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Mini Review

Current Status of Occurrence and Socio-Economic Impacts of Peste Des Petits Ruminants Virus (PPRV) on Small Ruminant Population in Ethiopia

Beredo Bedore[1]*, Mohammed Mustefa[1], Mitiku Tamire[1] and Tariku Geinoro[2]

[1]*College of Veterinary Medicine, Haramaya University, P.O.Box. 301, Haramaya, Ethiopia*
[2]*Veterinary Drug and Feed Administration and Control Authority South branch Office, Hawassa, Ethiopia*

***Address for Correspondence:** Beredo Bedore, College of Veterinary Medicine, Haramaya University, P.O.Box. 301, Haramaya, Ethiopia, E-mail: beredomsc10@gmail.com

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ABSTRACT

Peste Des Petits Ruminant (PPR) is a serious disease that hampers cross-border trade in many countries including Ethiopia. The small ruminant population of Ethiopia is about 30.70 million sheep and 30.20 million Goats. The potential of animal production remains low valued and one of the main limiting factors is the presence of PPR. The socio-economic impact of PPR results in heavy losses of small ruminant production, and its impact on market access of small livestock are paramount, affecting all players in the sector. Morbidity and mortality rates can be as high as 100 and 90 percent, respectively. In clean flocks, sheep and goats of all ages can be affected during an outbreak. This impact negatively on the livelihoods, food security and socio-economic activities of livestock keepers in affected areas. PPR is among the commonest of the diseases that affect small ruminants entailing a huge economic loss as it is listed trans- boundary diseases affecting the economy of the country through limiting international trade of animals and animal products. Currently, PPR is endemic in Ethiopia and the National Veterinary Institute (NVI) produces live attenuated vaccine using PPR75/1 (LK6 Vero74) strain.

Keywords: PPRV; Socio-economic; Control; Small ruminant

INTRODUCTION

The small ruminant population of Ethiopia is about 30.7 million sheep and 30.2 million Goats [1]. Owing to their high fertility, short generation interval and adaptation even in harsh environments, sheep and goats are considered as an important asset of poor farmers. Small ruminants are exploited in the country for diverse purposes. However, small ruminant production and productivity and producers benefits are far below expectations due to diseases and other factors. A Peste Des Detits Ruminantis Virus (PPRV) is among important diseases affecting the productivity of small ruminant [2]. PPR is a highly contagious viral disease of domestic and wild small ruminants characterized by fever, anorexia, necrotic stomatitis, diarrhea, mucopurulent nasal and ocular discharges, enteritis and pneumonia [3].

Morbidity and mortality rates can be as high as 100 and 90 percent, respectively. In clean flocks, sheep and goats of all ages can be affected during an outbreak. This impact negatively on the livelihoods, food security and socio-economic activities of livestock keepers in affected areas. The important direct economic losses caused by PPR are often further aggravated by sanitary measures imposed by authorities in controlling animal movement and trade restrictions on their by-products [2]. The disease has been associated with increased animal movement for commercial and trade purposes, transhumance and nomadic customs, climatic changes and extensive farming practices [3]. The causative agent of this economically important disease of small ruminants is Peste Des Petits Ruminants Virus (PPRV), which is grouped under genus *Morbillivirus*, of the family *Paramyxoviridae* [4].

PPR was clinically suspected for the first time in Ethiopia in 1977 in a goat [5] and serological evidence reported in 1984 and later confirmed in 1991 with cDNA probe [4]. PPR is among the commonest of the diseases that affect small ruminants entailing a huge economic loss as it is listed trans-boundary diseases affecting the economy of the country through limiting international trade of animals and animal products [6]. Currently, PPR is endemic in Ethiopia and the National Veterinary Institute (NVI) produces live attenuated vaccine using PPR75/1 (LK6 Vero74) strain [3]. The economic impact and losses in a PPR outbreak can be very high with mortalities among sheep and goats up to 90 percent; for villagers and communities this can be devastating in terms of food security, livelihoods and availability of quality products [7]. Serological investigations of PPRV were conducted in different regions of Ethiopia and revealed that the prevalence of 36.6% in Afar reported by [8], 27.3% in Gambella reported by [2], 24.5% in Benji Maji reported by [9] and 47.5% in Tigray reported by [9]. This was summarized below table 1.

Table 1: Review on Sero-prevalence of PPRV in Ethiopia.

Author	Year	Regions	Prevalence (%)
[22]	2015	South nation nationalities of people	
[10]	2011/2012	Tigray	47.5
[21]	2006/2007	Afar	1.7
[24]	1999	Somali	21.3
[25]	1999	Afar	15.3
[25]	1999	Tigray	15.3
[25]	1999	Benshengul Gumuz	8
[25]	1999	Amhara	4.6
[25]	1999	South nation nationalities of people	1.8
[25]	1999	Oromia	1.7
[16]	2006/7	Afar	36.6
[22]	2009/10	Afar(Adaar)	38.3
[26]	2009/10	Gambella(Itang)	27.3
[27]	2001	Shewa,	9

Source: combined from different sources

In this regards, comprehensive quantification of the occurrence of the disease and its associated risk factors and assessment of the losses due to this disease would have great contribution to determine the status and socio-economic impacts of the disease which in turn help to design and implement appropriate control strategy.

There for the objective of this review were;

- To indicate the Sero-prevalence and to determine the associated risk factors of PPR and
- To determine socio-economic impacts of PPR in small ruminants.

EPIDEMIOLOGY OF PPRV

Distributions of PPRV

Peste des Petits Ruminants virus was long considered to be confined to West Africa but later it has expanded to cover large regions of Africa, the Middle East and Asia [11]. It was first recognized as a disease entity in the Ivory Coast. It started to expand rapidly to other West African countries and continued to spread towards Central and East-Africa [12]. Subsequently, PPR was disseminated outside Africa into Asia and further to Turkey [13]. The disease is now endemic

in nearly most of African countries excluding countries south of Tanzania and Angola, in all Arabian- Peninsula and Middle-Eastern countries, in a wide belt of Asia including central, southern and south-eastern countries [14,10]. Within the European continent PPR is currently present only in Turkey [15,16,4,2]. In Northern Africa, PPR has been identified in Tunisia [16] and Algeria [17]. It has now spread north of the Sahara and only Libya has not reported the disease in the region [18]. In addition, PPR outbreaks have also been reported in East and Central African countries like: Ethiopia [19], Democratic Republic of Congo [20] and Kenya and Uganda [21].

Morbidity and mortality

In Ethiopia PPR disease outbreaks are under reported, due to the poor reporting system, an increasing trend has been observed in PPR outbreaks between the years 1996 and 2005 [25]. Periodic outbreaks may be seen in endemic regions, particularly when animals are mixed or new animals are introduced into the herd. Some epizootics are associated with changes in weather, such as the beginning of the rainy season or a cold and dry period [3]. It might circulate sub clinically in small ruminant populations and emerging, when immunity wanes or naive animals are introduced. In endemic regions, animals between three months and two years of age are most severely affected; young animals that are still nursing and older animals tend to be spared [3]. Morbidity and mortality can be as high as 100% and 90%, respectively, when associated with other diseases such as caprioles [14].

Risk factors

There are numerous environmental, husbandry and animal related factors that affect the occurrence of PPRV in small ruminants. In pastoral areas, livestock trade, nomadic herding and the congregation of susceptible populations close to watering points during dry seasons and/or in livestock markets play an important role in spreading the disease [21]. Movement of animals and introduction of newly purchased animals from the market therefore play an important role in transmission and maintenance of the virus [27]. In addition, trade in small ruminants, especially at markets where animals from different sources are brought into close contact with one another increases the opportunities of PPR transmission [28]. It has been reported that in Maghreb countries of North Africa, traditional sacrifices of sheep during major Islamic festivals provide a major opportunity for seasonal clustering of small ruminants of multiple sources whose health status is often unknown, thus creating a favorable environment for the transmission and dissemination of the PPR virus [29].

Age of the animals is also among animal related risk factors known to affects the occurrence of PPR in small ruminants. Kids over four months and under one year of age are most susceptible to the disease. In a particular flock, risk of an outbreak is greatly increased when a new PPR infected stock is introduced or when animals are returned unsold from livestock markets at endemic area. The increase in incidences of PPR outbreaks has been attributed more to an increased number of susceptible small ruminants recruited rather than seasonal upsurges in the viral activity [30]. It has also been reported that the recent PPR disease outbreaks have been attributed to the cessation of rinderpest vaccination and loss of antibody cross protection between the PPR and Rinderpest, leaving the small ruminants fully exposed to PPRV [31].

Among the environmental factors affecting the occurrence of PPR, season is believed to be in the forefront. Low environmental temperatures with high humidity, stress of as well as nutritional deficiencies, are known to influence the occurrence of PPR small ruminants. Limited fodder availability often, leads to nutritional deficiency, resulting in increased susceptibility to infection [32,33]. Furthermore, large numbers of animals become infected during this period and these animals then help to maintain the circulation of the virus throughout the year by frequent animal-to-animal transmission which, play a key role in the transmission of PPR [34]. The seasonal epidemiologic patterns of the PPR disease differ in different ecological systems, geographical areas and are dependent on culture and livelihood patterns of small stock owners [35].

Diagnosis

Since sheep and goat are infected by both PPR and Rinderpest, it is difficult to diagnosis both disease tentatively alone, therefore laboratory techniques should have to be used. The laboratory techniques used for the detection of the virus includes virus isolation, detection of viral antigens, nucleic acid sequencing and detection of specific antibody in serum [36,33].

Virus isolation: Recovery of PPR virus is not always successful. But, virus isolation in cell culture can be attempted with several different cell lines. African green monkey kidney cells (Vero-cell) have been used for a long time as the cells of choice for the isolation and propagation of PPRV [32]. However, some isolates may not grow well in these cells. Recently, transformed monkey cells expressing sheep/goat Signaling Lymphocytic Activation Molecules (SLAM or CD150) have been shown to possess increased sensitivity. Techniques for virus isolation cannot be used as routine diagnostic tests as they are time-consuming and cumbersome. Moreover, the preservation of samples collected under field conditions is not always adequate for successful laboratory results [37].

Antigen detecting methods: Peste des petits ruminates virus antigens can be detected by using an Immune Capture ELISA (ICELISA) [38], Counter Immune Electrophoresis (CIEP) or Agar Gel Immune Diffusion (AGID) [39], haem-agglutination tests [20,39], latex agglutination tests [25] and immune fluorescence [40]. Immuno-capture ELISA and counter immune electrophoresis assays can distinguish between PPRV and RPV. Although AGID test is simple and cheap, it cannot differentiate PPRV and RPV due to its less sensitivity [39]. But, Immuno-capture ELISA is a rapid, sensitive and virus specific test for PPRV antigen detection and it can differentiate between RP and PPR viruses. Moreover, it is more sensitive than AGID [2].

Detection of antibody: The (c-ELISA) based on Monoclonal Antibodies (MAbs) against the N or H proteins and virus neutralization tests [40,13,34] are the most important diagnostic techniques used for the detection of antibodies to PPRV. Currently, competitive ELISA is the most commonly used diagnostic techniques for PPRV antibody detection. The overall specificity of c-ELISA test is 98.4% with a sensitivity of 92.2% when compared with VNT. The diagnostic efficacy of the assay in terms of sensitivity and specificity was calculated using two-sided contingency table. Sensitivity of the assay was taken as proportion of positive samples out of actual positive Sample [40]. The c-ELISA for the detection of antibodies to PPRV in sera from cattle, camel, sheep and goats has been standardized by [2]. In Ethiopia, It is performed strictly as per the protocol outlined in the user manual supplied with the kit where the method is developed [31].

Nucleic acid sequencing: Molecular detection of PPRV is performed by using loop-mediated isothermal amplification techniques [20] and a Real-Time Polymerase Chain Reaction (RT-PCR) assay based on sequence of the N protein gene [9]. From those methods RT-PCR assay based on sequence of the N protein gene is the most and rapid methods for viral Nucleic acid sequencing [9,10].

Prevention and control: Prevention and control of PPR outbreak is based on movement control combined with proper disposal of carcass and the use of vaccine. Restriction on importation of sheep and goats from affected areas or newly introduced animal should be quarantined for three weeks. Additionally, carcass and contact fomites should be buried or burned, Barns, tools and other items that have been in contact with the sick animals must be disinfected with common disinfectants such as phenol, sodium hydroxide 2%, virkon as well as alcohol, ether and detergents. Vaccination should be carried before the start of the rainy season and annually in endemic areas [34].

Socio economic impacts of PPR in Ethiopia

The socio-economic losses associated with PPR mainly result from the high mortality rate that is characteristic of the disease. This negatively affects income from production and value addition in small ruminants marketing chains. PPR disease is a constraint to international trade, although this impact is mitigated in local and regional markets due to wide geographic distribution of the disease at present [41]. However, the direct economic losses caused by the disease are reduced by the sanitary measures imposed by authorities to control animal movement and by trade restrictions on animal by-products [41,42]. Because of the negative economic impact on countries affected by PPR, the disease is one of the priorities among international and regional livestock disease research and control programs [43]. Moreover, it has also been ranked by pastoral communities as one of the top ten diseases of small ruminants [18].

CONCLUSION AND RECOMMENDATIONS

PPR is an important animal disease which now threatens the billion strong ruminant's population in Africa, the Middle and Near East, South West and Central Asia. PPR is a disease of animals, sheep and goats, which contribute significantly to the livelihoods of rural poor farmers, its control should therefore be considered in programs that aim at alleviating poverty in developing countries. In addition, as disease of public concern and thus its control should benefit from all international concerning organizations. In Ethiopia beside seasonal occurrences of the disease illegal animal movement within and across the borders is a great hindrance for prevention and control of the disease.

Therefore, based on above conclusion the following points are recommended;

- Regular mass vaccination should be carried out; tempo-spatial pattern of the disease should purposely have studied to implement proper intervention measures in lining illegal animal movement control.
- Awareness on the risk of direct introduction of purchased animals into herds should be created among small ruminant rearing communities.

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