The authors accepted full responsibility for any artificial intelligence tools utilized in the preparation of this manuscript and confirmed that they bear sole responsibility for the accuracy, originality, and integrity of the content throughout submission, revision, and final publication.

Funding

The present study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

- Ahmad SU, Li B, Sun J, Arbab S, Dong Z, Cheng F, Zhou X, Mahfuz S, and Zhang J (2021). Recent advances in microencapsulation of drugs for veterinary applications. *Journal of Veterinary Pharmacology and Therapeutics*, 44(3): 298-312. DOI: <https://www.doi.org/10.1111/jvp.12946>
- Beugnet F, Taweethavonsawat P, Traversa D, Fourie J, McCall J, Tielemans E, and Geurden T (2022). World association for the advancement of veterinary parasitology (WAAVP): Second edition of guidelines for evaluating the efficacy of anthelmintics for dogs and cats. *Veterinary Parasitology*, 312: 109815. DOI: <https://www.doi.org/10.1016/j.vetpar.2022.109815>
- Beugnet F, Bourdeau P, Chalvet-Monfray K, Cozma V, Farkas R, Guillot J, Halos L, Joachim A, Losson B, Miró G et al. (2014). Parasites of domestic owned cats in Europe: Co-infestations and risk factors. *Parasites & Vectors*, 7: 291. DOI: <https://www.doi.org/10.1186/1756-3305-7-291>
- Brooks MB, Harr KE, Seelig DM, Wardrop KJ, and Weiss DJ (2022). *Schalm's veterinary hematology*, 7th Edition. Wiley Blackwell., Hoboken, New Jersey, USA, pp. 980-995. DOI: <https://www.doi.org/10.1002/9781119500537>
- Cutolo AA, Jardina DTG, De Vito GG, Grisi do Nascimento C, Heidmann MJ, Ferreira Nantes JD, Bassetto KV, Chagas IC, Pereira Junior EF, de Castro BG et al. (2022). Efficacy of two endectoparasiticide products combining fipronil and (S)-methoprene or esafloxolaner with eprinomectin and praziquantel against fleas and intestinal helminths in cats naturally infested in Brazil. *Parasite*, 29: 12. DOI: <https://www.doi.org/10.1051/parasite/2022012>
- D'Abbrunzo I, Procida G, and Perissutti B (2024). Praziquantel fifty years on: A comprehensive overview of its solid state. *Pharmaceutics*, 16(1): 27. DOI: <https://www.doi.org/10.3390/pharmaceutics16010027>

- Food and agriculture organization of the United Nations (FAO), World organisation for animal health (OIE), and World health organization (WHO) (2021). A key role for veterinary authorities and animal health practitioners in preventing and controlling neglected parasitic zoonoses: A handbook with focus on *Taenia solium*, *Trichinella*, *Echinococcus* and *Fasciola*. FAO, OIE, and WHO, Paris, France. DOI: <https://www.doi.org/10.4060/cb6313en>
- Gupta A, Baker C, Wang H, Targa N, Pfefferkorn A, and Tieleman E (2021). Target animal safety evaluation of a novel topical combination of esafloxolaner, eprinomectin and praziquantel for cats. *Parasite*, 28: 18. DOI: <https://www.doi.org/10.1051/parasite/2021015>
- Kuevi DNO, Acquah FA, Amuquandoh A, and Abbey AP (2023). Challenges and proven recommendations of praziquantel formulation. *Journal of Clinical Pharmacy and Therapeutics*, 2023: 3976392. DOI: <https://www.doi.org/10.1155/2023/3976392>
- Machado JC, Shimizu FM, Ortiz M, Pinhatti MS, Carr O, Guterres SS, Oliveira Junior ON, and Volpato NM (2018). Efficient praziquantel encapsulation into polymer microcapsules and taste masking evaluation using an electronic tongue. *Bulletin of the Chemical Society of Japan*, 91(6): 865-874. DOI: <https://www.doi.org/10.1246/bcsj.20180005>
- Ministry of Health of the Republic of Indonesia (2020). *Farmakope Indonesia*, 6th Edition [Indonesian pharmacopoeia, 6th Edition]. Ministry of Health of the Republic of Indonesia, Jakarta, Indonesia. Available at: <https://farmalkes.kemkes.go.id/unduh/farmakope-indonesia-edisi-vi/>
- Münster M, Mohamed-Ahmed AHA, Immohr LI, Schoch C, Schmidt C, Tuleu C, and Breikreutz J (2017). Comparative *in vitro* and *in vivo* taste assessment of liquid praziquantel formulations. *International Journal of Pharmaceutics*, 529(1-2): 310-318. DOI: <https://www.doi.org/10.1016/j.ijpharm.2017.06.084>
- Münster M, Schoch C, Schmidt C, and Breikreutz J (2017). Multiparticulate system combining taste masking and immediate release properties for the aversive compound praziquantel. *European Journal of Pharmaceutical Sciences*, 109: 446-454. DOI: <https://www.doi.org/10.1016/j.ejps.2017.08.034>
- Papich MG (2020). *Papich handbook of veterinary drugs*, 5th Edition. Elsevier Health Sciences., St Louis, Missouri, USA, pp. 768-770. Available at <https://www.sciencedirect.com/book/9780323709576/papich-handbook-of-veterinary-drugs>
- Park SK, Friedrich L, Yahya NA, Rohr CM, Chulkov EG, Maillard D, Rippmann FS, Pangenberg T, and Marchant JS (2021). Mechanism of praziquantel action at a parasitic flatworm ion channel. *Science Translational Medicine*, 13(625): eabj5832. DOI: <https://www.doi.org/10.1126/scitranslmed.abj5832>
- R Core Team (2026). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at: <https://www.R-project.org/>
- Rajesh R and James JJ (2019). A validated RP-HPLC method for simultaneous estimation of pyrantel pamoate and praziquantel in bulk and pharmaceutical dosage form. *International Journal of Pharmacy and Pharmaceutical Sciences*, 11(5): 62-67. DOI: <https://www.doi.org/10.22159/ijpps.2019v11i5.30488>
- Reynolds BS, Boudet KG, Germain CA, Braun JP, and Lefebvre HP (2008). Determination of reference intervals for plasma biochemical values in clinically normal adult domestic shorthair cats by use of a dry-slide biochemical analyzer. *American Journal of Veterinary Research*, 69(4): 471-477. DOI: <https://www.doi.org/10.2460/ajvr.69.4.471>
- Ridwan Y, Sudarnika E, Dewi TIT, and Budiono NG (2023). Gastrointestinal helminth parasites of pets: Retrospective study at the veterinary teaching hospital, IPB University, Bogor, Indonesia. *Veterinary World*, 16(5): 1043-1051. DOI: <https://www.doi.org/10.14202/vetworld.2023.1043-1051>
- Symeonidou I, Sioutas G, Gelasakis AI, Beugnet F, and Papadopoulos E (2025). Efficacy of a topical esafloxolaner, eprinomectin and praziquantel combination against most commonly found metazoan parasites of client-owned cats in Greece. *Veterinary Sciences*, 12(4): 385. DOI: <https://www.doi.org/10.3390/vetsci12040385>
- Tatar E, Ateş G, and Küçükgülzel İ (2015). Development and validation of a RP-HPLC method for quality control of oxantel pamoate, pyrantel pamoate and praziquantel in tablets. *Marmara Pharmaceutical Journal*, 19(1): 27-35. DOI: <https://www.doi.org/10.12991/mpj.2015198607>
- Tieleman E, Otsuki T, Cheesman T, Selmes F, Pfefferkorn A, and Prullage J (2021). Efficacy of a novel topical combination of esafloxolaner, eprinomectin and praziquantel against fleas in cats, under field conditions. *Parasite*, 28: 22. DOI: <https://www.doi.org/10.1051/parasite/2021018>
- Waechter A, Cezanne B, Maillard D, Sun R, Wang S, Wang J, and Harder A (2023). Praziquantel: 50 years of research. *ChemMedChem*, 18(12): e202300154. DOI: <https://www.doi.org/10.1002/cmdc.202300154>
- Xie S, Lu Y, Wang J, Lin C, Ye P, Liu X, Xiong W, Zeng Z, and Zeng D (2023). Development and validation of an LC-MS/MS method for the simultaneous quantification of milbemycin oxime and praziquantel in plasma: Application to a pharmacokinetic study in cats. *Frontiers in Veterinary Science*, 10: 1285932. DOI: <https://www.doi.org/10.3389/fvets.2023.1285932>

Publisher's note: Sciencline Publication Ltd. remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Open Access: This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <https://creativecommons.org/licenses/by/4.0/>.

© The Author(s) 2026