RESEARCH PAPER

Anticataract Activty Of Moringa Olifera Gum & In-Vitro Preclinical Evaluation Using Isolated Goat Lens

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ABSTRACT

Cataract, a leading cause of visual impairment globally, is characterized by the opacification of the eye's lens due to oxidative stress, inflammation, and protein aggregation. Conventional pharmacological interventions often show limited efficacy in reversing or halting cataract progression, thereby necessitating alternative therapeutic strategies. Moringa oleifera, known for its rich phytochemical profile, has gained attention in ocular therapeutics. Recent studies suggest that the gum derived from Moringa oleifera exhibits significant antioxidant, anti-inflammatory, and anti-glycation properties, which are crucial in cataract prevention and management. The gum composed predominantly of polysaccharides and bioactive compounds may help stabilize lens proteins, scavenge free radicals, and inhibit aldose reductase key mechanisms implicated in cataractogenesis. Additionally, its biocompatibility and mucoadhesive nature make it a potential excipient or carrier in ocular formulations for sustained drug delivery. This abstract highlights the emerging role of Moringa oleifera gum in cataract therapy and supports further pharmacological and clinical evaluations to establish its efficacy and safety as a novel phytopharmaceutical agent in ocular health.

Keywords: Visual Impairment, Cataractogenesis, Moringa Olifera Gum, Antioxidant, Phytochemical...

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INTRODUCTION

Herbal medicines are increasingly becoming a part of mainstream healthcare, as more people turn to alternatives to conventional drugs. This trend is partly fuelled by growing concerns about the dangers of counterfeit pharmaceuticals. According to a World Health Organization (WHO) survey, around 80% of the global population trusts traditional medicine and is willing to use herbal remedies as their main form of healthcare.

India, in particular, plays a significant role in this field among developing nations. It produces about 75 % of the worlds cultivated medicinal herbs, with more than 6,000 different species. Numerous manufacturing units have been established to produce herbal products, positioning India thanks to its rich clinical heritage to emerge as a global leader in herbal medicine production.

Herbal Drug Therapy and Its Importance in Research:

Herbal drug therapy, also referred to as herbal medicine or phytotherapy, involves the use of plant-derived substances to address various health issues.

Advantages:

Natural option: Herbal treatments are commonly viewed as a more natural substitute for conventional pharmaceutical drugs.

Potentially fewer side effects: Some plant-based remedies may cause fewer adverse effects than synthetic medications.

Examples of Herbal Treatments

Turmeric (Curcuma longa): Commonly used to reduce inflammation and alleviate pain.

Ginger (Zingiber officinale): Often taken to relieve nausea and improve digestion.

St. John Wort (Hypericum perforatum): Typically used for managing mild symptoms of depression.

Important Considerations

Regulation: Herbal products may not be subjected to the same rigorous oversight as standard pharmaceuticals.

Drug interactions: These remedies may interact with prescription drugs or exacerbate existing medical conditions.

Product quality: The effectiveness and safety of herbal products can differ depending on how and where they are produced.

Considerations:

Regulation: Herbal treatments are often not subject to the same strict regulations as conventional pharmaceuticals.

Interactions: These remedies may interact with other drugs or exacerbate specific medical conditions.

Quality Control: The consistency and reliability of herbal products can differ based on the producer and origin.

Moringa oleifera Lam. is a widely cultivated tree found across tropical and subtropical regions. It is commercially grown in countries such as India, various parts of Africa, Central and South America, Mexico, Hawaii, and many regions of Asia and Southeast Asia. The **drumstick** tree is referred to by several name s**ee"** due to its long seed pods, **"horseradish tree"** because of the spicy flavour of its root, and **"ben oil tree"** for the oil extracted from its seeds. In certain regions, people consume the young seed pods, while the leaves are a staple food owing to their rich nutritional value. Despite its popularity as a food source, there are no documented human clinical studies confirming its effectiveness in addressing malnutrition. The **seeds, leaves, oil, bark, sap, roots, and flowers** of the plant are frequently used in traditional medicinal practices around the world. Moringa is regarded as one of the world's most valuable trees, as nearly every part of it can be utilized for food, medicine, or industrial applications Its leaves, flowers, and young pods are commonly consumed as vegetables, while others use it as feed for livestock (e tree holds great promise for enhancing nutrition, strengthening food security, and promoting rural development. However, many people in South Africa remain unaware of Moringa potential benefits. Beyond its medicinal and nutritional uses, Moringa oleifera is widely recognized for the effective coagulating properties of its seeds, particularly in water purification. These seeds function as natural coagulants by binding and removing suspended organic particles from water and are utilized in preliminary treatment processes at water purification facilities. Notably, their coagulating action remains effective across a broad pH range, offering a more stable alternative to aluminum sulfate, the conventional chemical coagulant used in such systems Additionally, M. oleifera seeds have been evaluated for treating wastewater in aquaculture, demonstrating their ability to reduce turbidity, eliminate suspended solids, and decrease microbial loads. This suggests their potential to fully partially

Fig No. 01: ***Moringa Olifera Gum***

PREPATION OF GEL:

Collection and Purification of *Moringa oleifera* Gum: Collect the gum from Moringa oleifera trees, dry it, and purify it for use.

Extraction: Perform solvent extraction using suitable solvents like ethanol or aqueous solutions to obtain the bioactive compounds from the gum.

Gel Formulation: Mix the extracted gum with a gelling agent like carbopol or HPMC (hydroxypropyl methylcellulose) in a suitable solvent.

Addition of Active Ingredients: Incorporate antioxidants or other beneficial compounds found in Moringa oleifera to enhance cataract prevention properties.

pH Adjustment and Finalization: Adjust the pH and finalize the gel formulation for ophthalmic use.

PHYTOCHEMICAL STUDIES

S. NO	**CONSTITUENTS**	**RESULTS**
1	TEST FOR STEROIDS	+ +
2	TEST FOR ANTHRAQUINE	_ _
3	TEST FOR CARBOHYDRATES	_ _
4	TEST FOR PHENOLS	+ +
5	TEST FOR TANNIS	+ +
6	TEST FOR SAPONINS	+ +
7	TEST FOR AMINOACIDS	_ _
8	GENERAL TEST FOR ALKALOIDS	+ +

Fig No. 02: Phytochemical Test

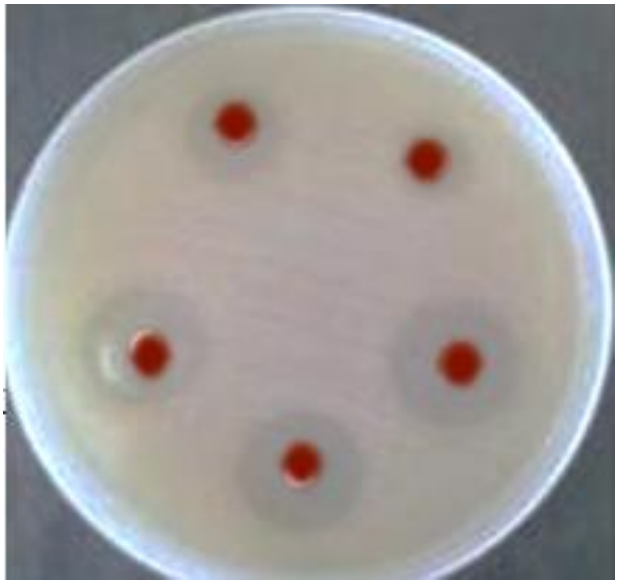

Fig No. 03: Formulated *Moringa Oleifera* Gel

ANTI-MICROBIAL STUDY OF FORMULATED *MORINGA OLEIFERA* GEL

Prepare the gel: Formulate the Moringa oleifera gel according to the desired concentration.

Microbial culture: Prepare a microbial culture (e.g., bacteria, fungus) and inoculate it on an agar plate.

Well diffusion assay: Create wells in the agar plate and fill them with the formulated gel.

Incubation: Incubate the plate at a suitable temperature (e.g., 37°C) for 24-48 hours.

Measure the ZOI: Measure the diameter of the inhibition zone around the well.

Zone of Inhibition (ZOI) = Diameter of Inhibition zone - Diameter of Well

Moringa oleifera gel showed positive antimicrobial activity in the agar well diffusion method. It formed clear zones of inhibition around the wells, especially against bacteria E. coli (14 mm). This indicates that the gum has moderate to good antibacterial and Anti-fungal properties, and it can be used as a natural antimicrobial agent.

CATARACT:

Cataract condition in which the lens of the eye becomes cloudy or opaque, leading to a condition**.** Decrease in vision. It commonly develops with aging but can also result from injury, certain diseases, or genetic Cataracts block or scatter light as it passes through the lens, making vision blurry, dim, or faded. A cataract is a condition where the eye's lens becomes cloudy or opaque, causing vision to deteriorate. It often occurs as a part of aging, but can also be caused by injuries, specific medical conditions, or inherited factors. Cataracts interfere with the passage of light through the lens, leading to blurred, dim, or washed-out vision. Cataract is a complex disease influenced by various factors such as aging, female gender, genetic susceptibility, smoking, diabetes, certain medications, and environmental exposure to UVB radiation. Earlier reviews have typically focused on specific aspects of cataract epidemiology, including common risk factors, cost-effectiveness of treatment strategies, and comparisons of treatment outcomes across European countries while some epidemiological studies have identified cataract as a potential side effect of frequently prescribed medications, this dimension of cataract causation has not been comprehensively reviewed. Therefore, this literature review aims to present a broad overview of cataract epidemiology, associated risk factors, the economic impactt disease, and explore the potential for preventive measures in Europe.

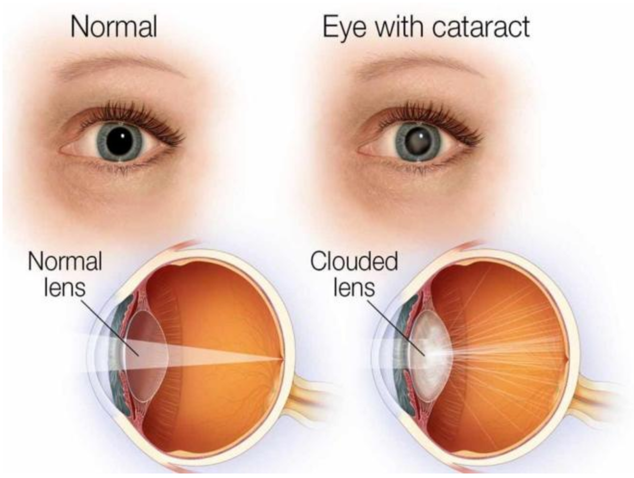

Fig No. 04: Normal Eye & Cataract Eye

CAUSES:

Age

Eye injuries can damage the lens and lead to cataract formation.

Medical Conditions:

Certain medical conditions, such as diabetes, can increase the risk of developing cataracts. As people age, the proteins in the lens can break down and clump together, causing the lens to become cloudy.

Radiation Exposure:

Prolonged exposure to ultraviolet (UV) light or other radiation can damage the lens and increase the risk of cataracts.

SYMPTOMS:

Blurred vision.

Difficulty seeing at night and halos around lights.

Faded colours.

Glare Blurred vision.

Trouble with reading and other close-up tasks.

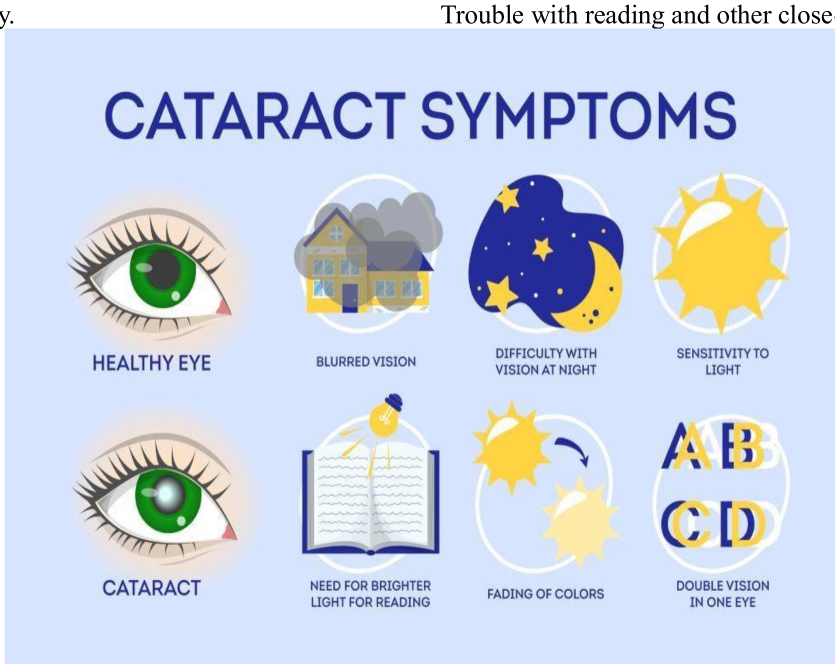

Fig No. 05: Symptoms of Cataract

MATERIALS AND METHODS

Goat eye lenses cultured *in-vitro* were pre-treated with MOSE (0.5 and 1 mg/mL) for 24h. Then, 1 mM hydrogen peroxide was added, and the goat lenses were cultured for a further 24h. The medium was then changed to normal culture medium. After 48 hr, lens opacification, reactive oxygen species (ROS) generation, reduced glutathione (GSH) content, and activities of superoxide dismutase (SOD) and catalase (CAT) were measured in lens tissues. In addition, the protein expression of peroxisome proliferator-activated receptor alpha (PPARβ), a nuclear receptor with potential benefits to improve vision-threatening eye diseases, was assayed. Goat eye lenses were divided into four groups: Group I served as the control, while Group II acted as the toxic control. Groups III and IV were treated with Moringa oleifera extract at concentrations of 250 µg/ml and 500 µg/ml, respectively. Groups II, III, and IV were exposed to 55 mM glucose in artificial aqueous humor to induce lens to induce lens opacification. The study involved the assessment of total and water-soluble protein levels, as well as catalase, glutathione, and malondialdehyde content, in addition to photographic documentation of the lens.

DEXTROSE INDUCED CATARACT

Goat eyes were divided into four groups,

Group 1: Lens was incubated in aqueous humour,

Group 2: Incubated with dexamethasone(10microgram),

Group 3 and 4: lens was incubated with dextrose and *Moringa oleifera* gum and subjected to photographic evaluation for opacity

PROCEDURE:

Collection of goats eyeballs: The anti-cataract potential of the plant extract was studied *in-vitro* in dextrose induced anti-cataractogenesis using goat eye lens. Goat eyeballs were obtained from the slaughterhouse and were transported to laboratory at 0.4C.

Lens culture: The lens was removed by extracapsular extraction and incubated in artificial aqueous humour (NaCl 140 mM, KCl 5 mM, $MgCl_2$ 2 mM, $NaHCO_3$, 0.5 mM, $NaH(PO4)_2$ 0.5 mM, $CaCl_2$ 0.4 mM, and Dextrose 5.5 mM) at room temp and pH 7.8 for 72 hours. Penicillin (32 mg/L) was added to the culture media to prevent bacterial contamination.

Generation of cataract: Dextrose in a concentration of 55 mM was used to induce cataract. At high concentration dextrose in the lens was metabolized to sorbitol pathway and accumulation of polyols (sugar alcohols), causing over hydration and oxidative stress. This led to cataractogenesis. In the present study, a dose of 0.2-0.4 µg/ml and of extract *Moringa oleifera* gum were used. A total of 24 lenses were divide into following categories (n=6 in each category).

GROUPING OF LENSES:

Group 1: (Normal Control)	Normal lens (Dextrose 5.5 mM)
Group 2: (Toxic Control)	Dextrose 55 mM
Group 3: (Standard)	Dextrose 55 mM + Ascorbic acid 20 µg/ml
Group 4: (Test Drug)	Dextrose 55 mM+ *Moringa Oleifera* Gum 250 µg/ml

Photographic evaluation of lens opacity:

After 72 hours of incubation, the lens is carefully removed from the incubation medium and gently washed with physiological saline to remove any adhering residues. The lens is then placed on a wire mesh or graph sheet, ensuring that the posterior surface is in direct contact with the mesh or grid lines. This orientation helps in maintaining consistency across all observations and minimizes optical distortion. Photographs are taken by positioning the lens centrally on the mesh under uniform illumination conditions to avoid shadows or glare that may interfere with image analysis.

The camera is fixed at a constant distance and angle relative to the lens to ensure reproducibility of images. High-resolution digital cameras or stereomicroscopes equipped with camera attachments are often utilized to capture clear images. The pattern of the mesh or grid lines, specifically the number of squares visible clearly through the lens, is recorded and analyzed as a measure of lens transparency or opacity.

Such methods are widely used in research focused on cataractogenesis, drug screening for anti-cataract activity, and toxicological studies involving ocular tissues. By adopting standardized photographic protocols, variability due to subjective visual assessment is minimized, ensuring more objective and reproducible results. The technique is non-destructive, preserving the lens for possible further analysis, such as histopathological examination or protein assays. Thus, photographic evaluation remains a crucial tool in ophthalmic research and experimental pharmacology.

EVALUTION OF LENS:

Grades	Description	Details
0	No Changes	Visible grid lines, lens outline and shape preserved.
1	Mild	Visible grid lines, minimal lens swelling, lens outline and shape preserved.
2	Moderate	Faintly visible grid lines, lens swelling present.
3	Moderate to Severe	Almost obstructed grid lines, lens outline and shape damaged.
4	Severe	Invisible grid lines, distorted lens shape and outline, mature cataract about to rupture.

RESULTS AND DISCUSSION:

Moringa Oleifera widely recognized for its medicinal and nutritional benefits, contains various bioactive compounds distributed across its leaves, seeds, pods, bark, and gum. Among these, *Moringa gum* a natural polysaccharide exudate has recently drawn attention for its potential biomedical applications, including ophthalmic uses such as cataract management.

Cataract Pathophysiology and Role of Natural Antioxidant:

Cataract is primarily caused by oxidative stress leading to protein aggregation and opacification of the lens. Reactive oxygen species (ROS) damage the lens proteins and lipids, leading to loss of transparency. Thus, agents with antioxidant potential are considered protective or therapeutic in delaying cataractogene

Group-1 normal lenses incubated with artificial aqueous humor solution and dextrose (5.5 mm). Group-2 is incubated the lens has been negative control with dextrose and its showed complete opacification of the lens to cataract formation.Group-3 lenses were incubated with ascorbic acid (20 µg) almost normal transparency and compared with the cataractous lenses. Group-4 is incubated simultaneously with dextrose (55 mm) the test drug is *Moringa Olifera* Gum. The result shows a positive effect of the selected gum extract from the plant *Moringa Olifera* on anti-cataract potential by displaying a reduction in the opacity of cataractous lenses.

Group-I (Normal)

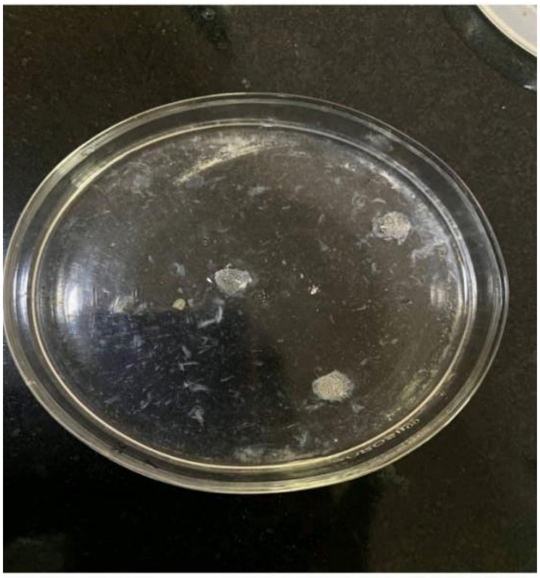

Fig No. 06: Normal lens treated with dextrose 5.5 mM

Group-II (Toxic Control)

Fig No. 07: Cataractous lens treated with dextrose 55 mM

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Group-III (Standard)

Fig No. 08: Lens incubated with dextrose 55 mM and Ascorbic acid 20 µg/ml

Group-IV (Test Drug)

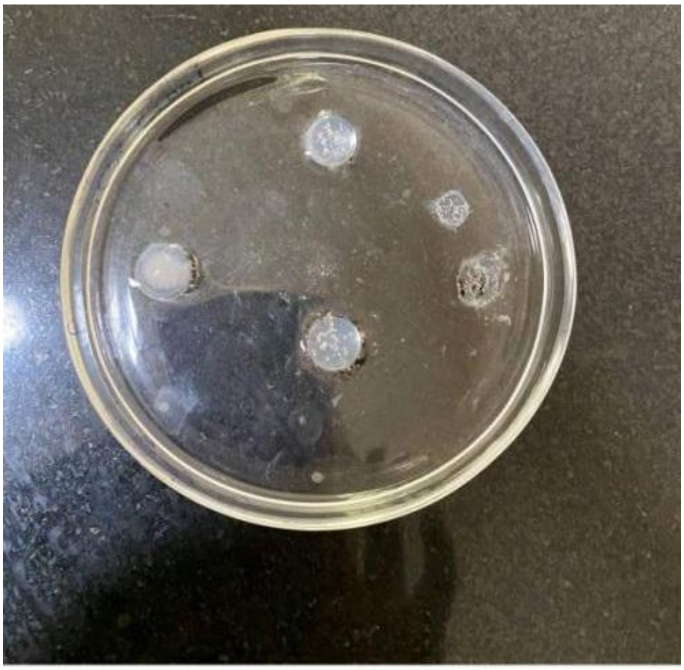

Fig No. 09: Lens incubated with dextrose 55 mM and *Moringa Oleifera* gel

The lens placed in normal and experimental groups are represented in the above figures, Group-1 is normal lenses incubated with the artificial aqueous humor solution and dextrose (5.5 mM) showed complete transparency. Group-2 is negative control in which the lens was incubated with dextrose (55 mM) showed complete opacification of the lens leading to cataract formation. Group-3 lenses were incubated with dextrose (55 mM) and Ascorbic acid 20 µg/ml revealed almost normal transparency when compared with the cataractous lenses. Group-4 in which the lens was incubated simultaneously with dextrose (55 mM) and the test drug *Moringa oleifera* gum (0.2-0.4 µg/ml) showed a significant reduction in the opacity of the lens when compared with cataractous lenses and was also found to be approximate to the Ascorbic acid treated lenses i.e., the standard group.

GRADES OF CATARACT CHANGES IN STUDY GROUPS

Group	Grades for Cataract Changes
Group-I (Normal Control)	0
Group-II (Toxic Control)	4
Group-III (Standard)	1
Group-IV (Test Drug)	1

SUMMARY:

Study reported that the lens group treated with the Moringa oleifera gum 0.2-0.4 µ/ml showed mild Grade 2 and 1 change with visible grid lines and maintenance of lens outline and shape, with minimal lens swelling compared to the lens in the negative control.

This finding suggests *Moringa oleifera* gum has potential in preventing or delaying cataract progression. The treated lens groups showed reduced opacity and maintained structural integrity. Photographic evaluation revealed visible grid lines, indicating minimal damage.

The anti-cataract activity of gum might be attributed to its antioxidant properties. Further research could explore optimal dosages and treatment durations. This study results are promising for addressing cataract-related blindness in India.

Moringa oleifera gum might offer a natural, cost-effective solution. Additional studies could investigate its effects on human cataracts.

The potential applications in ophthalmology warrant further investigation. If proven effective, it could contribute to reducing the burden of cataract-related blindness in India.

CONCLUSION

In isolated goat lens with experimental dextrose induced cataract, *Moringa oleifera* gum showed significant anticataract activity by inhibiting cataract formation and the effect was found to be dose dependent manner. There is a further need for assessing the antioxidant activity of these *Moringa oleifera* gum in this cataract model. Also, potency studies of the extract need to be done to explore the possible future steps for in vivo studies.

This study conclusion highlights *Moringa oleifera* gum has promising anticataract activity in isolated goat lenses. The dose-dependent effect suggests a potential therapeutic application. Further research is necessary to fully understand the gum's antioxidant properties and mechanisms. Assessing the gum's potency will be crucial for future *in vivo* studies. *Moringa oleifera* gum could offer a natural, cost-effective treatment for cataracts.

The findings warrant further investigation into the gum's potential applications in ophthalmology. Future studies could explore this gum extract effects on human cataracts or other eye conditions. The potential for *Moringa oleifera* gum to prevent or delay cataract progression is significant. Additional research could also investigate the gum's potential interactions with other medications. This study results provide a foundation for further exploring *Moringa oleifera* gum extract therapeutic potential.

In-vivo studies will be essential for determining the gels safety and efficacy. The potential benefits of *Moringa oleifera* gum gel for eye health are substantial. Further research could lead to new, innovative treatments for cataracts. This study finding have implications for addressing cataract-related blindness worldwide.

Moringa oleifera gel has potential as a natural remedy is promising. The antioxidant properties might also have applications beyond cataract treatment. Future studies could investigate the gel's potential anti-inflammatory effects.

The results are encouraging for the development of new ophthalmic treatments. *Moringa oleifera* gel has potential therapeutic applications extend beyond cataracts. This study finding contributes to the growing body of research on natural remedies for eye health

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