



Study of Sero-Prevalence and Risk Factors Analysis of Contagious Bovine Pleurio Pneumonia in South Eastern and Southern Oromia, Ethiopia



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Abstract

Contagious bovine pleuro pneumonia (CBPP) is a notifiable and highly contagious respiratory disease of cattle and water buffalo, caused by the *Mycoplasma mycoides* subspecies *Mycoides*. The Cross-sectional study was carried out in the East Bale zone in selected districts of Dawe Ketchen, Rayitu, and Ginnir, and in Borena zone, included Yabello and Dirre districts from November 2023 to May, 2024. With the general objective of identifying the Sero-prevalence of contagious Bovine pleuro-pneumonia and associated risk factors with the disease. The study was included all local breeds of Arsi and Borena. The zone and districts were selected purposefully based on the cattle population, and the accessibility of infrastructure. Accordingly, 880 sera samples were collected from cattle. During the present sero prevalence study, 50/149 (5.68%) from Dawe Ketchen, 39/128 (4.43%) from Rayitu, and 51/150 (5.80%) from Ginnir and a total of 140 (15.91%) out of 427 samples from East Bale were prevalent for CBPP antibody as tested by c-ELISA. In addition, 156/353 (17.73%) and 9/97 (1.02%) samples were found positive for the antibody of CBPP in Yabello and Dirre districts of Borena zone respectively. In general, 305 sera samples were positive for CBPP antibody out of 880. The disease was highly prevalent in Borena zone (18.75%) than East Bale. So, zone is associated as one of the risk factors without statistical significance ($P=0.258$). For instance, districts were identified as risk factors by logistic regression analysis computed using 95% CI and P-value at $P<0.05$, and the only 2 districts, Yabello ($p=0.033$) and Dirre (0.000) were statistically significant. On the other hand, CBPP is highly prevalent in adult animals than younger animals, regardless of statistical significance. And also, it is relatively prevalent more in female animals than male. The Current study findings were identified the Evidence on the CBPP sero-prevalence and association of a significant risk factors in which Districts (Agro-pastoral ecology) is playing the vital role, and the outcome of present vowed all stakeholders to take immediate action to disease control and prevention.

Key Words: Contagious Bovine Pleuropneumonia; Cattle; Disease; Prevalence; Risk factors

Abbreviations: CBPP: Contagious Bovine Pleuro Pneumonia; TAD: Transboundary Animal Diseases; PCR: polymerase chain reaction; CFT: complement fixation test; AHI: Animal health institute

Introduction

Contagious bovine pleuro pneumonia (CBPP) is a notifiable and highly contagious respiratory disease of cattle and water buffalo, caused by the *Mycoplasma mycoides* subspecies *Mycoides* (MmmSC) [1]. Bacterial agents are contained in the former List "A" Diseases grouping of the World Organization for Animal Health (WOAH) and are one of the major transboundary animal diseases (TADs) limiting the export trade of livestock in Ethiopia (Clemmons and Alfson, 2017). It causes significant economic losses and leads to a serious food security problem, negatively influencing people's livelihoods in affected countries [2]. Its economic importance is related to its high morbidity and mortality rates, costs related

to quarantine, increased cost of controlling the disease, delayed marketing, reduced draft power, reduced fertility, loss of market due to trade bans, and inhibition of sustained investment in livestock production [3]. In Ethiopia, CBPP accounts for losses of over 8.96 million USD per year due to the mortality of the disease [4].

In Ethiopia, CBPP is an endemic disease reported in different parts of the country, with prevalence varying between 1.78% and 96%. The principal transmission of CBPP is through the aerosol of infective droplets from active animals or carrier cases of the disease [5]. Overcrowding of animals around watering points or

at night in a paddock or pen facilitates the transmission of the disease [6]. Cattle movements are responsible for the spread of CBPP from one herd, region, or country to another [7]. Under natural conditions, the main source of infection is the excretion of infective droplets by the infected coughing animal. Nasal discharge, pleural fluid, and, rarely, urine from sick animals can serve as sources of infection.

In the diagnosis of CBPP, clinical signs, etiological agent isolation, polymerase chain reaction (PCR), serological tests, and necropsy findings are used. The competitive enzyme-linked immunosorbent assays (c-ELISA) and complement fixation test (CFT), which are used for, global trade, screening and eradication campaigns of CBPP. Restrictions on animal movement, quarantine, immunization, antibiotic therapy, and, in developed nations, the removal of sick animals from the herd are among the CBPP control measures. Due to a variety of social, cultural, political, and economic problems, developing nations are unable to effectively regulate the CBPP, in contrast to western nations [8]. Based on the economic and epidemiological significance of CBPP, few studies have been conducted in the South Eastern and Southern Oromia, Ethiopia on sero prevalence CBPP. The Bacterial Serology Research desk unit has been developed an annual plan for 2016 E.C (Ethiopian calendar). Therefore, the present study of Sero-prevalence and Associated Risk factors was conducted with the general objectives of Identifying the Sero-prevalence of contagious Bovine pleuro-pneumonia (CBPP) and to know the associated risk factors with the disease in selected districts of East Bale, and Borena zone.

Materials and Methods

Study area

This study was carried out in the East Bale zone in selected districts of Dawe Ketchen, Rayitu, and Ginir and in Borena zone, included Yabello and Dirre districts for sero-prevalence study in South eastern and Southern °Oromia, from November 2023 to May, 2024.

East Bale zone is the newly separated from former Bale zone. Most of its districts are present as pastoralists, and known by huge livestock population. The area is geographically located in the South eastern part of Oromia. The annual rainfall is between 300mm (millimeter) to 800mm millimeter) with temperature of 27°C to 30°C. However, the selected districts are commonly identified by having annual hot temperature of 26°C to 40°C, and general annual rainfall of lower than 300mm.

The Second study area is Borena zone, and it is characterized by Pastoralism, located in southern part of Oromia and bordered by Kenya, and geographically found between 40 2°56'58N and 380 13°35'39E. The area can have annual rain fall of 350 to 900 mm. The area is generally known as lowland and have annual temperature of 19°C to 42°C. However, Dirre district as small highlands which is favorable for farming of different crops. Its

elevation totally ranges from 750 to over 2400 meters above sea level as the information Borena zone Agriculture office.

Study population

The study was included all local breeds of Arsi and Borena. During the current study, all populations were local Arsi breeds in Bale, Borena cattle breeds managed under the Borena Cattle Breeding and Genetic Improvement Center and an extensive pastoral production system reared by the community were selected. Accordingly, all ages and both sexes of animals were used for the purpose of sero-prevalence investigation. Thus, the serum sample was collected from adult, young, Male and female species of bovine.

Study Design

The cross-sectional study was conducted to determine the sero prevalence and risk factors analysis of CBPP in present study area, based on zone, districts, age and sex of animals.

Method of sampling

Sample size was determined by using formula for sero prevalence by Thrusfield [9] based on 95% confidence level of 50% and additional 5% precision.

$$n = 1.962 P_{exp} (1 - P_{exp}) / d^2$$

Where,

n = n required sample size, P_{exp} = expected prevalence, and d = desired absolute precision (5%). Hence the minimum of sample size was 384 according to this formula. However, 880 serum samples were collected from cattle in selected districts of present study areas to increase the chance to know more about the current status of CBPP. The zone and districts were selected purposefully based on the cattle population, and the accessibility of infrastructure. Sampling units were by using the multistage simple random method. The information such as age, sex, zone and districts of sampled animals were recorded. The age of animals was determined as adult (>3 years old), and young (less than 3 years). This age category was used based on the method of Masiga and Windsor [10].

Size of sample collected

Totally, from five districts, and 880(table 1) sera samples for CBPP sero-Prevalence study were collected. All collected samples were submitted to the Animal health institute (AHI) sample reception unit for processing in the respective laboratory of bacterial serology for the detection of MmmSC antibody.

Laboratory examination

Competition ELISA commercial kit of (IDEXX CBPP, CIRAD-UMR15, FAO and OIE reference laboratory, United States of America) was used for detection of antibody against *Mycoplasma mycoides* subsp. *mycoides* biotype SC (MmmSC) in each of the individual bovine serum prepared for the test. During the

laboratory examination, all protocol or procedures were followed as recommended by manufacturer. Hence, the optical density (OD) of samples and controls were measured as 450nm by ELISA reader machine. The end interpretation of results were expressed in percentage of inhibition (PI) through comparing of OD in the blood serum wells with OD of monoclonal antibody (detection solution,

Mab) in the control wells. Accordingly, sample with percent of inhibition above 50% was considered as Positive and the sample that showed PI lower than 50% has been taken as negative for *Mycoplasma mycoides* subspecies *Mycoides* (MmmSC) (Peyraud et al., 2014; Selim et al., 2021).

Table 1: Number of Serum collected

No.	District	No.of Pas	No.sample	Type of sample	Remark
1	Dawe Kachen	4	149	Serum	
2	Rayitu	3	128	Serum	
3	Ginir	3	150	Serum	
4	Yabello	2	356		
5	Dirre	2	97		
	Total	14	427	Serum	

Data Management and Analysis

The laboratory results data generated in MS-Excel were analyzed by using Stata-64 software. Sero prevalence of the Contagious Bovine pleuro-pneumonia (CBPP) was measured at the 95% confidence intervals (CIs), and P- Value ($P < 0.05$). Association between risk factors and disease positivity was assessed using Chi-square (χ^2).

Results

Laboratory results

During the present sero study, 50/149(5.68%) from Dawe

kachen, 39/128(4.43) from Rayitu, and 51/150(5.80) from Ginnir and the total of 140(15.91%) out of 427 samples from East Bale were prevalent for CBPP antibody as tested by c-ELISA (table1). In addition, 156/353(17.73%) and 9/97 (1.02%) samples were found positive for the antibody of CBPP in Yabello and Dirre districts of Borena zone respectively as indicated in table 2. Also, it is highly prevalent in adult 181(20.57) than young (124/ 14.09%) animals (table 4), and it was 24.89%, 9.77% in female, and male respectively (table 5). For instance, highly prevalent in Borena zone (18.75%) than East Bale zone (15.91%). In general, 305 sera samples were positive for CBPP antibody out of 880(table 3) and overall sero-prevalence was 34.66%.

Table 2: The results regarding the districts.

S/n	Districts	Number of samples	Results		total
			Positive in number/%	Negative in number/%	
1	Dawekachen	149	50/5.68	99/11.25	149
2	Rayitu	128	39/4.43	89/10.11	128
3	Ginnir	150	51/5.80	99/11.25	150
4	Yabello	356	156/17.73	200/22.73	356
5	Dirre	97	9/1.02	88/10.00	97
Grand total	5	880	305/34.66	575/65.44	880

Table 3: Results in relation to Zone.

S/N	Zone	Number of Samples	Results		Total
			Positive In number (%)	Negative In number (%)	
1	East bale	427	140(15.91)	287(32.61)	427
2	Borena	453	165(18.75)	288(32.73)	453
Grand total	2	880	305(34.66)	575(65.34)	880

Table 4: Results regarding the age of animals.

S/n	Age	Number of samples	Results		Total
			Positive in number/%	Negative In number/%	
1	Young	335	124/14.09	221/25.11	335
2	Adults	535	181/20.57	354/40.23	535
Grand total		880	305	575	880

Table 5: Results regarding the sex of animals

S/n	Sex	Number of samples	Results		total
			Positive in number/%	Negative In number/%	
1	Male	252	86/9.77	166/18.86	252
2	Female	628	219/24.89	409/46.48	628
Grand total	2	880	305	575	880

Table 6: Associated risk variables (factors) and logistic regression analysis.

Used Vari-ables	Important Categories	Number of Sam-ples Tested	C-ELISA test results		OR (95%, CI)	P-Value
			Positive	Negative		
Zone	East Bale	427	140	287	0.85 (0.64-1.12)	0.257
	Borena	453	165	288		
	Total	880				
District	Dawe kachan	149	50	99	Reference	Reference
	Rayitu	128	39	89	1.15(0.69-1.91)	0.583
	Ginnir	150	51	99	0.98 (0.61-1.58)	0.935
	Yabello	356	156	200	0.65(0.43-0.96)	0.033
	Dirre	97	9	89	4.93(2.296-10.62)	0
	Total	880	305	575		
Age	Young	335	124	211	1.097(0.83-1.46)	0.521
	Adult	535	181	354		
	Total	880	305			
Sex	Male	252	86	166	0.97 (0.71-1.32)	0.834
	Female	628	219	409		
	Total	880				

Associated risk factors

The disease, CBPP is highly prevalent in Borena zone (18.75%) than Eastern Bale (15.91%). So, zone associated as one factor. However, it is not statistically significant ($P=0.258$) at $p<0.05$. For instance, districts were involved as risk factors (table 3), and logistic regression analysis computed using 95%, CI and P-value at $P<0.05$. Accordingly, the only 2 districts (Yabello and Dirre) (table 3) were statistically significant at $p<0.05$. On the other hand, CBPP is highly prevalent in aged (adult) animals than younger animals, regardless of statistical significance. And also, it is relatively prevalent more in female animals than male. The summary of statistical association of risk factors are illustrated in (table 6) below.

Discussion

Contagious Bovine pleuro pneumonia is prevalent in the present study areas of East Bale zone and Borena zone of Oromia national regional state as it was indicated by present study laboratory results by Competition Enzyme linked immuno-sorbent assay (c-ELISA) is used to detect the antibody of the organism as it was recommended so far by OIE Terrestrial Manual to certify animals as free from infection prior to movement, including international trade purposes [8].

Accordingly, the overall sero prevalence of CBPP antibody was 305(34.66 %) out of 880 serum samples by c-ELISA test. This result was nearly related to that of [12], the sero prevalence study conducted in Afar pastoral areas which recorded 37.6%, of

Ebisa et al. [12], and 31.8% in Amaro district of Southern nation nationality and peoples of Ethiopia (SNNP) region, and with the result of study performed in the districts of the western Oromia by Mersha [13] Inversely, it differs from and greater than that of Geresu et al. [2] which indicated 6.51%, and 12% finding of the research [14] in southern zone of Tigray region, 10.3% outcome of research in Somali region by Gizaw. [15], the prevalence of 14.3% in Horo guduru zone (Eyob et al., 2021), and 14.6% in a selected district of East Wollega and West Showa zones, western Ethiopia [16]. The Source of the dissimilarities in Sero-prevalence may be due to geographical location, the difference in breed of cattle, the number of tested animals, and the movement of livestock [13, 17, 12].

During the current study, the logistic regression analysis indicated that Zone is associated to highly advanced sero prevalence. Hence, it was higher (18.75%) than East Bale (15.91%) without statistical significance. For instance, the present study result was very significant and closely related to districts of study areas which were 5.68 % (Dawe kachan), 4.43 % (Rayitu), 5.80 % (Ginnir), 17.73 % (Yabello) and 1.09(Dirre) at the p- value (0.000), which confirmed ($p < 0.05$). Accordingly, it was highly supported by the report of 9.8%, 16.4% and 11.4% for Dubti, Asaita and Chifra, the sero prevalence study conducted so far in Afar regional state [11]. This is so related to the evidence in the difference of Agro-ecology, husbandry practices, huge livestock number and uncontrolled movements of animals [17].

On the other hand, the CBPP sero positivity of current study was greatly associated to the age of animals, and progressive in adult cattle (20.57%) than young animals which was 14.09 %. This was supported by study of Lesnoff et al. [18] the greater resistivity by young animals than adults. Hence, it is in lined with the research findings of Eyob et al. (2021), 17.3% in adult than in young animals (10.8%) in Horo Guduru wollega, and also, related to that of (8.19%) in adult animals and 1.9% in young animals in Dello Mena and Sawena Districts of Bale Zone, Oromia, south Eastern Ethiopia.

Although, it was statically insignificant ($P < 0.05$) by logistic regression analysis. This is related to previous sero prevalence study findings in sidama zone, southern Ethiopia [17], and also correlated to statically non-significant outcome by Teshale et al. [14]. The higher sero-prevalence of CBPP in Adult animals may be due to, the young animals commonly not move as adults for searching of water and pasture. This helps them to reduced contact with infected animals. Moreover, the disease can kill young ones as they are very susceptible to acute stage of CBPP, and truly they are not available for sampling. In contrast, the declaration of experimental research identified that CBPP is more prevalent in cattle under the age of 3 years and resistivity is greater in older (adult) age [20].

As the present study, the sex of cattle was associated to the sero prevalence, and as a result it was higher in female (24.89 %)

than male (9.77%), regardless of statistical significance by logistic regression analysis. This outcome was agreed with Schnier et al. [21], who reported a significantly higher prevalence in female animals and to 34.0%, and 3.6% in female and male respective findings of Negash and Dubie [11] in Afar region. However, it is different from the significant sero prevalence of (18.9%) in males and 11.1% in females with statistically significant ($p = 0.003$) (Eyob et al., 2021).

Further, it was not similar with the report of sero-positivity of male (11.24%) higher than female animals (2.79%), which was significantly associated with the seropositivity of CBPP in Dello Mena and Sawena Districts of Bale Zone, South Eastern Ethiopia, and CBPP seroprevalence among sexes (16.4%) in male and (13.2%) in female animals which was not statistically significant in the selected districts of East Wollega and West Showa Zones, Western Ethiopia [16]. In general, the present study has been identified the current sero prevalence and associated factors with higher significance. Therefore, this finding urges more comprehensive studies and control intervention of the disease.

Conclusion

The Current study findings were identified the Evidence on the CBPP sero-prevalence and association of significant risk factors. Among the allied risk factors, Districts (Agro-pastoral ecology) is playing the vital role. The greater overall sero prevalence of the Organism antibody can escalate the revolving livestock problem throughout the south eastern and southern part of Ethiopia's largest regional state, Oromia. These may be the major consequences in dwarfing the livestock production and productivity, the country's economy development and international trade income. Based, on the above conclusion; the outcome of present study vowed to all stakeholders to take immediate action to disease control and prevention.

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