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FACTORS INFLUENCING AND CONTROL STRATEGIES AGAINST LUMPY SKIN DISEASE THROUGH VACCINATIONS ON BOVINE

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ABSTRACT

This scoping research study was conducted on the epidemiological deadliest lumpy skin disease, caused by encapsulated host-specific vector-borne double stranded DNA, brick-shaped *Capripox virus*. Different vaccines and control strategies were employed on cross breed and local breed cattle species against LSDV in the district, Khairpur Mirs during 2023. The outcome of this study revealed that the maximum infection was noted in cross bread at (79.19) as compared to herd gathering factors (71.50) followed by grazing period factor (62.14), transportation (48.00), chordata animals (13.25), and nib of injection (09.13). As a precautionary treatment, lumpy VAC, lumpy VAX, LSD-dolvit vaccine, and neem oil were used against LSD in (n=365) normal cattle. Similarly, vaccines namely; dectron, ketoject, teragen, and pencilline+dettol were used in (n=361) cattle containing signs and symptoms of LSD. The main LSD causative agents reported mosquitoes, houseflies, and ticks, transmitting germs from infected to healthy cattle breeds. In conjunction with the LSD threats, epidemiological studies, isolation, identification, etiology, transmission, diagnosis, proper disposal, and cleaning, are all the control measures. Among them mass vaccination is the administrative approach, and the optimal way can give valuable insight to limit this fast-spreading viral disease. The lumpy VAC and dectron proved to be the best control hence, recommended. These vaccines should be done at the proper dose, time, and schedule for future disease mitigation and management. This study would increase the understanding of livestock owners, field vaccinators, and livestock regulators to deal with this contagious infection at different stages of bovine.

Keywords: *Capripox virus*, lumpy skin disease, lumpy vac, lumpy vax

INTRODUCTION

Geographically, Pakistan is situated at the 30°N, 70°E sub-tropical zone with favorable environmental conditions for the development and transmission of tick-borne diseases that cause problems in the livestock industry in Pakistan (Perveen, 2011). Lumpy skin disease is an arthropod-borne viral disease caused by the lumpy skin disease virus, belongs to the genus Capripoxvirus, and primarily affects cattle (Pruvot *et al.,* 2023). The lumpy skin disease has become a territorial cattle infectious illness that causes great losses in global concern, and massive economic devastation (Akhter *et al.,* 2023). This contagious vector-borne viral disease is known as knopvelsiekte, exanthema nodularis bovis, neethling poxvirus, and pseudourticaria (Baker *et al.,* 2023). LSD is an eruptive, extremely contagious infection found throughout the country and is considered a big problem (Imran *et al.,* 2023). Monkeypox virus is another major issue cause monkeypox disease in Sindh (Jamali *et al.,* 2022). LSD is a highly contagious, transboundary, and fast spreading viral disease causes devastating consequences in the livestock industry in Pakistan, and causes a significant economic threat (Hussain *et al.,* 2024).

The first clinical symptoms of LSD were reported in 1929 in Zambia, but currently, this extremely contagious disease is affecting a large

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portion of Asian cattle at a rapid rate (Luqman *et al.,* 2024). Among Asian countries, LSD outbreak has been reported first from Bangladesh, followed by China, India, Pakistan, and Afghanistan, later to spread Morocco, Algeria, Tunisia, Russia, and Turkey (Whittle *et al.,* 2023). LSD is a fast-spreading infection that could have an economically significant effect in the dairy, beef, milk, cattle export, noticeable reduction in body weight, and milk production (Rouby *et al.,* 2021), causes temporary or permanent infertility and even some time death of cattle's (Makalo *et al.,* 2024). The most likely of LSDV considerable transmitting hosts are flies ticks, mosquitoes, and midges as shown in (Figure 1) and secondary infection sites include kidney, liver, lungs, lymph nodes, embryo, blood, bone, wool, skin, animal by products, effluents, and wastage too (Amenu, 2018). Like this, the helminth population infects visceral organs and causes massive destruction to agro-friendly birds, especially the Jungle babbler (Sahito *et al.,* 2020; Mangrio *et al.,* 2017). The long humid and intense hot weather is responsible for activity and vector multiplication, autumn, low marshy land, and rainy summer epidemiologically more in favor of LSD (Malatu and Feyisa, 2018).

The early signs and symptoms include fever, increased lachrymation, and onset of fever, approximately 1-6 cm in diameter nodules appear on the animal's entire body then infected cattle release saliva, severe anorexia, and lameness (Datten *et al.,* 2023). The acute form is more severe with high pyrexia, depression, nasal discharge, swollen enlarged lymph nodes, mucous membrane, internal organ edema, hardness, rhinorrhea, infertility, abortion, morbidity, and occasionally even death (Tuppurainen and Qura, 2012). The nodules are usually spread all over the body, irregular, round, raised, hard with erected hairs, and at chronic stage, nodules develop into necrotic cores and may exude serum with a creamy gray to white appearance (Mathewos *et al.,* 2022). The nodules affect dermis and epidermis, skin of the neck, head, udder, genitalia, limbs, head, mucous membrane, internal organs, back, legs, perineum, eyelids, scrotum, nasolacrimal mucosa, lower ear and tail (Malatu, 2018), upper respiratory tracts, lips, tongue dorsum, cutaneous tissue, testicles and limbs (Tageldin *et al.,* 2014). LSD has an economic impact through poor quality of hides, meat, milk reduction, and abortion in case of bull infection leading to temporary or permanent infertility depending on host immunity (Tamire, 2022). The viable LSD controlling approach is vaccination, quarantine of sick animals, movement restrictions, tracing, surveillance, timely diagnosis, vector management, keeping separate infected animals from the rest of the herd, wisely trade transmission, avoiding sharing of feeding drinking troughs and proper treatment are the best preventive measures (Saltykov *et al.,* 2022). The main objective of this study is to find out the LSD causative agents and the application of different vaccines as precautionary measures to infected cattle breeds. The introduction of precautionary treatments with proper dosages, time and schedule is the best remedy for the conservation and augmentation of cattle breeds.

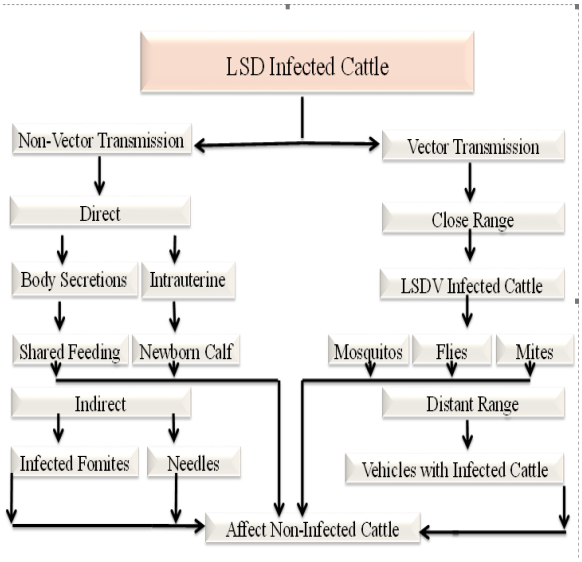

Figure 1. Transmission of LSDV through vector and non-vector

MATERIALS AND METHODS

A total of (n=365) normal and (n=361) LSD infected cross breed and local breed cattle, *Bos taurus* L. cloven hooved were observed for prevalence of lumpy skin disease from district Khairpur. The bovidae LSD infectious data was gathered at fortnightly interval basis from different talukas namely; T_1= Kingri, T_2= Khairpur, T_3= Kot Diji, T_4= Gambat, T_5= Sobho Dero, T_6= Thari Mirwah, T_7= Naro, and T_8= Faiz Ganj. The data was gathered from June to November 2023 and replicated six times. The study area as shown in map of Sindh (Figure 2), is situated at 27.5256°N, latitude and 68.7551°E longitude.

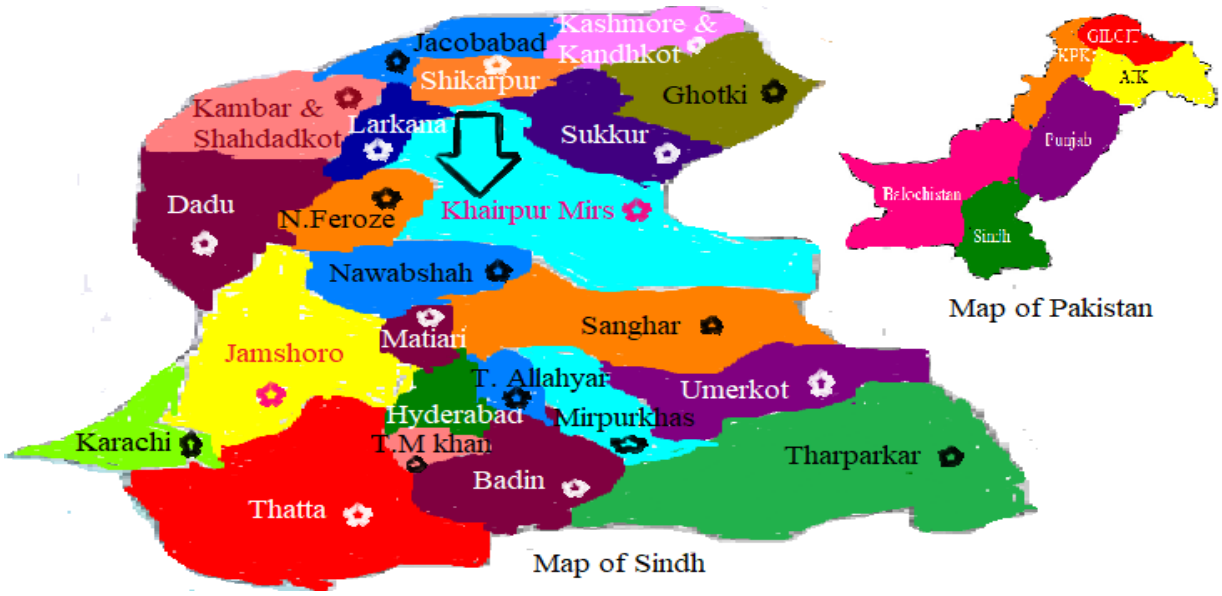

Figure 2. Aero in the map of Sindh shows the study area

Lumpy skin disease transmission factors in cattle breeds

Intensive attention was given to LSD spreading factors *viz.,* mosquitoes, houseflies, and ticks that carry the infectious germs from infected cattle to healthy cattle. The maximum and minimum infestations of LSD from the causative agents were noted in cross breads and local breads. The data was taken individually on fortnightly basis from the respondents by conducting interviews, personal experience, livestock veterinary experts, assistants, and technicians working on lumpy skin diseases at their respective district levels. The second source of the disease was also kept under observation in the herd, where infected and healthy cattle were to gather for grazing, resting, and spending time to furnish authentic results. Consequently, the partial sources of the disease were also kept under observation by treatment source or nib of injection.

Preventive efficiency of LSD vaccines

The efficiency of different vaccines against the lumpy skin disease virus has been applied as preventive measures. The age-specific variability in healthy cattle were selected for the precautionary treatment to determine the efficiency of vaccination in cattle herds. A total (n=365) of normal cattle were treated as T_1= Lumpy VAC (Turkey), T_2= Lumpy VAX (England), and T_3= LSD-Dolvit (Turkey) vaccines, including T_4= Neem oil massage as preventive measures against LSDV. After vaccination, the observations were made after the 15th, 30th, 45th, 60th, 75th and 90th days' on a fortnightly basis, respectively.

Curative efficiency of LSD vaccines

The efficiency of different vaccines as curative against lumpy skin disease virus was treated after the outbreak of LDS. The infected animals were kept at the same time of research conducted for the preventive measures. For this purpose, (n=361) cattle were vaccinated through T_1= dectron, T_2= ketoject, T_3= teragen spray, and the fourth T_4= penicillin+dettol. Finally, the LSDV reported data from the cross breeds and local breed herds were subjected to analysis, and mean values were compared to the LSD test using statistical analysis software, SXW-8.1, USA. The analysis of variance in different age-specific infected cattle found significant differences at (P< 0.05). The figures were made with the help of Origin 2017, 64Bit software.

RESULTS

Lumpy skin disease transmission factors in cross breeds and local cattle breeds

The obtained results of the research studies were confined to reliable and primary factors (mosquitoes, houseflies, ticks and other factors) are responsible for transferring the LSD to cattle. Through different ways, certain factors seemed

to transfer the LSD by carrying the infection germs from infected to healthy cattle. The study showed that the maximum infection of disease spread through arthropods (93.25) in cross breeds compared to (65.10) local breeds. Further, a second source of LSD was observed in herd where all infected and healthy cattle were gathered for feeding, resting, and spending time within the herd, and maximum cases were reported to cross breed (82.56) as compared to local breed (61.70). Furthermore, LSD spread during the grazing period at highest in cross bread (78.10) as compared to local bread (46.45). The transportation also proved the spreading sources of LSD with maximum rate of infection in cross breeds (59.15) followed by (37.25) in local breeds. The chordates to be seen in LSD spreading maximum in (21.45) cross breeds and (06.34) local breeds. The partial sources of LSD have been revealed as treatment or the same nib of injection with maximum infection in (12.78) cross breeds compared to (06.10) local breeds, as shown in (Table 1). When the infection reported, data was subjected to analysis, ANOVA found significant difference (DF= 1; F= 1.43; P=0.25) among both species of cattle's also significant difference (DF= 5; F= 7.09; P= 0.16) in LSD spreading factors.

Table 1. LSD transmitting factors on specific cattle breeds at Khairpur Mirs, 2023

Factors	Cross Breeds	Local Breeds
Arthropoda	93.25±03.35	65.10±11.50
Chordata	21.45±05.34	06.34±10.10
Grazing	78.10±10.46	46.45±07.45
Transportation	59.15±8.45	37.25±09.50
Herd	82.56±16.78	61.70±14.40
Vaccination	12.78±03.10	06.10±01.10

Overall LSD spreading factors in both species of cattle breeds

The overall mean value of the LSD infection rate between two cross breed and local breed species of cattle were marked as findings in Figure 3. This study showed that the major LSD carrier agents are arthropods (mosquitoes, houseflies, ticks), with the mean infection recorded (79.19), compared to herds that were transferred disease (71.50). The grazing factor was observed (62.14), compared with the transportation factor (48.00). The chordates also proved to be a spreading source of LSD (13.25) and this infection also speeded through contaminated sharing of syringes (09.13) at mean value among the cattle.

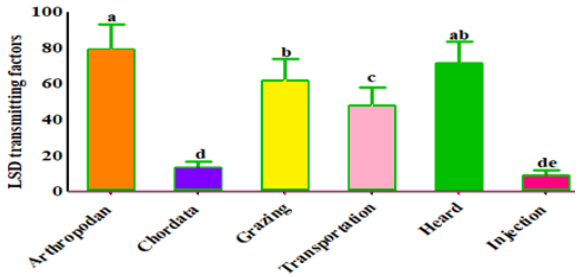

Figure 3. Overall mean infection value of LSD transmitting factors on cattle breeds, 2023

The efficacy of different vaccines against LSD infection

A total of (n=365) normal cattle animals were treated as precautionary treatment with three different vaccines, including neem oil message to examine their potential efficiency against lumpy skin disease. For this purpose (n=90) cattle were selected and treated lumpy VAC (Turkey) and no LSD signs and symptoms were seen till the 75th day but before the reach of 90th days only (n=02) cattle were found suspected of infection at (02.22%), the (n=88) cattle were reported as normal at (97.77%), respectively. Another vaccine, lumpy VAX (England) was medicated to (n=88) cattle. From the first fortnightly observation, cattle were found with positive symptoms of disease, and total (n=09) cattle were found with LSD positive at (10.22%), and (n=79) cattle were found as healthy at (89.77%). LSD-Dolvit (Turkey) vaccine was tended to (n=92) cattle, after administrating a dose of the vaccine for up to 15th days no infection was observed but gradually found till 90th days of observation, a total (n=13) cattle were based on signs and symptoms at (14.13%) and (n=79) as normal at (85.86%). The botanical pesticide neem oil was treated as a precautionary purpose in (n=95) cattle but fluctuations of disease symptoms were recorded and gradually increased up to 90th days and (n=27) cattle were reported as suspected at (28.42%), 68 normal at (71.57%), respectively as shown in Figure 4.

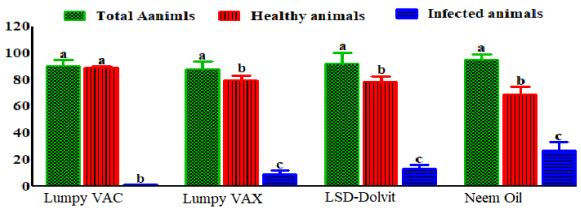

Figure 4. Overall mean efficacy of vaccines and neem oil against LSD, 2023

The curative potential of vaccines after the outbreak of LSD in both species of cattle breeds

A total of (n=361) LSD infected cattle were treated with three different vaccines and penicillin+dettol. It was used to evaluate their control efficacy against lumpy skin disease. The result revealed that after the active outbreak of LSD infection (n=95), cattle were treated with dectron ICI, after the 15th day (n=2), 30th day (n=4), 45th day (n=6), 60th day (n=9), 75th day (n=11), 90th day (n=15), and overall (n=47) cattle were found as normal at (49.47%), and (n=48) cattle were reported as un-recovered at (50.52%). The ketoject vaccine treated (n=92) cattle, after the 15th day (n=2), 30th day (n=3), 45th day (n=4), 60th day (n=5), 75th day (n=8), 90th day (n=9), and overall (n=31) cattle's found LSD infection free at (33.69%) and (n=61) with positive prevalence at (66.30%). Teragen Spray (Japan) were applied (n=84) cattle, after 15th day (n=1), 30th day (n=2), 45th day (n=3), 60th day (n=5), 75th day (n=6), 90th day (n=8), and overall infection recovery found (n=25) cattle's at (29.67%) and (n=59) with LSD signs and symptoms at (70.23%). A total of (n=90) LSD signs and symptoms containing animals were treated with the penicillin+dettol, after 15th day (n=1), 30th day (n=2), 45th day (n=3), 60th day (n=4), 75th day (n=6), 90th day (n=7), and overall (n=23) cattle were reported infection free at (25.55%) and (n=67) cattle with LSD signs and symptoms at (74.44%), respectively as justified in Figure 5.

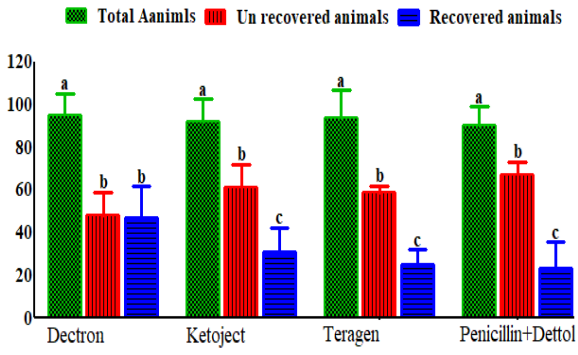

Figure 5. Overall mean efficiency of different treatments as curative against LSD

DISCUSSION

Livestock is the major uplifting industrial sector with a significant role in Pakistan, but recently LSD has been a burning issue of this pivotal sector. The demand of agricultural products and cattle is increasing, but current monetary and environmental policies have made it a typical challenge for developing nations like Pakistan to sustainable growth, and enhancement of food security and resources. The research studies were conducted on LSD, and its management techniques, and it was recorded that the maximum viral infection is spread by arthropods in cross breeds and local breeds as reported (Tuppurainen *et al.,* 2017) the direct or indirect contact of the arthropods is the most effective way for LSDV virus to spread but primarily spread through blood feeding arthropods. (Sahito *et al.,* 2017), reported *Haematopinus bispinosa* and *Haematopinus tuberculatus* tick species infecting cattle in district Sukkur, the adjoining area of the present study. In this study, chordata, grazing, and transportation were reported as spreading sources of LSDV. (Pandey *et al.,* 2022) documented this contagious disease can spread by long-distance transmission of infected asymptomatic animals and vectors during trade. Herd and unsterilized vaccinations can spread this illness, it is with the work agreement of (Hamdi *et al.,* 2021), the contaminated water troughs, feed, close contact, saliva, semen, nodules, mucous membrane of the eyes, mouth, nose, udder, rectum, ulcerate and genitalia all are significant viral transmission sources. Likely, LSD infection in cattle animals, helminths in farmer-friendly birds (Mangrio *et al.,* 2020), and hepatitis B and C among stroke patients caused negative impacts in study adjoining areas (Jamali *et al.,* 2023).

The results further indicated that a total of three vaccines including neem oil were used for prevention and lumpy VAC proved with maximum efficiency. Another group of curative vaccines were used and decotron vaccine found best control against LSD (Sikandar *et al.,* 2024). It is imperative to minimize the infection containing animals with proper diagnosis and vaccination treatment is the most efficient method to combat this contagious illness. Furthermore, the result revealed that evaluating the efficiency of different vaccines as prevention of lumpy VAC and curative by the dectron injection produced the best recovery. The outbreak of was LSD reported from all talukas of the district, as documented (Sahito *et al.,* 2023), with overall mean positive LSD cases from the same district, and maximum infection observed in female cattle at the weaning stage compared to males. Without effective collaboration between participants and cattle farmers in cattle

value chain concerns, LSD control cannot be accomplished effectively. The cattle farmers need to be educated, restrict the movement of infected cattle, apply ectoparasite control measures, routine monitoring of sick cattle, veterinary students, professionals, herdsmen, and cattle merchants, raise awareness of public and private veterinarians. Regular awareness campaigns among cattle farmers, stakeholders, livestock workers, application of chemical agents, insect repellents, robust and well-defined biosecurity policies, social and print media, radio and television, all are effective ways to combat against this disease.

CONCLUSION

This study aimed to examine the epidemiological and risk factors for LSD infection data, diagnosis, treatment, and control methods to stop illness from spreading as well as to explore future management possibilities against LSD. During the evaluation of LSD, the arthropods, chordates, grazing, transportation, and herd were proved the main diseases transmitting causative factors among local breeds and cross breeds. The lumpy VAC, (Turkey), lumpy VAX (England), LSD-dolvit and neem oil treatments were applied as precautionary purposes. While as, cattle breeds were treated to dectron, ketoject, teragen spray, and pencilline+dettol. From all treatments lumpy VAC and dectron proved with best treatments hence recommended. In this essence, the present findings are significant regarding the distribution, surveillance, comparisons, and vaccinations for better control measures in the vicinity of district Khairpur Mir's.

RECOMMENDATIONS

It has been frequently observed that arthropods are the causative agents of transmitting LSD to cattle breeds, hence affected animals should be kept separate from healthy ones. It is recommended and immediately needed to introduce holistic approaches to prevent the animals on a priority basis before the outbreak of this fatal disease.

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NOVELTY STATEMENT

Khairpur Mirs is the 2nd largest district of Sindh by land area. Mostly the people of this are engaged in livestock and agriculture as their main source of livelihood. Unfortunately, the majority of people are less aware of the destructive hazards of epidemic diseases. In this context, this study will be helpful in timely information and sustainable control against LSD.

AUTHOR'S CONTRIBUTION

W. M. Mangrio: Is the prime author of this research article, who vaccinated healthy cattle as precautionary treatment and wrote the paper.
S. A. Rid: Observed infected cattle's for pre-treatment and post-treatment, supervised, visualization throughout the study period.
H. A. Sahito: Applied treatment to LSD infected cattle and recorded recovery and non-recovery data.
F. I. Sahito: Formally analyzed data, performed conceptualization, methodology, software, validation, methodology, data curation, conceived, arranged, and designated tools.
A. H. Mastoi: Participated in data collection, helped in proof reading and final editing.

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