

Research Article



Seroprevalence of Contagious Caprine Pleuropneumonia in Goats from Selected Endemic Areas of Sindh

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Abstract | Contagious Caprine Pleuropneumonia (CCPP) is a serious and economically important respiratory disease which causes significant losses in goat population throughout Asia, Middle East, Europe and Africa. In order to investigate the seroprevalence of CCPP in goat population of Sindh province, a total of 800 serum samples from four districts of Sindh (Thatta, Tharparkar, Jamshoro and Larkana) representing four agro-ecological zones of Sindh were examined by using c-ELISA. The overall seroprevalence of CCPP in goat population was found to be 18.0%. The prevalence of CCPP varied significantly ($p < 0.001$) in the four districts. It was found highest in Tharparkar (24.5%) followed by Larkana (19.0%) Jamshoro (15.5%) and Thatta (13.0%). Sex-wise seroprevalence of CCPP in goats showed significantly higher ($p < 0.001$) occurrence in female goats (18.4%) than male goats (15.0%). Age wise investigation exhibited a higher ($p < 0.001$) seroprevalence of CCPP in goats older than 2 years of age (23.7%) than the goats 1-2 years of age (10.0%) and was lowest in goats younger than 1 year of age (8.0%). Breed-wise results showed higher ($p < 0.001$) seroprevalence of CCPP in Tapri goat breed (30.0%) than the Teddy (24.0%) and Pateri (11.0%) while it was lowest in Kamori goat breed (7.0%). These results concluded that CCPP is prevalent in the study area thus proper control strategies should be adopted to prevent economic losses.

Keywords | CCPP, c-ELISA, Goats, Seroprevalence, Sindh.

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INTRODUCTION

Goats play an essential part in the agricultural economy, providing milk, meat, and skin. Goats are maintained largely by farmers from lower socioeconomic classes who rely on the revenue generated by their animals for their livelihood. Several difficulties, including severe weather conditions, inadequate management, a shortage of fodder

supply and illness are faced by the goat farming (Samiullah, 2013). Despite of the above constraints, the Contagious Caprine Pleuropneumonia (CCPP) has become an impediment in the growth and production of goats. Small ruminants are a major source of meat, milk, and skin for a large portion of the world's population; although, the CCPP caused a significant damage either due to direct losses in terms production such as high morbidity, mortal-

ity, reduced production or indirect losses mainly the cost of treatment, surveillance, disease diagnosis, trade restrictions and low cost of animals (Yatoo et al., 2018).

The causative agents of CCPP in goats are bacteria of the genus *Mycoplasma*. Which consists of a group of species and subspecies like *Mycoplasma mycoides* clusters that includes *M. capricolum* subspecies *capricolum*, *M. capricolum* subspecies *capripneumoniae*, *M. mycoides* subspecies *capri*, *M. mycoides* subspecies *mycoides* large colony, *M. mycoides* subspecies *mycoides* small colony and *Mycoplasma* bovine group 7. Among them, some species have common antigenic and genomic properties (Laura et al., 2006). The classical form of the disease is caused by *Mycoplasma capricolum* subspecies *capripneumoniae* (*Mccp*). The acute septicemic disease is caused by *Mycoplasma mycoides* subspecies *capri* (*Mmc*) which is common in the “subcontinent” causing contagious caprine pleuropneumonia (Mondal et al., 2004).

The CCPP poses a danger to the global goat population due to the disease’s high contagiousness and propensity for fast transmission across national boundaries (Samiullah, 2013). As a result of its trans-boundary character, CCPP is classified as a List “B” illness by the Office International des Epizooties (OIE, 2017). The disease causes 100% morbidity and 80% mortality in both domestic and wild goat breeds (Nicholas, 2008; Arif et al., 2007; Ostrowski et al., 2011, OIE, 2009). Typical cases of CCPP are characterized by pyrexia (41-43°C) with respiratory symptoms. After an episode of high fever, respiratory symptoms become more pronounced accompanied by increased nasal discharge and lacrimation (OIE, 2008). When this illness manifests itself in the lung, fibrinous pleuropneumonia with an elevated amount of straw-colored pleural fluid may be seen (McMartin et al., 2012). Thiaucourt and Bolske (2016) reported that *Mccp* infects exclusively goat species, and that it does not infect sheep or other livestock.

The CCPP is an emerging disease in Pakistan and limited epidemiological information regarding its prevalence has been reported from Balochistan province (Awan et al., 2010), Punjab (Shahzad et al., 2016), KPK (Siddique et al., 2012; Shah et al., 2017; Rahman et al., 2022), Sindh (Chandio et al., 2019). This study was conducted for the first time in Sindh province of Pakistan where four districts representing four agro-ecological zones of province were chosen to estimate the prevalence of CCPP along with associated risk factors.

MATERIALS AND METHODS

STUDY AREA

The research was designed to estimate the seroprevalence of CCPP in goats in Thatta, Tharparkar, Jamshoro and

Larkana districts of Sindh, Pakistan. These four districts represent three distinct agro-ecological zones of province i.e., irrigated plain, western dry hilly area and eastern sandy desert area. Thatta is a coastal district with a hot humid climate, the Tharparkar district has a tropical sandy desert climate. During summer, it is extremely hot during the day, while nights are much cooler. The Jamshoro, has an arid hilly terrain and has sweltering summers with muggy and windy weather; the winters are short, comfortable, and dry; and it is mostly clear year-round. Larkana district is an irrigated plain having a hot desert climate with hot summers and cold winters.

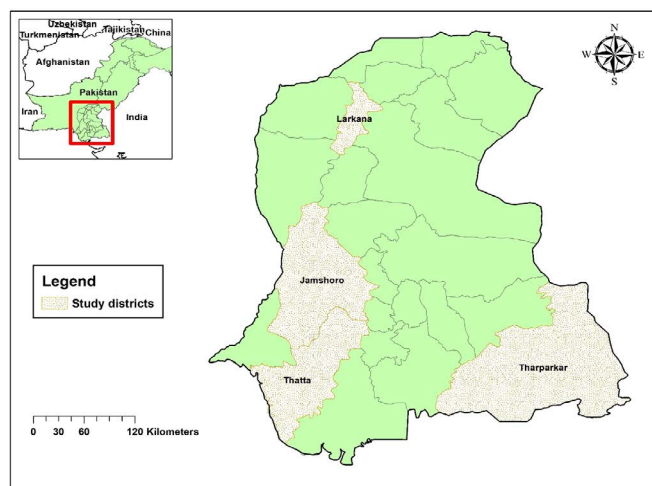


Figure 1: Study area for sample collection from four districts of Sindh province of Pakistan representing agro-ecological zones.

COLLECTION OF SAMPLES

For sample collection 80 non-vaccinated goat herds (herd size ranging from 70-140) were visited from which goats random blood samples were taken. A total of 800 blood samples were collected during September 2018 to April 2019. Samples were collected from both sexes of Teddy, Tapri, Pateri and Kamori breeds belonging to age groups of younger than 1 year, 1-2 years and older than 2 years. The blood samples were collected aseptically and transported in a cool chain to the Vaccine Production Unit, Central Veterinary Diagnostic Laboratory Tandojam, for the further investigation. Serum was separated from collected blood samples by centrifugation at 2000 rpm for 15 minutes and stored at -20°C till use.

DETECTION OF ANTIBODIES AGAINST CCPP

The samples were tested by c-ELISA as described by OIE (OIE, 2009). According to the manufacturer’s instructions, the obtained samples were tested for *Mccp* using a monoclonal antibody-based competitive c-ELISA test kit (IDEXX Laboratories, USA). The test process was controlled using negative and positive cutoff values. Using an ELISA plate reader (Immunoskan BDSL, Thermo Lab.

Systems, Finland), the optical density (OD) values were measured at 492nm. ELISA Data Interchange (EDI) software used the following method to convert the absorbance to percentage inhibition (PI):

$$PI = 100 - (OD \text{ control}/\text{test serum}) \times 100 \text{ (OD monoclonal control)}$$

Serum samples with a PI value of 50 or above were deemed positive for CCPP antibodies, whereas serum samples with a PI value of less than 50 were declared negative.

DATA ANALYSIS

The data collected was tabulated on Microsoft Excel Sheet. The frequency and percentage of different values were calculated. The significant differences ($P < 0.05$) between datasets were calculated by using Chi-square test. Statistix ver 8.1 software was used for analysis of data.

RESULTS AND DISCUSSION

Seroprevalence of CCPP in goat population of Sindh province is presented in (Table 1). Overall seroprevalence was 18.0 % in four districts of Sindh province. Results of four districts were compared and it was revealed that the difference between districts was significant ($P=0.009$). Among the districts, highest CCPP seroprevalence was found in goats of Tharparkar district (24.5%), followed by Larkana district (19.0%), Jamshoro district (15.5%) and district Thatta (13.0%). Variation in the CCPP prevalence among the districts could be attributed to the climatic condition of the area, management and housing system of animals, as previous literature showed these elements as risk factors for the incidence of infectious diseases (Ahmed et al., 2020; Zarea et al., 2021). Similar results were reported by Bekele et al. (2011) and Regassa et al. (2010) who reported that variation in CCPP prevalence rates could be the result of unregulated animal movement, differences in agro-ecology, husbandry systems and sick goat sampling. The findings of this study are in line with the reports of Selim et al. (2021) and Hussain et al. (2021) who reported 20% and 28.8% seroprevalence of CCPP, respectively. Findings of Ahaduz-zaman, (2020) recorded pooled seroprevalence of CCPP was 16.67% in sheep and 20.83% in goats in Pakistan. The results of present study are in accordance with findings of Chandio et al. (2019), who recorded an overall CCPP prevalence of 20% and 17% in goats using c-ELISA in districts Hyderabad and Tando Allahyar respectively. While, Askale et al. (2019) and Tsegaw et al. (2017) determined seroprevalence of 8.5% and 14% in goats. Similarly, Shah et al. (2017) determined seroprevalence of 20.5% in goats of Khyber Pakhtunkhwa, Pakistan. Previous findings of Mekuria and Asmare, (2010); Eshetu et al. (2007); Gelagay et al. (2007) and Regassa et al. (2010) are also matched with current study. They observed seroprevalence of 18.6%, 19.9%, 20.1%, and 22.4% in South Omo, Afar Pastoral

area, Borona Pastoral Area, and Afar region, respectively.

Table 1: Prevalence of CCPP in goats of various districts of Sindh province.

Districts	Samples #	Samples positive		Odd ratio	p-value
		No.	%		
Thatta	200	26	13.0	0.14	0.009
Tharparkar	200	49	24.5	0.32	
Jamshoro	200	31	15.5	0.18	
Larkana	200	38	19.0	0.23	
Total/ Mean	800	144	18.0 (95% CI: 13.69-22.3)	0.21	

Sex-wise seroprevalence of CCPP in goats exhibited relatively higher frequency in female goats (18.4%) than male goats (15.0%) ($p=0.064$) (Table 2). This result was in accordance with Tigga et al. (2014) who found that among female goats prevalence of CCPP was greater than the male goats. Similarly, Suryawanshi et al. (2015) recorded higher prevalence of CCPP in males (35.7%) than in females (17.1%). Findings of Bekele et al. (2011) and Yousaf et al. (2012) are also in accordance to our results as both studies reported higher prevalence in females than males. It might be due to reduced level of host protection mechanism due to malnutrition and poor physiological condition in female goats.

Age-wise prevalence of CCPP were higher in goat older than 2 years of age (23.7%) than the goats 1-2 years of age (10.0%) and younger than 1 year of age (8.0%) ($p=0.004$) (Table 2). It was reported that humoral immunity might be the reason for low seropositivity in young ones (Mohammad, 2010). The seroprevalence in old age as compared to young age might be explained by the fact that as with the increase in age, small ruminants are repeatedly exposed to various stress conditions due to (adverse weather, movement on long distance and malnutrition) which can predispose animal to disease. Further, with increasing age the probability of encounter with various infectious agents also increases. Similarly, significant variation in age groups has also been reported in several studies where young goats were less affected by the CCPP disease as compared to the goats of older age (Eshete, 2006; Bekele et al., 2011; Yousif et al., 2012; Kumar et al., 2014). Samiullah, (2013) reported that kids within the age of one year were rarely found under the infection of CCPP.

Breed-wise prevalence of CCPP was higher in Tapri goat breed (30.0%) than the Teddy goat breed (24.0%) and Pateri goat breed (11.0%) and was lower in Kamori goat breed (7.0%) ($p=0.002$) (Table 2). The difference in seropositivity may be due to variation in number of samples

Table 2: Overall risk factor association with seroprevalence of CCPP in goats.

Risk factor	Samples No.	Positive Samples		Odd ratio	p-value
		No.	%		
Sex					
Male	100	15	15.0	0.17	0.064
Female	700	129	18.4	0.22	
Age					
<1 year	100	8	8.0	0.08	0.004
1-2 year	220	22	10.0	0.11	
>2 year	480	114	23.7	0.31	
Breeds					
Teddy	200	48	24.0	0.31	0.002
Tapri	200	60	30.0	0.42	
Pateri	200	22	11.0	0.12	
Kamori	200	14	7.0	0.07	

Table 3: District-wise risk factors association with seroprevalence of CCPP.

Risk factors	Thatta		Tharparkar		Jamshoro		Larkana	
	No. (%)	p-value	No. (%)	p-value	No. (%)	p-value	No. (%)	p-value
Sex								
Male	3(3)	0.004	5(5)	0.004	3(3)	0.004	4(4)	0.004
Female	23(3.2)		44(6.2)		28(4)		34(4.8)	
Age								
<1 year	2(2)		4(4)		1(1)		1(1)	
1-2 year	7(3.1)	0.008	9(4.0)	0.002	3(1.3)	0.003	3(1.3)	0.003
>2 year	17(3.5)		36(7.5)		27(5.6)		34(7.0)	
Breeds								
Teddy	10(5)		15(7.5)		11(5.5)		12(6)	
Tapri	11(5.5)	0.000	25(12.5)	0.000	11(5.5)	0.000	13(6.5)	0.000
Pateri	2(1)		7(3.5)		6(3)		7(3.5)	
Kamori	3(1.5)		2(1)		3(1.5)		6(3)	

and time of sampling during outbreaks. Variation of breed wise seroprevalence was in line with findings of [Shahzad et al. \(2016\)](#), who reported prevalence of 18.1% and 8.1% in Okara district with epidemiological variation of 42.8%, 11.7% and 8.6% in Beetal, Nachi and Angora breeds at district Layyah.

Results presented in [\(Table 3\)](#) providing the further explanation (district-wise) for risk factors associated with the prevalence of CCPP in four districts viz. Thatta, Tharparkar, Jamshoro and Larkana. The seroprevalence was recorded high ($p < 0.001$) in female population as compared to male in all four districts. The seroprevalence was recorded high ($p < 0.001$) in goats aged older 2 as compared to age group of 1-2 year and younger than 1 year in all four districts. The seroprevalence was recorded high ($p < 0.001$) in Tapri breed as compared to Teddy, Pateri and Kamori breeds in all four districts. District-wise seroprevalence of

CCPP was significantly higher in Tharparkar than Thatta, Larkana and Jamshoro, respectively.

CONCLUSION

It is concluded that CCPP is well prevalent in Sindh province of Pakistan. The seroprevalence was found higher in females and adult goats and most of them were from Tapri breed. Among the four selected districts of Sindh province the seroprevalence of CCPP was the highest in Tharparkar district.

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The authors declare that there is no conflict of interest.

NOVELTY STATEMENT

Contagious Caprine Pleuropneumonia is an important disease of small ruminants whose prevalence has not been studied at the level of Sindh Province of Pakistan. We report that the prevalence of CCPP with respect to breed, sex and age of goats in four districts of Sindh province which represent four agro-ecological zones of the province.

AUTHORS CONTRIBUTION

Ghulam Mustafa Solangi conducted all experiments as part of PhD research. Dr. Zaheer Ahmed Nizamani and Dr. Mansoor Tariq designed experiments while Dr. Zubair Ahmed Leghari and Dr. Asghar Ali Kamboh analyzed the data, Barirah Rehman Talpur helped in data collection

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