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Effectiveness of Treating Foot and Mouth Disease Syndrome in Cattle Using Aqueous Extracts of Binahong Leaves, Cassava Arabica and Turmeric

(EFEKTIFITAS PENANGANAN SINDROM PENYAKIT MULUT DAN KUKU PADA SAPI MENGGUNAKAN EKSTRAKS AIR DAUN BINAHONG, SINGKONG ARAB DAN KUNYIT)

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ABSTRACT

Foot and Mouth Disease (FMD) in livestock is an infectious disease caused by a virus of the Aphtovirus genus. It affects ruminants (cattle, buffalo, goats, sheep, deer), pigs, camels and some wild animals. Theoretically, FMD is incurable because it is viral nature and its clinical symptoms may worsen with the onset of secondary bacterial infections. This study was aimed to evaluate the effectiveness of symptomatic and supportive treatment of FMD using herbal plants to address secondary infections, with the expectation that viral symptoms would subside or disappear entirely. This experimental research used a completely randomized design (CRD) involving 18 FMD-infected cattle, divided into three groups of six animals each. Group 1 served as the positive control (K), receiving penicillin and streptomycin (penstrep) and vitamin B_{12} injections and physiological natrium chloride (NaCl) solution sprayed on the wounds for five days. Treatment group P1 received oral administration of a 1000 mL/day extract containing binahong leaves, cassava leaves and turmeric (BSK), in addition to topical application on oral and hoof lesions three times daily. Treatment group P2 received the same BSK extract both orally and topically, combined with penstrep and vitamin B_{12} injections administered on days 1 and 3. Administration of the

BSK extract orally and topically continued for five days, and FMD symptoms were monitored daily during the treatment period. The results showed that in group P2, clinical signs of FMD had disappeared by day five of treatment, indicating recovery. Statistical analysis showed that P2 had significantly greater wound healing and disappearance of FMD symptoms compared to P1 and the control group ($p < 0.05$). This study demonstrates that treatment with aqueous extracts of binahong leaves, cassava leaves, and turmeric (BSK) is effective in alleviating FMD symptoms and promoting recovery.

Keywords: cattle with FMD; binahong (*Anredera cordifolia*); cassava arabica (*Manihot esculenta*); turmeric (*Curcuma domestica* Val.)

ABSTRAK

Penyakit mulut dan kuku (PMK) pada ternak merupakan penyakit menular disebabkan oleh virus genus Aphtovirus, menyerang ternak ruminansia (sapi, kerbau, kambing, domba, rusa), babi, unta, dan beberapa hewan liar. Secara teori PMK tidak dapat diobati karena disebabkan oleh virus dan gejala klinisnya bertambah parah jika terjadi infeksi sekunder oleh bakteri. Tujuan dari penelitian ini adalah untuk mengetahui efektivitas penanganan PMK secara simtomatik dan suportif menggunakan tanaman herbal guna mengobati infeksi sekunder, dengan harapan infeksi yang disebabkan oleh virus PMK menurun atau hilang sama sekali. Penelitian ini merupakan penelitian eksperimental dengan metode rancangan acak lengkap (RAL), menggunakan 18 ekor sapi terpapar PMK dibagi menjadi tiga kelompok, masing-masing kelompok terdiri atas enam ekor sapi. Pada kelompok 1 sebagai kontrol positif (K): diberikan injeksi penisilin dan streptomisin (pensrtep) dan vitamin B_{12} dan aplikasi spray luka dengan larutan garam natrium klorida (NaCl) fisiologis selama lima hari. Untuk perlakuan P1 (pemberian ekstraks daun binahong, daun singkong dan kunyit (BSK) secara per oral 1000 mL/ekor/hari serta diaplikasikan dengan spray pada luka di mulut dan kaki sehari tiga kali. Perlakuan P2 (injeksi penstrep dan vitamin B_{12} dikombinasi dengan ekstrak daun binahong, daun singkong dan kunyit secara per oral dosis 1000 mL/ekor/hari dan aplikasi spray pada luka di mulut dan kaki sehari tiga kali. Pemberian injeksi penstrep dan vitamin dilakukan sebanyak dua kali yaitu hari pertama dan hari ke tiga. Pemberian ekstraks BSK per oral dan secara topikal selama lima hari. Pengamatan terhadap sindrom PMK dilakukan setiap hari selama lima hari. Hasil penelitian menunjukkan bahwa pada kelompok P2 setelah pengobatan hari ke-5, sindrom PMK sudah tidak nampak atau ternak memperlihatkan kesembuhan. Analisis statistika menunjukkan bahwa pada perlakuan P2 terdapat proses penyembuhan luka dan hilangnya sindrom PMK dengan perbedaan yang nyata ($p<0,05$) terhadap perlakuan P1 dan kontrol positif (K). Penelitian ini menunjukkan bahwa pengobatan dengan menggunakan ekstraks aquadest daun binahong, daun singkong arab dan kunyit (BSK) dapat menyembuhkan sindom PMK.

Kata-kata kunci: sapi penderita PMK; daun binahong (*Anredera cordifolia*), daun singkong arab (*Manihot esculenta*); kunyit (*Curcuma domestica* Val)

INTRODUCTION

Foot and Mouth Disease (FMD) in livestock is an infectious disease caused by a virus from the Aphthovirus genus, affecting ruminants (such as cattle, buffalo, goats, sheep, deer), pigs, camels and some wild animals. The primary causes of FMD in cattle are several types of viruses, with the most common being FMD virus types A, B

and O, which belong to the Picornaviridae family and Aphthovirus genus. This disease has significant economic, social, and cultural impacts.

Indonesia was declared free from FMD in 1986, a status verified by the World Organisation for Animal Health (WOAH) in 1990. However, based on the Decree of the Minister of Agriculture of the Republic of Indonesia No.500.1/KPTS/PK/300/M/06/2022, FMD re-emerged as a re-emerging disease in livestock on June 25, 2022.

The FMD is highly contagious and can spread rapidly among susceptible livestock. The primary mode of transmission is direct contact between infected and healthy animals through saliva, urine, or fluid from lesions. Clinical symptoms of FMD include high fever (up to 41°C) accompanied by chills, loss of appetite (anorexia), a drastic drop in milk production in dairy cattle, weight loss, impaired thermoregulation, myocarditis, abortion in heifers, swelling of the mandibular lymph nodes, hypersalivation and the formation of blisters and erosions around the mouth, muzzle, nose, tongue, gums, hooves and teats (Verma *et al*., 2008). The disease cannot be cured directly as it is caused by a virus. Therefore, management focuses on symptommatic treatment, supportive therapy and antibiotics to treatment of infections.

This study was aimed to evaluate the effectiveness of treating FMD syndrome using extracts of binahong leaves, cassava arabica leaves and turmeric. By addressing secondary infections, it is expected that viral impacts may be reduced or eliminated altogether. Based on this rationale, the hypothesis of this study is that the aqueous leaves extracts of binahong (*Anredera cordifolia*), cassava arabica (*Manihot esculenta*), and turmeric (*Curcuma domestica* Val.) can significantly improve the clinical recovery of cattle affected by FMD by accelerating wound healing and reducing symptom severity when compared to conventional treatment alone.

Wound treatment in animals varies depending on the wound type, severity and species affected. Common treatment methods include wound cleansing, antibiotics, topical care and pain reliever management. Contaminated wounds are those with a high risk of infection due to microbial presence (Landen *et al*., 2016). Given the side effects of chemical drugs and the high cost of wound care, the use of medicinal plants is encouraged as an alternative or comple-mentary therapy. Herbal medicines are natural, more accessible and cost-effective. Among the potential medicinal plants are binahong, cassava arabica and turmeric.

Binahong (*A. cordifolia*) is a promising medicinal plant used traditionally for various ailments. All parts of the plant (roots, stems, leaves, flowers and tubers) have medicinal properties (Alrawaiq *et al*., 2014). Empirically, binahong is used to accelerate wound healing and skin regeneration. The leaves contain nitric oxide and oleanolic acid, which act as powerful antibacterial antioxidants. As an immune-stimulant, the flavonoid content enhances the effect of vitamin C, which supports neutrophil activity and lymphocyte transformation during inflammation. Additionally, ancordin in binahong stimulates antibody production, while nitric oxide improves blood circulation and promotes the release of growth hormones (Chuang *et al*., 2007). These effects aid in wound resistance and reduce erythema. Binahong extract also shows strong antioxidant activity, with an IC50 value of 40.27 ppm (Parwati *et al*., 2014). According to Rachmawati (2008), the leaves contain triterpenoid saponins, flavonoids and essen-tial oils. Phytochemical screening revealed the presence of flavonoids, phenols, saponins, alkaloids and steroids/triter-penoids (Anastar *et al*., 2013). Ethanol extracts of fresh and dried binahong leaves contain total flavonoids of 11.263 mg/kg and 7.81 mg/kg, respectively, mostly in the flavonol class, and total antioxidant levels of 4.25 mmol/100 g (fresh) and 3.68 mmol/100 g (dried) (Selawa *et al.*, 2013).

Cassava leaves (*M. esculenta*) are com-monly used to treat burns, suppurating wounds, and fresh wounds. They contain secondary metabolites with anti-inflammatory, antioxidant and antibacterial properties. Quercetin, a major flavonoid in

cassava leaves, acts as a potent antioxidant, promoting collagen production and vascular endothelial growth factor (VEGF), key factors in wound healing. Cassava leaves are also used tradi-tionally to treat rheumatism, fever, headaches, diarrhea, intestinal worms and to stimulate appetite (Hasim *et al*., 2016). Furthermore, Faezah *et al*. (2013) reported that cassava leaves contain several bioactive compounds, including alkaloids, flavonoids, tannins, phe-nollics and saponins. The leaves of *M. esculenta*, commonly referred to as "Arab cassava," contain amino acids that play an essential role in regenerating human cells and repairing damaged tissues, thereby restoring their function (Hasim *et al*., 2016). The vitamin B content in cassava leaves is necessary to support optimal metabolic processes in the body. Arab cassava leaves are also rich in antioxidants, which help protect body cells from damage caused by free radicals. Additionally, they are high in dietary fiber, promoting healthy digestion and preventing constipation. These leaves are a good source of iron, which helps prevent anemia, and they contain vitamins A and C, which are beneficial for eye and skin health. As such, Arab cassava leaves act as powerful antioxidants, aiding digestion, preventing anemia, supporting eye and skin health, enhancing immunity, reducing inflammation, preventing infections, and accelerating wound healing.

The use of water as the extraction solvent in this study was based on traditional practices of utilizing medicinal plants for wound therapy and on safety considerations for oral and topical administration in livestock. Water, being a polar solvent, primarily extracts polar to semi-polar secondary metabolites such as flavonoids, tannins, saponins, and glycosides, resulting in a metabolite profile distinct from that of organic solvent extracts such as methanol or ethanol, in line with the principle of “like dissolves like” (Hammond et al., 2006; Tshikalange, 2007; Yuslinda et al., 2012). Previous studies have reported that *Anredera cordifolia* leaves contain oleanolic acid with anti-inflammatory properties, *Manihot esculenta* leaves are rich in quercetin with antioxidant activity, and turmeric (*Curcuma domestica*) contains cur-cumin with antiinflammatory and antimicrobial effects, although most of these findings were obtained from extracts using organic sol-vents (Hammond et al., 2006; Tshikalange, 2007; Yuslinda et al., 2012). Other studies have shown that aqueous extracts of binahong leaves retain antibacterial activity against *Staphylococcus aureus* and *Esche-richia coli* (Setyowati et al., 2020) and inhibit the growth of *Colletotrichum capsici* (Yulia et al., 2016), supporting the notion that water-soluble components of the combined extracts of binahong, cassava leaves, and turmeric contribute to wound healing and clinical improvement in FMD-infected cattle through antiinflammatory, antibacterial, antioxidant, and tissue rege-neration mechanisms.

Turmeric (*C. domestica* Val.) contains curcumin, a potent antioxidant that can pre-vent cellular damage and mutations caused by free radicals (Kusumaningrum, 2008). Accor-ding to Winarsih *et al*. (2012), turmeric also possesses antiseptic and antibacterial proper-ties, making it effective in wound healing. The medicinal compounds in turmeric, known as curcuminoids, consist of curcumin, desmethoxycurcumin (approximately 10%), bisdemethoxycurcumin (1–5%), and other beneficial components, such as essential oils. These essential oils include sesquiterpene ketones like turmerone and tumeone (60%), zingiberene (25%), felan-drene, sabinene, borneol, and cineole. Seve-ral of these compounds can inhibit Cyclooxygenase-2 (COX-2) activity, thereby acting as antipyretics (Fahryl *et al*., 2019).

The primary components in turmeric rhizomes are curcuminoids and essential oils. According to research conducted by the Indonesian Spices and Medicinal Plants Research Institute (ISMPRI), the average curcumin content in turmeric rhizomes is 10.92% (Mohammad *et al*., 2007). Numerous studies and literature sources confirm the substantial pharmacological potential of turmeric rhizomes, including anti-inflam-

matory, immunomodulatory, antiviral, anti-bacterial, antifungal, antioxidant, antican-cer, anti-infective and antipyretic activities (Damayanti *et al*., 2014).

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RESEARCH METHODS

Experimental Animals

This research was an experimental study using a Completely Randomized Design (CRD) consisting of three treatment groups. A total of 18 female cattle infected with FMD were divided into three groups, with six animals in each group. The cattle were between 2.5 to 3.0 years of age, weighing 300–400 kg, and showed clinical signs of FMD such as high fever (pyrexia) reaching up to 41°C, anorexia (loss of appetite), excessive salivation (hypersaliva- tion) and lesions on the mouth, tongue and interdigital spaces of the hooves. The study was conducted on smallholder farms in Margawati Village, of District Kota Garut, Garut Regency, West Java Province.

Extract Preparation

Samples of binahong leaves (*A. cordifolia*), cassava arabica leaves (*M. esculenta*), and turmeric (*C. domestica* Val.) were collected from local farmers near the cattle farms. The binahong and cassava leaves were washed, sun-dried and hand-crushed, while turmeric was cleaned and sliced. Each plant material was weighed: 200 g of binahong leaves and 100 g of cassava leaves were macerated with distilled water (aquadest), stirred, left to settle and filtered using a 40 mesh sieve. The binahong and cassava extracts were then combined with turmeric and 2 liters of clean water, boiled at approximately 100 °C until the solution turned dark brown**,** filtered, cooled, and stored in bottles.. For topical application, the binahong-cassava-turmeric (BSK) solution was used directly. For oral administration, 100 g of palm sugar was added to 1000 mL of the solution. Water was used as the solvent in this study as it reflects traditional practices where communities use water to extract active compounds from these plants for wound treatment.

Treatment Procedures and Wound Measurement

Group K (positive control) received penicillin and strptomycin (Penstrep) and Vitamin B_{12} injections and had their wounds sprayed with physiological natrium chloride (NaCl) solution for five days. Treatment group P1 received BSK extract orally (1000 mL/ head/day) and topically (sprayed on mouth and foot lesions) three times a day, approximately 3–5 sprays per lesion per session to evenly cover the wound surface. Treatment group P2 received a combination of Penstrep and Vitamin B_{12} injections on days 1 and 3, along with oral and topical BSK extract administration at the same dosage and frequency as P1. Treatment lasted for five days. The FMD symptoms were monitored daily for five days, focusing on wound healing through the early proliferative phase and the disappearance of general clinical symptoms. The stages of wound healing include hemostasis, inflammation, proliferation and matu ration, with the inflammatory phase occurring immediately after injury and lasting for 3–4 days (Balqis *et al*., 2014). Wound measurements were conducted using a caliper. General clinical signs were assessed by mea-suring body temperature with a mercury thermometer, respiratory and heart rates using a stethoscope, and appetite by moni-toring the intake of forage and concentrate feed.

Data Analysis

Data were analyzed using SPSS version 21. One-Way Analysis of variance was performed with a significance level of $p<0.05$, followed by a post-hoc test to determine significant differences between treatment groups.

RESULTS AND DISCUSSION

The average measurements of wound/blister diameters on the mouth and gums are presented descriptively in Table 1. The research findings are presented in

Table 1. Treatment of FMD using a combination of binahong leaves, cassava ara-bica leaves and turmeric showed that within the first and second days following the final treatment, both treatment groups P1 and P2 demonstrated a reduction in inflammatory reactions in lesions on the mouth, tongue, gums and interdigital spaces. Remarkably, group P2 showed signs of complete healing. This result is likely attributed to the presence of active compounds in the herbal mixture including alkaloids, flavonoids, tannins, phenolics and saponins which possess antibacterial properties capable of suppressing secondary infections by eliminating bacteria in the wounds.

The healing observed (Figure 1, 2 and 3) in group P2 (receiving both pharmaceutical and herbal BSK treatment) was superior compared to group P1 (herbal extract only) and group K (pharmaceutical treatment only). Statistical analysis using One-Way ANOVA showed a significant difference ($p<0.05$) in lesion diameter across the three groups. Post-hoc analysis confirmed that group P2 had the smallest average lesion diameter (36.480a ± 0.076 cm) with a wound healing percentage of 83.13%. This suggests that the combined therapy produced a synergistic effect between the pharmaceutical components (Penstrep and Vitamin B_{12}) and the herbal compounds, effectively reducing inflame-mation caused by secondary bacterial infections in oral region and hoof lesions.

Group K, treated only with pharmaceu ticals, showed moderate recovery with an average lesion diameter of 37.007b ± 0.118 cm and 81.42% healing. Meanwhile, group P1 (herbal extract only) had an average lesion diameter of 38.441c ± 0.104 cm and 80.37% healing. The similarity in healing between P1 and K indicates that the herbal BSK extract alone was as effective as pharmaceutical drugs in wound recovery. Statistical drugs com-parison between P1 and K also revealed no significant difference ($p>0.05$), suggesting that herbal treatment could be a viable alternative to conventional therapy. This finding is similar to Chuang et al. (2007) report, who reported that binahong leaves contain nitric oxide and oleanolic acid powerful antioxidants with antibac-terial and immunestimulant effects. Flavo-noids in binahong enhance the efficacy of vitamin C by boosting neutrophil activity and lymphocyte transformation during inflamemation. Ancordin acts as an anti-gen to stimulate antibody production, while nitric oxide promotes blood flow and growth hormone release, accelerating the wound healing process.

Figure 1. In day-1, Cow K a control treatment:suffering from Fever (pyrexia) reaching 40.0°C, anorexia (loss of appetite), excessive salivation (hypersalivation), lesions on the mouth, gums, and interdigital spaces of the feet, able to stand normally (top left image); Cow P1 (beef cattle): Fever (pyrexia) reaching 40.2°C, anorexia, hypersalivation, lesions on the interdigital spaces, difficulty standing (top rigt image); Cow P2: Fever (pyrexia) reaching 40.3°C, anorexia, hypersalivation, lesions on the mouth, gums, and interdigital spaces. Unable to stand; collapsed (bottom right and left images).

Figure 2. In day-3, Cow K: Fever decreased to 39.1°C, appetite improved, mild and watery hypersalivation, lesions dried, standing normally, recovering process ongoing (top left image); Cow P1: Body temperature 39.1°C, normal appetite, no hypersalivation, lesions dried, standing normally, fully recovered (top right image); Cow P2: Average body temperature 39.0°C, no hypersalivation, normal appetite, mouth, gum, and foot lesions dried, standing and fully recovered (bottom left and right images)

Figure 3. In day-5, Cow K: Fever decreased to 39.1°C, appetite improved, mild and watery hypersalivation, lesions dried, standing normally, recovering process ongoing (top left image); Cow P1: Body temperature 39.1°C, normal appetite, no hypersalivation, lesions dried, standing normally, fully recovered (top right image); Cow P2: Average body temperature 39.0°C, no hypersalivation, normal appetite, mouth, gum, and foot lesions dried, standing and fully recovered (bottom left and right images).

Table 1. Average wound/blister diameter measurements on the mouth, gums, and hoof cracks

No	Treatment Group	AUC ± SEM	Healing Percentage (%)
1	Pharmaceutical (K)	37,007b ± 0,118	81,42 %
2	BSK Extract (P1)	38,441c ± 0,104	80,37 %
3.	Pharmaceutical + BSK (P2)	36,480a ± 0,076	83,13 %

Superscripts with different lowercase letters in the same row indicate significant differences ($p < 0.05$).

Tshikalange (2007) also noted that oleanolic acid in binahong has anti-inflammatory properties and reduces pain in burn wounds.

Anggraini *et al*. (2017) highlighted that cassava arabica leaves contain high levels of antioxidants that protect body cells from oxidative stress. Turmeric (*C. domestica* Val.), known for its antibacterial properties, helps eliminate bacteria in oral and hoof wounds. Quercetin in cassava leaves has strong antioxidant activity, pro-moting collagen production and enhancing vascular endothelial growth factor (VEGF), which plays a critical role in tissue regene-ration (Yuslinda *et al.,* 2012).

Administering multivitamins to cattle infected with FMD aims to strengthen their immune response against the virus. According to Duplessis *et al*. (2014), vitamins play a vital role in maintaining livestock health and productivity. Vitamin B-complex or B_{12} supplementation can reduce stress and boost stamina. Chen *et al*. (2011) further emphasized that vitamin B_{12} (cobalamin) is essential for cellular metabolism, especially in gastrointestinal, nervous and hematopoietic tissues, as well as for supporting overall cell growth.

Based on the data display by Figure 1, cattle in treatment group P2 initially

exhibited more severe clinical symptoms (including recumbency) compared to those in groups K and P1. However, following the combined treatment of pharmaceutical agents (vitamins, antibiotics and physiological NaCl spray) and the herbal extract of binahong leaves, cassava arabica leaves and turmeric (BSK), a marked improvement was observed by the third day (Figure 2). This included reduced inflammation, decreased body temperature, drying of oral lesions, reduction in hypersalivation, increased appetite, and the ability to stand. Recovery continued progresssively, with full clinical recovery observed by day five (Figure 3).

The rate of healing in group P2 was superior to groups K and P1 by day three, with clinical signs and lesions beginning to resolve. This suggests that the pharmaceutical treatment administered on day one, particularly Penstrep, effectively suppressed secondary bacterial infections, while the oral and topical administration of BSK extract enhanced general recovery and local wound healing. The combination therapy produced a synergistic effect that significantly accelerated healing.

Statistical analysis using one-way ANOVA revealed a significant difference ($p < 0.05$) between group P2 and both groups K (pharmaceutical treatment only) and P1 (herbal extract only). The enhanced healing in P2 is likely due to the combined action of Penstrep, vitamin B_{12}, physiological NaCl, and the BSK extract. Penicillin and streptomycin inhibit bacterial survival by disrupting cell wall synthesis (Ikiz *et al*., 2023; Suriyasathaporn, 2010). Supportive therapy with vitamin injections promotes tissue repair and overall recovery, while antiseptic NaCl spray helps reduce local microbial load.

As stated by Sudimartini *et al*. (2020), vitamin administration is essential for livestock health and longevity. Vitamin B_{12} plays multiple physiological roles, including cell metabolism in the gastrointestinal tract, bone marrow, nervous tissue, and growth cells (Grilo *et al*., 2015). Parwati *et al*. (2014) reported that binahong extract has strong antioxidant activity, with an Inhibitory Concentration 50% (IC50) value of 40.27 ppm. Cassava arabica leaves (*M. esculenta*) are rich in amino acids that support cell regeneration (Hasim *et al*., 2016). Turmeric rhizomes exhibit a wide range of pharmacological properties, including anti-inflammatory, antiviral, antibacterial, antifungal, antioxidant, anticancer, antipyretic and immune-modulating effects (Damayanti *et al*., 2014).

In group P1 (BSK extract only), symptom improvement was observed as early as day one or two post-treatment, surpasssing that of group K. This effect is likely due to the antiinflammatory, antibacterial and antioxidant actions of flavonoids, triterpenoids, tannins, saponins, curcumin, protein and vitamin C in the extract. These compounds enhance adrenocorticotropic hormone (ACTH) release from the pituitary, which in turn stimulates adrenal cortisol production, which then encourages the ongoing natural anti-inflammatory mechanism (Chu-ang *et al*., 2007).

In group K (pharmaceuticals only), recovery was relatively slower, with notable improvements seen only by day five. The slower response may be linked to higher stress levels in dairy cattle, which are more susceptible to FMD-related stress than beef cattle, potentially impairing immune response and delaying healing. Hansen (2014) emphasized that stress negatively affects immune function, reducing T-lymphocyte and macrophage activity. Kitching and Alexandersen (2002) also observed rapid debilitation and prolonged viral persistence in dairy cows following vesicular outbreaks.

Farooq *et al*. (2017) and Mesfine *et al*. (2019) reported that species, breed and viral strain influence FMD susceptibility and antibody titer levels. Exotic breeds tend to show lower seropositivity rates than local or crossbred animals. Additionally, female livestock often exhibit higher FMD seroprevalence (23.7%) compared to males (21.8%).

CONCLUSION

The combination of pharmaceutical drugs with aqueous extracts of binahong (*Anredera cordifolia*), cassava (*Manihot esculenta*), and turmeric (*Curcuma domestica Val.*) was effective in accelerating healing of lesions on the mouth, gums, and feet, and alleviating clinical symptoms in FMD infected cattle. This finding highlights the potential of herbal-based supportive therapy in improving recovery and mitigating the impact of FMD in livestock farming.

SUGGESTION

The combination of herbal extracts (binahong, cassava arabica, and turmeric) should be considered as an alternative treatment for FMD in cattle. Further research is needed to determine the optimal dosage and ensure safety. Standardization of the herbal preparation and integration into livestock health programs are also recommended.

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