LCCN 85-931448

ISSN: 1023-1072 (Print), ISSN: 2663-7863 (Online)
https://doi.org/10.47432

PAKISTAN JOURNAL OF AGRICULTURE AGRICULTURAL ENGINEERING AND VETERINARY SCIENCES

An Official International Biannual Publication of Sindh Agriculture University Tandojam, Pakistan

Volume 39 (2) December, 2023

SINDH AGRICULTURE UNIVERSITY TANDOJAM

http://pjaaevs.sau.edu.pk/index.php/ojs

.

Pak. J. Agri., Agril. Engg., Vet. Sci., 2023, 39 (2): 124-132
ISSN: 1023-1072 (Print), ISSN: 2663-7863 (Online)
https://doi.org/10.47432/2023.39.2.7

FIRST OUTBREAK OF LUMPY SKIN DISEASE IN CATTLE AT DISTRICT KHAIRPUR MIRS-SINDH

H. A. Sahito[1], S. A. Rid[2], W. M. Mangrio[1*], F. I. Sahito[3] and N. Qureshi[4]

[1]Department of Zoology, Shah Abdul Latif University, Khairpur Mir's, Pakistan
[2]Institute of Microbiology, Shah Abdul Latif University, Khairpur Mir's, Pakistan
[3]Department of Teacher Education, Shah Abdul Latif University Khairpur Mir's, Pakistan
[4]Department of Chemistry, Government College University, Hyderabad, Pakistan

ABSTRACT

The research study was conducted to examine the Lumpy skin disease in Cattle, *Bos taurus* L. cloven-hooved herbivores. *Capripox virus* infection is characterized by enlarged lymph nodes, fever, and circumscribed nodules particularly on hairless areas. The age-wise data of male and female (3 to 6) months weaning stage, (15 to 25) months bull/heifer (25 to above) months adults were kept under observation from April to September 2022 in all talukas of district Khairpur, Sindh-Pakistan. The maximum overall mean positive cases of LSD throughout the district level were reported from Kot Diji (73.63), followed by Kingri (66.53), Gambat (51.47), Thari Mirwah (45.65), Faiz Ganj (41.84), Sobho Dero (37.83), Naro (31.97) and Khairpur (29.17), talukas of district Khairpur. The age-wise specific data revealed that, the highest infection of lumpy skin diseases was recorded at the weaning stage in females (85.35) as compared to males (65.78), female heifer (47.67), bull (38.47), adults female (71.24) and male (57.00). The maximum number of cases was reported in females (67.57) and males (53.46), respectively. Both male and female cattle throughout the district of Khairpur were found with vigorous infestation. Generally, the clinical severity of LSD depends on immunological status, susceptibility, age of the host, and route of virus inoculation. Effective control measures against this economically divesting viral disease can be achieved through mass vaccination and separation of infected animals. Furthermore; it is recalling earlier understanding of the epidemiology, economic significance, and immediate control mechanisms of the disease is strongly needed to design suitable control measures.

Keywords: *capripox virus*, cattle, cow disease, epidemiology, hairless areas, nodules.

INTRODUCTION

Lumpy skin disease, sometimes known as cow disease, is a viral illness caused by *Capripox virus* (Leliso *et al*., 2021), frequently found in cattle animals (Huang *et al*., 2022). Previously, LSD was reported only in the African countries and very rare from Middle East, but now its outbreaks have been spread in Asian countries (Aleksandr *et al*., 2020). During the preceding ten years, it has left catastrophic influence on the economy particularly in formerly disease-free nations (Kumar *et al*., 2021). LSD results in considerable economic losses due to emaciation, decreased supply of milk, hide damage, infertility, mastitis, loss of production, and mortality (Sohier *et al*., 2019). This is a new, extremely hazardous disease rapidly spreading in many developed and under developing countries including Pakistan (Sajid *et al*., 2012). It is primarily spread by biting mechanism of certain species of mosquitoes, flies, and ticks (Moller *et al*., 2019).

LSD has been referred to be a "neglected disease" on a worldwide scale and the majority of their outbreaks occur during the rainy season from also *A. aegypti* is an effective mechanical vector to spread infection (Calistri *et al*., 2020). Early findings have also confirmed that, the virus is spread by tainted feed, contaminated water, and intrauterine transfer direct contact with seminal interferences (Kononov *et al*., 2020). *T.*

*Corresponding author: wali.mangrio@salu.edu.pk

striata and other variety of bird species, insect pests are causative agents to spread LSD (Anthal and Sahi, 2013). Thus, the interaction between herds of cattle, sheep, and goats in grazing/watering regions may increase the mechanical transmission of LSD, currently, this disease triggers an epidemic in Pakistan because of a recent animal's outbreak (Azeem *et al*., 2022). Despite Pakistan historically being devoid of LSDV incidences, more than 20,000 animals have been afflicted in Sindh alone and the majority of instances have been recorded across the province (Awan *et al*., 2022). The prevalence of *Haemaphysalis bispinosa* and *Haematopinus tuberculosis* in cattle reported from Sukkur, Sindh-Pakistan (Sahito *et al*., 2017). Consequently, the people in Pakistan are deeply concerned about the outbreak of LSD, they are unsure whether or not to eat meat (Shalaby *et al*., 2016). LSDV affects the cattle business significantly, and it is difficult to quantify the factors and their effects (Abutarbush and Tuppurainen, 2018).

The proper management, immunization, rigorous quarantine guidelines, and limitations on cattle movement may all work together to successfully stop the spread of the disease (Wallace *et al*., 2020). The use of antibiotic medication, vaccinations, diagnostic services, facility cleaning, and early treatment of animals, different control strategies against vector-borne diseases is the best remedy (Casal *et al*., 2018). Strict quarantine techniques, restriction of animal movement, right way to carcass disposal, cleaning, insect control mechanisms, isolation and slaughter of infected animals and timely vaccination is the most effective means of control in LSDV (Butt *et al*., 2023). The livestock agency has urged owners to often apply anti-mosquito spray and to keep ill animals isolated from healthy ones to safeguard cattle from LSD (Machado *et al*., 2021). Currently, there are no effective or reliable control programs are available to debate about on main causative transmission sources of LSD. However; the present research study might be the step for the control mechanism and informative tool against LSD.

MATERIALS AND METHODS

LSD data collection from different talukas at district Khairpur

Lumpy skin disease outbreaks data were taken at fortnightly interval basis from different talukas of district Khairpur-Sindh situated at 28.8820°C N, 69.0970°E, during April to September 2022. The interviews were conducted from different respondents collectively, who were directly involved in livestock field and their animals were infected with lumpy skin diseases in their respective taluka levels. The data was taken on the LSD rate, causes, mode of transmission, infected cattle's death rate, disease impact on animal's general body appearance, and economic losses. (Kumar *et al*., 2012) the described methodology was followed for LSD data collection. Specifically, the number of LSD-reported cases during April, May, June, July, August, and September, respectively. Further, the data were subjected to analysis of variance among all the standard months from small and large cattle farms in different taluka levels of district Khairpur Mir's.

The age-wise LSD infection in male and female cattle at different talukas

The data about the influence of disease separately in male and female cattle in different months were also kept under observation. The specific age-wise data *viz*., (3-6) months of the weaning stage, (15-25) months of bull and heifer, and (25 and above) months of adult stages were taken throughout the district Khairpur. The data was obtained on a fortnightly basis and average values were marked. Age-specific data was taken for the lowest to highest infection from different age-group animals. The reported maximum and minimum LSD cases data of different age groups in different months were gathered for the purpose to check out the comparison among age-wise gender basis. The reported lumpy skin disease cases data were subjected to analysis by using SWX student package software 8.1 USA. ANOVA of the infected cattle in different talukas found a significant difference at ($P< 0.05$). However, the figures were made with the help of Origin 2017, 64Bit software.

RESULTS

Reported LSD cases from taluka Kot Diji

The geographical distribution outbreaks data of lumpy skin disease was gathered from taluka Kot Diji from April to September 2022. After conducting the interviews from respondents, who were directly involved in cattle livestock fields. It was observed that the maximum outbreak of LSD reported during June at (87.11±3.78), followed by July (84.55±3.77), August (77.25±3.76), May (75.45±3.75), September (65.75±3.74) and April (51.65±3.73)

as shown in (Figure 1). When the data was statistically analyzed found with significant difference at (DF= 5; F= 68.13; P= 0.03) among the standard months. The curve line represents the standard error in the mean data of the LSD cases were reported in different months of the year. It was also observed that the infected cattle animals were also found with a high temperature and less feeding ability up to the seventh day after causing the disease if it was not cured within the time, ultimately causing the mortality in these cattle animals.

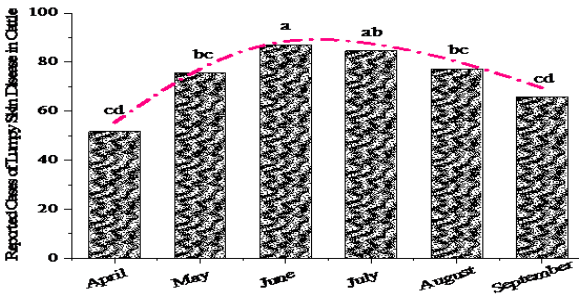

Figure 1. Reported LSD outbreaks Kot Digi in different months, 2022

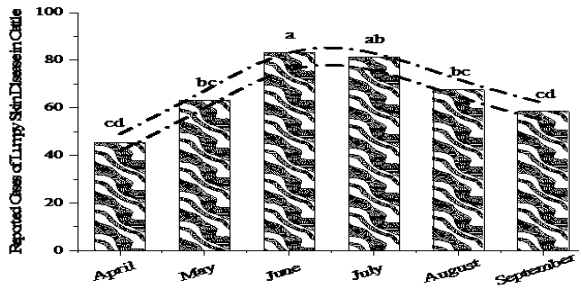

Figure 2. Reported LSD outbreaks from taluka Kingri in different months, 2022

LSD reported cases from taluka Kingri

The data of the LSD in cattle animals were taken throughout the taluka level, from April to September 2022, especially from the rural community as they used to graze on an independent wild pasture and few of them have their proper cattle-kept farms at their villages. The maximum outbreaks of lumpy skin disorder was found in the warmer months such as; June at (83.22±3.65), followed by July (81.35±3.64), August (67.55±3.63), May (63.15±3.62), September (58.45±3.61) and April (45.45±3.59) respectively. It was also observed that the disease as the reported cases of cattle animals gradually went beyond the maximum population affective of cattle animals starting in June. Further, the data showed the statistical differences (DF= 5; F= 56.64; P= 0.00) among the consequent standard months of enlarging the disease outbreaks as the data of reported cases from taluka Kingri, as depicted in (Figure 2).

Reported LSD cases from taluka Gambat

The data on the lumpy skin disease was gathered from different cattle farms and grazing pastures at taluka Gambat, from April to September 2022. The cattle animals were found in maximum and minimum LSD-positive fluctuations throughout the research period. It was observed that during June the maximum number of lumpy skin disease cases has been reported at (77.75±3.35), July (75.85±3.34), August (48.95±3.33), May (43.47±3.32), September (36.15±3.31), and April recorded at (26.65±3.28). Further, the data showed statistical difference (DF= 5; F= 89.78; P= 0.04) among the standard months of reported cases as depicted (Figure 3). During the geographical distribution of infected cattle with lumpy skin disease, it was kept under the observations that, how it enlarges its population among the animals as infected animal to the better health keeping animal.

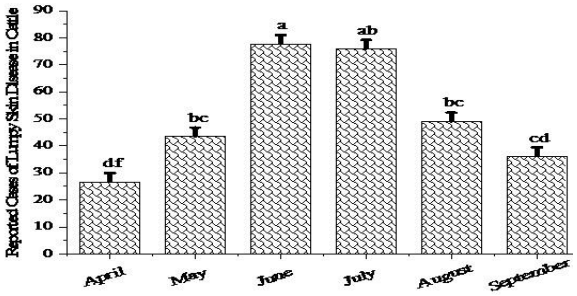

Figure 3. Reported LSD outbreaks from taluka Gambat in different months, 2022

Reported LSD cases from taluka Thari Mirwah

On fortnightly basis geographical distribution eruption data of lumpy skin disease in cattle animals were taken from taluka Thari Mirwah from April to September 2022. When the disease appeared grounds with severe fever, the nodules on the whole body's skin sometimes might be able to lead to bereavement. After

conducting interviews with various cattle respondents regarding the outbreaks of lumpy skin disease in different months of the year, the maximum rate of lumpy skin disorder was reported during June (74.65±3.17) followed by July (71.35±3.16), August (42.35±3.15), May (38.55±3.14), September (25.65±3.12) and April (21.35±3.11), respectively. When the data of the infected cattle with lumpy skin disease was statistically analyzed the ANOVA found with significant difference (DF= 5; F= 78.65; P= 0.02) among the different consequent months as depicted in (Figure 4).

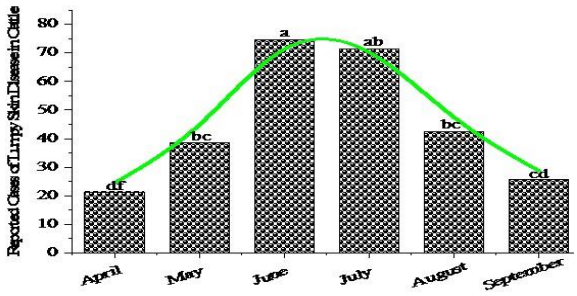

Figure 4. Reported LSD outbreaks from taluka Thari Mirwah in different months, 2022

Reported LSD cases from taluka Faiz Ganj

The geographical distribution data of infested animals containing lumpy skin disorders were taken in different standard months at taluka Faiz Ganj during, April to September 2022. After data collection from the respective taluka, the maximum cases of the disease were reported in June (71.45±2.93), followed by July (68.95±2.95), August (38.75±2.94), May (32.37±2.93), September (21.75±2.91) and April (17.75±2.89), respectively. Further data showed statically difference at (DF= 5; F= 78.45; P= 0.02) among the fortnightly data collected from reported cases in the cattle farming community as shown in (Figure 5).

Reported LSD cases from taluka Sobho Dero

For the purpose to find out the prevalence of lumpy skin disease the data was gathered from different animal vicinity of taluka Sobho Dero and disease outbreaks were reported in many villages of the taluka level from April to September 2022. During, the data collection, it was also noticed that LSD was prolonged with chiefly biting by the insects that might be definite species of flees and flies, mosquitoes, other noxious insects, and probably by the ticks and the mites. The maximum numbers of LSD cases were reported during June (68.55±2.65), July (65.85±2.64), August (33.45±2.63), May (26.65±2.62), September (17.25±2.61) and April (15.25±2.59) in cattle animals. ANOVA of the lumpy skin disease data when subjected to analysis found with significant difference (DF= 5; F= 57.62; P= 0.01) among the fortnightly data of reported cases in different standard months, as shown in (Figure. 6).

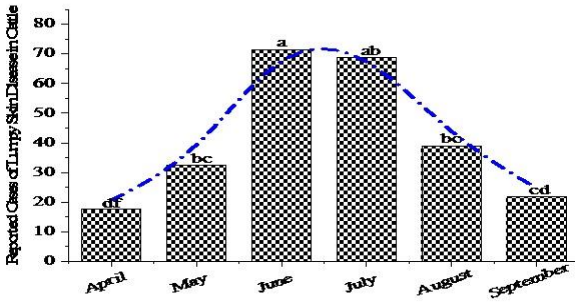

Figure 5. Reported LSD outbreaks from taluka Faiz Ganj in different months, 2022

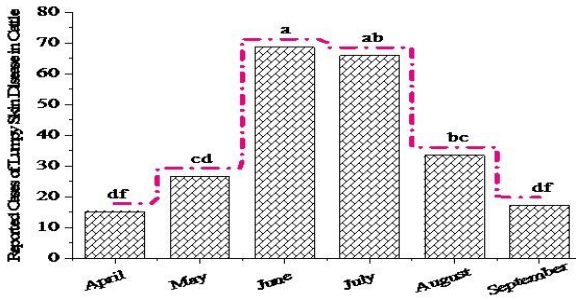

Figure 6. Reported LSD outbreaks from taluka Sobho Dero in different months, 2022

Reported LSD cases from taluka Naro

The data of the lumpy skin disorder from different animal farm hoses, and gazing pastures were gathered in different standard months from taluka Naro, for checking the outbreaks of the disease during, April to September 2022.. It was also noticed, when infected animal grazed in an open pasture with the healthy animal within the herd, it might be transferred through reliable sources from animal to animal. The highest infestation of LSD reported cases was reported in June (58.45±2.36), followed by July (56.65±2.35), August (29.75±2.34), May (21.75±2.33), September (13.75±2.32), and April up to (11.45±2.29), respectively. When the

collected data was statistically analyzed found with significant difference (DF= 5; F= 83.98; P= 0.00), among the different standard months. It was also observed that, it increased its densities in different age wise of cattle animals starting from the veining age to the adults even male and female ones, further justification given in (Figure 7).

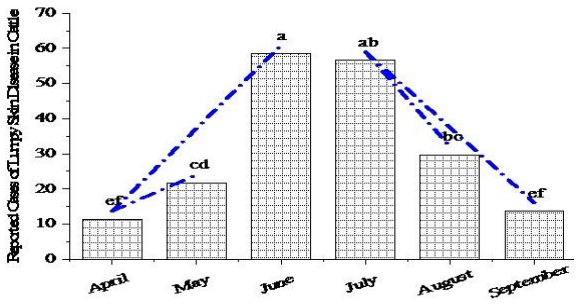

Figure 7. Reported LSD outbreaks from taluka Naro in different months, 2022

LSD reported cases from taluka Khairpur

On fortnightly basis, the data of lumpy skin disease in different months of age-wise were taken through conducting interviews from different respondents, veterinary experts, and microbiologists, who directly engaged in livestock during, April to September 2022. The maximum to the minimum number of lumpy skin disease cases was raised from June at (54.65±3.54), followed by July (51.45±3.53), August (27.35±3.52), May (19.85±3.51), September (11.75±3.49) and April (09.95±3.48), respectively. During the whole period of data collection cattle animals were found with positive prevalence. When the data was statistically analyzed found with significant difference (DF= 5; F= 43.47; P= 0.05) among all the standard months at taluka Khairpur, further justified in (Figure 8).

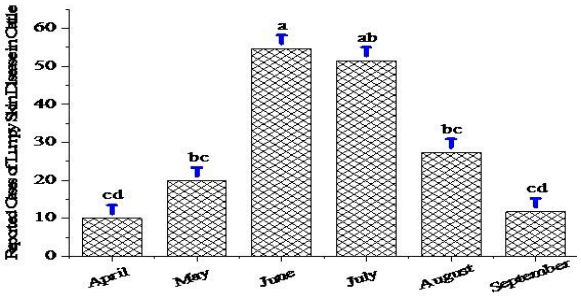

Figure 8. Reported LSD outbreaks from taluka Khairpur in different months, 2022

Overall taluka-wise reported LSD cases in District Khairpur

LSD data from eight talukas of the district were taken through respondents interviews directly who were involved in livestock, experienced veterinary experts, and microbiologists working on the lumpy skin diseases during, April to September 2022. Particularly, the maximum number of LSD reported cases with overall mean from Kot Diji at (73.63±4.11), followed by Kingri (66.53±3.95), Gambat (51.47±3.85), Thari Mirwah (45.65±3.78), Faiz Ganj (41.84±3.57), Sobhodero (37.83±3.85) Naro (31.97±3.55), and Khairpur (29.17±3.25), respectively. When the collected data of the disease-containing cattle were statistically analyzed found with significant difference at (DF= 8; F= 103.45; P= 0.03), among the different standard months from the vicinity of the district. Here, LDS was not reported before but the eruption of the disease was reported first time throughout the district during, 2022 as shown in (Figure 9).

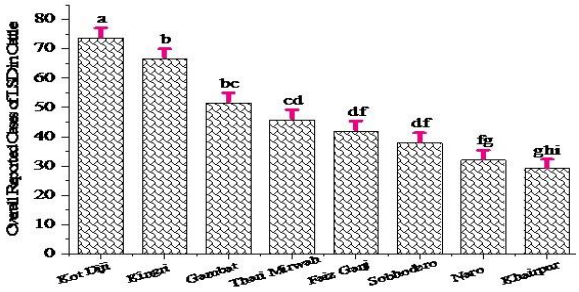

Figure 9. The overall mean reported LSD outbreaks from different talukas of districts Khairpur, 2022

LSD reported cases in male (♂) and female (♀) age-specific groups of the cattle

The influence of disease separately in male and female cattle at the different age wise such as; (3-6) months weaning stage, (15-25) months bull/heifer and (25 and above) months adult stages were observed against lumpy skin disease during, April to September 2022. The infected male or females were kept separated at the farmer's farm, when it was diagnosed with morphological ways in age-specific levels. Age-specific data revealed that the highest infection of lumpy skin diseases was recorded in females (85.35±2.95) compared to males (65.78±3.15), at the weaning stage. However, at the heifer stage, it was reported at (47.67±2.55), and bull stage at (38.47±2.75). LSD cases in adult females at (71.24±3.25), and adult males

(57.00±3.25), respectively. Further, the data showed statically significant difference (DF= 5; F= 27.32; P= 0.02) among the age-wise in gender basis as depicted in (Figure 10).

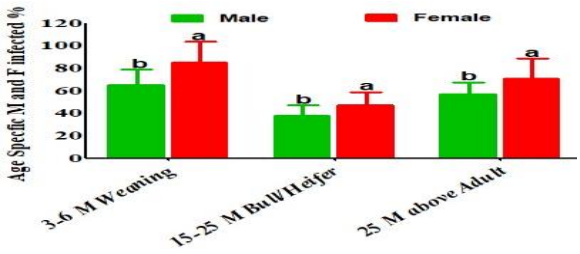

Figure 10. Age-specific reported LSD cases in male and female cattle, 2022

DISCUSSION

The findings of the present study showed that, there was positive prevalence of lumpy skin disease in all vicinities of the district Khairpur Mirs. The different specific age-wise fortnightly maximum data of the infestation was recorded from taluka Kot Diji. It is with the work similarity of (Gari *et al*., 2010) documented that the maximum intensity of the LSD found in older cattle animals in *Bos Taurus,* when it was compared with the *Bos indicus* which might be a relative abundance of biting flies. In taluka Kingri a severe attack of this disease was reported as discussed (Lubinga *et al*., 2013), Tabanidae, Muscidae, Glossina families of arthropods, and few species of hard ticks are also the causative agent of this disease. The increasing overall mean density of the LSD reported from the different locations of the taluka Gambat is to the published work of (Fakhrul-Islam *et al.,* 2017), the affected animals' decreased productivity and lead to the death of calves and young children. The outbreak of the lumpy skin diseases recovered from the cattle animals at taluka Thari Mirwah was justified (Al-Salihi and Hassan, 2015) LSD causes fever at 40 to 41ºC, and nodules on the skin.

The symptoms of this potential disease were also reported from different cattle farmhouses at taluka Faiz Ganj, with similar symptoms reported (Selim *et al*., 2021) additionally, two to seven-centimeter skin nodules on neck portions, tails, and legs immediately onset fever owing to their increased vulnerability infections and probably owing to weakened immune system antibodies, young calves, underweight animals, and nursing cows are more severely affected by the LSDV. LSD caused frequently radish puss-containing nodules on the skin at taluka Sobho Dero as reported (Acharya and Subedi, 2020) firstly assumption was made due to the insect stings and poisoning or an allergy to the skin of the cattle animals. The prevalence causative risk factors of this disorder also reported from the taluka Naro as documented (Calistri *et al.,* 2020), the *Stomoxys spp* of flies, *Aedes aegypti* species of blood-feeding mosquitoes, grazing and infected watering are the mechanical transmission source of this disease. From the taluka Khairpur, minimum cases of this viral disease were repeatedly found during the whole research period as described (Kiplagat *et al*., 2020), the horse flies and stable flies are the causative vector of this potential disease.

The ectodermal vector-borne and helminthological disorders are the destructive agents of live hoods and avifauna as documented (Mangrio *et al*., 2017, 2020, 2021) *Confluria capillaris*, *Hymenolepis mehrabpurensis* n.sp, and *Heterakis pavonis* species of cestodes and trematodes form the Jungle babbler, agro-friendly bird from district Naushahro Feroze. Hence; the flies take a key role to infest cattle through vector carrying from infected animals to healthy ones (Abera *et al*., 2015). It was also noticed that the lesions were found huge in the fetlock region of the cattle animal especially that enlarged within the sub cuts and sometimes to the muscles that underlie the skin of the whole body. In this situation very few animals recovered at calf or heifer stage most of them die.

CONCLUSION

It was concluded that, the highest infection of lumpy skin diseases was recorded weaning stage, followed by 25 months and above in adults, heifer, and bull in female and male cattle animals. It was frequently proved that the animal infected with lumpy skin disease either there was male or female found with fever 41ºC, swelling on legs, that made them unable to walk, increasing of lymph nodes, lameness with anorexia, rounded nodules slightly up raised to 3-4 cm in size, having server pain and those were self ruptured that found with a deep wound. Simultaneously; these nodules wound assaulted to be frequently by the secondary insects and bacterial infection that led to the sloughing and suppuration. During the research study, this disease was found with density increasing its dynamic fluctuation within all talukas of the district. Previously there is no such type of scientific documentary regarding lumpy skin disease and this is the first reported record of

LSD with positive fluctuations from the vicinity of Khairpur Mirs, Sindh.

RECOMMENDATIONS

It is recommended that, affected animals should keep separate from healthy cattle animals because this vigorous disease can eradicate most of the larger cattle farms. Farmers should be reluctant to alert veterinary authorities immediately about potential LSD outbreaks. Priority should be given to further research on the biology of LSDV to determine hypothetical observations that emerged from the novel (recombinant) LSDV. In the overall age-specific disease incidence of different stages of male and female, most of the females might be precaution with already injected with curative doses.

IMPACT STATEMENT

The variety of vector-borne insect species is the causative agent of this potential disease but in Pakistan there is no availability of the scientific record on the epidemiology of LSD. In this context, the present study will be found with a supportive tool in the identification and understanding of certain factors of LSD and the impact of LSDV on the skin of males and females of the cattle herd in district Khairpur, Sindh-Pakistan.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ACKNOWLEDGEMENTS

The researchers of the present scientific study are much thanked the cattle-keeping livestock at their grower's farms for their well-behaved manner.

AUTHOR'S CONTRIBUTION

H. A. Sahito: is the major author of this research article with a key role as point by point supervised the work and gathered support in LSD data collection from different vicinities of the district Khairpur.

S. A. Rid: arranged material for data collection and contacted livestock owners.

W. M. Mangrio: statistically analyzed reported cases of LSD from all talukas and wrote the paper.

F. I. Sahito: conceived, arranged, and designated tools for data of LSD.

N. Qureshi: helped in review the article.

REFERENCES

Abera, Z. H., G. Degefu, Z. Gari and Ayana. 2015. Review on epidemiology and economic importance of lumpy skin disease. International Journal of Basic and Applied Virology, 4: 8-21.

Abutarbush, S. M and E. S. M. Tuppurainen. 2018. Serological and clinical evaluation of the Yugoslavian RM65 sheep pox strain vaccine use in cattle against lumpy skin disease. Transboundary and Emerging Disease, 65 (6): 1657-1663.

Acharya, K. P and D. Subedi. 2020. First outbreak of lumpy skin disease in Nepal. Transboundary Emerging Disease, 67 (6): 2280-2281.

Aleksandr, K., B. Olga, W. B. David, P. Pavel, P. Yana, K. Svetlana, N. Alexander, R. Vladimir, L. Dmitriy and S. Alexander. 2020. Non-vector-borne transmission of lumpy skin disease virus. Scientific Reports, 10: 7436.

Al-Salihi, K. A. and I. Q. Hassan. 2015. Lumpy skin disease in Iraq: study of the disease emergence. Transboundary and Emerging Disease, 62 (5): 457-62.

Anthal, A. and D. N. Sahi. 2013. Food and feeding ecology of Jungle babbler, *Turdoides striatus sindianus* (Ticehurst) in district Jammu (Jammu and Kashmir), India. International Research Journal of Environment Science, 2 (7): 54-57.

Awan, H. A., A. M. Sahito, M. Sukaina, G. Khatri, S. Waheed, F. Sohail and M. M. Hasan.. 2022. Tuberculosis amidst COVID-19 in Pakistan: A massive threat of overlapping crises for the fragile healthcare systems. Epidemiology and Infection, 150 (41): 1-5.

Azeem, S., B. Sharma, S. Shabir, H. Akbar and E. Venter. 2022. Lumpy skin disease is expanding its geographic range: A challenge for Asian livestock management and food security. The Veterinary Journal, 279: 1-16.

Butt, A. I. K., H. Aftab, M. Imran and T. Ismaeel. 2023. Mathematical study of lumpy skin disease with optimal control analysis through vaccination. Alexandria Engineering Journal, 72: 247-259.

Calistri, P., K. De Clercq, S. Gubbins, E. Klement, A. Stegeman, A. Cortiñas and J. A. Broglia. 2020. Lumpy skin disease epidemiolo-gical report IV: Data collection and analysis. EFSA Journal, 18 (2): 6010.

Casal, J., A. Allepuz, A. Miteva, L. Pite, B. Tabakovsky, D. Terzievski, T. Alexandrov and D. Beltran-Alcrudo.2018. Economic cost of lumpy skin disease outbreaks in three

Balkan countries: Albania, Bulgaria and the Former Yugoslav Republic of Macedonia (2016-2017). Transboundary and Emerging Disease, 65 (6): 1680-1688.

Fakhrul-Islam, K. M., M. S. Jalal, S. Podder, M. N. Quader, M. Sahidur-Rahman, A. Dutta and S. Mazumder. 2017. Clinical investigation of foot and mouth disease of cattle in Batiaghata Upazilla veterinary hospital, Bangladesh. Veterinary Sciences: Research and Reviews, 2 (3): 76-81.

Gari, G., Waret-Szkuta, A., Grosbois, V., Jacquiet, P and Roger, F. 2010. Risk factors associated with observed clinical lumpy skin disease in Ethiopia. Epidemiology Infection 138: 1657-66.

Huang, C. W., L. J. Ting, Y. P. Liu, Y. J. Lin, F. Lee and C. J. Chiou. 2022. Complete coding sequence of Lumpy Skin Disease Virus isolated from Kinmen Island, Taiwan, in 2020. Microbiology Resource Announcements, 11 (4): 1-3.

Kiplagat, S. K., P. M. Kitala, J. O. Onono, P. M. Beard and N, A. Lyons. 2020. Risk Factors for Outbreaks of Lumpy Skin Disease and the Economic Impact in Cattle Farms of akuru County, Kenya. Frontiers in Veterinary Science, 7: 1-13.

Kononov, A., O. Byadovskaya, D. B. Wallace, P. Prutnikov, Y. Pestova, S. Kononova, A. Nesterov, V. Rusaleev, D. Lozovoy and A. Sprygin. 2020. Non-vector-borne transmission of lumpy skin disease virus. Scientific Reports, 10: 7436.

Kumar, N., Y. Chander, R. Kumar, N. Khandelwal, T. Riyesh, K. Chaudhary, S. Shanmugasundaram, A. Kumar, K. Kumar, G. Y. Madhurendu, S. K. Pal, S. Barua and B. N. Tripathi. 2021. Isolation and characterization of lumpy skin disease virus from cattle in India. PLoS ONE, 16 (1): 0241022.

Leliso, S. A., F. D. Bari, and T. R. Chibssa, 2021. Molecular characterization of Lumpy Skin Disease Virus isolates from outbreak cases in cattle from Sawena district of Bale Zone, Oromia, Ethiopia, Veterinary Medicine International, 1-9.

Lubinga, J. C., E. S. M. Tuppurainen, W. H. Stoltsz, K. Ebersohn, J. A. W. Coetzer and E. H. Venter. 2013. Detection of lumpy skin disease virus in saliva of ticks fed on lumpy skin disease virus-infected cattle. Experimental and Applied Acarology, 61: 129-38.

Machado, G., F. Korennoy, J. Alvarez, C. Picasso-Risso, A. Perez and K. VanderWaal. 2019. Mapping changes in the spatiotemporal distribution of lumpy skin disease virus. Transboundary and Emerging Disease, 66 (5): 2045-2057.

Mangrio, W. M., H. A. Sahito, T. Kousar, F. A. Jatoi, Y. A. Jamali, S. P. Solangi and N. H. Jakhrani. 2021. Morphotaxonomic characteristic and occurrence of nematode *Heterakis pavonis* from Jungle babbler in tropical region, Sindh-Pakistan. Annals of the Romanian Society for Cell Biology, 25 (7): 1551-1561.

Mangrio, W. M., H. A. Sahito, T. Kousar, Z. Shah, H and F. A. Jatoi. 2020. Morphotaxonomic characteristics of *Hymenolepis mehrabpurensis* N. sp., from (*Turdoides striata*, 1823 Leiothrichidae) of the tropical region, Sindh-Pakistan. Pure and Applied Biology, 9 (1): 979-988.

Mangrio, W. M., H. A. Sahito, T. Kousar, A. Ullah, F. A. Jatoi, Z. H. Shah and B. D. Ghumro, 2017. Pervasiveness and different characteristics of Cestode, *Confluaria capillaris* (Rudolphi, 1810) from Jungle babbler, *Turdoides striata* at Sindh, Pakistan. International Journal of Research Studies in Zoology, 3 (3): 33-43.

Moller, J., T. Moritz, K. Schlottau, K. Krstevski, D. Hoffmann, M. Beer and B. Hoffmann. 2019. Experimental lumpy skin disease virus infection: comparison of a field and a vaccine strain. Archives of Virology, 164: 2931-2941.

Sahito, H A., T. Kousar, M. A. Mughal, W. M. Mangrio, Z. H. Shah, B. D. Ghumro and F. A. Jatoi. 2017. Prevalence of Cattle Lice; *Haematopinus tuberculastus* and Ticks; *Haemaphysalis bispinosa* on Cattle at Region Sukkur, Sindh-Pakistan. International Journal of Research Studies in Biosciences (IJRSB), 5 (11): 1-5.

Sajid, A., Z. Chaudhary, U. Sadique, A. Maqbol, A. Anjum, M. Qureshi, Z. U. Hassan, M. Idress and M. Shahid. 2012. Prevalence of goat poxdisease in Punjab province of Pakistan. Journal of Animal and Plant Sciences, 22 (2): 28-32.

Selim, A., E. Manaa and H. Khater. 2021. Molecular characterization and phylogenetic analysis of lumpy skin disease in Egypt. Comparative Immunology, Microbiology and Infectious Disease, 79: 101699.

Shalaby, M. A., A. El-Deeb, M. El-Tholoth, D. Hoffmann, C. P. Czerny, F. T. Hufert, M.

Weidmann and A. Abd El Wahed. 2016. Recombinase polymerase amplification assay for rapid detection of lumpy skin disease virus. BMC Veterinary Research, 12 (244): 1-6.

Sohier, C., A. Haegeman, L. Mostin, I. De Leeuw, W. V. Campe, A. De Vleeschauwer, E. S. M. Tuppurainen, T. Van den Berg, N. De Regge and K. De Clercq. 2019. Experimental evidence of mechanical lumpy skin disease virus transmission by Stomoxys calcitrans biting flies and Haematopota spp. horseflies. Scientific Reports, 9: 20076.

Wallace, D. B., A. Mather, P. D. Kara, L. Naicker, N. B. Mokoena, A. Pretorius, T. Nefefe, N. Thema and S. Babiuk. 2020. Protection of Cattle Elicited Using a Bivalent Lumpy Skin Disease Virus-Vectored Recombinant Rift Valley Fever Vaccine. Frontiers in Veterinary Science, 7: 256.

(Received: December 21, 2023; Accepted: December 29, 2023)