

Smart Eye Healing: Formulation and Evaluation of Gentamicin and Marigold-infused ocular inserts

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ABSTRACT

This is the research built, characterized and evaluated a unique ocular insert developed using Gentamicin, a broad-spectrum aminoglycoside antibiotic, with Marigold (*Tagetes erect*) extract, with strong anti-inflammatory and wound healing properties. The ocular insert was fabricated by using solvent casting, and used polymeric components of hydroxypropyl methylcellulose (HPMC), and polyvinyl pyrrolidone (PVP), plasticizers of PEG-400 and glycerol to develop adequate flexibility and bioadhesive properties. Phytochemical screening of the Marigold extract revealed constituents of flavonoids, triterpenoids, phenolics, and steroids. Anti-inflammatory activity was measured using egg albumin denaturation assays, where the formulation displayed protein stabilization averages of 63.2%. Antimicrobial activity was validated through agar diffusion methods, with substantial zones of inhibition against *E. coli* and *S. aureus*; the higher levels of gentamicin displayed significantly increased inhibition. The in-vitro diffusion studies using the Franz cell apparatus saw the formulation continued drug delivery of 76.14% drug delivery over 4 hours and in turn, demonstrated that this formulation can successfully provide control drug delivery. Physicochemical assessments showed good results in the weight uniformity, pH, folding endurance and disintegration time evaluations, and we concluded that formulation was stable, biocompatible, and would act quickly in vivo. Taken together, the present findings suggest that synthetic ocular insert infused with Gentamicin and Marigold is a potential patient-friendly alternative to traditional eye drops, with improved bioavailability and drug-releasing capability, dosing frequency, and dual therapeutic action for infection and inflammation.

Keywords: Ocular Insert, Gentamicin, Marigold Extract, Anti-Inflammatory Activity, Antimicrobial

Efficacy, Sustained Drug Release, Solvent Casting Method, Ocular Drug Delivery System.

I. INTRODUCTION

Conjunctivitis and keratitis are widely seen ocular biofilms caused by bacteria, virus, or environmental irritants. In conjunctivitis we see inflammation of the conjunctiva present with redness, discharge, and irritation. In keratitis we see involve the keratitis, pain, blurring of vision, and can cause vision loss if left untreated. These ocular infections, often need prompt, effective treatment with antimicrobial agents and anti-inflammatory medications.

Conventional therapies such as eye drops are limited by poor retention time, frequent administration, and ultimately poor adherence by patients. Ocular inserts have been introduced as an alternative drug delivery method. Gentamicin is a commonly used aminoglycoside antibiotic. Marigold extract is included for its anti-inflammatory and wound-healing effects due to flavonoids and triterpenoids. This research project aims to investigate a sustained release ocular insert that combines gentamicin's antibacterial properties with the anti-inflammatory properties of marigold, allowing for a new approach to treatment for ocular infections.

Gentamicin is a well-known aminoglycoside antibiotic. It works through the 30S ribosomal subunit by exhibiting its bactericidal activity by inhibiting protein synthesis in bacteria. Marigold extract is used as an anti-inflammatory and wound healing agent, and was combined with gentamicin in a single formulation. It is also known to work as an anti-inflammatory and anti-microbial. (2) because of the high flavonoid and triterpenoid amounts. Marigold extract is a known bio-active molecule that reduces inflammation and oxidative stress by inhibiting cyclooxygenase (COX) and lipoxygenase (LOX). Studies show that Marigold extract at 147 µg/mL has better anti-inflammatory

activity than 10 µg/mL, making it a great component for our formulation.

II. LITERATURE REVIEW

Almeida et al. (2021) conducted a comprehensive survey of the evolution and use of smart dressings for the purpose of wound healing. Their assessment emphasized the evolution of traditional wound dressings to "smart" dressing systems that not only act as physical barriers, but can actively adapt to the specific properties of a wound. These smart dressings were described to perform a multifaceted function that would contain moisture, provide antibacterial functionalization, permit gaseous exchange, or administer drugs under controlled conditions. The authors included additional and future biomaterials and nanotechnologies that provided real-time measurements of the wound and promoted an optimal microenvironment for wound healing. This extensive research provided a good base understanding of smart delivery systems, and their potential ability to transform topical therapeutics in the future.

Cao et al. (2022) investigated the production of smart nanofiber coatings that have both self-warning and self-healing abilities. The coatings were fabricated using responsive polymers that can react to an external stimulus such as mechanical damage independently of the user. Initially, the coatings engines self-repair but also displayed significant color changes as a warning. These properties are compared to previous initiatives involving spatiotemporal selectivity. Their results exhibited a distinct process for materials design whereby functional implementations exceed a passive form of protection. Their research emphasized the promise of combining a sensory and therapeutic response

into one material system and provided examples in ocular or dermal drug delivery systems concerned about timely warning and recovery.

Cheng et al. (2023) pushed this area forward by creating photothermal coatings with layers that had self-reporting and self-healing features for corrosion protection. The photothermal coatings used photothermal-responsive materials with intelligent healing capabilities, which reacted to a lightning environment through detection of early-stage damage and the activation of a repair process that was activated via a lighting environment. The hierarchical nature of the design enabled controlled healing process, while also allowing visualization of damage state; although the studies were focused on protecting against corrosion, the ideas of self-responsiveness, layering to create structures, and responding independently should provide valuable context for our exploration ideas for smart therapeutic platforms like ocular inserts or bioadhesive patches.

III. MATERIALS AND METHODS

3.1 Materials

Gentamicin was purchased from Chandra Bhagat Pharma Ltd., while PEG-400 (Polyethylene Glycol), PVA, HPMC, HPC (Hydroxy propyl cellulose) and Glycerol were purchased from SD Fine Chem-Limited, and PVP from Research-Lab Fine Chem Industries. The ingredient used for nutrient agar, nutrient broth, and agar-agar were purchased from HIMEDIA. The reagents used for the preparation of phosphate buffer at pH 6.8, di-Sodium hydrogen orthophosphate and Potassium dihydrogen orthophosphate were purchased from SD Fine Chem-Limited. Bacterial culture of *P. aeruginosa* (ATCC 27853) and *B. subtilis* (ATCC 6051) were purchased from Lilavati hospital micro labs.

Table 1:List of Ingredients and their uses

Ingredients	Uses
Gentamicin	Antibiotic
Marigold	Antibiotic
PVA	Polymer
PVP	Polymer
HPMC	Polymer
PEG-400	Plasticizer
Glycerol	Plasticizer
Distilled Water	Solvent
Alcohol	Solvent

3.2 Preparation of Marigold Extract

- 1. Prepare the Plant Material:** Drying the Marigold Flowers: The Marigold flowers need to be dried prior to extraction; this allows for a decrease in moisture content, and releases the oils effectively. Grind the Plant Material: (6) To increase the surface area of the dried Marigold flowers for extraction, finely grind the dried Marigold flower.
- 2. Prepare the Soxhlet setup:** The dried Marigold flowers have been placed in the thimble, and then the thimble is placed into the Soxhlet extractor. In the round bottom flask pour in solvent ethanol. The solvent should just touch the bottom of the round bottom flask but not pour out of the flask. Complete the Soxhlet setup, connecting the extractor with the thimble and flowers to the cap of the Soxhlet extractor, connecting a condenser that will cool the vapor and re-deposit over the flask.
- 3. Extraction Process:** Heating: Heat the round-bottom flask by utilizing a heating mantle. As the flask is heated, the solvent will start to vaporize. Condensation: The vapor solvent rises into the condenser, where it will cool and condense back into a liquid state. Refluxing: The cooled and condensed solvent drips down into the Soxhlet extractor, where it comes in contact with the marigold flowers. The solvent will extract the active compounds from the marigold petals. Recycling: Once the solvent fills the extractor, it will siphon back into the round-bottom flask. The process can then be repeated and has the potential to be replicated many times. Each time the solvent washes through the plant materials, more compounds are extracted from the marigold petals.

- 4. Time to Extract:** The Soxhlet extraction process typically takes a number of hours (42 hrs often). The longer the extraction process, the more compounds extracted.
- 5. Extraction Complete:** In your round-bottom flask, once the extraction is complete, you will notice the solvent has darkened. This indicates that the desired compounds from the marigold flowers have been extracted. The plant material itself may lose its colour, indicating that most of the soluble material has been extracted as well.
- 6. The Extract I've retrieved:** After you have made your extraction, the round bottom flask contains the array of extracted compounds. In order to isolate the desired extract, the solvent must be evaporated or removed. This was done by steam distillation, and then any residual solvent evaporated with a water bath to give your extract in the form of a semi solid, dark brown material.

3.3 Film Preparation

The ocular patch was manufactured by solvent casting method.

Steps: The film forming polymer was weighed according to the formulation table, and added to the beaker. Afterward, glycerol and PEG 400 were added and stirred thoroughly for better clarity of base. To this solution, Gentamicin + Aq. Marigold extract were added and stirred until dissolved. Then, 15ml of alcohol was added to the solution to increase solubility of marigold extract and also to make the solution clearer. Next, this solution was placed on a sonicator for 15min to remove absorbed gases. This mixture was poured into a petri plate of uniform diameter and placed in hot air oven at 40 degrees Celsius to dry.

Table 2: Formulation table for primary selection of formulation for ocular insert

Ingredients	S1	S2	S3	S4	S5	S6	S7	S8
HPMC %	3	2	2	3	4	3	4	3
PVP%	3	3	2	1.5	1.5	2	1.5	2
PVA%	1	-	-	1	-	1.5	-	-
PEG-400%	1.5	1	1	-	2	1	1	1.5
Glycerol%	-	-	-	1	-	0.1	-	0.1
D.W(ml)	30	30	30	15	30	30	15	30
Alcohol	-	-	-	15	-	-	15	-

Table 3: Final selected formulation table insert

Ingredients	Quantity
Gentamicin (mg)	0.3
Marigold extract (ug)	147
PVP (%)	1.5
HPMC (%)	4
PEG-400(%)	1
Alcohol (ml)	15
D.W. (ml)	15

3.4 Calibration curve of Gentamicin and marigold extract

The standard calibration curve procedure involved the preparation of standard solutions of Gentamicin and marigold spanning concentrations from 1 mcg/ml to 7 mcg/ml. This was achieved by diluting the stock solution (100 mcg/ml) appropriately. Absorbance was measured at 257 nm and 406 nm. Subsequently, a calibration curve was constructed, plotting concentration (mcg/ml) against absorbance, revealing a linear relationship. Analysis of the curve determined the linearity range and correlation coefficient (R²), indicating the method's reliability for quantification of Gentamicin and marigold within the specified concentration range.

3.5 Anti-inflammatory Testing

The main aim of the egg albumin denaturation assay is to determine if agents or compounds can prevent/ inhibit the denaturation of egg albumin under laboratory conditions. This assay is a valuable resource for quantifying the anti-inflammatory activity of drugs or compounds based on their ability to inhibit or prevent the denaturation of egg albumin. The assay relies on the premise that substances that may possess anti-i-

nflammatory properties may also have the ability to stabilize protein structures and minimize denaturation, a process closely related to inflammation and tissue damage. Thus, agents or chemicals that would cause a significant drop in egg albumin denaturation in this assay may have potential as anti-inflammatory agents by gentamicin (10) and marigold extract.

Anti-inflammatory activity of actives can be assessed in vitro for inhibition of egg albumin (protein) denaturation. To commence a reaction mixture of 5 ml, 0.2 ml of egg albumin solution (from a fresh hen's egg or powdered commercially egg albumin), 2 ml of sample extract or standard (diclofenac sodium) for varying concentrations and 2.8 ml of phosphate buffer saline (PBS) of pH 7.4 were added. A control of 5 ml was formed as a mixture of 2 ml triple distilled water, 0.2 ml of 1-2% egg albumin solution and 2.8 ml of PBS pH 7.4 solution. The reaction mixtures were incubated at (37±2) °C for 30 mins, followed by heating in a water bath at (70 ± 2) °C for 15 mins. After cooling, the absorbance at 660 nm was recorded using UV/visible spectrophotometer (Peak instruments, USA) with triple distilled water as blank. Percent inhibition of protein denaturation was calculated by using Equation.

$$\% \text{ Inhibition} = \frac{\text{Absorbance of Control} - \text{Absorbance of Test Sample}}{\text{Absorbance of Control}} \times 100$$

Table 4: Procedure for Anti-inflammatory

	Volume of 1% albumin (in ml)	Volume of Drug solution/Formulation (in ml)	Volume of distilled water (in ml)	Volume of PBS pH 7.4 (in ml)
Test	0.2	2	0	2.8
Blank	0	2	2	2.8
Control	0.2	0	2	2.8

3.6 Antimicrobial Screening

Principle: Agar plate methods were used to assess antimicrobial activity. This is the method using disc diffusion and well diffusion sometimes

called agar diffusion because they all involve a principle of diffusion and growth inhibition. Gentamicin is placed on an agar plate that has been inoculated with bacteria E. coli and S. aureus. The

agent diffuses outward into the agar at an area of higher concentration, which establishes a concentration gradient. The bacteria are inhibited from growing at sufficient concentrations of the antimicrobial agent. Through the activity of the gentamicin on the agar plate, a visible clear zone will be present around the source of the antimicrobial agent.

Materials:

1. Nutrient agar plates (had a standard bacterial culture inoculated into them)
2. Sterile paper discs (6–8 mm in diameter)
3. Antibiotic solutions or test substances
4. Sterile tweezers
5. Sterile micro pipettors
6. Measuring scale (to measure the inhibition zones)
7. Bacterial culture broth.

Procedure:

1. Inoculate Agar Plates
 - Apply a standardised bacterial culture of *S. aureus* and *E. coli* to the surface of nutrient agar plates using a sterile loop. Make sure the culture is distributed evenly.
2. Prepare Discs:
 - Use a dry heat steriliser or autoclave to sterilise paper discs.
 - Impregnate the discs with the test material of interest or the antibiotic solution.
3. Create Wells:
 - The impregnated paper discs should be placed on the surface of the infected agar plates using sterile forceps.
 - To guarantee proper contact, gently push the discs into the agar.
4. Incubation:
 - For 16 to 24 hours, incubate the agar plates inverted (lid down) at the temperature necessary for bacterial growth, which is typically 37°C.
5. Examine Inhibition Zones:
 - Look for areas of inhibition surrounding the discs on the plates after incubation.
 - Inhibition zones are regions where the tested substance's activity inhibits bacterial growth.
6. Measure Zones:
 - Measure the clear zones of inhibition's diameter in cm using a measuring scale. This offers a numerical evaluation of antibacterial efficacy.
7. Interpretation:

- Greater antibacterial activity is indicated by larger inhibition zones.
 - To ascertain the efficacy of the test chemical, compare its inhibition zones to those of the positive control.
8. Record and Report:
- Note the outcomes, including the inhibition zone diameter and any other pertinent information.

Prepare a report to document the findings as needed.

3.7 In-vitro Diffusion Studies

The in-vitro diffusion studies conducted with the Franz cell apparatus were a significant exploration of the release profiles of Marigold extract and Gentamicin. This apparatus allowed for the controlled observation of drug release kinetics under simulated skin absorption conditions across a semipermeable membrane. Over a course of 4 hours, we allowed the marigold extract and Gentamicin to diffuse across the membrane. By sampling the receptor compartment over time, we were able to quantify the amount of each, as they were released, which informs us of their profiles and overall release rates. This study also provides useful information regarding the amount of active ingredients that can be delivered from this formulation, which assists with dose regimens and increased efficacy. Data obtained from the Franz cell apparatus provide insight into the release characteristics of Marigold extract and Gentamicin.

Procedure

1. Calculate the volume of the receptor compartment of the Franz diffusion cell.
2. Place the magnetic needle in the receptor compartment.
3. Fill the receptor compartment with phosphate buffer pH 7.4 to the top.
4. Place the patch (ocular insert) on the goat eye lens which acts as the parchment paper and place it between the receptor and donor compartments and clamp it in place.
5. Place the diffusion cell on the magnetic stirrer at room temperature and set at rpm 500 to 600.
6. Take 2 ml samples from the side arm at time intervals 0, 15, 30, 45, 60, 75 minutes.
7. Measure the absorbance of the samples at λ max of Gentamicin and λ max of Marigold extract.
8. Calculate % release at various time intervals by substituting in the linear regression equation of the calibration curve of the drug.
9. Draw a graph of % Drug Release v/s Time.

3.8 Hen’s egg-chorioallantoic membrane (HET-CAM Assay)

Hen’s egg-chorioallantoic membrane test (HET-CAM) is a test used to determine the irritation potential of substances and is an alternative test to the Draize Rabbit Eye Test. This test is performed in an 8-12 days old, fertilized egg. The eye is a complex structure and is subjected to various types of adverse effects therefore Het Cam assay is an important method as it is the only organotypic culture method that mimics the conjunctiva of the eye, providing data related to vascular events. The method aims to semi quantitatively assess the irritation potential of a chemical product on the chicken embryonic egg chorioallantoic membrane by observing its irritant effects on the membrane immediately after the application of pure or diluted chemical product To

check the irritancy of our formulations HET-CAM assay was performed.

Steps: Eggs aged 7 days were incubated in the incubator for 2 days.

On day 9 the eggs were candled with a source lamp to ensure their viability. The airspace delimited by the inner membrane at the large end of the egg seen against the light source was marked using a marker, the eggshell was removed using a needle and forceps. The inner exposed membrane was removed carefully by means of forceps without injuring any underlying blood vessels. The CAM then became visible which was then treated with the test substance and monitored. Blood vessels, capillaries and albumen were examined and scored for 5 min or until reactions such as hemorrhage, lysis and coagulation were observed. Later the score was calculated. All experiments were performed in triplicate.

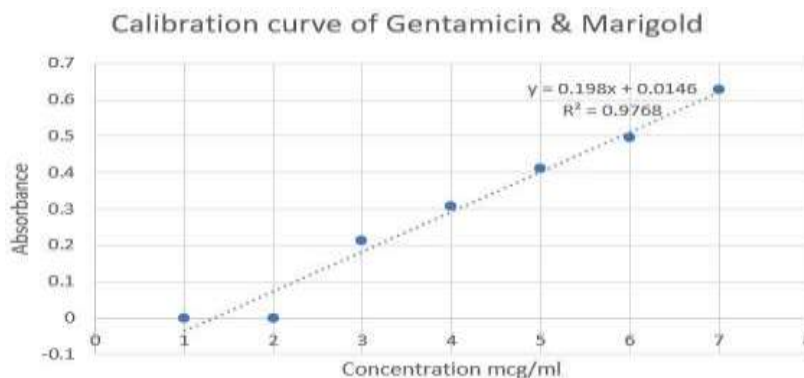
Table 5: HET-CAM Irritancy score

Irritancy Score	Irritancy
0to0.9	Non-Irritant
1to4.9	SlightIrritant
5to8.9	ModerateIrritant
9to21	SevereIrritant

IV. RESULTS AND DISCUSSION

4.1 Calibration Curve

Figure 1: Calibration curve of Gentamicin and Marigold extract



Gentamicin and marigold extract calibration plots demonstrated linearity ($R^2 = 0.9768$) between 1 and 7 mcg/ml.

4.2 Phytochemical Screening

Flavonoids, triterpenoids, anthocyanins, phenolic chemicals, and steroids were all detected in the marigold extract.

Table 6:Result for phytochemical testing

Phytochemical tests	Observation	Inference
Flavanols	Orange colour	Presence of flavonoids in marigold extract
Libermann - Burchard's	Red colour	Presence of triterpenoids in marigold extract
Shinoda Test	Red colour	Presence of anthocyanins in marigold extract
Ferric Chloride	Violet colour	Presence of phenolic compound in marigold extract
Salkowski Test	Red colour in lower layer	Presence of steroids in marigold extract
Lead Acetate	PPT	Presence of phenolic compound in marigold extract

4.3 In-vitro Drug Diffusion

For a drug in a formulation to have a pharmacological effect, it must penetrate both the formulation and the body's physical barrier (11). Hence, the studies are called in-vitro diffusion trials

(sometimes referred to as permeation studies), and their purpose is to determine if the drug can penetrate either the ocular insert or the body's physical barrier, and how much.

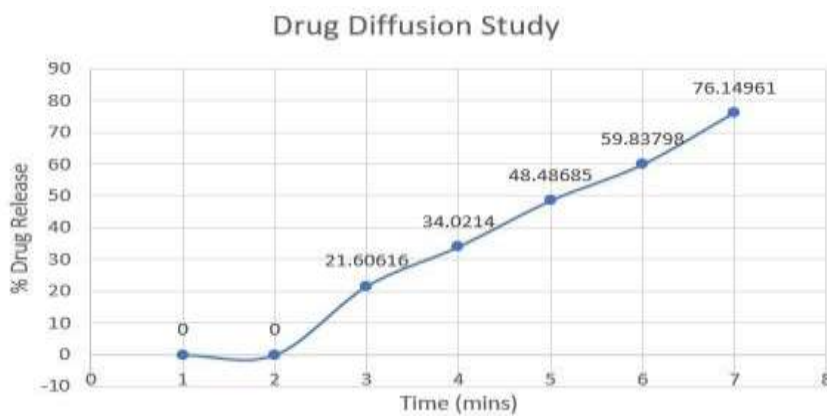


Figure 2:Drug diffusion study of Gentamicin and Marigold extract

In vitro Diffusion studies were performed giving a percent drug release of 76.14%

Bacterial strains:

4.4 Antimicrobial Activity

Drug Concentration Tested:

- Experiment(0.1% gentamicin)
- Experimental(0.3% gentamicin)

- E. coli(Gram-negative)
- S. aureus (Gram-positive)

Zone of Inhibition Observed:

- For 0.1% gentamicin:
- E.coli:3.1 cm

- S. aureus:3.3cm
- For 0.3% gentamicin:
- E.coli:4.3 cm
- S. aureus:4.4cm

Results and Observation:
 These findings support the efficacy of gentamicin for eye infections by showing a concentration-dependent increase in antibacterial activity.



Figure 3: E.coli (Gram -ve Bacteria)



Figure 4: S.aureus (Gram +ve Bacteria)

4.5 Anti-inflammatory Activity

- **Gentamicin: 59.7% inhibition**

Control Group Absorbance: 1.204

Test Groups Absorbance: 0.521, 0.565, 0.485, 0.520, 0.68

Table 7: Anti-inflammatory result of Gentamicin

Test Tube	Absorbance	Percent Inhibition
1	0.521	56.7%
2	0.565	53%
3	0.485	59.7%
4	0.520	56.8%
5	0.68	43.2%

Result: The result was that the formulation showed strong inhibition, reaching an average percent inhibition of 59.7%. It appears from the results that the addition of gentamicin enhanced the anti-inflammatory properties of the formulation. Researchers rely on reliable formulations, so the fact that all samples behave similarly is good sign that the formulation is effective. According to the

observations, the formulation may have potential for use in eye therapy.

- **Marigold extract (147 µg/mL): 77.2% inhibition**

Control Group Absorbance: 0.088

Test Groups Absorbance: for 10 µg/ml- 0.051, for 147 µg- 0.020

Table 8: Anti-inflammatory result of Marigold extract

Test Tube	Absorbance	Percent inhibition
T1	0.051	42%
T1	0.020	77.2%

Result: Data revealed that 147 µg/mL of marigold extract had greater protection against protein denaturation compared to the lower dose of 10 µg/mL (13).

• **Final formulation: 63.2% inhibition**
Control Group Absorbance: 1.117
Test Groups Absorbance: 0.430, 0.413, 0.425, 0.380, 0.374

Table 9: Anti-inflammatory result of Formulation

Test Tube	Absorbance	Percent Inhibition
1	0.430	61.5%
2	0.413	63%
3	0.425	61.1%
4	0.380	65.9%
5	0.396	64.5%

Result: An average of 63.2% of growth was inhibited by the formulation during the experiment. It appears that the presence of gentamicin and marigold extract helped the formulation have antimicrobial action. The uniformity in their inhibition values shows that the formulation can be depended on. Consequently, the findings suggest

that the formulation may be valuable for development and use in ocular therapy.

4.6 Patch Evaluation

Theophthalmic patch should be thin, soft, small in size and not irritate the eye.

Table 10: Results of evaluation test

Sr.No.	Physical characteristics	Result
1	Weight variation	0.05 mg
2	Thickness	0.06 mm
3	Tensile strength	0.874 gm/mm ² ± 0.0031 gm/mm ²
4	Folding endurance	370 ± 4
5	Moisture loss	10.06 % ± 0.03 %
6	Moisture uptake	3.65 % ± 0.03 %

4.7 HET CAM Assay of ocular insert

Table 11: HET CAM Assay

Test Substance	Event			Irritation Score	Category
	Haemorrhage (H)	Lysis (L)	Coagulation (C)		
Negative Control (0.9 % Saline Solution)	More than 300 sec	More than 300 sec	More than 300 sec	0.0697	Non-Irritant
Positive Control (0.1N NaOH Solution)	9.6 sec	78.3 sec	300 sec	10.08	Severe Irritant
Formulation	More than 300 sec	More than 300 sec	More than 300 sec	0.06999	Non-Irritant

Calculation:

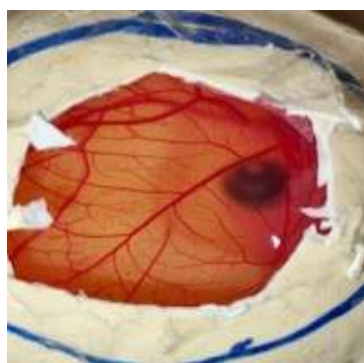
$$IRIndex = \frac{(301 - \text{Sec of Hemorrhage}) \times 5}{300} + \frac{(301 - \text{Sec of Lysis}) \times 7}{300} + \frac{(301 - \text{Sec of Coagulation}) \times 9}{300}$$

$$IRIndex = \frac{(301 - 300) \times 5}{300} + \frac{(301 - 300) \times 7}{300} + \frac{(301 - 300) \times 9}{300}$$

$$= \frac{(1) \times 5}{300} + \frac{(1) \times 7}{300} + \frac{(1) \times 9}{300}$$

$$= 0.01667 + 0.02333 + 0.03$$

$$= 0.06999$$



Negative Control



Positive Control



Formulation

Figure 5: CAM Assay results

Results and observations

The CAM assay results indicate that the formulated ocular insert exhibits minimal to no irritation, making it potentially safe for ocular use. Upon application of the test formulation, Nohaemorrhage was observed. No signs of lysis or coagulation were detected. The irritancy score was calculated as 0.069, which falls under the "non-irritant" category. However, additional confirmatory studies, such as in vivo ocular irritation tests, may be required to ensure complete safety and regulatory compliance.

V. CONCLUSION

The prepared ocular insert containing Gentamicin and Marigold extract has good potential as a controlled delivery system for ocular infections, especially conjunctivitis and keratitis. It can utilize the antimicrobial effect of Gentamicin and anti-inflammatory component of Marigold extract. Actually, it was seen that there were significant zones of inhibition and percentage inhibition from both bactericidal and anti-inflammatory assays and the combined formulations were able to successfully utilize the

medicinal properties of both Gentamicin and Marigold extract in the ocular insert for ocular infections. The formulation showed encouraging characterization data with respect to the weight and thickness, folding endurance, pH, disintegration and obviously their in-vitro diffusion study that came in at the high level of 76.14%, at the time of the study which we feel, is excellent data. In terms of anti-inflammatory testing conducted, they are promising in the sense that they showed a strong inhibition rate (score) from the final formulation (being 63.2%). Finally, all of these incorporated findings (results) are telling us, that the ocular insert is effective, safe and patient-friendly. It also shows promise as an option for patients who do not want to use drops, spectacles, or other conventional ocular drug delivery techniques since it provides advantages like increased bioavailability and reduced number of drops, which means increased compliance and decrease in complications related to ocular infections. Overall, this new technology has a future as an ocular insert (rod) product for management and possible separations of different ocular pathologies that impacts the ocular surface.

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