

COMPARATIVE EVALUATION OF DIFFERENT CLASSES OF INSECTICIDES IN THERAPEUTIC MANAGEMENT OF CAPRINE PEDICULOSIS

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Abstract: Phthiraptera (lice) are credited as vector for several human and animal diseases. With the delay in the advent of novel class of insecticide, lice are being selected for all classes of available drugs in recent times. Thus, a study was carried out in an organized goat farm at Navi Mumbai to evaluate the efficacy of commercially available ectoparasitocidal drugs. Goat lice viz. *L. stenopsis* and *D. caprae* were found to be distributed variably on forelegs, back, belly and thighs, with least infestation on head region. Application of Propoxur, deltamethrin and ivermectin resulted in 8, 40 and 80% reduction in louse population, respectively. Ivermectin was less efficacious against mellophagan lice, thus unlike tick and other arthropods a combinatorial, rotational and repeatable therapeutic approach along with managemental care should be followed for pediculosis.

Keywords: Pediculosis, Goat, Lice, Ivermectin.

Introduction

Globally around 3200 valid species of lice are reported yet only a small percentage of lice are of veterinary/human importance. Indian subcontinent is accredited with second largest goat population in the world (FAO, 2014). Phthiraptera (Lice) insects are adapted to infest wide host range, which includes both small as well as large ruminants. Morphologically, lice are wingless, dorso-ventrally flattened insects showing permanent parasitism on host. Members of Phthiraptera exhibit high level of host as well as site specificity. Lice cause a chronic skin disease known as pediculosis which is characterized by constant irritation and itching of the skin because of which animals rub their body against hard objects, often leading to self inflicted physical injuries and alopecia. Further, excessive scratching may complicate the cases by way of secondary bacterial infections. Lice are hemimetabolus insects, some with blood feeding habit and in heavy numbers may result in anaemia. Lice cause economic losses by way substantial reduction in growth rate and hide

value. Lice infestation results in discrete areas of hair loss termed as light spot or fleck. Next to the mosquito, lice act as second most potent vector of human diseases (Roult and Roux 1999) such as epidemic typhus (*Rickettsia prowazekii*), five day fever (*Bartonella quintana*) and louse borne relapsing fever (*Borrelia recurrentis*). A bulk of literature is available on lice infestation in human, pets and large ruminants, hitherto, a little consideration has been given to menace created by lice in small ruminant industry (Obi *et al.*, 2014). Lice infestation in sheep and goats leads to poor lambing/kidding rate and unthriftiness resulting in poor economic returns.

Domestic goats can be infested with the blood sucking lice, *Linognathus africanus*, *L. stenopsis* as well as with the chewing species, *Damalinia caprae*, *D. crassipes* and *D. limbata* (Kettle, 1995). Of these, *L. stenopsis* and *D. caprae* are quite prevalent in Indian subcontinent (Sarkar *et al.*, 2010). The distribution of lice on body of goats varies with the species of lice, *Damalinia caprae* found to be distributed on trunks, hind legs, neck and pelvic, while *Linognathus stenopsis* species of lice found to be distributed on trunk, hind legs, pelvic region, neck, ear and head. (Urquhart *et al* 2001). Lice populations are seasonal, building up during the autumn, reaching a peak in winter, declining in spring and remaining low throughout the summer (Soulsby, 1982). For the purpose of treatment and control of lice infestation one has to rely on multiple treatment with selective insecticides so that all stages can be well exposed to chemicals (Finney, 1971). Hence, in this view a brief study was undertaken to determine the better therapeutic management for treatment and control of lice infestation in small ungulates.

Materials and methods

Study location: For the purpose of the study, a well established organized Black Bengal goat farm following intensive rearing practices was selected near around Navi Mumbai. The farm had a total of 50 goats, out of which 25 were females, 7 males and 18 kids.

Physical examination: In order to record and identify the incidence rate of nits and adult lice affecting goats in Mumbai region, body was divided into five regions viz. head, forelegs, back, belly and thighs. General body conditions of all the goats were recorded.

Laboratory examination: The lice were collected in sterile screw capped plastic container from the adult goats and kids and were transported to the Department of Veterinary Parasitology, Bombay Veterinary College for further processing and identification of species of lice. Initially, lice were placed in clean and neat, long glass test tube containing small volume of 10%KOH and solution is gently heated till the lice became transparent. Then the

mounting of lice specimen were done in DPX mountant following procedures of dehydration with ascending grades of alcohol started with 30% and clearing with help of clove oil following Standard operating protocols (Cable, 1957).

Treatment protocol: Three treatment protocols were devised and followed subsequently on 48 goats irrespective of the sex. The protocol includes treatment of lice infested sheep using three different classes of insecticides in 3 phases.

Phase I: Use of carbamate class of insecticide. The treatment strategy constituted of two treatments with Propoxur dusting powder (Notix 1% w/w, Petcare) with a gap of three days between the treatments.

Phase II: Use of pyrethroid class of insecticide. Deltamethrin (Butox 12.5% w/v, MSD Animal Health) was sprayed at the dose rate of 1-2ml/L water.

Phase III: Use of macrocyclic lactone as insecticide. Ivermectin (Neomec 1%, Intas pharmaceuticals) was administered at the dose rate of 0.2mg/kg b.wt., subcutaneously, which is repeated once after 14 day interval.

Antibiotics, multivitamins, NSAIDs and antihistamines were administered as supportive therapy.

Results:

Clinical signs and symptoms: Anamnesis revealed that, the goats were suffering with lice infestation since long duration of time. Goats were showing signs and symptoms of emaciation, stunted growth, restlessness, rough skin coat, irritation and poll abrasion. Physical examination showed rough dry hair coat, patchy alopecia and pallor conjunctival mucus membranes (anaemia).

Sex related prevalence prior to treatment: In the present study, 12 males and 36 female goats were screened for lice infestation which revealed proportionally greater infestation in male goats as compared to female goats. Twelve male goats and thirty six female goats including kids were found to be infested with a total of 70 and 86 adult lice and nits, respectively.

Incidence of lice infestation: It was found that, incidence and distribution of nits and lice was high in belly and back region while moderate in thigh and forelegs in case of both adult goats and kids. Whereas, in case of kids, negligible lice infestation was recorded in head region, however, some degree of infestation was noticed in case of adult goats (Table 1).

Table 1: Distribution of lice on different body regions

Body Region	Intensity	
	Adult goat	Kids
Head	+	-
Forelegs	++	++
Belly	+++	+++
Back	+++	+++
Thighs	++	++

*+ / ++ / +++: Degree of infestation

Species of lice: The species of lice were identified based on the keys given by Tuff (1977) and Nasser *et al.* (2015). Two species of lice were recognized in the present study viz. *Linognathus* spp. (sucking type) and *Damalinia* spp. (biting type) based on their host specificity and morphological characters.

Response to therapy: Phase I therapy didn't show any significant effect (2-8% reduction) on the both nits and as well as adult lice. However, a decline of about 40% lice infestation was recorded in phase II trial. Final and most effective was the Phase III trial with macrocyclic lactones which resulted in around 68-78% reduction in lice population in host animals (Table2).

Table 2: Comparative evaluation of lousicidal activity of three commercial drugs

S. No.	Group of Goats		No. of Goats examined	Before Treatment		Phase I		Phase II		Phase III	
				Nits	Adults	Nits	Adults	Nits	Adults	Nits	Adults
1	Adults	Male	07	28	12	27	12	17	07	09	02
		Female	25	32	17	32	16	21	11	11	05
2	Kids	Male	05	21	09	21	09	13	05	07	01
		Female	11	24	13	22	10	12	08	06	03
3	Total	Male	12	49	21	48	21	30	12	16	03
		Female	36	56	30	54	26	33	19	17	08
4	Grand total (M+F)		48	105	51	102 (2.8 5)	47 (7.84)	63 (40)	31 (39.2)	33 (68.5 7)	11 (78.4)

Figures in parenthesis indicates percent reduction

Discussion:

Parasites poses the major thrust on economy of small ruminant industry. Compared to gastrointestinal nematodes which deprives animal of nutrients, the ectoparasites aggravates

economic loss by degrading hide quality, blood sucking as well as acting as vector of several zoonotically importance diseases. The sheep and goats are often reared in flock basis and over-crowding often results in lice infestation. Control method mainly relies upon the use of commercially available insecticides. The present study was primarily carried out to identify the most suitable insecticide for the control of lice infestation in goats. The data generated shows, none of the commercially available formulation was able to 100% eliminate the lice population but a control can be made to some extent. Control is the ultimate aim rather than elimination while executing any ectoparasite control programme. Propoxur, a carbamate insecticide is regularly used for therapeutic management of ectoparasite in pet animals due to its high safety index, but the data generated showed highly insignificant contribution in control of lice infestation in goats. Synthetic pyrethroids (SP), a next generation insecticide presently dominates the market because of its high knock down effect and less residue problem. In present study a decline of about only 40% lice population was recorded that may be attributed to SP resistance. In a recent report Butox[®] has been found to be inefficacious against ticks (Kumar *et al.*, 2016). The reduced efficacy may also be attributed to poor quality drug formulation rather than solely because of selection of lice to particular class of insecticides resulting in resistance development (Bates *et al.*, 2001). Further, due to indiscriminate use of insecticide and under-dosing there are several reports of SP resistance in a short span of five years (Shyma *et al.*, 2012; Sharma *et al.*, 2012; Kumar *et al.*, 2013; Singh *et al.*, 2010). Macrocyclic lactones are one of the recent classes of insecticide and showed 60-80% efficacy in the present study suggesting the most appropriate insecticide class in the present scenario for small ruminants. Ivermectin although considered as wonder drug, but not found to be 100% efficacious in the lice due to confinement of its effect on blood feeding arthropods, whereas chewing lice (Mallophaga) are not affected by avermectins (Bates, 1999; Bates, 2001).

Till now, no attempt has been made on calculation of country wise discriminating dose (DD) for the members of Phthiraptera, therefore, insecticides were used at manufacturer recommended dosage. As for literature concerning insecticide resistance in goat lice, no such systematic published reports are available from India. However, there are reports of resistance against diazinon (Levot, 2000) and cypermethrin (Coleshaw *et al.*, 1992) in Australia and England, respectively. Resistance against organochlorine insecticides viz. BHC, aldrin and dieldrin and DDT has been reported in *Linognathus* spp. in South Africa (FAO, 1991).

In small ruminants, the predilection site and degree of ectoparasite infestation differs largely due to presence of wool and also within goat breeds based on size of hairs. Ears, neck, back, limbs, abdomen and chest are the major predilection sites reported for lice infestation in goat (Obi *et al.*, 2014). In contrast, we recorded higher lice infestation in belly and back followed by legs and least infestation was noticed in head region. According to Chandler and Reed, ears and neck region are rich in capillaries supply, thus more prone to ectoparasite infestations, however, in our studies very minute lice infestation was recorded in head and neck region probably due to scant hairs in head region of adult goats and kids. Secondly, unlike ticks, lice are not obligate blood feeders and thus close association of blood supply is not mandatory. Females of ruminants are often recorded with higher ectoparasite infestation (Obi *et al.*, 2014) which can be attributed to their less activity, more confinement during lactation and gestation and low immunity (Veen and Mohammed, 2005). Contrary to above reports, in the present study comparatively greater lice infestation was recorded in male goats, which can be attributed to intensive rearing practice followed in the farm due to unavailability of pasture land in Mumbai region.

Conclusion

It can be concluded that the sole use of carbamates, SP or macrocyclic lactone is not completely reliable for long term ectoparasitic control under intensive management system. A combinatorial and rotational approach along with better managerial practices should be followed in order to reduce the economic losses due to ectoparasite burden. Lice being the important vector of human and animal diseases, no organized effort has been made to control lice infestation in India and other tropical countries. Till now there is no available class of insecticide which is showing high level of efficacy against both sucking and biting lice, in such case herbal alternative having synergistic activity can serve as future promising candidate for sustainable lice control.

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