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TURPENTINE-INDUCED ACUTE DERMATITIS IN RABBITS: ACUTE PHASE PROTEIN RESPONSES AND MODULATION BY TOPICAL CORTICOSTEROID AND *ALLIUM CEPA*

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SUMMARY: Acute inflammatory skin conditions are commonly encountered in veterinary practice and are characterised by complex clinical, haematological, and biochemical responses that reflect underlying tissue injury and systemic acute phase reactions. This study evaluated the acute phase response, haematological alterations, and therapeutic modulation of turpentine-induced dermatitis in rabbits using topical hydrocortisone and *Allium cepa* (onion) juice. Twenty healthy adult New Zealand White rabbits were randomly assigned to four groups: control, turpentine-induced untreated, turpentine-induced treated with topical hydrocortisone, and turpentine-induced treated with onion juice. Dermatitis was induced by subcutaneous injection of 0.5 mL turpentine oil, and treatments were applied topically for three consecutive days beginning 12 hours post-induction. Clinical severity was assessed using a modified Draize scoring system, while haematological indices and serum biochemical parameters, including acute phase proteins, were evaluated at 0, 24, 48, and 72 hours. Turpentine administration induced marked heterophilic leukocytosis, elevated serum C-reactive protein and haptoglobin concentrations, and a reduction in albumin levels ($P < 0.05$). These changes were significantly attenuated by topical hydrocortisone, while onion juice produced moderate but consistent anti-inflammatory effects. The study supports the use of turpentine-induced dermatitis as a reproducible rabbit model for acute phase reactions and suggests that *Allium cepa* possesses adjunct anti-inflammatory potential in veterinary dermatological management.

Keywords: Acute phase response; C-reactive protein; Dermatitis; *Allium cepa*; Rabbits; Turpentine oil.

INTRODUCTION

Acute phase response (APR) is a systemic reaction to tissue injury marked by changes in levels of acute phase proteins (APPs) produced by the liver. This response involved increased production of positive APPs, such as C-reactive protein (CRP), haptoglobin, and fibrinogen. Conversely, negative APPs like albumin decrease due to catabolism and redistribution (Ehlting *et al*., 2021; Jain *et al*., 2011; Harvanová and Duranková, 2025). Notably, the immune system responds to injury by increasing circulating white blood cells, often resulting in heterophilic leukocytosis in rabbits (Chmielewski *et al*., 2018).

Turpentine-induced inflammation is a widely used experimental model for studying the clinico-pathological responses in localized inflammatory reactions which often triggers a complex cascade of biological events aimed at eliminating the irritant and facilitating tissue repair (Greguła-Kania *et al*., 2021; Mahajan *et al*., 2023; Božajić, 2025). On the other hand, rabbits serve as valuable biomedical models for investigating human diseases, owing to their notable physiological similarities with humans (Bosze and Houdebine, 2006; Wancket *et al*., 2022).

Recent studies have highlighted the therapeutic potential of topical agents in treating inflammation-induced dermatitis (Lee *et al*., 2023, Zawawi *et al*., 2025). Corticosteroids are commonly used to alleviate symptoms of inflammatory dermatoses due to their potent anti-inflammatory properties (Livingstone *et al*.,

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2024; Radhakrishnan *et al*., 2024). *Allium cepa* (onion) extract which is rich in sulphur compounds, flavonoids, and quercetin, has also shown promise as a natural remedy for its anti-inflammatory, antimicrobial, and wound-healing effects (Marefati *et al*., 2021; Lee *et al*., 2023).

Despite their clinical effectiveness, topical corticosteroids are associated with well-recognised limitations, including cutaneous atrophy, delayed wound healing, local immunosuppression, and potential systemic absorption with repeated use, particularly in prolonged or recurrent dermatological conditions (Livingstone *et al*., 2024; Radhakrishnan *et al.,* 2024). These concerns have stimulated growing interest in safer bioactive agents that may complement or reduce reliance on corticosteroids. In this context, the present investigation was designed to evaluate whether *Allium cepa*, a plant with documented anti-inflammatory and antioxidant properties, could attenuate inflammatory and acute phase responses in experimental dermatitis and thus serve as a supportive therapeutic option rather than a direct pharmacological substitute.

Furthermore, despite the widespread use of turpentine-induced inflammation as an experimental model, limited data exist on the concurrent dynamics of acute phase proteins, haematological indices, and topical therapeutic modulation in rabbits. Acute phase proteins differ in their induction kinetics and biological persistence, which is relevant for interpreting time-dependent inflammatory responses (Berczi and Szentivanyi, 2003; Kushner and Mackiewicz, 2020). In rabbits, C-reactive protein is regarded as a rapidly responsive acute phase marker, rising within 12–24 hours following tissue injury and declining relatively quickly as inflammation resolves (Cray, 2012; Al Ali *et al*., 2025). Haptoglobin exhibits a slower onset but a more sustained elevation, reflecting prolonged hepatic response to inflammatory stimuli (Jain *et al*., 2011; Ehlting *et al*., 2021), whereas albumin functions as a negative acute phase protein with gradual reductions resulting from altered hepatic synthesis and redistribution (Cray, 2012; Kushner and Mackiewicz, 2020). Understanding these temporal characteristics provides essential context for evaluating the sequential changes observed following turpentine-induced dermatitis and therapeutic intervention.

Although *Allium cepa* has been reported to possess anti-inflammatory and antioxidant properties, its comparative efficacy against standard topical corticosteroids in acute dermatitis models remains inadequately characterised. The turpentine-induced dermatitis model offers translational relevance to naturally occurring inflammatory skin conditions encountered in veterinary practice, as it reproduces hallmark features such as localised erythema, oedema, leukocyte recruitment, and systemic acute phase activation. These processes parallel acute contact dermatitis, injection-site reactions, and traumatic inflammatory lesions commonly observed in domestic animals, thereby supporting the applicability of this model for therapeutic evaluation. Therefore, this study aimed to establish a rabbit model of turpentine-induced dermatitis and to test the hypothesis that topical onion juice would attenuate clinical inflammation and acute phase protein responses, albeit to a lesser extent than topical hydrocortisone.

MATERIALS AND METHODS

Animals and Experimental Design

Twenty healthy adult New Zealand rabbits were obtained and housed individually in standard cages under controlled environmental conditions. To minimise stress and ensure physiological adaptation, all rabbits were acclimatised for one week before the experiments began. During this period, they were monitored for signs of illness or abnormal behaviour. The experimental protocol was reviewed and approved by the Institutional Animal Care and Use Committee (IACUC) of the University of Ilorin, Nigeria (Approval No. URE/FVM/2023/019). The rabbits were randomly divided into four groups (n=5 per group) to study the effect of turpentine-induced inflammation and the efficacy of topical corticosteroid and onion juice treatments. The experimental design is summarised in Table 1.

Turpentine oil (rectified, density 0.86 g/mL) was sourced from a pharmaceutical-grade

supplier and used to induce sterile dermal inflammation, 1% Hydrocortisone cream (Xepa) was commercially available, selected for its proven anti-inflammatory efficacy in topical applications for dermatitis. Fresh bulbs of *Allium cepa* were washed thoroughly under running water, peeled, and homogenised using a sterile laboratory blender. The homogenate was filtered through sterile gauze to obtain fresh onion juice, which was used immediately to minimise degradation of bioactive compounds. Although fresh extraction was employed to preserve bioactive constituents, quantitative standardisation of individual phytochemicals was not performed. To reduce variability, onions were sourced from the same batch, processed under identical conditions, and applied immediately after preparation. Variability in phytochemical concentration is acknowledged as a methodological limitation.

All treatments were applied gently using sterile cotton swabs to ensure even coverage over the inflamed area (approximately 2 cm^2) without causing additional trauma.

Table 1. Experimental Design and Treatment Protocol

Group	No. of Rabbits	Inflammatory Agent	Treatment
I (Control)	5	Sterile distilled water (0.5 mL, SC	None
II (Untreated)	5	Turpentine oil (0.5 mL, SC	None
III (Corticosteroid-Treated)	5	Turpentine oil (0.5 mL, SC	Hydrocortisone (1%) cream applied topically at 12 hours post-injection and daily for 3 days
IV (Onion Juice Treated)	5	Turpentine oil (0.5 mL, SC	Freshly extracted onion juice was applied topically to the injection site at 12 hours post-injection and daily for 3 days

*Key: SC = subcutaneous injection.

Induction of Dermatitis and Treatment Administration

Dermatitis was induced in the rabbits through a subcutaneous injection of 0.5 mL turpentine oil (CDH Fine Chemical, India) into the shaved skin of the right thigh under mild sedation achieved with intramuscular administration of ketamine (Pfizer, Canada) at 10 mg/kg and xylazine (Interchemie, Netherlands) at 1 mg/kg. The control group was administered an equivalent volume of sterile distilled water.

Approximately 1 mL of the freshly prepared juice was applied topically to the inflamed area using sterile cotton swabs once daily for three consecutive days, beginning 12 hours after turpentine injection.

To minimise loss of topically applied agents through grooming behaviour, rabbits were closely observed for 30 minutes following each application. The treated area was positioned on the lateral thigh to reduce direct oral access, and animals were temporarily distracted with feed immediately after application. No physical restraints or occlusive dressings were used to avoid additional stress or interference with skin physiology. This approach was applied uniformly across treatment groups to reduce potential bias.

Topical treatments were initiated 12 hours post-injection and continued daily for 3 consecutive days. The rabbits were monitored daily for clinical signs and severity of dermatitis utilising a modified Draize scoring system (Draize, 1944) (Table 2), which scores from 0 to 8 based on the presence of erythema and oedema at the injection site.

Dermatitis severity was assessed at the right thigh injection site across all time points with scoring conducted under controlled lighting (Draize, 1944). Clinical scoring was performed independently by two trained observers who were blinded to treatment allocation. Final scores were derived from the mean of both assessments to minimise inter-observer variability.

Table 2. Modified Draize Criteria for Scoring Dermatitis Severity

Score	Erythema Description	Oedema Description	Total Score (Erythema + oedema)
0	No erythema	No Oedema	0
1	Very Slight erythema (barely perceptible)	Very Slight oedema (barely perceptible)	2
2	Well defined erythema	Slight oedema (edges of area well defined by definite raising)	4
3	Moderate to severe erythema	Moderate edema, (raised approximately 1mm)	6
4	Severe erythema (beet redness) to slight eschar formation (injuries in depth)	Severe edema, raised by > 1mm and extending beyond the area of exposure	8

Blood Sampling and Analysis

Blood samples (3 mL) were collected aseptically from the experimental rabbits using EDTA tubes for haematology and plain tubes for serum analysis. Haematological parameters, including red blood cell counts (RBC), white blood cell counts (WBC), haemoglobin, packed cell count (PCV), and platelet count were measured using an automated analyser, with differential leukocyte counts assessed via Giemsa-stained smears. In addition to graphical presentation, total and differential leukocyte counts were summarised in tabular form across all time points to enhance data transparency, and graphical figures were optimized for clarity and legibility.

Serum was separated by centrifugation and analysed for liver and kidney function using a chemistry analyser by means of commercial test kits (Randox, UK). Acute phase proteins such as haptoglobin and C-reactive protein were quantified using ELISA kits, with concentrations determined via optical density readings. The ELISA kits used for C-reactive protein and haptoglobin quantification were commercially validated for rabbit samples by the manufacturer. Assay sensitivity and intra-assay variability were assessed according to kit specifications, and all samples were analysed in duplicate to ensure analytical reliability.

Statistical Analysis.

Data were expressed as mean ± standard error of the mean (SEM). Two-way analysis of variance (ANOVA) was performed to evaluate the effects of treatment group and time, including their interaction. Where significant differences were detected, Tukey's *post-hoc* test was applied for multiple comparisons. Statistical significance was set at $P < 0.05$. Analyses were performed using Graphpad Prism version 8.

RESULTS

Clinical Observations

Observations were limited to 72 hours to capture the acute inflammatory and early resolution phases of turpentine-induced dermatitis. This time frame aligns with the expected peak and initial decline of rapidly responsive acute phase proteins, while allowing evaluation of treatment-associated modulation without confounding effects of chronic tissue remodelling.

In rabbits with induced inflammation, a localised reaction characterised by erythema, oedema and warmth within 12 hours after injection. The dermatitis severity showed a significant decrease in inflammation scores in both corticosteroid-treated and onion juice-treated groups relative to the untreated inflammatory group (Figure 1).

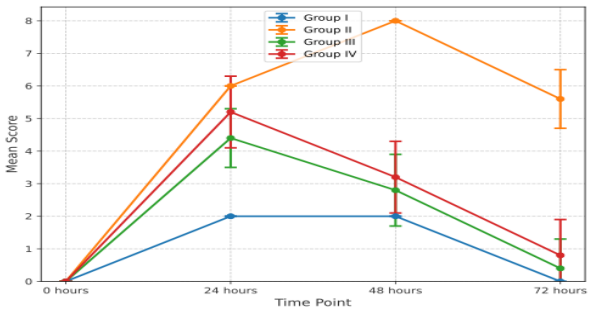

Figure 1. Clinical severity of turpentine-induced dermatitis in rabbits**.**

Mean ± SEM Draize scores (erythema + oedema; scale 0–8) in control (Group I), untreated inflamed (Group II), corticosteroid-treated (Group III), and onion juice-treated (Group IV) rabbits at 0, 24, 48, and 72 hours post-induction. Scores represent the average of two blinded observers.

Haematological Responses

Peripheral blood smears revealed normal leukocyte morphology at baseline, with heterophils, lymphocytes, monocytes, eosinophils, and basophils displaying typical structural features for rabbits. At inflammatory time points, heterophilia with relative lymphopenia was observed in untreated animals, without evidence of toxic change or dysplasia. Baseline haematological values across all groups fell within established reference intervals for healthy adult rabbits.

The erythrogram parameters (red blood cell count, haemoglobin concentration and PCV, along with the platelet count showed no significant variation ($P > 0.05$) across the experimental groups throughout the study (Table 3). However, a notable disparity was found in the total WBC count between the groups. The untreated inflammatory group displayed a considerable rise in WBC count marked by heterophilic leukocytosis in comparison to the groups treated with corticosteroid and onion juice (Figure 2).

Table 3. Summary of Other Haematological Parameters in Rabbits Following Turpentine-Induced Inflammation

Time (h)	Parameter	Group I (Control)	Group II (untreated)	Group III (Corticosteroid)	Group IV (Onion Juice)
0	RBC ($x10^{12}$/L)	4.08 ± 0.27[a]	4.10 ± 0.19[a]	4.22 ± 0.26[a]	4.08 ± 0.23[a]
	Hb (g/dL)	12.18 ± 0.57[a]	12.24 ± 0.41[a]	11.93 ± 0.35[a]	12.01± 0.41[a]
	PCV (%)	39.2 ± 1.8[a]	39.4 ± 1.7[a]	38.2 ± 1.1[a]	40.2 ± 1.6[a]
	Platelets ($x10^{12}$/L)	319 ± 36[a]	325 ± 62[a]	313 ± 61[a]	317 ± 32[a]
24	RBC ($x10^{12}$/L)	4.07 ± 0.23[a]	4.04 ± 0.20[a]	4.02 ± 0.25[a]	4.14 ± 0.24[a]
	Hb (g/dL)	12.12 ± 0.47[a]	12.18 ± 0.50[a]	12.06 ± 0.58[a]	12.42 ± 0.40[a]
	PCV (%)	39.0 ± 1.5[a]	38.6 ± 1.4[a]	38.4 ± 1.5[a]	40.0 ± 1.3[a]
	Platelets ($x10^{12}$/L)	310 ± 28[a]	323 ± 48[a]	325 ± 57[a]	342 ± 37[a]
48	RBC ($x10^{12}$/L)	4.12 ± 0.25[a]	4.08 ± 0.25[a]	4.03 ± 0.17[a]	4.13 ± 0.20[a]
	Hb (g/dL)	12.36 ± 0.50[a]	12.00 ± 0.44[a]	12.24 ± 0.59[a]	12.48 ± 0.49[a]
	PCV (%)	39.8 ± 1.6[a]	39.2 ± 1.7[a]	38.8 ± 1.0[a]	40.2 ± 1.2[a]
	Platelets ($x10^{12}$/L)	312 ± 33[a]	332 ± 62[a]	332 ± 48[a]	334 ± 35[a]
72	RBC ($x10^{12}$/L)	4.14 ± 0.22[a]	4.04 ± 0.22[a]	4.06 ± 0.21[a]	4.14 ± 0.18[a]
	Hb (g/dL)	12.42 ± 0.46[a]	11.87 ± 0.33[a]	12.48 ± 0.49[a]	12.29 ± 0.53[a]
	PCV (%)	40.0 ± 1.5[a]	38.6 ± 1.4[a]	38.4 ± 1.0[a]	41.2 ± 0.7[a]
	Platelets ($x10^{12}$/L)	317 ± 61[a]	317 ± 32[a]	336 ± 62[a]	335 ± 24[a]

Mean ± SEM of red blood cell count (RBC), haemoglobin (Hb), packed cell volume (PCV) and platelets counts in control (Group I), untreated (Group II), corticosteroid-treated (Group III) and onion juice-treated (Group IV) rabbits following turpentine-induced inflammation at 0, 24, 48 and 72 hours. The same superscripts [a] in the same row indicate no significant difference observed ($P > 0.05$).

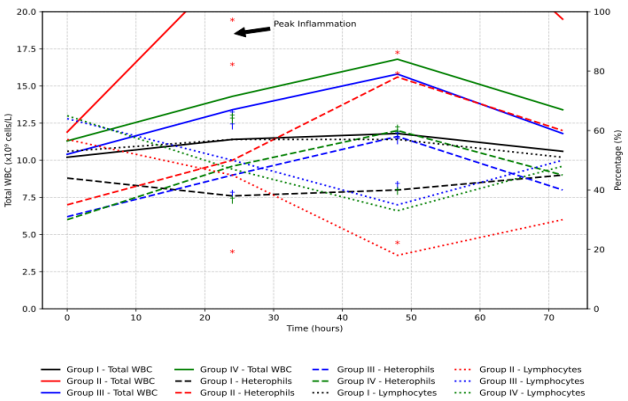

Figure 2. Time-dependent leukocyte responses following turpentine-induced dermatitis.

Changes in total white blood cell count, heterophil percentage, and lymphocyte percentage in control, untreated, corticosteroid-treated, and onion juice-treated rabbits over 72 hours. Values are mean ± SEM. *P < 0.05 versus control at corresponding time points; †P < 0.05 versus untreated inflamed group.

Serum Biochemical Responses

The levels of blood urea nitrogen (BUN), creatinine and the serum activities of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) did not change significantly throughout the experiment (Table 4). In contrast, positive APPs (C-reactive protein and haptoglobin) were remarkably higher in the untreated inflammatory group compared to the groups treated with corticosteroid and onion juice (Table 4, Figures 3 and 4). On the other hand, albumin, a negative APP showed a significant decrease in concentration (Table 4, Figure 5). This decrease was accompanied by a substantial rise in globulin levels which helped to maintain the total protein concentration (Table 4).

Table 4. Summary of Serum Biochemical Parameters in Rabbits Following Turpentine-Induced Inflammation

Time (h)	Parameter	Group I (Control)	Group II (untreated)	Group III (Corticosteroid)	Group IV (Onion Juice)
0	TP (g/L)	69.0 ± 5.4[a]	72.0 ± 5.2[a]	69.4 ± 4.5[a]	67.6 ± 4.2[a]
	Globulin (g/L)	30.8 ± 3.0[a]	30.2 ± 2.3[a]	32.8 ± 2.1[a]	34.1 ± 2.7[a]
	Creatinine (mg/dL)	0.9 ± 0.3[a]	1.1 ± 0.2[a]	1.0 ± 0.3[a]	1.3 ± 0.3[a]
	BUN (mg/dL)	15.7 ± 2.1[a]	16.0 ± 2.5[a]	16.0 ± 2.2[a]	16.6 ± 2.2[a]
	AST (IU/L)	14.6 ± 1.8[a]	14.8 ± 1.7[a]	15.4 ± 2.1[a]	14.8 ± 2.0[a]
	ALT (IU/L)	56.6 ± 3.0[a]	58.2 ± 2.6[a]	58.2 ± 2.4[a]	57.0 ± 2.9[a]
24	TP (g/L)	70.4 ± 4.7[a]	71.1 ± 4.2[a]	68.1 ± 5.0[a]	68.2 ± 3.7[a]
	Globulin (g/L)	36.2 ± 3.7[a]	41.4 ± 3.4[b]	39.2 ± 3.4[a]	41.6 ± 3.2[a]
	Creatinine (mg/dL)	1.0 ± 0.3[a]	1.2 ± 0.3[a]	1.2 ± 0.2[a]	1.4 ± 0.3[a]
	BUN (mg/dL)	16.0 ± 2.2[a]	15.8 ± 2.9[a]	15.8 ± 2.6[a]	16.3 ± 2.4[a]
	AST (IU/L)	13.8 ± 1.4[a]	14.2 ± 1.7[a]	15.0 ± 2.7[a]	15.4 ± 2.1[a]
	ALT (IU/L)	57.8 ± 3.6[a]	56.4 ± 2.6[a]	56.2 ± 2.2[a]	58.4 ± 2.6[a]
48	TP (g/L)	70.1 ± 4.5[a]	72.4 ± 4.5[a]	71.2 ± 4.5[a]	68.0 ± 3.7[a]
	Globulin (g/L)	33.2 ± 2.1[a]	44.6 ± 3.2[b]	3.2 ± 4.0[a]	42.0 ± 4.1[a]
	Creatinine (mg/dL)	1.1 ± 0.2[a]	1.1 ± 0.2[a]	1.5 ± 0.4[a]	1.4 ± 0.4[a]
	BUN (mg/dL)	15.9 ± 2.3[a]	15.6 ± 2.5[a]	16.6 ± 2.2[a]	16.4 ± 1.9[a]
	AST (IU/L)	13.8 ± 1.6[a]	14.6 ± 1.5[a]	15.2 ± 2.5[a]	14.6 ± 1.2[a]
	ALT (IU/L)	59.6 ± 3.8[a]	59.5 ± 2.2[a]	59.8 ± 3.9[a]	58.0 ± 2.2[a]
72	TP (g/L)	71.0 ± 4.5[a]	73.2 ± 4.9[a]	71.5 ± 3.8[a]	69.0 ± 5.4[a]
	Globulin (g/L)	33.0 ± 2.5.0[a]	47.8 ± 3.6[b]	37.4 ± 2.2[a]	41.9 ± 4.4[a]
	Creatinine (mg/dL)	1.1 ± 0.2[a]	1.1 ± 0.2[a]	1.3 ± 0.2[a]	1.2 ± 0.2[a]
	BUN (mg/dL)	15.4 ± 1.6[a]	16.8 ± 2.8[a]	16.2 ± 2.4[a]	16.8 ± 2.1[a]
	AST (IU/L)	14.2 ± 1.4[a]	14.8 ± 1.1[a]	14.8 ± 1.4[a]	15.0 ± 2.8[a]
	ALT (IU/L)	55.0 ± 2.8[a]	57.8 ± 2.2[a]	58.4 ± 2.3[a]	56.4 ± 2.9[a]

Reference intervals for adult rabbits: Total protein (60–80 g/L), albumin (30–45 g/L), globulin (25–45 g/L), ALT (45–80 IU/L), AST (10–30 IU/L), creatinine (0.5–2.5 mg/dL), BUN (10–25 mg/dL).

Mean ± SEM of total protein (TP), globulin, creatinine, blood urea nitrogen (BUN), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in control (Group I) untreated (Group II), corticosteroid-treated (Group III) and onion juice-treated (Group IV) rabbits following turpentine-

induced inflammation at 0, 24, 48 and 72 hours. Different superscripts [a] in the same row indicate a significant difference ($P < 0.05$) between the groups.

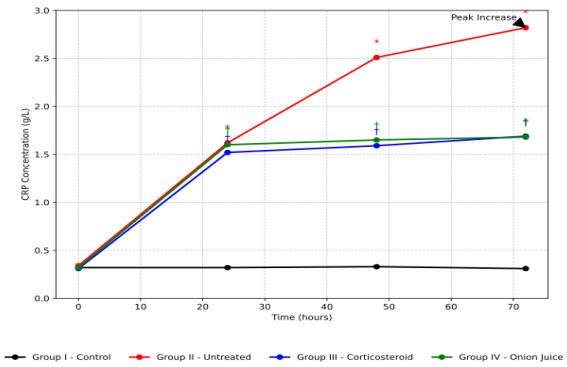

Figure 3. Serum C-reactive protein responses following turpentine-induced dermatitis.
Temporal changes in CRP concentration across experimental groups. *P < 0.05 versus control; †P < 0.05 versus untreated inflamed group.

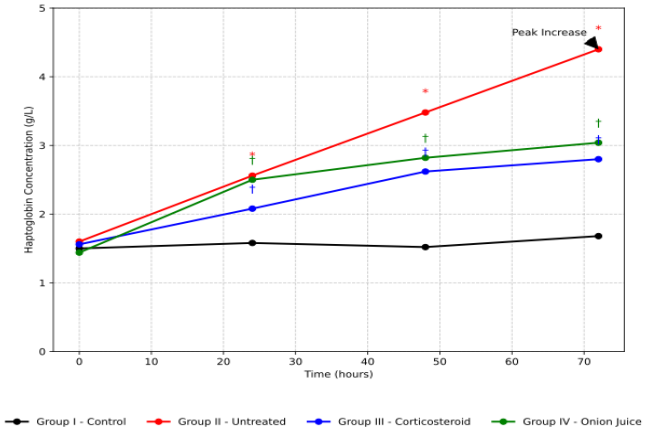

Figure 4. Haptoglobin dynamics following turpentine-induced dermatitis.
Serum haptoglobin concentrations over time in control and treatment groups. *P < 0.05 versus control; †P < 0.05 versus untreated inflamed group.

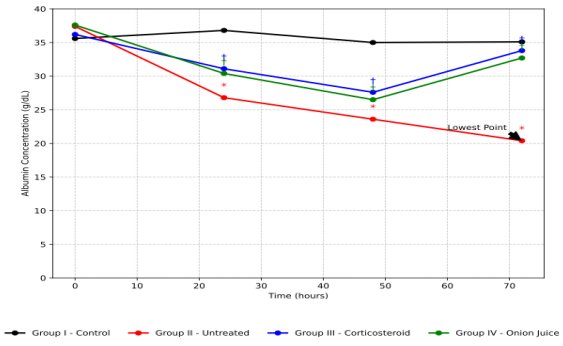

Figure 5. Albumin as a negative acute phase protein during experimental dermatitis.
Time-dependent changes in serum albumin concentration across groups. *P < 0.05 versus control; †P < 0.05 versus untreated inflamed group.

Summary of Acute Phase Protein Responses

For correlation analyses, statistical significance was interpreted cautiously, and patterns were evaluated in conjunction with biological plausibility to reduce the likelihood of spurious associations arising from multiple comparisons. A heatmap of Pearson correlations (Figure 6) demonstrates the interrelationship between Draize score, white blood cell count, heterophils, C-reactive protein, haptoglobin and albumin, highlighting the anti-inflammatory effects of the treatments. At 72 hours post-injection, gross examination of skin lesions (Figure 7) showed persistent erythema and oedema in the untreated inflammatory group. In contrast, both corticosteroid-treated and onion juice-treated groups exhibited reduced inflammation and signs of resolution.

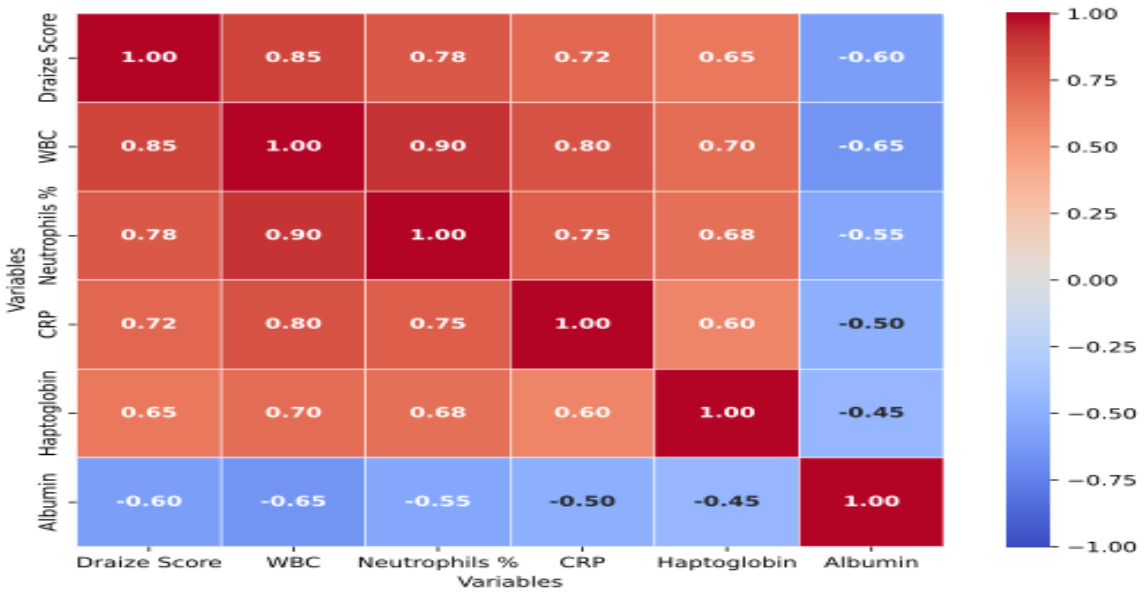

Figure 6. Correlation heatmap of clinical, haematological, and biochemical parameters.
Pearson correlation coefficients illustrating relationships among Draize score, leukocyte indices, C-reactive protein, haptoglobin, and albumin at 72 hours post-induction.

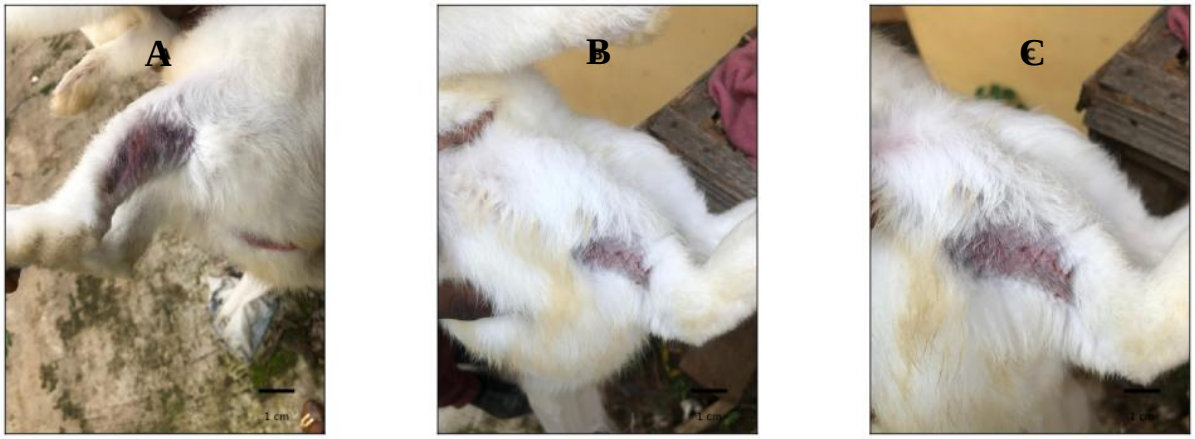

Figure 7. Gross morphology of skin lesions at 72 hours post-induction.
(A) Untreated inflamed group showing persistent erythema, oedema, and crusting.
(B) Corticosteroid-treated group showing mild residual inflammation with healing.
(C) Onion juice-treated group showing mild erythema and oedema with visible resolution.

DISCUSSION

Turpentine-induced dermatitis proved to be a robust experimental model for investigating acute inflammatory responses and their systemic manifestations in rabbits. Local tissue irritation by turpentine is known to activate innate immune pathways, resulting in vascular changes, leukocyte recruitment, and hepatic acute phase responses, making it suitable for integrated clinicopathological evaluation of inflammation (Ehlting *et al.*, 2021; Harvanová and Duranková, 2025). The present study reinforces the utility of this

model for studying inflammatory modulation in veterinary species.

The leukocytic changes observed in inflamed rabbits are consistent with activation of innate immunity, particularly the mobilization of heterophils, which serve as the functional equivalent of neutrophils in lagomorphs. Such responses are characteristic of acute inflammation and reflect cytokine-mediated stimulation of bone marrow leukopoiesis and peripheral recruitment (Chmielewski and Strzelec, 2018; Wancket *et al*., 2022). The modulation of leukocyte responses following topical treatment suggests that attenuation of local inflammation can translate into reduced systemic immune activation, supporting earlier observations that localized dermal inflammation may exert systemic hematologic effects (Buters *et al*., 2022).

Alterations in acute phase protein profiles further highlight the systemic dimension of the inflammatory response. The coordinated regulation of positive acute phase proteins, such as C-reactive protein and haptoglobin, alongside suppression of negative acute phase proteins like albumin, reflects hepatic reprioritization driven by pro-inflammatory mediators (Cray, 2012; Ehlting et al., 2021). The attenuation of these changes following treatment indicates effective dampening of inflammatory signaling pathways and supports the growing recognition of acute phase proteins as sensitive and reliable biomarkers for inflammation severity and therapeutic monitoring in veterinary medicine (Murtaza et al., 2024; Al Ali et al., 2025).

Topical hydrocortisone demonstrated predictable anti-inflammatory activity, consistent with its established pharmacological actions, including inhibition of pro-inflammatory cytokine synthesis, suppression of leukocyte migration, and stabilization of vascular permeability (Livingstone et al., 2024; Radhakrishnan et al., 2024). These effects corroborate previous reports emphasizing the effectiveness of topical corticosteroids in managing inflammatory dermatoses across species (Zawawi et al., 2025).

In contrast, the anti-inflammatory effects associated with *Allium cepa* are likely attributable to its rich content of flavonoids, sulfur-containing compounds, and quercetin, which have been shown to modulate oxidative stress, inhibit inflammatory signalling pathways, and suppress cytokine production (Marefati et al., 2021; Lee et al., 2023). Although its effects were comparatively moderate, the consistent modulation of inflammatory biomarkers suggests potential adjunctive value rather than replacement of corticosteroid therapy. This aligns with emerging interest in plant-based therapies as supportive or alternative options in veterinary dermatology, particularly where long-term corticosteroid use may be undesirable (Beigoli et al., 2021; Zawawi et al., 2025). From a clinical perspective, the magnitude and consistency of the observed effects suggest that *Allium cepa* is best interpreted as an adjunctive anti-inflammatory agent rather than a replacement for corticosteroid therapy, particularly in acute dermatological conditions requiring rapid and robust suppression of inflammation.

The observed relationships between clinical severity scores, leukocyte indices, and acute phase protein responses underscore the interconnected nature of local tissue injury and systemic immune regulation. Such associations support the use of combined clinical scoring systems and laboratory biomarkers to achieve a more comprehensive and objective assessment of inflammation and therapeutic response (Jain et al., 2011; Murtaza et al., 2024). This integrative approach enhances the translational relevance of experimental models and strengthens their applicability to clinical veterinary practice.

A key limitation of this study is the absence of histopathological evaluation of skin lesions, which restricted direct assessment of cellular infiltration, epidermal integrity, and dermal remodelling associated with treatment effects. Furthermore, inflammatory cytokines were not quantified, restricting the mechanistic interpretation of the observed acute phase responses. The relatively short duration of observation also limits extrapolation to chronic inflammatory conditions. Future studies incorporating histopathology, cytokine profiling, and longer follow-up periods are warranted to further elucidate the therapeutic potential of Allium cepa in veterinary dermatology.

CONCLUSIONS

The findings of this study support turpentine-induced dermatitis as a valid model for acute inflammation in rabbits and demonstrate that both conventional and plant-derived topical therapies can influence systemic inflammatory markers. The study contributes to a growing body of evidence supporting the incorporation of acute phase proteins and haematological indices into experimental and clinical evaluation of inflammatory conditions in veterinary species.

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