OPEN ACCESS
Journal of Multidisciplinary Applied Natural Science Vol. 6 No. 2 (2026) https://doi.org/10.47352/jmans.2774-3047.363
Check for updates
Research Article

Hoof Pathologies in Cattle

Serhii Kulynych, Anastasiia Klymas, Oleksandr Shabalin , Tamila Zvenihorodska*, Maksym Petrenko, Ihor Kolomak, Oleksandra Tul, Viktor Slynko, Nataliia Avramenko, Tetiana Panasova, and Hanna Omelchenko

Received : May 10, 2025	Revised : September 23, 2025	Accepted : December 22, 2025	Online : March 4, 2026

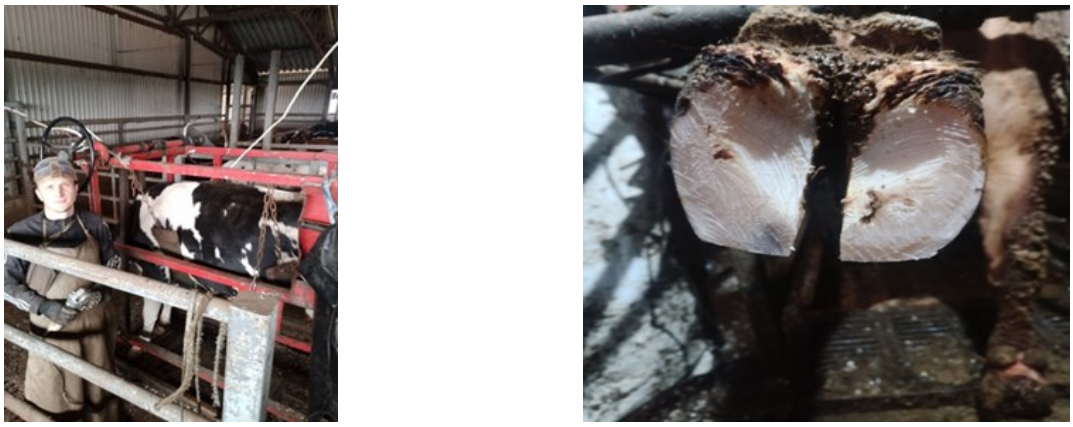
Abstract
Hoof pathologies are among the most widespread orthopedic disorders in dairy cattle and are a major contributor to reduced animal welfare and productivity. The present study investigated the prevalence, clinical presentation, and treatment outcomes of the most common hoof lesions – digital dermatitis (Mortellaro's disease), Rusterholz ulcers, purulent pododermatitis, and interdigital dermatitis – across multiple dairy farms in Ukraine. Clinical examinations and therapeutic procedures were performed on more than 9,800 cows from 7 farms during 2022–2023. Diagnosis was conducted during scheduled functional hoof trimming using an orthopedic crush and was confirmed based on lesion morphology, presence of exudate, odor, and pain response. A locally formulated topical powder composed of copper sulfate, zinc oxide, iodoform, and potassium permanganate was applied to purulent –necrotic lesions and compared with a control treatment using a commercial chemi-spray. Therapeutic efficacy was evaluated by lesion healing dynamics and locomotion scores (AHDB system) on days 3, 14, 21, and 45. Digital dermatitis was identified as the predominant lesion, accounting for 50–66% of all diagnosed hoof disorders. The locally formulated powder showed markedly superior therapeutic performance relative to the chemi-spray, accelerating tissue repair and improving locomotion, with full recovery achieved in 86.7–100% of treated cows, depending on farm and lesion type. These findings confirm the persistently high prevalence of hoof diseases in dairy herds and demonstrate the clinical advantage of an affordable, locally prepared treatment formulation. Routine functional trimming, early lesion detection, and evidence-based local therapy remain critical components of effective lameness management in modern dairy production systems.

Keywords: animal welfare, cattle, digital dermatitis, hoof lesions, lameness, prevalence, risk factors

1. INTRODUCTION

Hoof pathology in cattle remains a widespread and clinically significant issue. According to García -Muñoz et al. [1], orthopedic examinations revealed that 41.2% of cows showed no sole lesions, whereas 28.4% exhibited sole hemorrhages, 8.8% had thin soles, and 6.8% presented vertical cracks. Stilwell et al. [2] emphasized that hoof diseases markedly reduce dairy cow productivity and welfare, noting that removal of excessive or damaged horn tissue is a critical component of successful therapeutic management. Jury et al. [3], using the ICAR Hoof Health Atlas, reported high prevalence rates of heel horn erosion (92.9%/64.7%), digital dermatitis (55.9%/20.7%), white line disease (81.5%/17.7%), and sole hemorrhage (66.4%/11.6%) across Swiss dairy herds. Similarly, Fenster et al. [4] examined 2,220 cows and found that non-infectious hoof lesions were predominant, particularly in the pelvic limbs, with over 82% of affected cows showing digit-localized lameness and more than 80% involving the lateral claw.

Omontese et al. [5] demonstrated an association between hoof lesions and reduced fertility in Jersey cows, particularly in cases involving digital dermatitis and sole ulcers. Browne et al. [6] documented substantial differences in lesion prevalence between grazing and housed systems, confirming that environmental and managerial factors strongly influence lameness outcomes. By contrast, O'Driscoll et al. [7] observed a weak correlation between flooring hardness and hoof pathology, indicating that additional multifactorial contributors are involved, and reported that dry-period housing did not increase lameness risk. Jewell et al. [8] found that sole ulcers have a more pronounced negative effect on locomotion compared to digital dermatitis or sole hemorrhage. Neirurerová et al. [9] highlighted the value of continuous locomotion monitoring through automated systems. Complementing these findings, Beer et al. [10] demonstrated that sensor-based automated lameness detection achieved 90.2% sensitivity and 91.7% specificity, with lame cows displaying reduced feeding behavior and slower movements.



(a) (b)

Figure 1. Hoof trimming: (a) fixation of the animal in an orthopedic crush and (b) hooves after trimming.

Kofler [11] noted that computerized hoof-trimming databases implemented in several European countries and the USA provide essential herd-level health monitoring tools. Ferraro et al. [12] evaluated borescope-based diagnostics and confirmed its high accuracy for digital dermatitis assessment without the need for prior hoof cleaning. Gianesella et al. [13] showed that infrared thermography is an effective non-invasive diagnostic method, with affected cows exhibiting significantly elevated hoof surface temperatures. Schulz et al. [14] reported that early detection and routine therapeutic intervention significantly reduce lesion prevalence, based on 580 clinical examinations. Cutler et al. [15] demonstrated that the application of therapeutic hoof blocks improves mobility without adverse effects on milk production. Thomsen et al. [16] found that hoof trimming around the dry period lowers the incidence of sole ulcers by approximately 20%. Ninkovic et al. [17] further stressed the effectiveness of twice-yearly trimming in reducing the prevalence of sole ulcers and white line disease. Kučević et al. [18] established that housing systems strongly influence hoof disease patterns, with free-stall herds showing higher heel erosion rates and tethered systems presenting more cases of laminitis. Volkmann and Kemper [19] confirmed that pasture access significantly decreases the prevalence of hoof lesions. Additionally, Kulynych et al. [20] demonstrated that incorporating intravenous laser blood irradiation into treatment protocols improves both lameness resolution and lesion healing rates. The aim of this study was to evaluate the prevalence and structure of orthopedic hoof pathologies in dairy cows under commercial farm conditions and to assess the therapeutic efficacy of a locally prepared multicomponent powder for the local treatment of purulent-necrotic hoof lesions in comparison with a commercially available chemi-spray.

2. MATERIALS AND METHODS

The research was carried out at 7 dairy farms located in the Kharkiv region (Krasnohrad district, Mykolo-Komyshuvata village, LLC “Komyshuvatskyi Dairy Complex”), Sumy region (Sumy district, Kindrativka village, LLC “Agrofirm Lan”), Donetsk region (Pokrovsk district, Malynivka village, LLC Agrofirm “Yednist”), and Poltava region (Lubny district, Novyi Bairak village, SVK “Andriivskyi”; Iskivtsi village, FG “Vitas and K”; Poltava district, Mykhailivka Persha village, FG “Myr”; Vysoke village, PSP “Vysoke”). The study focused on purulent–necrotic lesions of the distal limbs in cattle. The research was conducted over a two-year period (2022–2023). Diagnosis of hoof lesions was performed during routine functional trimming using an orthopedic crush. The instrumentation included an angle grinder equipped with an orthopedic burr, hoof pliers, and standard hoof knives (Figure 1). Diagnostic assessment was based on visual inspection, identification of purulent exudate, detection of characteristic odor at the lesion site, and evaluation of localized pain responses elicited during manipulation. Lesions were classified

Table 1. Prevalence of orthopedic disorders in animals according to monitoring data.

Date	Location	Farm Name	Total Heads	Heads Trimmed	Affected Animals	% Affected	Pathology and number of affected animals
09.2022	Kharkiv region, Krasnohrad district, Mykolo-Komyshuvate	LLC Komyshuvatskyi Dairy Complex	1800	750	123	16.4	M-87, R-13, T-5, P-8, ID-10
01.2023			1800	750	77	10.3	M-47, R-15, T-3, P-10, ID-2
11.2022	Poltava region, Lubny district, Iskivtsi village	FG Vitas and K	1200	470	64	13.6	M-40, R-4, T-3, P-12, ID-5
05.2023			1500	670	83	12.4	M-55, R-5, T-3, P-13, ID-7
12.2023	Donetsk region, Pokrovsk district, Malynivka village	LLC Agrofirm Yednist	1300	530	25	4.7	M-13, R-3, T-1, P-5, ID-3
03.2023			1300	550	7	1.2	M-2, R-3, T-1, P-1
04.2023	Poltava region, Poltava district, Vysoke village	PSP Vysoke	500	200	18	9.0	R-8, T-2, P-5, ID-3
08.2022	Poltava region, Lubny district, Novyi Bairak village	SVK Andriivskyi	2000	800	72	9.0	M-42, R-7, T-6, P-14, ID-3
04.2023			2000	850	59	6.9	M-31, R-5, T-7, P-10, ID-6
07.2022	Poltava region, Poltava district, Mykhailivka Persha village	FG Myr	1500	700	38	5.4	M-12, R-11, T-5, P-7, ID-3
01.2022	Sumy region, Sumy district, Kindrativka village	LLC Agrofirm Lan	1500	700	44	6.3	M-23, R-9, T-7, P-4, ID-1

Notes: M – Mortellaro's disease; R – Rusterholz ulcer; T – Traumatic lesions; P – Purulent pododermatitis; ID – Interdigital dermatitis

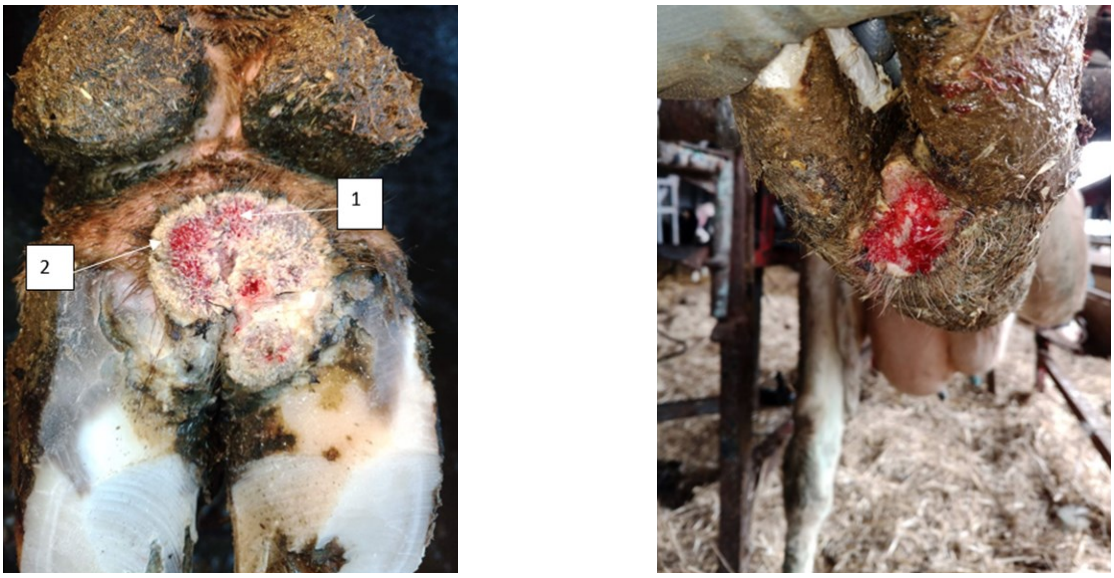
according to internationally recognized criteria described by Espinasse et al. (1982). For each cow, lesions were recorded as present or absent on the hind limb claws, following the methodological approach outlined in the previous work [20].

When necessary, photographs of pathological lesions were taken to document lesion morphology. Initial images were captured using a smartphone camera positioned approximately one meter behind the cow, followed by additional photographs from both the left and right sides to obtain lateral views. The number of animals examined at each dairy farm ranged from 500 to 2,000, resulting in a total of 9,800 cows screened for orthopedic pathologies during 2022–2023. The number of cows treated for hoof disorders varied between farms and ranged from 18 to 123 animals. For therapeutic intervention, after cleaning the lesion, performing curative trimming, and removing purulent–necrotic tissue, a topical powder composed of 30.0% copper sulfate, 30.0% zinc oxide, 30.0% iodoform, and 10.0% potassium permanganate was applied directly to the defect and secured with a bandage. The procedure was repeated after three days when clinically indicated. The therapeutic performance of the powder was compared with that of a commercial chemi-spray, which served as the control treatment. Both approaches were used to manage digital dermatitis (Mortellaro's disease), Rusterholz ulcers, traumatic lesions, purulent pododermatitis, and interdigital dermatitis.

Therapeutic efficacy was evaluated based on lesion healing rate and reduction in lesion size. Initial treatment and follow-up examinations were performed on days 0, 3, 14, and 21. Mobility assessment of treated cows within the milking herd was conducted at the same intervals as they exited the milking parlor following morning, afternoon, or evening milkings. Locomotion was evaluated using the AHDB mobility scoring system, and herd-level mobility was assessed as cows entered the parlor. Mobility scores ranged from 0 (normal mobility) to 3 (severe impairment). The scoring criteria were defined as follows: Score 0 – Good mobility: The cow walks evenly with balanced weight distribution and a regular rhythm on all four limbs; the back remains level and stride length are long and fluid. Score 1 – Imperfect mobility: Steps show slight irregularities in rhythm or weight distribution, or strides are shortened; the affected limb(s) are not immediately identifiable. Score 2 – Impaired mobility: Noticeable uneven weight distribution on a clearly identifiable limb; steps are shortened, commonly accompanied by an arched back. Score 3 – Severe mobility impairment: The cow is unable to maintain pace with the herd at a normal walking speed, shows pronounced lameness, bears minimal weight on the affected limb, and maintains a

(**a**) (**b**)

Figure 2. Mortellaro's disease: (a) Ulcer located on the lateral digit of the pelvic limb above the heel. 1 – small granulations, 2 – epithelial growth. and (b) Lesion affecting both digits, characterized by an ulcer above the heel. 1 – accumulation of necrotic tissue, 2 – growth of small granulations.



(**a**) (**b**)

Figure 3. Mortellaro's disease: (a) Ulcer located in the posterior third of the interdigital space of the pelvic limb digits, above the heel. 1 – small granulations; 2 – necrotic tissues and (b) Ulcer located in the anterior third of the interdigital space of the pelvic limb digits, above the coronary band. 1 – accumulation of necrotic tissue; 2 – growth of small granulations.

markedly arched back during standing and movement.

3. RESULTS AND DISCUSSIONS

Upon analyzing the data presented in Table 1, it was determined that the percentage of orthopedic pathologies diagnosed during hoof trimming ranged from 1.2% to 16.4%.

Among the identified conditions, infectious lesions caused by Mortellaro's disease were found to be the most prevalent (Figures 2 and 3).

According to the orthopedic trimming data obtained at LLC "Komyshuvatskyi Dairy Complex," Mortellaro's disease accounted for 70.7% of all orthopedic pathologies in 2022 and 61.0% in 2023, indicating a year-to-year decrease of 13.8%. At FG "Vitas and K" (Poltava region, Lubny district, Iskivtsi village), the prevalence of Mortellaro's disease reached 62.5% in 2022 and increased to 66.5% in 2023, representing a rise of 6.1%. At SVK "Andriivskyi" the proportion of affected cows decreased from 58.3% in 2022 to 52.5% in 2023, corresponding to a 10% reduction. High therapeutic effectiveness of curative trimming was particularly evident at LLC Agrofirm "Yednist" where the prevalence declined sharply from 52.0% to 28.5% between 2022 and 2023, reflecting a 45.2% reduction. At FG "Myr," Mortellaro's disease accounted for 31.5% of diagnosed hoof disorders, whereas at LLC Agrofirm "Lan," it represented 52.5% of cases.

Overall, Mortellaro's disease was the most prevalent pathology across the monitored farms, frequently constituting more than 60% of all orthopedic lesions. This finding aligns with previously published data identifying digital dermatitis as one of the major causes of lameness in dairy cattle. Laven and Logue [21] reported that digital dermatitis typically represents 60–70% of hoof pathologies in affected herds due to its high transmissibility and tendency toward chronic, recurrent lesions. These authors also emphasized that local therapeutic interventions usually lead to rapid improvement, with active epithelialization occurring within 14–21 days. The treatment dynamics observed in our study—particularly the marked reduction in lesion numbers by days 14 and 21—correspond closely with the literature and confirm the high clinical responsiveness of Mortellaro's disease to targeted local therapy [22] [23].

Rusterholz ulcer represented another important contributor to lameness, although its prevalence

varied considerably between farms, ranging from isolated cases to more than 40% of all identified hoof lesions. This variation is consistent with earlier reports indicating that the development of sole ulcers is influenced by multiple risk factors, including excessive loading of the lateral claw, subclinical laminitis, flooring characteristics, and prolonged standing times [24]. Randall et al. [25] further noted that claw conformation and horn quality strongly determine ulcer susceptibility, which may explain the substantial differences observed between farms with contrasting housing and management systems. The favorable treatment responses recorded in our study, particularly the rapid recovery in experimental groups, are in line with the findings of other authors showing that timely corrective trimming and evidence-based local therapy significantly accelerate horn regeneration and resolution of ulcerative lesions.

At LLC "Komyshuvatskyi Dairy Complex," the prevalence of Rusterholz ulcers increased from 10.5% in 2022 to 19.4% in 2023, representing an 84.7% rise (Figure 4).

At FG "Vitas and K" the incidence of Rusterholz ulcer remained stable at approximately 6% within the overall structure of hoof pathologies during 2022–2023. At LLC Agrofirm "Yednist" only isolated cases were detected (three cases across both years). In contrast, at PSP "Vysoke" this lesion constituted the largest proportion of hoof disorders, accounting for 44% of all diagnosed pathologies. At SVK "Andriivskyi" the prevalence decreased by 13.5%, from 9.7% in 2022 to 8.4% in 2023. Similarly, at FG "Myr" Rusterholz ulcer accounted for 28.9% of lesions, while at LLC Agrofirm "Lan" the prevalence reached 20.9%. Regarding purulent pododermatitis (Figure 5), a substantial increase was observed at LLC "Komyshuvatskyi Dairy Complex" where the proportion doubled from 6.5% in 2022 to 12.9% in 2023. At FG "Vitas and K" the prevalence declined by 16.6%, decreasing from 18.7% in 2022 to a lower rate in 2023. LLC Agrofirm "Yednist" recorded 18.5% of cases in 2022, whereas only a single case was observed in 2023. At SVK "Andriivskyi" the prevalence decreased from 19.4% in 2022 to 16.9% in 2023, corresponding to a 12.9% reduction.

Purulent pododermatitis demonstrated substantial variability among the studied farms, with its prevalence ranging from less than 1% to more than 55% of all hoof pathologies. According to Toussaint Raven (1989), purulent forms of pododermatitis are commonly secondary to mechanical trauma, inadequate hoof care, or prolonged exposure to moisture—factors that compromise the integrity of the sole horn and predispose the tissue to bacterial invasion [26]. Kofler [27] further emphasizes that early identification and timely local treatment are essential to prevent deeper tissue involvement and reduce the risk of chronic lameness. The therapeutic outcomes observed in our study—particularly the rapid disappearance of purulent exudate and complete recovery by day 21 in most herds—correspond well with these principles, indicating that the applied treatment protocol effectively addressed both the infectious and mechanical components of the lesion. At PSP "Vysoke,"

(**a**) (**b**) (**c**) (**d**)

Figure 4. Rusterholz ulcer: (a) Initial stage showing blood infiltration of the sole horn; (b) thinning of the horn, necrosis, and ulcer formation in the heel region; and (c,d) severe tissue necrosis, open wounds, and hemorrhages.

(a) (b) (c) (d)

Figure 5. Purulent pododermatitis: (a, b) Hoof deformation as the primary cause and (c, d) purulent pododermatitis with sole detachment in the toe region.

(a) (b)

Figure 6. Traumatic hoof lesions: (a) Defect of the lateral hoof and (b) application of a bandage.

purulent pododermatitis represented 55.5% of all hoof pathologies, while the prevalence at FG "Myr" reached 18.4%, and at LLC Agrofirm "Lan" it was limited to only 0.9%.

Analysis of traumatic hoof lesions (Figure 6) showed that at LLC "Komyshuvatskyi Dairy Complex," FG "Vitas and K," and LLC Agrofirm "Yednist," their proportion ranged from 1.4% to 4.6% during 2022–2023. In contrast, at PSP "Vysoke," SVK "Andriivskyi," FG "Myr," and LLC Agrofirm "Lan," the prevalence was two to three times higher, ranging from 8.3% to 15.9%. Statistical analysis of interdigital dermatitis (Figure 7) revealed a marked decrease at LLC "Komyshuvatskyi Dairy Complex" where prevalence declined from 8.1% in 2022 to 2.5% in 2023. At FG "Vitas and K" and LLC Agrofirm "Yednist" the incidence remained relatively stable across both years, at approximately 7.8–8.4% and 12.0–14.0%, respectively. By contrast, SVK "Andriivskyi" exhibited an increase from 4.1% in 2022 to 10.1% in 2023. At PSP "Vysoke" interdigital dermatitis accounted for 16.6% of hoof pathologies, while at FG "Myr" it constituted 7.8%, and at LLC Agrofirm "Lan" only 2.2%.

Analyzing the obtained data (Table 2) regarding Mortellaro's disease, it was established that lesions in cows were locally registered at the stages of exudative or proliferative ulcers.

Using the proposed therapeutic powder at LLC "Komyshuvatskyi Dairy Complex" a dense protective scab formed over the lesion within the first three days. By day 3, granulation tissue with a characteristic pale, coagulated appearance was noted beneath the scab. From day 14 onward, lesions smaller than 2 cm had either completely resolved or were actively epithelializing in 9.1% of affected animals. By day 21, the number of cows with active lesions in the experimental group had decreased by 55.9% compared with baseline and was reduced by half relative to day 14. In contrast, in the control group treated with chemi-spray, complete resolution of small ulcers was recorded in only 30.0% of cows.

After 1.5 months of observation, 10.3% of cows in the experimental group still had incompletely healed but dry lesions. The proportion of such cases in the control group was threefold higher. Clinical

(a) (b) (c)

Figure 7. Interdigital dermatitis: (a, b) Tissue necrosis of the interdigital space and ulcer formation.

Table 2. Treatment outcomes for cows with Mortellaro's disease.

Date	Farm Name	Group	Affected Cows	Day				
				0	3	14	21	45
09.2022	LLC	E	77	77	77	70	34	8
	Komyshuvatskyi	C	10	10	10	10	7	3
01.2023	Dairy Complex	E	37	37	37	31	15	4
		C	10	10	10	10	7	5
11.2022	FG Vitas and K	E	30	30	30	27	20	2
		C	10	10	10	5	3	2
05.2023		E	45	45	45	43	21	6
		C	10	10	10	9	7	3
12.2023	LLC Agrofirm	E	10	10	10	7	2	0
	Yednist	C	3	3	3	3	1	0
08.2022	SVK Andriivskyi	E	32	32	32	27	16	0
		C	10	10	10	8	5	2
04.2023		E	21	21	21	15	10	0
		C	10	10	10	9	5	1
07.2022	FG Myr	E	7	7	7	7	4	0
		C	5	5	5	5	3	0
01.2022	LLC Agrofirm	E	13	13	13	11	7	0
	Lan	C	10	10	10	10	5	0

patterns across other farms were generally similar; therefore, only the therapeutic efficacy results are presented below. At FG "Vitas and K" in 2022, recovery in the experimental group began from day 14, with 10.0% of cows healed at this time. By day 21, one-third of the experimental group had recovered, compared with 30.0% in the control group. Final therapeutic effectiveness reached 93.4% in the experimental group versus 70.0% in the control group.

In 2023 at the same farm, 11.2% of animals in the experimental group and 10.0% in the control group had recovered by day 14. By day 21, recovery rates reached 50.0% and 40.0%, respectively. By day 45, final recovery rates were 86.7% in the experimental group and 80.0% in the control group. At LLC Agrofirm "Yednist" 30.0% of cows in the experimental group had recovered by day 14, increasing to 80.0% by day 21. By day 44, no active lesions remained. In the control group, one-third of cows had recovered by day 21, and complete recovery was also achieved by the end of

the experiment. At SVK "Andriivskyi" in 2022, the recovery rate by day 14 was 15.7% in the experimental group and 20.0% in the control group. By day 21, 50.0% of animals in both groups had healed. By day 45 (Figure 8), therapeutic effectiveness reached 100.0% in the experimental group and 80.0% in the control group.

After 1.5 months of observation, 10.3% of cows in the experimental group still had incompletely healed lesions, although the lesion surfaces were dry and showed no signs of active inflammation. In the control group, the proportion of such cases was three times higher. The 2023 study demonstrated treatment efficacy relative to baseline values of 28.6% in the experimental group and 10.0% in the control group by day 14; 50.0% in both groups by day 21; and 100.0% in the experimental group versus 90.0% in the control group by day 45. At FG "Myr" the first recovery was recorded on day 21, with 42.9% of cows in the experimental group and 60.0% in the control group fully healed at that time. By day 45, all animals in both groups had recovered.

At LLC Agrofirm "Lan" 15.6% of cows in the experimental group had recovered by day 14. By day 21, recovery rates reached 46.2% in the experimental group and 50.0% in the control group. By day 45, no active lesions remained in either group. The results presented in Table 3 confirmed the high therapeutic effectiveness of the treatment

(**a**) (**b**)

Figure 8. Mortellaro's disease: (a) 1. Before treatment: 1 – ulcers in the heel region; 2 – bruising on the sole and (b) after 1.5 months of treatment: 1 – skin regeneration; 2 – absence of sole bruising.

Table 3. Treatment outcomes for cows with Rusterholz ulcer.

Date	Farm Name	Group	Affected Cows	Day 0	Day 3	Day 14	Day 21	Day 45
09.2022	LLC	E	10	10	10	5	0	0
	Komyshuvatskyi	C	3	3	3	1	0	0
01.2023	Dairy Complex	E	12	12	12	2	0	0
		C	3	3	3	1	0	0
08.2022	SVK	E	4	4	4	1	0	0
	Andriivskyi	C	3	3	3	1	0	0
07.2022	FG Myr	E	8	8	8	5	1	0
		C	3	3	3	3	1	1
01.2022	LLC Agrofirm	E	6	6	6	2	0	0
	Lan	C	3	3	3	1	0	0
04.2023	PSP Vysoke	E	5	5	5	1	1	0
		C	3	3	3	2	1	0

Table 4. Treatment outcomes for cows with purulent pododermatitis.

Date	Farm Name	Group	Affected Cows	Day 0	Day 3	Day 14	Day 21
09.2022	LLC	E	5	5	5	2	0
	Komyshuvatskyi	C	3	3	3	2	0
01.2023	Dairy Complex	E	7	7	7	2	0
		C	3	3	3	1	0
11.2022	FG Vitas and K	E	9	9	9	3	0
		C	3	3	3	1	0
05.2023		E	10	10	10	2	0
		C	3	3	3	1	0
08.2022	SVK Andriivskyi	E	11	11	11	3	0
		C	3	3	3	2	0
04.2023		E	7	7	7	1	0
		C	3	3	3	1	0
07.2022	FG Myr	E	4	4	4	1	0
		C	3	3	3	1	0

protocol in cows with Rusterholz ulcers. Cows were classified as recovered when lameness was no longer observed, no purulent exudation was present, and the lesion site was actively filled with newly forming sole horn.

According to the data presented in Table 3, by day 14 of observation, 50.0% of cows in the experimental group at LLC "Komyshuvatskyi Dairy Complex" had recovered, compared with 66.0% in the control group. At SVK "Andriivskyi" the recovery rates were 83.4% in the experimental group and 66.6% in the control group. At FG "Myr" 37.5% of cows in the experimental group were healed, while at LLC "Agrofirm Lan" recovery reached 66.6% in both the experimental and control groups. At PSP "Vysoke" the recovery rate reached 80.0% in the experimental group and only 33.0% in the control group. By day 21, one cow remained affected in both groups at FG "Myr." The cow in the control group remained affected through day 45, while the remaining animals recovered.

Evaluation of local treatment efficacy for purulent pododermatitis (Table 4) was based on the disappearance of lameness and absence of purulent exudate. At LLC "Komyshuvatskyi Dairy Complex," 66.0% of cows in the experimental group had recovered by day 14 in 2022, compared with 33.0% in the control group. In the 2023 follow-up study at the same farm, recovery rates reached 71.5% and 66.0% in the experimental and control groups, respectively. Across other farms, the following results were recorded. At FG "Vitas and K" recovery in 2022 reached 66.0% in both groups by day 14. In 2023, the experimental group achieved an 80.0% recovery rate, whereas the control group remained at 66.0%. At SVK "Andriivskyi" the 2022 recovery rates were 72.8% in the experimental group and 33.0% in the control group. In 2023, the values were 71.5% and 66.0%, respectively. At FG "Myr," recovery rates reached 75.0% in the experimental group and 66.0% in the control group.

In accordance with the objectives of the study, local treatment was also applied to cows diagnosed with interdigital dermatitis (Table 5). Compared with other orthopedic pathologies, affected cows demonstrated markedly faster recovery. By day 3, clinical signs had resolved in 28.6% of cows in the experimental group at LLC "Komyshuvatskyi Dairy Complex" At FG "Vitas and K" improvement was recorded in 25.0% of animals, while at SVK "Andriivskyi" 33.0% of cows in both the experimental and control groups exhibited early clinical improvement. By day 14, most cows across all studied farms had recovered. At LLC "Komyshuvatskyi Dairy Complex" therapeutic effectiveness relative to baseline reached 85.8% in the experimental group and 66.0% in the control

group. At FG "Vitas and K" both groups achieved a 66.0% recovery rate, whereas at SVK "Andriivskyi" complete recovery (100.0%) was recorded in all treated cows.

To enhance the effectiveness of local treatment and reduce the likelihood of lesion recurrence, hoof baths were introduced at the exit of the milking parlor. The procedure was initiated on the fourth day after treatment, immediately after bandages were removed from the affected limbs. The hoof bath system consisted of two consecutive baths: the first filled with clean water and the second with a 7.0% copper sulfate solution. Baths were administered twice weekly with a three-day interval between sessions. Each bath had a capacity of 200 L, providing an estimated consumption of 1 L/cow, sufficient for approximately 200 cows. The solution was replenished as needed to maintain effective disinfectant concentration.

Interdigital dermatitis demonstrated considerably faster clinical improvement compared with other hoof disorders, with most animals recovering by day 14 of observation. This clinical pattern aligns with the descriptions provided by Kofler (2017), who characterizes interdigital dermatitis as an early-stage inflammatory condition that responds rapidly to appropriate local antimicrobial therapy [14]. Relun et al. (2012) further emphasize that, unlike digital dermatitis or sole ulcers, interdigital dermatitis often resolves quickly when environmental moisture is reduced and targeted treatment is initiated without delay [28]. The results of the present study—particularly the early regression of lesions observed as early as day 3 and the near-complete recovery across farms by day 14—are consistent with these published findings and confirm the high responsiveness of interdigital dermatitis to timely therapeutic intervention. Mobility assessment (Table 6) of cows treated for Mortellaro's disease revealed that, on day 3, 79.3% of cows in the experimental group exhibited a lameness score of 1, while 20.7% scored 2. By day 14, no signs of lameness were observed in this group. In contrast, among control cows, 70.4% had a score of 1 and 29.6% a score of 2 on day 3. Assessment of mobility in cows with Rusterholz ulcers showed that, on day 3, 75% of animals in the experimental group exhibited lameness with a score of 2, and 26.6% had a score of 1. In the control group, 66.6% scored 2, 22.2% scored 1, and 11.1% scored 3.

4. CONCLUSIONS

The results of the present study clearly demonstrate the high prevalence of hoof pathologies in dairy cattle, with Mortellaro's disease representing the largest proportion of diagnosed lesions (50–66%). The proportion of Rusterholz ulcers ranged from 6% to 28.9%, purulent pododermatitis from 0.9% (LLC Agrofirm "Lan") to 19.4% (SVK "Andriivskyi"), and interdigital dermatitis from 2.2% (LLC Agrofirm "Lan") to 16.6% (PSP "Vysoke"). These variations reflect the influence of housing systems, environmental hygiene, claw horn quality, and farm -specific management practices on the distribution of hoof disorders. The study confirmed that the local application of the proposed therapeutic powder for purulent-necrotic hoof lesions provides consistent and progressive healing in the majority of affected cows. In terms of therapeutic efficacy, the formulation was comparable to—and in many instances exceeded—the effectiveness of a

Table 5. Treatment outcomes for cows with interdigital dermatitis.

Date	Farm Name	Group	Affected Cows	Day 0	Day 3	Day 14	Day 21
09.2022	LLC	E	7	7	5	1	0
	Komyshuvatskyi	C	3	3	3	1	0
	Dairy Complex						
05.2023	FG Vitas and K	E	4	4	3	1	0
		C	3	3	3	1	0
04.2023	SVK	E	3	3	2	0	0
	Andriivskyi	C	3	3	2	0	0

Table 6. Mobility score assessment of treated cows according to the AHDB system.

Pathology	Group	Affected Cows	Day	Score 0	Score 1	Score 2	Score 3	Score 0	Score 1	Score 2	Score 3
Mortellaro's disease	E	343	Day 3	0	272	71	0	Day 14	0	0	0
	C	88	Day 3	0	62	16	0	Day 14	0	0	0
Rusterholz ulcer	E	45	Day 3	0	12	31	2	Day 14	5	35	5
	C	18	Day 3	0	4	12	2	Day 14	4	11	3
Purulent pododermatitis	E	53	Day 3	0	18	35	0	Day 14	16	37	0
	C	21	Day 3	0	7	14	0	Day 14	10	11	0
Interdigital dermatitis	E	14	Day 3	0	7	7	0	Day 14	4	10	0
	C	9	Day 3	0	6	3	0	Day 14	2	7	0

commercially available chemi-spray, as demonstrated by faster lesion resolution and more rapid restoration of mobility. From an economic standpoint, the use of an inexpensive, locally prepared treatment offers clear advantages: reduced medication costs, shorter recovery periods, and lower milk yield losses associated with prolonged lameness. This makes the formulation particularly valuable for farms with limited access to imported pharmaceuticals or constrained budgets. These findings underscore the importance of regular hoof trimming, early lesion detection, and evidence-based local therapy as essential components of herd health management. Ensuring timely intervention not only improves animal welfare but also helps prevent chronic lameness, reduces culling risk, and supports stable milk production. Future research should explore the long-term productivity benefits associated with improved hoof health, including effects on reproductive performance, lactation persistence, and culling dynamics. Additional studies are also warranted to evaluate this therapeutic protocol across diverse housing systems, feeding strategies, and environmental conditions to enhance the generalizability and practical applicability of the treatment approach in different dairy production contexts.

AUTHOR INFORMATION

Corresponding Author

Tamila Zvenihorodska — Department of Surgery and Obstetrics, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0002-4186-5700
Email: tzvenig@gmail.com

Authors

Serhii Kulynych — Department of Surgery and Obstetrics, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0003-1660-643X

Anastasiia Klymas — Department of Surgery and Obstetrics, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0002-6633-1553

Oleksandr Shabalin — Department of Surgery and Obstetrics, Poltava State Agrarian University, Poltava-36003 (Ukraine);

orcid.org/0000-0002-4882-6173
Maksym Petrenko — Department of Infectious Pathology, Hygiene, Sanitation and Biosafety, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0002-5275-9401
Ihor Kolomak — Department of Normal and Pathological Anatomy and Physiology of Animals, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0002-1601-893X
Oleksandra Tul — Department of Surgery and Obstetrics, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0002-2430-1575
Viktor Slynko — Department of Animal Production Technology, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0002-1673-5840
Nataliia Avramenko — Department of Normal and Pathological Anatomy and Physiology of Animals, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0002-1920-5757
Tetiana Panasova — Department of Surgery and Obstetrics, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0002-4103-7956
Hanna Omelchenko — Department of Normal and Pathological Anatomy and Physiology of Animals, Poltava State Agrarian University, Poltava-36003 (Ukraine);
orcid.org/0000-0001-9389-8400

Author Contributions

S. K. – study conception, methodology design, and supervision; A. K. – clinical data acquisition, and field supervision; O. S. – statistical analysis and result validation; T. Z. – writing – original draft preparation and visualization; M. P. – data curation and laboratory evaluation; I. K. – investigation and diagnosis validation; O. T. – data analysis and editing.; V. S. – treatment protocol implementation; N. A. – project administration and animal welfare oversight. H. O. and T. P. – review and editing and manuscript final approval.

Conflicts of Interest

The authors declare no conflict of interest.

DECLARATION OF GENERATIVE AI

During the preparation of this work, the authors used ChatGPT (OpenAI) to check spelling, verify the accuracy of English translation, and format the reference list. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the pub.

REFERENCES

[1] S. García-Muñoz, N. Singh, C. Leonardi, and N. Silva-Del-Río. (2017). "Effect of Hoof Trimmer Intervention in Moderately Lame Cows on Lameness Progression and Milk Yield". *Journal of Dairy Science.* **100** (11): 9205-9214. 10.3168/jds.2016-12449.

[2] G. T. Stilwell, A. M. Ferrador, M. S. Santos, J. M. Domingues, and N. Carolino. (2019). "Use of Topical Local Anesthetics to Control Pain During Treatment of Hoof Lesions in Dairy Cows". *Journal of Dairy Science.* **102** (7): 6383-6390. 10.3168/jds.2018-15820.

[3] A. Jury, C. Syring, and J. Becker. (2021). "Prevalence of Claw Disorders in Swiss Cattle Farms". *Schweizer Archiv für Tierheilkunde.* **164** (11): 779-790. 10.17236/sat00327.

[4] L. L. Fenster, L. R. Ruchti, and B. C. Credille. (2023). "Retrospective Evaluation of the Causes and Distribution of Lameness in Beef and Dairy Cattle Evaluated by Ambulatory and In-House Clinical Services at a North American Veterinary Teaching Hospital". *Journal of the American Veterinary Medical Association.* **261** (7): 989 -994. 10.2460/javma.22.11.0506.

[5] B. O. Omontese, R. Bellet-Elias, A. Molinero, G. D. Catandi, R. Casagrande, Z. Rodriguez, R. S. Bisinotto, and G. Cramer. (2020). "Association Between Hoof Lesions and Fertility in Lactating Jersey Cows". *Journal of Dairy Science.* **103** (4): 3401-3413. 10.3168/jds.2019-17252.

[6] N. Browne, C. D. Hudson, R. E. Crossley, K. Sugrue, J. N. Huxley, and M. Conneely. (2022). "Hoof Lesions in Partly Housed Pasture-Based Dairy Cows". *Journal of*

Dairy Science. **105** (11): 9038-9053. 10.3168/jds.2022-22010.

[7] K. O'Driscoll, L. Boyle, P. French, and A. Hanlon. (2008). "The Effect of Out-Wintering Pad Design on Hoof Health and Locomotion Score of Dairy Cows". *Journal of Dairy Science.* **91** (2): 544-553. 10.3168/jds.2007-0667.

[8] M. Jewell, M. Cameron, S. McKenna, M. Cockram, J. Sanchez, and G. Keefe. (2021). "Relationships Between Type of Hoof Lesion and Behavioral Signs of Lameness in Holstein Cows Housed in Canadian Tiestall Facilities". *Journal of Dairy Science.* **104** (1): 937-946. 10.3168/jds.2019-17296.

[9] P. Neirurerová, P. Strapák, and T. Hegerová. (2020). "The Effect of Claw Disorders on the Locomotion Activity of Dairy Cows". *Acta Fytotechnica et Zootechnica.* **24** (MI-prap): 135-139. 10.15414/afz.2021.24.mi-prap.135-139.

[10] G. Beer, M. Alsaaod, and A. Starke. (2016). "Use of Extended Characteristics of Locomotion and Feeding Behavior for Automated Identification of Lame Dairy Cows". *PLoS One.* **11** (5): e0155796. 10.1371/journal.pone.0155796.

[11] J. Kofler. (2013). "Computerised Claw Trimming Database Programs as the Basis for Monitoring Hoof Health in Dairy". *The Veterinary Journal.* **198** (2): 358-361. 10.1016/j.tvjl.2013.06.009.

[12] S. Ferraro, S. Buczinski, S. Dufour, M. Rousseau, J. Dubuc, J. P. Roy, and A. Desrochers. (2020). "Bayesian Assessment of Diagnostic Accuracy of a Commercial Borescope and of Trimming Chute Exams for Diagnosing Digital Dermatitis in Dairy Cows". *Journal of Dairy Science.* **103** (4): 3381-3391. 10.3168/jds.2019-17129.

[13] M. Gianesella, F. Arfuso, E. Fiore, S. Giambelluca, E. Giudice, L. Armato, and G. Piccione. (2018). "Infrared Thermography as a Rapid and Non-Invasive Diagnostic Tool to Detect Inflammatory Foot Diseases in Dairy Cows". *Polish Journal of Veterinary Sciences.* **21** (2): 299-305. 10.24425/122597.

[14] T. Schulz, Y. Gundelach, M. Feldmann, and M. Hoedemaker. (2016). "Early Detection and Treatment of Lame Cows: Effect on Duration and Prevalence of Lesion-Specific Lameness". *Tierärztliche Praxis Großtiere.* **44** (1): 5-11. 10.15653/TPG-150534.

[15] J. Cutler, J. Shearer, D. Kelton, G. Cramer, P. Gorden, and S. Millman. (2015). "An Observational Study of the Effects of Therapeutic Hoof Blocks on the Locomotion, Behavior, and Production of Healthy Dairy Cattle". *Journal of Applied Animal Welfare Science.* **18** (4): 363-374. 10.1080/10888705.2015.1033626.

[16] P. Thomsen, L. Foldager, P. Raundal, and C. Nynne. (2019). "Lower Odds of Sole Ulcers in the Following Lactation in Dairy Cows That Received Hoof Trimming Around Drying Off". *The Veterinary Journal.* **254** : 105408. 10.1016/j.tvjl.2019.105408.

[17] M. Ninkovic, S. Arsic, J. Zutic, N. Zdravkovic, D. Glisic, Z. Z. Sapundzic, B. Bojkovski, and J. Bojkovski. (2021). "Frequency of White Line Disease and Sole Ulcers and Impact of Hoof Trimming in the Examined Herds of Simmental Cows". *Large Animal Review.* **27** (6).

[18] D. Kučević, I. Hadžić, S. Trivunović, M. Plavšić, I. Pavlović, T. Papović, and V. Gantner. (2022). "The Effect of Housing Systems on Hoof Diseases/Disorders and Percentage of Culling in Holstein Dairy Cows". *Veterinarski Arhiv.* **92** (3): 243-250. 10.24099/vet.arhiv.1525.

[19] N. Volkmann and N. Kemper. (2018). "Claw Condition and Claw Health in Dairy Cows: How Important Is Access to Pasture?". *Veterinary Record.* **182** (3): 76-78. 10.1136/vr.k193.

[20] S. M. Kulynych, O. O. Bublyk, I. I. Yurchenko, T. G. Panasova, G. O. Omelchenko, S. O. Kravchenko, and T. P. Lockes-Krupka. (2019). "Efficiency of Intravascular Laser Blood Irradiation in Cattle with Inflammatory Surgical Pathology". *World of Medicine. Medicine and Biology.* **1** (67): 216. 10.26724/2079-8334-2019-1-67-216.

[21] R. A. Laven and D. N. Logue. (2006). "Treatment Strategies for Digital Dermatitis

for the Milking Herd". *In Practice.* **28** (6): 362-369. 10.1136/inpract.28.6.362.

[22] S. L. Berry and D. H. Read. (2019). "The Pathogenesis and Control of Digital Dermatitis in Cattle". *Veterinary Clinics of North America: Food Animal Practice.* **35** (2): 165-181. 10.1016/j.cvfa.2019.02.001.

[23] A. C. Krull, J. K. Shearer, P. J. Gorden, P. J. Plummer, and L. C. Visser. (2016). "Deep Sequencing Analysis Reveals Temporal Microbiota Changes Associated with Development of Bovine Digital Dermatitis". *PLoS One.* **11** (8): e0159404. 10.1371/journal.pone.0159404.

[24] R. C. Bicalho, V. S. Machado, and L. S. Caixeta. (2009). "Lameness in Dairy Cattle: A Debilitating Disease or a Disease of Debilitated Cattle?". *Journal of Dairy Science.* **92** (7): 3185-3194. 10.3168/jds.2008-1827.

[25] L. V. Randall, M. J. Green, M. G. G. Chagunda, C. Mason, and S. C. Archer. (2016). "Lameness Risk Factors Related to Sole Lesions and Physical Characteristics of the Hoof in Dairy Cows". *PLoS One.* **11** (7): e0157946. 10.1371/journal.pone.0157946.

[26] E. Toussaint-Raven. (1989). "Cattle Footcare and Claw Trimming". Farming Press, United Kingdom.

[27] J. Kofler. (2017). "Anatomy and Diseases of Bovine Digits". *Veterinary Clinics of North America: Food Animal Practice.* **33** (2): 177-209. 10.1016/j.cvfa.2017.02.005.

[28] A. Relun, A. Lehebel, N. Bareille, and R. Guatteo. (2012). "Effectiveness of Different Regimens of a Collective Topical Treatment Using a Solution of Copper and Zinc Chelates in the Cure of Digital Dermatitis in Dairy Farms Under Field Conditions". *Journal of Dairy Science.* **95** (7): 3722-3735. 10.3168/jds.2011-4983.