Journal of Tropical Resources and Sustainable Science
Website : http://journal.umk.edu.my/index.php/jtrss/
eISSN : 2462-2389
Vol: 13, Issue 2, 2025,
DOI: https://doi.org/10.47253/z4kkef69

RESEARCH ARTICLE

Therapeutic potential of topical black ginger (*Kaempferia parviflora*) against naturally occurring *Notoedres cati* infestation in cats

Nik Nur Najihah Nik Mohd Azrihan[1], Murshidah Mohd Asri[1*], Suganthi Appalasamy[3,4], Nivaarani Arumugam[3,4], Maryana Mohd Nor[3], Ruhil Hayati Hamdan[1,2], Nur Zulaikha Mat Zawawi[1], Tan Li Peng[1,2*]

[1] Faculty of Veterinary Medicine, Universiti Malaysia Kelantan, Pengkalan Chepa, 16100 Kota Bharu Kelantan, Malaysia.
[2] Research Center for Zoonotic and Transboundary Animal Diseases (ZOTRAD), Faculty of Veterinary Medicine, Universiti Malaysia Kelantan, Pengkalan Chepa, 16100 Kota Bharu Kelantan, Malaysia.
[3] Institute of Food Security and Sustainable Agriculture, Universiti Malaysia Kelantan, Jeli Campus, 17600 Jeli, Kelantan, Malaysia.
[4] Faculty of Earth Science, Universiti Malaysia Kelantan, Jeli Campus, 17600 Jeli, Kelantan, Malaysia.

ARTICLE HISTORY
Received : 16 July 2024
Accepted : 15 September 2024
Online : 15 December 2025

KEYWORDS
Kaempferia parviflora
Black ginger paste
Notoedres cati
Feline scabies
Herbal therapy

☒ * **CORRESPONDING AUTHORS**
Dr. Tan Li Peng,
Dr. Murshidah Mohd Asri
Faculty of Veterinary Medicine,
Universiti Malaysia Kelantan,
Pengkalan Chepa, 16100 Kota Bharu,
Kelantan, Malaysia.
Email: li.peng@umk.edu.my;
murshidah.ma@umk.edu.my

ABSTRACT

Mange or scabies in cats, caused by *Notoedres cati* and *Sarcoptes scabiei*, is a highly contagious parasitic skin disease. Research efforts have been intensified in both developed and developing countries to evaluate the use of clinical and scientifically validated herbal drugs on humans and also animals. This study aimed to evaluate the therapeutic efficacy of black ginger (*Kaempferia parviflora*) paste against mange in stray cats naturally infested with *N. cati*. Twelve cats exhibiting clinical signs of mange were captured in Kota Bharu, Kelantan, and housed in isolation. Infestation was confirmed via deep skin scrapings, and lesion severity scores were recorded before treatment. Cats were randomly assigned to four treatment groups (n=3 per group). Results indicated that a higher concentration of black ginger paste (0.7 g/ml) demonstrated superior efficacy compared to a lower concentration (0.5 g/ml). However, no significant differences (P-value = 0.105) were observed among the four treatment groups (extra virgin coconut oil, 0.5 and 0.7 g/ml black ginger pastes, and ivermectin). No viable mites were revealed from cats treated with the paste and with a concentration of 0.7 g/ml. Black ginger paste in this concentration was able to achieve an efficacy percentage of almost 30% of *Notoedres*-induced skin lesion score reduction. These preliminary findings suggest that *K. parviflora* may offer a promising plant-based alternative for managing notoedric mange in cats, pending further confirmatory studies with larger sample sizes.

1. INTRODUCTION

Feline scabies, resulting from notoedric mange, particularly *Notoedres cati*, is a communicable and zoonotic affliction predominantly observed in domestic cats (*Felis catus*). Transmission occurs through direct contact with infected animals or by contact with contaminated bedding or areas frequented by infested animals. While domestic cats are commonly infested, *N. cati* has been documented in over 15 animal hosts, including dogs, foxes, and rabbits (Foley et al., 2016). The infestation induces severe pruritus, causing substantial discomfort to the affected cats. Persistent itching may lead to self-mutilation, resulting in lesions and secondary bacterial infections. Clinical manifestations include alopecia, scales, crusts, and skin lichenification, with initial lesions manifesting on the pinnae and swiftly spreading to the ear, face, eyelids, and neck. In severe instances, the lesions may extend to the feet and perineum, accompanied by potential weight loss and, in extreme cases, fatality (Deplazes et al., 2021).

Although individual cases may go unnoticed, outbreaks or epizootics have been documented, particularly in environments such as cat colonies, breeding facilities, or catteries where animals are in close contact and hygiene may be compromised (Miller et al., 2013; Leone & Han, 2020). Actual prevalence data are limited, with reported rates ranging from 0.6% in stray cats in Israel (Salant et al., 2014) to 2.35% in Greece (Lefkaditis et al., 2015). A current report from the government clinic of the Malaysian Department of Veterinary Services revealed the pet cats infested with *N. cati* were 1.96% (Premaalatha et al., 2023). Beyond the clinical consequences, notoedric mange also poses an economic burden, particularly in multi-cat facilities. Costs associated with diagnosis, treatment, and quarantine measures can be substantial. Additionally, infestations may necessitate temporary closure of breeding operations or shelters, reduced adoptability of affected cats, and long-term management strategies, all contributing to financial losses for caretakers, rescue groups, and veterinary services.

Even though there are several treatment protocols suggested for combating mange in cats (Dryden, 2025), only two products are registered for the treatment of mange (including *Notoedres cati*): Prazimec-C (Biovet JSC, Bulgaria) and Advocate™ for cats (Elanco, US). Both products contain macrocyclic lactones, which have been proven to be effective against *Notoedres cati* (Hellmann, 2013; Sivajothi, 2015). However, other macrocyclic lactones such as eprinomectin, moxidectin, and selamectin also demonstrated high efficacy in treating notoedric mange in domestic cats, being used off-label in cats for decades (Salman, 2023; Dryden, 2025). Commonly used protocols of macrocyclic lactones include two to three treatments of ivermectin (0.3 mg/kg) given subcutaneously at 7-day intervals and topical application of selamectin at the dose of 6 mg/kg (Itoh et al, 2004). Other protocols, such as lime sulphur dip, are also used widely, especially in kittens with notoedres mange (Dryden, 2025). The treatment gap identified in current mange protocols for cats lies in the off-label use of macrocyclic lactones, potential side effects, the need for repeated treatments, and limited options for sensitive populations like kittens. These gaps highlight the need for alternative or supplementary treatments which could offer a safer, cost-effective, and topical solution, particularly for cats that may be sensitive to conventional treatments or in regions where pharmaceutical options are less accessible.

For the last two decades, research efforts have been intensified in both developed and developing countries to evaluate the use of clinical and scientifically validated herbal drugs on humans and also animals (Ural et al., 2019; Atanasov et al., 2021). The global surge in adopting alternative medicine, particularly herbal remedies, is evident across diverse demographic segments (Welz et al., 2018). Black ginger (*Kaempferia parviflora* Wallich. ex *Baker.*) is a plant from the Zingiberaceae family distributed widely throughout the tropics, particularly in Southeast Asia. Its rhizome has been traditionally used as a folk medicine for managing various diseases, including inflammation, ulcers, abscesses and allergies (Charoensup et al., 2022; Tan et al., 2024), with several pharmacological studies that proved to have various medicinal properties (Saokaew et al., 2017; Chen et al., 2018; Klinngam et al., 2024). To the best of our knowledge, there is currently no *in vivo* study evaluating the use of black ginger paste in cats. However, given the well-documented therapeutic potential of black ginger and the extensive safety data derived from rodent studies (Chivapat et al., 2015; Huang et al., 2024), its application presents a feasible alternative for the supportive management of mange-infested cats. Given the promising prospects of this herbal medicine, this study employed a topical paste formulated with black ginger to investigate the therapeutic efficacy of black ginger as a topical treatment for naturally occurring *N. cati* infestations in cats.

2. MATERIALS AND METHODS

2.1. Ethics statement

The study protocol was reviewed and approved by the Animal Ethics Committee 2022 of the Faculty of Veterinary Medicine, Universiti Malaysia Kelantan: UMK/FPV/ACUE/FYP/018/2022. Cats were handled with due regard for their well-being.

2.2. Topical paste preparation

The black ginger powder was obtained by processing one kilogram of fresh *Kaempferia parviflora* cultivar *ifssa* rhizomes from the Institute of Food Security and Sustainable Agriculture, Universiti Malaysia Kelantan. Fresh rhizomes were cleaned thoroughly first with tap water and twice with distilled water to remove contaminated soil and dirt. The cleaned rhizomes were then cut into smaller pieces and dried in a food drying machine (HAOYUNMA, China) at 40°C for five days till a constant weight was achieved. The dried rhizome pieces were ground to form fine powder using a food processor (Philips, Netherlands). Ground rhizome powder was kept in a desiccator at 20°C till further use.

The prepared fine powdered form of rhizomes was used to prepare a topical paste for this study (Atifah & Kurnia, 2024). For the topical paste preparation, 1 g and 1.4 g of black ginger powder were added to 2 ml of extra virgin coconut oil (Country Farm Organics) and homogenised using a brush in a stainless-steel bowl in order to obtain the 0.5 g/ml and 0.7 g/ml black ginger paste. The 0.5 and 0.7 g/ml doses of black ginger paste were selected based on several practical considerations, as there is no prior research or established dosage guidelines for the use of black ginger paste in cats. These doses were determined primarily by the availability of black ginger powder. Furthermore, the chosen doses ensured the consistency of the paste, striking a balance between being neither too watery nor too sticky, making it easier to apply to the cats' skin while maintaining an effective concentration of active compounds.

2.3. Study animals

The twelve cats included in the study were stray cats caught around the wet market in Kota Bharu, Kelantan. The cats are short-haired cats of both sexes, aged between 6 and 48 months, apparently healthy except for confirmed naturally notoedric mange infestation, based on clinical signs and positive results for viable *N. cati* mites on deep skin scrapings. Skin scrapings were performed by removing the hair over the sampling areas, then scraping (about 1 cm² each) from three different sites using a scalpel blade made of 2 cm scalpel blade so that capillary oozing occurred. Immediately

afterwards, the removed material (skin debris) was placed on a glass slide with glycerol and observed under a compound microscope at 40x enlargement.

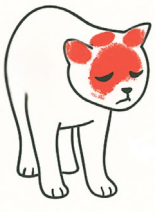
These cats were placed individually in a stainless-steel cage in an isolation animal holding room at the Faculty of Veterinary Medicine, UMK. In each cage, they were equipped with a plastic feed, water bowl, and litter box. All cats were fed with ad libitum commercial dry food and water twice daily. They were acclimatised for one week before starting the experimental study. Physical examinations, including measuring body weight, heart rate, respiratory rate and temperature, were done on Day 0 before starting the treatment to ensure the cats were fit to undergo the treatments. A final physical examination was also conducted at study completion by a licensed veterinarian before the removal of the animals.

2.4. Study design

Three cats each confirmed with *N. cati* mites were randomly assigned to the negative control (extra virgin coconut oil), positive control (ivermectin, 0.4 mg/kg), and two treatment groups (Black ginger powder + extra virgin coconut oil, 0.5 g/ml & 0.7 g/ml). For all enrolled cats, general health observations were performed daily during the whole study duration by observing the animals' appetite, defecation, and urination from Day 0 until Day 14. The sample size of 3 cats per group was chosen based on ethical considerations, principles to minimize animal use while still gathering preliminary data. As a proof-of-concept study, this small sample allowed for the initial assessment of the safety and potential efficacy of black ginger paste in managing mange infestation in cats. Although this limited sample size reduces statistical power, it provides valuable baseline data that will inform the design of future studies with larger sample sizes to achieve more robust, statistically significant results.

Cats were once treated subcutaneously with ivermectin at 0.4 mg per kg body weight using a 1ml syringe, 23-gauge needle. The treatments were administered once (Day 0) directly on the skin, after parting the hair and sterilising the surface with an alcohol swab, in one spot in the midline of the neck between the base of the skull and the shoulder blades. Topical administration for negative control (extra virgin coconut oil) and treatment groups (black ginger paste) will be applied twice a day at the area of the skin lesion. Skin scrapings were collected 7 days before Day 0 and on Day 14 from the edges of active lesions or, if lesions regressed, from the area where active lesions were located at study commencement. At each skin scraping collection time-point, the severity and extent of mange lesions were evaluated based on the characteristic scores from Hellmann et al. (2013) with modification (Table 1).

Table 1: Clinical *Notoedres* mange scores.

Score	Severity	Extension	Illustration
0	no skin lesions, no alopecia, no scratching	no skin lesions	
1	mild skin lesions, mild alopecia, occasionally scratching	ear region	
2	moderate skin lesion, moderate alopecia, intensive scratching, scratching wounds	ear, face and neck region	
3	severe skin lesion, severe alopecia, thick/crusty and scabby appearance of the skin, intensive scratching, scratching wounds	ear, face, neck and feet region	

* Illustrations on the severity of mange infection were generated via ChatGPT and modified.

Both scores were added and expressed as *Notoedres*-induced skin lesions score (NISLS), with values between 0 and 6. A final clinical assessment of the efficacy of the treatments was performed based on NISLS on Day 14. The following outcomes were possible:

- Clinical cure → 100% reduction on the last observation day
- Clinical improvement II → 50 – 99% reduction on the last observation day
- Clinical improvement I → 25 – 49% reduction on the last observation day
- Clinical failure → < 25% reduction on the last observation day

2.5. Statistical analysis

Efficacy percentage was calculated using arithmetic means according to the formula:

$$\text{Efficacy (\%)} = \frac{100 \text{ x (mean NISLS post} - \text{treatment} - \text{mean NISLS pre} - \text{treatment)}}{\text{mean NISLS pre} - \text{treatment}}$$

The efficacy objective was to compare quantitatively, based on the reduction of NISLS, which is the severity and/or

extension of skin lesions caused by notoedric mite infestation (clinical cure), and qualitatively based on the presence of notoedric mite (parasitological cure), 14 days post-treatment. The data were statistically analysed using IBM SPSS Statistics 26. The notoedric lesion score results between treatment groups were analysed using a one-way analysis of variance, Kruskal-Wallis.

3. RESULTS AND DISCUSSION

All cats experienced no health changes other than those associated with notoedric mange, observed throughout the study. No adverse effects were observed aside from a few cats showing signs of itching for a short period during the first application of the black ginger paste. All cats' appetites, bowels, and urination were normal throughout the study.

Prior to treatment, all cats had clinical *Notoedres* mange scores ranging from 2 – 6 points. Positive controls using ivermectin resulted in considerable clinical improvement, while NISLS were worsened in the negative control cats on the last day of observation (Day 14). Ivermectin and black ginger paste, 0.7 g/ml, were able to achieve clinical improvement I and II, respectively, during the 14-day observation periods (Table 2). However, there is no significant difference between treatment groups in terms of their efficacy in reducing the NISLS (P-value = 0.105). Post-treatment skin scraping analysis indicated the presence of notoedric mites in only one cat from the ivermectin group, while all cats from the other treatment groups did not reveal the presence of notoedric mites.

Clinical improvement was observed in the infested cat after a 14-day treatment with 0.7 g/ml black ginger paste. Reduction in pruritus, evidenced by decreased scratching frequency from moderate to minimal, and improvement in alopecic regions, with crusty lesions and lichenification on the head resolving to only a few 0.5mm diameter alopecic areas on the ear pinna, were noted post-treatment (Figure 1).

Ivermectin is a broad-spectrum anti-parasitic drug primarily deployed to combat parasitic worms in veterinary and human medicine (Crump, 2017). Besides, it is also effective against several other parasite-induced epidermal parasitic skin diseases, as well as insect infestations. This drug has been replaced by the off-label use of other avermectins (e.g. selamectin) in the treatment schemes for feline scabies (Fukase et al., 1991; Mark, 2016) due to selamectin has a wide margin of safety in both dogs and cats when used according to the label directions (Farnoosh et al., 2023). However, in many European countries, no products from these compounds have been licensed for feline scabies treatment, concerning reports of neurologic dysfunction, including seizures and sudden death, which have been reported in kittens (Merck Veterinary Manual, 1998).

This study showed that cats treated with ivermectin reduced NISL scores by almost 50% within 14 days. The substantial improvement of the skin lesions from this group might be due to wound wound-healing properties of ivermectin, which can promote cutaneous wound healing through modulation of inflammation and regulation of TGF-β1 and VEGF levels (Cairns et al., 2018; Sia et al., 2020). One cat from the ivermectin-treated group had viable mites and no improvement in NISL scores after the experimental period. One possible reason for this failure could be attributed to non-compliance with the established ivermectin protocol for treating mite infestation in cats. Aside from that, FeLV/FIV screening before treatment allocation in future studies is suggested as immunocompromised cats may also influence the treatment outcome and reduce clinical improvement. The worldwide ivermectin protocol for mite infestations would be 200 – 300 mcg/kg (orally or subcutaneously), 1-2 weeks for 2-4 treatments (Florez and Leon, 2021; Dryden, 2022). Therefore, the possibility of underdosing in the ivermectin control group due to the constraints of the research time frame cannot be discounted from the findings. However, drug resistance should also be considered as there was an *in vitro* study report on reducing the efficacy of ivermectin against mange when the survival times of mites with the presence of ivermectin increased from 1 hour in 1997 to 2 hours in 2006 (Currie et al., 2004; Mounsey et al., 2009; Thomas et al., 2015).

Cats treated with extra virgin coconut oil as a negative control, in general, showed worsening in NISL scores. This result contradicts with all previous research that stated coconut oil can promote wound healing due to its retained vitamins, antioxidants, antimicrobial and anti-inflammatory properties (Intahphuak et al., 2010; Mansor et al., 2012; Yeap et al., 2015; Nevin & Rajamohan, 2010). The negative effect of extra virgin coconut oil on mange lesions might be due to an inadequate observation period, as natural products usually take a longer time to show effects. A research showed that cream containing virgin coconut oil can accelerate the healing of mange within 5-6 weeks (Solikhah et al., 2021). Another study conducted by Zahran et al. (2022) showed that infested animals treated with coconut seed extract exhibited improvement in clinical signs, which started gradually from day 4 post-treatment until the end of the experiment (Day 21). *In vitro* study of this research also proved that coconut seed extract was able to cause 99% mite mortality and able to eradicate the mites 10 days post-treatment.

The treatment groups using black ginger paste showed positive results, generally with a reduction of NISL scores, although cats applied with 0.5 g/ml black ginger paste were unable to achieve the outcome of improvement. The potential mechanisms of action of *K. parviflora* in reducing mite load and skin lesions in mange-infected cats can be attributed to its bioactive compounds, including polymethoxyflavones (PMFs). Like many other medicinal plants under Zingiberaceae, black ginger was proven to consist of antioxidants (Varghese et al., 2021), antimicrobials (Jeong et al., 2016; Sornpet et al., 2017; Sitthichai et al., 2022), antiparasitic (Leesombun et al., 2019), and anti-inflammatory (Sae-wong et al., 2009; Park et al., 2014; Lee et al., 2018; Takuathung et al., 2021). The overall results of black ginger paste were better than the results of using extra virgin coconut oil alone. No viable mites were revealed from cats treated with the paste, and with the concentration of 0.7 g/ml, it was able to achieve an efficacy percentage of almost 30% of NISL scores reduction. This could be the result of the synergistic effect of these two natural products, as research has shown that black ginger extract has synergistic effects combined with gentamicin against carbapenem-resistant bacteria (Sookkhee et al., 2022). In general, ivermectin when administered in cats with parasitic infection works by targeting the chloride channels in the parasite's cells. The channels are sensitive to the neurotransmitter glutamate and by opening these channels, the drug interrupts with the normal functioning of the cell's central nervous system which then leads to paralysis and death of the parasite (Fox, 2006).

The extracts of black ginger on the other hand improves the immune system of an organism by acting as a redox scavenger which avoids cell-damaging effects. This enhanced immunomodulatory effect was exhibited in murines using extracts of black ginger (Jin & Lee, 2018) which could explain the antiparasitic action mechanism of the plant extract.

The data presented herein suggest that *K. parviflora* (black ginger) paste may serve as a supportive treatment for feline scabies, showing potential in reducing Notoedres-induced skin lesions and eradicating mites within 2 weeks. While it should not be considered a replacement for conventional treatments like ivermectin, its use could reduce ivermectin dosage, lower treatment costs, and potentially shorten treatment duration. Toxicology reports indicate that black ginger is generally well-tolerated, with superior safety profiles observed in both *in vitro* and *in vivo* studies (Mohammad Aidiel et al., 2024). However, further research with larger sample sizes, extended treatment periods, and *in vitro* studies on the acaricidal effects of black ginger against *N. cati* are essential to confirm these findings and explore its role in managing drug resistance and developing novel acaricidal options.

Table 2: Overview of efficacy percentage in the different treatment groups 14 days post-treatment.

Treatment	Notoedres-Induced Skin Lesions Score		Reduction Efficacy	Outcome
	Day 0	Day 14		
Extra Virgin Coconut Oil	4	5	+ 30%	Failure
	4	6		
	2	2		
Black Ginger (0.5 g/ml)	2	2	- 10%	Failure
	6	5		
	2	2		
Black Ginger (0.7 g/ml)	2	2	- 33%	Improvement I
	3	2		
	4	2		
Ivermectin (0.4 mg/kg)	3	3*	- 50%	Improvement II
	6	2		
	5	2		

* Cat positive with notoedric mites

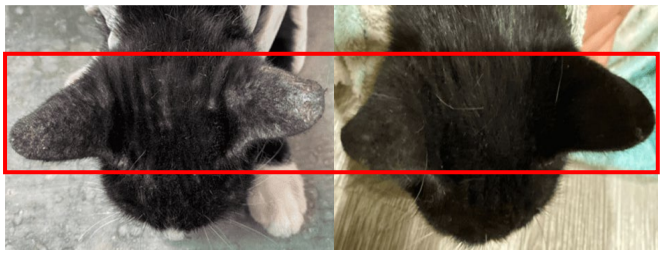


Figure 1 *Notoedres*-Induced Skin Lesions condition of a cat before (Left) and after (Right) finishing the two weeks' black ginger paste (0.7 g/ml) treatment.

4. CONCLUSION

This study provides the first in vivo evidence of the therapeutic potential of *Kaempferia parviflora* (black ginger) paste in cats naturally infested with *Notoedres cati*. The topical application of black ginger, particularly at 0.7 g/ml, demonstrated promising effects in reducing lesion severity and eradicating mites within 14 days, without observable adverse reactions. While ivermectin achieved greater overall improvement, black ginger paste showed comparable efficacy in terms of mite clearance and lesion reduction, suggesting its value as a supportive or alternative treatment option. The findings highlight the potential role of black ginger as a safe, accessible, and plant-based intervention for feline scabies, especially in regions with limited access to conventional drugs or where drug resistance may be of concern. Nevertheless, the small sample size and short treatment period limit the generalizability of these results. Future studies with larger populations, extended treatment durations, and mechanistic investigations are warranted to validate these preliminary findings and to explore the integration of black ginger into broader mange management strategies.

ACKNOWLEDGEMENT

This work was supported by the Universiti Malaysia Kelantan through the UMK Rising Star 2021 Grant (R/STA/A0800/01350A/007/2021/00937), and gratitude to Nursery of Ginger and Herbs, Institute of Food Security and Sustainable Agriculture, UMK, for providing the samples. This research is classified under Public Health and Zoonotic Diseases (RG 1) and Natural Products and Veterinary Ethno-Medicine (NapVeT) (RG 2), Faculty of Veterinary Medicine, Universiti Malaysia Kelantan.

REFERENCES

Atanasov, A.G., Zotchev, S.B., Dirsch, V.M., The International Natural Product Sciences Taskforce, & Supuran, C.T. (2021). Natural products in drug discovery: advances and opportunities. *Nature Reviews Drug Discovery*, 20, 200–216. https://doi.org/10.1038/s41573-020-00114-z

Atifah, Y., & Kurnia, A. (2024). Potency of Turmeric Extract (*Curcuma domestica* Val.) with Virgin Coconut Oil (VCO) Against Incision Wound Healing. *Biology Medicine. & Natural Product Chemistry*, 13(2), 343-349. https://doi.org/10.14421/biomedich.2024.132.343-349

Cairns, D.M., Giordano, J.E., Conte, S., Levin, M., & Kaplan, D.L. (2018). Ivermectin Promotes Peripheral Nerve Regeneration during Wound Healing. *ACS Omega*, 3(10), 12392–12402. https://doi.org/10.1021/acsomega.8b0145

Charoensup, R., Duangyod, T., Phuneerub, P., & Pimpa, R. (2022). Validation of Thai traditional medicine: Current scenario, in: Mukherjee, P.K., (Eds) Evidence-Based Validation of Herbal Medicine (Second Edition), Elsevier, US

Chen, D., Li, H., Li, W., Feng, S., & Deng, D. (2018). *Kaempferia parviflora* and Its Methoxyflavones: Chemistry and Biological Activities. *Journal of Evidence-Based Complementary & Alternative Medicine*, 16, 4057456. https://doi.org/10.1155/2018/4057456.

Chivapat, S., Chavalittumrong, P., Attawish, A., & Rungsipipat, A. (2015). Chronic Toxicity Study of *Kaempferia parviflora* Wall ex. Extract. *The Thai Journal of Veterinary Medicine*, 40(4), 377–383. https://he01.tci-thaijo.org/index.php/tjvm/article/view/35774

Crump, A. (2017). Ivermectin: enigmatic multifaceted 'wonder' drug continues to surprise and exceed expectations. *The Journal of Antibiotics*, 70, 495–505. https://doi.org/10.1038/ja.2017.11

Currie, B.J., Harumal, P., McKinnon, M., & Walton, S.F. (2004). First documentation of *in vivo* and in vitro ivermectin resistance in *Sarcoptes scabiei. Clinical Infectious Diseases*, 39, e8–12. https://doi.org/10.1086/421776

Deplazes, P., Joachim, A., Mathis, A. , Strube, C., Taubert, A., von Samson-Himmelstjerna, G. , & Zahner, H. (2021). Parasitologie für die Tiermedizin (4th ed.), Thieme, Stuttgart, Germany.

Dryden, M.W. (2022). Flea Allergy Dermatitis in Dogs and Cats. Merck Veterinary Manual, https://www.merckvetmanual.com/integumentary-system/fleas-and-flea-allergy-dermatitis/flea-allergy-dermatitis-in-dogs-and-cats.

Dryden, M.W. (2025). Mange in dogs and cats. https://www.msdvetmanual.com/integumentary-system/mange/mange-in-dogs-and-cats.

Farnoosh, K., Farnaz, K., & Mahedeh, S. (2023). Selamectin, in: Wexler, P. (Ed) Encyclopedia of Toxicology (Fourth Edition), Academic Press, US.

Florez, A.A.M., & Leon, J.C.P. (2021). Notoedric Mange in a Domestic Cat: Application of Ivermectin and Supportive Therapy. *International Journal of Veterinary Science*, 10(4), 344-346. https://doi.org/10.47278/journal.ijvs/2021.059

Foley, J., Serieys, L.E., Stephenson, N., Riley, S., Foley, C., Jennings, M., Wengert, G., Vickers, W., Boydston, E., Lyren, L., Moriarty, J., & Clifford, D.L. (2016). A synthetic review of notoedres species mites and mange. *Parasitology*, 143(14), 1847-1861. https://doi.org/10.1017/S0031182016001505

Fox, L.M. (2006). Ivermectin: uses and impact 20 years on. *Current Opinion in Infectious Diseases*, 19(6), 588-593. https://doi.org/10.1097/QCO.0b013e328010774c

Fukase, T., Kajiwara, T., Sugano, H., Shikata, R., Chinoe, S., & Itagaki, H. (1991). Treatment of *Notoedres cati* infestations of demestic cats with ivermectin. *Jouranl of Veterinary Medicine Japan*, 44, 41–45.

Hellmann, K., Petry, G., Capari, B., Cvejic, D., & Krämer, F. (2013). Treatment of naturally Notoedres cati-infested cats with a combination of imidacloprid 10%/ moxidectin 1% Spot-on (Advocate®/Advantage® Multi, Bayer). *Parasitology Research*, 112, 57-66. https://doi.org/10.1007/s00436-013-3281-y

Huang, J., Tong, Y., Wang, S., Tagawa, T., Seki, Y., Ma, S., Zhang, Z., Cao, T., Kobori, H., & Suzuki, K. (2024). 8-Week *Kaempferia parviflora* Extract Administration Improves Submaximal Exercise Capacity in Mice by Enhancing Skeletal Muscle Antioxidant Gene Expression and Plasma Antioxidant Capacity. *Antioxidants*, 13(9), 1147. https://doi.org/10.3390/antiox13091147

Intahphuak, S., Khonsung, P., & Panthong, A. (2010). Anti-inflammatory, analgesic, and antipyretic activities of virgin coconut oil. *Pharmaceutical Biology*, 48, 151-157. https://doi.org/10.3109/13880200903062614

Itoh, N., Muraoka, N., Aoki, M., & Itagaki, M. (2004). Treatment of *Notoedres cati* infestation in cats with selamectin. *Veterinary Record*, 154, 409.

Jeong, D., Kim, S.K., Kang, S.H., Jang, H.S., Park, J.H., Kim, Y.J., Kang, I.B., Song, K.Y., Yim, J.H., Kim, H.S., Lee, S.K., Kim, H., Chon, J.W., Kim, D.H., & Seo, K.H. (2016). Antibacterial Effect of Crude Extracts of *Kaempferia parviflora* (Krachaidam) against *Cronobacter* spp. and Enterohemorrhagic *Escherichia coli* (EHEC) in Various Dairy Foods: A Preliminary Study. *The Journal of Milk Science & Biotechnology*, 34(2), 63-68. https://doi.org/10.22424/jmsb.2016.34.2.63

Jin, S., & Lee, M.Y. (2018). *Kaempferia parviflora* Extract as a Potential Anti-Acne Agent with Anti-Inflammatory, Sebostatic and Anti-*Propionibacterium acnes* Activity. *International Journal of Molecular Science*, 19(1), 3547. https://doi.org/10.3390/ijms19113457

Klinngam, W., Rungkamoltip, P., Wongwanakul, R., Joothamongkhon, J., Du-a-man, S., Khongkow, M., Asawapirom, U., Iempridee, T., & Ruktanonchai, U. (2024). Skin Rejuvenation Efficacy and Safety Evaluation of *Kaempferia parviflora* Standardized Extract (BG100) in Human 3D Skin Models and Clinical Trial. *Biomolecules*, (7), 776. https://doi.org/10.3390/biom14070776

Lee, M.H., Han, A.R., Jang, M., Choi, H.K., Lee, S.Y., Kim, K.T., & Lim, T.G. (2018). Antiskin Inflammatory Activity of Black Ginger (*Kaempferia parviflora*) through Antioxidative Activity. *Oxididative Medecine & Cellular Longevity,* 2018, 5967150. https://doi.org/10.1155/2018/5967150

Leesombun, A., Boonmasawai, S., & Nishikawa, Y. (2019). Ethanol extracts from Thai plants have anti-plasmodium and anti-toxoplasma activities *in vitro*. *Acta Parasitologica*, 64, 257-261. https://doi.org/10.2478/s11686-019-00036-w

Lefkaditis, M.A., Sossidou, A.V., Panorias, A.H., Koukeri, S.E., Paştiu, A.I., & Athanasiou, L.V. (2015). Urban stray cats infested by ectoparasites with zoonotic potential in Greece. *Parasitology Research*, 114, 3931-3934. https://doi.org/10.1007/s00436-015-4688-4

Leone, F. H., & Han S. (2020). Ectoparasitic diseases, in: Noli, C., Colombo, S., (Eds). Feline Dermatology, Springer Nature, Switzerland.

Mansor, T.S.T., Che Man, Y.B., Shuhaimi, M., Abdul Afiq, M.J., & Ku Nurul, F.K.M., (2012). Physicochemical properties of virgin coconut oil extracted from different processing methods. *International Food Research Journal*, 19, 837-845.

Mark, G.P. (2016). Selamectin, in: Papich, M.G., (Ed). Saunders Handbook of Veterinary Drugs (Fourth Edition), W.B. Saunders, US.

Miller, W.H., Griffin, C.E., & Campbell, K.L. (2013). Parasitic skin disease, in: Miller, W.H., Griffin, C.E., Campbell, K.L. (Eds). Muller and Kirk's Small Animal Dermatology (7th ed.), Saunders Elsevier, US.

Mohammad Aidiel, M.R., Maisarah, A.M., Khalid, K., Nik Ramli, N.N., Tang, S.G.H., & Adam, S.H. (2024). Polymethoxyflavones transcends expectation, a prominent flavonoid subclass from *Kaempferia parviflora*: A critical review. *Arabian Journal of Chemistry*, 17(1), 105364. https://doi.org/10.1016/j.arabjc.2023.105364

Mounsey, K.E., Holt, D.C., McCarthy, J.S., Currie, B.J., & Walton, S.F. (2009). Longitudinal evidence of increasing *in vitro* tolerance of scabies mites to ivermectin in scabies-endemic communities. *Archives Dermatology*, 145(7), 840–1. https://doi.org/10.1001/archdermatol.2009.125

Nevin, K.G., & Rajamohan, T. (2010). Effect of topical application of virgin coconut oil on skin components and antioxidant status during dermal wound healing in young rats. *Skin Pharmacology & Physiology*, 23, 290-297. https://doi.org/10.1159/000313516

Park, J.E., Pyun, H.B., Woo, S.W., Jeong, J.H., & Hwang, J.K. (2014). The protective effect of *Kaempferia parviflora* extract on UVB-induced skin photoaging in hairless mice. *Photodermatology Photoimmunology Photomedicine*, 30(5), 237–245. https://doi.org/10.1111/phpp.12097

Premaalatha, B., Fazly Ann, Z., Faizah Hanim, M.S., & Farah Haziqah, M.T. (2023). Ectoparasite Infestation on Domestic Cats in Ipoh, Perak. *Malaysian Journal of Veterinary Research*, 14(1), 22-32.

Salant, H., Mumcuoglu, K.Y., & Baneth, G. (2014), Ectoparasites in urban stray cats in Jerusalem, Israel: Differences in infestation patterns of fleas, ticks and permanent ectoparasites. *Medical & Veterinary Entomology*, 28, 314-318. https://doi.org/10.1111/mve.12032

Salman, M., Kamalla, R., & Shirisha, A. (2023). Feline mange: Diagnosis and therapeutic management of *Notoedres cati*. *The Pharma Innovation*, 12(9), 1360-1362.

Sae-wong, C., Tansakul, P., & Tewtrakul, S. (2009). Anti-inflammatory mechanism of *Kaempferia parviflora* in murine macrophage cells (RAW 264.7) and in experimental animals. *Journal of Ethnopharmacology*, 124(3), 576–580. https://doi.org/10.1016/j.jep.2009.04.059

Saokaew, S., Wilairat, P., Raktanyakan, P., Dilokthornsakul, P., Dhippayom, T., Kongkaew, C., Sruamsiri, R., Chuthaputti, A., & Chaiyakunapruk, N. (2017). Clinical Effects of Krachaidum (*Kaempferia parviflora*): A Systematic Review. *Journal of Evidance-Based Integrative Medicine*, 22(3), 413–428. https://doi.org/10.1177/2156587216669622

Sia, D.K., Mensah, K.B., Opoku-Agyemang, T., Folitse, R.D., & Darko, D.O. (2020). Mechanisms of ivermectin-induced wound healing. *BMC Veterinary Research*, 16(1), 397. https://doi.org/10.1186/s12917-020-02612-z

Sitthichai, P., Chanpirom, S., Maneerat, T., Charoensup, R., Tree-Udom, T., Pintathong, P., Laphookhieo, S., & Sripisut, T. (2022). *Kaempferia parviflora* Rhizome Extract as Potential Anti-Acne Ingredient. *Molecules*, 27, 4401. https://doi.org/10.3390/molecules27144401

Sivajothi, S., Sudhakara, R.B., Rayulu, V.C., & Sreedevi, C. (2015). *Notoedres cati* in cats and its management. *Journal of Parasitic Diseases*, 39(2), 303-305. https://doi.org/10.1007/s12639-013-0357-7

Solikhah, T.I., Solikhah, G.P., & Susilo, R.J.K. (2021). *Aloe vera* and Virgin Coconut Oil (VCO) accelerate healing process in domestic cat (*Felis domesticus*) suffering from scabies. *Iraqi Journal of Veterinary Sciences*, 35(4), 699-704. https://doi.org/10.33899/ijvs.2020.127884.1539

Sookkhee, S., Sakonwasun, C., Mungkornasawakul, P., Khamnoi, P., Wikan, N., & Nimlamool, W. (2022). Synergistic Effects of Some Methoxyflavones Extracted from Rhizome of *Kaempferia parviflora* Combined with Gentamicin against Carbapenem-Resistant Strains of *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii*. *Plants (Basel, Switzerland)*, 11(22), 3128. https://doi.org/10.3390/plants11223128

Sornpet, B., Potha, T., Tragoolpua, Y., & Pringproa, K. (2017). Antiviral activity of five Asian medicinal plant crude extracts against highly pathogenic H5N1 avian influenza virus. *Asian Pacific Journal of Tropical Medicine*, 10(9), 871–876. https://doi.org/10.1016/j.apjtm.2017.08.010

Takuathung M.N., Potikanond S., Sookkhee S., Mungkornasawakul P., Jearanaikulvanich T., Chinda K., Wikan N., & Nimlamool W. (2021). Anti-psoriatic and anti-inflammatory effects of *Kaempferia parviflora* in keratinocytes and macrophage cells. *Biomedicine & Pharmacotherapy*, 143, 112229. https://doi.org/10.1016/j.biopha.2021.112229

Tan, T.Y.C., Lim, X.Y., Krishnan, P., Muhamad Rosli, S.H., Chan, J.S.W., Voon, Y.L., Ahmad, I.F., Siau, T.C., Awang, N., & Syed Mohamed, A.F. (2024). Application of *Kaempferia parviflora*: A Perspective Review. *Natural Product Communications*,19(10). https://doi.org/10.1177/1934578X241281615

The Merck Veterinary Manual, Edition 8 (1998). Aiello, S.E., (Ed), Wiley, US.

Thomas, J., Peterson, G.M., Walton, S.F., Carson, C.F., Naunton, M., & Baby, K.E. (2015). Scabies: an ancient global disease with a need for new therapies. *BMC Infectious Diseases*, 15, 250. https://doi.org/10.1186/s12879-015-0983-z

Ural, K., Gültekin, M., & Erdoğan, H. (2019). Efficacy of topical *Curcuma longa* and *Nigella sativa* combination for feline head and neck dermatitis: An open pilot study. *Kafkas Universitesi Veteriner Fakultesi Dergisi*, 25(4), 517-522. https://doi.org/10.9775/kvfd.2018.21260

Varghese, B.A., Nair, R.V.R., Jude, S., Varma, K., Amalraj, A., & Kuttappan, S. (2021). Green synthesis of gold nanoparticles using *Kaempferia parviflora* rhizome extract and their characterization and application as an antimicrobial, antioxidant and catalytic degradation agent. *Journal of the Taiwan Institute of Chemical Engineers*, 126, 166-172. https://doi.org/10.1016/j.jtice.2021.07.016

Welz, A.N., Emberger-Klein, A., & Menrad, K., (2018). Why people use herbal medicine: insights from a focus-group study in Germany. *BMC Complementary Medicine and Therapies*, 18, 92. https://doi.org/10.1186/s12906-018-2160-6

Yeap, S.K., Beh, B.K., Ali, N.M., Yusof, H.M., Ho, W.Y., Koh, S.P., Alitheen, N.B., & Long, K. (2015). Antistress and antioxidant effects of virgin coconut oil *in vivo*. *Experimental & Therapeutic Medicine*, 9, 39-42. https://doi.org/10.3892/etm.2014.2045

Zahran, E.M., Abdel-Maqsoud, N.M.R., Tammam, O.Y., Abdel-Rahman, I.M., Elrehany, M.A., Bakhsh, H.T., Altemani, F.H., Algehainy, N.A., Alzubaidi, M.A., Abdelmohsen, U.R., & Elmaidomy, A.H. (2022). Scabicidal Potential of Coconut Seed Extract in Rabbits via Downregulating Inflammatory/Immune Cross Talk: A Comprehensive Phytochemical/GC-MS and In Silico Proof. *Antibiotics*, 12(1), 43. https://doi.org/10.3390/antibiotics12010043

