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PREVALENCE AND RISK FACTOR ANALYSIS OF GASTROINTESTINAL PARASITES IN RELATION TO ENVIRONMENTAL CONDITIONS IN DIFFERENT AGRO-CLIMATIC ZONES OF RAJASTHAN (INDIA)

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ABSTRACT

An epidemiological survey in relation to environmental conditions covering all most the entire agro-climatic zones of Rajasthan (India) was conducted to determine the prevalence of gastrointestinal parasitism in crossbred and local cattle. A total of 733 faecal samples (464 cattle and 269 buffaloes) were collected and screened from dairy animals by sedimentation and floatation technique. The overall prevalence of was 22.5%, with Semi-arid Eastern plain zone at higher infection risk (48.25%); followed by Arid Western zone (30.43%). Lowest infection was recorded from Transitional plain of Luni Basin zone (4.11%). Regarding different species of parasite, highest infection was recorded of *Balatidium coli* (10.10%) followed by Strongyle eggs (5.46%) and lowest was of *Toxocara vitulorum* and *Moniezia expansa* (0.82%). In relation to various risk factors Indigenous animal displayed higher risk of infection as compare to cross-bred cattle (OR = 4.36, 95% CI = 29.60 - 63.84). Older animals have higher risk of infection as compared to young one (OR = 2.03, 95% CI = 13.59 - 30.44). Female are more prone to significant infection as compared to their male counterpart (OR = 1.94, 95% CI = 11.38 - 33.42). Samples screened during monsoon season depicted highest level of infection (OR = 45.99, 95% CI = 39.00 - 53.14). Farms having other companion animal have more incidence of infection (23.45%) as compared to other farms (OR = 1.22, 95% CI = 8.07 - 18.66).

Key words: Gastro-intestinal parasites, faecal examination, agro-climatic zone, Rajasthan

INTRODUCTION

Livestock plays an important role in the Indian economy and is an important sub-sector of Indian agriculture. Among the livestock population, cattle (190.9 million) and buffalo (108.7 million) plays a major role in India's economy and account 37.3 and 21.2%, respectively, of the total livestock population (Ministry of Agriculture, 2012). As per the 19th livestock census 2012, Rajasthan has 57.73 million livestock which include cattle, buffalo, sheep, goat, horse and ponies, mules, donkeys, camel and pig and 8.02 million poultry birds *(http://animalhusbandry.rajasthan.gov.in/livestock_census.aspx)*.

Gastrointestinal (GI) parasitic infections are common and responsible for causing considerable economic losses as a consequence of abridged weight gain in infected animals. It is a worldwide problem for both small and largescale farmers and at present is a great threat to livestock industry (Saddiqi *et al.,* 2010). Intestinal protozoan and helminthic infestations are the major diseases of animal origin together with public health predicament in several developing countries

including India (Chhabra and Singla, 2009). It is recognized as the most important constraint to livestock production by causing clinical and sub-clinical parasitism. Subclinical GI parasitic infections are most common and economically important in India (Chowdhury *et al.,* 1994). The prevalence of subclinical infections is responsible for high morbidity and mortality in young animals and enormous production losses in adults. The economic losses caused by GI parasites are lowered fertility, reduced work capacity, reduction in food conversion efficiency and lower weight gain together with lower milk production, increased treatment cost and mortality in heavily parasitized animals (Fikru *et al.,* 2006).

GI helminths and protozoan infections are recognized as a major constraint to livestock production throughout the tropics and elsewhere (Githiori *et al.,* 2004). It is estimated that US$ 2.5 billion is spent on pharmaceutical products in cattle industry for nematode parasite control (Williams and Loyacano, 2001). Likewise, protozoan diseases are one of the major constraints in dairy farming development all over the world, particularly in developing countries (Om *et al.,* 2010). Risk factor responsible for infection are low levels of sanitation, lack of safe water supply, poor hygiene, low socio-economic status, age group and impoverished health services. In India, a wide range of prevalence of these intestinal parasites (11-90%) has been reported from different geographical provinces and populations (Marothi and Singh, 2011). In the available literature the information concerning prevalence of GI parasitic infections covering most of major agro-climatic zone of Rajasthan (India) is very scanty so it has prompted the authors to undertake this pioneer investigation. Moreover, the assessment of associated risk factors may be helpful to the epidemiologists and clinicians for their proper implementation of control strategies.

MATERIALS AND METHODS

Study areas and sampling frame

Rajasthan, a North-Western state of India, covers a geographical area of 342,239 km^2 and lies between 27° 00' N latitude and 74° 00' E longitudes (*https://www.revolvy.com/main/index.php?s=Rajasthan%20State%20Archives&item_type=topic*). On the eastern side of the Aravalli range, the rainfall ranges from 55 cm in Ajmer to 102 cm in Jhalawar. In plains, Banswara (92 cm) and Jhalawar (95 cm) districts receive the maximum annual rain. Mount Abu (Sirohi district) in the south-west, however, receives the highest rainfall in the state (163.8 cm). The representative bovine faecal samples were collected from of 24 districts in Rajasthan. The study area have extreme climatic conditions and is divided into ten agro-climatic zones with various districts [Arid Western zone (Barmer and Jodhpur), flood-prone Eastern plain (Alwar, Bharatpur and Dholpur), Humid South-eastern plain (Karauli, SawaiMadhopur, Baran and Jhalawar), Humid Southern plains (Banswara and Dungarpur), Hyper Arid partially Irrigated zone (Bikaner, Churu and Jaisalmer), Internal Drainage Dry (Junjhunu and Sikar), Semi-arid Eastern plain (Ajmer, Dausa and Jaipur), Sub-humid Southern plain (Bhilwara and Chittorghar), Transitional plain of Luni Basin (Jalore and Pali) and Irrigated North-western plains (Hanumanghar)] based on the climatic and edaphic factors (Fig. 1). To study the status of prevalence of the concurrent infection, the expected prevalence of 50% with confidence limits of 95% and a desired absolute precision of 5% to collect maximum number of samples was considered (Thrusfield, 2005). The number of samples thus calculated was adjusted for finite population and was correlated with 733 samples (514 cattle and 219 buffaloes) collected from ten agro-climatic zones.

Study period

The study was conducted from April 2016 to April 2017 and divided into four seasons *viz.*, Pre-monsoon (March to May), Monsoon (June to September), Post-monsoon (October and November) and winter (December to February).

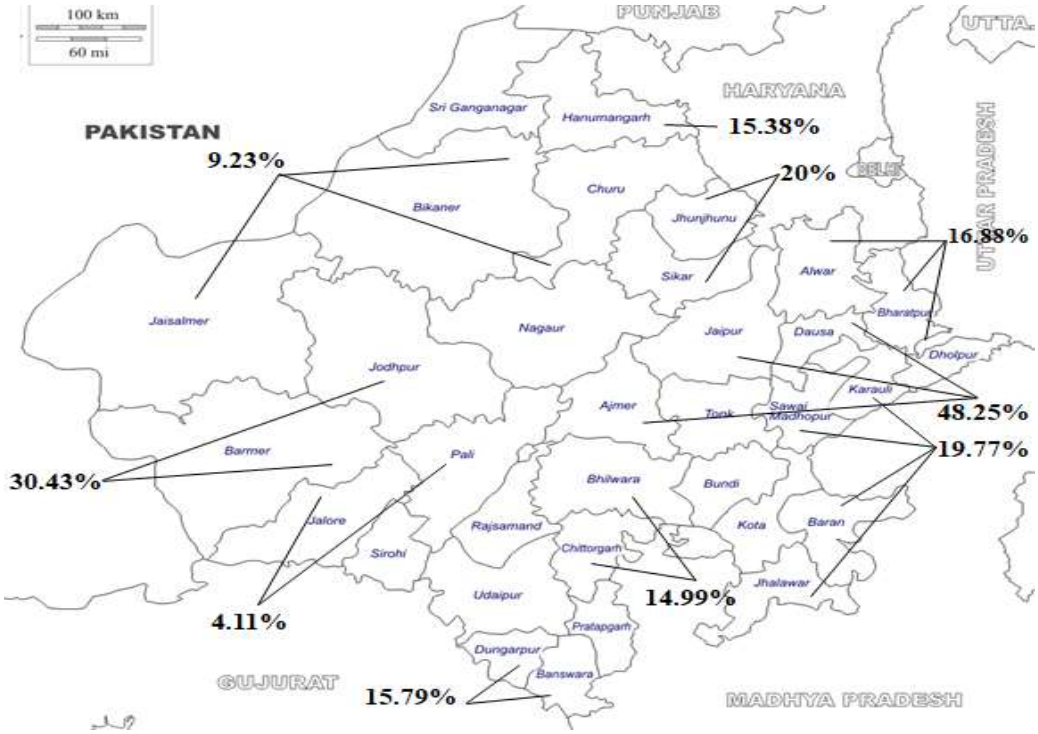

Fig. 1: Map of different districts of Rajasthan (India)

Sample collection

Faecal samples were collected directly from the rectum of the individual animal and kept in marked plastic pouch/vials. A predesigned epidemiological questionnaire addressing the species, breed, age of animal, sex, companion animal, management and season was maintained to calculate the risk associated with parasitic infection. The farms with inappropriate management system having kacha floor (raw/without concrete), poor sanitation and open grazing system were classified as 'unorganized farms' while those with proper scientific management conditions were considered 'organized farms'.

Parasitological techniques

To detect parasitic eggs/ova/cyst in faecal samples of cattle and buffalo, the samples were examined by flotation and sedimentation techniques (Soulsby, 1982). Saturated sodium chloride (specific gravity 1.20) solution was used as floating fluid. The samples which could not be examined on the same day were preserved and stored at refrigerated temperature (4°C) for examination on next day.

Statistical analysis

The prevalence of various parasites with respect to various physical and biological factors was statistically analyzed employing Pearson's χ^2 test ($p \leq 0.05$). Also, the potential risk factors were analyzed using WinEpiscope software v. 0.1 and online software (*http://statpages.info/ctab2x2.html*).

RESULTS AND DISCUSSION

By parasitological examination, of the 733 cattle's samples screened 165 samples (22.5%) showed the presence of parasitic eggs/oocyst (Table 1). The prevalence of infection varied significantly among all the agro-climatic zones ($\chi^2 = 83.87$). The highest prevalence was observed in Semi-arid

Eastern plain zone (48.25%), while the lowest was noticed in Transitional plain of Luni Basin zone (4.11%). The highest level of mixed infection was noticed in Semi-arid Eastern plain zone (13.29%). It may be accredited to the fact that the favoured warm and slight wet atmosphere of are favourable for the development of pre-parasitic free-living stages of parasites (Muraleedharan, 2005). Semi-arid eastern plain region receives annual rainfall of between 40 to 60 cm and has average temperature during summer season ranges from 28 to 34^{o}C which is optimum for survivability of various parasites (*http://shodhganga.inflibnet.ac.in/bitstream/10603/24677/10/ 10_ chapter%204.pdf*). Moreover, the difference in zone-wise prevalence of Rajasthan may be due to the variation in animal husbandry practices, pasture management of dairy animals and difference in the deworming programmes (Gupta *et al.,* 2012). Perusal of literature reveals that this is the first report of gastro-intestinal parasitic epidemiological survey covering ten important agro-climatic zone of Rajasthan (India) along with complete risk factor analysis using basic parasitological techniques. Regarding different species of parasite, highest infection was recorded of *Balatidium coli* (10.1%) followed by Strongyles eggs (5.46%) and lowest was of *Toxocara vitulorum* and *Moniezia expansa* (0.82%). Infection of *Balatidium coli* varies significantly among all zones (χ^2 = 16.92) [Table 1].

Various risk factors considered in this study (Table 2) had distinct odds ratios. Indigenous animal displayed higher risk of infection (42.86%) as compare to cross-bred cattle (OR = 4.36, 95% CI = 29.60 - 63.84) to various GI parasite, it may be due to the fact that improved husbandry measures along with strategic anthelmintic therapy contributed less parasitic infection in cross-bred animal (Awraris *et al.,* 2012; Akanda *et al.,* 2014; Renwal *et al.,* 2016). Older animals have higher risk of infection as compared to young one (OR = 2.03, 95% CI = 13.59-30.44). Similar observations have also been made by Awraris *et al.* (2012) and Akanda *et al.* (2014). It may be due to the presence of maternal antibodies in the young one. Female are more prone to significant infection as compared to their male counterpart (OR = 1.94, 95% CI = 11.38 - 33.42), may be due to high preference of livestock keepers owing to their utilization for draught, milking and breeding (Moretti *et al.,* 2010; Sumbria *et al.,* 2014). Samples screened during monsoon season depicted highest level of infection (31.50%) [Table 2], followed by post-monsoon season (Renwal *et al.,* 2017). From different parts of India various researcher (Swarnakar *et al.,* 2014; Maharana *et al.,* 2015) have shown the seasonal dynamics of GI parasitic infections and coated that highest prevalence occur in rainy season. This may be due to sufficient dampness and most favourable

Table 1: Prevalence of GI parasite in cattle of different agro-climatic zone of Rajasthan (India)

Agro-climate zone	Number of samples (%)								
	Total sample	Positive	Mixed infection	*Balantidium coli*	*Strongyle* spp.	Amphistome	*Moniezia expansa*	Coccidian oocyst	*Toxocara vitulorum*
AW	69	21 (30.43)	9 (13.04)	10 (14.49)	5 (7.25)	0	1 (1.45)	3 (4.35)	2 (2.90)
FPEP	77	13 (16.88)	5 (6.49)	6 (7.79)	4 (5.19)	1 (1.30)	0	2 (2.60)	0
HSEP	86	17 (19.77)	5 (5.81)	8 (9.30)	3 (3.49)	2 (2.33)	0	4 (4.65)	0
HSP	57	9 (15.79)	3 (5.26)	3 (5.26)	2 (3.51)	0	0	3 (5.26)	1 (1.75)
HAPI	65	6 (9.23)	0 (0)	2 (3.08)	2 (3.08)	0	1 (1.54)	1 (1.54)	0
IDD	55	11 (20)	2 (3.64)	5 (9.09)	3 (5.45)	0	0	3 (5.45)	0
SAEP	143	69 (48.25)	19 (13.29)	33 (23.08)	15 (10.49)	4 (2.80)	4 (2.80)	11 (7.69)	2 (1.40)
SSP	69	10 (14.49)	3 (4.35)	4 (5.80)	3 (4.35)	0	0	2 (2.90)	1 (1.45)
TPLB	73	3 (4.11)	0 (0)	1 (1.37)	1 (1.37)	0	0	1 (1.37)	0
INWP	39	6 (15.38)	1 (2.56)	3 (7.69)	2 (5.13)	0	0	1 (2.56)	0
Total	733	165 (22.51)	47 (6.41)	74 (10.10)	40 (5.46)	7 (0.95)	6 (0.82)	31 (4.23)	6 (0.82)
χ^2		83.87*	28.11*	16.92*	11.77	11.05	11.41	8.33	7.03

*P≤0.05

AW - Arid Western zone, FPEP – Flood-prone Eastern plain, HSEP - Humid South Eastern plain, HSP - Humid Southern plains, HAPI – Hyper-arid partially Irrigated, IDD - Internal Drainage Dry, SAEP – Semi-arid Eastern plain, SSP - Sub-humid Southern plain, TPLB - Transitional plain of Luni Basin and INWP - Irrigated North Western plains

Table 2: Distribution of variables identified to determinate the risk factors associated with GI parasites prevalence in cattle from Rajasthan (India)

Factors	Variables	Samples	Positive (%)	Odds ratio (95% CI)
Species	Cattle	464	99 (21.34%)	1.19 (8.27-17.37)
	Buffalo	269	66 (24.56%)	
	χ^2		0.99	
Breed	Indigenous	203	87 (42.86%)	4.36 (29.60-63.84)
	Cross-breed	530	78 (14.72%)	
	χ^2		27.24*	
Age	> 2 years	453	122 (26.93%)	2.03 (13.59-30.44)
	< 2 years	280	43 (15.36%)	
	χ^2		13.20*	
Sex	Male	140	20 (14.20%)	1.94 (11.38-33.42)
	Female	593	145 (24.45%)	
	χ^2		5.85*	
Companion animal	Present	533	125 (23.45%)	1.22 (8.07-18.66)
	Absent	200	40 (20%)	
	χ^2		0.99	
Management	Organized	577	103 (17.85%)	3.03 (2.03-4.54)
	Unorganized	156	62 (39.74%)	
	χ^2		33.74*	
Season	Pre-monsoon	103	20 (19.42%)	24.10 (16.17-34.31)
	Monsoon	273	86 (31.50%)	45.99 (39.00-53.14)
	Post-monsoon	158	33 (20.89%)	26.40 (19.46-34.75)
	Winter	199	26 (13.06%)	15.03 (10.47-21.11)
	χ^2		23.64*	
Total		733	165	

*P≤0.05

temperature in monsoon season which favours the growth and survival of infective stages of parasite in the pasture (Akanda *et al.*, 2014).

Organized farm has less chance of infection (17.85%) as compared to unorganized farm (39.74%), as these farms follow strict vaccination/deworming schedule (Akanda *et al.*, 2014). Buffalo showed non-significant rise in infection (24.56%) as compared to cattle (OR = 1.19, 95% CI = 8.27 - 17.37) and the outcome was in concordance with the other studies (Wadhwa *et al.*, 2011; Gupta *et al.*, 2012). Farms having other companion animal like sheep, goat etc. have more incidence of infection (23.45%) as compared to other farms (20%), similar finding has been coated in literature (Kumar *et al.*, 2013).

Conclusion: To our knowledge, this study, for the first time, brings out a comprehensive report on the status on GI parasite state in agro-climatic zone of Rajasthan state (India), thoroughly investigated by basic parasitological techniques in relation to physical and environmental risk factors. This study puts for the various commodities at risk which can be helpful in formulating a comprehensive control and preventive strategy.

Conflict of interest: Authors have no conflict of interest

Ethical statement: As this study does not involve the any blood collection or any experimental procedure so there is no need of permission from animal ethical committee.

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