



Review of the Major Microbial Diseases Associated with High Mortality in Ruminants in Nigeria

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ABSTRACT

Ruminants remain a major source of animal protein for tens of millions of Nigerians. With an estimated ruminant population of 18.4 million Cattle, 43.4 million Sheep, and 76 million goats, livestock production is one of the largest agricultural sub-sectors of the Nigerian economy, contributing more than one-third of Nigeria's Gross Domestic Product (GDP). Despite this, diseases of varying morbidity and mortality have plagued livestock and seasonally, threaten to wipe out specific animals in some areas in Nigeria. These outbreaks and epizootics are often unreported, unconfirmed, or poorly documented. Thus, this review provides information on the role of pathogenic microorganisms in ruminant mortality and production losses in Nigeria. A scoping review method was utilised to generate baseline data on ruminant diseases and interventions for the control and eradication of diseases of high mortality in ruminants in Nigeria. Overall, brucellosis, contagious bovine pleuropneumonia (CBPP) and foot and mouth Disease (FMD), were identified as the major ruminant diseases in Nigeria. Mortalities were mostly associated with CBPP and brucellosis in cattle. FMD constituted the other impediments of moderate to high morbidities and mortalities to ruminant production in Nigeria. The endemicity of these diseases is driven by poor herd health management systems, inadequate financial support from the government, animal movement, border porosity, poor surveillance activities, inadequate outbreak reporting mechanisms, animal identification and quarantining activities, insufficient number of vets and paravets working in the government and public services.

Keywords: Ruminants, Livestock, Brucellosis, CBPP, FMD, Mortality, Nigeria

Introduction

Agricultural production is a major contributor to Nigeria's gross domestic product (GDP). Between

July and September 2021 alone, the agricultural sector contributed 30% of Nigeria's GDP (Varrella,

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2021). As a country, Nigeria is heavily dependent on oil revenue as a major contributor to its GDP. However, due to the growing population as well as the urgent need for economic diversification, agriculture has been looked into as a key source of improved GDP.

The constantly increasing population in Nigeria further places a high demand on the need for livestock as a source of food (FAO, 2018). To put in context the relationship between potential increases in population in Nigeria and dependency on livestock production, a look at the population expansion in Nigeria is important. Over 38 years (1974 to 2012), the population in Nigeria grew from 62 to 168 million (UN, 2017), an increase of almost 100 million people. It is estimated that by 2050, Nigeria will have a population of 398 million people (UN, 2017). These population estimates show the importance agriculture, particularly livestock production, plays in the economic projections and outlooks of Nigeria. Another major issue Nigeria is battling with that directly affects agriculture is that Nigeria is largely import dependent. For example, between 2016 and 2019, import of agriculture-related products was 3.35 trillion Naira, which was a lot higher than the 803 billion Naira that was for export of the same products (PWC, 2020).

The rapid increase in the Nigerian population, as described above, has not been met with a proportionate increase in livestock production in Nigeria. In 1987, Nigeria was estimated to have 12.2 million cattle, 13.2 million sheep and 26.0 million goats (FAO, 1988). In 1999, Adamu and Ajogi, (1999), reported ruminant population in Nigeria as 20.49 million cattle, 23.07 million sheep and 28.07 million goats. At present, Nigeria has a ruminant population of 18.4 million Cattle, 43.4 million Sheep, and 76 million goats (FAO, 2021). The huge disparity between population growth and lack of sufficient increase in livestock production has significant economic implications.

Various factors have been identified that hamper livestock production in Nigeria. They include; capital, access to veterinary services, vaccines and drugs, high costs of animal feeds, animal diseases, transportation, farmers attitude; climate change, infrastructures and incentives, inadequate manpower, inadequate extension services, market and storage facilities, urbanization, the role of government and level of education of the farmers (Bamaiyi, 2013). Animal disease is a major factor influencing animal production in Nigeria. Livestock diseases such as Contagious Bovine Pleuropneumonia (CBPP), peste des petits ruminants (ovine rinderpest) (PPR), Brucellosis, Bovine tuberculosis (TB), Trypanosomiasis, Foot and Mouth Disease (FMD), Endoparasitism and Ectoparasitism are listed by the OIE as reportable diseases for global health protection (Olorunshola *et al.*, 2017). Thus, this review evaluates the impact of pathogenic microorganisms in ruminant mortality and production losses in Nigeria. This review employed a scoping approach, covering geographical and demographic description of the six regions in Nigeria, Livestock populations and patterns, Major diseases affecting ruminants, disease control practices by the Government and private sectors, sources of data on prevalence of livestock disease and some ideas for effective control and preventive measures targeted at various ruminant diseases.

Bovine Pleuropneumonia (CBPP), peste des petits ruminants (ovine rinderpest) (PPR), Brucellosis, Bovine tuberculosis (TB), Trypanosomiasis, Foot and Mouth Disease (FMD), Endoparasitism and Ectoparasitism are listed by the OIE as reportable diseases for global health protection (Olorunshola *et al.*, 2017). Thus, this review evaluates the impact of pathogenic microorganisms on ruminant mortality and production losses in Nigeria. This review employed a scoping approach, covering geographical and demographic description of the six regions in Nigeria, Livestock populations and

patterns, Major diseases affecting ruminants, disease control practices by the Government and private sectors, sources of data on prevalence of livestock disease, and some ideas for effective control and preventive measures targeted at various ruminant diseases.

BRUCELLOSIS IN RUMINANTS

Brucellosis is one of the most important zoonotic diseases affecting cattle in Nigeria. It is a major cause of economic loss in livestock (Agada *et al.*, 2017). Brucellosis is an infectious disease caused by bacteria of the genus *Brucella*. There are various species of *Brucella*, based on characteristic primary host and specificity. Major species of common livestock include: *B. melitensis* (goats), *B. abortus* (cattle), *B. ovis* (sheep), etc. (Nymo *et al.*, 2011). Brucellosis among ruminants is endemic in Nigeria, and causes huge economic losses due to decreased calving percentage, delayed calving, culling for infertility, cost of treatment, decreased milk production, abortions or stillbirth and birth of weak calves (Mai *et al.* 2012). Cases of bovine brucellosis have been reported in Nigeria as early as 1926.

Different studies in Nigeria have shown varying prevalences of brucellosis with different degrees of effect (Table 1). Furthermore, the lack of official policy on the control of brucellosis in Nigeria has worsened the incidence of brucellosis. Additionally, transmission is worsened by the unrestricted movement of animals, a factor that has contributed to the circulation of *Brucella* in herds as well as trade cattle in the country (Mbuk *et al.*, 2011). Consequently, therefore, the majority of poorly performing and infected animals sourced from various herds in Northern Nigeria and other African countries end up in abattoirs in Southwestern Nigeria where the demand for beef is high (Cadmus *et al.*, 2006).

Risk factors Associated with Brucellosis

There are limited data available on the risk factors responsible for the occurrence and spread of brucellosis amongst different cattle production systems in Nigeria, despite its significant impact on livestock production. However, there are some measurable parameters identified, to be considered in the epidemiology of brucellosis in Nigeria. Seropositivity to *Brucella* was lowest in cattle kept under a transhumant management system (4.7%), followed by those in sedentary systems (7.9%) (Cadmus *et al.* 2013). Keeping flocks of other species (such as goats) in close contact with cattle herds, especially under sedentary conditions, could also be a factor influencing transmission of the disease.

Age of animals has been shown to influence the prevalence of brucellosis in Nigeria. Older animals are twice as likely to be positive for brucellosis than younger herds. Younger animals tend to be more resistant to infection and frequently clear infections, although re-infection could occur at a later time (Radostits *et al.*, 1995). The higher prevalence of brucellosis in older cattle could be attributed to consistent exposure of the cattle to the infectious agent. This was observed in the study by Akinseye *et al.* (2016), who in their study of the risk factors associated with bovine brucellosis among slaughtered cattle in Nigeria showed a higher prevalence of brucellosis in adult cattle when compared to other age groups. Sexually mature and pregnant cattle have been found to be more susceptible to *Brucella* infection than the sexually immature ones (Akinseye *et al.*, 2016).

Higher prevalence of brucellosis has been identified among female cattle than among males in different studies across Nigeria (Zubairu *et al.*, 2014, Mohammed *et al.*, 2020). Major reasons attributed to the higher prevalence among female cattle include the short periods of retaining male animals in

breeding herds, while their female counterparts tend to be kept longer in the herd for the purpose of reproduction and breeding (Zubairu *et al.*, 2014, 4595 Mohammed *et al.*, 2020).

Another factor that influences the prevalence of brucellosis in Nigeria is the size of herd. Investigations carried out by Cadmus *et al.* (2013) among large herds showed a higher seropositivity rate than those from small herds (33.3% vs. 25.0%; $p = 0.670$). Cattle originating from herds larger than 120 animals were approximately one and a half times more likely to be seropositive for *Brucella* than those from herds with fewer than 120 animals.

Large herd size increases the potential for animal contact with one another at common feeding and watering points, thus enhancing the risk for infection with bovine brucellosis. In addition, prevalence of bovine brucellosis may be influenced by herding different species together, use of common pastures and water sources (Bertu *et al.*, 2015), breed of herd (Cadmus *et al.*, 2008), lactation status (Junaidu *et al.*, 2011) and weather season (Bertu *et al.*, 2012). However, the role of different cattle production systems needs to be assessed given the uncontrolled free movement of animals, especially as practiced by the Fulani herdsmen, and unsupervised introduction of new animals into herds (Cadmus *et al.*, 2013).

Table 1: Prevalence and occurrence of Brucellosis in Nigeria

Country/Region	State	Report
Northern Nigeria	Jigawa	Brucellosis prevalence of 4.04% was recorded among pastoralists (Farouk <i>et al.</i> , 2011). Mohammed <i>et al.</i> , (2011), using Rose Bengal Plate test (RBT) and competitive enzyme immunoassay observed a prevalence of 4.04% and 3.86% from 570 cattle across 20 herds respectively.
	Adamawa Kaduna Kano	Using RBT, seroprevalences of 45.1% (nomadic) 22.0% (seminomadic), 23.8% (commercial), and 15.9% (zero-grazing) (Mai <i>et al.</i> , 2012).
	Sokoto State	Out of 1547 serum samples and 99 milk samples, 19.5% prevalence of Brucellosis was reported among cattle, while 25.25% of the milk sample were positive for the brucella antigens (Junaidu <i>et al.</i> 2011).
	Zamfara State	Using ELISA techniques, Lawal <i>et al.</i> , (2012) reported a 20% prevalence of bovine brucellosis out of the 320 serum samples collected from cattle.
Southern Nigeria	Lagos and Oyo State.	Using RBT and competitive ELISA (cELISA) on samples from 2480 cattle (1239 in Lagos; 1241 in Oyo) result obtained showed a seroprevalence rate of 4.9% and 7.8% in Lagos and Oyo states respectively (Joseph <i>et al.</i> , 2015)
	Ogun State (Yewa Division)	Cadmus <i>et al.</i> , (2013) reported an overall prevalence of 8.6% and 5.7% using RBT and cELISA, respectively, in a cross-sectional study aimed to determine the prevalence of bovine brucellosis in three cattle production systems in Yewa Division.

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CONTAGIOUS BOVINE PLEUROPNEUMONIA (CBPP)

Contagious bovine pleuropneumonia (CBPP) was first described by Gallo in 1550 and it spread to Africa through South Africa by importation of a Friesian bull from Holland in 1854, this importation led to CBPP spread to other African countries like Namibia (1856), Zimbabwe (1861), Zambia (1861) and Nigeria (1924) (Olorunshola *et al.*, 2017). CBPP was regarded as extinct in Nigeria as of 1965, as a result of 10 years of mass vaccination, harmonized disease reporting system, prompt laboratory diagnosis, and quarantine and slaughter policy. Although achieved by 1965, the control of CBPP did not last long as the disease re-emerged a few years later, possibly from the bordering countries of Niger, Chad and Cameroon, or as a result of the low vaccination figure between 1973 - 1974, due to deployment of staff for national Census operation. In spite of an eradication campaign launched in 1970, outbreaks rose rapidly from 1986 to a peak in 1989 when over 10,000 cattle were infected (Fadiga *et al.*, 2013).

CBPP is a highly contagious bronchopneumonia of cattle which is associated with consolidation of the lung, fibrinous pleurisy, fluid accumulation in the pleural cavity and 'marbling' of the lungs. It is caused by *Mycoplasma mycoides* subspecies *mycoides*, Small Colony. CBPP can occur as an acute, sub-acute or chronic respiratory disease of cattle and is characterized by serofibrinous pleuropneumonia and

pulmonary sequestra. Acute cases show painful, difficult breathing with lowered and extended head and cough, progressing to recumbence and death in 3–4 weeks. Infective carrier states that are not detectable clinically or serologically exist, with 25% of recovered animals infected with pulmonary sequella (Radostits *et al.*, 2003).

CBPP is usually spread by movement of infected animals across international boundaries, with devastating consequences to cattle, particularly in severe outbreaks (Thiaucourt *et al.*, 2011). Transmission occurs mainly by aerosol through close contact with infected animals within herds and from herd to herd through direct contact and repeated contact between sick and healthy animals, and occasionally from latent carriers intermittently shedding *Mycoplasma* organisms from sequestered lung lesions (Radostits *et al.*, 2003).

CBPP causes considerable economic hardship to nomads in Nigeria who own approximately 90% of the cattle population. The persistence of CBPP in Nigeria poses a serious threat to the rest of Africa, particularly to neighbouring countries that trade cattle with Nigeria. The CBPP outbreaks and burden has negative impacts on the Nigerian economy since most cattle in Nigeria are owned by nomadic Fulani herdsmen who move long distances within and outside the country thereby exacerbating the spread of CBPP. CBPP is considered to be a disease of economic significance due to its ability to

4597 compromise food security. When CBPP outbreaks occurs in a herd that has not been previously challenged by the disease, morbidity could be as high as 100% and mortality as high as 50% (Masiga *et al.*, 1996).

In 2003, the Nigeria Animal Diseases Information System (NADIS) classified Nigeria as an endangered zone based on the CBPP status. The monetary value of these losses was assessed nationally and across the four agro-ecological zones of Nigeria to be NGN 1.307 billion (US \$8.7 million) (Alleweldt *et al.*, 2009). Economically, Nigeria suffers direct losses through infection and deaths of cattle, while indirect losses include exclusion from participation in international livestock and livestock product trade.

Since the first incidence of CBPP in Nigeria in 1924 (Foluso, 2004), the disease has become endemic with pockets of outbreaks occurring particularly in the northern part of the country, where most of the cattle populations are located. In the last two decades, the rate of civil unrest in the north has further spread and increased the incidence and prevalence of CBPP in all of the six geopolitical zones in Nigeria, extending to the surrounding countries (Olorunshola *et al.*, 2017). The insurgencies, coupled with mass migration of the cattle herdsman from the north to south, makes accurate monitoring a difficult task. Incidences of CBPP are underreported and annual outbreaks still

occur, with more in the northern region which harbors three-quarter of the country's cattle (Khatua, 2011).

Several epidemiological studies have been conducted to determine the status of CBPP in Nigeria. The disease has been reported in North -West Nigeria covering Kano, Katsina, Borno, Sokoto and Kaduna States of Nigeria (Nawathe, 1992), North -Central region (Danbirni *et al.*, 2010; Mailafia *et al.*, 2010), and South West region (Ajuwape *et al.* 2004; Babalobi, 2007). Information about the disease in the North West part of the Country is however very scanty, in spite of the region's rich livestock resources. Table 2 summarizes the prevalence of CBPP in Nigeria.

Challenges to effective control of CBPP in Nigeria, according to the OIE (2015), include; illegal cattle movement, ineffective vaccination campaigns, and the lack of contingency plans. Aliyu *et al.* (2015) made the following recommendations based on their findings:

Public health sensitization campaigns should be intensified as poor information dissemination is likely to enhance the spread of CBPP and other livestock diseases.

More grazing and watering facilities for livestock production should be made available to cattle herdsman, particularly in dry season when such points are few.

Table 2: Prevalence of CBPP in Nigeria

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Author and Year	Topic	Region/ State	Result
Billy <i>et al.</i> (2017)	Sero-Prevalence of <i>Contagious Bovine Pleuropneumonia</i> in Three Senatorial District of Kaduna State, Nigeria Using Latex Agglutination Test.	Kaduna State	CBPP prevalence rate of 26% among 900 cattle across the state was reported with seroprevalence of CBPP found highest (30%) among cattle less than 6 years. Although CBPP was found more among the female cattle, (27%) than male (21%), there was no statistical relationship between CBPP prevalence in the state and the sex of cattle.
Alhaji <i>et al.</i> , (2016)	Sero-positivity and associated risk factors for <i>Contagious Bovine Pleuropneumonia</i> under two cattle production systems in North Central Nigeria	Niger State	Results showed a CBPP seroprevalence rate of 16.2%, as well as establishing that age and agro-ecological zones statistically contributed to the prevalence of CBPP in Niger state.
Gumel <i>et al.</i> , (2015)	Dry Season Prevalence of <i>Contagious Bovine Pleuropneumonia</i> Based on Postmortem Examination at Hadejia Abattoir, Jigawa State.	Jigawa State	2.9% of 172 cattle slaughtered and examined over a three months period were ascertained to contain CBPP lesions, with infections being significantly higher in female cattle than males and in cattle within the range of 3.5 – 4 years.
Musa <i>et al.</i> , (2015)	Detection of Antibodies to <i>Mycoplasma mycoides</i> subspecies <i>mycoides</i> in Cattle using Competitive Enzyme-Linked Immunosorbent Assay	Bornu state	Only one of the sixty cattle tested positive for CBPP.
Suleiman (2012)	Seroepidemiology of <i>Contagious Bovine Pleuropneumonia</i> in Northern and Central Parts of Kaduna State, Nigeria.	Kaduna state	Result showed that 160 cattle out of 516 tested positive (cELISA-positive) for CBPP in Kaduna state. A seroprevalence rate of 31% across all herds surveyed. CBPP was found to be more common in female cattle between the ages of 3 and 4. The Igabi and Chukun breed had prevalence rates of 41.7% and 25%, respectively.
Okaiyeto <i>et al.</i> , (2011)	On-farm diagnosis of <i>Contagious Bovine Pleuropneumonia</i> in nomadic herds using latex agglutination test (LAT)	Katsina state	16.7% and 17.5% CBPP prevalence rate was observed for adult cattle and calves, respectively.
Tambuwal <i>et al.</i> , 2011)	An appraisal of awareness of Contagious Bovine Pleuropneumonia amongst settled and Semi settled Farmers and Pastoralists in the two cattle producing States (Sokoto and Kebbi), Nigeria	Kebbi and Sokoto	At Kebbi abattoir, 862 cattle lungs were reported to be condemned for CBPP out of 293,491 cattle slaughtered (0.29%) during a five-year period investigation. In an abattoir based in Sokoto, 3,338 (2.1%) of the 162,111 cattle slaughtered, had their lungs condemned as a result of CBPP.

4599	Douglas, (2008)	Serological and Molecular Studies of Mycoplasma <i>Mycoides</i> Small Colony in Northern Nigeria	Kano State, Sokoto State, Katsina State, Bauchi State, Borno State, Jigawa State, Kebbi State, Kaduna State, Gombe State, Taraba State, Adamawa State, and Plateau State	CBPP infection ranged from 2.1% to 32.5% in the states surveyed, with an average prevalence rate of 10.8% across the twelve states. The study also showed that 82 out of a total of 497 (16.5%) males were positive for CBPP infection compared to 137 out of 1529 (9%) cows tested.
	Aliyu <i>et al.</i> , (2003)	Prevalence of Contagious Bovine Pleuropneumonia (CBPP) in northern Nigeria	Adamawa, Bauchi, Borno, Kano and Sokoto States between 1988 and 1998	Of the 500 cattle, 18.8% had lesions suggestive of CBPP, 27.4% were seropositive using complement fixation test (CFT) while 32% were seropositive using competitive ELISA (C-ELISA) diagnostic technique. An average of 30 outbreaks were reported annually from all the states.

FOOT AND MOUTH DISEASE (FMD)

Foot and mouth disease (FMD), is a highly contagious viral trans-boundary disease of both domestic and wild cloven-hoofed animals, characterized by high morbidity and decreased livestock productivity (Ularamu *et al.*, 2020). Due to its low mortality, FMD is not often considered a disease of high importance in Nigeria (Ularamu *et al.*, 2020). Distribution of FMD is by direct and indirect contact, direct contact involves mechanical transfer of droplets from infected animals to other susceptible animals, while the latter route is through contaminated personnel, vehicles, and fomites (Ularamu *et al.*, 2020).

Foot and mouth diseases was first discovered in Nigeria in 1920, caused by Serotype 018 and reported in an outbreak in a cattle herd in the Northern region of Nigeria. It is an endemic disease of cattle in Nigeria, infecting both calves and adult cows. The disease has substantially contributed to economic loss in the livestock

sector of the economy (Chukwuedo *et al.*, 2003). In Nigeria, the Migrant Fulani herds are not routinely vaccinated against FMD, hence, there are yearly outbreaks of disease among cattle in Nigeria.

In the northern part of Nigeria, wide spread cases have been reported in cattle and pigs (Fakai, *et al.*, 2015). Studies have shown that despite the low priority level placed on FMD in Nigeria, the disease is an important viral disease of cattle in Nigeria. The disease has been reported in the northern and southern parts of the country. During outbreaks, mortality is usually highest in calves (Olabode *et al.*, 2014) and all ages, sex, breeds of cattle (Ishola *et al.*, 2011, Olabode *et al.*, 2014).

FMD causes serious economic downturn through disastrous impact on herds which may include; death of young animals, marked reduction in milk yield, abortion in advanced pregnancy, reduced working ability of the animals, quality and quantity of meat, reduction in fertility, and loss of

quality of semen in breeding bulls. The disease also restricts the possible export of livestock and livestock products (Olabode *et al.*, 2014).

the disease remains unexploited and poorly understood (Olabode, 2012; Olabode *et al.*, 2014). Based on the risks of infection, in a typical population of cattle, sheep and goats in Nigeria, cattle will be at the highest risk of infection for FMD, followed by sheep, while goats remain the lowest risk group. Table 3 shows the distribution pattern of FMD in Nigeria.

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In Nigeria, despite the annual disease burden, extensive studies on FMD infections and outbreaks are inadequate due to poor understanding of the epidemiology of the disease. Hence, the occurrence and distribution patterns of

Table 3: Reported Distribution Pattern of FMD infections in Nigeria

Author And Year	Topic	Region/State	Result
Aiki-Raji <i>et al.</i> , (2016)	Seroprevalence of Foot-and-Mouth Disease in slaughtered Pigs in Ibadan, Southwest Nigeria	Oyo state (Ibadan)	Results showed an overall seroprevalence of 46.2%, with 40.9% of the males and 49.0% of the females being positive.
Wungak <i>et al.</i> , (2016)	Foot-and-mouth disease (FMD) prevalence and exposure factors associated with seropositivity of cattle in north-central, Nigeria.	Plateau and Niger States	An overall prevalence rate of 70.98%. FMD seroprevalence was found to be higher in Niger State (85.4%) than Plateau State (54.2%). The study further showed that sex, herd mixing, and trans-boundary crossing were found to be statistically associated with the prevalence of FMD in the study areas.
Olabode <i>et al.</i> (2014)	Foot and Mouth Disease in Nigeria-The Current Status and Control Efforts	Kwara state	Out of the 4,248-cattle population Outbreak investigated, 842 were clinically affected and 39 calf Deaths were recorded with morbidity, mortality and case fatality rates of 19.82%, 0.92% and 4.63%, respectively.
Lazarus <i>et al.</i> , (2012)	Sero-epidemiology of foot-and-mouth disease in some Border States of Nigeria	The study population was distributed among states. 1. Cattle from Adamawa, Plateau, Borno, Yobe, Taraba, Sokoto and Ogun states; 2. Sheep and goats from Bauchi state; 3. Pigs from Kaduna state.	Higher seroprevalence was recorded in cattle samples from Yobe State(82%), followed by those from Plateau (80%Adamawa (68%), Borno (67%), and Sokoto (63%). Bauchi (27.84%), only studied sheep and goats. None of the pig sera obtained from Kaduna was positive), Ogun (77.77%), Taraba (73.50%),

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The economic consequences of FMD on the cattle industry include low mortality but high morbidity, and inability for FMD endemic countries to participate in international cattle trade. One of the significant dilemmas at the local level is that farmers are compelled to sell affected animals at a cheaper rate and at reduced values, particularly those that are of reproductive, productive and market values (Olabode *et al.*, 2014). FMD is still a fundamental problem among the Fulani livestock pastoralist/herders, therefore, a biosecurity awareness campaign among Fulani herdsmen should be organized to ensure early detection and disease reporting. The recruitment of more veterinary personnel empowered with field strain matching of FMD vaccines for vaccination is also advocated.

PESTE DES PETITS RUMINANTS (PPR)

Peste des petits ruminants (PPR) is a major disease affecting ruminants, particularly sheep and goats (Amarasinghe *et al.*, 2017). The causative agent for PPR is peste des petits ruminants virus (PPRV), a virus that belongs to the family Paramyxoviridae and genus Morbillivirus (Mantip *et al.*, 2021). At present, PPR is one of the most important diseases affecting ruminants globally, and is at the heart of a global eradication programme World Organisation for Animal Health and the Food and Agriculture Organization of the United Nations (FAO) (OIE & FAO, 2015). Morbidity in a flock infected with PPR can be as high as 100% with mortality getting as high as 90% (Baron *et al.*, 2016; Mantip *et al.*, 2021). The economic importance of PPR eradication is enormous, as a net benefit of US\$74.2 billion can be gained over a 15-year period from PPR eradication (Jones *et al.*, 2016). The OIE and the FAO, in their joint strategy for control and eradication of PPR, have set the goal of eradicating the disease by 2030.

Outbreaks of PPR occurs intermittently in small ruminants in Nigeria. Woma *et al.* (2016) reported overall PPRV antibodies of 23.16% in the 4,548 serum samples from 3,489 goats and 1,059 sheep collected in 12 states in Nigeria (Table 4). There were significant differences in the seroprevalence between the states ($p = 0.001$). Taraba State had the highest seroprevalence of 29.51%, whilst the lowest seroprevalence of 14.52% was observed in Cross River State. There were no significant differences in the PPRV seroprevalence between male and female animals ($p = 0.571$), age ($p = 0.323$) and between species ($p = 0.639$) (Woma *et al.*, 2016).

Lawal *et al.* (2011), reported an outbreak of PPR with high mortality in goats, particularly in kids less than one year of age, with none of such among sheep reared together in Eruwa, South-western Nigeria. Clinical, pathological and serological findings were reported. The clinical findings observed included loss of appetite, oculonasal mucopurulent discharges, dyspnoea, profuse diarrhoea and death, with the findings leading to the tentative diagnosis of PPR. Serum samples from fifteen out of twenty affected, 10 out of 10 recovered and 7 apparently healthy goats tested positive for the presence of PPR antibodies using cELISA. It was also observed that PPRV antibodies were high in goats below one and half years of age. However, no PPR antibodies were detected in sheep reared together with the goats. At histopathology, there was thickening of the alveolar septa walls with mononuclear cells and presence of varying numbers of macrophages and characteristic giant cells within the alveoli. This is apparently another documented case of PPR after thirty-one years since the first report. Enhanced awareness and sensitization campaigns among the stockowners towards adoption of annual vaccination of goats before the onset of rain was recommended (Lawal *et al.* 2011).

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Luka *et al.* (2011) validated the potency of the current PPRV using those outbreaks in 2007 and 2009 from Kaduna and Plateau States. Of the 33 clinical samples analyzed, 51.52% (n = 17) were positive for primers identified a gene (F protein gene primer (F1/F2), that is indicative of PPRV. All the samples had a sequence similarity of 98-100% among them and 92-97% with the reference vaccine (Nig 75/1) strain. The deduced amino acid homology ranges between 96.3-99.7%. Phylogenetically all the Nigerian sequences cluster with Nigeria 75/1 and Nig 76/1 in lineage 1. They concluded that the strains involved were genetically closely related to the vaccine strain

(Nig 75/1) and that continued outbreaks in the country is not due to the efficacy of the vaccine and the current control strategies should be re-evaluated.

Ezeibi *et al.* (2010) used rats as animal models to study the immune response to vaccination with PPR monospecific vaccine. One group (n=10) was vaccinated with PPR vaccine (Nigeria 7511). The second group (n=10) served as unvaccinated controls. Two weeks -post-vaccination, haemagglutination-inhibition (HI) test was done. The vaccinated group had higher HI titre suggesting that the rats could be used for assessment of immune response to PPR vaccine (Ezeibi *et al.*, 2010).

Table 4: Prevalence of Peste des petits ruminants (PPR) across 12 states in Nigeria

State	Number of samples analysed	Number positive	Apparent prevalence (%)
Adamawa	379	76	20.05
Taraba	379	106	27.97
Anambra	379	74	19.53
Imo	379	102	26.91
Akwalbom	379	94	24.8
Cross River	379	56	14.76
Plateau	379	79	20.84
Kwara	379	101	26.65
Kano	379	108	28.49
Sokoto	379	84	22.16
Ogun	379	67	17.68
Ondo	379	71	18.73

Conclusion and Recommendations

4603 Infectious diseases of ruminants are becoming more important and of serious economic and veterinary concern in recent times, as they impact livestock trade, commerce, international exports and other health concerns of a country. The extent of the impact of pathogenic microbiological agents in the morbidity and mortality of ruminants (livestock) have been extensively discussed in this review, highlighting the urgent need for control and preventive measures against the continuous spread and transmission of these diseases among livestock.

In Nigeria, it is pertinent that swift actions are made, on the part of governing bodies and appropriate health agencies, to curb the unchecked spread of ruminant diseases in the country. Also, the appropriate and consistent administration of vaccines for livestock must be implemented and monitored for adherence by livestock farmers and/or herders. Finally, adequate enlightenment for livestock farmers or herders, as well as creation of a flexible financial structure for animal farmers should be prioritized. These measures should help to eradicate ignorance of nature, transmission and symptoms of the diseases, as well as providing easy access to the vital medical care that is needed for the animal's health.

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