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Development and Characterization of Lornoxicam-Infused Ocular Gel for Effective Treatment of Ocular Inflammation in Domestic Cats

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A B S T R A C T

Lornoxicam (LOX) is a non-steroidal anti-inflammatory drug (NSAID) effective in managing ocular inflammation. Traditional delivery methods like liquid drops are cleared rapidly and may not provide sustained therapeutic levels, necessitating the development of an ocular gel formulation. Mucoadhesive polymers such as hyaluronic acid (HA), hydroxypropyl methylcellulose (HPMC), and Carbopol have been identified as suitable excipients to modify drug release profiles. This study aims to formulate an effective ophthalmic 0.1% w/w lornoxicam gel administered to pets for topical and continuous drug release, enhancing therapeutic efficacy while minimizing possible side effects. Eight formulations of lornoxicam ocular gel were developed by different concentrations of hyaluronic acid (HA) and hydroxypropyl methylcellulose (HPMC K100) with 0.5% w/v Carbopol P934. These formulations were in vitro evaluated for viscosity, spreadability, and drug release characteristics to the best formula G6. The formulation with optimal performance was G6 (0.5% w/v Hyaluronic acid). Ocular irritation testing was performed to assess the safety and tolerability of the formulation using a Rattus norvegicus Domestica (domestic Norwegian rat) model. Furthermore, the therapeutic potential of the lornoxicam gel was investigated in a domestic cat case study, demonstrating its efficacy in treating ocular inflammation resulting from traumatic eye injury. The optimized formula G6 formulation 0.5% w/v demonstrated appropriate viscosity and spreadability, making it suitable for ocular administration. In vitro release, studies revealed an initial burst release of 92.5% within the first two hours, followed by a sustained release over the subsequent 6 hours. Ocular irritation testing using a rat model confirmed that the lornoxicam ocular gel was non-irritating. Furthermore, the therapeutic effects of the gel were observed in domestic cats, with notable improvements in ocular conditions, including reduced swelling, redness, and dryness, for less than 7 days of treatment. The lornoxicam ocular gel demonstrates promising characteristics for safe and effective treatment of ocular inflammation in domestic cats.

Keywords: Carbopol p934, hyaluronic acid, lornoxicam, ocular gel, ocular inflammation

INTRODUCTION

Lornoxicam, a non-steroidal anti-inflammatory drug (NSAID), is increasingly utilized in the treatment of ocular infections due to its potent anti-inflammatory and analgesic effects (1). Its primary mechanism of action involves the inhibition of cyclooxygenase (COX) enzymes, specifically COX-2, which plays a crucial role in the biosynthesis of prostaglandins. Prostaglandins are lipid compounds that significantly contribute to the inflammatory response, causing symptoms such as redness, swelling, and pain (2). By suppressing the production of

these inflammatory mediators, lornoxicam effectively reduces inflammation and alleviates pain associated with ocular infections (3). Prostaglandins, which are produced through the conversion of arachidonic acid via the COX-1 and COX-2 pathways, contribute to the development of postoperative macular oedema. During surgical procedures, particularly in ocular surgeries, the synthesis of COX-2 is up regulated, leading to increase prostaglandin production and subsequent inflammation. The use of NSAIDs to inhibit prostaglandin synthesis can therefore reduce macular edema (4).

Although the COX-2 pathway is a primary contributor to surgical inflammation in the eye, topical NSAIDs such as Lornoxicam that inhibit both COX-1 and COX-2 are often employed postoperatively to reduce inflammation (5). COX and Nuclear Factor-Kappa B (NF-kB) are activated by ultraviolet B (UVB) radiation. The COX inhibitors protect against skin damage brought by UVB rays, Lornoxicam (0.4 mg/kg BW intraperitoneal) treatment markedly reduced the degree of corneal opacity and significantly improved the ultrastructural damage by radiation (6). The preparation of 0.1% Lornoxicam ocular gel for the treatment of eye infections in domestic animals aims to deliver a localized, effective anti-inflammatory and analgesic therapy while improving drug bioavailability and retention on the ocular surface (7). As NSAID, Lornoxicam acts by inhibiting COX enzymes, which are responsible for the synthesis of prostaglandins, key mediators of inflammation, pain, and edema. This mechanism of action helps reduce ocular inflammation, pain, and discomfort associated with infections or other ocular conditions in animals (8). Lornoxicam ocular gel offers distinct advantages over diclofenac sodium drop for treating ocular conditions in domestic animals (9). In comparison to diclofenac sodium, Lornoxicam may offer superior bioavailability and a more favorable safety profile, potentially enhancing the convenience and effectiveness of ocular treatment in veterinary practice, specifically in dogs and cats (10).

The objective of this study is to investigate the prolonged ocular retention time of Lornoxicam, which aims to facilitate sustained drug release, thereby optimizing therapeutic efficacy while minimizing systemic absorption and reducing the risk of adverse effects. Additionally, the study seeks to evaluate Lornoxicam's rapid onset of action, providing prompt relief in the management of acute ocular inflammation, particularly in conditions such as traumatic eye injury, ocular trauma, and postoperative inflammation.

MATERIALS AND METHODS

Lornoxicam, hyaluronic acid, and crospovidone were obtained from Henan Grange Biotechnology Co., Ltd., China. Hydroxypropyl methylcellulose K100 and Carbopol 934 were purchased from Shanghai Ruiz Heng Chemical Technology, China. Sodium chloride, sodium bicarbonate, and calcium chloride dihydrate were obtained from Pioneer, Iraq. Rattus norvegicus domestica (domestic Norwegian rat) and domestic cats were used in the study.

Construction of Calibration Curves of Lornoxicam in Simulated Tear Fluid

To prepare the calibration curve, 10 mg of lornoxicam was dissolved in 100 mL of simulated tear fluid (STF) to create a stock solution with a concentration of 100 µg/mL. From this stock, 30 mL was diluted to 50 mL with STF to achieve a concentration of 60 µg/mL as sub stock solution, which was further diluted with STF by taking appropriate volumes to produce a range of concentrations (3, 6, 9, 12, 15, 18, and 21 µg/mL). The absorbance of each concentration was measured using UV-visible spectrophotometer (Shimadzu, Japan) at a maximum wavelength of 376 nm, and the absorbance values were plotted against the corresponding concentrations, the calibration curve was constructed (10).

Preparation of 0.1% Lornoxicam Ocular Gel

To prepare a 0.1% Lornoxicam ocular gel, the process began by kneading Lornoxicam with Crospovidone as solubilizing agent using ethanol and tri-ethanol amine as solvents (1:0.5) v/v to ensure a uniform surface solid dispersion of the drug (11). 0.5% w/v Carbopol P934 was dispersed separately in purified water, under continuous stirring 750 rpm until it became fully hydrated, and a gel base was formed (9). Then 600 mg of Lornoxicam-Crospovidone surface solid dispersion (equivalent to 0.0.1% w/v of Lornoxicam) was carefully incorporated into this Carbopol gel. To optimize the gel's viscosity and spreadability, Hydroxypropyl Methylcellulose (HPMC) K100 and Hyaluronic Acid (HA) were added separately in different ratios as shown in Table 1, and the mixture was blended thoroughly (12). The pH of the formulation was adjusted to approximately 7 using triethanolamine to ensure ocular compatibility.

Table 1. Lornoxicam ocular gel formulas composition expressed as %w/w

Formulation code	Lornoxicam	Carbopol P934	HPMC K100	HA
G1	0.1	0.5	0.1	
G2	0.1	0.5	0.15	
G3	0.1	0.5	0.25	
G4	0.1	0.5		0.15
G5	0.1	0.5		0.25
G6	0.1	0.5		0.5
G7	0.1	0.5		0.75
G8	0.1	0.5		1

HPMC K100=Hydroxypropyl Methylcellulose K100, HA=Hyaluronic Acid

In vitro Evaluation of Lornoxicam Ocular Gel

Determination of Viscosity

The viscosity of the formulations was measured at room temperature (25, 34±2°C) using a Brookfield viscometer digital (Brookfield, USP) at 100 rpm with spindle R6 (13).

One important indicator of sustainability and ease of administration for ocular gel compositions is their viscosity. The drug's residence time in the eye is mostly determined by the viscosity properties of gel- forming drug delivery systems. Viscosity was measured using Brookfield viscometer digital (Brookfield, USP) spindle R6. The rpm

was gradually increased from 12, and 30 rpm to 100 rpm and then dropped once more. The viscosity of the formulations was given in centipoise (cp) (14).

Spreadability

The spreadability of the gel was assessed by calculating the diameter of the circle that formed when the 0.1% Lornoxicam gel (equivalent to 0.5 g) was placed between two glass slides 25.5×76.2 cm. A one-centimeter-diameter circle was drawn on the slide. An exact measurement of 0.5 g of gel was then collected and put on a slide in a circular pattern. Then, a second slide was carefully placed on top of it. The slides allowed for a five-minute stay in place. The circle's circumference was seen to increase as the gel spread. Triplicate runs of the test were carried out (15).

Determining the Drug Content

The drug content was determined by diluting 10 g of each formula (equivalent to 10 mg drug) and adding 100 mL of freshly prepared simulated tears fluid (STF) prepared it in lab by mixing sodium chloride 0.670 g, potassium chloride KCL 0.2 g, and calcium chloride dihydrate 0.008 g dissolve in 100mL DW and adjust the pH to 7.4 (12). The formulas were removed from different parts of the container. Then, 1 mL was taken out and further diluted to make 10 mL using STF. The concentration of lornoxicam was determined using a UV-visible spectrophotometer (Shimadzu, Japan) at a maximum wavelength of 376 nm (16).

In vitro Ocular Gel Release

In vitro studies on drug release were conducted utilizing a UK Dissolution apparatus type 2 (Faithful, China). The dissolution medium comprised 500 mL of simulated tears fluid (STF, pH 7.4) maintained at 34°C and stirred at 150 rpm (17). At specified intervals 30 min,1 h, 2 h, and 6 h, 5 mL samples were withdrawn, and equivalent volumes of STF were replenished to maintain sink conditions. The concentration of the drug in the samples was subsequently analyzed using a UV-visible spectrophotometer (Shimadzu, Japan) with a detection wavelength set at 376 nm (18).

Histological Analysis

The corneas were extracted and left for histological examination in 10% formaldehyde after fixation. The samples were put into cassettes that had been pre-designated, dried repeatedly in increasing alcohol concentrations, and then washed in xylene. Each cornea was then cut in half and submerged in paraffin. Five micrometer sections were cut from paraffin-dipped corneas. Sections were deparaffinized overnight, treated with xylene, and then dehydrated in progressively stronger alcohols for 30 minutes. Subsequently, the sections were stain-treated with H&E and viewed under a light microscope at 10× and 40× (19).

Statistical Analysis

The dissolution profiles were analyzed using a similarity factor (f2) to determine statistical significance. Quantitative data analysis of the dissolution profiles was validated using statistical analysis utilizing a similarity factor (f2). The value of this component ranges from 50 to 100. When the f2 value > 50 (50-100), it meant that the two dissolution profiles were deemed to be similar. However, if the f2< 50, it indicated that the comparison profiles were not similar. P>0.05 were considered to be non-significant. Using the DD Solver, a significant P<0.05 was significant. The equation was used to define the similarity factor (f2).

$$f2 = 50x\, log\left[1 + \frac{1}{n}\sum_{t=1}^{n}[R_t - T_t]^2\right]^{-0.5} \times 100 \quad (20)$$

Where n is the representation of the total number of dissolution time points. As a percentage at time (t), the test and reference dissolution values are (Rt, Tt), respectively. The remaining results are evaluated using the one -way ANOVA (SPSS) (21).

Ethical Approval

Animal subjects: REACUBCP352004k, the code number for the study approved by the University of Baghdad's College of Pharmacy's ethical committee REcAuBCP372023L protocol number was issued

Draize Ocular Irritation Test Evaluation of 0.1% Lornoxicam Ocular Gel

The ocular irritation potential of the 0.1% Lornoxicam ocular gel was evaluated, The Draize ocular irritation test was conducted on 12 rats (6 males and 6 females) to assess the irritation potential of the formulated ocular gel. The 0.5 g of gel was instilled into the right eye of each rat, while the left eye served as the untreated control. After instillation, the rats were observed for 1, 24, 48 and 72 h for any signs of ocular irritation, including redness, swelling, corneal opacity, and discharge as shown in Table 2.

Table 2. Irritation was scored according to the Draize Ocular Scoring System (22)

Scoring	Result	Expression
0-1	Non-irritant	No redness
2-4	Mild irritation	Mild redness
5-8	Moderated irritation	Moderated redness
9-12	Severe irritation	Severe redness

Evaluating the Effect of Lornoxicam 0.1% Ocular Gel on Domestic Cats

Study Design

This study employed an uncontrolled clinical trial design involving six domestic cats (male and female), all of which received the lornoxicam 0.1% ocular gel. The objective was to assess the therapeutic efficiency of the gel in reducing clinical signs of ocular inflammation, including redness, swelling, discharge, and dryness (23).

Animal Selection

The domestic cats referred to the outpatient veterinary clinic exhibited redness and irritation of the mucous

membranes of the eyes. Those subjected to the study had the following criteria, age: 1-5 years, body weight: 3-5 kg, no history of systemic or ocular diseases, and no prior ocular treatments within the last month based on the information from owners.

Treatment Administration

All six cats received 0.5 g of the lornoxicam ocular gel applied to the affected eye twice daily for 7 days. The cats were diagnosed with ocular inflammation due to trauma based on clinical signs such as conjunctival redness, ocular swelling, discharge, and dryness. The inflammation was graded using a standardized ocular scoring system (Table 3) that evaluated swelling, redness, discharge, and dryness on a scale from 0 (no signs) to 3 (severe signs). Ocular inflammation was assessed at baseline (Day 0), Day 3, and Day 7 post-treatment (24).

Table 3. Clinical signs were evaluated and scored at baseline (Day 0), Days 3, and 7days. The scoring criteria were as follows (25)

	Scoring				
Sign	0	1	2	3	4
Swelling	No swelling	Mild	Moderate	Severe	Sever
Discharge	No discharge	Serous	Mucoid	Purulent	
Redness	No redness	Mild	Moderate	Severe	
Dryness	Normal tears	Slight dryness	Moderate	Severe	

Statistical Analysis

The effectiveness of lornoxicam 0.1% ocular gel in reducing ocular inflammation over three time points (Day 0, Day 3, Day 7) was assessed using repeated measures ANOVA, with animal ID as a within-subject factor. Descriptive statistics were reported as mean ± standard error of the mean (SEM). Post-hoc pairwise comparisons with Bonferroni correction were planned for significant results. Statistical significance was set at $P \leq 0.05$. All analyses were conducted using JMP Pro 16.0.0 (SAS Institute Inc., Cary, NC, USA).

RESULTS AND DISCUSSION

Calibration Curve

The calibration curve is shown in Figure 1. The curve is linear at the concentration measured suggesting alliance with Beers Lambert with a R^2 of 0.9987).

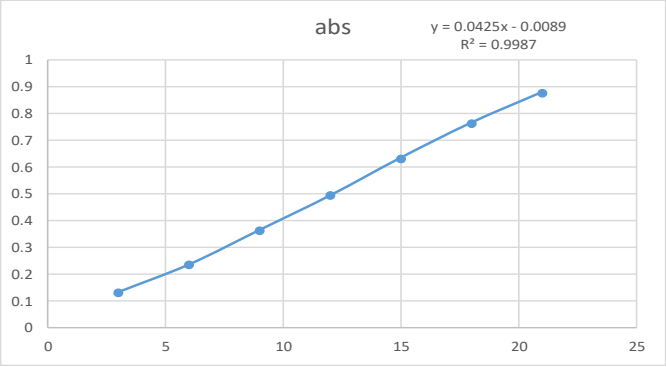

Figure 1. Calibration curve of Lornoxicam in stimulated tears fluid pH 7.4

Evaluation of Lornoxicam Gel

Viscosity

The increase in viscosity with higher concentrations of HPMC K100 and HA is due to enhanced molecular interactions and network formation. As the concentration of HPMC K100 rises, the polymer chains become more entangled, creating a denser gel network that resists flow. Similarly, higher HA concentrations lead to increased polymer chain density and stronger intermolecular interactions, thickening the gel. HPMC K100 generally causes a greater viscosity increase due to its more pronounced gel network, while HA is preferred for ocular gels due to its biocompatibility and moisturizing properties (12). The gels demonstrated shear-thinning behavior, meaning their viscosity decreased with increasing shear rates, which is beneficial for spreadability upon application Figure 2. This characteristic is particularly important for ocular gels, facilitating smooth distribution across the eye surface and promoting comfort and effective drug delivery (26).

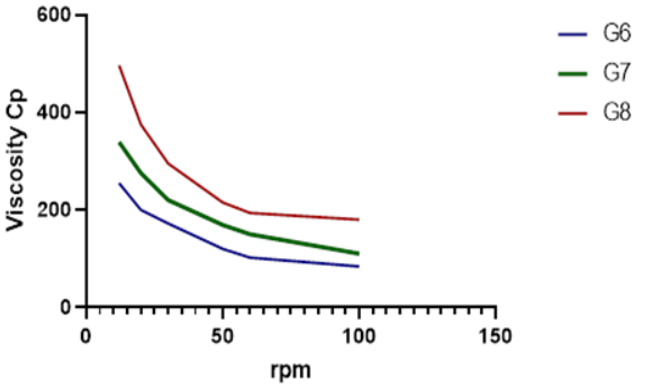

Figure 2. Rheological profile of Lornoxicam ocular gel formulations (G6-G8) with increasing Hyaluronic Acid concentrations

Spreadability

Spreadability values among the formulations ranged from 28 to 39 cm^2 as shown in Table 4, indicating that lower concentrations of HPMC and HA enhanced spreadability, while higher concentrations tended to decrease it. Formulation G6 displayed the most favorable balance between viscosity and spreadability, achieving an optimal value of 32 cm^2, conducive to easy application and adequate coverage over the ocular surface as shown in Figure 3 (27).

Drug Content

The drug content in the ophthalmic gel was found to be 94.90% in (STF, indicating uniform drug distribution within the formulation as shown in Table 4. This result meets the criteria for dosage forms as outlined by the United States Pharmacopeia (USP) (16).

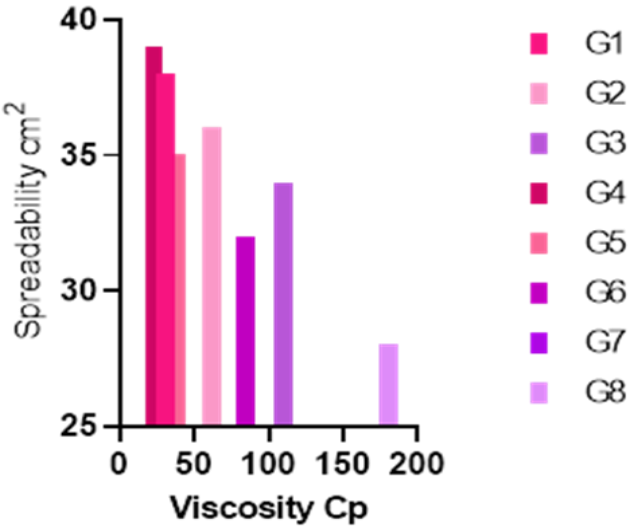

Figure 3. Correlation between viscosity and spreadability of ocular gel formulations (G6-G8)

Table 4. Evaluation parameters of Lornoxicam ophthalmic gel formulations (Data are expressed as means ± SD, n = 3)

Formula code	Drug content%	Viscosity cp (at 100 rpm)	Spreadability cm^2
G1	90.6±0.853	30.5	38
G2	90.8±0.859	62	36
G3	90.9±0.849	109.7	34
G4	91.8±0.861	22.8	39
G5	90.6±0.853	37.9	35
G6	94±0.852	84.2	32
G7	94.3±0.854	110.3	30
G8	94.2±0.853	180	28

In Vitro Drug Release of Lornoxicam Ocular Gel

In vitro drug release studies showed that 70% to 92.5% of the drug was released within 6 h across formulations G6 to G8. Notably, G6 displayed a similarity factor of less than 50, indicating a distinct release profile. One-way ANOVA confirmed G6 statistically significant superior drug release rates ($P<0.05$), underscoring its potential for effective ocular drug delivery. Formulations G6, G7, and G8 (Figure 4) featured increasing concentrations of HA at 0.5% w/v, 0.75% w/v, and 1% w/v, respectively the increased HA concentration enhances viscosity, creating a thicker gel matrix that slows drug diffusion (28). Thus, G6 with 0.5% w/v HA released the drug more rapidly due to its less restrictive structure, while G7 and G8 provided a slower, sustained release. Additionally, the presence of Crospovidone, a super disintegrant, further improved drug dissolution and release efficiency (29).

Irritation Ocular Test

The irritation scores from ocular tests of the 0.1%w/w Lornoxicam gel indicated minimal irritation. The mean scores were 0.2 ± 0.4 for conjunctival redness and 0.1 ± 0.3 for swelling in the right eye (which received the gel), resulting in a total irritation score of 0.3 ± 0.6. Statistical analysis using one – way ANOVA revealed no significant differences ($P>0.05$) between the treated right eye and the control left eye, confirming the gel's non-irritating nature (30).

Histopathological Findings

The histopathological finding shows that rat treated eye exhibited normal histology of the ciliary processes, cornea, and iris, with no signs of inflammation as shown in Figure 5.

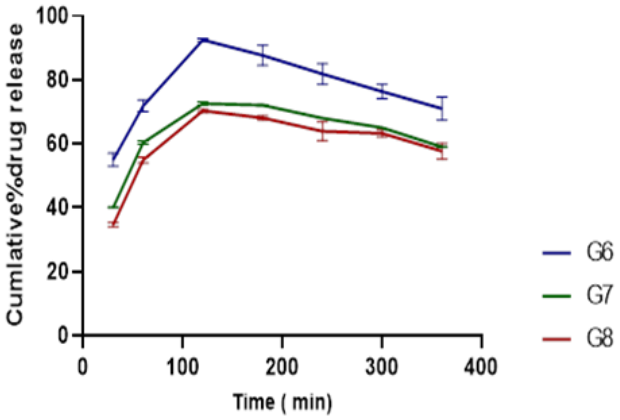

Figure 4. Comparative drug release profile of Lornoxicam from ocular gel formulations (G6-G8) with varying Hyaluronic Acid concentrations (means ± SD, n = 3)

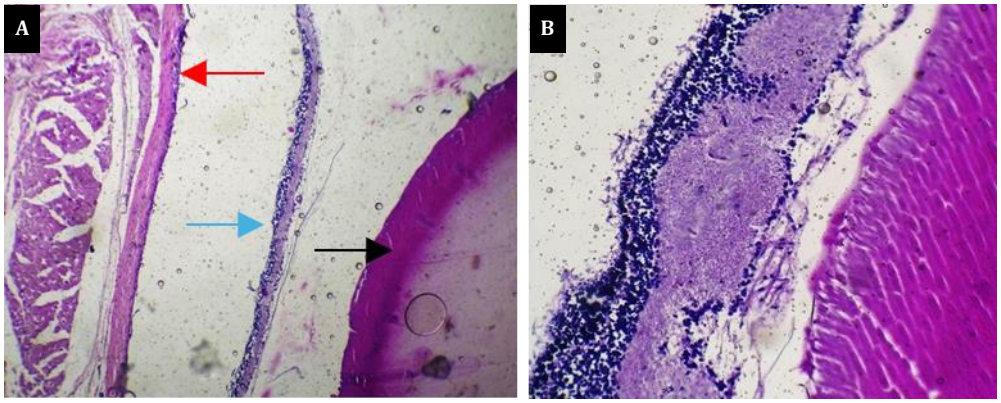

Figure 5. Rat Ocular Irritation Test: **(A)** The section of the rat eye illustrates the normal structural details of the eye wall, including the lens with a transparent amorphous appearance (black arrow), retina (blue arrow), and cornea (red arrow) (H&E stain, 10× magnification). **(B)** The section reveals the lens and retina exhibiting multilayered structures (H&E stain, 40× magnification)

Treatment of Ocular Inflammation in Domestic Cats a Clinical Case Study

The mean scores (±SEM) for swelling, redness, discharge, and dryness at baseline (Day 0), Day 3, and Day 7 are presented in Table 5. The clinical signs of ocular inflammation swelling, redness, discharge, and dryness showed varying degrees of improvement over the three time points. Swelling scores decreased significantly (P=0.003) over time, with mean values of 3.00 ± 0.00 at Day 0, 1.67 ± 0.33 at Day 3, and 0.33 ± 0.33 at Day 7. Dryness scores also showed a significant reduction (P=0.003), decreasing from 3.00 ± 0.00 at Day 0 to 1.67 ± 0.33 at Day 3, and 0.67 ± 0.33 at Day 7. For discharge, mean scores significantly dropped from 2.33 ± 0.33 at Day 0 to 1.00 ± 0.00 on Day 3, reaching 0.00 ± 0.00 by Day 7.

Table 5. Mean (± SEM, n=6) scores of clinical parameters for ocular inflammation in domestic cats across time points

Parameter	Day 0	Day 3	Day 7	*P*-value
Swelling	3.00 ± 0.00 [a]	1.67 ± 0.33 [b]	0.33 ± 0.33 [c]	0.003
Redness	2.67 ± 0.33 [a]	1.33 ± 0.33 [b]	0.00 ± 0.00 [c]	0.003
Discharge	2.33 ± 0.33 [a]	1.00 ± 0.00 [b]	0.00 ± 0.00 [c]	0.003
Dryness	3.00 ± 0.00 [a]	1.67 ± 0.33 [b]	0.67 ± 0.33 [c]	0.003

Means within the same row that do not share a common superscript letter are significantly different (P≤0.05)

The significant reductions observed for swelling, redness, discharge, and dryness scores indicate the effectiveness of lornoxicam 0.1% ocular gel in reducing these clinical signs of ocular inflammation (31). The reduction in inflammation was consistent across all subjects, and no significant adverse effects were observed during the study period (22). The results of this study demonstrate that Lornoxicam 0.1% ocular gel is effective in reducing trauma-induced ocular inflammation in domestic

cats. Lornoxicam works as a selective COX-2 inhibitor, which reduces the production of prostaglandins that mediate inflammation, pain, and fever. This mechanism of action is particularly relevant in the eye, where inflammation following trauma can lead to significant discomfort and tissue damage. By inhibiting COX-2, Lornoxicam effectively reduces the inflammatory response, providing both anti-inflammatory and analgesic benefits (32). The use of hyaluronic acid as a lubricant in the ocular gel formulation also helped mitigate the dryness and irritation commonly associated with ocular trauma, contributing to the overall efficiency of the treatment (28). The combination of anti-inflammatory effects from lornoxicam and the soothing properties of hyaluronic acid may explain the rapid and significant improvement observed in all cats by Day 7. Comparatively, other NSAIDs like diclofenac can cause systemic absorption and potential side effects, such as gastrointestinal or renal toxicity (9). In contrast, Lornoxicam, when administered topically in the ocular gel form, offers the advantage of targeted therapy with minimal risk of systemic side effects. The absence of ocular discomfort or irritation in this study further supports the safety and tolerability of Lornoxicam 0.1% ocular gel (8). Lornoxicam 0.1% ocular gel is an effective and well-tolerated treatment for trauma-induced ocular inflammation in domestic cats as shown in Figure 6.

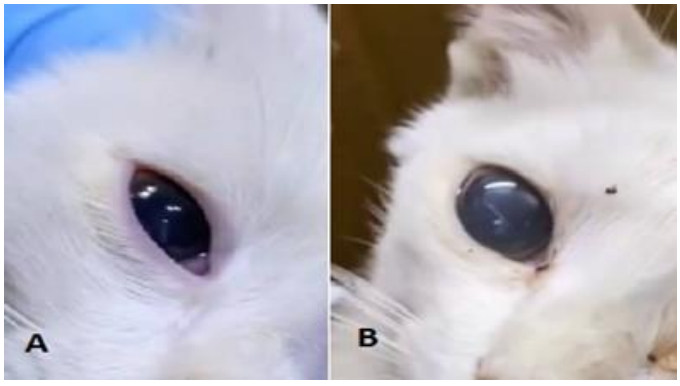

Figure 6. Evaluation of ocular healing progress following lornoxicam gel treatment at Day 7: **(A)** Pre-treatment status, **(B)** Post-treatment with 0.1% Lornoxicam ocular gel

The developed lornoxicam ocular gel represented a promising therapeutic option for managing ocular inflammation in domestic cats. The optimized formulation demonstrated a suitable viscosity for ocular application, along with an effective release profile characterized by an initial burst followed by sustained drug release. Safety assessments confirmed that the gel is non-irritant, supporting its potential for clinical use. These findings highlight the efficacy of the lornoxicam ocular gel in enhancing therapeutic outcomes while minimizing side effects.

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N/A.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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تطوير وتوصيف جل عيني يحتوي على عقاراللورنُوكسيكام لعلاج فعال لتورم العين في القطط المنزلية

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الخلاصة

ان لورنوكسيكام هو عقار فعال مضاد للتورم غير ستيرويد يستخدم في تخفيف التورم من ضمنها تورم العين، الطرق التقليدية لمعالجة تورم العين تتضمن القطرات السائلة، التي تغسل بالدمع عادة. لذا فان البوليمرات التي تلتصق بالأغشية المخاطية (مثل حمض الهيالورونيك، وهيدروكسيد بروبل ميثيل سلولوز والكاربابول) مناسبة لإبقاء العقار فترة أطول بالعين وتقليل خسارة الدواء عن طريق الدمع. تهدف هذه الدراسة إلى صياغة هلام لورنوكسيكام بتركيز (٠,١٪وزن/حجم) لعين الحيوانات الأليفة لمعالجة تورم العين موضعيا وضمان تحرر الدواء المتأني، مما يعزز الفعالية العلاجية مع تقليل الآثار الجانبية المحتملة. تم تطوير ثمان تركيبات مختلفة من هلام لورنوكسيكام للعين مكون من(٠,٥٪ وزن/حجم)الكاربابول وتراكيز مختلفة من حمض الهيالورونيك (HA) وهيدروكسي بروبيل ميثيل سلولوز (HPMC K100) و من ثم تم تقييم هذه الصيغ بالفحوصات الاساس مثل اللزوجة وقابلية الانتشار و تحرر الدواء. التركيبة التي اظهرت الأداء الأمثل هي G6، التي تحوي.(٠,٥٪وزن/حجم)كاربابول و(٠,٥٪وزن/حجم) حمض الهيالورونيك. بينما تم إجراء اختبار تهيج العين لتقييم سلامة وتحمل التركيبة باستخدام نموذج الفئران النرويجية المنزلية Rattus norvegicus Domestica علاوة على ذلك، أجريت دراسة سريرية لهلام لورنوكسيكام لعلاج تورم العيني الناتج من الإصابات في نموذج القطط المنزلية. أظهرت الصيغة المختارة G6 لزوجة وقابلية انتشار مناسبة، مما يجعلها ملائمة للإعطاء العيني. كشفت دراسات تحرير في المختبر عن تحرير مبدئي سريع بنسبة ٩٢,٥٪ في الساعتين الأوليتين، تلاه تحرر للعقار بطيء على مدى ٦ ساعات تالية. أكدت اختبارات تهيج العين باستخدام نموذج الفئران أن هلام لورنوكسيكام العيني غير مهيج. علاوة على ذلك، تم ملاحظة التأثيرات العلاجية للهلام في القطط المنزلية، حيث هناك تحسن ملحوظ في الحالات العينية، بما في ذلك تقليل التورم، والاحمرار، والجفاف، خلال أقل من ٧ أيام من العلاج. يظهر هلام لورنوكسيكام خصائص واعدة للعلاج فعال و امين لتورم العين في القطط المنزلية.

الكلمات المفتاحية: اللورنُوكسيكام، الكاربابول، جل عيني، تورم العين، حمض الهيالورونيك