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ORIGINAL ARTICLE

Recurrent Outbreaks of Lumpy Skin Disease and its Economic Impact on a Dairy Farm in Jos, Plateau State, Nigeria

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SUMMARY

Lumpy skin disease (LSD) is an acute, severe and economically important transboundary disease of cattle caused by LSD virus (LSDV). Suspected outbreaks of LSD are frequently reported in Nigeria, but laboratory diagnosis is seldom carried out and the economic impact of the disease is unknown. This study investigated suspected recurrent outbreaks of LSD and its economic impact on a dairy farm. A dairy farm in Jos, Plateau State, Nigeria, experienced morbidity and mortality amongst Holstein Friesian (HF) calves as a result of skin infection suspected to be LSD in the year 2010, 2013-2014. LSD was tentatively diagnosed and skin biopsies samples were collected for laboratory investigation. The samples were subjected to DNA extraction and polymerase chain reaction (PCR). Economic losses were determined based on mortality of the HF recorded during the LSD outbreaks. Clinical signs observed were fever, nodular skin lesions and oedema of the dewlap. LSDV was detected by PCR in 100% (4/4) of the samples collected. In 2013, Farm records showed highest morbidity of 14.81% (36/243) and mortality of 5.3% (13/243). Twenty-three (23) HF calves died during repeated outbreaks of LSD with estimated value of N3, 180, 000 ($17,377.05). LSD is a devastating disease and a threat to the fledgling dairy industry in Nigeria. Diagnosis of LSD in affected animals was confirmed based on clinical signs and PCR results. Huge economic losses were incurred by the dairy farm as a result of the LSD outbreaks. Livestock farmers should routinely vaccinate their cattle against LSD to forestall economic losses.

Key words: Dairy farm, Holstein Friesian, Lumpy skin disease, polymerase chain reaction, Nigeria.

INTRODUCTION

Lumpy skin disease (LSD) is an acute and economically important transboundary disease of cattle caused by Lumpy Skin Disease Virus (LSDV) (Tuppurainen and Oura, 2012). The LSDV is a double stranded DNA virus of the genus *Capripoxvirus,* subfamily *Chordopoxvirinae,* family *Poxviridae* (Tulman *et al.,* 2001). Goatpox

virus (GTPV) and sheeppox virus (SPPV) are the other members of the genus *Capripoxvirus* (Tulman *et al.,* 2001). Lumpy skin disease is categorized as a notifiable disease by World Organisation for Animal Health (OIE) because of its severe economic impact during outbreaks (Tuppurainen and Oura, 2012). Lumpy Skin disease was first reported in Zambia in 1929, while first report in Nigeria was in 1974 (Wood, 1988; OIE, 2012). Lumpy skin disease has been reported in Africa, Middle East, Asia and several European countries (Tuppurainen *et al.,* 2015). The characteristic clinical signs of LSD include lacrimation, fever (40–41^0 C), lymphadenopathy, nodular skin lesions that progress to sitfasts lesions, which can persist for many months (Babiuk *et al*., 2008). In some LSD outbreaks affected animals develop swelling of one or more legs and lameness; and oedema of the dewlap (Tuppurainen *et al.,* 2005, Tuppurainen and Oura, 2012). The morbidity rate in LSD outbreaks varies from 3-85%, while mortality rate is usually low; about 1–3% but 40%- 75% mortality has been reported in naïve animals (Babiuk *et al.,* 2008; Tuppurainen and Oura, 2012). The disease is severe in cows during peak lactation and causes a sharp drop in milk yield, which may lead to secondary bacterial mastitis, in addition LSD may also cause temporary or permanent infertility in cows and bulls (Tuppurainen and Oura, 2012). Emaciation of infected animals and a convalescence period lasting for several months causes a decreased growth rate in beef cattle (Ayelet *et al.,* 2014). The LSDV is transmitted mechanically by biting insects, while transmission by contact is usually not effective, however, the disease can be transmitted through sharing of common drinking troughs as well as suckling calves from infected dams (Tuppurainen *et al.,* 2015). Diagnosis of LSD is confirmed based on clinical signs, viral isolation, serological tests, histopathology, immunohistochemistry and nucleic acid assay like polymerase chain reaction (OIE, 2012).Lumpy skin is amongst the top ten most important diseases of cattle in the world (OIE/World bank 2011). The disease is also a commonly reported livestock disease and the fourth most widely distributed transboundary disease in Africa in the years 2013 and 2014 (AU-IBR year book 2014). Suspected outbreaks of LSD are frequently reported in Nigeria, but laboratory diagnosis is seldom carried out. There is also paucity of data on the status of LSD and its economic impact on livestock production in Nigeria. This study was designed to investigate outbreaks of LSD and the economic impact of the disease on a dairy farm in Jos, Plateau State, Nigeria.

MATERIALS AND METHODS

Study area

The study area was Jos which is part of the administrative capital of Plateau State and situated approximately on latitude 9.729^0, longitude 8.792^0 E. Jos lies close to the geographical centre of Nigeria.

Case history and sample collection

A dairy farm with over 250 Holstein Friesian (HF) breed of cattle in Jos, Plateau State, Nigeria, experienced mortality as a result of three outbreaks of a nodular skin infection suspected to be LSD between the years 2010, 2013-2014. The animals were kept under intensive management system, without history of previous outbreaks of LSD on the farm. During investigation, the animals were examined for clinical manifestation of LSD and skin biopsies were collected from suspected cases. The samples were collected by anaesthetizing the area with the skin nodules with 2% lidocaine after shaving, the nodules excise aseptically and the wound sutured. The samples collected were placed on ice and transported to the Viral Skin Disease Laboratory, National Veterinary Research Institute (NVRI), Vom for laboratory investigation.

Polymerase Chain reaction

The skin samples were homogenized using sterile mortars and pestles with the aid of sterile sand and physiological buffer saline. The homogenates were subjected to DNA extraction using QIAamp DNA Mini kit from QIAGEN (Germany) following the manufacturer's instructions. The extracted DNA was amplified using primers as described by Le Goff *et al.* (2009), the primers (Forward: 5'TTAAGTAAAGCATAACTCCAACAA AAATG3', Reverse: 5'TTTTTTTATTTTTTATCCAATGCTAA TACT 3') amplifies the entire G protein coupled chemokine receptor (GPCR) gene of the Capripox virus at position 6961–8119. The expected PCR product size is 1200bps. An LSDV vaccine strain (available in the Viral Skin diseases laboratory, NVRI, Vom) was also subjected to DNA extraction and used as PCR positive control.

The PCR reaction mix was carried out in a 25 µl volume reaction mix comprising of 10 mM Tris–HCl, $MgCl_2$ 2.5 mM, dNTPs mix 1µl, 20pmol of each primers and 2.5 units of Taq polymerase. The PCR was carried out under the following thermal cycling conditions using Geneamp thermocycler (Applied Biosystem, USA). Initial denaturation for 2 minutes at 94 °C followed by 35 cycles for 40 seconds at 94 °C, 30 seconds at 55 °C and 72°C for 30 seconds, then final extension at 72 °C for 5 min, the samples were held at 4 °C. Electrophoresis of the amplified product was then carried out on a 1.5% agarose gel stained with ethidium bromide and run at 80 volts for 60min. A 1Kb Plus ladder (Thermo Scientific) was added alongside the amplicons. The gel was then viewed under UV light in a Syngene Bio-imaging system.

Determination of morbidity and mortality rates of lumpy skin disease outbreaks on the dairy farm

Morbidity and mortality rates were determined based on the records obtained from dairy farm using percentages.

Estimation of economic losses caused by Lumpy skin disease outbreaks on the dairy farm

The direct estimated economic losses were calculated based on the number of animals that died during outbreaks of LSD in 2010, 2013-2014 as revealed by the dairy farm records. The values of the animals were estimated based on the price list obtained from the dairy farm.

Plate I: A Holstein Friesian calf with skin nodules (arrows) characteristic of LSD on the dairy farm in Jos, Plateau State, Nigeria

Plate II: A Holstein Friesian calf skin nodules (arrow) characteristic of LSD on the dairy farm in Jos, Plateau State, Nigeria, the area was shaved in other to collect skin biopsy

RESULTS

Clinical manifestation of LSD

Clinical presentations of LSD in the animals affected included skin nodules (Plate I and II), oedema of the dewlap (Plate III) lacrimation and salivation.

Detection of Lumpy skin disease virus by polymerase chain reaction

Analysis of PCR products from the samples by agar gel electrophoresis showed a single DNA fragment of 1200bp (Plate IV). The PCR results also revealed the detection of LSDV in 100% (4/4) of the samples collected.

Records of Lumpy skin disease outbreaks on the dairy farm

Records revealed that the farm had experienced LSD outbreaks with morbidity and mortality in the year 2010, 2013 and 2014 (Table 1). However, there were no outbreaks of LSD on the farm in the year 2011 and 2012. The highest morbidity of 14.81% (36/243) and mortality of 5.3% (13/243) were recorded in the year 2013 (Table 1). Furthermore, the lowest morbidity of 11.5% (32/272) and mortality of 1.5% (4/272) was in 2014 (Table 1).The farm records also revealed that LSD affected mostly calves below one year of age (Table 1).

Economic losses due to mortalities as a result of Lumpy skin disease on the dairy farm

The records of the farm revealed that the total number of animals that died during the three outbreaks of LSD was 23 HF calves consisting of 10 heifers and 13 bulls. The estimated value of animals that die as a result LSD outbreak on the farm was ₦3, 180,000 or USD 19,875 (Table II). The indirect losses like cost of managing the animals affected by LSD, effect of LSD on milk production of the animals that recovered were not estimated.

Plate III: A dead Holstein Friesian heifer with oedema of dewlap (Red arrow) characteristic of LSD in the dairy farm in Jos, Plateau State, Nigeria

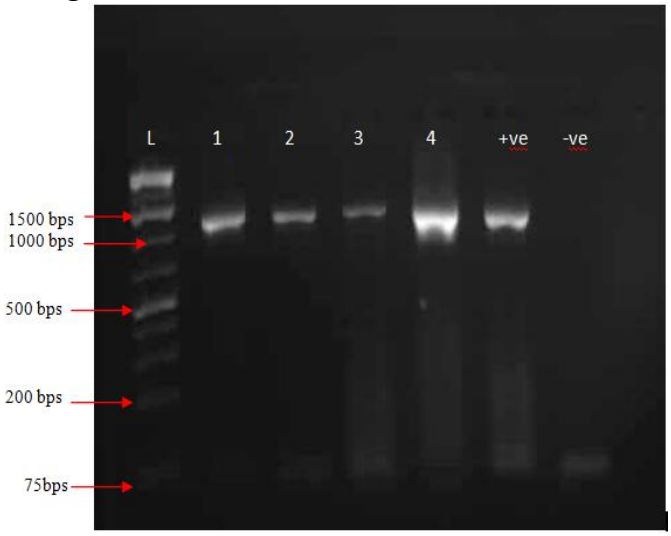

Figure 1: Agar electrophoresis amplification product of LSDV from skin biopsy samples collected from the dairy farm in Jos, Plateau State, Nigeria in a 1.5% agar gel

DISCUSSION

Lumpy skin disease was diagnosed on the dairy farm based on the clinical signs observed and PCR results obtained. Lumpy skin disease has been identified as a major obstacle to genetic improvement of cattle breeds in Africa due to its devastation on cattle particularly the exotic breeds

TABLE 1: The morbidity and mortality pattern of affected animals during recurrent outbreaks of Lumpy skin disease in the dairy farm in Jos, Plateau State, Nigeria in the year 2010, 2013-2014

Year	2010			2013			2014		
	No in a group	Morbidity (%)	Mortality (%)	No. in a group	Morbidity (%)	Mortality (%)	No in a group	Morbidity (%)	Mortality (%)
Calves (1wk - 2mths)	40	10 (25)	1 (2.5)	38	21(55.2)	6 (15.7)	30	15 (25.3)	1 (5.1%)
Young stock (3mths-12mths)	36	22 (61.1)	5 (13.8)	25	15 (60.0)	7(28)	42	17(40.5)	3(7.14)
Lactating (24mths >)	155	-	-	180	-	-	200	-	-
Total	231	36(13.8)	6 (2.6)	243	36 (14.81)	13(5.3)	272	32 (11.76)	4(1.5)

TABLE II: Economic losses due to mortalities as a result of lumpy skin disease outbreak in the Year 2010, 2013-2014, on the dairy farm in Jos, Plateau State, Nigeria

Age group	Total Mortality (Year 2010, 2013-2014)	Average price of animals in Naira	Total amount in Naira	Total amount in USD
Calves (1wk -2 mths)	8	60,000	480,000	2622.95
Young stock (3-12 mths)	15	180,000	2,700,000	14,754.10
Lactating (24 mths >)	0	300,000		
Total	23		3,180,000	17,377.05

* The official rate of USD to the Naira at the time of the last lumpy skin disease outbreak i.e Year 2014 was $ 1 to N 183

(Tuppurainen *et al.*, 2015). In this study, the clinical signs observed were classical presentations of LSD. Tentative diagnosis of LSD can be done based on clinical signs; however, LSD can be confused with other skin diseases of cattle like Dermatophilosis, Demodicosis, Besnoitiosis and Pseudocowpox (Hunter and Wallace, 2001; Tuppurainen *et al*., 2005). Therefore, rapid laboratory confirmation is very expedient in outbreaks for effective control of the disease. Polymerase chain reaction is a rapid, specific, reliable and sensitive method for laboratory diagnosis of LSD during outbreaks (Tuppurainen *et al*, 2005). In this report LSDV was detected by PCR from skin biopsies which are the most appropriate sample for use in the laboratory diagnosis of LSD. Suspected outbreaks of LSD occur annually in Nigeria but laboratory investigations are not carried out and disease outbreaks are also not reported despite the fact that LSD is a reportable disease (Aba-Adulugba *et al*., 2006). This is probably due

to the low mortality rates associated with LSD outbreaks particularly in the local breeds of cattle (Gari *et al.,* 2011). Another challenge with laboratory diagnosis of LSD in Nigeria is that farmers are reluctant to allow skin biopsies to be taken from their animals because of the wound that would be created. The dairy farm records in this study revealed that the highest morbidity and mortality rates of 14.8% and 5.3% respectively were recorded in the year 2013. A previous study in Nigeria reported morbidity of 20-30% in local breeds of cattle (Nawathe, *et al.*, 1978). Our findings revealed lower morbidity and mortality rates compared to findings in Israel, in which Brenner *et al*. (2009) reported 41.3% morbidity rate and Somasundaram, (2011) reported morbidity of 30-35% with a mortality of 12% in Oman. In LSD outbreaks, morbidity rates are usually high or varied while mortality rate is usually low. Calves below one year of age were the only affected group by the LSD outbreaks in this study. The probable reason could be that the adult animals had prior exposure to the LSDV and therefore may have developed immunity to the virus. Studies have shown that animals that had recovered from natural infection of LSD have lifelong immunity against the disease and are not carriers of the LSDV (Babiuk *et al.,* 2008). Calves should have acquired maternal antibodies from exposed dams and are supposed to be immune against LSD, however, calves of the age group 3-12 months were the ones mostly affected and the immune status of the dams were not determined in this study. Furthermore the vaccination history of the farm against LSD is unknown. The dairy farm did not experience outbreaks of LSD in years 2011 and 2012; the plausible reasons are also unknown. Research studies have revealed that recurrent outbreaks of LSD occur in cycles with quiescent periods lasting several years which may be what is being experienced in this dairy farm (Hunter and Wallace, 2001; Tuppurainen *et al.,* 2015). A total of 23 calves died in the three outbreaks of LSD on the farm which were valued at ₦ 3,180,000 ($17,377.05). This is a serious economic loss to the farm and these animals were probably part of replacement stock of the farm. In a study by Somasundaram, (2011) in the Sultanate of Oman, LSD was reported to have caused 45-65% loss in productivity in an intensive dairy farm. Another study in Ethiopia reported susceptibility, mortality rates and estimated economic losses as result of LSD per head was higher in HF/cross breeds compared to the local Zebu cattle (Gari *et al*., 2011). The estimation of economic losses as result of management of the sick animals, period of convalescence, loss of milk production, damage to hide and skin, and other indirect losses was not carried out in this study, hence the economic impact may be more than the estimated value quoted. The economic losses caused by LSD can hinder the development of small-scale dairy production units and hence it is a threat to the fledgling dairy industry in Nigeria, because of its devastating effect on exotic dairy cattle and milk production. Another important effect of LSD on livestock farmers is reduction of draft power needed for field cultivation (Gari *et al*., 2011). Apart from economic losses incurred by farmers in Nigeria due to LSD; it is also a transboundary disease which can cause restrictions on international trade of live cattle and their products.

In conclusion, the diagnosis of LSD on the dairy farm was confirmed based on clinical signs and positive PCR results obtained. Direct economic losses to the dairy farm attributed to LSD during three outbreaks were estimated to be ₦ 3,180,000 ($17,377.05). It is therefore recommended that routine laboratory diagnosis should be carried out during suspected outbreaks of LSD so that the current status of LSD in Nigeria can be determined. It is also important that livestock farmer vaccinate their cattle against LSD to forestall further economic losses during outbreaks.

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