



A Survey of Viral Diseases of Livestock Characterized by Skin Lesions in Kanam Local Government Area of Plateau State, Nigeria

Gambo, P.¹; Maguda, A. S.²; Adole, J. A.²; Dyek, D. Y.²; Ifende, V. I.²; Bot, C.¹ and Adedeji, A. J.^{2*}

¹ Federal College of Animal Health and Production Technology, Vom Nigeria. ²National Veterinary Research Institute, Vom, Plateau State, Nigeria. *Corresponding author: Email: yinkadeji@yahoo.com; Tel No:+2348033559785

SUMMARY

A survey on the status of viral diseases of livestock characterized by skin lesions was carried out between November, 2016 and March 2017 in Kanam Local Government Area (LGA) of Plateau State, Nigeria. Questionnaires were administered and suspected cases of Lumpy skin disease (LSD), Goat pox (GTP), Contagious ecthyma (CE) and Bovine papilloma (BP) were investigated. Samples collected were subjected to polymerase chain reaction (PCR). The questionnaires were administered to livestock farmers (n=109), butchers (n=11) and livestock traders (n=13). The results indicated that majority of livestock farmers (94.50%), butchers (100%) and livestock traders (100%) were familiar with these viral diseases of livestock. Farmers in the study area also indicated that they had observed LSD (64.5%) and BP (7.34%) in cattle; GTP (67.9%) and CE (59.5%) in sheep and goats in the last 12 months. Data collated from the questionnaire survey showed these viral diseases of livestock also affect trade price with reduction of about 50-75% of real value of affected animals. The PCR result of samples collected from clinically diagnosed cases of orf shows that 3 out of 4 samples analyzed were positive. Likewise, 1 out of 3 samples collected from clinically diagnosed cases of GTP were positive by PCR. The PCR results validate the respondents' feedback on the presence these viral skin diseases of livestock in study area. This report provides baseline epidemiological data on the status of these diseases of livestock and further investigation is needed to better understand the impact of viral skin diseases of livestock in Kanam LGA.

Key words: Survey; viral skin diseases; Kanam; Nigeria.

INTRODUCTION

Viral diseases of livestock characterized by skin lesions which have been reported in Nigeria and Plateau State are: Lumpy skin disease (LSD) and Bovine papilloma (BP) in cattle; Goat pox, (GTP), and Contagious ecthyma (CE) or Orf in sheep and goats

(Nawathe *et al.*, 1982; Zwandor *et al.*, 2008; Adedeji *et al.*, 2017; Adedeji *et al.*, 2018). LSD and GTP are OIE listed transboundary diseases caused by LSD virus (LSDV) and GTP virus (GTPV) respectively which are members of the genus: *Capripoxvirus* (OIE,

2012; Tulman, *et al.*, 2001). These diseases are of economic importance in endemic areas particularly for livestock farmers due to mortalities and trade restrictions (OIE, 2012) associated with them. Contagious ecthyma is caused by Orf virus (ORFV) belonging to genus: *Parapoxvirus* and it is zoonotic disease (Nandi *et al.*, 2011). However, LSDV, GTPV and ORFV are all pox viruses belonging to the family *Poxviridae* (Haller *et al.*, 2014). Bovine Papilloma is caused by BP virus (BPV) belonging to the family *Papillomaviridae* (Ogawa *et al.*, 2004). The family *Papillomaviridae* comprises a large number of small DNA oncogenic viruses infecting the epithelium and mucosa of many animals (Bocaneti *et al.*, 2013). Viruses of this family also affect humans causing benign hyperproliferative lesions or cancers (Bocaneti *et al.*, 2013). Lumpy skin disease and GTP occurs in Asia and Africa and parts of Europe (Mercier *et al.*, 2016; Tuppurainen *et al.*, 2017). Insects and fomites are important in the transmission and spread of LSD (Chihota *et al.*, 2001; Lubinga *et al.*, 2013); while transmission of GTP occurs via aerosol, insect vector and vertical transmission has also been reported (Bhanuprakash *et al.*, 2011). Lumpy skin disease is characterized by lachrymation and fever (40–41^oC), enlarged lymph nodes and nodular skin lesions (Hunter and Wallace, 2001). Morbidity as a result of LSD in cattle varies from 5 to 45 % while mortality rate is usually not more than 10%, although it can be higher (Tuppurainen *et al.*, 2017). Clinical signs in GTP include nodular skin lesions with scabs, diarrhea, depression, emaciation, abortion and notably the development of lung lesions (Rao and Bandyopadhy, 2000). Goat pox can cause high morbidity and mortality rates particularly in young and naïve animals (Rao and Bandyopadhy, 2000; Bhanuprakash *et al.*, 2011). Contagious ecthyma is characterized by pyrexia, papules and pustules, anorexia, scab and weakness, although morbidity may be high and

mortality is usually low (Nandi *et al.*, 2011). The clinical presentation of BP is characterized by the fever, emaciation and wart-like nodules or generalized pedunculated cauliflower-like growths (warts) on the body of affected animals (Bernard *et al.*, 2010). Tentative diagnosis of LSD, GTP, CE and BP can be based on characteristic clinical signs. But confirmatory diagnosis of these diseases can be done by histopathology and using polymerase chain reaction (PCR) (Rao and Bandyopadhy, 2000; Ogawa *et al.*, 2004; Walid *et al.*, 2010; Nandi *et al.*, 2011). There have been reports of suspected cases of LSD, GTP, CE and BP in Kanam Local Government Area (LGA) for the past few years with varied morbidity and mortality rates (Farmers *per com*). However, most of the suspected cases of these viral skin diseases has neither not been investigated nor the risk factors associated these diseases elucidated. In addition, livestock is a major source of income and serves as bank for households in Kanam LGA. This study reports a survey of viral diseases of livestock characterized by skin lesions in Kanam LGA, Plateau State, Nigeria.

MATERIAL AND METHODS

Study area

Kanam local government area (LGA) is located on 9.54 N and 10.09 E central zone of Plateau State with Dengi town as headquarters (Figure 1A&B). The LGA is bordered by Kanke, Langtang North, Wase LGAs and on the North by Bauchi State. Most of the people in the study area are livestock farmers and Kanam LGA has four (4) districts namely: Dengi, Kantana, Garga and Kanam. The estimated livestock population of Kanam LGA is as follows: Cattle; 90,000, goats; 70,124, sheep; 60,000 (Livestock Division, Plateau State Ministry of Agriculture and Natural Resources, 2018). Hide and skin processing is also an important economic activity in Kanam LGA of Plateau State.

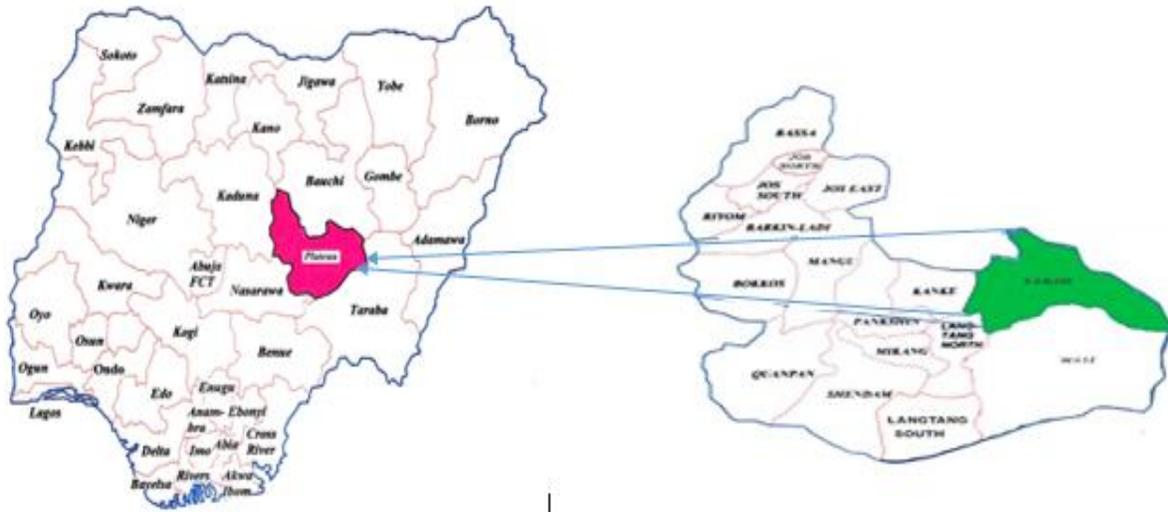


Figure 1: Map of Nigeria showing Plateau State and Map of Plateau State showing Kanam Local Government (National Centre for Remote Sensing, Jos, Nigeria)

Field data collection

The survey included administration of questionnaires from November, 2016 to March, 2017. Sampling was based on convenience and availability of the respondents for interview. Two types of questionnaires were designed and administered to livestock farmers, livestock traders and butchers. The first questionnaire was administered to livestock farmers using structured interviews during field visits to the study area. The questions were translated into the local language and the interview conducted with the aid of pictures showing lesions of viral diseases of livestock characterized by skin lesions in the

Field outbreak investigation and sample collection

Field investigation was carried out during the administration of questionnaires. Farmers and livestock traders were asked if they had observed cases of LSD, GTP, CE and BP in flocks or herds of livestock. Samples were collected from only farmers whose animals were showing clinical signs suggestive of these diseases and also consented. Irrespective of whether sampling was allowed or not, complete history and clinical examination of suspected cases of

appropriate animals for better understanding. The questionnaire focused on management system, type of livestock kept, familiarity with diseases (LSD, GTP, CE and BP), age, clinical signs associated with these diseases and occurrence of outbreaks in their herd/flock in the last one year. Other questions include risk factors associated with outbreaks. The second questionnaire was administered to livestock traders/butchers. The questionnaire inquired on respondent's familiarity with viral diseases of livestock characterized by skin lesions, how often they see these diseases and their views on economic impact in terms of trade value of the affected livestock.

LSD, GTP, CE and BP were done and recorded. Scab and skin samples were collected from suspected cases of GTP and CE. The samples collected were placed on ice and transported to the Viral Research Division, National Veterinary Research Institute, Vom and stored at -20°C until used

Polymerase Chain Reaction

The samples were homogenized and DNA extracted using Qiagen Mini kit (Qiagen, Germany). The extracted DNA was stored at -20°C until used. The GTPV specific

primers used are follows: F; 5'ttaagtaaagcataactccaacaaaatg3', R; 5'ttttttttttttateccaatgctaataact 3'. The PCR reaction mix for amplification of GTPV was carried out in a 25 µl comprising of 10 mM Tris-HCl, MgCl₂ 2.5 mM, dNTPs mix 1µl, 20 pmol of each primers and 2.5 units of Taq polymerase. While thermal cycling conditions using Gene ampthermocycler (Applied Biosystem, USA) was 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. Orf virus specific primers were used as published by Torfason and Gunadottir (2002) which amplifies the viral RNA polymerase gene which encodes the RPO132 of the ORFV. The positive samples were amplified at 140 bps. The PCR reaction mix comprised of 50µl of 10µl 5X Phusion HF buffer, 1 µl of 10mM dNTPs, 10 pmol each of the forward and reverse primers, 0.5µl of Phusion DNA polymerase, 1.5µl of DMSO, 5µl of DNA template, and make the volume up to 50µl using nuclease free water. The cycling conditions for the reaction in a PCR thermal cycler (GeneAmp, Applied Biosystem) consisted of an initial denaturation for 12 minutes at 94 °C, followed by 40 cycles of subsequent denaturation at 94 °C for 30 seconds and 68 °C for 45 seconds, after the final extension at 65 °C for 3 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. The gel was then viewed using Syngene Bio-imaging system. All samples collected were analyzed for detection both GTPV and ORFV by PCR because the two diseases serve as differentials to each other.

Data analysis

Data obtained from the questionnaires were entered into a Microsoft spreadsheet and presented in percentages and Tables. The results of the field investigations are also presented in a table.

RESULTS

A total of 133 questionnaires were returned: farmers (n=109), butchers (n=11) and livestock traders (n=13). The results indicate that most livestock farmers (95.4%) practice extensive system of farming (Table I), while 78.8% (n=86) of farmers keep mixed herd/flock of cattle, sheep and goats (Table I). Farmers in the study area also indicated that they had observed LSD (64.2%) and BP (7.3%) in their herds of cattle; GTP (67.9%) and CE (59.6%) in their flocks of sheep and goats in the last 12 months (Table II). All respondents interviewed i.e farmers, butchers and livestock traders stated that viral diseases of livestock characterized by skin lesions are of economic importance (Table II). Feedback of most farmers, butchers and livestock traders showed that viral skin diseases of livestock cause 50-75% price reductions of trade prices of affected animals (Table II). Majority of farmers observed skin nodules (89.9-92.67%), weight loss (83.49-91.75%), anorexia (80.74) and swollen limbs (70.66-77.99) clinical signs associated with LSD and GTP as stated in Table III. Equally, most farmers (89.9-91.74%) observed scab lesions around the mouth and eye, nostrils, on mammary glands as clinical signs of CE in sheep and goats (Table III). Of the farmers interviewed, majority considered raining season, insects and proximity to water bodies as risk factors in the outbreaks of LSD, GTP and CE in Kanam LGA (see Table IV). During the field investigation, the clinical examination of the suspected cases of LSD include: nodular skin lesions all over the body particularly the neck and shoulder region in cattle (Table V, Plate IA). Four cases of LSD were identified during the field investigations, although the farmers did not allow sampling of their animals. The herd/flock size and clinical signs observed are stated in Table V. Tentatively cases of LSD were diagnosed based on clinical signs. The morbidity rate of 8-20% and mortality

rate of 1%, One case of BP was clinically diagnosed (Plate IB) in a bull with warts

lesions around the eye, neck and shoulder. It

Table I: Management System of livestock in Kanam local government, Plateau State

Management	Frequency
Extensive system	104 (95.42)
Intensive system	1 (0.09)
Semi intensive	4 (3.67)
Total	109
Types of livestock kept	
Goats	3(1.83)
Cattle	2(1.83)
Cattle, sheep and goats	86 (78.8)
Cattle and sheep	2 (1.83)
Sheep and goats	7(6.42)
No response	9(8.25)
Total	109

TABLE II: Feedback of farmers, butchers and livestock traders on familiarity, observation of cases and economic impact of viral diseases of livestock characterized by skin lesions in Kanam local government of Plateau State

Variable	Farmers N=109 (%)	Butchers N=11 (%)	Traders N=13 (%)
Familiar with disease			
Lumpy skin disease	98 (89.90)	10(90.9)	11(84.6)
Goat pox	103 (94.50)	11 (100)	13 (100)
Orf	105(96.33)	11 (100)	13 (100)
Bovine papilloma	24 (22.01)	NA	NA
Observed cases in the past one year in their herd/flock (Farmers only)			
Lumpy skin disease	70 (64.22)		
Goat pox	74 (67.89)		
Orf	65 (59.64)		
Bovine papilloma	8 (7.34)		
Viral skin diseases of livestock are of economic importance			
Yes	109(100)	11(100)	13(100)
No			
Viral skin disease affects market price of affected animal			
Yes	109 (100)	11 (100)	13 (100)
No			
Percentage reduction in price of animals			
10---25%	13 (11.93)	1(9.09)	2 (15.39)
50---75%	92 (84.40)	10 (90.90)	11 (84.62)
Above 75%	2 (1.84)	0 (0.00)	0 (0.00)

NA= Not available

TABLE III: Common clinical signs observed by farmers during outbreaks of viral diseases of livestock characterized by skin lesions in Kanam local government, Plateau State based on the questionnaire survey

Clinical signs	Lumpy skin disease N=109 (%)	Goat pox N=109 (%)	Orf N=109 (%)
Skin nodules	98 (89.90)	101 (92.67)	0
Weight loss	91 (83.49)	100 (91.75)	82 (75.23)
Weakness	88 (80.74)	90 (82.57)	77 (70.65)
Anorexia	88 (80.74)	88 (80.74)	90 (82.57)
Reduced milk production	83 (76.15)	-	-
Abortion	89 (81.66)	93 (85.33)	87 (79.72)
Swollen limbs	77 (70.65)	85 (77.99)	NA
Lesions on mouth	-	86 (78.90)	NA
Scab lesions on mouth	0	-	99 (90.83)
Scab lesions on mammary gland	0	0	100(91.74)
Scab lesions on eye	0	0	99 (90.83)
Scab lesions on limbs	0	0	98 (89.90)

NA=Not available

TABLE IV: Risk Factors associated with viral diseases of livestock characterized by skin lesions in Kanam Local Government Area, Plateau State based on the questionnaire survey

Variable		Lumpy skin Disease n= 109(%)	Goat pox (%)	Orf (%)
Season	Dry	6(5.5)	8 (3.6)	15 (11.93)
	Rainy	76(65.1)	93 (85)	66 (71.56)
	Both	15 (13.76)	17 (11.0)	17 (15.60)
	No response	12(11.0%)	1(0.9)	11(10.0)
Sex	Female	0	3 (2.7)	1 (0.92)
	Male	2 (1.84)	0 (0)	1 (0.00)
	Both	96(98.17)	96 (97.3)	96 (99.08)
	No response	11(10.0)	10(9.2)	11(10.0)
Age	Young	1 (0.92)	0 (0)	0 (0.00)
	Adult	0 (0.00)	0 (0)	1 (0.92)
	Both	96 (99.08)	98 (100)	97 (99.08)
	No response	12(11.0)	11(10.0)	11(10.0)
Others (N=109)	Proximity to water bodies	91(82.9)	86 (78.9)	85 (77.99)
	Presence of Insects	101 (92.66)	105 (96.33)	104 (95.42)

was observed in this study farmers carry their diseased animals showing clinical signs of viral diseases with skin lesions to livestock markets. The clinical signs observed in cases of GTP were generalized

skin nodes (Plate IC), dyspnea and fever. While proliferative scab lesions around the mouth, noses, mammary gland were observed in cases of CE. The PCR result of samples collected from clinically diagnosed

cases of Orf (Plate 1D Table V) shows that 3 out of 4 samples analyzed were positive. Likewise, 1 out of 3 samples collected from clinically diagnosed cases of GTP were positive by PCR (Figure 2A&B).

DISCUSSION

This study has established the presence of LSD, GTP, CE and BP and risk factors associated with the outbreaks of these viral diseases in Kanam LGA based on the questionnaire survey, the field investigation/observations and or laboratory

results. Livestock serve as source of food, income and bank for rural populace worldwide including Nigeria (Ørskov, 2011; Awobajo *et al.*, 2016) and hence controlling diseases that affect livestock will alleviate poverty in these rural communities (Diallo, 2006). However, because diseases like LSD and GTP may be confused with skin diseases like dermatophilosis, demodocosis and mange, pictures were used as aid while administering the questionnaires. The outcome revealed that respondents interviewed were familiar with LSD, GTP,

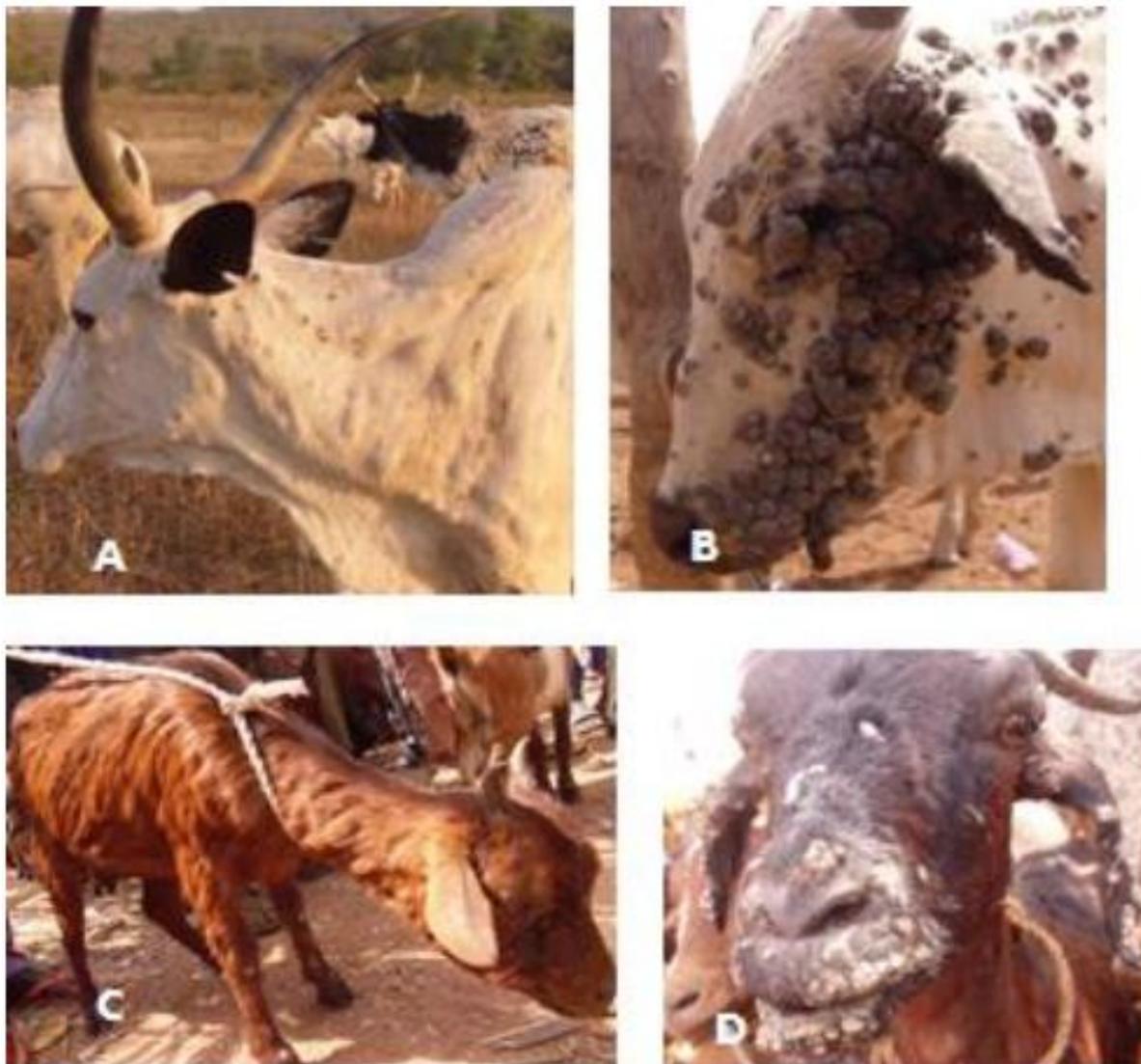


Plate I: (A) A cow showing clinical sign of nodular skin characteristic of lumpy skin disease in Kanam LGA. **B:** Wart-like lesions in a bull with Bovine Papilloma Jarmai Market, Kanam LGA. **C:** Generalized nodular skin lesions in goat with goat pox in Dengi market of Kanam LGA. **D:** A case of contagious ecthyma in goat with proliferative skin lesions in Dengi market of Kanam LGA

TABLE V: Field observations and samples collected from viral diseases of livestock characterized by skin lesions in Kanam LGA of Plateau State, Nigeria

S/NO	Species	Location	Herd/ flock size and clinical signs observed	Samples collected	PCR results/Diagnosis
1	Cattle	Dadin kowa/ Dengi	Lachrymation, salivation Nodular skin lesions on the neck, shoulder and perineum. Morbidity 20% (10/50). No mortality	NA*	Lumpy skin disease, diagnosis based on history/ clinical signs
2	Cattle	Kyangmi	Fever, anorexia, Lachrymation, salivation nasal discharges, emaciation and nodular skin lesions, rough hair coat, Morbidity 8% (4/50), culled 3	NA*	Lumpy skin disease, diagnosis based on history/ clinical signs
3	Cattle	Zango	Emaciation and generalized nodular skin lesions, rough hair coat, Morbidity 9% (9/100), mortality 1% (1/100)	NA*	Lumpy skin disease, diagnosis based on history/ clinical signs
4	Cattle	Furyam	Generalized skin nodules, morbidity 6.4% (2/31).	NA*	Lumpy skin disease, diagnosis based on history/ Clinical signs
5	Cattle	Jarmai market/Kanam	Warts lesions on the around the eyes on the neck	NA*	Bovine Papilloma, diagnosis based on history/ clinical signs
6	Goat	Kumbuti/Dengi	Generalized skin nodules, nasal discharges, morbidity 30%(20/60) mortality 16.6% (10/60)	Scab/skin	GTPV/ORFV not detected by PCR
7	Goat	Tungtung	Fever, anorexia, generalized nodular skin lesions	Scab lesion	GTPV was detected by PCR. Goat pox was diagnosed based clinical signs& PCR result
8	Goat	Dengi market	Generalized skin nodules,	Scab	GTPV/ORFV not detected by PCR
9	Goat	Dengi market	Scab lesions around the mouth, nose and legs	Scab	ORFV detected by PCR, contagious ecthyma diagnosed based on clinical signs& PCR results
10	Sheep	Dengi slaughter slab	Scab lesions around the mouth, nose and legs	Skin/scab	ORFV detected by PCR, contagious

					ecthyma diagnosed based on clinical signs& PCR result
11	Sheep		Emaciation and generalized nodular skin lesions, rough hair coat, respiratory dyspnea, nasal discharge	Scab	GTPV/ORFV not detected by PCR
12	Goat	Dengi	Scab lesions around the mouth, nose and legs	Scab	ORFV detected by PCR, contagious ecthyma diagnosed based on clinical signs& PCR results

NA*= sample not collected or appropriate

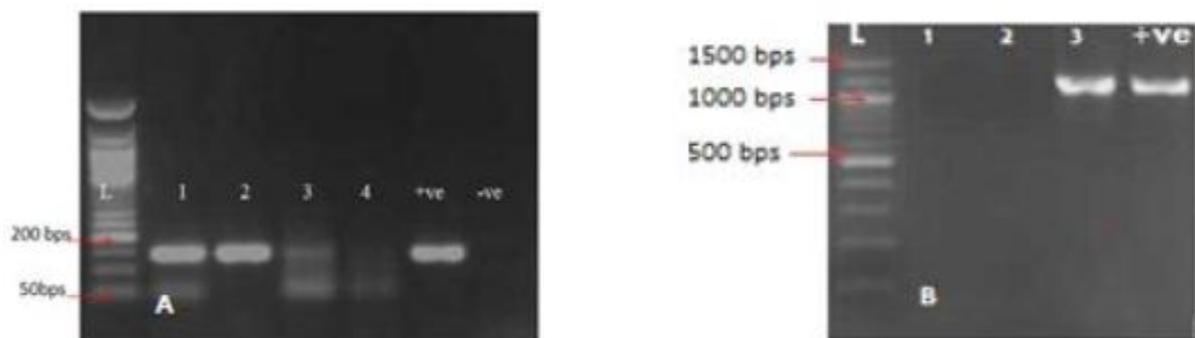


Figure 2A: Gel electrophoresis of PCR product of Orf virus from scab sample collected in Kanam LGA. Lanes 1-4 is scab samples, +ve is the positive control and -ve is the negative control. Positive samples were amplified at 140 bps and the ladder is 50bps. **B:** Visualization of polymerase chain reaction product of goat pox virus from skin sample collected in Kanam LGA. Lanes 1-3 are skin samples, +ve is the positive control. Positive samples were amplified at 1150 bps and the ladder is 100bps

CE and BP. In addition, 7.34 - 67.89% had noticed cases of these viral diseases of livestock that are characterized by skin lesions in their herds/flocks in the past 12 months. The high percentage of farmers that have observed outbreaks of these diseases in their herds/flocks within the last 12 months may be attributed to the convenient sampling method used. In which most of the respondents willing to be interviewed were the ones that had observed outbreaks of these diseases in their herds/flocks. Albeit, this does not negate the fact that cases of LSD, GTP, CE and BP frequently occurred in the study area. From this study, respondents of the questionnaire survey indicated that cases of viral diseases of

livestock characterized by skin lesions are associated with raining or wet season, closeness to water bodies and insects. Besides, insects are commonly found in the rainy season and hence the association of these viral skin diseases with raining season by the respondents. Reports by Woods, (1988) and Tuppurainen *et al.* (2013) suggested that insects play a role in the mechanical transmission of LSD. Moreover, studies in South Africa, Ethiopia, Zimbabwe and Nigeria reported that cases of CE and LSD occur more commonly during raining season compared to dry season (Scagliarini *et al.*, 2012; Hailu *et al.*, 2014; Mafirakureva *et al.*, 2016; Adedeji *et al.*, 2018). The common clinical signs of viral skin diseases

observed by the farmers were skin nodules, fever, anorexia and weight loss for LSD and GTP. These clinical signs are common with these diseases, particularly skin nodules which is pathognomonic sign of LSD and GTP (Babiuk *et al.*, 2008). On the economic impact of these viral skin diseases, all respondents affirmed that these diseases cause economic losses to livestock owners in the study area. In fact, the losses are as high as 50-75% reduction in the trade prices of affected animals apart from losses due to mortality and low productivity. Similarly, Adedeji *et al.*, (2017) and Adedeji *et al.*, (2018) in Jos, Plateau State reported severe economic losses attributable to LSD in cattle and CE in goats respectively. In this study suspected cases of LSD and BP were clinically diagnosed based on history and clinical signs observed during field investigations. Although, samples were not collected, because the livestock owners did not give their consent due to the erroneous belief that sampling the animals will aggravate the disease. Nevertheless, clinical signs of LSD observed while carrying out the field investigations were highly characteristic presentation of the disease. These signs include nodular skin lesions at specific predilection site including the skin of the head, neck and perineum as described by Tuppurainen *et al.* (2017). LSD can be distinguished from other skin diseases of cattle such as dermatophilosis, demodicosis and pseudocowpox based on clinical signs. Skin lesions of LSD are deep nodules involving all layers of the skin, subcutaneous tissue and sometimes even the underlying muscles which are easily recognizable (Tuppurainen *et al.*, 2017). Another viral skin disease clinically diagnosed in this study was BP. These are tumours also known as papillomas or warts which can be benign or malignant (Carvalho *et al.*, 2011). Again, the case shown on Plate IB was encountered during field investigation and is highly suggestive of BP, with warts lesions on the face and neck of a bull. These lesions are similar to the ones

described by Meseko *et al.*, (2008), Zwandor *et al.*, (2008), Jelinek and Tachezy (2004) in cases of BP in cattle in Nigeria and Czech Republic respectively. The PCR results from this study confirms that cases of GTP and CE occurs in Kanam LGA which agrees with the feedback from the farmers, butchers and livestock traders interviewed as part of the questionnaire survey. Polymerase chain reaction is the most reliable technique for the laboratory diagnosis of GTP and CE (Tuppurainen *et al.*, 2005, Kottaridi *et al.*, 2006; Hosamani *et al.*, 2009). GTP and CE are differentials of each other during outbreaks and these pox diseases cannot be differentiated serologically, hence PCR is a useful tool for both detection and differentiation of diseases caused by Pox viruses (Lamien *et al.*, 2011). In addition, the clinical signs observed in cases of GTP and CE were distinctive signs of these diseases (Plate IC & D, Table V). It is however worrisome that livestock farmers send sick animals for sale once clinical signs of viral skin diseases is observed which makes control of these diseases difficult. The diseases surveyed in the study cause damage to hide and skin in affected livestock, this is of serious economic importance to Kanam LGA where the processing of hide and skin is important part of economic activities.

CONCLUSIONS

Viral diseases of livestock characterized by skin lesions namely LSD, GTP, CE and BP occurs in Kanam LGA, Plateau State with severe economic implication to livestock farmers. This report provides baseline epidemiological data on the status of these diseases of livestock in the study area. Further investigation is needed to better understand these diseases in Kanam LGA. Farmers should be educated on the need to promptly report suspected outbreaks of these diseases so that preventive and control measures can be instituted.

REFERENCES

- ADEDEJI, A.J., ADOLE, J. A., DOGOYARO, B.B., KUJUL, L.B., TEKKI, I.S., ASALA, O.F.C., CHIMA, N.C., DYEK, Y.D., MAGUDA, A. S, and ADULUGBA, A.(2017). Recurrent outbreaks and the impact of lumpy skin disease in a dairy farm in North Central Nigeria. *Nigeria Veterinary Journal*, 38(2):153-160.
- ADEDEJI, A.J., ADOLE J. A., CHIMA, N.C., MAGUDA, A.S., DYEK, Y. D., JAMBOL, A., ANEFU, E., SHALLMIZHIL, J.J. and LUKA, P.D. (2018). Contagious ecthyma in three flocks of goats in Jos-South, Plateau State, Nigeria. *Sokoto Journal of Veterinary Sciences*, 16(1):107-112.
- AWOBAJO, O.K., SALAKO A. E., AKINYEMI, M. A. and OSAIYUWU, O.H. (2016). Analysis of genetic structure of West African Dwarf goats by allozymemarkers. *Small Ruminant Research*, 136:145–150.
- BEARD, P.M. (2016). Lumpy skin disease: a direct threat to Europe. *Veterinary Record*, 178:557–558.
- BERNARD, H.U., BURK, R.D, CHEN, Z., VAN DOORSLAER, K., ZUR, H.H., DE VILLIERS, E.M (2010). Classification of Papillomaviruses (PVs) Based on 189 PV Types and Proposal of Taxonomic Amendments. *Virology*, 401: 70-79.
- BHANUPRAKASH, V., HOSAMANI, M. and SINGH, R.K. (2011). Prospects of control and eradication of capripox from the Indian subcontinent: a perspective. *Antiviral Research*, 91:225–232.
- BOCANETI, F., ALTAMURA, G., CORTEGGIO, A., VELESCU, E. ROPERTO, F. and BORZACCHIELLO, G. (2016). Bovine Papillomavirus: New Insights into an Old Disease *Transboundary and Emerging Diseases*, 63:14–23
- CHIHOTA, C.M., RENNIE, L. F., KITCHING, R. P. and MELLOR, P. S. (2001). ‘Mechanical transmission of lumpy skin disease virus by *Aedes aegypti* (Diptera: Culicidae). *Epidemiology and Infection*, 126:317–321.
- DIALLO, A. (2006). Control of Peste des Petits Ruminants and Poverty Alleviation? *Journal of Veterinary Medicine B*, 53:11–13
- HAILU, B., TOLOSA, T., GARI, G., TEKLUE, T. and BEYENE, B. (2014). Estimated prevalence and risk factors associated with clinical Lumpy skin disease in north-eastern Ethiopia. *Preventive Veterinary Medicine*, 115:64–68.
- HALLERA, S. L., PENG, C., MCFADDEN, G. and ROTHENBURG, S. (2014). Poxviruses and the Evolution of Host Range and Virulence. *Infection and Genetic Evolution*, doi:10.1016/j.meegid.2013.10.014.
- HOSAMANI, M., SCAGLIARINI, A., BHANUPRAKASHV, MCINNES, C.J. and SINGH, R.K. (2009). Orf: an update on current research and future perspectives. *Expert Review of Anti-infective Therapy*, 7(7): 879–893
- HUNTER, P. and WALLACE, D. (2001). Lumpy skin disease in southern Africa: a review of the disease and aspects of control. *Journal of the South African Veterinary Association*, 72:68–71.
- JEL'INEK, F. and TACHEZY, R. (2005). “Cutaneous papillomatosis in cattle,” *Journal of Comparative Pathology*, 132: 70–81.
- KOTTARIDI, C., NOMIKOU, K., LELLIS, R., MARKOULATOS, P. and MANGANA, O. (2006). Laboratory diagnosis of contagious ecthyma: comparison of different PCR protocols with

- virus isolation in cell culture. *Journal of Virological Methods*, **134**:119–124
- KUMAR, P., NAGARAJAN, N. SAIKUMAR, G. ARYA R. S. and SOMVANSHI R. (2015). Detection of bovine papilloma viruses in wartlike lesions of upper gastrointestinal tract of cattle and buffaloes. *Transboundary and Emerging Diseases*, **62**: 264–271.
- LE GOFF, C., LAMIEN, C. E., FAKHFAKH, E., CHADEYRAS, A., ABA-ADULUGBA E.P., LIBEAU, TUPPURAINEN, E., WALLACE, D.B., ADAM T., SILBER R., GULYAZ V., MADANI F., CAUFOUR P., HAMMAMI, S., DIALLO, A. and ALBINA, E. (2009). Capripoxvirus G-proteincoupled chemokine receptor: a hostrange gene suitable for virus animal origin discrimination *Journal of General Virology*, **90**: 1967-1977.
- LUBINGA, J. C., E. S. TUPPURAINEN, W. H. STOLTSZ, K. EBERSOHN, J. A. COETZER, and VENTER, E. H. (2013). Detection of lumpy skin disease virus in saliva of ticks fed on lumpy skin disease virus-infected cattle. *Experimental and Applied Acarology*, **61**: 129–138.
- MAFIRAKUREVA, P., SAIDI B. and MBANGA J. (2016). Incidence and molecular characterisation of lumpy skin disease virus in Zimbabwe using the P32 gene. *Tropical Animal Health Production*. **49**(1):47-54. DOI 10.1007/s11250-016-1156-9
- MESEKO, C.A., ADEDEJI, J.A. and FAGBAMILA, I.O. (2008). What is your Diagnosis. *Nigerian Veterinary Journal*, **29**(3):58
- NANDI, S., UJJWAL, K. D. and CHOWDHURY, S. (2011). Current status of contagious ecthyma or Orf disease in goat and sheep—A global perspective. *Small Ruminant Research*, **96**:73–82
- NAWATHE, D. R., ASAGBA, M. O. ABEGUNDE, A. AJAYI, S. A. and DURKWA, L. (1982): Some observations on the occurrence of lumpy skin disease in Nigeria. *Zentralbl Veterinarmed*, **29**: 31–36.
- OGAWA, T., TOMITA, Y., OKADA, M., SHINOZAKI, K., KUBONOYA, H., KAIHO, I. and SHIRASAWA H. (2004). Broad-spectrum detection of papillomaviruses in bovine teat papillomas and healthy teat skin. *Journal of General Virology*, **85**: 2191–2197.
- OIE (2012). Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, 7th edition. The World Organisation for Animal Health (OIE), Paris.
- ØRSKOV, E.R. (2011). Goat production on a global basis. *Small Ruminant Research*, **98**: 9–11.
- RAO, T.V. and BANDYOPADHYAY, S.K. (2000). A comprehensive review of goat pox and sheep pox and their diagnosis. *Animal Health Research Review*, 127-136.
- TORFASON E. G. and GUONADOTTIR, S. (2002). Polymerase chain reaction for laboratory diagnosis of Orf virus infections. *Journal of Clinical Virology*, **24**: 79–84.
- TULMAN, E. R., AFONSO, C. L. LU, Z. ZSAK, L. KUTISH, G. F. and ROCK, D. L. (2001). Genome of lumpy skin disease virus. *Journal of Virology*, **75**: 7122–7130.
- TUPPURAINEN E., ALEXANDROV T., and BELTRÁN-ALCRUDO D. (2017). *Lumpy skin disease field manual –A manual for veterinarians*. FAO Animal Production and Health Manual No. 20. Rome. Food and Agriculture Organization of the United Nations (FAO) 60 pages.

- TUPPURAINEN E.S.M., LUBINGA, J.C., STOLTSZ, M., TROSKIE W. H., CARPENTER S. T., COETZER J.A.W., VENTER E. H. AND OURA C. A. L. (2013). Mechanical transmission of lumpy skin disease virus by *Rhipicephalus appendiculatus* male ticks. *Epidemiology and Infection*, **141**: 425–430.
- WALID S.A., IBRAHIM A.K., KHALED MAHRAN K., FARARH K. M. and MONIEM M. I. A. (2010). Evaluation of different diagnostic methods for diagnosis of Lumpy skin disease in cows. *Tropical Animal Health Production*, **42**:777–783.
- ZWANDOR N.J., AKALUSI Y., NGULUKUN S.S., MESEKO CA., AKANBI BO., ADEDEJI J.A. and FAGBAMILA I.O. (2008). Outbreak of severe cutaneous bovine papillomatosis in a cattle herd. *Vom Journal of Veterinary Science*, **5**: 67-72.