International Journal of Innovation Scientific Research and Review
Vol. 04, Issue, 11, pp.3562-3574, November 2022
Available online at http://www.journalijisr.com
SJIF Impact Factor 4.95

IJISRR

ISSN: 2582-6131

Research Article

OUTBREAK OF LUMPY SKIN VIRAL DISEASE OF CATTLE AND BUFFALO IN INDIA IN 2022: ETHNOVETERINARY MEDICINE APPROACH

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Received 16th September 2022; Accepted 17th October 2022; Published online 21th November 2022

ABSTRACT

This literature review paper highlights the recent outbreak of **Lumpy Skin viral Disease** (LSVD) affecting thousands of dairy cattle and domestic water buffaloes in **India** in **2022**. **Lumpy Skin Disease** (LSD) was first time reported from **India** in **2019** and second outbreak is recorded in **2022** has emerged as a challenge for the dairy sector. A lump like **nodules** in the external skin and mucous membrane with fever and swollen lymph nodes are the preliminary noticeable clinical signs of this devastating disease. Lumpy skin disease (LSDV) is caused by the **double - stranded DNA** virus belongs to genus **Capripoxvirus** and family **Poxviridae**. Lumpy Skin Disease (LSD) is not **zoonotic** infecting cattle's but not humans. **Lumpy Skin Disease** (LSD) is a contagious vector-borne disease spread by the vectors like mosquitoes, some biting flies, and ticks. The **hallmark feature of LSD** is the **skin lesions** with **nodules**. **Vaccination** along with strict quarantine measures and vector control could be effective for preventing the spread of the disease. In India, the **Goat Pox Virus Vaccine (**GTPV) **Uttarkashi strain** is being evaluated for the level of protection against **Lumpy Skin Disease** (LSD) as compared to the LSDV vaccine and is already used for **emergency vaccination**. **Ethno veterinary** practices concern to animal healthcare is as old as the domestication of various livestock species. There is a rich and efficient ethno veterinary traditions exist in the villages of **India**. However, ethno-veterinary medicines are often not as fast-working and potent as allopathic medicines. Therefore, **Ethno-veterinary** medicines may be less suitable to control and treat epidemic and endemic infectious diseases. **Ethno-veterinary** medicines have promising potential and are widely used, many of them remain untested and their use also not monitored.

Keywords: Buffaloes, Cattle, Ethno-veterinary, India, Lumpy Skin Disease, medicinal plants, Skin lesions with nodules, Viral infection.

INTRODUCTION

Lumpy Skin Disease (LSD) is an infectious disease in cattle and Asian water buffalo caused by Lumpy Skin Disease Virus (LSDV) belongs to the family **Poxviridae** (1-26). **Lumpy Skin Disease** (LSD) was first time reported from **India** in 2019. In India, currently epidemiological status of the disease is unknown (2, 6, 10, 17, 19, 20, 21, 26). Vaccination along with strict quarantine measures and vector control could be effective for preventing the spread of the disease (2, 6, 10, 17, 19, 20, 21, 26). **Lumpy skin disease** (LSD) is not a **zoonotic virus** which means that the disease can not spread to humans (1-26). Humans are also resistant to the virus (1-26). Lumpy skin disease (LSD) is a trans-boundary animal viral disease which causes considerable financial losses to the livestock industries (2, 6, 10, 17, 19, 20, 21, 26). It is a **contagious** vector-borne disease spread by vectors like **mosquitoes**, some biting flies, ticks and usually affects host animals like **cows** and water buffaloes (1-26).

A **lump like nodules** in the external skin and mucous membrane with fever and swollen lymph nodes are the preliminary noticeable clinical signs of this devastating disease (2, 6, 10, 17, 19, 20, 21, 26). The characteristic **nodular** skin **lesions** appear on head, neck, chest, abdomen, perineum, genitalia, udder and limbs. The centre of the lesion often ulcerates with time and a scab forms on top (1-26). It is commonly an **arthropod-borne** contagious illness, correspondingly the non-vector spreading through body discharge and infected fomites (2, 6, 10, 17, 19, 20, 21, 26). The incubation period ranges from **one to four weeks** leading to viremia (1-26). A pronounced socio-economic collapse is driven by reduced quantity and quality of milk, udder infection, thinness, low quality hides, loss of draught power, abortion, infertility, limitation to meat ingestion, higher morbidity, etc. Animals of any age and gender are susceptible to the disease (1-26).

The recent unprecedented spread of Lumpy skin disease virus (LSDV) in **India** and several other countries has highlighted the need for better research efforts into this rapidly emerging pathogen (2, 6, 10, 17, 19, 20, 21, 26). The disease has already spread to several Indian states *viz*; Karnataka, **Rajasthan, Gujarat,** Punjab, Haryana, Uttar Pradesh Kerala, Tamil Nadu, Andhra Pradesh, Telangana, Odisha, Jharkhand, West Bengal, Assam, Chhattisgarh, Maharashtra and Madhya Pradesh of the country and has caused considerable economic losses to the **livestock** industry (1-26).

Lumpy Skin Disease Virus (LSD): 2022- Outbreak in India

Lumpy skin disease (LSD) is caused by the lumpy skin disease virus (LSDV) is an **OIE notifiable**, vector-borne disease of cattle and Asian water buffalo that causes substantial economic losses (1-26). Its name originates from the clinical presentation of the disease generally associated with the appearance of **skin nodules** that may cover the entire body of the animal during severe infection (1-26). The recent Lumpy skin disease virus (LSD) introductions in Asia are of concern as India, China and Bangladesh have some of the world's **largest bovine populations** (2, 6, 10, 17, 19, 20, 21, 26).

The current outbreak of Lumpy Skin Disease Virus (LSDV) in more than **15 Indian states in 2022** has emerged as a challenge for the dairy sector (2, 6, 10, 17, 19, 20, 21, 26). India is the **world's**

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largest milk producer at about **210 million tones** annually. The spread of the disease can lead to substantial and severe economic losses to the dairy sector in India in 2022 (1-26). However, the large portion of milk in Asia is processed. After collection, the milk is either pasteurised or boiled or dried to make milk powder (1-26). This process ensures that the virus is inactivated or destroyed (2, 6, 10, 17, 19, 20, 21, 26). The Indian Veterinary Research Institute (IVRI) notified that it is safe to consume the milk from cattle infected by Lumpy Skin Disease (LSD) since the disease is a **non-Zoonotic** which will not infect human beings (1-26).

India has the **largest headcount of cattle and buffalo** worldwide. Asia is a major pillar for cattle and buffalo production globally, being home to more than **650** million head of cattle and buffaloes, accounting for about 39 percent of the global stock (1-26). Most are concentrated in South, Southeast, and East Asia. **India** has the largest number with nearly **300 million head**, followed by China (approximately 90 million), and Pakistan (approximately 85 million) (2, 6, 10, 17, 19, 20, 21, 26). The long porous borders between India, Nepal and Bangladesh allowed for a significant amount of bilateral and informal animal trade, including cattle and buffaloes (1-26). This may have favored the spread of Lumpy Skin Disease (LSD) in **July–August 2019** between **Bangladesh** and **India** (2, 6, 10, 17, 19, 20, 21, 26). The reasons of the disease spread to **India are unknown** but it may be due to livestock movement across international borders or may be due to **vectors movement** from the neighboring countries (1-26). In first published report of Lumpy skin disease (LSD) outbreak in India in 2019, it was found that out of 2539 animals, 182 were positive with no mortality but 7.1% morbidity (2, 6, 10, 17, 19, 20, 21, 26). On the basis of phylogenetic analysis, the strain present in **India** was genetically close to **South African** NI2490/KSGP-like strains rather than European strains (1-26).

The current outbreak has started in **Rajasthan, Gujarat** around July 2022, and had spread to Punjab, Himachal Pradesh, Andman and Nicobar Island, Uttarakhand, Jammu and Kashmir, Uttar Pradesh, Madhya Pradesh, Haryana, Jharkhand, New Delhi, Maharashtra, Karnataka, Tamil Nadu state of India (1-26). Lumpy Skin Disease Virus (LSDV) has infected nearly **18 lakh cattle's** in **250** districts of India as of October 20th 2022. Further, **1, 50, 000 cattle** have been found infected with viral disease which has killed **75, 000** cattle mostly cows have been reported from **Rajasthan, and Gujarat states of India.** The morbidity of the disease varies between 2 to 45% (1-26). Furthermore, mortality or death rate is less than 10%. However, the reported mortality of the current outbreak in India in 2022 is up to 15% particularly in cases reported in the **western** part of **Rajasthan state**, India (1-26). In Rajasthan state, which is witnessing the **worst impact of lumpy skin disease in 2022** has reduced the milk production which is decreased by about **3 to 6 lakh litres a day**. In addition to this, milk production has also gone down in Punjab owing to the spread of the Lumpy Skin Disease (LSD) (1-26). The disease leads to **reduced milk production** as the animal becomes weak and also loses **appetite due to mouth ulceration** (1-26).The income losses can also be due to poor growth, reduced draught power capacity and reproductive problems associated with abortions, infertility and lack of semen for artificial insemination (2, 6, 10, 17, 19, 20, 21, 26). Lumpy skin disease has led to serious economic losses in affected countries. The disease causes a considerable **reduction in milk yield** (from 10% to 85%) due to high fever and secondary mastitis. Other consequences of the disease include damaged hides, decline of the growth rate in beef cattle, temporary or permanent infertility, abortion, treatment and vaccination costs and death of infected animals (1-26). Clinically, all classical symptoms of Lumpy skin disease virus (LSD) *viz*; fever, generalized **skin nodules**, enlargement of **lymph nodes**, anorexia, oedema of legs and lameness were observed in most of the cases observed in the outbreak in **Ranchi** (India) (2, 6, 10, 17, 19, 20, 21, 26). Disease was not observed in **buffaloes**; however, a deer exhibited skin nodules. Cattle movement and trade bans after infection also put an economic strain on the whole value chain (1-26).

Lumpy Skin Disease Virus (LSD): Geographic distribution

Lumpy Skin Disease (LSD) was detected and diagnosed for the first time in **Zambia in 1929** and then reported in several regions of African countries (2, 6, 10, 17, 19, 20, 21, 26). The disease was considered as a case of poisoning or hypersensitivity reaction for **insect bites** as per the abundance of biting insects at that time of year. The degree of infectiousness was first documented when it struck Zimbabwe, Botswana, and the Republic of **South Africa** from 1943 to 1945 (1-26). Primarily the disease was endemic in most Sub-Saharan regions of Africa, consequently extent to Middle East, Europe, and Asia. The disease was constrained to Sub-Saharan Africa till 1986 (2, 6, 10, 17, 19, 20, 21, 26). Outside this region, the first LSD outbreak occurred in Egypt in 1988, followed by Israel in 1989. The disease hit the Middle Eastern countries since 1990 including Kuwait (1991), Lebanon (1993), Yemen (1995), United Arab Emirates (2000), Bahrain (2003), and Oman (2010) (1-26). Subsequently, outbreaks were reported in Jordan, Iraq, and Turkey in the year 2013, and Iran, Cyprus, and Azerbaijan in 2014. In 2016, along with Saudi Arabia, Russia, Armenia, Georgia, and Kazakhstan, LSD was also pronounced in South-Eastern European countries, namely Greece, Bulgaria, North Macedonia, Serbia, Kosovo, Albania and Montenegro (2, 6, 10, 17, 19, 20, 21, 26). In Russia, Lumpy skin disease virus (LSD) appeared for the first time in 2015 and continued until 2019. Recently devastating effects of the disease has been reported in significant number of **Asian countries** and the initial source of the virus spread has yet to be determined (1-26). Therefore, the elevated risk of the spread of disease into the rest of Europe and Asia should be considered. Since the year 2000, it spread to several countries of the Middle East and was confirmed in Turkey in 2013 (1-26).

According to the OIE, **India** in **2019** faced three primary outbreaks of Lumpy skin disease virus (LSDV) at **Mayurbhanj district** in the state of **Odisha**, followed by one incursion each at four more districts, bringing the total number of outbreaks in the Eastern share of the country (2, 6, 10, 17, 19, 20, 21, 26). There were **182** clinically affected among **2539 susceptible animals** accounted for the apparent morbidity rate 7.1% with no recorded mortalities (1-26). In terms of districts affected, **Cuttack** displayed the highest morbidity rate of 38.34%, and **Kendrapara** showed 0.75% (2, 6, 10, 17, 19, 20, 21, 26). Almost after a year pause, **Nepal** encountered its first outbreak of **Lumpy skin disease virus** (LSDV) at June, 2020 in some adjoin cattle farms at **Morang** bordered by India (1-26). Consequently, few other districts were affected throughout July **2020.** All the external **nodule** samples (34 samples) reacted positive to RT-PCR and no information available of animal death (2, 6, 10, 17, 19, 20, 21, 26).

Currently, a substantial part of South-East Asian animal is becoming affected at a fast pace by the highly contagious disease, LSD (1-26). The first land in the continent of Asia to report an occurrence of Lumpy skin disease virus (LSDV) was **Bangladesh** (2, 6, 10, 17, 19, 20, 21, 26). According to the situation report of OIE and recent scientific articles, there are eight countries in this defined region reporting the outbreak of the disease including Bangladesh, China, India, Nepal, Bhutan, Vietnam, Hong Kong and Myanmar until the investigation is conducted (2, 6, 10, 17, 19, 20, 21, 26). **Chattogram** has still been found as the highest **prevalent area** in **Bangladesh** reporting 23% morbidity among cattle (1-26). In the South-Eastern part of Asia, the disease has first been introduced in Bangladesh in July 2019 followed by China, India, Nepal, Bhutan, Vietnam, Hong Kong and Myanmar (2, 6, 10, 17, 19, 20, 21, 26).

Bangladesh recorded the maximum attack rate in **Chattogram** whereas at **Cuttack** in India (1-26). Particular vulnerable locations of other countries are yet to be confirmed. There is no **epidemiological** proceeding considering the present Lumpy skin disease (LSD) situation report from rest of Asia (1-26). Strict **quarantine, vector control**, and prophylactic **vaccine** might be the **best remedy** for limiting the risk factors of the disease (2, 6, 10, 17, 19, 20, 21, 26).

On the 3rd of August 2019, **China** became the second country in Southeast Asia to have an epidemic. Based on OIE situation portal, five more countries in South-East Asia namely Taiwan, Bhutan, Vietnam, Hong Kong and Myanmar had been attacked by the Lumpy skin disease virus (LSDV) (2, 6, 10, 17, 19, 20, 21, 26).

Lumpy Skin Disease Virus (LSDV) : Double- Stranded DNA Virus

Lumpy skin disease virus (LSDV) is a **double- stranded DNA** containing around 151 kilobase pairs (kbp) with relatively large sizes (320 x 260 nm), enclosed in a lipid **envelope** belongs to genus **Capripoxvirus** and family **Poxviridae** (1-26). LSDV is a brick shaped **enveloped virus** and have complex symmetry and replicates in cytoplasm of the host cell. LSDV contains 30 structural and non-structural genes homologous to sheeppox and goatpox virus sharing **97% nucleotide** identity (2, 6, 10, 17, 19, 20, 21, 26). Therefore, **Capripoxvirus** is genetically related to the **sheep pox** (SPPV) and **goat pox** (GTPV) viruses (1-26). Smallpox and monkeypox virus are also belongs to the genus **Capripoxvirus. Lumpy skin disease** (LSD) shares **antigenic similarities** with sheeppox virus and goatpox virus (1-26). The family contains two subfamilies: Chordopoxvirinae, infecting vertebrate host and Entomopoxvirinae infecting invertebrate hosts. The Chordopoxvirinae subfamily comprises 10 genera including Capripoxvirus genus (1-26). This genus contains viruses of three species, **sheeppox virus** (SPPV), **goatpox virus** (GTPV) and **lumpy skin disease virus** (LSDV) infecting sheep, goat and cattle, respectively (1-26). The capsid or nucleocapsid of the virus is brick or oval shaped containing the genome and lateral bodies (2, 6, 10, 17, 19, 20, 21, 26).

Lumpy Skin Disease Virus (LSDV) :OIE Notified Disease

Lumpy skin disease (LSD) is caused by the lumpy skin disease virus (LSDV) is a **vector-borne** disease of **cattle** and **Asian water buffalo** that causes substantial economic losses (2, 6, 10, 17, 19, 20, 21, 26). This virus is the most economically significant in the Poxviridae family affecting domestic ruminants (1-26). According to OIE, at present this disease is prevalent in countries including various African, European and Asian countries (1-26). The disease is **endemic in African** countries but recently the disease has been reported from new territories around the world (1-26). Lumpy skin disease virus (LSDV) causing Lumpy skin disease belongs to Poxviridae family that contains group of viruses causing diseases in most of the domestic animals except dog (2, 6, 10, 17, 19, 20, 21, 26). Currently the Lumpy Skin Disease (LSD) has been emerged as a devastating threat for the large domesticated ruminants in Asia, Europe and the Middle East (1-26). The disease is enlisted by the **OIE** (World Organization for Animal Health) due to its capacity for fast trans-boundary spread. Lumpy skin disease (LSD), a major threat to stockbreeding, can cause acute or sub acute disease in cattle and water buffalo (1-26). Furthermore all ages and breeds of cattle are affected, but especially the young and cattle in the peak of lactation (2, 6, 10, 17, 19, 20, 21, 26). Therefore, **World Organization for Animal Health (OIE)** has placed this trans boundary disease on the **Notifiable Disease list** due to its significant economic losses and the potential for rapid spread. Lumpy Skin Disease (LSD) requires technically sound and coordinated efforts for its prevention and control (1-26).

Lumpy Skin Disease Virus (LSDV) : Survival and Inactivation

Lumpy skin disease virus (LSDV) is a large, **double-stranded DNA virus** (1-26). It is stable in the environment and may remain viable up to **three months** in dry scabs on skin (1-26). At least six months remain alive in dirty, shaded pens and infected tissue culture fluid stored at 4°C (1-26). Infected animals shed **scabs** from **skin lesions** and inside the scabs the virus may remain infectious for several months (1-26). Lumpy skin disease virus (LSDV) survives in **necrotic skin nodules** for at least **39** days even dried out prior to sequestration and in air-dried hides at room temperature for at least 18 days (2, 6, 10, 17, 19, 20, 21, 26).

There are no studies published that identify how long it takes for **Lumpy skin disease virus** (LSDV) to lose infectivity in different environments (2, 6, 10, 17, 19, 20, 21, 26). The virus is stable in ambient conditions for long period. It can persist in desiccated skin crusts for 35 days, in necrotic nodules for **33** days and in air-dried hides for at least 18 days (2, 6, 10, 17, 19, 20, 21, 26). Lumpy skin disease virus (LSDV) survives well within the **pH range** (6.3-8.3). It is highly **susceptible** to sunlight, high alkaline or acidic pH (2, 6, 10, 17, 19, 20, 21, 26). Virus gets **inactivated** at 55ºC temperature for 2 h, 60º C for 1 h and 65ºC for 30 min (1-26). The Lumpy skin disease virus (LSDV) is susceptible to **Ether** (20%), **chloroform, formalin (1%), phenol (2% for 15 min), sodium hypochlorite (2–3%), iodine compounds** (1:33 dilution) and **quaternary ammonium compounds** (0.5%) (2, 6, 10, 17, 19, 20, 21, 26). The virus is also **inactivated** by most **detergents** such, as **sodium dodecyl sulphate** and detergents containing **lipid solvents**; (2 percent) Virkon®, (2–3 percent) **sodium hypochlorite**, (20 percent) **chloroform**, (2 percent) **phenol** in 15 min, (1 percent) **formalin,** (1:33) **iodine compounds**, and (0.5 percent) quaternary **ammonium compounds** (2, 6, 10, 17, 19, 20, 21, 26).

Lumpy skin disease virus (LSDV) is very stable and can be recovered even after **10 years** from the **skin nodules** kept at -80ºC and after 6 months from the infected tissue culture fluid kept at 4ºC (2, 6, 10, 17, 19, 20, 21, 26). **Sunlight and lipid detergents** can **destroy** virus quickly but virus can persist for many months in dark environment like animal sheds and feed stores (1-26). It is susceptible to **highly alkaline** or **acidic pH** but can sustain pH 6.6–8.6 for 5 days at 37°C without significant reduction in titres (2, 6, 10, 17, 19, 20, 21, 26).

Lumpy Skin Disease Virus (LSDV): Clinical Features and Pathogenesis

The clinical features of the Lumpy Skin Virus (LSD) disease include fever, in appetence, nasal discharge, salivation and lachrymation, enlarged **lymph nodes**, a considerable reduction in milk production, loss of body weight and sometimes death (1-26). The **hallmark feature of LSD** is the **skin lesions** with **nodules.** The incubation period in naturally infected animals may be up to **28** days (2, 6, 10, 17, 19, 20, 21, 26). Clinical signs in cattle, besides the skin nodules, include high fever (>40.5°C), appetite loss, enlarged sub scapular and prefemoral lymph nodes, necrotic plaques in oral and nasal mucous membranes and reduced fertility (1-26). Once scabs are found, the virus has probably been circulating within the herd for at least 3–4 weeks (1-26).

Lumpy skin disease virus (LSDV) is present in the **skin lesions** and the scabs, blood, nasal, oral and ocular secretions, semen, and sometimes in the skin of cattle without visible clinical signs (1-26). One of the study showed that only half of experimentally infected cattle develop skin lesions (2, 6, 10, 17, 19, 20, 21, 26). Non-

clinical but viraemic animals are common and may be a source of infection through vectors such as mosquito's that feed directly on small blood vessels or spread the disease when moved by foot or in a vehicle (1-26). **Infected animals** shed the virus through oral and nasal secretions which may contaminate common feeding and water troughs (2, 6, 10, 17, 19, 20, 21, 26). Experimental studies confirmed that virus transmission through artificial insemination and the negative impact of Lumpy skin disease virus (LSDV) contaminated semen on *in vitro* fertilization (1-26). Animals are usually treated using supportive therapy of local wounds to prevent fly infestation and secondary infections (2, 6, 10, 17, 19, 20, 21, 26).

Systemic antibiotics may be given for more serious cases of disease (2, 6, 10, 17, 19, 20, 21, 26). The animals may become debilitated for up to six months, with a drop in milk production, caused by loss of feed intake due to mouth lesions (2, 6, 10, 17, 19, 20, 21, 26). **Mobility** and fertility can also be impacted. Under pastoral conditions, animals may become dehydrated and starved to death (1-26). Secondary bacterial infections of **skin lesions** are common and pneumonia may be a complication in animals with mouth lesions (2, 6, 10, 17, 19, 20, 21, 26).

Furthermore, the disease is characterized by firm, slightly raised, circumscribed skin nodules that are 2–7 cm in diameter and typically appear on the neck, legs, tail and back, shortly after the beginning of fever (2, 6, 10, 17, 19, 20, 21, 26). The Lumpy Skin Disease (LSD) affects the **lymph nodes** of the infected animal causing the nodes to enlarge and appear like lumps on the skin (2, 6, 10, 17, 19, 20, 21, 26). The cutaneous nodules **2-7cm** in diameter appear on the infected cattle head, neck, limbs, udder, genitalia and perineus (2, 6, 10, 17, 19, 20, 21, 26). The **nodules** may later turn into ulcers and eventually develop scabs over the skin (2, 6, 10, 17, 19, 20, 21, 26). The other symptoms include high fever, sharp drop in milk yield, discharge from the eyes and nose salivation, loss of appetite, depression, damaged hides, emaciation (thinness or weakness) of animals, infertility and abortions (2, 6, 10, 17, 19, 20, 21, 26). The incubation period or the time between infection and symptoms is about 28 days according to the FAO, and 4 to 14 days according to some other estimates (1-26).

The complications of severe disease were reported as keratitis, dysentery, lameness, pneumonia, mastitis and myiasis (2, 6, 10, 17, 19, 20, 21, 26). Following LSDV infection, virus replication, viremia, fever, cutaneous localization of the virus and development of nodules occur (1-26). The pathogenesis is characterized by 4 to 7 days post-infection (DPI): localized swelling as 1–3 cm **nodules** or plaques at the site of inoculation (1-26). This is followed by 6 to 18 DPI: viremia and shedding of the virus via oral and nasal discharge (1-26). 7 to 19 DPI: regional lymph adenopathy and development of generalized. skin nodules (2, 6, 10, 17, 19, 20, 21, 26). 42 days after fever: presence of virus in semen (2, 6, 10, 17, 19, 20, 21, 26). It seems that young calves, lactating cows and underweight animals are more susceptible to natural infections, probably due to impairment of humoral immunity (1-26).Animals that have recovered from **natural infection** by the virus have shown lifelong **immunity** or is similar in the immune response to those viruses (2, 6, 10, 17, 19, 20, 21, 26).

Lumpy Skin Disease Virus (LSDV): Symptoms

Clinically, Lumpy Skin Virus (LSD) has been reported in **cattle** only (1-26). The incubation period of the disease is 4–12 days. The clinical picture starts with fever (40–41.5˚C) which persists for 1–3 days (1-26). This is accompanied by increased nasal and pharyngeal secretions, lachrymation, enlargement of lymph nodes, anorexia, dysgalactia, general depression and a disinclination to move (2, 6, 10, 17, 19, 20, 21, 26). The skin nodules appear within 1–2 days, which gradually become harder and necrotic thereby, inducing severe discomfort, pain and lameness (2, 6, 10, 17, 19, 20, 21, 26). In 2–3 weeks, the **nodules** either regress, or necrosis of the skin results in hard, raised areas (sit-fasts) clearly separated from the surrounding skin (1-26). Some of the skin may slough away, leaving a full **skin hole** in the skin which usually gets infected by bacteria or becomes liable to myasis (1-26). Some animals become extremely emaciated, and euthanasia may be warranted (2, 6, 10, 17, 19, 20, 21, 26). Besides, the bulls may become temporarily or permanently infertile and may secrete the virus for a prolonged period (1-26). The morbidity in Lumpy Skin Virus (LSD) varies from 50–100% (1-26). The mortality rate is usually low (1–5%) but occasionally reported to be much higher (1-26). This constituted a serious hazard to the food security of the people in the affected areas (2, 6, 10, 17, 19, 20, 21, 26). The occurrence of Lumpy Skin Disease Virus (LSD) causes **decreased milk production**, loss of hide and draft (2, 6, 10, 17, 19, 20, 21, 26).

Lumpy Skin Disease Virus (LSDV): Transmission Vectors

The **Lumpy Skin Disease** (LSD) is transmitted through **arthropods** (hard ticks, mosquito ***Aedes aegypti*** and flies) particularly blood-sucking, contaminated feed and water (1-26). Lumpy skin disease (LSD) is a **host-specific** disease affecting severely the cattle and Asian water buffalos (*Bubalus bubalis*) (1-26). Buffalo have a substantially lower morbidity rate than cattle (1-26). Lumpy skin disease virus (LSDV) can infect, persist, and develop within susceptible host while gets a proper environment (1-26). Further direct transmission in the later stages of the disease via saliva, nasal secretions and semen (2, 6, 10, 17, 19, 20, 21, 26). Some studies have showed no positive correlation between cattle density and infection rates, indicating low importance of direct virus transmission, at least in the early stages of the disease, compared with the higher significance of indirect transmission (1-26). As most **Lumpy Skin Disease** (LSD) outbreaks have occurred in the summer when arthropods are most active (1-26). This may indicated the involvement of various vector species, especially the blood-feeding insects in virus spread (1-26). Several studies have suggested a possible role of **hard ticks** in virus transmission (2, 6, 10, 17, 19, 20, 21, 26).

The role of **arthropod vectors** in the transmission of Lumpy skin disease virus was experimentally confirmed (1-26). Several blood-sucking hard ticks, for instance, *Rhipicephalus appendiculatus* (brown ear tick), *Rhipicephalus decoloratus* (blue tick), and *Amblyomma hebraeum*, mosquito *Aedes aegypti* and flies *Stomoxys calcitran, Haematobia irritans* and *Musca domestica* have been implicated in the spreading of Lumpy skin disease virus (LSDV) in sub-Saharan Africa (1-26). In the tick host, Lumpy skin disease virus (LSDV) is trans-stadially and transovarially transmitted during cold temperatures (1-26). The virus may spread in short distances of a few kilometers, and even cover longer-distance due to unrestricted animal movements across international borders (1-26).

Warm and humid climatic conditions that favor higher proliferation of mosquitoes, flies, and ticks are reported as important environmental risk factors (1-26). The disease is mostly seen during wet seasons when there is an abundance of **blood-sucking insects** in surroundings (1-26). Common grazing and watering points may facilitate virus circulation through the transmission of vectors (1-26). Moreover, the entry of new animals in herds without observing proper quarantine periods was reported as risk factor for **Lumpy skin disease** (LSD) (1-26).

Lumpy skin disease virus and viral antigen were found in the saliva and the different organs of ticks, including the haemocytes, salivary glands and midgut (2, 6, 10, 17, 19, 20, 21, 26). Furthermore, the transstadial and mechanical transmission of the virus by ticks was proved based on molecular evidence (1-26). However, their prolonged attachment to the host does not explain the rapid

occurrence of extensive epidemics (1-26). Therefore, it seems that ticks may be acting as reservoirs for the virus (1-26). ***Aedes aegypti*** is the sole dipteran to be able to fully transmit the virus to susceptible cattle (1-26).

Lumpy Skiny Disease (LSD) can remain viable for long periods in the environment at ambient temperatures, especially in dried scabs (1-26). It is reported that the virus persists in necrotic skin nodules for up to 33 days or longer, in desiccated crusts for up to 35 days and for at least 18 days in air-dried hides (1-26). The main sources of infection are considered to be skin lesions as the virus persists in the lesions or scabs for long periods (1-26). The virus is also excreted via the blood, nasal and lachrymal secretions, saliva, semen and milk (transmissible to suckling calves) (1-26). According to the United Nations Food and Agriculture Organization (FAO), infected animals shed the virus through oral and nasal secretions which may contaminate common feeding and water troughs (1-26). Thus the disease can either spread through direct contact with the vectors or through contaminated fodder and water. Studies have shown that it can spread through animal semen during artificial insemination (1-26).

Risk factors associated with the spread of Lumpy skin disease (LSD) include a warm and humid climatic conditions supporting an abundance of **vector populations**, such as those seen after seasonal rains, and the introduction of new animals to a herd (1-26). The herd size, vector populations, distance to the lake, migration of herd, transport of infected animals into disease-free areas, common pasture and water sources have all been considered as other risk factors, which may increase the disease prevalence (1-26). All ages and breeds of cattle, as well as both sexes, are susceptible to the disease (1-26).

Also, risk factors associated with Lumpy skin disease (LSD) are **seropositivity** include age, sex, management type, mean annual rainfall and common water source (1-26). **Seropositivity** can demonstrate the possible role of animals in the epidemiology of the LSD disease (1-26). The susceptibility of springbok, impala and giraffe to the virus has been demonstrated (1-26). Other species which have been **seropositive** for the virus include African buffaloes, blue wildebeest, eland, giraffe, impala and greater kudu. However, the role of wildlife in the epidemiology of Lumpy skin disease (LSD) is not yet well understood (1-26).

Lumpy Skin Disease (LSD): Diagnosis

Despite a primary clinical diagnosis of Lumpy skin disease (LSD), the diagnosis is confirmed by using conventional PCR or real-time PCR techniques (1-26). A **real-time PCR technique** has also been established, differentiating among Lumpy skin disease (LSD), **sheep** and **goat poxviruses** (1-26). Furthermore, electron microscopy, virus isolation, virus neutralization and serological techniques have been utilized for Lumpy skin disease (LSD) detection (1-26). For differentiating virulent Lumpy skin disease (LSD) from the vaccine strain, Restriction Fragment Length Polymorphism (RFLP) has also been used (2, 6, 10, 17, 19, 20, 21, 26). It is stated that molecular methods are more precise, reliable and rapid compared with other methods (1-26).

Among **serological techniques**, the virus neutralization test, which is slow and costly with a high specificity and low sensitivity, is the only currently validated/valid test (2, 6, 10, 17, 19, 20, 21, 26). One of the experimental study established **immuno histochemical detection** of Lumpy skin disease (LSD) antigen in an experimental study (2, 6, 10, 17, 19, 20, 21, 26). Despite the specificity and sensitivity of the western blot test, it is expensive and difficult to perform (2, 6, 10, 17, 19, 20, 21, 26). Fluids like saliva, nasal swab, or whole blood can be collected from clinically infested animals for **viral isolation** and molecular testing (2, 6, 10, 17, 19, 20, 21, 26). Additionally, the disease can be detected using serological tests using **Enzyme-linked Immunosorbent Assay** (ELISA), Indirect Fluorescent Antibody test (IFAT), Indirect Immunofluorescence test, **Virus Neutralization Test** (VNT) and Serum Neutralization Test (SNT) (2, 6, 10, 17, 19, 20, 21, 26). However, the Enzyme-linked Immunosorbent Assay (ELISA) has been confirmed experimentally showing higher sensitivity and specificity in comparison with IFTA or VNT (2, 6, 10, 17, 19, 20, 21, 26). A fairly new assay called **Immuno-peroxidase Monolayer Assay** (IPMA) has been identified for potential use in Lumpy skin disease (LSD) diagnosis (2, 6, 10, 17, 19, 20, 21, 26). It is a cheap and convenient test, adapted to low bio safety levels, and has higher sensitivity and specificity than Virus Neutralization Test (VNT) and commercial Enzyme-linked Immunosorbent Assay (**ELISA**) (2, 6, 10, 17, 19, 20, 21, 26).

Lumpy Skin Disease (LSD): How to control the disease

Lumpy skin disease (LSD) has devastating economic impact (1-26). During the last decade, LSD had spread to climatically new and previously disease-free countries, which also includes its recent emergence in the Indian subcontinent in 2019 and 2022 (2, 6, 10, 17, 19, 20, 21, 26). Members of the **capripoxvirus** are known to provide cross-protection (2, 6, 10, 17, 19, 20, 21, 26). **Vaccination** is the only effective method to control the disease in endemic areas along with movement restrictions and the removal of affected animals (2, 6, 10, 17, 19, 20, 21, 26). Presently only live, attenuated vaccines are available against Lumpy skin disease (LSD) virus (2, 6, 10, 17, 19, 20, 21, 26). The commercially accessible vaccines against LSD are **live attenuated vaccines** (1-26). Live vaccines produce a strong and long-lasting immune response, and are efficient in the control of viral disease spread (1-26). There is ongoing research on the development of inactivated vaccines. In another major development, the **Goat Pox virus vaccine (GTPV) (**Goatpox virus, live, **Uttarkashi** strain, Hester, India) is very effective against Lumpy Skin Disease (LSD) and is being used across the affected Indian states to control the virus (2, 6, 10, 17, 19, 20, 21, 26). As of the first week of September, 2022, 98 lakh doses of vaccination have been administered in India. In India, the **Goat Pox Virus Vaccine (**GTPV) **Uttarkashi strain** is being evaluated for the level of protection against LSD as compared to the LSDV vaccine and is already used for emergency vaccination (1-26). In Bangladesh GTPV vaccine was used in **Chattogram** and found to be effective against LSD (2, 6, 10, 17, 19, 20, 21, 26). With successful testing, validation and approval, the **GTPV Uttarkashi strain** vaccine could be a more affordable option that is more quickly available and useful for large scale i**mmunization** programmes (1-26). There are also several studies of the GTPV vaccine based on the **Gorgan strain** with successful results (2, 6, 10, 17, 19, 20, 21, 26). Further homologous (**Neethling LSDV strain**) and heterologous (sheeppox or goatpox virus) **live attenuated vaccines** can also be used to protect cattle against Lumpy skin disease (LSD) infection (1-26).

The treatment of Lumpy skin disease (LSD) is only symptomatic and targeted at preventing secondary bacterial complications using a combination of antimicrobials, anti-inflammatory, supportive therapy and anti-septic solutions (1-26). The culling of affected animals, movement restrictions and compulsory, and consistent vaccination have been recommended as control strategies (1-26). In Lumpy skin disease (LSD)-free countries, the use of the **Sheep pox vaccine** (SPP) to protect sheep against sheep pox was recommended. Further use of the same vaccine (Sheep pox vaccine) during Lumpy skin disease (LSD) outbreaks was also recommended because of the potential safety issues associated with the live **attenuated LSDV vaccine** use (2, 6, 10, 17, 19, 20, 21, 26). Furthermore, the rapid confirmation of a clinical diagnosis is essential so that eradication measures, such as quarantine, slaughter-out of

affected and in-contact animals, proper disposal of carcasses, cleaning and disinfection of the premises, and insect control can be implemented as soon as possible during the eruption (1-26). It is known that complete immunity against LSD was not provided by sheep pox vaccines (SPP) (2, 6, 10, 17, 19, 20, 21, 26). Nevertheless, they are used in some countries such as Iraq, Iran, Turkey and African countries with overlap between LSD, SPP and GTPV (2, 6, 10, 17, 19, 20, 21, 26). Therefore, accurate and timely **diagnosis** in endemic areas, vaccination with the homologous strain of the LSDV, vector control, **animal movement restriction** and LSDV testing of bulls used for breeding are highly recommended as tools to control further spread (1-26).

The affected Indian states have put **movement bans** in place and are **isolating** infected cattle and buffaloes (1-26). Another method is implementing bio-security through vector control by sanitising sheds, strengthening active and **passive surveillance**, spreading awareness on risk mitigation among all stakeholders involved, creating large protection and surveillance zones and **vaccinatio**n zones (1-26). Then spraying insecticides to kill the vectors like **mosquitoes, flies** and **hard ticks** (2, 6, 10, 17, 19, 20, 21, 26). However, regarding the role of arthropod vectors, elimination of the disease is likely to be difficult and any delays in the removal of infected animals increase the risk of LSD transmission (2, 6, 10, 17, 19, 20, 21, 26). Educating veterinarians and livestock workers would enable them to perform timely diagnoses of clinical cases, helping to slow the spread of disease (2, 6, 10, 17, 19, 20, 21, 26).

In another major breakthrough, 2 institutes of **Indian Council of Agricultural Research (ICAR**) have developed an indigenous vaccine for LSD. This vaccine is based on LSD virus samples taken from infected cattle in **Ranchi in the 2019 outbreak** (2, 6, 10, 17, 19, 20, 21, 26). The results of the clinical trial experiments are still awaited. **Prophylactic immunization** with homologous (**Neethling strain**) or heterologous live attenuated vaccine (Sheep/Goat pox vaccine) is the best medical prophylaxis for Lumpy skin disease (LSD) (2, 6, 10, 17, 19, 20, 21, 26).

Lumpy Skin Disease (LSD): Vaccine

Currently, there are three vaccine producers manufacturing attenuated homologous LSDV vaccines (1-26). Live, attenuated LSDV vaccines provide good protection in cattle if 80 percent coverage can be attained (1-26). There is a evidence of mild adverse effects of attenuated LSDV vaccines called the ''**Neethling** response''(2, 6, 10, 17, 19, 20, 21, 26). At the same time, according to recent studies, after vaccination with live attenuated Neethling LSD vaccine (LSDV Neethling strain OBP, South Africa), there is no significant change in mortality or milk production during the 30 days post-vaccination (2, 6, 10, 17, 19, 20, 21, 26). Further there was no difference between the pre- and post-vaccination periods in routine culling, immediate culling and in-farm mortality for those animals vaccinated for the first time (2, 6, 10, 17, 19, 20, 21, 26).

The ten-fold dose of attenuated SPPV vaccines (Jovivac, Sheeppox virus strain RM-65 JOVAC, Jordan) is recommended for immunization of bovines against Lumpy skin disease (LSD) (2, 6, 10, 17, 19, 20, 21, 26). Nevertheless, compared to the Neethling vaccine, the efficacy of SPPV vaccines is significantly lower (2, 6, 10, 17, 19, 20, 21, 26). Commercially available **GTPV Gorgan strain** has been demonstrated to provide the same protection against LSD as the LSDV vaccines (1-26). **Gorgan GTPV** vaccine (Caprivac, Freeze dried live attenuated Goatpox Virus strain Gorgan, JOVAC, Jordan) vaccine is a good, cost-effective alternative in those countries where GTP and Lumpy skin disease (LSD) overlap (2, 6, 10, 17, 19, 20, 21, 26). Considering the positive experience in Lumpy skin disease (LSD) virus control in Israel and the Balkan region of Europe, the live attenuated LSDV vaccine should be the most preferred option (2, 6, 10, 17, 19, 20, 21, 26).

Following is the list of **available vaccines** against Lumpy skin disease (LSD) infection.

1. **Potential attenuated GTPV vaccine (**Goat Pox Vaccine* Goatpox virus, live, **Uttarkashi** strain, Hester, **India**).
2. **Attenuated LSDV vaccines** (MSD Animal Health Lumpyvax LSDV, Neethling strain MSD, Animal Health, **South Africa**;
   BOVIVAX LSD, LSDV, Neethling strain, MCI Santé Animale, **Morocco**;
   Herbivac LS LSDV, Neethling strain Deltamune, **South Africa**;
   LSD-NDOLL LSDV, Neethling strain Dollvet, **Turkey**;
   Lumpyvac™, LSDV Neethling strain, Vetal Animal Health Products S.A., **Turkey**; Onderstepoort Biological Products Lumpy skin disease vaccine for cattle LSDV, Neethling strain OBP, **South Africa**).
3. **Attenuated SPPV vaccines** (Jovivac, Sheeppox virus strain RM-65 JOVAC, **Jordan**)
4. **Attenuated GTPV vaccine** (Caprivac, Freeze dried live attenuated Goatpox Virus strain Gorgan vaccine. Goatpox virus strain Gorgan, JOVAC, **Jordan**).

Prophylactic actions of Lumpy skin disease (LSD) is hardly attempted in epidemic situations other than the symptomatic and supportive treatment like wound repair sprays and antibiotic drugs to restrain the secondary bacterial infections of the skin abrasions (2, 6, 10, 17, 19, 20, 21, 26). Anti-inflammatory drugs and intravenous fluid therapy might be administered to upsurge the appetite although it has no prolific feedback (2, 6, 10, 17, 19, 20, 21, 26). Literally, no precise antiviral drugs are available for the treatment of Lumpy skin disease (LSD), thus prevention through vaccination is the only effective way of restraining the disease (2, 6, 10, 17, 19, 20, 21, 26).

Lumpy Skin Disease (LSD): Ethnoveterinary Medicine Approach

The Indian subcontinent has a rich ethno veterinary health traditions that are the products of decades of experiences (27-40). India has one of the sophisticated medical cultures with a tradition of over 5000 years (28-65). The unique advantage is that India is one of the world's 12 mega diversity countries accounting for 8% global plant genetic generations and higher share of microorganisms (29-67). Ethnoveterinary medicines are used extensively and quite effectively for primary health care treatment and maintaining animals productive (29-67). Ethno veterinary remedies are accessible, easy to prepare and administer at little or no cost at all to the farmer (29-67). Ethnoveterinary practices concern to animal healthcare is as old as the domestication of various livestock species (129). They comprise belief, knowledge, practices and skills pertaining to healthcare and management of livestock. The Indian subcontinent has rich ethnoveterinary health traditions that are the products of decades of experiences (120-129).

Livestock economy plays a major role of our agricultural economics. In rural areas, tribal's are still depending on plants and household remedies for curing various veterinary ailments (128). There has been a rich traditional knowledge about animal health care in India and has also been used for ages by farmers to manage ailments in livestock (128). Livestock raisers everywhere have traditional ways of classifying, diagnosing, preventing and treating common animal diseases. There is a rich and efficient ethno veterinary traditions exist in the villages of India (29-128). In some remote areas, people have great undocumented traditional knowledge about animal diseases, herbal treatments, formulations, etc., but due to modernization, this traditional veterinary knowledge is

on the verge of extinction. The only means of acquisition of this knowledge is from what has been passed down over the generations and the lack of interest for traditional veterinary knowledge in the present generation is leading to its extinction (128). Traditional folk veterinary medicine is the integration of the local knowledge related skills and custom procedures created by people for purpose of preserving health and welfare of working and productive animals (120-129).

Ethnoveterinary practices are often cheap, safe, time tested and based on local resources and strengths (40-67). There has been a rich traditions and indigenous knowledge about animal healthcare and remedies are based locally on available herbs (29-126). Plant extracts have a wide variety of active compounds, including flavonoids, terpenoids,lignans, sulphides, polyphenolics, coumarins, saponins, furyl compounds, alkaloids, polyines, thiophenes, proteins, and peptides (29-127). Moreover, certain volatile oils have indicated a high level of antiviral activity (29-127). Medicinal plants with substantial antiviral activity, as well as those containing new plant-derived antiviral compounds, have been found to treat viral infections in people and animals (127). Herbal medicines and purified natural products provide a rich resource for novel antiviral drug development (30-127).

In India, veterinary science can be classified into **codified** traditions and **folk** medicine which has a documented history of around 5000 years (29-67). The codified knowledge exist in the form of text manuscripts at various aspects of veterinary care of the livestock (30-67). The folk health practices largely remain undocumented and are passed on from one generation to the other by the word of mouth (30-67). Rich and efficient ethno veterinary traditions still exist in the villages of India comprised of belief knowledge, practices and skills pertaining to health care and management of livestock (29-65). Medicinal plants have a long history of use in the treatment of both human and animal diseases (28-65, 68-126).

There is a rich and efficient ethnoveterinary beings exist in the villages of India which form integral part of the family and plays an important social, religious and economic role (28-65). They comprise of belief, knowledge, practices and skills pertaining to health care and management of livestock (29-65). High cost and indiscriminate use of antibiotics and other veterinary drugs and their residues in the milk and other animal products are serious problems of present veterinary services in India (29-67). The presence of drug *residues results in development of drug resistant microorganisms that are difficult to treat and the world is looking for safer herbal alternatives (30-67).* General observations and studies showed that the farmers are using several ethnoveterinary practices for curing various diseases. Some of these have enough potential to cure the diseases while others are based on superstitions and mythological religious faiths or there is hardly any basis to be considered as effective treatments (27-67).

The traditional medicines that are commonly used for animal healthcare can cut down costs considerably (68-126). Moreover, they are readily available to the farmer. The livestock owners in India have been using traditional medication based on plant formulations immemorial (27-67). Livestock raisers and healers everywhere in India have traditional ways of classifying, diagnosing, preventing and treating common animal diseases (27-67). Ethnoveterinary practices concern to animal healthcare is as old as the domestication of various livestock species (27-67). Many of these "ethno veterinary" practices offer alternatives or complements to conventional, Western style Veterinary Medicine especially where the latter is out, unavailable or inappropriate (30-67). There are local healers in India who are knowledgeable and experienced in traditional veterinary health care (30-67). They use the locally available medicinal plants for treatment of animals (27-67). The ethnoveterinary systems are ecosystem and ethnic specific and therefore, the characteristics, sophistication, and intensity of these differ greatly among individuals, societies, and regions (30-67).

Ethnoveterinary medication, the scientific concept for traditional animal diseases treatment, offers low-cost approaches to allopathic medicines (27-67). Ethnoveterinary practices and ethnobotanical knowledge serve as potential therapeutic approaches used to manage and prevent cattle diseases in India (27-67). Farmers and cattle herders in rural communities rely on ethnoveterinary medicine (EVM) as a sustainable alternative to western veterinary practices (30-67).

Ethnoveterinary medicine encompasses a variety of systems and knowledge of maintaining animal health that is based on beliefs, traditional knowledge, skills, methods, medicinal plants, metaphysics, surgical procedures, technologies, and teachings that are used in healing livestock (30-67). The studies in ethnoveterinary medicine are necessary because plants contain a wide range of phytochemicals (27-67). These plants can provide the lead candidates for drug discovery and development of active products, which are useful in managing the health of livestock (30-67, 68-126). In India, the rich and unique flora have been well-utilised in traditional medicine, thereby creating more interest in the potential use of medicinal plants (30-67, 68-126). Cattle diseases are major veterinary health problems, which are experienced by livestock farmers in developing countries (30-67). Recently, the Conventional Veterinary Services and Drug Resistance reported a rise in the number of cattle diseases that are affecting cattle production (27-67).

Following is the list of medicinal plants with antiviral activity used as a remedy for skin disease of cattle and buffalo. These medicinal plant paste (leaf, stem, bark, rhizome, root or seeds) is used for the topical applications of skin diseases.

1) *Abrus precatorius* L. (*Fabaceae*). **2**) *Acacia catechu* (*Fabaceae*). **3**) *Acorus calamus L.* (*Acoraceae*). **4**) Aegle marmelos *(L.)* (Rutaceae). **5**) **Turmeric- *Curcuma longa*** *L.* (*Zingiberaceae*). **6**) ***Costus speciosus*** (*Zingiberaceae*). **7**) *Ficus tinctoria* (*Moraceae*). **8**) Podocarpus henkelii. **9**) *Momordica charantia* (*Cucurbitaceae*). **10**) *Moringa oleifera* (*Moringaceae*). **11**) *Ocimum sanctum* (*Lamiaceae*). **12**) *Olea dioica* (*Oleaceae*). **13**) *Pongamia pinnata (Fabaceae*). **14**) *Quercus infectoria (Fagaceae).* **15**) *Ricinus communis* (*Euphorbiaceae*). **16**) *Santalum album (Santalaceae).* **17***)* *Semecarpus anacardium* (*Anacardiaceae*). **18**) *Senna alata.* **19**) ***Tamarindus indica*** (*Caesalpiniaceae*). **20**) ***Terminalia chebula*** (*Combretaceae).* **21**) *Urginea indica (Liliaceae).* **22**) ***Withania somnifera*** (*Solanaceae*). **23**) *Tridax procumbens* (*Asteraceae*). **24**) *Plumbago zeylanica* (*Plumbaginaceae*). **25**) *Pongamia pinnata* (*Fabaceae*). **26**) *Randia dumetorum* (*Rubiaceae*). **27**) *Quercus infectoria* (*Fagaceae*). **28)** *Acalypha indica* (*Euphorbiaceae*). **29**) Pinus kesiya, Pinus roxburghii (Pinaceae). **30**) **Liquorice** or **Mulethi** (Glycyrrhiza glabra) (Fabaceae) Roots. **31**) **Neem** (**Azadirachta indica**) (Meliacaee). **32**) Calendula officinalis (Asteraceae). **33**) Madagascar periwinkle (Vinca rosea or **Catharanthus roseus**) (Apocynaceae). **34**) Red sandalwood (Pterocarpus santalinus) (Fabaceae). **35**) **Lawsonia alba** (Lawsonia inermis) (Lythraceae). **36**) Adusa (Adhatoda vasica) (Acanthaceae) Leaves. **37**) **Papaya** (Carica papaya) (Caricaceae) Latex, fruit. **38**) **Betle Piper** (Piper betle L) (Piperaceae) Leaves. **39**) Common wireweed (Sida acuta) (Malvaceae) whole plant. **40**) Indian olive (Olea europaea) (Oliaceae) Leaves and oil. **41**) **Burdock** (Arctium lappa) (Asteraceae). **42**) German chamomile (Chamomilla recutita) (Asteraceae) Apigenin is the rarest flavonoid in chamomile flora and has a remarkable effect on the wound healing process. **43**) Angelica sinensis (Apiaceae) in wound healing. **44**) Celosia argentea (Amaranthaceae). **45**) **Cinnamomum camphor** (Lauraceae), **46**) **Terminalia arjuna** (Combretaceae). **47**) Kutaja (Holarrhena antidysenterica) (Apocynaceae) Bark and leaf. **48**) A mixture- dried fruits of the three

plant species, Emblica officinalis (Amalaki or the Indian Gooseberry) (Family-Euphorbiaceae), Terminalia bellirica (Bibhitaki or Karitaki) (Family-Combretaceae), and Terminalia chebula (Haritaki) (Family-Combretaceae). **49**) Salvia miltiorrhiza (Lamiaceae). **50**) Artocarpus communis (Moraceae). **51**) Ephedra alata (Ephedraceae), **52**) Boswellia sacra (Bursaraceae). **53**) **Sarracenia purpurea (Indian Pitcher Plant). 54)** Carbonal (Mimosa tenuiflora) (Fabaceae). **55**) Asthma Weed (Euphorbia hirta) (Euphorbiaceae) Leaves. **56**) Wood Apple -Limonia acidissima (Rutaceae). **57**) Azima tetracantha (Uppina mullu) (Salvadoraceae). **58**) Alangium salvifolium (Alangiaceae). **59**) Dodonaea viscosa (Sapindaceae). **60**) Aloe (Aloe vera) (Liliaceae) Leaves. **61**) Bacopa monniera (Plantagiaceae). **62**) Calotropis procera (Apocynaceae). **63**) **Baobab -*Adansonia digitata*** L. (Malvaceae). **64**) Achillea fragrantissima. **65)** Jasiona Montana. **66**) Anacardium occidentale (Anacardiaceae). **67**) Calotropis gigantea (Asclepiadaceae). **68**) Gossypium herbaceum (Malvaceae). **69**) Lippia javanica (Verbenaceae). **70**) Madhuca indica (Sapotaceae). **71**) Swertia angustifolia (Gentianaceae). **72**) Zizyphus mauritiana (Rhamnaceae).

Major Issues with Ethnoveterinary medicine Approach

1. Ethno-veterinary medicines are often not as fast-working and potent as allopathic medicines. Therefore, Ethno-veterinary medicines may be less suitable to control and treat epidemic and endemic infectious diseases. Further, effectiveness of Ethno-veterinary medicines practices is questionable against emerging infectious diseases (130).
2. Many 'so called effective Ethno-veterinary medicines remedies' may be virtually ineffective and some are difficult to prepare or use under field situation (130).
3. Majority of the traditional animal healthcare practices are unregulated and prone to be affected by abuse and quackery due to concealment, distortions and misleading claims. A large proportion of conventional practitioners, whether in human or animal health care, are therefore skeptical about the value of alternative practices (130).
4. Certain Ethno-veterinary medicines practices can be harmful if used improperly or without appropriate knowledge and study. Even herbal preparations that are safe for use in some animal species may be toxic to others (130).
5. Lack of documentation, inappropriate scientific validation and failure to disseminate and promote evaluated practices for field application adversely affect development and full utilization of Ethno-veterinary medicines by the end users (130).
6. The underlying science of Ethno-veterinary medicines is poorly researched and understood. The diagnosis of disease and identification of underlying cause are inadequate (130).
7. Depleting medicinal plant resources and seasonal availability of certain plants is making ingredients unavailable for preparing medicine (130).
8. Rapid decline in experienced traditional healers and pastoralist communities. Young generation is not keen to use Ethno-veterinary medicines, probably due to lack of information and interest or rural exodus (130).

Advantages of Ethnoveterinary medicine Approach

1. Ethno-veterinary medicines may be a potential tool to create better understanding between vets and extension personnel and communities. It can ensure proper health and productivity of animals in the areas where modern veterinary services are not readily available (130).
2. Validated Ethno-veterinary medicines practices, seems to be the most realistic choice for financially poor stock raisers who can neither afford nor have access to expensive high-tech modern healthcare practices (130).
3. In emergencies or during fast spreading epidemics, traditional healers and their treatments may be more easily available with minimum expenses on transport and opportunity costs. There are fewer chances that expired or spurious allopathic drugs are sold to uneducated animal owners when Ethno-veterinary medicines options are available for treatment of diseases (130).
4. Ethno-veterinary medicines research and developments have practical applications for cost-effective ways to control several economically important health problems such as internal or external parasitism, whether related to epidemiology, diagnostics and therapy, or to comprehensive disease control methods leading to integrated pest/disease management (130).
5. Low-cost Ethno-veterinary medicines remedies may ensure freedom from pain and diseases concerning welfare of animals with low market value (130).
6. Proper application and adoption of Ethno-veterinary medicines treatment approaches can provide a plausible answer to side effects of conventional drugs. These can limit any unnecessary use of antibiotics and other chemical drugs to overcome residue problems and the growing resistance of micro-organisms (130).
7. Ethno-veterinary medicines provides a highly intricate indigenous knowledge systems pertaining to animal husbandry that have been developed by several pastoral societies to 'shape' their animals according to their own specific breeding goals and animal utilization (130).
8. Traditional practices constitute a potential knowledge resource for novel ideas and hypotheses. It is reported that 25% of conventional drugs and 120 pharmaceutical substances are plant derived and 41% of the Pharmaceutical development has herbal origin (130).
9. Ethno-veterinary medicines practices may effectively prevent occurrences of diseases thereby avoiding financial loss in the form of treatment cost and production losses (130).
10. Ethno-veterinary medicines may be an effective resource for community development and to protect the right of ethno-vets and owners of traditional knowledge at community level (130).
11. Ethno-veterinary medicines bridges the gap between natural resources and their human management for the future. Since Ethno-veterinary medicines characteristically promotes traditional practices and facilitates conservation, protection and propagation of floral biodiversity (130).

CONCLUSION

Lumpy skin disease (LSD) is a viral infection afflicting thousands of **dairy cattle** (*Bos taurus*) and domestic **water buffaloes** (*Bubalus bubalis*). Lumpy skin disease (LSD has spread to **15 of the 33 districts** in the Indian State of **Gujarat** and **Rajasthan** in 2022. High number of viral disease cases have been recorded in **Kutch** and **Jamnagar** districts of Gujarat state of India. Lumpy skin disease (LSD) is a trans-boundary animal viral disease which causes considerable financial losses to the livestock industry. A **lump like nodules** in the external skin and mucous membrane with fever and swollen lymph nodes are the preliminary noticeable clinical signs of this devastating disease. The current outbreak of Lumpy Skin Disease Virus (LSDV) in more than **15 Indian states** in **2022** has emerged as a challenge for the dairy sector. Clinically, LSD has been reported in **cattle** only. The occurrence of LSD causes decreased milk production, loss of hide and draft. It is a contagious vector-borne disease spread by vectors like mosquitoes, some biting flies, ticks and usually affects host animals like cows and water buffaloes. The recent unprecedented spread of Lumpy skin disease virus (LSDV) in

India in 2022 and several other countries has highlighted the need for better research efforts into this rapidly emerging pathogen.

Cattle production plays a key role in the rural economies of developing countries particularly in India in terms of food security, poverty alleviation, and diverse cultural activities in rural communities. Due to their use as draft animals, cattle provide a significant source of food and nutrition, and nitrogen-rich manure for replenishing soils. They also fulfill a wide variety of socio-cultural roles. However, cattle in rural areas are often susceptible to various diseases. Farmers and cattle herders in rural communities rely on **ethnoveterinary** medicine (EVM) as a sustainable alternative to western veterinary practices.

However, Ethno-veterinary medicines are often not as fast-working and potent as allopathic medicines. Therefore, **Ethno-veterinary** medicines may be less suitable to control and treat epidemic and endemic infectious diseases. Further, effectiveness of Ethno-veterinary medicines practices is questionable against emerging infectious diseases. However, much of the evidence comes from animal and *in vitro* studies and overall clinical Evidence-Based Complementary and Alternative Medicine evidence to support these herbal interventions remains weak and lacking.

The other problems of Ethno-veterinary medicines treatment is the lack of definite and complete information about the composition of extracts. Although some Ethno-veterinary medicines have promising potential and are widely used, many of them remain untested and their use also not monitored. This makes knowledge of their potential **adverse effects** are limited and identification of the safest and most effective therapies as well as the promotion of their rational use more difficult. Ethno-veterinary medicines needs to be tested for efficacy using conventional trial methodology and several specific herbal extracts have been demonstrated to be efficacious for specific conditions.

Finally, there is a possibility that these treatments might be associated with the induction of harmful effects. In addition, preclinical and clinical trial evaluations of these Ethno-veterinary medicines for **Lumpy skin disease** (LSD) have not specifically been conducted, so further investigations related to this are warranted.

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