B-3761
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Indian J. Anim. Res.,
Print ISSN:0367-6722 / Online ISSN:0976-0555

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com/www.ijaronline.in

Parasites of mithun (*Bos frontalis*) in North Eastern hilly region of India-A review

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Received: 28-11-2018 Accepted: 07-02-2019 DOI: 10.18805/ijar.B-3761

ABSTRACT

Parasitism is a common problem for mithun (*Bos frontalis*) resulting in production losses in terms of meat and milk. Prevalence of ectoparasites infestation including *Rhipicephalus microplus, Ambylomma testuidinarium, Ixodes ovatus* and *I. acutitarsus*, has been reported based on taxonomic studies and PCR amplification of conserved gene. Different gastrointestinal helminth like *Haemonchus contortus, Mecistocirrus digitatus, Trichostrongylus* spp., *Oesophagostomum* spp., *Trichuris* spp s, *Thelazia* species, *Strongyloides papillosus*, different amphistomes and *Fasciola gigantica* were also reported from mithun from India. Among filarial worms, *Setaria digitata* was recorded from peritoneal cavity of mithun and its molecular confirmation was done based on PCR amplification of marker genes. Tapeworm infestation *viz. Moniezia expansa, M. benedeni*, hydatid cyst and *Cysticercus tenuicollis*, were also commonly occurred in mithun. Enteric protozoa like different species of *Eimeria*, *Cryptospordium* species, *Balantidium coli*, has been diagnosed based on morphological identification sporulated oocysts and developmental stages found on faecal examination.. Another obligate intracellular parasites *Toxoplasma gondii*, was also diagnosed based on ELISA and modified agglutination test. An integrated approach incorporating deworming, good livestock management and optimum feeding management practice coupled with vaccination programme will make successful parasite control programme in near future.

Key words: Epidemiology, India, Mithun, Parasites, Pathology.

Mithun *(Bos frontalis*) is a strongly built free range unique bovine species domesticated in hilly tract of North Eastern India. The animal is basically raised as ceremonial animal and sacrificed for meat purpose during festivals and social ceremonies by tribal people. Looking at the geo-climatic condition, north eastern region is quite conducive for growth and propagation of parasites. Wild animals including mithun may play important role in transmission of parasitic diseases as well as other infectious pathogens domestic animals and humans and it has also been quoted by certain researchers that most of the diseases emerge from wildlife (Moudgil and Singla 2013). Reports on different external and internal parasites of mithun are available from different workers from time to time in India (Rajkhowa *et al*. 2005b, Tandon *et al.* 2005; Chamuah *et al.* 2009b; Chamuah *et al.* 2013a; Chamuah *et al.* 2014; Chamuah *et al*. 2016b). The external parasitic infections including tick, lice and leech, and infections with helminths and protozoans commonly occurring in the mithun in the north east hilly region of India.These are being reviewed here under in the present write up.

Tick infestation in mithun: Ticks and tick borne diseases are a major constraint for improved production performance of the animals (Salih *et al.*, 2015). Prevalence of several tick species from domestic ruminants has been reported by different workers (Saravanan *et al*. 2008; Ronghang and Roy, 2014) but very limited reports are available on the prevalence of ticks on the mithun (Rajkhowa *et al*. 2005c, Chamuah *et al.* 2012; Chamuah *et al.* 2016a). In India, *Ixodes acutitarsus* has been reported earlier from domestic cattle and yak in Arunachal Pradesh, Assam and Sikkim (Ghosh *et al.* 2007; Sarvanan *et al.* 2008) and in mithun this tick species was reported from Arunachal Pradesh by Ronghang and Roy (2014) for the first time based on their morphological features like surrounding of anus anteriorly, followed by absence of festoons along with ventral surface armed with pregenital, median, anal, epimeral and adanal paired shields. This tick species was reported on mithun in Nagaland by Chamuah *et al*. (2016b). Based on the morphological features and sequencing of internal transcribed spacer-2, the tick species of mithun were identified as *I. acutitarsus* and *I. ovatus* (Chamuah *et al*., 2016c). *Rhipicephalus microplus* is the other common tick species infesting mithun with highest prevalence reported in summer season (Rajkhowa *et al*. 2005b; Chamuah *et al*. 2012; Chamuah *et al.* 2013b). In addition to the above ticks, few cases of *Haemaphysalis daivasi* and *H. neumani* infestation in mithun have also been reported earlier by Miranpuri and Naithani, (1978). But the major factors that govern the distribution of tick population on mithun have not been well defined, though rainfall,

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humidity, temperature and microclimate have been indicated as the limiting factor for distribution of ticks. Macroclimatic factors also influence the seasonal dynamics of ticks (Singh *et al.,* 2000).

Chamuah *et al*. (2016a) reported *Amblyomma testudinarium* infestation on mithun based on morphological features of live engorged. *A. testudinarium* has been reported as highly prevalent tick species in different host species of domestic and wild animals from north-eastern states like Assam, Meghalaya and Arunachal Pradesh (Miranpuri *et al*. 1976, Saravanan *et al*. 2008). This tick species is predominantly found in animals living in and around forests on the foothills of Himalayas. *Ambylomma* ticks in hilly region of Bangladesh adjoining north-eastern hilly region of India have also been reported (Islam *et al.* 2006; Mohanta *et al.* 2011). Ecological and climatological factors evidenced by the dense forested hilly environment with average temperature ranging from 10°-20°C in winter to 15°-30°C during summer months and abundant rainfall might be the contributing factors for the prevalence of this tick species in this region.

Lice infestation in mithun: *Linognathus vituli* from mithun calves is the only sucking lice reported from this animal and causing great irritation, intense pruritus, loss of hair follicle and loss of body condition (Chamuah *et al*. 2014b). This louse was identified on the morphological features.

Leech infestation in mithun: A common problem encountered in mithun is leech infestation of the body as well as in the nasal cavity causing complications such as pain, itching, inflammation, severe anemia, short-term bleeding, hypersensitivity and anaphylactic reactions on their host (Ahmadizadeh, 2002; El-Awad and Patil, 1990).The parasite in the respiratory tract causes death of animals through asphyxia. Some reports have mentioned that hirudinosis may cause severe anemia with hemoglobin lesser than 5g/dl (Hemmati *et al*. 2002).

Nematodosis: Most commonly recorded gastrointestinal parasites in mithunfrom India are *Haemonchus contortus, Mecistocirrus digitatus, Oesophagostomum* spp., *Trichostrongylus* spp., *Cooperia* spp., *Trichuris* spp., *Toxocara vitulorum, Strongyloides papillosus* and *Bunostomum* spp. (Chamuah *et al*. 2009b). Among these, *T. vitulorum, S. papillosus, B. phlebotomum* and *H. contortus and M. digitatus* are the major cause of anemia and mortality in calves below 1 year of age. Seasonal incidence of gastrointestinal nematodosis has been reported to be significantly higher during monsoon and post-monsoon periods (Chamuah *et al*. 2009b). *Strongyloides papillosus* infection has been reported to be high in calves below 1 month of age, due to prenatal transmission or through colostrum. *Trichuris* spp. isolated from colon and sometimes from large intestine was found to cause formation of tunnels in the intestinal mucosa. Pimply gut condition caused by *Oesophagostomum* spp. is characterized by nodule formation in the large intestine and is also very common in mithun calves in India (Chamuah *et al.* 2016c). Toxocarosis is responsible for calf mortality in mithun, with significant changes in haemoto-biological parameters being recorded in calves (Rajkhowa *et al*. 2003). Infection with *S. papillosus* is common in younger age group of 1-2 months (Chamuah, 2005). Parasites like *Trichuris* spp., *Trichostrongylus* spp. and *Cooperia* spp. are in general not much pathogenic. However, heavy infection results into significant changes in haemoto-biological parameters in affected mithun (Rajkhowa *et al*. 2003). The occurrence of *M. digitatus* is very common in mithun calves, also chief cause of calves' mortality. Their identification was attempted with marker genes (Chamuah *et al*., 2017b) The soil type, pH, alkalinity and type of pasture vegetation and nature of winds of a particular area influence the possibility of infection or existence of particular parasites in a locality. Moreover, grazing habitat also influence the probability of infection. The periparturient rise of helminth infection in female always leads to pasture contamination and rise in the infection rate of naïve animals.

The occurrence of microfilaria is very common phenomena in mithun and *Setaria digitata* is the cause of this microfilariamia (Rajkhowa *et al.* 2005a; Chamuah *et al*. 2016). Intensity of infection of microfilaraemia has been reported higher in older animals than in younger animals and prevalence higher in summer seasons due to more activity of culicoides flies.

Microfilariae infection: The occurrence of microfilariae is very common phenomena in mithun and was identified morphologically as *Setaria digitata* based on standard morphology key described by Soulsby, (1986). However, molecular study was also attempted with marker genes for accurate identification of parasite with subsequent sequence analysis confirmed the parasite as *S. digitata*, (Chamuah *et al*. 2015b). As per study of Chamuah *et al.* (2015b), *Setaria* sp. of mithun is also showing similar pattern of epidemiological feature of microfilariae infection as per findings of Rajkhowa *et al.* (2005a). Intensity of infection of microfilaraemiae is higher in older animals than that of younger animals and prevalence is higher in summer seasons due to more activity of culicoides flies. Gender of host does not influence the occurrence of infection in mithun (Rajkhowa *et al.* 2005a).

Trematode and cestode infections in mithun: The trematode and cestode infections are very common in mithun. Among trematodes, *Fasciola gigantica, Paramphistomum epiclitum, Calicophoron calicophorum* and *Expalnatum explanatum* are common due to sharing of life cycle with snails available in mithun rearing areas. The prevalence based on serological assays in both free-ranging and semi-intensive conditions was recorded by Chamuah *et al.* (2014a). The

associated pathological conditions like cirrhosis and fibrosis of hepatic lobule were also documented (Chamuah, 2005). Molecular markers, including the internal transcribed spacer 2 (ITS-2), 28S rDNA and mitochondrial NADH dehydrogenase sub-unit1 (nad1) were also used to confirm the identification of the trematode and cestode species (Chamuah *et al.* 2016c). Cestode infection is also a common ailment in both mithun calves and adults. Among tapeworms *Moneizia expansa* and *M. benedeni*, are commonly associated with pot belly condition and blockage of intestinal tract. Cystic echinococcosis caused by *Echinococcus granulosus* and *E. ortleppi* was found to be highly prevalent in the mithun, with *E. ortleppi* being reported for the first time in mithun.

Pathology of gastrointestinal helminth infestation in mithun: Pathology of pimply gut in calves was reviewed by Chamuah *et al.* (2016). It was characterized by extensive nodule formation in the entire large intestinal wall mainly in the rectum in the form of greyish white in color ranging in size from pinhead to a pea. Microscopically, the encysted larvae were visible in the muscularis mucosae and in the submucosa surrounded by eosinophilic infiltration and fibrous connective tissue proliferation.

Pathology of other gastrointestinal helminths were extensively studied from mithun from Arunachal Pradesh (Chamuah *et al.* 2017a). Histopathological examination of hydatid cysts in lung parenchyma showed severe emphysema with the presence of cyst and collapsed hydatid membrane. Spleen showed cystic cavity formation with accumulation of few necrotic debris and scolices, with depletion of lymphocytes from the lymphoidal follicle. The microscopic changes showed thickening of cyst wall, pressure atrophy of hepatic lobule, marked fibrosis of liver and infiltration of mononuclear cells etc.

In toxocarosis, polymorphonuclear infiltration in the sub-mucosa with hyper activity of goblet cells leading to occlusion of the gland was observed in the tissue sections. In amphistomosis, the intestines were heavily studded with large numbers of immature amphistomes that were embedded in the mucosal surface. The intestinal mucosa showed diffuse hyperemia, thickening and ulceration. Presence of parasites in the abomasal mucosa revealed the presence of petechial haemorrhages.

In *Trichuris* infection, the rectum showed both hypertrophy and hyperplasia of the goblet cells with hyperactivity of goblet cells and focal mononuclear cells. In Fascioliasis, the liver was greyish white in color and hard in consistency and thickened (Chamuah, 2005). Microscopically, adult flukes in the bile duct caused cholangitis along with marked fibrosis of the hepatic lobules forming pseudolobulation. Liver parenchyma showed infiltration of mononuclear cells.

Tissue protozoa: Among tissue protozoa, toxoplasmosis is very common in mithun due to close proximity of animals with wild animals (Rajkhowa *et al.* 2005d). The overall seroprevalence of antibodies to *T. gondii* in mithun was 42% when detected by modified direct agglutination test in free ranging animals of Nagaland (Rajkhowa *et al.* 2008). The serum antibodies to *T. gondii* by modified direct agglutination test in captive condition were 28% as compared to lower findings of 4.38% reported by Chamuah *et al.* 2015b. The possible reason for occurrence of *T. gondii* antibodies in mithun in the north eastern region could be due to confinement of animals in forest with sharing of a sylvatic type of life cycle. Moreover, positive animals may constitute an important source of infection to other animals. Because of the cultural habit of the tribal people, keeping of these animals in forest and utilizing it for meat purpose, there is possibility that toxoplasmosis will be transmitted to human beings also. Any rituals in the society, feast with mithun meat is common phenomena; this may be also one of the common factor in the epidemiology of disease transmission.

Prevalence of coccidiosis in mithun: Coccidiosis is one of the chief causes of calf mortality (Rajkhowa *et al.* 2004; Chamuah 2005 and Chamuah *et al.* 2009a, Chamuah *et al.* 2013b). The most prevalent *Eimeria* species reported in mithun are *Eimeria bovis, E. zuernii, E. ovoidalis, E. bukidonensis E. auburnensis, E. ellipsoidalis, E.subspherica* and *E. albamensis* (Rajkhowa *et al.* 2004) due to optimum climatic conditions for sporulation of oocyst. The prevalence of Eimerian species is generally highest in monsoon season (Chamuah *et al.* 2009a). *Eimeria* infection has been reported in all age groups of mithun but pathogenicity has been observed to be always higher in young mithun. Moreover, the prevalence is closely associated with managemental conditions. The incidence is higher in animal herds reared under semi-intensive system with unhygienic conditions as compared to free range system. Rajkhowa *et al.* (2004) observed *Eimeria* species prevalence was highest (84.6%) during monsoon, lowest (27.3%) in pre-monsoon and 41.7% in winter in mithun calves in Nagaland. Chamuah *et al.* (2009a) also recorded highest prevalence in monsoon that too significantly in calves below one year of age. Overall, mithun harbors significantly low prevalence of *Eimeria* species in north eastern hilly terrain due to high rainfall, peculiar topography and altitudinal variation of hilly region. However, in semi-intensive conditions low incidence of the infection has been maintained due to optimum and better scientific management.

Few other protozoa like *Balantidium coli* and *Cryptosporidium bovis* have also been found to be common in mithun calves. Cryptosporidiosis mostly affects young calves. It has been identified as one of the major causes of calf diarrhoea and the incidence has been found highest in mithun calves less than 1-2 months of age.

FUTURE DIRECTIONS

Parasitism is one of the hurdles in the improvement in production performance of the animals. Primary aim for controlling parasite is the right approach of treatment followed by preventive strategy. Therefore, proper planning with right execution of work may lead to success of parasite control in near future. In the advance of science and technology, particularly in the field of recombinant DNA technology, protein preparations having antigenic moieties are important in order to achieve protective immunity against the specific antigen. In parasitic cases also, few orphan vaccine has been developed, however, lack of interest and funding programme from Govt and private companies, control programme has not been successful. We, the faculty of Parasitology people and Scientists should come together for the achievement of controlling measure against the parasites in near coming future.

ACKNOWLEDGEMENT

Authors are thankful to Director, ICAR-NRC on Mithun, Nagaland for providing logistic support.

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