

Original Research Article

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Comparative Studies of Antioxidant and Anti-Inflammatory Activity of Rosa X Hybrida and Rosa X Alba

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ABSTRACT

Keywords

Rosa x hybrida, Rosa x alba, rose petals, phytochemicals, antioxidant, anti-inflammatory.

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The present study was designed to comparatively evaluate the antioxidant and anti-inflammatory activities of petal extracts of Rosa x hybrida and Rosa x alba. Red rose (Rosa x hybrida) and White rose (Rosa x alba) is a well-known cultivated ornamental flowering plant. Rose possesses significant medicinal importance due to the presence of various bioactive compounds. Rose petals are a rich source of bioactive phytochemicals, including phenolic compounds, flavonoids and other secondary metabolites that may contribute to their antioxidant and anti-inflammatory properties. Petals of both Rose species were extracted using hexane and ethyl acetate solvents. The resulting extracts were evaluated for preliminary phytochemical constituents and their antioxidant potential using suitable in-vitro assays such as DPPH assay method. Anti-inflammatory activity was assessed and the activities of the extracts were comparatively analyzed. Total phenolic and flavonoid contents may be determined to investigate their possible relationship with their biological activity. The findings may contribute to the identification of promising rose petal extracts for further phytochemical characterization and investigation of their potential applications in pharmaceutical, nutraceutical and natural-product research.

Introduction

Rose belongs to the genus Rosa under the family Rosaceae and is one of the most widely cultivated ornamental plants across the world. It is commercially important due to its aesthetic appeal, fragrance, and horticultural value. Traditionally, roses are propagated through vegetative techniques such as cuttings, budding, and grafting in order to maintain desirable cultivar

characteristics. However, these conventional methods are often limited by slow multiplication rate and seasonal constraints, which affect large-scale production. The development of advanced propagation techniques has significantly improved the commercial cultivation and genetic improvement of rose varieties (Pati *et al.*, 2006).

Different parts of the plant, including petals, leaves, stems, and rose hips, contain essential nutrients and

secondary metabolites that contribute to therapeutic properties. Scientific investigations have demonstrated that rose exhibits antioxidant, antibacterial, antifungal, and anti-inflammatory activities. These pharmacological effects support its traditional use in herbal medicine and highlight its potential application in pharmaceutical and cosmetic industries (Nanda & Das, 2015).

The genus *Rosa* comprises numerous species distributed mainly in temperate regions and is recognized for its rich chemical composition. Rose species are known to contain significant amounts of vitamins, particularly vitamin C, along with phenolic compounds and other secondary metabolites that contribute to biological activity. Due to this diverse chemical profile, *Rosa* species have gained increasing scientific interest for their nutritional and therapeutic value (Tolekova *et al.*, 2020).

Recent studies have highlighted the protective effects of rose extracts against oxidative stress and inflammation, particularly in skin-related conditions. Rose petals contain bioactive compounds such as polyphenols, flavonoids, tannins, triterpenoids, and saponins that contribute to their antioxidant and anti-inflammatory activities. Experimental findings also show that rose extracts can scavenge free radicals and inhibit protein denaturation, suggesting their potential use in cosmetic and therapeutic applications (Abidi *et al.*, 2019).

Rosa X Hybrida: Red rose is one of the most widely cultivated ornamental flowers and is commonly used in indoor decorative settings. Contact with natural elements, including fresh flowers, plays an important role in promoting human health and well-being. Visual exposure to fresh red roses can positively influence physiological functions in the human body. Observing red roses has been associated with changes in brain activity related to relaxation. Viewing fresh roses may enhance parasympathetic nervous activity and reduce stress-related responses. Natural visual stimuli, such as red roses, are considered beneficial for psychological comfort and emotional stability. Red roses may contribute to improvements in mood and subjective feelings of relaxation.

Phytochemical Constituents

Red rose petals are rich in diverse phytochemical compounds, particularly phenolics that contribute to their biological activity. These phenolic constituents are known for their strong reducing capacity and protective

effects against cellular damage. In addition, processed or heat-treated rose petal extracts have been reported to exhibit improved bioactive properties, suggesting that treatment conditions may influence phytochemical availability. The abundance of such natural compounds supports the potential application of red rose petals in functional foods and herbal preparations (Kim, 2020). White rose petals contain important bioactive compounds, particularly phenolic substances and flavonoids, which contribute to their functional value. Due to the presence of these natural compounds, white rose is considered a promising source of health-promoting constituents for food and medicinal applications (Seong *et al.*, 2017).

Antioxidant Activity

Red rose petals demonstrate strong antioxidant potential due to their ability to neutralize reactive oxygen species (ROS) such as superoxide and hydroxyl radicals. Excess accumulation of ROS leads to oxidative stress, which damages lipids, proteins, and DNA within cells. Studies indicate that ethanol extracts of red rose petals effectively scavenge free radicals and reduce oxidative stress markers. By controlling ROS levels, red rose extracts help maintain cellular integrity and may reduce the risk of oxidative stress-related disorders. These findings highlight red rose petals as a promising natural antioxidant source (Kim, 2020). The antioxidant potential of white rose is mainly attributed to its high phenolic content. These findings indicate that white rose possesses strong antioxidant properties and may contribute to reducing oxidative stress when used in functional formulations (Seong *et al.*, 2017).

Anti-Inflammatory Activity

Beyond antioxidant effects, red rose petals possess notable anti-inflammatory properties. Experimental investigations using LPS-stimulated macrophage cells demonstrated that red rose ethanol extracts significantly reduced nitric oxide (NO) production by suppressing inducible nitric oxide synthase (iNOS) expression. Furthermore, the extract inhibited the activation and nuclear translocation of the NF- κ B signaling pathway, which plays a central role in inflammatory responses. By modulating these molecular mechanisms, red rose petals reduce the production of pro-inflammatory mediators and cytokines. These results suggest that red rose extracts could serve as potential natural agents for managing inflammation-related conditions (Kim, 2020). White rose

(*Rosa hybrida*) has demonstrated significant anti-inflammatory potential through its ability to regulate key inflammatory mediators. These observations highlight the potential of white rose as a natural source of anti-inflammatory agents for therapeutic applications (Lee *et al.*, 2011).

Anti-diabetic activity

Extracts prepared from red rose flowers showed the ability to reduce elevated blood glucose levels in diabetic experimental models (Ju *et al.*, 2014).

Potential long-term anti-diabetic effect

The study suggests that red rose flower extracts may contribute to sustained blood sugar management (Ju *et al.*, 2014).

Rich Source of Phenolic Compounds

White rose petal extract contains a high amount of phenolic substances, which are biologically active compounds known for their health-protective properties (Seong *et al.*, 2017).

Taxonomic Classification

Kingdom: Plantae

Division: Magnoliophyta (Angiosperms)

Class: Magnoliopsida (Dicotyledons)

Order: Rosales.

Family: Rosaceae

Genus: Rosa

Species: Rosa × hybrid

Rosa X Alba: White rose (*Rosa × alba*) is a well-known ornamental flowering plant belonging to the family Rosaceae and is widely cultivated across temperate regions for its fragrance, elegance, and therapeutic relevance. These compounds play an important role in neutralizing free radicals and reducing oxidative stress, which is a major contributing factor to cellular damage, premature aging, and various chronic diseases. Traditionally, white rose petals have been used in herbal preparations for soothing skin irritation, promoting wound healing, and improving complexion due to their mild anti-inflammatory and skin-protective properties. Therefore, white rose is not only valued for ornamental purposes but also recognized as a promising natural

source of therapeutic compounds with potential health benefits (Choi *et al.*, 2015).

Taxonomic Classification

Kingdom: Plantae

Division: Magnoliophyta (Angiosperms)

Class: Magnoliopsida (Dicotyledons)

Order: Rosales

Family: Rosaceae

Genus: Rosa

Species: Rosa × alba

Materials and Methods

Plant Sample Collection

The Rosa x hybrida and Rosa x alba flower were collected from the local market.

Preparation of plant extracts:

The collected plant were washed with water and dried in the shade at room temperature. Dried plant sample were powder and 20 gram of plant sample powder was measured with 200 ml of Hexane and Ethyl Acetate. Then the sample was filtered using whatman number one filter paper. The extract was stored for further studies.

Preliminary phytochemical screening

Preparation of samples

Approximately 100mg of the extract were weighed and dissolved in 25ml of the appropriate solvents. These samples were used for qualitative phytochemical analysis.

1. Test for Phenolic compounds

Ferric Chloride Test: To the sample, few drops of alcoholic FeCl₂ solution was added. Bluish green or Bluish black indicated the presence of phenol.

2. Test for reducing sugars

Fehling's Test: The sample was mixed with Fehling's solution I and II and formation of red coloration indicated the presence of sugars

3. Tests for Flavones

Alkaline Reagent Test: The sample was mixed with 10% sodium hydroxide solution or ammonia. Dark yellow color indicated the presence of flavones.

4. Tests for Saponins

Frothing Test: The samples were shaken well with water and formation of copious lather indicated the presence of saponins.

5. Test for Alkaloids

A) Mayer's reagent: To the sample few drops of acetic acid and Mayer's reagent was added and shaken well.

A creamy white colored precipitation indicated the presence of alkaloids.

B) Wagner's reagent: To the sample, few drops of acetic acid and Wagner's reagent was added and shaken well.

A reddish brown precipitation indicated the presence of alkaloid.

6. Test for Quinones

To the sample, sodium hydroxide was added. Blue and green or red color indicated the presence of quinones.

7. Test for Proteins

Biuret Test: To the sample few drops of Biuret reagent was added and formation of blue colour indicated the presence of protein.

Anti-Oxidant Assay

In-vitro DPPH Radical scavenging activity

This method is a simple, rapid and sensitive method to measure the antioxidant activity of any compound.

DPPH is a stable free radical with purple in colour, readily accepts the hydrogen from the antioxidants and the colour change from purple to yellow. 2,2-Diphenyl-1-picrylhydrazyl will get converted to 2,2-Diphenyl-1-picrylhydrazine when combined with the antioxidant.

Anti-Inflammatory Assay

Preparation of Erythrocyte Suspension

Erythrocyte suspension was prepared according to the method described in Shin de *et al.*, with some modifications. Whole human blood was collected from a healthy human subject. The blood was centrifuged at 3000 rpm for 5 min in heparinized centrifuge tubes, and washed three times with equal volume of normal saline (0.9% NaCl). After the centrifugation, the blood volume was measured and reconstituted as a 10% (v/v) suspension with isotonic buffer solution (10 mM sodium phosphate buffer pH 7.4). Composition of the buffer solution (g/L) used was NaH₂PO₄ (0.2), Na₂HPO₄ (1.15), and NaCl (9.0).

Heat-Induced Hemolysis

This test was carried out as described by Okoli *et al.*, with some modifications as described In Gunathilake *et al.*, Briefly, 0.5 ml of blood cell suspension and 0.5 ml of the test Extracts were mixed with 2.9 ml phosphate buffer (pH 7.4). The mixture was incubated at 54 °C for 20 min in a shaking water bath. After the incubation, the mixture was centrifuged (2500 rpm for 3 min), and the absorbance of the supernatant was measured at 540 nm using a UV/VIS Spectrometer (Optima, SP-3000, Tokyo, Japan). Phosphate buffer solution was used as a control for the experiment. The level of hemolysis was calculated using the following equation based on the Okoli *et al.*,

% inhibition of hemolysis = $100 \times (1 - A_2/A_1)$, Where A₁ = absorption of the control, and A₂ = absorption of test sample mixture.

Results and Discussion

The present study was designed to comparatively evaluate the antioxidant and anti-inflammatory activities of hexane and ethyl acetate petal extracts of Rosa × hybrida and Rosa × alba. The investigation included phytochemical screening, DPPH radical scavenging assay, and HRBC membrane stabilization method for anti-inflammatory activity. Preliminary phytochemical screening in both Rosa × hybrida and Rosa × alba revealed the presence of various bioactive constituents such as phenolic compounds, flavonoids, saponins, alkaloids, quinones, and reducing sugars in both rose species.

Fig.1 Rosa x hybrida flower



Fig.2 Rosa x hybrida petals



Fig.3 Rosa x alba flower



Fig.4 Rosa x alba petals



Fig.5 Sample preparation of Rosa x hybrida petals



Fig.6 Sample preparation of Rosa x alba petals



Table.1 The phytochemicals analysis and Rosa x hybrida petals in Hexane and Ethyl acetate extract.

S. No	Phytochemical Parameters	Rosa x hybrida in Hexane extract	Rosa x hybrida in Ethyl Acetate extract
1	Test for Phenolic Compounds	+++	—
2	Test for Reducing Sugar	—	—
3	Test for Flavones	+++	—
4	Test for Saponins	+++	—
5	Test for Alkaloids (Wagner's Test)	+++	++
6	Test for Alkaloids (Mayer's Test)	—	—
7	Test for Quinones	+++	—
8	Test for Proteins	—	—

Table.2 The phytochemicals analysis and Rosa x alba petals in Hexane and Ethyl acetate extract.

S. No	Phytochemical Parameters	Rosa x alba in Hexane extract	Rosa x alba in Ethyl Acetate extract
1	Test for Phenolic Compounds	—	++
2	Test for Reducing Sugar	—	—
3	Test for Flavones	+++	—
4	Test for Saponins	+++	—
5	Test for Alkaloids (Wagner's Test)	+++	++
6	Test for Alkaloids (Mayer's Test)	—	—
7	Test for Quinones	+++	—
8	Test for Proteins	—	—

Table.3 DPPH radical scavenging assay of Hexane extracts of Rosa x hybrida and Rosa x alba. (Control-0.6255)

Concentration (µg/mL)	% inhibition AS	% Inhibition Rosa x hybrida (Hexane extract)	% Inhibition Rosa x alba (Hexane extract)
50	69.53	20.0	25.0
100	72.73	25.0	32.0
150	74.17	34.0	40.0
200	76.57	45.0	55.0
250	80.8	70.0	75.0

Table.4 DPPH radical scavenging assay of Ethyl acetate extracts of Rosa x hybrida and Rosa x alba

Concentration (µg/mL)	% inhibition AS	% Inhibition Rosa x hybrida (Ethyl acetate extract)	% Inhibition Rosa x alba (Ethyl acetate extract)
50	69.53	15.0	19.0
100	72.73	21.0	24.0
150	74.17	35.0	27.0
200	76.57	42.0	38.0
250	80.8	55.0	48.0

Table.5 Effect of *Rosa x hybrida* (Hexane) and Standard on HRBC membrane hemolysis and membrane stabilization

Conc (µg/ml)	% Hemolysis of Rosa x hybrida	% Stabilization of Rosa x hybrida	% Hemolysis of Diclofenac sodium	% Stabilization of Diclofenac sodium
50	42.25	63.89	47.18	52.81
100	31.33	69.45	23.47	76.54
250	20.76	74.67	18.68	81.32
500	14.78	81.25	14.34	85.67
1000	8.45	85.67	7.43	92.58

Table.6 Effect of *Rosa x alba* (Hexane) and Standard on HRBC membrane hemolysis and membrane stabilization

Conc (µg/ml)	% Hemolysis of Rosa x alba	% Stabilization of Rosa x alba	% Hemolysis of Diclofenac sodium	% Stabilization of Diclofenac sodium
50	53.10	65.66	47.18	52.81
100	42.56	69.21	23.47	76.54
250	31.88	78.31	18.68	81.32
500	19.64	86.14	14.34	85.67
1000	5.45	88.56	7.43	92.58

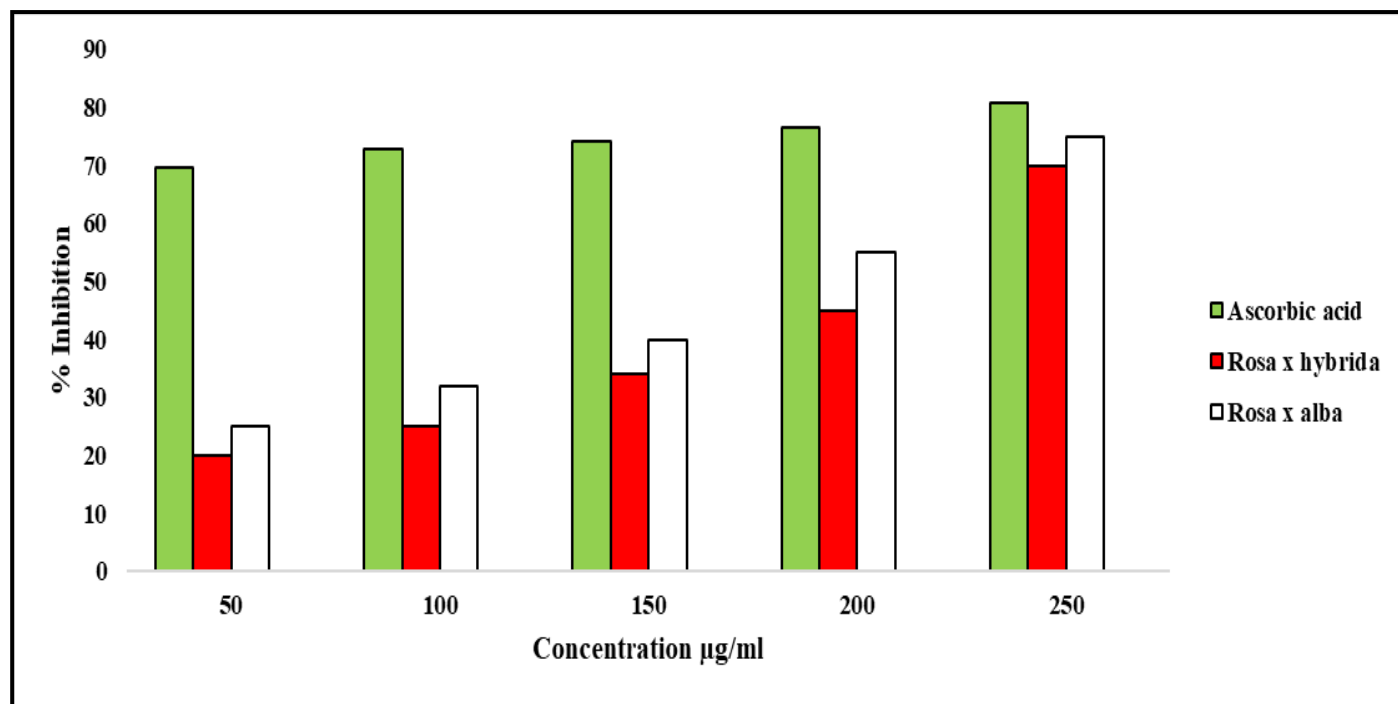
Table.7 Effect of *Rosa x hybrida* (Ethyl acetate) and Standard on HRBC membrane hemolysis and membrane stabilization

Conc (µg/ml)	% Hemolysis of Rosa x hybrida (Ethyl acetate)	% Stabilization of Rosa x hybrida (Ethyl acetate)	% Hemolysis of Diclofenac sodium	% Stabilization of Diclofenac sodium
50	62.25	43.23	47.18	52.81
100	51.23	49.13	23.47	76.54
250	30.67	54.09	18.68	81.32
500	28.61	61.43	14.34	85.67
1000	12.40	75.22	7.43	92.58

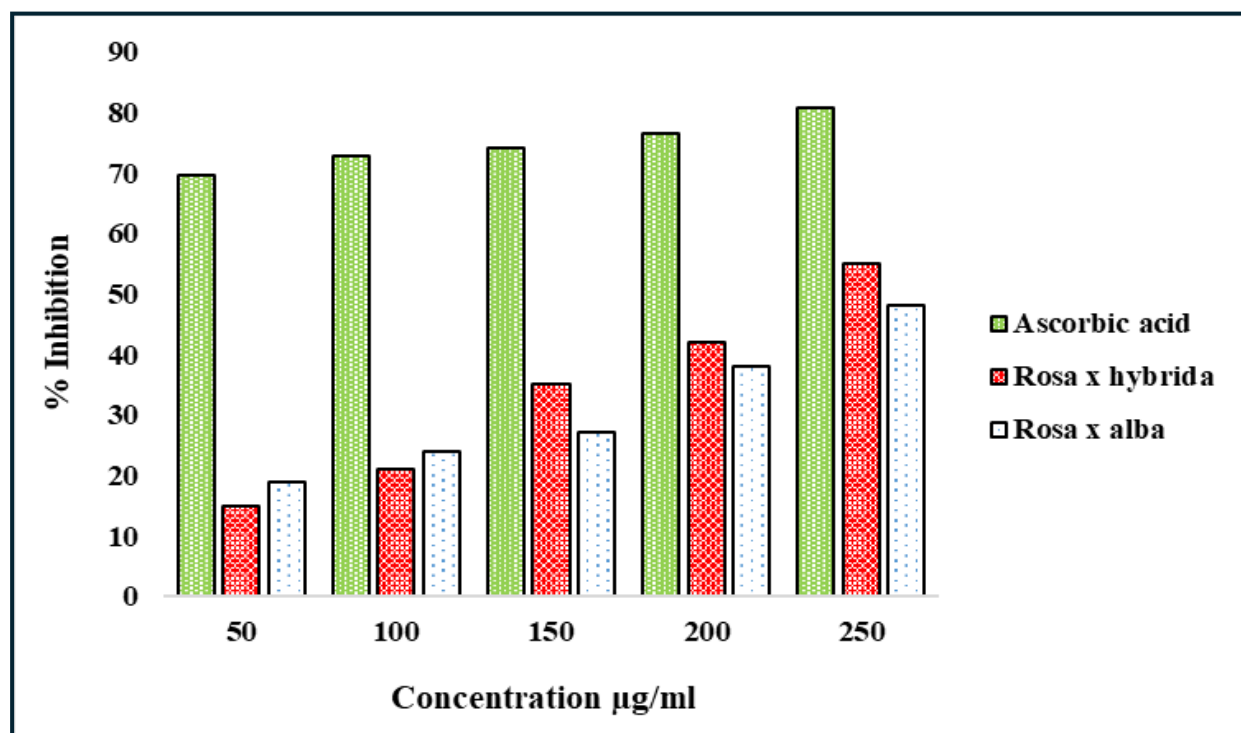
Table.8 Effect of *Rosa x alba* (Ethyl acetate) and Standard on HRBC membrane hemolysis and membrane stabilization

Conc (µg/ml)	% Hemolysis of Rosa x alba (Ethyl acetate)	% Stabilization of Rosa x alba (Ethyl acetate)	% Hemolysis of Diclofenac sodium	% Stabilization of Diclofenac sodium
50	58.10	55.66	47.18	52.81
100	52.56	59.21	23.47	76.54
250	41.88	62.31	18.68	81.32
500	39.64	71.14	14.34	85.67
1000	15.45	75.56	7.43	92.58

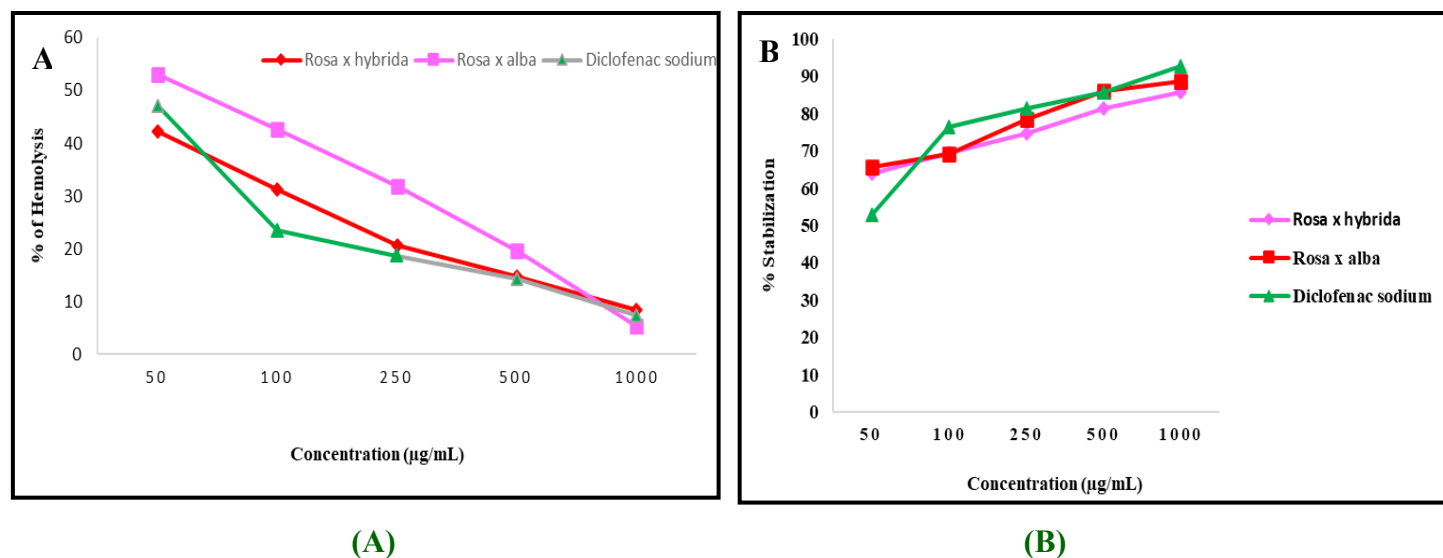
Graph.1 DPPH radical scavenging assay of Ascorbic acid (standard) and Hexane extract of *Rosa x hybrida* and *Rosa x alba*.



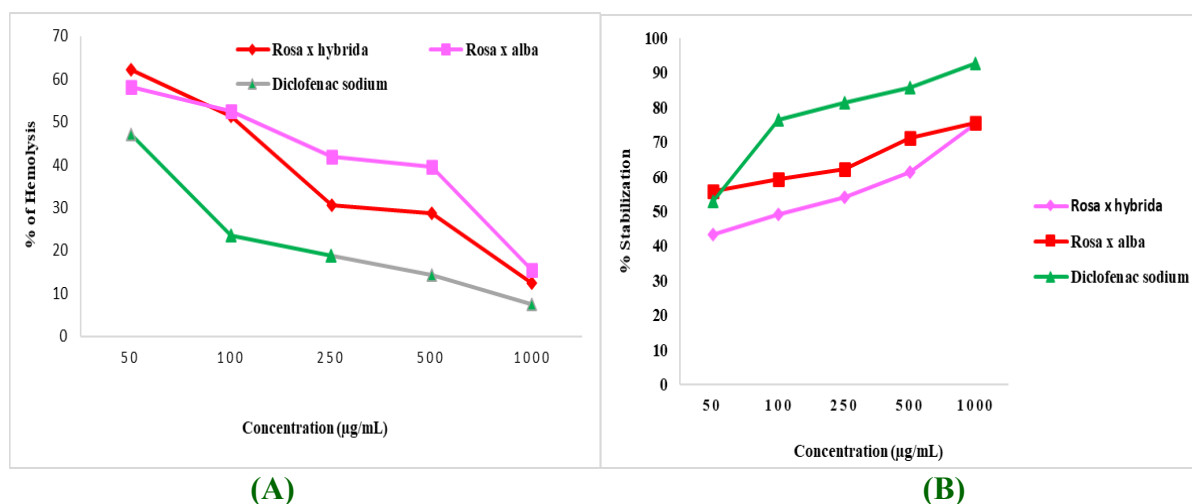
Graph.2 DPPH radical scavenging assay of Ascorbic acid (standard) and Ethyl acetate extract of *Rosa x hybrida* and *Rosa x alba*.



Graph.3 Effect of *Rosa x hybrida* and *Rosa x alba* (Hexane) on HRBC membrane hemolysis (A) and HRBC membrane stabilization (B)



Graph.4 Effect of *Rosa x hybrida* and *Rosa x alba* (Ethyl acetate) on HRBC membrane hemolysis (A) and HRBC membrane stabilization (B)



The antioxidant activity assessed using the DPPH radical scavenging assay demonstrated that both rose extracts exhibited considerable free radical scavenging potential. DPPH is a stable free radical, and reduction in its absorbance indicates antioxidant capacity.

The anti-inflammatory activity evaluated using the heat-induced hemolysis method further supported the medicinal significance of both rose species. The extracts demonstrated protective effects against heat-induced hemolysis, indicating their potential to inhibit

inflammatory responses. The anti-inflammatory effect observed in this study correlates with previous reports that rose petals possess bioactive compounds capable of suppressing inflammatory processes.

Comparatively, differences in antioxidant and anti-inflammatory activities between

Overall, the comparative analysis provides scientific evidence that both *Rosa x hybrida* and *Rosa x alba* are valuable natural sources of bioactive compounds with

potential therapeutic applications. The findings suggest that these flower extracts could be utilized in pharmaceutical, cosmetic, and nutraceutical industries for developing natural antioxidant and anti-inflammatory formulations.

In conclusion, the present study successfully carried out a comparative evaluation of antioxidant and anti-inflammatory activities of hexane and ethyl acetate petal extracts of *Rosa × hybrida* and *Rosa × alba*. In conclusion, both red and white rose petal extracts exhibit significant antioxidant and anti-inflammatory properties, confirming their potential as natural therapeutic agents.

Although variations in activity were observed between species and solvent extracts, both roses demonstrated promising pharmacological potential. These findings suggest that rose petals can serve as valuable natural resources for the development of herbal medicines, functional foods, and cosmetic formulations.

Author Contributions

Amna Rifa K.K: Conceived the original idea and designed the model and wrote the manuscript. G. Gomathy: Designed the model and the computational framework and analysed the data.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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