Clinico-pathological and therapeutic evaluation of Black Bengal goats (*Capra hircus*) infested with *Psoroptes cuniculi* mange

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Abstract The objective of the present study was to investigate the clinico-pathological changes and therapeutic evaluation of gamma-benzene hexachloride and cetrime along with vit A, D3, E and H in Black Bengal goat infested *Psoroptes cuniculi* mange. The study was conducted on 14 Black Bengal goats; 6 clinically infested with *Psoroptes* mange (group I) and 8 healthy goats (group II). Haemato-biochemical profile viz., haemoglobin concentration, packed cell volume, total leukocyte count, albumin and albumin globulin ratio revealed significantly ($P < 0.05$) decreased level; whereas, globulin, alanine aminotransaminase, aspartate aminotransaminase, serum creatinine and blood urea nitrogen level were significantly ($P < 0.05$) increased in goats of group I animals as compared to healthy control (group II) on day 0. Gamma-benzene hexachloride and cetrime along with adjunct therapy (group I) showed parasitological recovery on day 21 while complete elimination of clinical signs observed on day 28 of post-therapy in all clinical cases.

Keywords Black Bengal goat · Haemato-biochemicals · *Psoroptes cuniculi* · Therapeutic evaluation

Abbreviations

ALT Alanine amino transaminase

A G ratio	Albumin globulin ratio
AST	Aspartate amino transaminase
BUN	Blood urea nitrogen
Hb	Haemoglobin
PCV	Packed cell volume
PSLS	Psoroptes-induced skin lesions score
TEC	Total erythrocyte count
TLC	Total leukocyte count

Introduction

Goats are among the main meat-producing animals in India, whose meat (chevon) is one of the choicest meats and has huge domestic demand. Besides meat, goats provide other products like milk, skin, fibre and manure. With more than 124 million population, goats account for more than 25 % of the total livestock in the country and contribute Rs. 1,06,335 million annually to the national economy. They provide food and nutritional security to the millions of marginal and small farmers and agricultural labourers (Kumar 2007). Ectoparasite infestation often imposes severe economic constraints on goat production across the world. Amongst the ectoparasites, *Psoroptes cuniculi* (ear mite) in goats usually affects the ears but can spread to the head, neck and body and cause severe irritation and dermatitis imposes major economic threat in terms of poor quality of meat, low production of milk and make a major trade embargo in leather industry.

Recent findings suggest that tissue damage attributed by oxidative stress and reactive oxygen species (ROS) play a key role in pathogenesis in many ecto-parasitic and skin diseases (Camkerten et al. 2009; Barnes 1990; Schirmer et al. 1987; Okayama 2005). Increased amount of endogenous oxidants are implicated in various disorders including

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inflammation, sarcoptic mange (Camkerten et al. 2009; De and Dey 2010; Saleh et al. 2011), psoroptic mange (Dimri et al. 2008a), canine demodicosis (Dimri et al. 2008b) and canine sarcoptes scabie (Behera et al. 2011). Body fights against excess free radicals via antioxidant defense system that comprises antioxidant enzymes, like superoxide dismutase, catalase, glutathione-S-transferase and nutritional antioxidants, such as ascorbic acid (vitamin C), zinc, copper, α -tocopherol (vitamin E) and ceruloplasmin. Antioxidant vitamins, such as vitamins E and C, act by quenching singlet oxygen and prevent free radical formation and their supplementation in diseases associated with oxidative stress hastens clinical recovery (Morita et al. 2006). The roles of the highly ROS in the pathogenesis of ectoparasitic infections has been an area of hot debates in recent years; however, status of oxidative stress in caprine psoroptic mange has not been explored so far. Antioxidant potential of Vitamin A, D3, E, and H has been demonstrated earlier in rabbit with *Psoroptes cuniculi* infestation (Singh et al. 2012). Therefore, the present investigation was under taken to observe the clinico-pathological changes associated with *Psoroptes cuniculi* infestation and its therapeutic management with γ -benzene hexachloride 1 % w/v + cetrimide 0.1 % w/v/ml along with vitamin A, D3, E, and H.

Materials and methods

Animal selection criteria and study plan

A total 14 Black Bengal goats were taken in the present study; group I consisting of six goats positive for *Psoroptes cuniculi* based on skin scraping examination, were considered as disease control, whereas, eight goats negative for any ectoparasite were used as healthy control (group II). Diagnosis for *P. cuniculi* was performed by standard procedure (Soulsby 1982). The goats of group I were treated with local application of a combination product of γ -benzene hexachloride 1 % w/v and cetrimide 0.1 % w/v/ml [Ascabiol® topical lotion, Piramal HC] with ethyl alcohol (2:1) once daily for 15 days and vitamin A, D3, E, and H supplementation [(Lavitone-H® intramuscular injection for animals, ttk Health care); a commercial formulation containing vit. A 2.5 lac IU, vit. D3 25,000 IU, vit. E 100 IU, and biotin 12.5 mcg/ml] given at a dose rate of 1 ml/25 kg intramuscularly at the weekly intervals for four occasions. The goats were examined daily for the clinical improvements, and the skin scrapings, 1 cm² of skin area scraped from three different lesions and were examined once in a week for the presence and density (the number of mites per ten microscopic fields) of the mites. Five clinical symptoms/lesions (pruritus, erythema, crusts/scabs, alopecia, and pyoderma lesions) were assessed to determine the

severity of *Psoroptes*-induced skin lesions and rated on a scale from 0 (absent) to severe (3). The five scores were added up and expressed as a *Psoroptes*-induced skin lesions score (PSLS) that could have values between 0 and 15 (Singh et al. 2012). The clinical recovery was evaluated on the basis of improvement in PSLS and reduction in the mite density. The main efficacy criterion of the selected drug/combination(s) was the parasitological cure rate, which was calculated as the proportion of goats negative for psoroptic mites on the basis of microscopic examination of deep skin scrapings obtained on days 0, 7, 14, 21 and 28 post therapies.

Haemato-biochemical studies

Approximately, 3 ml blood samples were obtained from jugular vein in sterilized tubes containing EDTA as an anticoagulant. Blood samples were obtained from all goats on day 0 (before therapy) and on day 28 post-therapy. For hematology, blood was used to determine hemoglobin % (Hb%), packed cell volume (PCV %), total erythrocyte count (TEC) and total leukocyte count (TLC) as per standard protocol (Jain 1986). Standard procedures were employed to determine the levels of total protein and albumin (Verley 1980), globulin, albumin:globulin ratio, alanine aminotransferase (ALT; Reitman and Frankle 1957), aspartate aminotransferase (AST), blood urea nitrogen (BUN; Wybenga et al. 1971) and creatinine (Frankel et al. 1970). The values of serum globulin were measured as the difference between total protein and albumin and from this albumin: globulin ratio was also estimated.

Statistical analysis

The values were expressed as mean $\pm$ SE, and comparisons between the groups were performed using the ANOVA and Post hoc Tukey's tests. The level of statistical significance for all the comparisons made was established at $P \leq 0.05$. All data were analyzed by means of the statistical package SPSS 15 (SPSS Sciences Chicago, IL).

Results

Microscopic examination of skin scrapings taken from the infected goats revealed the presence of *Psoroptes cuniculi* (Fig. 1). *Psoroptes* infested goats revealed characteristic clinical signs of inappetence, alopecia, scaling, and crusting were noted over the pinna, withers, commissure and dorsal midline. There was marked accumulation of cerumen in the external ear canal and extensive alopecia, crusting of both pinna and commissure (Figs. 2, 3).

Fig. 1 *Psoroptes cuniculi* with prominent mouth parts

Fig. 3 Crusting of both pinna and commissure with alopecia

Fig. 2 Accumulation of cerumen in the external ear canal with extensive alopecia

Frequent head shaking and ear scratching were observed in 4 cases. On day 28 post-therapy the skin lesions had improved dramatically; there was no crust or scale and the hair had started to regrow. Vitamin supplementation of the gamma-benzene hexachloride-treated goats revealed faster clinical (28 days; Fig. 4) and parasitological (21 days) recovery. The mean $\pm$ SE values of clinical scores for severity (PSLS) in the treatment group on days 0, 7, 14, 21, and 28 were 8.66 ± 0.67 , 6.83 ± 0.60 , 4.00 ± 0.63 , 0.00 and 0.00, respectively. Whereas, the percent improvements in PSLS on day 7, 14, 21, and 28 were 21.13, 53.81, 80, and 100, respectively. Haematology showed significant ($P < 0.05$) reductions in Hb%, PCV, and TEC in group I animals as compared to group II healthy goats on day 0. However, total leukocyte count, ALT, AST, globulin, creatinine and BUN were significantly raised ($P < 0.05$) in group I mite-infected goats in comparison to group II healthy goats on day 0 (Table 1). Whereas albumin and

Fig. 4 Clinically recovered Black Bengal goat on day 28 of therapy

albumin:globulin ratio were significantly ($P < 0.05$) low in goats of group I suffering from mite infection as compared to group II healthy goats on day 0. By day 28 post-therapy, group I revealed significant alleviation ($P \leq 0.05$) of Hb, PCV, TEC, TLC, ALT, AST, BUN, serum creatinine, albumin, globulin and A:G ratio levels towards normalcy, compared with the values pertaining to those in day 0 and achieved the comparable values to that of the healthy controls (Table 1).

Discussion

Mites in the genus *Psoroptes* are wide spread and cause skin lesions in the ears or on the body of domestic and wild ungulates and rabbits. Ear irritation and sporadic encrusted lesions of the external ear are the chief clinical manifestations. The severe dermatitis exhibited by these cases is

Table 1 Comparison of haemato-biochemical profile of goats affected with psoroptic mange and healthy controls on day 0 and on day 28 post-therapy (mean $\pm$ SE)

Parameters	Infected goats (group I)		Healthy goats (group II)	
	Day 0	Day 28	Day 0	Day 28
Hb (g/dl)	6.80 $\pm$ 0.49 ^a	9.62 $\pm$ 0.14	9.39 $\pm$ 0.18	9.44 $\pm$ 0.13
PCV (%)	21.03 $\pm$ 1.51 ^a	28.27 $\pm$ 0.76	28.00 $\pm$ 0.62	28.46 $\pm$ 1.35
TEC ($\times 10^6/\mu\text{l}$)	6.74 $\pm$ 0.53 ^a	11.67 $\pm$ 0.24	12.23 $\pm$ 0.19	12.38 $\pm$ 0.15
TLC ($\times 10^3/\mu\text{l}$)	8.96 $\pm$ 0.33 ^a	6.63 $\pm$ 0.25	6.66 $\pm$ 0.24	6.59 $\pm$ 0.21
Total protein (gm/dl)	6.39 $\pm$ 0.07	6.37 $\pm$ 0.11	6.36 $\pm$ 0.13	6.40 $\pm$ 0.10
Albumin (gm/dl)	2.20 $\pm$ 0.08 ^a	3.30 $\pm$ 0.12	3.31 $\pm$ 0.15	3.36 $\pm$ 0.12
Globulin (gm/dl)	4.52 $\pm$ 0.39 ^a	2.91 $\pm$ 0.18	3.15 $\pm$ 0.08	3.04 $\pm$ 0.11
A/G ratio	0.50 $\pm$ 0.04 ^a	1.15 $\pm$ 0.08	1.10 $\pm$ 0.07	1.12 $\pm$ 0.07
ALT (U/l)	39.64 $\pm$ 1.84 ^a	16.35 $\pm$ 1.32	14.89 $\pm$ 1.33	16.37 $\pm$ 1.22
AST (U/l)	106.98 $\pm$ 3.45 ^a	81.39 $\pm$ 2.62	82.76 $\pm$ 2.61	80.36 $\pm$ 2.08
BUN (mg/dl)	39.24 $\pm$ 1.69 ^a	17.77 $\pm$ 1.19	17.52 $\pm$ 1.58	17.92 $\pm$ 1.11
Serum creatinine (mg/dl)	1.25 $\pm$ 0.05 ^a	0.77 $\pm$ 0.03	0.83 $\pm$ 0.04	0.79 $\pm$ 0.04

Values are expressed mean and standard error of mean

^a Statistically significant difference ($P \leq 0.05$) when compared with the values pertaining on day 28 of the same group and on day 0 and 28 of healthy goats

not typical of psoroptic mange in goats. However, dermatitis of similar severity has been reported in old debilitated goats in Fiji (Munro and Munro 1980) and in a Numbian doe (Lofstedt et al. 1994). Reported sequelae of *Psoroptes otcariasis* include otitis media/interna (Wilson and Brewer 1984) and meningo-encephalitis (Yeruham et al. 1984); these complications were not observed in our case. The natural *P. cuniculi* infestation can shift the oxidant/antioxidant balance of goats towards oxidative status. This may be the result of overproductions of free radicals by the inflammatory cells recruited to combat the parasites and consequent exhaustion of the antioxidant system of the infested goats. Amelioration of the altered oxidant/antioxidant balance towards normalcy in gamma-benzene hexachloride + vitamin A, D3, E, and H given in rabbits indicates its potential antioxidant action of the adjunctive therapy (Kanbur et al. 2008; Singh et al. 2012). In our study, the supplementation of vitamins along with gamma-benzene hexachloride might have shifted the altered oxidant/antioxidant balance towards normalcy with a faster rate in these goats. Hematological parameters revealed that there were marked reductions in Hb, PCV, and TEC in diseased goats as compared to healthy control. Similar observations were also observed in experimental sarcoptic mange in goats and dogs with ivermectin (Arlian et al. 1995; Sengupta and Basu 2008; De and Dey 2010). In present study, low haematocrit values could be due to feeding of *Psoroptes* mites on whole blood and production of scabs (Radostitis et al. 2010). High values of TLC could be due to puncture of epidermis by adult *Psoroptes* mites and local inflammation resulting in itchiness

followed by secondary bacterial infection associated with psoroptic infection. Though there was no significant difference in total protein, however, mite-infected goats showed hypoalbuminemia and hyperglobulinemia. The probable reason of enhanced globulin in *Psoroptes*-infected goats could be attributed to chronic antigenic stimulation caused by mite infestation and secondary bacterial infection (Lofstedt et al. 1994). Serum globulin level can also increase as a result of inadequate liver function (Cornelius 1963). On day 0 of study, raised ALT, AST, serum creatinine, BUN level as well as hypoalbuminemia were noted in infected groups as compared to control healthy goats. A variety of parasitic diseases led to change in serum biochemical parameters in goat. Altered value of various biochemical indicators have also been reported from severe mite infection in calves and goats (Fisher 1982; De and Dey 2010). It seems that alteration of such biochemical parameters may be associated with compromised organ functions from severely *psoroptes*-infected goats.

In conclusion, results of clinico-pathological and therapeutic efficiency in our study may be used as basic data for further research and therapeutic measures in *Psoroptes*-infested goat, respectively. The results of present report suggest the involvement of compromised organ function in severe *psoroptes* mange infestation. However, further studies are required to establish actual mechanism of pathogenesis of *Psoroptes* mange. Gamma-benzene hexachloride along with adjunct therapy may be used for the treatment of severely affected *Psoroptes* mange infestation.

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