

Sero Prevalence and associated risk factor of PPR disease in Goats of Bahirdar Zuria District

Zelalem Asmare^{1*}, Habtamu Tasew² and Yeshwas Ferede²

^{1*} Amhara Agricultural Research Institute, Andassa Livestock Research Center, P.O. Box 27
Bahir Dar, Ethiopia

² Bahir Dar University Colleges of Agriculture and Environmental Science, P.O. Box 5501
Bahir Dar, Ethiopia

Corresponding author email: z.asmare@gmail.com

Copyright: ©2024 The author(s). This article is published by BNJAR and is licensed under the CC BY 4.0 license (<http://creativecommons.org/licenses/by/4.0/>).

ABSTRACT

Received: February 15, 2023

Revised: May 26, 2023

Accepted: June 24, 2023

Available online: June 28, 2023

Keywords: Antibody, PPR, Prevalence, Risk factor

A cross-sectional study design was employed from April 2018 to November 2018 with the objectives of determining the sero-prevalence of PPR and identifying its associative putative risk factors in selected sites of Bahir Dar Zuria district. Study sites were selected purposively, while simple random sampling technique was employed to select study households and individual animals. Accordingly, a total of 384 goats were considered for this study and serum samples were collected from PPR vaccine non-vaccinated goats. R-software was used to manage and analyze data. Univariable logistic regression was used to evaluate causation and quantify the association between the putative risk factors and sero-prevalence of PPR. All significant variables ($P < 0.05$) tested in the univariable logistic regression was further tested by multivariate logistic regressions to adjust confounding and see their independent effect on PPR sero-positivity. A confidence limit of less than 5% was used to indicate a significant level. The overall sero-prevalence of PPR was 28.12%, with 6.77 and 21.35% in Wondama and Dehina Mariam kebele, respectively and it varies significantly ($P < 0.000$). Location, Sex and herd size were also found significantly associated with PPR sero-positivity by multivariable logistic regression. In conclusion, though goats were the major source of livelihood in the study areas, the prevalence of PPR was higher and it is the major constraint that seriously hindering goat production and productivity. Thus, improved goat management practices along with seasonal PPR vaccination is highly recommended in order to prevent PPR outbreak.

1. INTRODUCTION

Livestock production in Ethiopia is an important agricultural activity and it has one of the largest livestock populations in Africa with estimated domestic animal number of 57.83 million cattle, 28 million sheep, 28.6 million goats, 1.23 million camels, 60.5million poultry, 2.1 million horses, 0.4 million mules and 7.88 million donkeys (CSA 2016/17). The majority of the goat population is found in large flocks in the arid and semi-arid Lowlands. However, in the highland goats are widely distributed in the mixed crop-livestock production systems with small flock size (Solomon Abegaz 2014).

Goat production accounts for 16.8% of total meat supply (Ameha Sebsibe 2008) and 16.7% of milk consumed in the country (Tsedeke Kocho 2007) and the average annual meat consumption per capita is estimated to be 8kg/year which was lower than the global average meat consumption (38kg/year) (Matawork Milkias 2016). There have been many challenges that faced goat Production and productivity in our country. Feed shortage is one of major constraint which results from grazing lands overstocked and overgrazed and scarce amounts of crop residues hence goats are not even be able to maintain their body weight. Moreover, heavy burden of goat infectious disease is one of the major factors restricting maximum efficiency of goat production and productivity. Peste des Petits Ruminants is one of such disease which is becoming endemic in some of the affected countries in Africa and Asia and it is one of the epizootic diseases of small ruminants and is similar to Rinder pest Virus (RPV) of cattle (Couacy-Hyman *et al* 1995).

Peste des petits ruminant is an acute, highly contagious, and frequently fatal viral disease of sheep, goats, and wild small ruminants. It is characterized by fever, mucopurulent ocular and nasal discharges, necrotizing and erosive

stomatitis, severe enteritis, and pneumonia leading to death (Furley *et al* 1987). Peste des petits ruminant is a transboundary animal disease of significant economic importance, ranking among the top ten diseases affecting small ruminants (Dialo 2006). Even though the National Veterinary Institute (NVI) has been producing live attenuated vaccine against PPR, outbreak is still striking causing high mortality and morbidity in different parts of Ethiopia. Therefore, this study was conducted with the objective of determining the sero prevalence of PPR and identifying the possible associative risk factors for PPR disease occurrence in the study area.

2. MATERIALS AND METHODS

2.1. Description of the Study Area

The study was conducted in selected kebele's of Bahir Dar Zuria district, where goat production is the main practice and source of livelihood. The specific sites covered by this study were Wondata and Dehinamariam Kebeles. Bahir Dar Zuria district is found around Bahir Dar city which is the capital city of Amhara National Regional State. The district's area covers almost 1443.37 sq km (CSA 2011). Bahir Dar Zuria is Part of the West Gojjam Zone, which is bordered by Yilmana Densa, Mecha, Abay River, which separates from North Achefer; to the South, South West and North West, respectively. It is situated on the southern shore of Lake Tana. The topographic features of the district indicate that approximately 48% can be defined as rolling, 32% hilly, 13% mountainous, and 7% valleys. Agriculture is the main stay of the prop in the study area as it contributes about 100% of the population with in the area depends on this sector of the economy (CSA 2016). The major crops grown in the area were wheat, barley, millet, teff and maize. The city is located approximately 565 km north-northwest of Addis Ababa, having a latitude and longitude of 11°36' N and 37°23' E coordinates, and an elevation

of 1840m above sea level. Its temperature ranges from 10 to 38⁰ C. The area receives mean annual rainfall of 750mm (DOA 2000).

Sampling Strategy

Two kebeles from 23 kebeles of Bahir Dar Zuria district were purposively selected based on their flock size and more importantly, these sites were planned to be established as model goat breeding villages by Andassa Livestock Center, where basic preliminary data was obtained before the commencement of this study. Whereas study animals were randomly sampled. Both sexes and above five months age groups of goats were sampled. Age classification was made based on Zahur *et al* (2009). Hence goats were categorized as young (6-18 months) and adult (>18months) as per the given age classification.

Sample Size Determination and Study Design

The sample size was determined by taking the relative population of goats and relative number of houses hold to get their proportion. Since there was no prior similar study conducted in the area, 50% expected prevalence was assumed to get the maximum number of samples sizes required. The absolute precisions were decided to be 5% and 95% confidence level. Therefore, a total of 384 goats were examined according to the formula given by Thrusfield (2007).

$$n = \frac{1.96^2 P \exp (1 - P \exp)}{d^2}$$

- where n is the required sample size
- $P \exp$ is the expected prevalence
- d^2 is the desired absolute precision

Due to the difference in population size among the selected working villages, sample size was allocated proportionally

based on the existing goat population per kebele. Hence in Wondata kebele, 21.99% (n=86) and 26.08% (n=102) samples were drawn from Ayandie and Terara mender village, respectively. Likewise, about 27.87% (n=109) from Mesenta village and 24.8% (n=97) samples were taken from Dehina Mariam village in Dehina Mariam kebele. Cross-sectional study design was employed in order to estimate the sero-prevalence and the associated risk factors of PPR in selected kebeles of Bahir Dar Zuria district from February to December 2018.

Method of Data Collection

Blood sample collection

Blood samples for serum were collected from goat flocks before and after vaccination. About 6 ml of blood was collected from jugular-vein of goats using plain 10 ml vacutainer tubes and sterile needles. The collected blood was allowed to clot for up to 24 hours in the shade and then the serum was being decanted in to cryovials. The serum was transported to the laboratory in cooled containers with ice bags and it was stored at -20°C until laboratory investigation performed. The serological test was carried out at the National Veterinary Institute (NVI, Debreziet, Ethiopia).

Laboratory analysis

Serum samples were tested at NVI using a competitive enzyme linked immunosorbent assay (c-ELISA) test kit (ID Screen® PPR Competition, Montpellier, France) following the instructions of the manufacturer (FAO reference laboratory CIRADEVMT, Montpellier France) and a corresponding assay protocol was used in the analysis. The kit had a high diagnostic sensitivity (90.5%) and specificity (99.8%) (Abubakar *et al* 2012).

Data Management and Analysis

The collected data were entered to Microsoft Excel 2007 spreadsheet. It was

managed and analyzed by XL Stat (version 2014) and R software (ver.3.5). The sero-prevalence was estimated by dividing the number of c-ELISA positive animals by the total number of animals tested. Binary and multinomial logistic regression was used to examine causation and quantify the association between putative risk factors with PPR. Statistical significance was considered at $P < 0.05$.

3. RESULT AND DISCUSSION

3.1.Sero-Prevalence of PPR

Peste des petits ruminants (PPR) disease causes varying degree of morbidity and mortality in susceptible population (Radostits *et al* 2000) and its outbreak causes more than 60% mortality (Abraham Gopilo; 2005). This study was carried out in selected sites of Bahir Dar zuria district in order to estimate the prevalence of PPR along with the associate risk factors. Out of the total (384) number of the samples collected overall sero-prevalence of PPR virus was 28.12% (108). It was also 82(41.2%) from Dehinamariam and 26 (14.05%) from Wondata were found positive. The prevalence of PPR varies significantly ($P < 0.00$) between study locations (Table 1).

The present study was comparable with some previous reports, conducted in different part of Ethiopia under extensive goat production system; 28.6% in unvaccinated goat in Eastern Amhara (Biruk Alemu 2014); 26.3% in non-vaccinated goat in Gambella (Bekele Megersa *et al* 2011). Conversely, the present finding was relatively found higher than some similar reports of Faris Delil *et al* (2011), 2.3% in Awash Fentale District 2.28% in Awash Fentale District (Faris Delil *et al* 2012) and 3.49% in Bench maji Zone (Tamirat Haile *et al* 2017). It is also relatively lower than the reports of Berihun Afera *et al* (2014) 46.53% in Tigray, Bekele Megersa *et al* (2011) 38.3% in Afar and Kibrom Mebrahtu *et al* (2018) 41.8% in South Omo. This variation could arise from differences in the situation of the disease during the time of sampling, the variation in temporal and spatial distribution of the disease, the sensitivity and specificity of the serological tests used and variation in the agro-ecology, management and production systems of small ruminants

Table 1: Risk factors associated with PPR sero-positivity using binary logistic regression analysis

Risk factors		N	Positive	Prevalence (%)	Odds ratio	95% Conf. Interval of OR	P-value
Kebeles	Dehina M.	199	82	41.2	1	-	-
	Wondata	185	26	14.05	0.27	0.141- 0.386	0
Sex	Female	194	65	33.5	1	-	-
	Male	190	43	22.63	0.56	0.357- 0.884	0.018
Age	Young	158	33	20.89	1	-	-
	Adult	226	75	33.19	1.88	1.18- 3.05	0.009
Flock size	Small	51	7	13.72	1	-	-
	Medium	117	41	35.04	3.39	1.47 - 8.84	0.007
	large	216	60	27.78	2.41	1.09 – 6.14	0.042
Source of goat	Home	237	61	25.73	1		
	Purchasing	147	47	31.97	1.74	1.47-3.16	0.187

Putative risk factors investigated against PPR sero-positivity

Higher sero-positivity was also recorded in female (33.5%), adult (33.19%), purchased goat (31.97%) and medium herd size (35.04%) than their counterparts (Table 2). Study kebeles, sex, age and herd size were found significantly ($P < 0.05$) associated with PPR sero-positivity based on binary logistic regression. Those all-significant variables by binary logistic regression analysis, were further subjected for multivariable logistic regression analysis. Multivariable logistic regression was performed to ascertain the effects of kebele, sex, age and herd size the likelihood of having PPR disease. Those goats found at Wondata kebele were 0.22 times less likely to be infected with PPR disease than Dehina Mariam. Male goats were 0.51 times less likely to have PPR disease than females. Based on the result all risk factor except age had statistically significant ($P < 0.05$) association with sero-positivity (Table 2).

The Prevalence of PPR was significantly higher in does than bucks. This finding was in line with the report of Berihun Afera *et al* (2014) who reports sero prevalence in female goats was higher than males and with reports of Kibrom Mebrahtu *et al* (2018), Bashir (2013) and Shuaib *et al* (2014), who reported higher sero-prevalence of PPR in females. The probable reason why females are highly affected than males could be due to the physiological differences. Bekele Megersa *et al* (2011) stated that females reveal some degree of predominance infection as a result of production and reproduction related stresses. In addition, males are allowed to stay in the flock for a shorter period as they sold for meat earlier between 1 to 2 years of age. Hence, male goats are less likely to acquire PPR in the flock when compared to females which end up staying in the flocks for longer periods for productive purposes females (Singh *et al* 2004). However, Mohamed *et*

al (2017) and Subir and Islam (2011) reported that PPR sero-prevalence was higher in males than in females. It has been hypothesized that males are more prone to disease because of genetic variation (Razmi *et al* 2006).

In this study, location was significant factor for PPR prevalence, with the highest prevalence in Dehina Mariam Kebele than Wondata. This significant difference may be due to the variation of goat population, availability of animal health services, and movement of goat flocks for market and management system of goats. It was suggested that there is large variation between regions and districts of the country (Waret-Szkuta *et al* 2008).

In this study, goat flock size was identified as a risk factor for PPR sero positivity. Especially in medium goat flock size PPRV was significantly higher ($p < 0.007$) sero prevalence than low goat flock size. This significant difference might be those farmers who had medium goat flock size kept their goats for the purpose of breeding and they stay for long period of time for reproduction. Therefore, the probability of being exposed for PPRV would be higher in these groups. In addition to that during this study our observation indicates that those farmers who had low and high goat flock size were local goat traders. Even if it was not significant, sero-prevalence of PPRV of large flock was also higher than those of low goat flock size. It is in agreement with report of Al-Majali *et al* (2008) large herd size was identified as a risk factor for PPR sero-positivity in sheep and goat flocks in Jordan. Because of large herd size increase flocks' chance to contract infectious diseases and health management in larger flocks is more difficult and requires more attention.

Sero-prevalence of PPRV among age group was not statistically significant. This result was in agreement with the observation made by Bekele Megersa *et al*

(2011); Almeshay *et al* (2017) and Tsegaw Fentie *et al* (2018) where age of the animals was not associated with sero positivity to PPR. However, the highest prevalence of PPR was observed in adults compared to young age. It was due to the fact that most of goat keepers (29.1%) kept their goat for 3 years which means farmer kept their goat until they become adult and older. These findings are in agreement

with previous reports Biruk Alemu (2014); Tamirat Haile *et al* (2017); and Ozkul *et al* (2002); where they reported high prevalence in adults. It has been suggested that sheep and goats exposed to natural infection to PPRV at a very young age may carry antibodies for 1-2 year following exposure and remains positive for a long time (Ozkul *et al* 2002).

Table 2: Risk factors associated with PPR sero-positivity using multivariable logistic regression analysis

Risk factors		N	Positive	Prevalence (%)	Odds ratio	95% Interval of OR	Conf. P-value
Kebeles	Dehina M.	199	82	41.20	1.0	-	-
	Wondata	185	26	14.05	0.22	0.13 - 0.37	0.000
Sex	Female	194	65	33.50	1.0	-	-
	Male	190	43	22.63	0.51	0.30 - 0.85	0.009
Age	Young	158	33	20.89	1.0	-	-
	Adult	226	75	33.19	1.42	0.83 - 2.44	0.199
Flock size	Small	51	7	13.72	1.0	-	-
	Medium	117	41	35.04	2.57	1.05 - 7.01	0.048
	Large	216	60	27.78	1.97	0.84 - 5.19	0.138

4. CONCLUSION AND RECOMMENDATION

This study reveals that goats were the major source of livelihood in the study areas. But, PPR was found to be endemic in the study areas that seriously hinder goat production and productivity through mortality and morbidity. The sero-prevalence of PPR in the study kebeles was higher; but the disease is still poorly recognized and possible measures were not yet taken as expected. It is also confirmed that location, sex and Flock size were examined as a risk factor for the disease. Based on the above conclusive remarks the following recommendations are forwarded: there should be proper management of goats especially during browsing and watering, PPR vaccination is highly recommended on seasonal basis in order to prevent the outbreak and strict and regular surveillance and monitoring should be

implemented by the respective bodies

REFERENCES

- Abubakar M, Arshed J, Zahur B, Ali Q and Banyard C (2012). Natural infection with peste des petits ruminants virus: a pre and post vaccinal assessment following an outbreak scenario. *Virus Research*, **167**; 43-47.
- Almeshay M, Gusbi A, Eldaghayes I, Mansouri R, Bengoumi M and Dayhum S (2017). Peste des petits ruminants in Tripoli Region, Lybia. *Vet. Italiana*, **53**(3); 235-242.
- Ameha Sebsibe (2008). Sheep and goat meat characteristics and goat production handbook for Ethiopia. Ethiopian sheep and goat productivity improvement program (ESGPIP), Addis Ababa.

- 323-328.
- Bashir B (2013). *Serological studies on peste des petits ruminants (PPR) in sheep, goats and camels in Sokoto state, Nigeria*. MSc Thesis, Ahmadu Bello University, Zaria Nigeria.
- Bekele Megersa, Biffa Demelash, Belina Dinaol, Debela Etana, Regassa Alemayehu, Abunna, F, Rufael, Tesfaye, Stubbsjøen S M and Skjerve, E (2011). Serological investigation of Peste des Petits Ruminants (PPR) in small ruminants managed under pastoral and agro-pastoral systems in Ethiopia. *Small Ruminant Research*, **97**; 134-138.
- Berihun Afera, Daniel Hussein and Kassaw Amsalu (2014). Seroprevalence of Peste des Petits Ruminants in goats of Southern parts of Tigray region. *Glo. Vet*, **12** (4); 512-516.
- Biruk Alemu. 2014. *Epidemiology and identification of Peste des petits ruminants (PPR) virus circulating in small ruminants of eastern Amhara region bordering Afar, Ethiopia*. MSc, Thesis, College of Veterinary Medicine and Agriculture of Addis Ababa University, Bishoftu. 1-112.
- Central Statistical Authority (2011). Central Statistical Authority Abstract of Federal Democratic Republic of Ethiopia. Addis Ababa, Ethiopia.
- Central Statistical Authority (2016). Agricultural sample survey report on livestock and livestock characteristics, volume II, Addis Ababa, Ethiopia.
- Couacy-Hymann E, Bidjeh K, Angba A, Domenech J and Diallo A (1995). Protection of goats against RP by vaccination with attenuated PPR virus. *Res. Vet. Sci.* **59**; 106-109.
- Department of Agriculture (2000). Annual progress reports; Bahir Dar Zuria district, Ethiopia
- Diallo A (2006). Control of peste des petits ruminants and poverty alleviation, *J Vet Medicine*, **53**(1); 11–13.
- Faris Delil, Yilkal Asfaw and Berhe Gebreegziabher (2012). Prevalence of antibodies to peste des petits ruminants virus before and during outbreaks of the disease in Awash Fentale district, Afar, Ethiopia. *Trop Anim Health Prod*, **44**;1329–1330
- Faris Delil, Yilkal Asfaw, Berhe Gebreegziabher and Belihu Kelay (2012). Sero prevalence and sero-conversion after vaccination against Peste des Petits Ruminants in sheep and goats from Awash Fentale District, Afar, Ethiopia. *Prev. Vet Medie.* **103**; 157– 162
- Kibrom Mebrahtu, Senait Getachew, Tegegn Tesfaye, Ergete Sahlul and Kassaye Aragaw (2018). Sero-epidemiological study of peste des petits ruminants (PPR) in sheep and goats under different production systems in South Omo, southern Ethiopia, *Small Ruminant Research*, <https://doi.org/10.1016/j.smallrumres.2018.06.017>
- Matawork Milkias Gobena (2016). Production Performance, Challenges and Opportunity of Goat Production in Ethiopia. *Advances in Life Science and Technol*, **50**; 26-35.
- Ozkul A, Akca Y, Alkan F, Barrett T., Karaoglu T, Dagalp S B, Anderson J, Yesilbag K, Cokcaliskan C, Gencay A and Burgu I (2002). Prevalence, distribution, and host range of peste des petits ruminants virus, Turkey. *Emerging and Infectious Diseases*, **8** (7); 708-712.
- Radostits O M, Gay C C, Blood D C and Hinchcliff K W (2000). Peste des

- petits ruminants. In: Veterinary Medicine, 9th edition. W.B. Saunders, London. 1077-1079.
- Razmi G R, Dastjerdi K, Hossieni H, Naghibi A, Barati F and Aslani M R (2006). An epidemiological study on Anaplasma infection in cattle, sheep, and goats in Mashhad Suburb, Khorasan Province, Iran. *Annals New York Acad Sci*, **1078**; 479-481.
- Shuaib Y A, El-Fadil A A M, Abdel-Rahman M E, Negussie Haileleul and Zessin K H (2014). Seroprevalence and risk factors of Peste des petits ruminants in sheep in the Kassala and North Kordofan States of the Sudan. *Inter J of Vet Scie.*, **3**(1); 18-28.
- Singh R P, Saravanan P, Sreenivasa B P, Singh R K and Bandyopadhyay S K (2004). Prevalence and distribution of peste des petits ruminants (PPR) virus infection in small ruminants of India. Scientific and Technical Review of the Office International des Epizooties, **23**(3); 807-819.
- Solomon Abegaz (2014). *Design of community-based breeding programs for two indigenous goat breeds of Ethiopia*. Phd Thesis University of natural resources and life science, department of sustainable of agricultural system. Austria, Vienna.
- Subir Sarker and Hemayeatul Islam (2011). Prevalence and Risk Factor Assessment of Peste des petits ruminants in Goats in Rajshahi, Bangladesh. *Vet. World*, **4** (12); 546-549
- Tamirat Haile, Murga Soma, Tadesse Ferki and Amare Beyene (2017). Sero Prevalence of Peste Des Petitis Ruminants (PPR) of Sheep and Goats in Bench Maji Zone, Southern Ethiopia. *Global Vet.*, **19** (5); 622-626.
- Thrusfield M (2007). Veterinary Epidemiology, 3rd Edn. UK, Blackwell Science Ltd, 233–250
- Tsedeke Kocho (2007). *Production and marketing systems of sheep and goats in Alaba, Southern Ethiopia*. MSc thesis Hawasa University, Ethiopia.
- Waret-Szkuta A, Roger F, Chavernac D, Yigezu L, Libeau G, Pfeiffer D U and Guitian J (2008). Peste des petits ruminants (PPR) in Ethiopia: analysis of a national serological survey. *Vet Research*, **4**; 34
- Zahur A, Ullah A, Irshad H, Farooq M, Hussain M and Jahangir M (2009). Epidemiological investigations of a peste des petits ruminants (PPR) outbreak in afghan sheep in Pakistan. *Pakistan Vet. J.*, **29**(4); 174-178.