

An Overview on Lumpy Skin Disease: Transmission and Treatments

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Abstract:- Lumpy skin disease is a life threatening disease mainly seen in cattle's and buffalo's. It possesses a double stranded DNA genome which encodes 30 duplicates of poxvirus proteins, structural as well as non-structural. In 1929, the first case of lumpy was noted in Zambia then, it spread to Andaman and Nicobar, northern, western states, 8 states of India, and Union Territory as well. From last 10 years, LSD has expanded rapidly into Eastern Europe and China. Due to this virus, approximately 7300 cows were deceased and more than 1.60 lakhs were affected. LSDV leads to infertility in males and lose of milk production in females. Virus can be directly transmitted by sharing food and water with infected animals or by infected animals nasal and salivary discharge or by sucking of milk by calves as well as Insects that feed on blood (arthropods vectors) transmit the disease indirectly i.e. mosquitoes, butterflies and ticks. South-East Europe controlled this viral infection through use of the live-attenuated LSDV vaccine based upon the Neethling strain of the virus, but this vaccine can also cause adverse reaction, with clinical signs similar to infections with virulent LSDV. Different medicines and home remedies show positive results against infected cattle's. There are various test performed for the analysis of the lumpy virus.

Keywords: Lumpy Skin Disease, Transmission, Hematophagous Vectors, Prevention, Treatments, Herbal Remedies.

I. INTRODUCTION

LSDV, a life threatening disease in animals mainly observed in cows is characterised by multiple cutaneous lumps. The infection is acquired from Poxviridae family viruses. This disorder is also pronounced as "Pseudo-urticaria", "LSD", and "Neethling Virus" [1-2]. It owns a double strand DNA genome that encodes about 30 duplicates of pox viral proteins, both non-structural and structural. The virus shares a nucleotide sequence upto 96% with goat pox virus and sheep pox virus species. These viruses extends into target organs, reproduce at their entry points, and spreads into the environment as a part of the

pathogenic process [3]. The analysis and estimation of biochemical profile helps to demonstrate the pathogenesis and diagnosis the LSDV. The biochemical parameter of the animal's blood exhibit important variation from serum separation [3]. The animals that didn't brings back food from its stomach and chew it again are not infected by this disease. There are 156 putative genes in the infection set-up as 151-kbp genomes containing the central coding region enclosed with upside-down terminals. However, the collinerity of genome is disrupted in the terminal regions with low or no amino acids [4]. From last 10 years, LSD has expanded rapidly into Eastern Europe and China from the Middle East, though it has generally been found only in Southern Africa [5].

II. CASE HISTORY

Firstly, Lumpy skin disease was endemic in the Saharan area of Africa, but later spread to central Asia and neighboring countries such as China, India and Iran [2]. In 1929, Lumpy skin disease was firstly noted in Zambia. The mortality rate was 5% and morbidity rate was 45% at that time [6]. In 1989, LSDV also transmitted in South Africa, Sudan, Israel and Egypt [7]. In India, an epidemic of LSD was reported in the Chhotanagpur district which consists of parts of Jharkhand, Orissa, West Bengal, and Chhattisgarh. In Orissa on 12/08/2019, Dr Chaturvedi reported nine cases and on 17/08/2019, twenty cases in Patalipura, Betnoti, Mayurbhanj, and Orissa [8]. In, M.P. near about 32 villages, 13 calves, 2 Asian buffaloes, 150 oxen, 34 cows was infected between August to October 2020 [9]. The two institute of Indian Council Of Agriculture Research developed vaccines against LSDV to cure the virus in cows and buffaloes. Recently, the virus is also spread to Andaman and Nicobar also in northern and western states. The problem was spread to 8 states and a union territory as well. Around 7300 cows were perished and around 1.60 lakh cows were affected by this virus [10]. Skin nodules, fever, running nose, swelling of lymph nodes and mucosal plague was the clinical signs of LSDV were seen in cattle's. After a fever, the viral particles were ejected through semen for 3 weeks but no spot of disease is seen in semen. In mid 2019 Chattogram (Bangladesh), the disease infected cattle's in

large population which results in loose for the farmers who was practicing animal farming [11]. In August 2019, spread of lumpy skin disease in 5 districts of Odisha. Around 180 cows out of 2540 cows were infected with this virus. There was zero mortality and near about 7% morbidity rate [12].

Thailand had its first case of lumpy skin disease in animals i.e. cows in 2022. In Bangladesh, India, Nepal and Sri Lanka, lumpy skin disease is originated as a vector-borne transboundary viral disease. As a result of the virus spreading throughout South Asia, it reached Chinese Taipei, Hong Kong, Bhutan, Vietnam, China and Myanmar. North eastern Thailand experienced an outbreak of lumpy skin disease on 29 March, 2021 [13]. In October 2014, signs of lumpy skin disease were noted on new born calf whose mother was infected by this disease [14]. The first case of Lumpy skin disease was reported in Huu Lung District on October 13, 2020 [15]. In Maharashtra Bhandara and Akola district, 440 infected animals are treated against lumpy skin disease by giving the combination of some drugs such as: - Amoxicillin-cloxacillin in an amount of 10 milligram/kilogram, Strepto-penicillin in an amount of 10 milligram/ kilogram and some of drugs are given without any combination such as Enrofloxacin in an amount of 5 milligram/kilogram, Chlorpheniramine maleate in an amount of 0.25 milligram/ kilogram 1M, B-complex in an amount of 5-10 milliliter 1M [16]. In Rajasthan and Gujarat, 3000 cows expire due to lumpy skin disease [17]. According to The Global Alliance for Vaccines and Immunization it is an emergency to treat cattle's in world [18]. In Nizwa and Sohar, mortality and morbidity percentile were reported i.e. 30% and 27% or 14% and 16% respectively. In Omani, the LSD epizootic in Oman infected several wildlife and a huge area, including the eastern, interior, and Batinah region and becomes big concern to milk industries. The virus is expected to endure via infection cycling in existing lesions or in cattle, and it is possible that the virus have a low rate of persistence in wildlife. A cow sickness that resembled LSD was reported from the Nezwah, Alqabelsohar, and Burimi area in April 2009 [19]. Its antigenic characteristics are similar to that of Variola and GTPV (Goatpox virus). Virus is not zoonotic type therefore not transmitted into human beings [20]. A total 438 cases were reported, out of which 427 (97.27%) involved cattle and 12 (2.73%) affected buffalo, indicating that cows are more susceptible than the buffalo, 88.61% being females and 11.39% being males. 372 animals (84.74%) crossbred and 67 animals (15.26%) non-descript showed a higher susceptibility. Among cattle aged 1-5 years, 58.54% were affected, followed by cattle aged over five years (34.86%) and cow's age below 1 year (6.64%). Moreover, lactating animals (35.77%) were infected more than pregnant animals like cows (23.54%) [16]. PCR, TEM, and series comparisons confirmed the first occurrence of lumpy skin disease in Taiwan in Kinmen Island on July 8, 2020. There are two kinds of bovine species affected by this disease (*Bos indicus* and *Bos Taurus*) and water buffalo. Several lumpy skin disease cases have reported outside of Africa: Indonesia in 2022; Russia in 2017; Thailand in 2021; Albania in 2016; Georgia in 2018; Greece, Macedonia, and

Russia in 2017; Bangladesh, China, India, Israel, Palestine, Russia, and Syria, 2019 [5]. In LSDV, the homologue gene shortens, then restore in chloroviruses, Entomopoxviruses, Orthopoxviruses and some viruses from the Mimiviridae family encode SOD-like proteins [21]. Vaccines against LSD for cattle are available which provide immunity to animals from Onderstepoort Biological Products (OBP) and MSD Animal Health [22]. Bangladesh's Chattogram division has reported an outbreak of LSD in mid-2019. The risk factors for LSD in cattle in the Chattogram region were investigated through a cross-sectional observational study between August and December 2019 [23]. Kazakhstan registered its first cases of LSDV in July 2016. 459 cattle were infected and 34 died in Makash, Kurmangazinsky district, Atyrau area [24]. Infected animals may experience chronic debility similar to that caused by mouth and foot disease [25]. In April 2021, the Office International des Epizooties collected news about an epidemic of LSDV. Pakistan reported lumpy skin disease in 2022 as an enzootic infectious, eruptive disease and rarely fatal. Animals with lumps on their skin can experience variable morbidity and mortality rates. As a result of LSDV, Pakistani animal keepers face economic losses because of male sterility; reducing milk, beef production and, female abortions [26].

In South Asia, the disease has spread to Vietnam, China, Bangladesh, Nepal, and India. In India, the first case was reported in Odisha, with a morbidity rate of 7.1% and no deaths [27]. It was observed on 11 August 2020 that a 10 year old Holstein Friesian crossbred cow at NCRP Farm Rampur, Chitwan had nodules on the majority of her body and was salivating more than usual [28]. It is estimated that 18.5 lakh bovine animals have been affected by the LSDV, which has spread to nearly 15 states. Over 80,000 animals have died from the current version of the deadly virus, according to the most recent study. This study was organized by scientists of Council of Scientific and Industrial Research-Institute of Genomics and Integrative Biology (CSIR-IGIB) and the State Disease Diagnostic Centre, Jaipur that characterized circulating strains [29]. Indian cattle and buffalo numbers are 192.49 and 109.85 million, respectively, according to the 20th Livestock Census [30]. During November 2020, it was observed that LSD-like lesions were present on the neck, brisket, abdomen, thighs and udders of both local (Butana) and cross-bred cattle in Nahr Atbara and Halfa El Jadida region, Kassala State [31].

➤ *Transmission:*

LSDV is transmitted through different modes from one infected animal to others as shown in Fig. 1. The maggots flies of various families associated with farming animals. These flies mainly stable in winter season from September to November and extensively spread in every country and topographic zones that infects the animals and human [32]. Under favourable climate conditions, these flies and mosquitoes transmit virus through hematophagous vectors [33]. The virus takes 1- 5 weeks to grow and spread in animals. Over the past decade, the LSDV pathogen has

spread from Africa and the Middle East to south-east Europe, the Caucasus, Russia, and, more recently, Asia [12, 34-38]. Thousands of cows have been infected by this Eurasian LSDV epidemic, causing significant economic loss through loss of livestock, decreased productivity, and avoidance and control campaigns [39]. South-east Europe has been able to control the virus through the large scale use of the live-attenuated LSDV vaccine based on the Neethling strain of the virus [36, 40]. An inactivated oily vaccine based on the Neethling strain was developed and evaluated on cows. Vaccination was safe and did not cause any adverse reactions. High levels of specific antibodies were obtained starting on the seventh day. Protection against virulent challenging strains that causes typical infection in control animals was achieved. Amblyomma, Rhipicephalus, Aedes, and Stomoxys are the main vectors of LSDV transmission. There is a 10% mortality rate associated with this disease [41]. To prevent LSDV, only live attenuated vaccines (that was prepared in different ways in cell culture and in the embryonated chicken egg chorioallantoic membranes to attenuate these vaccines) are commercially available, but they are not currently certified in the European Union. In addition, these vaccine virus strains can cause significant adverse reactions with clinical signs similar to infections with virulent LSDV. Various diagnostic tools were evaluated using specimens collected in the field and from experimental inoculation, along with pan-capripox real-time qPCR, duplex real-time qPCR assays for determining virulent versus attenuated strains, and serological tests (Serum neutralization, indirect immunofluorescence and enzyme-linked immunosorbent assay). The mortality rate of lumpy skin disease outbreaks tends to be 40-75%, while morbidity ranges from 3-85% have been recorded in native community [42]. 156 putative genes encoded in the central region of the genome, which is a double-stranded, linear DNA genome (151 kbp). Animals with the virus shed it through their oral and nasal secretions, contaminating common water and feeding troughs, according to the United Nations Food and Agriculture

Organization (FAO). Later, the nodules may transform into ulcers, followed by a scab around the area. A recent spread of LSDV in India has a mortality rate of up to 15%, especially in the western part of the country, where the disease has a morbidity of 2% to 45%. Goats and sheep's are not affected by this virus. Virus persists for 33 days or longer in necrotic skin nodules in animals [25]. Viruses can be directly transmitted by sharing food and water with infected animals, or by infected animals' nasal and salivary discharges, or by sucking of milk by calves. Insects that feed on blood (arthropods vectors) transmit the disease indirectly i.e. butter flies and ticks. Non-biting insects can also spread this virus i.e. housefly, blowflies and bushfly [43]. In the Middle East, Europe, and Asia, the disease has spread. Initially reported in Asia and the Pacific region (Bangladesh, China, and India), lumpy skin disease spread to Taiwan, Myanmar, Vietnam, Thailand, and Hong Kong in 2019. An NBL-1 [ATCC-CCL-22] Madin-Darby bovine kidney cell line was used to isolate the sample [44]. An outbreak of LSD in Egypt was spread by an insect that feeds on blood i.e. Stomoxys calcitrans. There were outbreaks of LSD in Bahrain and Lebanon (1993), Yemen (1995), and United Arab Emirates (2000) [45]. In 1929, the disease was first identified in Northern Rhodesia (Zambia), and it has since spread to most of sub-Saharan Africa and North Africa, as well as to parts of the Middle East [46]. According to the OIE, this disease is listed on "List A" because of its rapid spread, severe economic consequences, such as decreased milk production and weight gain, mastitis, infertility, and death [47]. There are various agents that cause cruelty of the LSD, that involves the harshness of the virus strain that are endangered to the host and the different group of animals [48]. As compared to intravenous delivery that are less effective [49]. The bloodsuckers belonging to family Brachycera Cyclorrapha suborder both males and females of Stomoxys calcitrans L. They are less serve on pigs and horse as compared to cattle's [32]. Current study illustrates the spreading of lumpy skin disease by Rhipicephalus microplus ticks was confirmed [50].

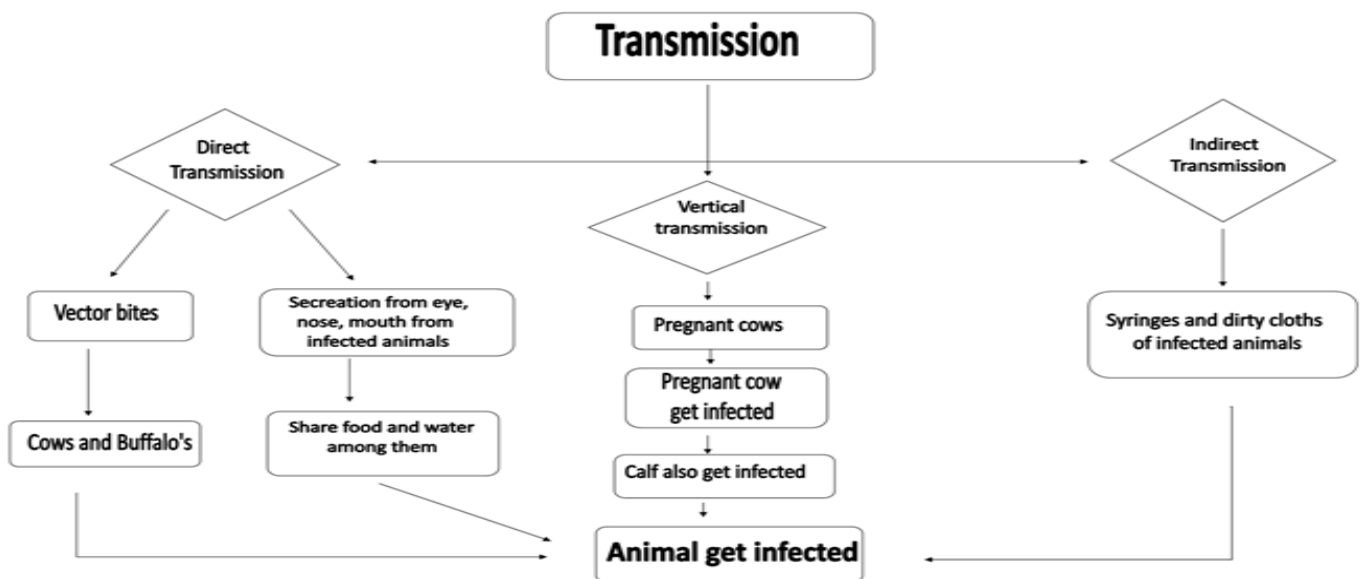


Fig 1 Transmission of LSDV

➤ *Clinical Finding:*

Cattles under the age of 4months-14years are more prone to get infected by this virus. The clinical signs in affects cattle's were circular lumps, anorexia, depression, constant high temperature. It is characterized by high temperature, nodular lesions on the skin, as well as inflammation of the mucosa of the respiratory tract and digestive tract. The diameter of nodules around 2-5cm. The nodules of infected cattle's on limbs are swollen because of edema. These nodules affects almost all parts of body mainly involving tails, udder, neck, face, ears, nasal, and legs. These nodules lead to insignificant complexity of ulcerative lesion, myiasis, mastitis, lameness, pneumonia, dysentery, and keratitis in affected animals. The temperature of normal cattle's ranges from 36 -39 °C, but the temperature of infected cattle's raises –upto 41 °C [9, 16, 51]. It may originate infertility in males and lose of milk production in females as well as miscarriages were also reported in the pregnant cattle's. Milk production in the cattle's is reduced up to 60% [18]. The clinical signs were watery eyes, running nose, hard flat-topped lumps on the body [51]. The rate of mortality of disease is low on [18]. As compared to its morbidity [7]. The Animal movement restrictions, vaccination costs, and secondary bacterial infections contribute to economic loss in Eastern Africa. Affected animals suffer permanent skin damage as a result of LSD infection, resulting in a reduction in their commercial value [53]. Symptoms of LSD include lymphadenopathy and nodules on all over the body [8].

➤ *Pathogenesis:*

At the site of inoculation an inflammation was appeared locally after 4-7 days that is post-infection (DPI) and show 0.01m-0.03m nodules or plaques and increase in lymphadenopathy between 7 and 19 DPI. After, 42 days of infection LSDV is found in bull's semen. Due to intracellular replication of the LSDV the tissues are damaged and cause vasculitis and lymphangitis. The virus mostly affects calves, underweight cattle's and lactating cow [8, 51]. Gray-white color's lumps are present on each layer of skin as well as on subcutis layer and in muscle fascia. The subcutaneous tissue showing a reddish-yellow edema in the region of various lesions. Pharyngeal lesions necrosis is much faster as compared to the skin lesions. Lumps in respiratory or alimentary tract, or in the prostate, vagina or uterine wall, has the similar feature [8, 54]. Many of cattle's infected by natural infections, automatically acquire immunity against LSDV. Thereafter, their calves also fight with LSDV after 6 months of their birth [8].

➤ *Structure of LSD Virus:*

The Neethling poxvirus is also called as prototype strain. Goat pox virus and sheep pox virus having an antiquing link with Lumpy virus [31, 55]. In lumpy virus, the shape of capsid or nucleocapsid were brick or oval, that contain genome and lateral bodies, that are enveloped or pleomorphic form of double stranded DNA having 70-91kilodalton molecular weight and 105000 nanometer molecular size. The bovine and ovine cells of animals were damaged by the LSDV that have a cytopathic reaction and

the pock lumps were caused by membrane of embryonic chicken eggs. The virus was suppressed for 1 hour at 55°C temperature [43, 56]. By using Nanopores and illumina technologies, the whole sequence of LSDV were analyzed. The virus contains 150445 base pair long, 156 pulative gene codes and has upside-down same terminals either on both ending. The double strand straight gene of LSDV was coated with double layer [27].

➤ *Clinical Diagnosis:*

By using molecular appliances such as B22R, RPO30, EEV glycoprotein genes and GPCR the virus was determined [12]. Research Laboratory give the approval of characteristics cases of lumpy through Regional Disease Investigation Laboratory, Department of Animal Husbandry, Akola, as per guidelines in the OIE manual [16]. For another verification of the disorder, it is desirable to collect a skin biopsy sample. Protective covering of specimens with glycerol in phosphate buffer saline of about 20% to 50%. Viruses were analysed by electron microscopy on skin samples [57]. Sheep pox can be diagnosed using a battery of diagnostic tests, including AGPT, Neutralization, Fluorescent antibody technique, PCR, Counter immune electrophoresis, Latex agglutination (LAT), ELISA, SRID [58]. Current levels of pseudo-lumpy skin disease need a different investigation [7]. A dose of 40ml of Oxytetracycline-SA Sig is given OD, Intramuscular for a week. A dose of 20ml was dispenses daily OD, Intramuscular, for a week using Meloxicam with Paracetamol. An injection of Chlorpheniramine Maleate is administered every alternate day for three days along with Intramuscular injection. At least for 3 days the herbal spray was sprayed on all over the body. Quarantine the inflamed animals and kept them in isolation sheds [28]. For the treatment of LSD the two different vaccines were used in Land of Sahara. A strain of Neethling of Lumpy Skin Disease were passed 50 times in the cell culture of lamb kidney cell and then in embryonated eggs for 20 times in southern Africa. In cattle's, the strain was immunogenic and painless, but local reactions in various animals are noted after vaccination. By using this vaccination, there is no contamination were occurred. The freeze-dried by-product was originated in tissue culture [25].

➤ *Medication:*

Anti-histamines, ivermectin (an anthelmintic drug), NSAID's and broad-spectrum antibiotics were given to the infected animals and positive results were observed within seven days of treatment. With the help of RT-PCR the samples of infected cattle's were analyzed [12, 16]. Various countries used homologous medication (for LSD virus) and dissimilar medication for live GTPV or SPPV for the treatment of virus. In India, 2019 the heterogeneous live attenuated vaccines were used to treat the infected cattle's [27]. After 90-92 days the virus is present in skin scab and after 5-12 days in blood and it was analyzed by using the polymerase chain reaction test in lab. Usage of Strepto-Penicillin at a dosage of 10 mg/kg, Chlorpheniramine maleate at dose of 0.25 mg/kg i.m., Meloxicamat dose of 0.25 mg/kg IM and B-complex at the dose of 5–10 ml,

Amoxicillin-Cloxacin at the dose of 10 mg/kg., Enrofloxacin at the dose of 5 mg/kg were also effective against LSDV [16]. An Intradermal vaccine was also developed to treat this viral infection [51].

- Medication For Lumpy Skin Disease Virus By Using Household Therapy:
The different herbal remedies which shows positive results against lumpy skin virus are shown in Fig. 2 [18].

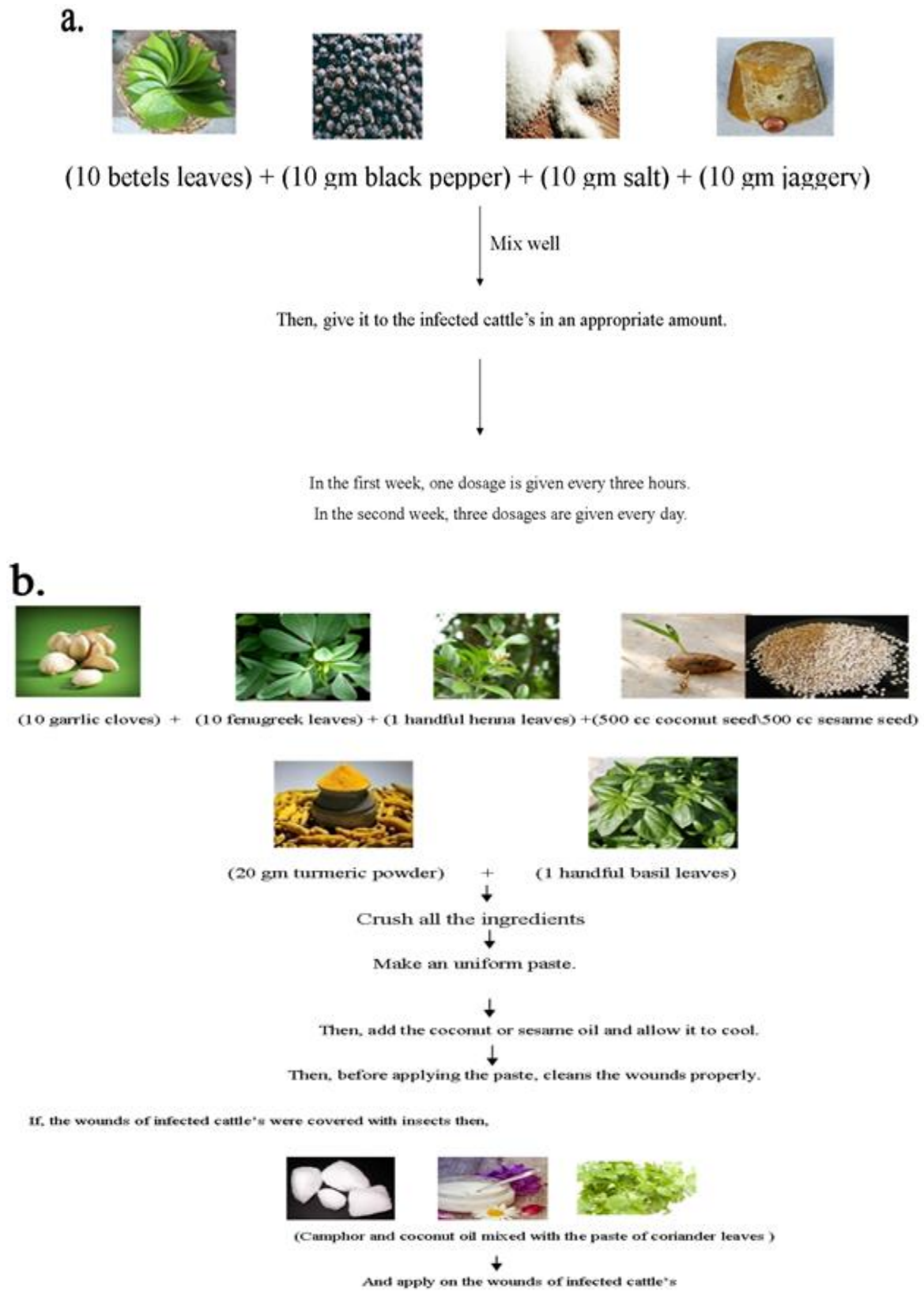


Fig 2 Herbal Remedies for Lumpy Skin Disease (a) Oral Administration; (b) Local Application.

➤ *Control And Prevention:*

Any live attenuated virus were used, contain the Neethling, for vaccination against sheep pox [7]. For the prevention and control of LSDV infections, the following way could be used: that is regular testing, quarantining, control the movement of sick animals, and decontaminating them, vaccination and immunotherapy, vector control, and treating morbid animals and in addition to ring vaccinations, quarantine, movement restrictions, and culling are often used [4, 59]. Antibodies were exposed to 6 species but prevalence is low [55]. Infected animals can be treated by using diclofenac gel to overcome swelling, along with broad spectrum antibiotics, and dexamethasone as anti-inflammatory medicine [4]. According to severity, penicillin, cephalosporin, tetracycline, fluoroquinolones, and others are given for at least one week [60].

➤ *Morbidity and Mortality*

The incubation period of virus is 2 to 4 weeks, and morbidity is 2 to 45 percent. The mortality rate of this disease is usually less than 10% depending on the immune status, age, and breed of the host. In most outbreaks, 2% of cases die, but some outbreaks may have a higher fatality rate [31]. In native regions, mortality ranges from 1% to 3% [61]. The mortality and morbidity rates of LSDV are between 3 and 85%, and from 1 to 40%, depending on the outbreak occurs in an endemic or non-endemic region [53]. Mortality was 0.96 percent and morbidity was 12.9% [62]. Sometime, mortality rates are as high that is 40%. LSDV harm to island breeds. It has been reported that mortality rates can exceed 40 percent, although they are usually between 1 and 5 percent [63]. The rate of mortality in native cattle can reach 5%, on the other hand 3% to 85% of morbidity rate [25].

➤ *Biology Of Lsdv:*

In daylight, the virus were deactivates for one hour at 55°C temperature under ultraviolet light. The virus was found to be susceptible to 20% chloroform, 2–3% sodium hypochlorite, 1% formalin, ether, 0.5% quaternary ammonium compounds, 2% phenol, and detergents containing lipid solvents [63].

➤ *Risk Factor:*

It reduces the production of milk by 10% to 85%, and in Nepal, it reduces milk production by 58.7%. Indirect economic impacts may include restrictions on animal trade, vaccination costs, treatment costs, and the cost of maintaining biosecurity [4]. LSD virus is transmitted primarily by arthropods [60]. Milk production is decreased, hides are damaged, absorption occurs, and male animals may become sterile temporarily or permanently. Diagnostic expenses, treatment costs, vaccination costs, and trade restrictions contribute to indirect losses [27].

III. CONCLUSION

Lumpy skin disease is a growing disease in the animals characterized by multiple cutaneous lumps in the skin of affected animals. In suitable climatic conditions, flies and mosquitoes transmit this virus through hematophagous vectors. It can be directly transmitted by sharing food and water with infected animals, or by infected animals' nasal and salivary discharges, or by sucking of milk by calves. Insects that feed on blood (arthropods vectors) transmit the disease indirectly. Damaged tissues promote vasculitis and lymphangitis due to intracellular replication of the LSDV. In 1929, firstly Lumpy skin disease was reported in Zambia. LSDV also transmitted in South Africa, Sudan, Israel and Egypt in 1989. Recently, the virus is also spread to Andaman and Nicobar also in northern and western states. In august 2019, it spread in India in 5 districts of Odisha. Thailand had its first case of lumpy skin disease in animals. In South Asia, the disease has spread to Vietnam, China, Bangladesh, Nepal, and India. As per recent studies, approximately 80,000 animals have been died from the current version of lumpy virus. The infection leads to infertility in males and reduces milk production in female animals upto 85%. The infected animals were medicated with anti-histamine, anti-inflammatory, NSAID's ivermectin, and broad-spectrum antibiotics for at least 5-7 days. Exposure to ultraviolet light at a temperature of 55°C denatures in day light. Ring quarantine, culling, movement restrictions, and mass vaccinations also reduce the chances of infection in animals. Research Laboratory give the approval of characteristics cases of lumpy through Regional Disease Investigation Laboratory, Department of Animal Husbandry, Akola, as per guidelines in the OIE manual. As the infection is spreading more and more day by day, it will lead to a great loss of animals which ultimately leads to economic loss to country. Therefore, it should be a major concern for the researchers.

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