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PREVALENCE OF ECTOPARASITES IN DOGS AND COMPARATIVE EFFICACY OF TREATMENT REGIMES AGAINST MITES

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ABSTRACT: The objectives of this study were (1) to assess the prevalence of ectoparasites in dogs, and (2) to evaluate the comparative efficacy of the different treatment regimens against mites in dogs. The study was carried out at Jangsa Animal Saving Trust (JAST) dog shelter and laboratory analysis was done at National Centre for Animal Health, Serbithang. A total of 100 dogs of different ages and sex housed at JAST were included in the study and screened for ectoparasites. Three types of arthropod ectoparasites (ticks, fleas and mites) were detected. All of the dogs were infested with at least one species of ectoparasites. Mixed ectoparasite infestation with two or more ectoparasites was higher (82%) than single infestation (18%). The most common combination was (fleas and mites) (52%). There was no significant difference (p>.05) in the prevalence of ectoparasites in relation to gender, age and body condition score. The assessment of efficacy of treatment was carried out based on examination of reduction of mites but fleas and ticks were not considered due to low intensity. A total of 60 clinical cases of dogs infested with Demodex along with ticks or fleas were divided into four groups with 15 animals in each group. Group A was considered as the control without providing any treatment whereas Group B, C and D were treated externally with amitraz (12.5%) and deltamethrin (12.5%) and ivermectin at 0.1 mg/kg SC respectively at their recommended dose at weekly intervals for 4 consecutive weeks. The Wilcoxon Signed Ranks Test showed that the reduction in the mite count for amitraz and ivermectin group before the start of the trial and after completion of the trial was statistically significant (p<.05) while there is no significant difference in deltamethrin (p>.05) and control group (p>.05). Treatment with amitraz revealed 60% of recovery rate and ivermectin treatment showed 53.33% followed by deltamethrin 46.67%. Compared to other groups, the rate of reduction of mite counts as well as clinical recovery rate was also faster in amitraz Group. This study revealed that amitraz has comparable efficacy against mite infestation in dogs (Amitraz > Ivermectin > Deltamethrin). Therefore, amitraz treatment protocol can be adopted for treating demodex mite infestation in dogs.

Keywords: Amitraz; deltamethrin; demodex canis; ectoparasites; ivermectin; prevalence

1. INTRODUCTION

The dog man's best friends were the first species to be domesticated by humans for various purposes such as companion guide, guard, security, herding of animals and for transportation of goods based on the socio-cultural background of the society (Costa et al. 2013). Dogs provide companionship and comfort to the people who crave unconditional interaction with another living being (Rodríguez-Hidalgo et al. 2017). However, among many other infectious diseases, dog health is also constrained by the presence of a wide range of ectoparasites including ticks, mites, lice, and fleas. Ectoparasites are a common and important cause of skin disease in dogs. They can transmit and cause hypersensitivity disorders and life-threatening anemia in young and debilitated animals (Scot et al. 2001). Ectoparasites such as fleas, mites, and ticks may transmit pathogens like viruses, bacteria including rickettsia, protozoa (Babesiosis), and filarial nematodes (onchocerciasis) to other animals and humans (Mosallanejad et al. 2011).

Ectoparasites cause major economic loss in production and its control is of veterinary importance, which is heavily dependent on the use of chemicals targeting arthropod nervous system (Taylor 2001). The drugs such as ivermectin, doramectin, flumethrin, amitraz, cypermethrin and deltamethrin are used as acaricides to control ectoparasites infestation in various species of animals worldwide (Kumar et al. 2018). However, effective management of ectoparasites still remains a challenge despite a high prevalence of ectoparasites in dogs due to the absence of clear treatment regime in many parts of the world (Jamshidi et al. 2012). As the usage of ectoparasitic drugs is an inevitable part of the livestock production system in Bhutan, a relatively huge amount is spent on the procurement of ectoparasiticides drugs annually (Rinzin et al. 2016). Therefore, regulation and monitoring of the effectiveness of ectoparasitic drugs through regular inspection is vital to ensure the efficacy of drugs and to minimize the expenditure. Despite country having a large dog population, the status on the prevalence of the ectoparasites in domestic dogs is not available. Therefore, the objectives of this study were (1) to assess the prevalence of ectoparasites in dogs, and (2) to evaluate the comparative efficacy of the different treatment regimens against mites in dogs.

2. MATERIALS AND METHODS

2.1 Study area

The study was conducted at Jangsa Animal Saving Trust (JAST) dog shelter located in Serbithang, Thimphu because of the availability of different age dog groups that were infected with ectoparasites and also for logistic reasons. The shelter keeps sick, disabled, and weak animals collected from different areas. This area is located at an altitude of 2,400 meters above sea level with recorded average temperature of -2.5ºC in January and 25ºC in summer, with an average rainfall of 100 mm (Royal Government of Bhutan [RGoB] 2018). The study was carried out from the 1st week of February till the end of March 2021.

2.2 Selection of animals and group assignment

A total of 100 dogs were randomly selected from the JAST animal shelter and screened for ectoparasites. The ectoparasites were identified morphologically except for the mites where skin scrapping was taken for laboratory confirmation. All the dogs infested with mite dermatitis were included in the clinical trial. A total of 60 dogs infested with mites with co-infestation with other ectoparasites (ticks, fleas) were selected for the experimental study. Of the 60 dogs in total, 15 dogs each were randomly assigned to four different treatments namely control, amitraz (T1), deltamethrin (T2), and ivermectin injection (T3) (Table 1).

The percentage, prevalence and frequency of infestation was calculated using the formulae adopted by (Ebrahimzade 2016):

Percentage of ectoparasites = (No of specific ectoparasites/Total no of ectoparasites) x 100.

Percentage of infestation = (No of animals infested with ectoparasite species/No of dogs sampled) x100.

Frequency of infestation= (No of animals infested/No of dogs sampled) x100.

Table 1: Different ectoparasiticides drugs, their composition and dose and route used during experiment (weekly interval).

Treatments	Drugs	Dosage	Composition	Route
Control	-	-	-	-
T1	Amitraz	2 ml/liter of water	Amitraz (AMT) 5% w/v, 60 ml bottle	Topical
T2	Deltamethrin	2 ml/liter of water	Deltamethrin (DMT) 1.25% w/v, 1 L jar	Topical
T3	Ivermectin	0.1 mg/kg BW	Ivermectin (IVM) 10mg/ml, 10 ml vail	S/C

Whereas, efficacy of the treatment regime was evaluated using the formula below***:***

$$Percentage\ efficacy = ([\ N_0 – [N/ N_0]) \times 100.$$

Where N_0 is the number of mites (Demodex) before treatment and N is the number of mites after treatment.

2.3 Data collection

A questionnaire was used to collect details of animals such as age, sex, breed, source of animals, feeding and reason for admission in the shelter and treatment history for the ectoparasites. Information on the body condition before treatment and detail of skin lesions were also observed and recorded.

2.4 Sample collection and identification of ectoparasites

The dogs were non-descriptive or local breeds with age classified into young and adult determined based on teeth, eyes, and fur color or physical appearance of the dogs. They were identified with coat color and kept in respective kennels. All dogs included in the study were screened for ectoparasites. The identification of ectoparasites was done at ectoparasite type level for ticks and fleas whereas mite was identified at genus level through a laboratory test. A skin scrapping sample was collected for mites and the digestion method (Alkali maceration technique) was used. The individual specimen was placed in the test tube and 5ml of potassium hydroxide solution was added. Specimens were heated gently to around 15 minutes in the water bath till a homogenous suspension was obtained. A drop of the sediment was placed on a glass slide and observed under low magnification (10x) microscope for mites.

2.5 Efficacy indicator

Initial day of the treatment was considered as 0 day and the observations regarding the response to treatment were made on the seventh day after the treatment. To measure the efficacy, skin scrapping sample was collected weekly and a mite count per 100 fields was recorded. The decrease in mite count per 100 fields was considered effective and the complete disappearance of mite was considered a successful treatment.

2.6 Data analysis

The data obtained were tabulated in Microsoft Excel (Microsoft excel 2013, Redmond, USA) and statistical analyses were conducted in Statistical Packages for the Social Sciences (SPSS) version 23. Based on different testing variables different analysis test such as descriptive (means, median, minimum and maximum), Pearson Chi-square, Wilcoxson Signed Rank test, Kruskal Wallis test and Tuckey HSD for post hoc test was administered. All significant values of $p < 0.05$ were considered statistically significant.

3. RESULTS AND DISCUSSION

3.1 Prevalence of ectoparasites

All the dogs (n=100) included in the study were infested with at least one type of ectoparasites giving an overall ectoparasite prevalence of 100% in our study (Table 2). Different types of

Table 2: Prevalence of different type of ectoparasites and infestation

Prevalence	No. of infected (%)	(95%CI)
Ectoparasites type		
Mites	60 (60%)	50% - 70%
Fleas	92 (92%)	85% - 96%
Ticks	41 (41%)	31% - 51%
Type of infection		
Single	18 (18%)	11% - 26%
Mixed	82 (82%)	73% - 89%
Mixed infestation		
Mites, Fleas, Ticks	13 (13%)	7% - 25%
Mites, Ticks	19 (19%)	12% - 28%
Mites, Fleas	52 (52%)	42% - 62%
Ticks, Fleas	35 (35%)	26% - 45%
Single infestation		
Ticks	2 (2%)	0.2% - 7%
Mites	0	0% - 3%
Fleas	18 (%)	11% - 26%

Table 3: Distribution of ectoparasites on body parts of infested dogs

Body Parts	Mites	Fleas	Ticks
Head	41 (63%)	54 (59%)	31 (76%)
Pinna	24 (40%)	37 (40%)	29 (70%)
Neck	42 (70%)	40 (43%)	14 (34%)
Back	28 (47%)	39 (42%)	15 (36%)
Limb	21 (35%)	36 (39%)	14 (34%)
Genital	20 (33%)	28 (30%)	15 (36%)
Stomach	40 (40%)	62 (67%)	25(61%)

ectoparasites namely ticks, fleas and mites were detected. Our finding of 100% prevalence of ectoparasites in dogs was found to agree with the results of González et al. (2004); but found higher than the findings of Chee et al. (2008) and Costa et al. (2013), who reported ectoparasites infestation prevalence of 45.6% and 63% respectively.

It was observed that mixed ectoparasitic infestation with two or more ectoparasites (82%) was higher than single infestation with (18%). These results were similar to reports of Abuzied et al. (2015) (84%) of mixed ectoparasites. However, the observation was lower than the reports of González et al. (2004) (96.6%) in Argentina, El-Gayar (2005) (93.3%) in Ismailia City, while higher than the result of Troyo et al. (2012) (66%) in Costa Rica.

The most common combination in the present study was fleas and mites (52%) followed by fleas and ticks (35%). The Triple infestation (fleas, mites, ticks) of 13% was recorded. This result was consistent with the results of El-Gayar (2005); Troyo et al. (2012); Costa *et al.* (2013) found that the most common combination was fleas and mites (*Ctenocephalides felis* and *Demodex*) and González et al. (2004) (triple infestation [Ticks-fleas-mites] was the most common combination).

Contrary to our finding, a higher incidence of infestation by single ectoparasite than mixed infestation has been reported in Gwang-city (Jamshidi et al. (2012). The variation in the prevalence of ectoparasites can be ascribed to differences in host habitat/climatic factors and the sampling period (Mirzaei et al. 2016). Peak prevalence of ectoparasites usually occurs during the warm dry months.

The most common prediction site of mites was on the neck region with the prevalence of 70% (*n*=42) while the fleas and ticks were most commonly found in the stomach (67%) (*n*= 62) and head region (76%) (n= 31) respectively (Table 3). Mites, fleas, and ticks show low distribution on body parts such as limbs, genital area, and the back of dogs. This finding agrees with the findings reported by Omojino and Somwemimo (2009). The preferential location of the ectoparasites might be due to thin stratum corenum, comparatively sparse hair, high humidity, and protection from grooming make the area prone to infestation (Sultan and Khalafalla 2014).

3.2 Comparative outcome of the treatments

The evaluation on efficacy of treatment regime was determined based on reduction in *Demodex* mites count and hair regrowth. The reduction of fleas and ticks count were not considered due to low intensity of ticks and fleas. In total, 60 clinical cases of dogs infested with Demodex along with ticks or fleas were included in the experiment of which 24 were female and 36 were males.

The Wilcoxon Signed Ranks Test showed that the reduction in the mite count for amitraz and ivermectin group before the start of the trial and after completion of the trial was statistically significant (p<.001) except for deltamethrin and control group (p=0.30) and (p=0.26) respectively. The details of reduction in mite count are provided in Table 4. Poor response of the deltamethrin in present study corroborates with that of Graf et al. (2004) & Brito et al. (2011) who evaluated the comparative efficacy of deltamethrin and reported to be lesser than ivermectin against mite infections in pigs. This is probably due to development of resistance by mites against the deltamethrin.

Table 4: Comparison of the mean count of mites in dogs treated with amitraz, deltamethrin, and ivermectin using skin scrapping examinations (mean ± SD)

Groups	Day 0	Day 7	Day 14	Day 21	Day 28
Control	1.33±1.29	0.87±1.25	0.87±1.12	0.53±0.64	1.33±1.72
Amitraz	24.40±15.81	14.00±8.04	5.67±5.18	3.40±4.01	0.93±1.33
Deltamethrin	21.80±40.89	12.27±23.11	6.20±10.68	3.80±6.95	19.67±51.94
Ivermectin	21.80±40.88	12.27±23.12	6.20±10.68	3.80±6.96	2.27±4.51

Table 5: Comparison of recovery rate of ectoparasites for different treatment regime.

Treatment Group	Outcome variable		Total	p-value
	Not recovered	Recovered		
Control	7 (46.67%)	8 (53.33%)	15 (100%)	0.911
Deltamethrin	8 (53.33%)	7 (46.67%)	15 (100%)	
Ivermectin	7 (46.67%)	8 (53.33%)	15 (100%)	
Amitraz	6 (40%)	9 (60%)	15 (100%)	

The Amitraz treatment group brought about drastic improvement in the reduction of mite count (Table 4). These results were inconsistent with the previous study done by Kumari et al. (2018). It is a product used intensively for *Demodex* as well as *Sarcopte*s mite infestation in dogs even though their use in livestock is still limited in India (Kumar et al. 2015).

The recovered rate was recorded high by amitraz (60%) followed by ivermectin (53.3%) and deltamethrin (46.67%) in 28 days after treatment (Table 5). Although there was no significant difference in the number of cases recovered at weekly intervals among the different treatment groups ($p > .05$), there is a difference in the change in percentage of cases recovered compared to before and after the treatment trial. Amitraz was highly effective against the mite infestation in dogs followed by ivermectin. The present result concurs with that of Kumar et al. (2018) who reported that the amitraz treated dogs showed a faster reduction in mite density compared to the deltamethrin treated group and faster recovery of alopecia. They regarded that increase in the reduction of mites count may be associated with one of the several reasons. The first reason, the inappropriate repeated usage of deltamethrin and ivermectin in the region of study might be the cause in the development of resistance against mite whereas the minimum usage of amitraz might be the cause to be found susceptible to the mite. The second possible reason, mites are unable to develop resistance against amitraz due to the mode of action that involves the interaction with the neuromodulator octapamine. Similarly, Sudha et al. (2018) concluded that amitraz was more effective compared to other ectoparasiticides.

4. CONCLUSIONS & RECOMMENDATION

The first objective of the study was to study the prevalence of ectoparasites in dogs. So, the ectoparasites observed in dogs were fleas (92%), mites (60%), and ticks (41%). They were abundantly found on head, neck, pinna and stomach. The frequency of the ectoparasites were mixed ectoparasites infestation (82%) was higher than the single infestation (18%). The ticks and fleas infestation was not associated with age, sex and BCS (p>.05). However, there was a significant difference (p<.05) in the prevalence of mites in relation to body condition score. There is no doubt that the government spends huge expenditure on combating the issues of ectoparasites and their related diseases in dogs. The second objective was to evaluate the comparative efficacy of different treatment regimes. The efficacy of amitraz and ivermectin was found comparable to deltamethrin against the Demodex mite infection. Both products have immediate clinical and parasitological recovery properties against mites and effectively reduce the nuisance of ectoparasites. Therefore, amitraz would be the first choice of drugs against the demodectic mange followed by ivermectin and deltamethrin.

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