Review

Przhevalskiana silenus, Goat Warble fly: A lesser known parasite of economic significance infesting goat

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ABSTRACT

Parasitic infections in goat are encountered worldwide causing economic losses in terms of health and productivity. Although considerable importance is given to gastrointestinal parasitism in India, myiasis caused by warble fly *Przhevalskiana silenus* has been neglected; because of being a regional disease. The disease is much prevalent in the Jammu province of Jammu and Kashmir (J&K), India. Second and third stage larvae of the fly are found in subcutaneous tissues of animal's back and flank resulting in tissue destruction. It causes huge economic losses to the tune of crores to meat and hides industry of the J&K state. The current climatic change has increased the susceptibility of drastic change in the epidemiology of parasitic diseases. For now, the goat warble fly is restricted to the dry areas of Jammu region but detailed study of the prevalence and epidemiology of the disease is warranted. Moreover a diagnostic kit that detects the infection at an early stage will prevent the losses to meat and hide industry and help in eradication of disease.

Keywords: Goat, Myiasis, Parasite, *Przhevalskiana silenus,* Warble fly

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INTRODUCTION

India has a goat population of around 148.88 million during 2019 which contributes 27.8% to total livestock population (as per 20th livestock census). Total goat has increased by 10.14% over previous Livestock Census (2012). Since ages, goat is being referred to as poor man's cow. The socio-economic upliftment of the marginal livestock holders is based on better returns from the livestock and agriculture. So improving the health of the animals is mandatory for increased productivity. It is beyond doubt that gastrointestinal parasitism is of major concern to the farmers and veterinarians but diseases like myiasis have been neglected. Although some literature about *Hypoderma* spp highlighting the importance of cattle myiasis is available but meager work has been done regarding goat myiasis. Goat warble fly infestation (GWFI) is a myiasis caused by larvae of fly, *Przhevalskiana silenus*. This disease is characterized by presence of subcutaneous warbles (swellings) on the dorsal and lumbar region of domestic and wild ruminants (Zumpt, 1965). It is a major problem among the goat population in the state of Jammu and Kashmir, India. GWFI is locally known as "Midu" by farmers of Jammu province (Yadav *et al.,* 2011). It causes heavy economic losses in terms of decreased meat and milk production. Its presence also necessitates carcass trimming and downgrading with depreciation of hides. The common misconception among the farmers is that the disease is caused either by hitting animal with stick of plant *Grewia asiatica* or by damage of skin with thorns of bushy plants located in hilly areas.

Fly and the cycle of infestation

The adult *P. silenus* fly looks like a honey bee, lacks mouth parts and survives 5–10 days on resources

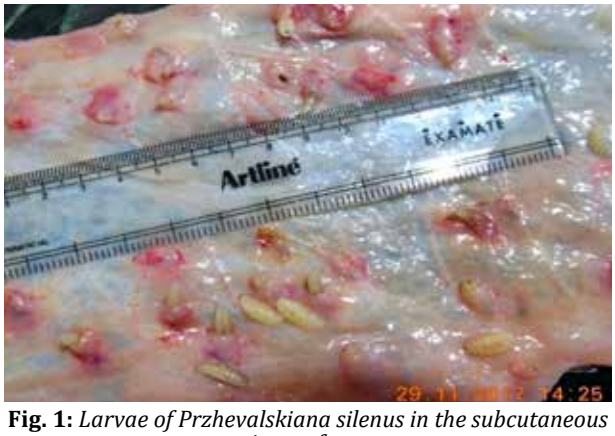

Fig. 1: *Larvae of Przhevalskiana silenus in the subcutaneous tissue of goat*

Fig. 2: *Larvae (L1, L2 and L3) extracted from subcutaneous tissue of goat*

accumulated during the larvae period (Tassi *et al.,* 1989). Fertilized female lays about 100 eggs on goat hairs resulting in emergence of first-instar larva in 5 to 6 days because of collagenolytic enzymes of salivary and intestinal glands. Second and third stage larvae are formed in subcutaneous tissues of animal's back and flank resulting in warbles' formation (typical swellings) (Fig. 1,2). Mature larvae drop, pupate in the ground, and emerge into adult fly. Over the years it has been observed that all the larval instars are present only in subcutaneous tissues of dorsal region which suggests that there is no internal migration of larva as observed in cattle hypodermiosis. Conditions favorable to the prevalence of myiasis-causing flies, viz., availability of susceptible animal host as well as suitable temperature and humidity abound in tropical countries like India. The adult flies are present from April to June while first stage larvae are found in subcutaneous tissues from May to August. The second stage larvae develop from September to November and third stage larvae begin to appear on the back of animal from December up to February.

Factors affecting prevalence of disease

The overall prevalence of *P. silenus* larvae on goats of Jammu region is 47.22% (Yadav *et al.,* 2011). Low moisture, loose soil, and hot and dry summer weather promotes the growth of larvae and pupae of fly. This is the major reason for high prevalence (71.68%) of GWFI among animals of dry belt, located in foot hills of Himalaya at an altitude of 325–800 masl (meters above sea level). The region has shallow soil, full of boulders with negligible water and climate remaining hot during March to August. The mean monthly temperature remains 13.5°C. The rainfall is mainly noticed in July to September. The threshold temperature required for pupal development is 12°C (Tassi *et al.,* 1989), which is observed in March and April. The adult flies are active from April to June as warm and sunny days are favorable for *P. silenus* activity rather than cool, cloudy, and stormy days which retard complete mating flight behavior of adult fly. The growth of pupae on ground is hampered by the high moisture soil or clay loam soil which may be the probable reason for non-occurrence of warble fly infestation in plain, irrigated areas. At higher altitudes (>1500 msl), summer is not so hot as compared to other zones, which is the main reason for low prevalence of *P. silenus*. The areas located between 800-1500 msl witness moderate infestations of warble fly in goats (40.12%). A survey based on district-wise occurrence of warble fly infestation has revealed high prevalence of GWFI in goats of Udhampur, Kathua, Jammu, and Rajouri district while low infestation has been recorded from Poonch and Doda.

The age of animal is an important factor that predisposes animals to warble fly infestation. In animals<1 year low level of infestation has been ascribed to observed to colostral immunity and stall feeding leading to less time of exposure to fly (Otranto *et al.,* 1999). However, lower prevalence in more than 3-year-aged animals as compared to 1–3 year aged animals may be explained by fact that the immune response of animal against migrating larvae developed as a result of previous exposure halts their development (Otranto and Puccini, 2000). There is variation in the level of larval infestation among different breeds of goats. Bakerwali goats are generally owned by nomads and are mainly kept on free grazing, whereas Beetals are kept by marginal farmers maintained by stall-feeding or on partial grazing. This is the major reason for high prevalence of GWFI in Bakerwali as compared to Beetals.

Economic losses

A recent study from north India attributed an overall annual loss of Rs.7.326 crores annually in the form of body weight loss, deficits in milk production and hide depreciation due to holes in hides of diseased goats (Yadav *et al.,* 2012). Abattoir studies have revealed holes in hides and trimming of carcass leading to annual losses of Rs. 73.91 lakhs and Rs. 1.05 crores, respectively. The mean body weight loss of warbled goats is approximately 2.40 kg leading to an annual loss of Rs. 3.54 crores. The mean milk yield loss per warbled goat per day is estimated to be 101.7 g resulting in losses to the tune of Rs. 1.98 crores.

Diagnosis

Physicoclinical observation by palpation of warbles on infested animals is routinely used for diagnosis at L2 and L3 stages which occurs about 3 months after infestation. A clear identification of larvae may be performed either by morphological and molecular methods (Otranto and Stevens, 2002). Serological tests have advantages over physic-clinical observation in terms of early detection and high sample throughput along with wide diagnostic time window, as antibodies in the infested host may persist for about 16 weeks (Otranto *et al.,* 1998). Presently, recombinant protein based microtitre plate-ELISAs are widely used in routine diagnosis and sero-epidemiological studies of goat warble fly diagnosois (Yadav *et al.,* 2022). Recently Dot-ELISA, have also been developed having advantage of inexpensive, sensitive and specific assay that provides utility to be performed at less equipped regional labs and provide visual readouts without spectrophotometry (Yadav *et al.,* 2023).

Treatment

Presently, farmers of this region extract the warbles manually after they appear on the back of infested animals. Although this procedure disrupts the life cycle of *P. silenus*, but by this time the third instar larvae (L3) has already appeared on the back and has inflicted considerable internal damage, it is of little benefitto the host. Thus, the main aim in GWFI control should be to target and kill the first instar larvae (L1) as it will significantly minimize production losses. Based on the earlier studies conducted in the region (Yadav *et al.,* 2014), the administration of pour-on mini doses of ivermectin (5 µg/kg body weight) and eprinomectin (50 µg/kg bodyweight) as treatment options for GWFI offers some important advantages such as the ease of application and low cost. Since control of adult fly is difficult, so to break the life cycle of *P. silenus*, treatment at specific point such as late August to mid-September will be beneficial as the entire adult fly population will be present as first-stage larvae in the infected animals at this time of the year. Therefore, just like in case of cattle hypodermosis, pour on mini doses of ivermectin and eprinomectin can be used under field conditions in the month of July as an effective chemoprophylactic measure against goat warble fly infestation. In addition, such measures if adopted in goat warble fly control campaigns can help to overcome economic losses suffered by goat industry in Jammu particularly.

CONCLUSION

Infestation by larvae of warble fly in goats is a major economic problem of the Jammu and adjoining districts of Jammu Kashmir, India. A detailed study on the prevalence of the disease and identification of hot spots is of prime importance for developing an immunoprophylactic strategy. To prevent the economic losses due to larval infestation, control of flies in the pre monsoon period coupled with early diagnosis and treatment with mini doses of ivermectin or eprinomectin, in the month of July can ameliorate the disease and help in its eradication. Keeping in view the climate change and its effect on different vector populations, the disease may emerge in dry areas of the neighboring states, adding to disease burden of goats.

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