EVALUATION OF ANTI-INFLAMMATORY POTENTIAL OF CELECOXIB-BASED NANOGEL

***[1] Km Priyanka, [1]Sunil Gupta, [2]Amarjeet Singh**

**[1]Department of Pharmacy, Manglayatan Institute of Pharmaceutical Education and Research Manglayatan University, Aligarh- 202145 (UP) India*

[2]Innovative College of Pharmacy, K.P.- III, Greater Noida -201310 (UP) India

Corresponding author:
Priyanka
Research Scholar, Department of Pharmacy, Institute of Biomedical Education and Research Manglayatan University, Aligarh- 202145 (UP) India
bhatiipriyanka.02@gmail.com

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KEYWORDS

celecoxib, nanogel, carrageenan, anti-inflammatory activity, Wistar rats.

ABSTRACT

The aim of study was the evaluation of anti-inflammatory potential of celecoxib-based nanogel. Animal House, Innovative College of Pharmacy, plot no. 6, NP-2, Greater Noida provided rats (either sex) weighing 180-220g. All the rats were separately in 4 groups (n=6) as group 1 given normal saline each day, group 2 given carrageenan (2%) intradermally, group 3 given carrageenan (2%) + oxalgin nanogel (applied topically), and group 4 given carrageenan (2%) + NG2 for 21 days. The anti-inflammatory potential of nanogel was performed through carrageenan induced paw edema. Celecoxib was found soluble in ethanol, methanol, and insoluble in distilled water. Moreover, in contrast to disease control group, the Carrageenan (2%) + NG 2 treated rats showed the volume of left hind paw as 3.26±0.14mm and 3.17±0.25mm, respectively. As the results indicate that developed celecoxib nanogels exhibited significant anti-inflammatory activity. Significant inhibition was recorded in the celecoxib nanogel (NG2) when given with carrageenan. In conclusion, celecoxib nanogels might be much significant in reducing the inflammation and counter it. It suggests to study the mechanism of absorption of celecoxib nanogel. It also needed to further researchers to affirm its mode of action for anti-inflammatory response. .

INTRODUCTION

Nanogels are nano-sized, swellable molecules that are connected chemically or mechanically are known as nanogels, or nanosized hydrogels. It may exist in both ionic and anionic forms [1]. During the first decade of research, nanogels were demonstrated to be a promising structure for controlled drug release at the target region, multifunctional nanocarrier design for theragnostic, and systemic drug release [2]. The skin (surface area 1.5-2m²) refers as largest organ in the body; separating the biological system from the environment [3].

Celecoxib and other non-steroidal anti-inflammatory medications (NSAIDs) have analgesic, antipyretic, and anti-inflammatory effects when the cyclooxygenase-2 (COX) enzyme is suppressed. medicinal management of musculoskeletal conditions. Numerous ailments, such as lower back pain, gouty arthritis, rheumatoid arthritis, ankylosing spondylitis, osteoarthritis, dysmenorrhea, and acute spondylitis, have been treated with celecoxib in clinical studies. "Rheumatoid arthritis" (RA) was first used by Sir Alfred Baring Garrod in 1859. The chronic disease known as RA is characterized by joint stiffness, discomfort, and swelling. Prajapati et al. (2011) state that it may also lead to impairments and have a detrimental effect on the economy [4].

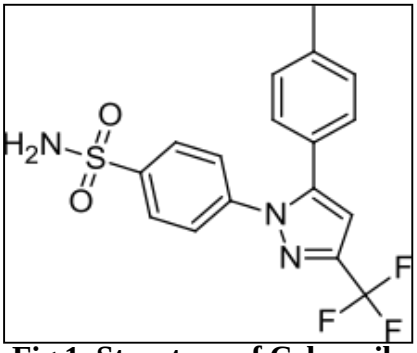

Fig 1. Structure of Celecoxib

It is commonly known that NSAIDs can be used to reduce inflammation and discomfort associated with arthritis. They mainly function by inhibiting cyclo-oxygenase (COX), an essential enzyme that transforms arachidonic acid into prostaglandins (PGs) and thromboxane (Sadia et al., 2020). PGs are the main mediators of pain and inflammation, whereas thromboxane possesses hypertensive, vasoconstrictive, and platelet-aggregating/activating effects. The two isoenzymes that comprise COX are COX-1 and COX-2 [5]. COX-1, which produces prostanoids that regulate physiological processes like hemodynamics, platelet aggregation, and GI mucosal integrity, is constitutively expressed in most tissues [6]. The object of study was the evaluation of anti-inflammatory potential of celecoxib-based nanogel.

MATERIALS AND METHODS

Chemicals

Celecoxib-based nanogel formulation, carrageenan, oxalgin nanogel and distilled water. All the chemicals of laboratory grade were purchased from the certified manufacturer and supplier only.

Evaluation of anti-inflammatory potential

Procurement of animals

Animal House, Innovative College of Pharmacy, plot no. 6, NP-2, Greater Noida provided rats (either sex) weighing 180-220g. The animals were maintained in excellent condition i.e., 12-hour light-dark cycle and room temperature. The rats were given a standard rodent diet and unrestricted access to water, while the relative humidity was maintained at 50±2% [7].

Experimental protocols

Animals were kept separately in 4 groups (n=6) and treated for 21 days as below-

Group	Treatment
1	Normal saline
2	Carrageenan (2%)
3	Carrageenan (2%) + Oxalgin nanogel (applied topically)
4	Carrageenan (2%) + NG2 (applied topically)

Carrageenan- induced paw edema

Each of the four groups of rats weighed between 180 and 220 grams. Rats' skin was treated with the nanogels. The left paw was used as a control, and 0.1 ml of 2% carrageenan was applied to the right foot pad. The reference medicine Oxalgin nanogel was applied topically concurrently with the phlogistic agent. Just above the ankle joint, both rear paws are examined, and the amount of inflammation is noted. At 5, 10, 15, and 21 days, the drug treatments are repeated [8].

RESULTS AND DISCUSSION

Evaluation of anti-inflammatory potential

- **Carrageenan-induced paw edema**

Volume of left hind paw was estimated after 30min, 60min, 120min and 180min for all 4 groups. Carrageenan (2%) treated rats showed the volume of left hind paw as 4.42±0.30mm and 4.18±0.19mm at 120min & 180min, respectively. Oxalgin nanogel (10mg/kg) + Carrageenan (2%) treated rats showed a decreased volume of left hind paw. Moreover, in contrast to disease control group, the Carrageenan (2%) + NG 2 treated rats showed the volume of hind paw as 3.26± 0.14mm and 3.17± 0.25mm, respectively.

Table 1. Volume of hind paw (left) in control, standard and celecoxib nanogel treated rats

Treatment	Volume of hind paw (left) (Mean± SEM)			
	30 min	60 min	120 min	180min
Normal saline	1.68±0.34	1.54±0.29	1.62±0.17	1.48±0.36
Carrageenan (2%)	2.74±0.29	3.27±0.14	4.42±0.30	4.18±0.19
Oxalgin nanogel + Carrageenan (2%)	2.19±0.37	2.49±0.16	2.57±0.34	3.08±0.20
Carrageenan (2%) + NG 2	2.34±0.16	2.29±0.52	3.26±0.14	3.17±0.25

Similarly, % inhibition was estimated as 76.48±0.16% and 69.15±0.34% in Oxalgin nanogel + Carrageenan and Carrageenan (2%) + NG 2 treated rats, respectively.

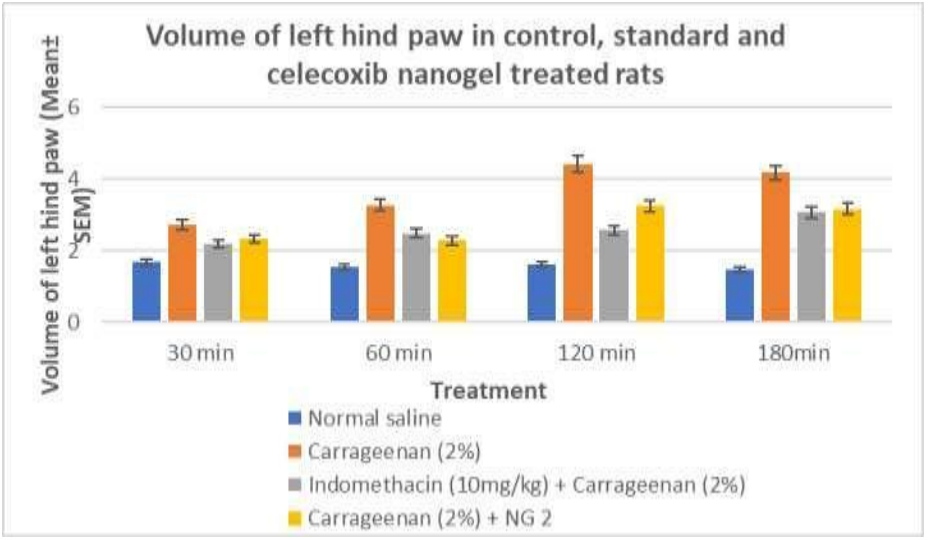

Fig 2. Volume of hind paw (left) in control, standard and celecoxib nanogel treated rats

Table 2. % Inhibition of in control, standard and celecoxib nanogel treated rats

Compound	% Inhibition
Normal saline	Nil
Carrageenan (2%)	Nil
Oxalgin nanogel + Carrageenan (2%)	76.48±0.16
Carrageenan (2%) + NG 2	69.15±0.34

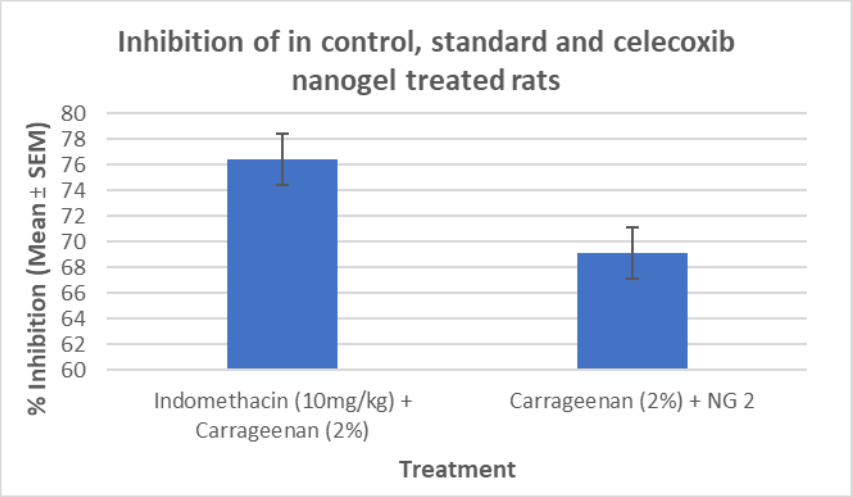

Fig 3. % Inhibition of in control, standard and celecoxib nanogel treated rats

When compared anti-inflammatory activity among NG2 was found excellent formulated nanogel in terms of maximum % inhibition as comparable to disease control group. Celecoxib nanogels successfully developed and exhibited significant anti-inflammatory activity.

The new nanogel form is a better and more efficient carrier for transdermal/topical preparations; the prepared nanogel formulation demonstrated improved skin penetration, which may be due to increased skin-drug contact from increased surface area and hydration; the formulation demonstrated stability throughout the study period and a significant increase in efficacy in animal studies [9][10]; the prepared formulation is a better alternative for oral administration of celecoxib (NSAID) and removes the drug's drawbacks, such as gastric disturbances, low bioavailability, short half-lives, and first-pass effects; the formulation's manufacturing is also better and more economical than oral dosage forms. This action might be due to involvement in suppression of prostaglandins, cytokines responsible for edema and inflammation, in fact. It may be assumed that nanogel blocked COX and LOX enzymes.

As the results indicate that developed celecoxib nanogels exhibited significant anti-inflammatory activity. Significant inhibition was recorded in the celecoxib nanogel (NG2) when given with carrageenan. The reduction of prostaglandins, which are actually the cytokines that cause inflammation and edema, may be the cause of this activity. Celecoxib nanogels are thought to have inhibited the non-selective COX and LOX enzymes, which in turn reduced inflammation and the synthesis of inflammatory mediators.

CONCLUSION

In conclusion, celecoxib nanogels may play a big role in preventing and lowering inflammation. It recommends researching the celecoxib nanogel's absorption mechanism. Additionally, more research was required to confirm its anti-inflammatory response mechanism. Because non-opioid analgesics are readily available, their production would be economical and accessible to all patients, including those in the economy class.

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