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RESEARCH ARTICLE OPEN ACCESS

Therapeutic Evaluation of *Swertia chirayita* on Polypropylene Induced Lung Inflammation in Experimental Animal

Nikita Wankhade,Vivek V. Paithankar,AnjaliWankhade, Jugal Vyas
Vidyabharati College Of Pharmacy,Amravati,India

ABSTRACT: Microplastic pollution has emerged as a major environmental and public health concern due to its widespread presence in air, water, and food. Among various microplastics, polypropylene is extensively used in packaging materials, textiles, medical devices, and household products, leading to continuous human exposure through inhalation. Recent studies suggest that inhaled polypropylene particles can accumulate in lung tissues and trigger pulmonary inflammation, oxidative stress, and respiratory dysfunction. The present study was designed to evaluate the therapeutic potential of ethanolic extract of Swertiachirayitaagainst polypropylene-induced lung inflammation in experimental animals. The study involved induction of lung inflammation using polypropylene particles followed by treatment with different doses of Swertiachirayitaextract. Various inflammatory and biochemical parameters such as total cell count, neutrophil count, LDH activity, CINC-1, CINC-2, MPO levels, body weight, and histopathological changes were assessed to determine the protective effect of the plant extract. Results indicated that treatment with Swertiachirayitasignificantly reduced inflammatory markers and improved lung histopathology compared to the induced group. The anti-inflammatory and antioxidant properties of the phytoconstituents present in Swertiachirayitamay contribute to its protective activity against polypropylene-induced pulmonary damage. Thus, the study suggests that Swertiachirayitacould serve as a promising natural therapeutic agent for the management of microplastic-associated lung inflammation.

Index Terms: Microplastics, Polypropylene, Lung inflammation, Swertiachirayita, Pulmonary toxicity, Oxidative stress, Experimental animals, Anti-inflammatory activity.

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I. INTRODUCTION

With the progress of human civilization, plastics have become integral to numerous daily-use products and materials due to their affordability, ease of manufacture, and remarkable versatility. Since the 1950s, when mass production of plastics began, around 8.3 billion metric tons have been produced, with annual production reaching roughly 370 million metric tons by 2019. The widespread use of plastics has, however, contributed significantly to environmental pollution, increasing exposure risks for both marine ecosystems and humans. Discarded plastics gradually break down into smaller fragments under physical forces such as ultraviolet radiation. Research has explored the toxic effects of microplastics on marine organisms and suggested potential human health risks through the consumption of contaminated seafood.

Polypropylene particles have been found in the lungs of both humans and birds, suggesting that inhalation is a primary route of exposure. This raises concerns regarding the potential biological effects of polypropylene when inhaled. Studies also indicate that microplastics are present at high concentrations not only in the general environment but also in occupational settings. Polypropylene is commonly used in food and medical packaging and serves as a raw material for manufacturing surgical masks. Consequently, individuals involved in plastic production may be at risk of exposure in workplace environments. It is therefore crucial to determine the Lowest Observed Adverse Effect Level (LOAEL) and No Observed Adverse Effect Level (NOAEL) for microplastics to assess safe exposure limits.

Swertiachirayitais an endangered medicinal herb native to the temperate Himalayan region. The species holds immense ethnobotanical importance in India, Nepal, Bangladesh and Bhutan. The herb is known to host a plethora of bioactive phytoconstituents that imbue it with a

wide variety of medicinal properties. Swertiachirayita (commonly known as chirayita) widely used in traditional Ayurvedic, Unani, and folk medicine. Its pharmacological activities include anti-inflammatory and antioxidant effects, which are mainly attributed to its phytochemical constituents such as secoiridoid glycosides (swerchirin, amarogentin, mangiferin, swertiamarin), xanthones, flavonoids, and phenolic compounds.

II. MATERIALS AND METHODS

Experimental Animal

Healthy Wistar albino rats, aged 6-8 weeks and weighing 180-250 g b.w. were obtained from the Vidyabharati College of Pharmacy, Amravati, India (CCSEA Registration no. 1504/PO/RE/S/11/CPCSEA). The animals were housed in a temperature-controlled (22 ± 3°C) environment with a 12-hour light/dark cycle and had free access to standard rodent chow and water. The experimental protocol was approved by the Institutional Animal Ethical Committee (IAEC) and conducted in accordance with the guidelines of the committee for control and supervision of Experiments on Animals (CCSEA).

Selection of the plant

The medicinal plant Swertiachirayita(Family: Gentianaceae) was selected for lung protective activity based on the literature survey.

Preparation of plant extract

Swertiyachirayitaleaves would becollected, leaves were washed in running tap water for removing of dust particle and foreign particles and shade dried for 8 days. Shade dried leaves were used for preparation of powder with electric blender. These powders were stored in plastic container for further use. Around 25 gm powder used for extraction in 250 ml ethanolic solvents. The extraction was done by simple extraction techniques till dark coloration of the solvent and discolorations of powder extract. The solvents were evaporated to complete dryness by rotavator and stored in Eppendorf's tube at 4 ˚C for further use.

Phytochemical screening:

The ethanolic extract of Swertiyachirayitaleaves was screened for the presence of various phytochemicals, including alkaloids, flavonoids, tannins, Xanthone, glycosides, phenols, Saponin were carried out using standard test procedures

Drugs and chemicals:

Inducing Agent: Polypropylene Powder (10 mg/m^3)
Standard Drug: N-acetylcysteine 10 mg/kg (Intravenous route)
Treatment: Ethanolic extract of Swertiachirayitaleaves

Methodology

Thirty male albino wistar rats weighing 180 - 250 g were selected for the study. Among the 5 groups with 6 animalsin each group. Rats were divided into five groups with six animals each. The first group control received the vehicle at a dose of (1 ml/kg) orally, while Second group induced was exposed to polypropylene powder (10 $mg/m^{3)}$ via the inhalation route to induce lung inflammation. Third group standard received N-acetylcysteine at a dose of 10 mg/kg, where as fourth group and group five treatment groups received Swertia chirayitaextract at doses of 100 mg/kg and 200 mg/kg orally, respectively, to evaluate its anti-inflammatory activity.

Instruments and equipment:

Centrifuge weighing balance, pipettes, test tube/racks, timer, biochemical analyser,inhalation chamber, air pump, microscope.

Preparation of doses and treatments.

The activity of ethanolic extract of Swertiyachirayitaleaves as a lung protective plant using polypropylene - induced lung damage in rat. Lung inflammation was induced by exposing the rats to polypropylene powder via the inhalation route. The ethanolic extract of Swertiachirayitaleaves was administered at doses of 100 and 200 mg/kg, selected based on a prior sub-acute toxicity study. N-acetylcysteine was used as the standard drug and administered to the animals via the intravenous route.

A) Treatment protocol:

The rats were randomly divided into 5 groups of 6 rats each.

Table 1 : Treatment protocol for all groups:

Sr. No.	Group	No. Of Animal	Treatment And Dose	Route of Administration
1.	I (Normal Control)	6	Saline treatment	Oral
2.	II (Inducing group)	6	Single dose of Polypropylene Powder (10 mg/m^3)	Inhalation Exposure
3.	III (Standard group)	6	N-acetylcysteine (10 mg/kg)	Intravenous
4.	IV (Treatment 1)	6	Polypropylene Powder (10 mg/m^3)+ Swertia chirayitaextract (100 mg/kg)	Inhalation and Oral
5.	V (Treatment 2)	6	Polypropylene Powder (10 mg/m^3)+ Swertia chirayitaextract (200 mg/kg)	Inhalation and Oral

Histopathology

Lung tissues from each group were fixed in 10% formalin, processed, and embedded in paraffin. Sections were stained with hematoxylin and eosin (H&E) to assess histopathological changes under a light microscope.

Statistical analysis

The data obtained from the screenings were subjected to statistical analysis following One-way ANOVA followed by Dunnett Comparison Test to assess the statistical significance of the results using Graph Pad prism 9 software. The difference was considered significant if $p < 0.05$, moderately significant if $p < 0.01$, and highly significant if $p < 0.001$

III. RESULTS

Phytochemical Screening :

Preliminary phytochemical screening for the presence of alkaloids, flavonoids, tannins, Xanthone, glycosides, phenols, Saponin were carried out using standard test procedures.

Pharmacological evaluation parameters for lungprotective:

Evaluation parameters:

1] Effect of ethanolic extract of leaves of Swertiachirayitaon the Total cell counts in BALF:

Polypropylene exposure caused a significant increase ($P<0.0001$) in total cell count in BALF compared to the control group, indicating severe pulmonary inflammation. Treatment with N-acetylcysteine (10 mg/kg) significantly reduced the elevated cell count. Administration of SwertiaChirayitaat 100 mg/kg and 200 mg/kg also significantly decreased the total cell count compared to the polypropylene-induced group, with 200 mg/kg showing better protective activity against lung inflammation.

Table 1: Effect of ethanolic extract of leaves of Swertiachirayitaagainst polypropylene induced lung inflammation-related parameters in rats (Total Cell Counts).

Sr. No.	Group	Treatment (n=6)	Total Cell Counts in BALF (×10^3 cells/mL)
1.	Control	Normal control	240±3.29
2.	Induced	Polypropylene (10 mg/$m^{3)}$	274.6±3.01
3.	Standard	N-acetylcysteine (10 mg/kg)	247.3±2.31

4.	Treatment 1	Swertiachirayita(100mg/kg)	253.3±1.20
5.	Treatment2	Swertiachirayita(200mg/kg)	258.5±3.57

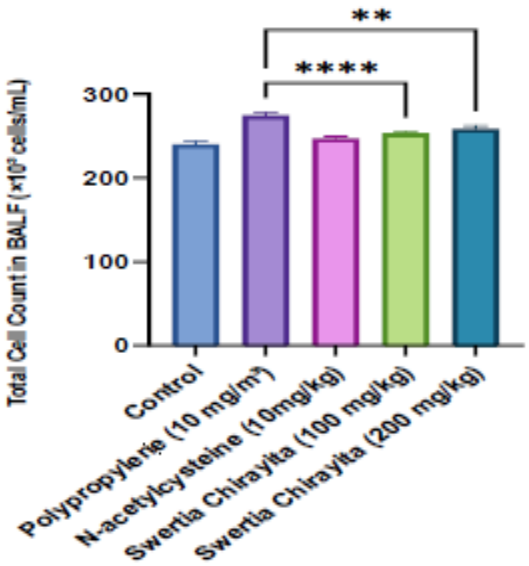


Figure 01: Effect of Polypropylene, ethanolic extract of Swertiachirayitaleaves(100 mg/kg ; 200 mg/kg), and N-acetylcysteine (10 mg/kg) on total cell count. Values are mean ± SEM (n = 6) and analyzed with one-way ANOVA followed by Dunnet's test ****p < 0.0001 vs. Polypropylene (10mg/$m^{3)}$ group.

2] Effect of ethanolic extract of leaves of Swertiachirayitaon the Neutrophil counts in BALF:

Polypropylene exposure caused a significant increase (P<0.0001) in neutrophil counts in BALF compared to the control group, indicating marked inflammatory response in the lungs. Treatment with N-acetylcysteine (10 mg/kg) significantly reduced the elevated neutrophil counts. SwertiaChirayitatreatment at 100 mg/kg and 200 mg/kg also significantly decreased neutrophil infiltration compared to the polypropylene-induced group, with the 200 mg/kg dose showing comparatively better anti-inflammatory activity.

Table 2 : Effect of ethanolic extract of leaves of Swertiachirayitaagainst polypropylene induced lung inflammation-related parameters in rats (Neutrophil Counts).

Sr. No.	**Group**	**Treatment (n=6)**	**Neutrophil counts in BALF (×1000cells/mL)**
1.	Control	Normal control	2.15±0.076
2.	Induced	Polypropylene(10 mg/$m^{3)}$	6.133±0.105
3.	Standard	N-acetylcysteine (10 mg/kg)	3.05±0.076
4.	Treatment 1	Swertiachirayita(100mg/kg)	3.75.±0.076
5.	Treatment 2	Swertiachirayita(200mg/kg)	3.4±0.058

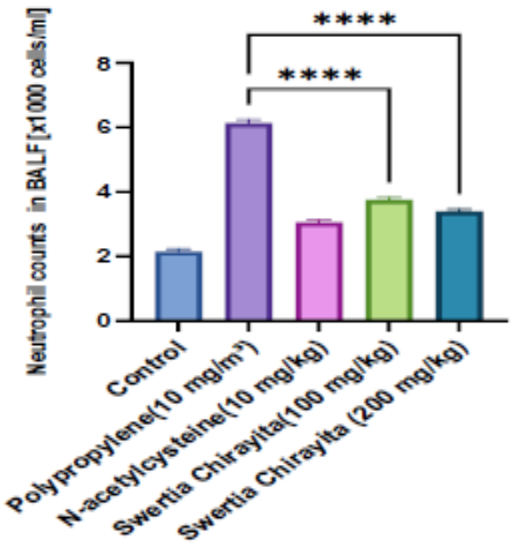


Figure 02: Effect of Polypropylene, ethanolic extract of Swertiachirayitaleaves (100 mg/kg ; 200 mg/kg), and N-acetylcysteine (10 mg/kg) on neutrophil counts. Values are mean ± SEM (n = 6) and analyzed with one-way ANOVA followed by Dunnet's test ****p < 0.0001 vs. Polypropylene (10mg/m$^{3)}$ group.

3] Effect of ethanolic extract of leaves of Swertiachirayitaon the LDH activity in BALF [U/L]

Polypropylene exposure (10 mg/m³) significantly increased LDH activity in BALF compared to the control group, indicating lung damage. Treatment with N-acetylcysteine and SwertiaChirayita(100 and 200 mg/kg) reduced LDH levels, with N-acetylcysteine showing the strongest protective effect. Significant differences were observed compared to the polypropylene group (****p < 0.0001).

Table 3: Effect of ethanolic extract of leaves of Swertiachirayitaagainst polypropylene induced lung inflammation-related parameters in rats (LDH activity)

Sr. No.	Group	Treatment (n=6)	LDH activity in BALF [U/L]
1.	Control	Normal control	231.66±6.009
2.	Induced	Polypropylene (10 mg/m$^{3)}$	500±9.66
3.	Standard	N-acetylcysteine (10 mg/kg)	253.3±4.41
4.	Treatment 1	Swertiachirayita(100mg/kg)	313.33±4.41
5.	Treatment 2	Swertiachirayita(200mg/kg)	283.33±4.41

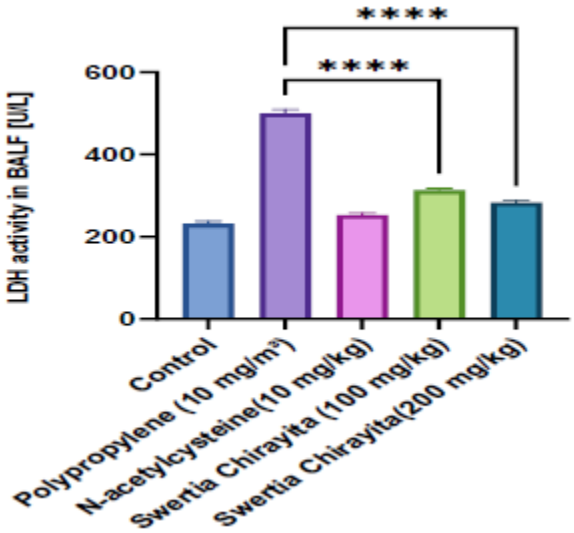


Figure 03 : Effect of Polypropylene, ethanolic extract of Swertiachirayitaleaves(100 mg/kg ; 200 mg/kg), and N-acetylcysteine (10 mg/kg) on LDH activity. Values are mean ± SEM (n = 6) and analyzed with one-way ANOVA followed by Dunnet's test ****$p < 0.0001$ vs. Polypropylene ($10mg/m^{3)}$ group.

4] Effect of ethanolic extract of leaves of Swertiachirayitaon the CINC-1 in BALF [pg/mL] in BALF

CINC-1 levels in BALF were significantly increased in the polypropylene-treated group compared to the control group ($p < 0.0001$). Treatment with N-acetylcysteine (10 mg/kg) significantly reduced CINC-1 levels compared to the polypropylene group ($p < 0.01$), indicating a protective effect. Swertiachirayitatreatment at 100 and 200 mg/kg also reduced CINC-1 levels, although the effect was less pronounced than N-acetylcysteine.

Table 4 : Effect of ethanolic extract of leaves of Swertiachirayitaagainst polypropylene induced lung inflammation-related parameters in rats (CINC-1)

Sr. No.	Group	Treatment (n=6)	CINC-1 in BALF [pg/mL]
1.	Control	Normal control	42±0.57
2.	Induced	Polypropylene($10 mg/m^{3)}$	55±0.73
3.	Standard	N-acetylcysteine(10 mg/kg)	47.16±0.94
4.	Treatment 1	Swertiachirayita(100mg/kg)	50.83±0.60
5.	Treatment 2	Swertiachirayita(200mg/kg)	49.5±0.76

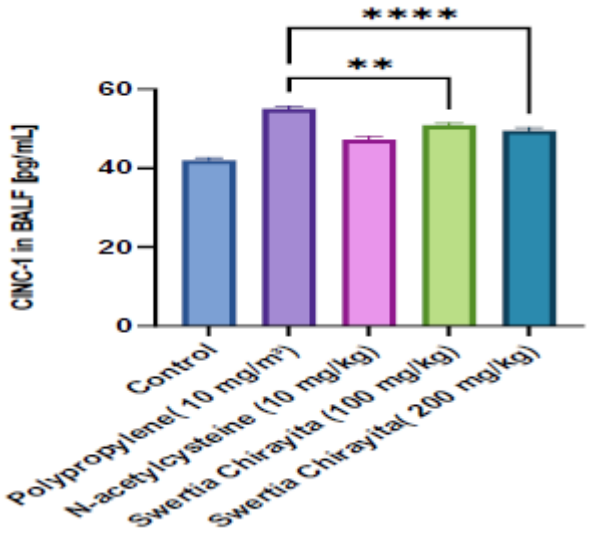


Figure 04 : Effect of Polypropylene, ethanolic extract of Swertiachirayitaleaves(100 mg/kg ; 200 mg/kg), and N-acetylcysteine (10 mg/kg) on CINC-1 . Values are mean ± SEM (n = 6) and analyzed with one-way ANOVA followed by Dunnet's test ****p < 0.0001 vs. Polypropylene (10mg/m^3 group.)

5] Effect of ethanolic extract of leaves of Swertiachirayitaon the CINC-2 in BALF [pg/mL] in BALF

CINC-2 levels in BALF were significantly increased in the polypropylene (10 mg/m³) exposed group compared to the control group. Treatment with N-acetylcysteine (10 mg/kg) and SwertiaChirayitaat 200 mg/kg significantly reduced CINC-2 levels when compared with the polypropylene group. Statistical analysis showed a highly significant difference among groups (p < 0.0001).

Table 17: Effect of ethanolic extract of leaves of Swertiachirayitaagainst Polypropylene induced lung inflammation-related parameters in rats (CINC-2)

Sr. No.	Group	Treatment (n=6)	CINC-2 in BALF [pg/mL]
1.	Control	Normal control	269.6±2.90
2.	Induced	Polypropylene (10 mg/$m^{3)}$	410.83±5.3
3.	Standard	N-acetylcysteine (10 mg/kg)	294.5±4.4
4.	Treatment 1	Swertiachirayita(100mg/kg)	327.16±3.8
5.	Treatment 2	Swertiachirayita(200mg/kg)	313.66±5.9

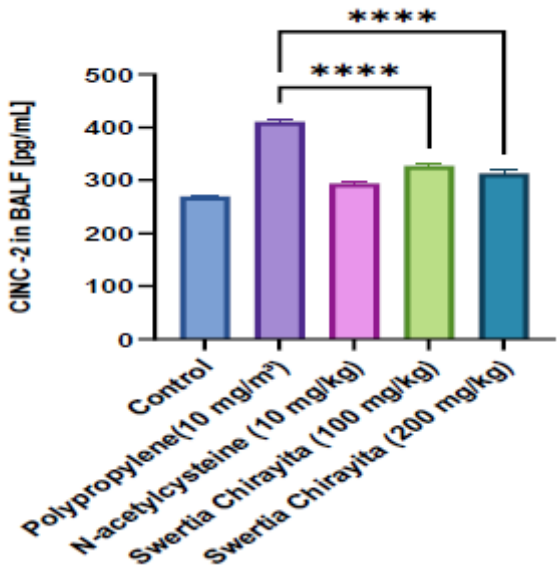


Figure 05: Effect of Polypropylene, ethanolic extract of Swertiachirayitaleaves (100 mg/kg ; 200 mg/kg), and N-acetylcysteine (10 mg/kg) on CINC-2. Values are mean ± SEM (n = 6) and analyzed with one-way ANOVA followed by Dunnet's test ****p < 0.0001 vs. polypropylene (10mg/m^3 group.)

6] Effect of ethanolic extract of leaves of swertiachirayitaon the MPO in BALF [ng/mL]

MPO levels in BALF were significantly increased in the Polypropylene-exposed group compared to the control group. Treatment with N-acetylcysteine and SwertiaChirayitamarkedly reduced MPO levels, with the 200 mg/kg dose showing better protection than the 100 mg/kg dose. The reductions were highly significant compared to the Polypropylene group ($p < 0.0001$).

Table 18: Effect of ethanolic extract of leaves of Swertiachirayitaagainst Polypropylene induced lung inflammation-related parameters in rats (MPO)

Sr. No.	Group	Treatment (n=6)	MPO in BALF [ng/mL]
1.	Control	Normal control	20±0.5
2.	Induced	Polypropylene(10 mg/m$^{3)}$	68± 1.0
3.	Standard	N-acetylcysteine(10 mg/kg)	27±1.3
4.	Treatment 1	Swertiachirayita(100mg/kg)	40.667±0.7
5.	Treatment 2	Swertiachirayita(200mg/kg)	31.5±1.8

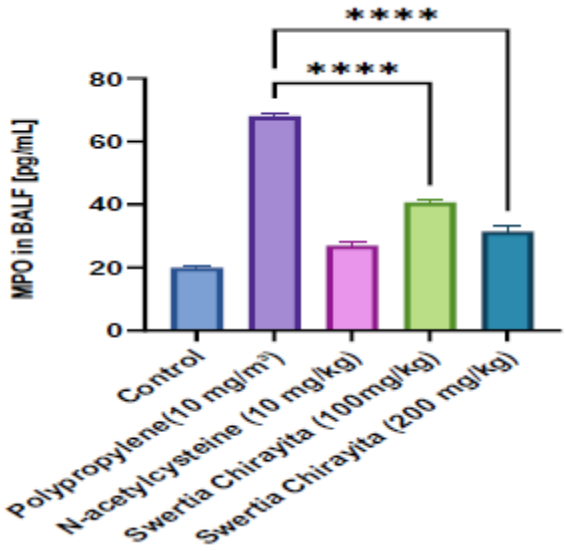


Figure 11: Effect of Polypropylene, ethanolic extract of Swertiachirayitaleaves(100 mg/kg ; 200 mg/kg), and N-acetylcysteine (10 mg/kg) on MPO. Values are mean ± SEM (n = 6) and analyze with one-way ANOVA followed by Dunnet's test ****p < 0.0001 vs. polypropylene (10mg/m^3 group.)

7] Effect of ethanolic extract of leaves of Swertia chirayita on the Body weight [gm]:

Polypropylene treatment significantly reduced body weight compared with the control group. Administration of N-acetylcysteine (10 mg/kg) and SwertiaChirayitaextract (100 and 200 mg/kg) significantly restored body weight, with the standard drug showing better protection than the treatment groups. Among the treatments, swertiachirayita 200 mg/kg produced greater improvement than 100 mg/kg. Overall, both standard and treatment groups showed significant recovery in body weight ($p < 0.0001$, $n = 6$).

Table 19: Effect of ethanolic extract of leaves of Swertiachirayitaagainst Polypropylene induced lung inflammation-related parameters in rats (Body Weight).

Sr. No.	Group	Treatment (n=6)	Week 1	Week 2	Week 3	Week 4
1.	Control	Normal control	214±0.36	217±0.57	219 ± 0.61	221±0.57
2.	Induced	Polypropylene (10 mg/$m^{3)}$	172±0.36	160±0.47	152.16 ±0.47	144.16 ± 0.47
3.	Standard	N-acetylcysteine (10 mg/kg)	174±0.36	189±0.47	207 ± 0.52	208±0.57
4.	Treatment 1	Swertia chirayita(100mg/kg)	176±0.36	166±1.72	193 ± 0.57	196±0.50
5.	Treatment 2	Swertia chirayita(200mg/kg)	177±0.36	177±2.55	200 ± 0.54	203±0.58

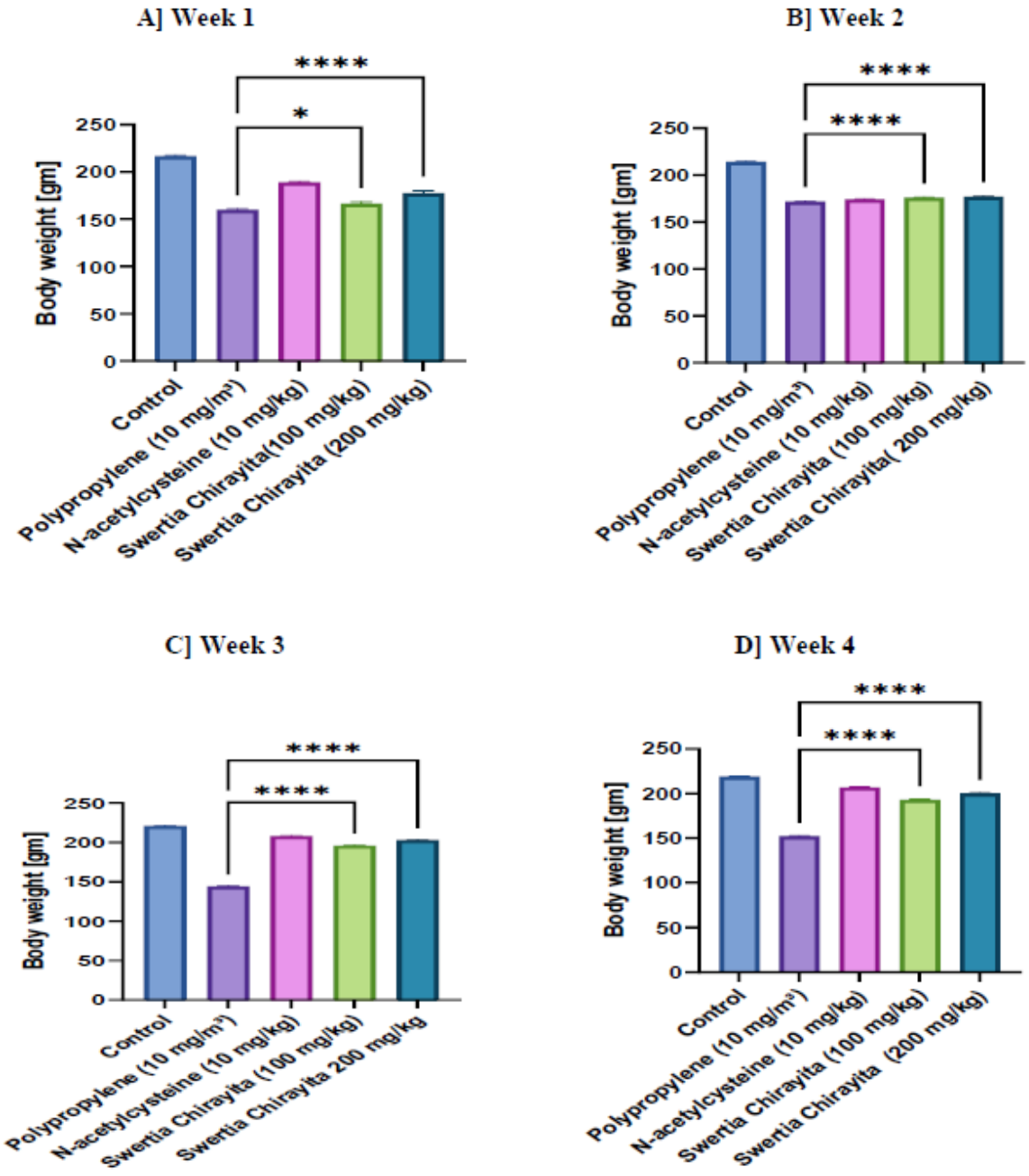
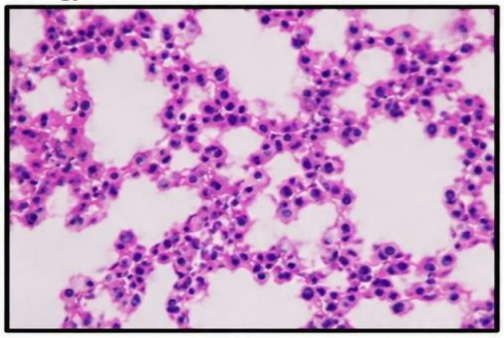
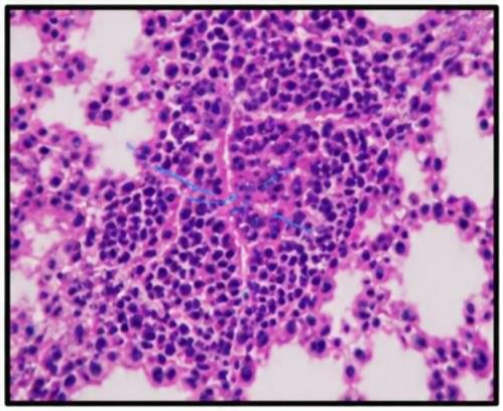


Figure 12: Effect of Polypropylene, ethanolic extract of Swertiachirayitaleaves(100 mg/kg ; 200 mg/kg), and N-acetylcysteine (10 mg/kg) on Body weight. Values are mean ± SEM (n = 6) and analyzed with one-way ANOVA followed by Dunnet's test ****p < 0.0001 vs. Polypropylene (10 mg/m^3 group)

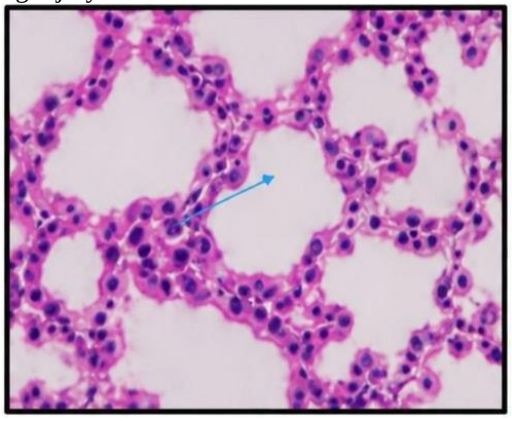
Histology:



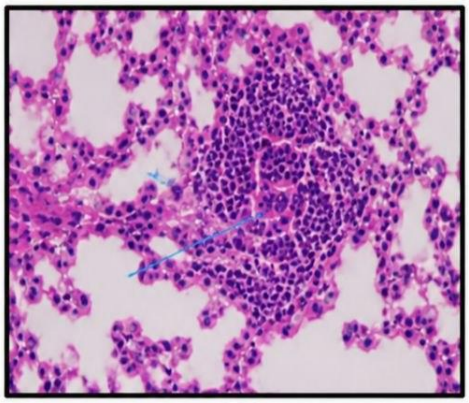
(A) Control group: Lung tissue shows normal histological architecture with thin alveolar septa, clear alveolar spaces, and absence of inflammatory cell infiltration or edema. Pulmonary parenchyma appears intact and healthy



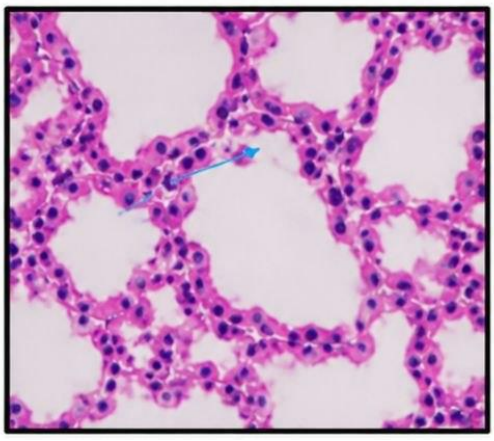
(B) Induced Group: Severe pathological alterations are observed including thickened alveolar walls, dense inflammatory cell infiltration, congestion, edema, and marked destruction of normal alveolar architecture, indicating significant lung injury**.**



(C) Induced + Standard: Lung tissue shows considerable protection against induced damage. Alveolar spaces are comparatively preserved with reduced inflammatory infiltration and mild septal thickening. Histology is closer to normal control, indicating strong therapeutic efficacy of the standard drug.



(D) Induced + Treatment (100 mg/kg): Moderate improvement in lung architecture is observed compared to the induced group. Inflammatory infiltration and septal thickening are reduced, but some pathological changes are still present, indicating partial protective activity at 100 mg/kg dose



(E) Induced + Treatment (200 mg/kg): Lung tissue demonstrates better recovery than the 100 mg/kg treatment group with more preserved alveolar spaces, minimal inflammatory infiltration, and near-normal architecture. However, protection is slightly less pronounced than the standard-treated group.

IV. DISCUSSION

The present investigation was carried out to study the protective effect of ethanolic extract of Swertiachirayitaagainst polypropylene-induced lung inflammation in experimental animals. Continuous exposure to polypropylene microplastics has become a growing health concern because these particles can enter the respiratory tract and trigger inflammatory responses in lung tissues. In the current study, polypropylene administration produced noticeable pulmonary damage, which was confirmed by increased inflammatory markers, elevated cellular infiltration, oxidative stress, and histopathological alterations in lung tissue.

Animals exposed to polypropylene showed a significant rise in total cell counts and neutrophil counts in bronchoalveolar lavage fluid, indicating activation of inflammatory processes within the lungs. Increased neutrophil accumulation is considered an important indicator of acute pulmonary inflammation because activated neutrophils release proteolytic enzymes and reactive oxygen species that contribute to tissue injury. Elevated MPO activity observed in the induction group further supported enhanced neutrophilic activation and oxidative stress. Similar inflammatory responses following polypropylene exposure have also been reported in earlier experimental studies, suggesting that polypropylene microplastics are capable of producing persistent lung inflammation.

The induction group also demonstrated increased LDH activity along with elevated CINC-1 and CINC-2 levels. LDH is a marker of cellular damage and membrane leakage; therefore, its elevation reflects pulmonary tissue injury caused by polypropylene exposure. Increased CINC-1 and CINC-2 levels indicate enhanced chemokine mediated recruitment of inflammatory cells into lung tissue. These findings collectively confirm the successful induction of lung inflammation in the experimental model.

Treatment with ethanolic extract of Swertiachirayitasignificantly improved these altered biochemical and inflammatory parameters. Both treatment doses reduced inflammatory cell infiltration, neutrophil count, MPO activity, LDH release, and cytokine levels when compared with the polypropylene-treated group. The higher dose produced greater protective effects and showed activity comparable to the standard drug NAC. Improvement in body weight observed in treated animals further suggested recovery from inflammatory stress and restoration of normal physiological function.

The protective activity of Swertiachirayitamay be associated with the presence of important phytoconstituents such as xanthones, flavonoids, iridoids, and secoiridoid glycosides. These bioactive compounds are known for their antioxidant and anti-inflammatory properties. Previous reports have shown that compounds isolated from Swertiachirayitacan inhibit inflammatory mediators such as TNF-α, IL-6, and NF-κB signaling pathways. The antioxidant action of the plant may also help neutralize reactive oxygen species generated during polypropylene induced oxidative stress, thereby protecting lung tissues from further injury.

Histopathological examination strongly supported the biochemical observations. Lung sections from the induction group showed inflammatory cell infiltration, alveolar wall thickening, congestion, and disruption of normal lung architecture. In contrast, treatment with Swertiachirayitamarkedly reduced these pathological changes and restored near-normal alveolar structure. The higher dose exhibited better improvement, indicating dose-dependent protective activity.

The overall findings of the present study demonstrate that ethanolic extract of Swertiachirayitapossesses significant protective effects against polypropylene-induced pulmonary inflammation. The extract effectively reduced oxidative stress, inflammatory mediator release, and tissue injury, thereby improving overall lung condition in experimental animals.

V. CONCLUSION

The present study demonstrated that polypropylene microplastic exposure induces significant pulmonary inflammation and lung tissue damage in experimental animals. Increased inflammatory cell infiltration, elevated MPO, LDH, CINC-1, and CINC-2 levels, along with histopathological alterations, confirmed the development of lung injury following polypropylene exposure. Administration of ethanolic extract of Swertiachirayitasignificantly reduced these inflammatory and biochemical changes in a dose-dependent manner. The higher dose showed greater protective activity and produced results comparable to the standard treatment group. Improvement in body weight and

restoration of normal lung architecture further supported the protective effect of the plant extract.The beneficial effects of Swertia chirayita may be attributed to its rich phytochemical constituents possessing antioxidant and anti-inflammatory activities. Overall, the findings suggest that Swertia chirayita has considerable potential as a natural therapeutic agent for the management of polypropylene-induced pulmonary inflammation. Further detailed studies are recommended to validate its mechanism of action and future clinical applicability.

REFERENCES

[1]. Saha SC, Saha G. Effect of microplastics deposition on human lung airways: a review with computational benefits and challenges. Heliyon. 2024;10(2):e24355. doi:10.1016/j.heliyon.2024.e24355.

[2]. Danso IK, Woo JH, Lee K. Pulmonary toxicity of polystyrene, polypropylene, and polyvinyl chloride microplastics in mice. Molecules.

[3]. BaselConventionPlasticWasteOverview.Availableonline:https://www.basel.int/Implementation/Plasticwaste /Overview/tabid/8347/Default.aspx (accessed on 29 November 2023).

[4]. Jenner,L.C.;Rotchell,J.M.;Bennett,R.T.;Cowen,M.;Tentzeris,2022;27(22):7926.doi: 10.3390/molecules2722 7926. V.; Sadofsky, L.R. Detection of Microplastics in Human Lung Tissue Using MFTIR Spectroscopy. Sci. Total Environ. 2022, 831, 154907.

[5]. Baeza-Martínez, C.; Olmos, S.; González-Pleiter, M.; López-Castellanos, J.; García-Pachón, E.; MasiáCanuto, M.; Hernández-Blasco, L.; Bayo, J. First Evidence of Microplastics Isolated n European Citizens' Lower Airway. J. Hazard. Mater. 2022, 438, 129439.

[6]. Chen, Q.; Gao, J.; Yu, H.; Su, H.; Yang, Y.; Cao, Y.; Zhang, Q.; Ren, Y.; Hollert, H.; Shi, H.; et al. An Emerging Role of Microplastics in the Etiology of Lung Ground Glass Nodules. Environ. Sci. Eur. 2022, 34, 25.

[7]. Amato-Lourenço, L.F.; Carvalho-Oliveira, R.; Júnior, G.R.; Dos Santos Galvão, L.; Ando, R.A.; Mauad, T. Presence of Airborne Microplastics in Human Lung Tissue. J. Hazard. Mater. 2021, 416, 126124. [Google Scholar] [CrossRef]

[8]. Cary CM, Seymore TN, Singh D, Vayas KN, Goedken MJ, Adams S, Polunas M, Sunil VR, Laskin DL, Demokritou P, Stapleton PA. Single inhalation exposure to polyamide micro and nanoplastic particles impairs vascular dilation without generating pulmonary inflammation in virgin female Sprague Dawley rats. Part FibreToxicol. 2024;21(1):10.

[9]. Qiu, L.; Lu, W.; Tu, C.; Li, X.; Zhang, H.; Wang, S.; Chen, M.; Zheng, X.; Wang, Z.; Lin, M.; et al. Evidence of Microplastics in Bronchoalveolar Lavage Fluid among Never-Smokers: A Prospective Case Series. Environ. Sci. Technol. 2023, 57, 2435–2444.