3.1. **MIMUSOPS ELENGI BARK**

1. **Anti-anxiety activity**

The anti-anxiety activity of methanolic (50, 100 and 200mg/kg body weight), aqueous (100 and 200mg/kg body weight) and n-butanol (200mg/kg body weight) extracts of bark of *Mimusops elengi* was studied in Swiss albino mice by Ganu G. et.al. It was found that methanolic extract at 200mg/kg had more significant anxiolytic activity as compared to aqueous and n-butanol extracts.

2. **Antihyperlipidemic activity**

Ghaisas MM et.al investigated antihyperlipidemic activity of methanolic extract of bark in wistar rats. *Mimusops elengi* showed significant reduction in levels of triglyceride and total cholesterol as compared to hyperlipidemic group after 7 and 24 hrs of induction. Even after 48 hrs the groups treated with *Mimusops elengi* at 300 and 600mg/kg showed significant decrease in level of triglyceride and decrease in level of total cholesterol compared to hyperlipidemic group. Moreover HDL level was significantly elevated in the groups treated at 300 and 600mg/kg after 7 and 24 hrs, however, it was significantly elevated only in group treated at 600mg/kg after 48 h of the treatment. It was concluded that *Mimusops elengi* had antihyperlipidemic effect owing to its ability to reduce the levels of total cholesterol, triglyceride and increasing the level of HDL.

3. **Antiulcer activity**

The effect of *Mimusops elengi* bark was studied against experimental gastric ulcer. The 50% alcoholic extract of *Mimusops elengi* and its different fractions namely ethyl acetate, n-butanol, methanol and aqueous were studied in ethanol induced, pylorus-ligated and water immersion plus stressed induced gastric ulcer models in mice. 50% alcoholic extract of bark at a dose of 50, 100, 300 and 500mg/kg and its different fractions (100mg/kg) showed significant reduction in gastric ulceration.

Prakash D. et.al also demonstrated the effect of alcoholic and petroleum ether extracts of bark (200mg/kg body weight) of *Mimusops elengi* on gastric ulcers. The alcoholic extract showed significant antiulcer activity compare to petroleum ether extracts of bark.
4. Anticonvulsant activity\textsuperscript{137}

Gayatri Ganu et.al studied anticonvulsant activity of 50, 100, 200mg/kg methanol, aqueous, and n- butanolic extract of bark of \textit{Mimusops elengi} in maximal electroshock test (MES) and isoniazid (INH) induced convulsions. All the extracts had dose dependent delay in convulsions & increase survival time in both the models. Methanol extract of \textit{Mimusops elengi} showed maximum significant increase ($p<0.01$) in onset and survival time.

5. Antioxidant activity\textsuperscript{138,139,140}

Ashok et al. studied \textit{invivo} antioxidant activity of petroleum ether, chloroform, and alcohol extracts of bark of \textit{Mimusops elengi} and reported that the alcohol extract had more potent antioxidant activity than petroleum ether and chloroform extracts.

The methanolic bark extract of \textit{Mimusops elengi} in another study offered significant \textit{in-vitro} reducing power capacity and radical scavenging activity.

Rao et.al. demonstrated that the chloroform extract of bark of \textit{Mimusops elengi} contained high level of total phenolic compounds and showed strong antioxidant activity by inhibiting DPPH, hydroxyl radical, nitric oxide and ABTS radical scavenging activities when compared with standard ascorbic acid. Further, there was a linear relationship between the antioxidant activity and phenolic content, indicating that phenolic compounds could be major contributors to antioxidant activity.

6. Antiurolithiatic effect\textsuperscript{138}

Antiurolithiatic activity of petroleum ether, chloroform, and alcohol extracts of \textit{Mimusops elengi} bark was studied by Ashok P et.al. Oxalate, calcium, and phosphate were monitored in the urine and kidney. The alcohol extract bark significantly lowers the elevated levels of the oxalate, calcium, phosphate in urine and kidney as compared to petroleum ether and chloroform extract.
8. Antibacterial effect\textsuperscript{141,142,143}

There are several studies reporting antibacterial potential of extracts prepared from different parts of \textit{Mimusops elengi}.

Dried and powdered bark of \textit{Mimusops elengi} was extracted with various solvents for evaluation of antibacterial activity against gram-positive and gram-negative bacteria and other microorganisms isolated from tooth-tartar of dental patients by Tatke P.A et.al. Among all the extracts tested, chloroform extract exhibited major antibacterial activity at 200mg against all the microorganisms present in tooth-tartar of dental patients.

Ali M.A. et.al also demonstrated the antibacterial activity of petroleum ether, ethyl acetate and methanol extracts from bark, fruits and leaves of \textit{Mimusops elengi} against some pathogenic bacteria. Bark displayed good antibacterial activity than fruits and leaves.

In another study by Rangama BNLD et.al, the ethanolic bark extract of \textit{Mimusops elengi} when tested for its antimicrobial activity against the bacterial isolates \textit{Staphylococcus aureus}, \textit{Pseudomonas aeruginosa} and \textit{Escherichia coli}, showed inhibitory activity against three \textit{Staphylococcus} isolates including \textit{Staphylococcus aureus} with MIC 128 mg/l.

9. Antifungal effect\textsuperscript{142,144}

Petroleum ether, ethyl acetate and methanol extract from bark of \textit{Mimusops elengi} were tested for antifungal activities against some pathogenic fungi. The extracts displayed good activity against \textit{Trichoderma viride}.

The effect of aqueous extracts of leaf and bark of \textit{Mimusops elengi} on the radial growth and sclerotial development (number and size) of the polyphagous fungus \textit{Sclerotinia sclerotiorum (Lib.)} de Bary was investigated by Niranjan K et.al. The unsterilized aqueous bark extract showed significantly higher inhibition of radial growth and number and size of sclerotia compared to the sterilized and unsterilized aqueous leaf extract. Further, unsterilized aqueous bark extract at 30\% concentration showed highest...
sensitivity reducing radial growth by 56.54%, sclerotia number by 65.15% and sclerotial size by 68.90-73.11%

10. Antihyperglycemic and Antidiabetic effect

Ganu P. et al. studied the antihyperglycemic and antidiabetic activity of methanolic extract (400 mg/kg body weight, p.o.) of Mimusops elengi bark in alloxan-induced diabetic rats. The extract exhibited significant antihyperglycemic effect with onset at 2\textsuperscript{nd} hrs peak activity at 6 hrs. The antihyperglycemic effect of extract was persistent up to 24 hrs after drug administration. There was reduction in elevated glucose levels in glucose-loaded non-diabetic animals. Further the extract demonstrated significant reduction in elevated glucose levels 2 hrs before glucose administration and 6 hrs after glucose load in oral glucose tolerance test in diabetic animals. Thus the extract demonstrated antihyperglycemic activity in diabetic as well as non diabetic glucose loaded mice.

11. Cytotoxic activity

The cytotoxic effects of ethanolic extract of bark Mimusops elengi were investigated by Bhujbal S S. et al. on meristematic cells of root tips of Allium cepa. After 48 hrs and 96 hrs of treatment, the photomicrographs showed chromosomal abnormalities, stickiness, etc. and there was a significant decrease in percent mitotic index and root length of A. cepa with respective time and increasing concentration of extract.

Nasrin et al. also studied cytotoxic activity of methanolic bark extract by brine shrimp lethality bioassay. The extract exhibited good cytotoxic activity with LC\textsubscript{50} value of 40µg/ml.

12. Diuretic effect

The diuretic and electrolyte excretion activities of petroleum ether, chloroform and alcoholic extracts (200mg/kg body weight, p.o) of bark of Mimusops elengi were investigated by Koti B C. et al. The highest diuretic and electrolyte excretion activities were presented by the alcoholic extract.
Kate deshmukh RG et.al also demonstrated the diuretic effect of ethyl acetate, ethanol and aqueous extracts (250mg/kg body weight, p.o) of *Mimusops elengi* bark. The aqueous extract showed a significant diuretic activity compared to other extracts.

13. Wound healing effect

A methanolic extract from bark of *Mimusops elengi* was examined for wound healing activity in the form of ointment. The extract ointments showed considerable response in all the wound models compared to standard drug Betadine ointment in terms of wound contracting ability, wound closure time, tensile strength and dry granuloma weight. Histological analysis was also consistent with the proposal that *Mimusops elengi* bark extract exhibits significant wound healing.

16. Anthelmentic activity

The methanolic bark extract of *Mimusops elengi* was screened for *in vitro* anthelmintic activity against earthworms (*Pheretima posthuma*). The extract showed anthelmintic activity at all the concentrations of 25 mg/ml, 50 mg/ml and 100 mg/ml. But the potent anthelmintic activity was observed at the concentration of 100 mg/ml.

Dhamija et. al demonstrated anthelmintic activity of ethanolic and aqueous extracts of bark of *Mimusops elengi* against adult earthworm *Eisenia foetida* (redworm). The paralysis time (Vermifuse), and death time (Vermicidal) was noted down. Both ethanolic and aqueous extract of bark of *Mimusops elengi* was found to have significant anthelmintic action at the dose of 4 mg/ml or more.

18. Anti-inflammatory, Antipyretic and Analgesic Activities

Purnima BC. et.al studied anti-inflammatory, analgesic and antipyretic activities of ethanolic extract (200 mg/kg body weight, p.o) of bark of *Mimusops elengi* in carrageenan-induced paw edema and in cotton pellet model. It reduced the transudative weight and little extent of granuloma weight. In analgesic models, the extract decreased the acetic acid-induced writhing and reduced the rectal temperature in Brewer's yeast induced pyrexia. However, there was no increase the latency time in the hot plate test.
Nasrin M. et.al also demonstrated the analgesic and neuropharmacological effects of methanol extract (100, 200 and 400 mg/kg body weight) of *Mimusops elengi* bark. In tail immersion test, the extract produced an increase of latent time to flick tail compared to control in a dose dependent manner. In acetic acid-induced writhing test, the extract at 400 mg/kg showed a maximum of 65.48% inhibition of writhing compared to the control. In CNS depressant activity tests, the extract significantly decreased motor activity and exploratory behavior of mice in hole cross and open field tests respectively. The results suggested that the extract possesses analgesic and CNS depressant activity.

The pretreatment with ethanolic bark extract (200 and 400mg/kg body weight, p.o) and isolated compound β-amyrincaprylate (5 mg/kg body weight) exhibited significant anti-inflammatory activity in acute and chronic models.

**20. Immunostimulatory Activity**

The immunostimulatory activity of methanolic extract (10, 20, 40 mg/kg body weight) of bark of *Mimusops elengi* in mice was studied by Carbon Clearance Test (CCT), Haemagglutination Antibody Titre (HA) and Delayed Type Hypersensitivity using Sheep R.B.C. as antigen by Kadam P. V. et.al. The *Mimusops elengi* extract showed a dose dependent increased immunostimulatory response.

**21. Larvicidal Activity**

In a study, hexane (HEX), ethyl acetate (EA) extract and fractions of ethyl acetate extract i.e EA1, EA2 and EA3 and isolated compound Cubebin of *Mimusops elengi* bark were evaluated for larvicidal activity against IV instar larvae of *A. aegypti* and *C. quinquefasciatus*. The extract EA was less effective but its three fractions EA1, EA2 and EA3 show remarkable toxicity to the larvae. EA1 was the most active. It exhibited 100% mortality after 24 hrs exposure at 200 ppm dose in case of both the species, whereas EA2 and EA3 were active at 300 ppm showing 100% kill after 48 hrs of exposure. Cubebin, which was isolated from the hexane extract, exhibited 100% mortality at the lowest dose of 60 ppm in case of *Ae. aegypti* and 100 ppm in case of *Cx. quinquefasciatus* after 24 hrs.
3.2. MIMUSOPS ELENGI FRUITS

1. Antioxidant activity

The antioxidant capacities of the phenolic compounds extracted from immature green, mature green and orange ripe fruits of *Mimusops elengi* were investigated by Boonyuen et al. The antioxidant capacity of the crude extract from immature fruit (GAE = 318.5 ± 12.3 mg/g extract) was higher than that of either the mature (GAE = 234.1 ± 9.2 mg/g extract) or the ripe fruit (GAE = 111.9 ± 4.9 mg/g extract). High performance liquid chromatographic analysis confirmed that all phenolic fractions contained gallic acid as a constituent. *M. elengi* fruits appeared to be a good source of natural antioxidant.

Narayanaswamy N et al also investigated the antioxidant potential of aqueous, methanol and petroleum ether extracts of *Mimusops elengi* fruits by DPPH and ferric reducing power assay. The methanol extract of fruits (97.15%) possessed the highest inhibition of DPPH radical when compared to other extracts. The ferric reducing capacity of all extracts was very low.

2. Antimicrobial activity

Ali MA et al demonstrated the antimicrobial activity of petroleum ether, Ethyl acetate, Methanol, extracts of *Mimusops elengi* fruits were screened for their antibacterial and antifungal activity against some pathogenic bacteria viz; *S. aureas*, *S- b-heimolyticus*, *B- subtilis*, *Klebsiella species*, *Shigella species*, *Penecillum sp.*, *A. niger*, *T. viride*, *A.s flavus*, *C. albicans*, and *H. sativum*. Among the extracts, methanol extract showed maximum activity.

Shahwar D et al. also investigated the antibacterial activity of *Mimusops elengi* fruit extracts viz; dichloromethane, chloroform, ethyl acetate, acetone methanol-chloroform methanol, ethanol, acetone-water, methanol-water and ethanol-water by using spectrophotometric method against gram positive and gram negative strains. All the extracts were inactive towards all 6 pathogens.
3. Antityrosinase activity

Antityrosinase activity of water, methanol and petroleum ether extracts of *Mimusops elengi* fruit was investigated by Narayanaswamy N et.al. Methanol extract exhibited highest antityrosinase activity (64.39%) as compared to aqueous (30.35%) and petroleum ether (25.45%) extract.

3.3. *ROSA DAMASCENA FLOWER PETALS*

1. Hypnotic activity

Hypnotic effect of ethanolic, aqueous and chloroform extracts at 100, 500 and 1000 mg/kg of *Rosa damascena* flower petals was investigated in pentobarbital induced sleeping time by Rakhshandah H et.al. The ethanolic and aqueous extracts in doses of 500 and 1000 mg/kg significantly increased the pentobarbital induced sleeping time. The chloroform extract showed no hypnotic effect.

In another study by Rakhshandah H et.al, hypnotic effect of the ethanol crude extract of *Rosa damascena* and its fractions (water, ethyl acetate and n-butanol) at 250 and 500mg/kg was investigated in mice. Ethanol extract and fractions of *Rosa damascena* at 250 and 500mg/kg doses prolonged the pentobarbital induced sleeping time in mice. Among all fractions, aqueous fraction has the least, and the ethyl acetate fraction at 500mg/kg dosage has the best hypnotic effect.

2. Antidepressant activity

Antidepressant effect of ethanolic extract of *Rosa damascena* (15, 60 and 90 mg/kg, i.p) by forced swimming test (FST) was evaluated by Dolati K. The extract at tested doses did not showed antidepressant effect.

3. Anti-inflammatory and Analgesic activity

Analgesic effect of aqueous, ethanol and chloroform extract of *Rosa damascena* at 100, 500 and 1000 mg/kg were studied using hot plate and tail flick methods. Ethanol extract showed significant analgesic effect.
Hajhashemi V et.al also demonstrated the effect of hydroalcoholic extract and essential oil of *Rosa damascena* for its possible anti-inflammatory and analgesic activities. The extract was administered at the doses (p.o.) of 250, 500 and 1000 mg/kg and the doses of essential oil were 100, 200 and 400 µl/kg. The acetic acid-induced writhing response, formalin-induced paw licking time in the early and late phases and light tail flick test were used in mice to assess analgesic activity. For evaluation of anti-inflammatory effect carrageenan-induced paw edema served as a valid animal model. The extract significantly attenuated the writhing responses induced by an intraperitoneal injection of acetic acid and also showed potent analgesic effect in both phases of formalin test but not in light tail flick test. Essential oil of the plant at all administered doses failed to show any analgesic or anti-inflammatory effect in above mentioned tests.

4. Antitussive activity

Shafei M N et.al studied the antitussive effect of aerosols of two different concentrations of ethanolic extract (5 and 10% w/v), aqueous extract (10 and 20% w/v) of *Rosa damascena*, were tested counting the number of cough produced due to aerosol of citric acid. The results showed a significant reduction in the number of coughs obtained in the presence of both concentrations of ethanolic extract and higher concentrations of aqueous extract.

5. Bronchodilatory activity

The relaxant effects of ethanolic extract and essential oils of *Rosa damascena* on tracheal chains of guinea pigs were conducted by Boskabady M H et.al. The relaxant effects of four cumulative concentrations of ethanolic extract (0.25, 0.5, 0.75, and 1.0 vol %) and essential oils (0.25, 0.5, 0.75, and 1.0 vol %) were examined by their relaxant effects on precontracted tracheal chains of guinea pig. The extracts and essential oil showed concentration dependent relaxant effects.

6. Anti- HIV activity

Mahmood N et.al studied the effect of water and methanol extracts of *Rosa damascena* on HIV infection *in vitro*. In this study, anti-HIV activities of the nine compounds
including a new compound 2-phenylethanol-O-(6-O-galloyl)--D-glucopyranoside which were purified from the methanol extract were evaluated on C8166 human T lymphoblastoid cells infected with HIV-1MN and H9 human T-cell lymphoma cells chronically infected with HIV-1IIIB. Kaempferol 1 and its 3-O-- D-glucopyranosides 3 and 6 exhibited the greatest activity against HIV infection of C8166 cells, whereas kaempferol-7-O--D-glucopyranoside showed no effect. Similarly, quercetin-7-O--D-glucopyranoside was inactive compared to quercetin 2. Compound 8, a new natural product exhibited some anti-HIV activity, presumably due to the presence of the galloyl moiety since 2-phenylethanol-O--D-glucopyranoside was inactive. In this study, authors compared the anti-HIV activities of the nine compounds and showed that the activity of the crude extract is due to the combined effects of different compounds acting additively against different stages of virus replication.

7. Effect on cardiovascular system

Boskabady MH et.al studied the effects of aqueous-ethanolic extract from Rosa damascena on heart rate and contractility. Rosa damascena potentially increased heart rate and contractility in isolated guinea pig heart.

8. Anti-diabetic activity

Anti-diabetic activity of methanol extract of Rosa damascena in normal and diabetic rats was studied by Gholamhoseinian A. et.al. Oral administration of this plant extract (100 to 1000 mg/kg body wt.) significantly decreased blood glucose in normal and diabetic rats in a dose-dependent manner.

9. Anti-oxidant activity

G. Ozkan et.al studied the antioxidant effect of fresh (FF) and spent (SF) flowers. The antioxidant activity of FF extract was higher than that of SF extract.

The presence of phenolic compound in ethanolic extract of Rosa damascena has been shown by Kumar et. al. They determined antioxidant activity of this extract compare to standard antioxidant L-ascorbic acid by 1, 1-diphenyl-2-picryl hydrazyl (DPPH) free radical method. This study showed that Rosa damascena has high antioxidant activities.
Yassa N et.al also demonstrated the antioxidant activity of hydro-alcoholic extract of petals and essential oil by DPPH free radical scavenging activity and by ferric ammonium thiocyanate method. The extract and essential oil exhibited potent antioxidant activity.

C.R Achuthan et.al studied the in-vitro antioxidant potential of acetone fraction of *Rosa damascena*. Oral administration of acetone fraction at 50 mg/kg significantly reduced the serum alkaline phosphatase, glutamine pyruvate transaminase and glutamine oxaloacetate transaminase activity and lipid peroxide levels in rats.

In a study, Shahriari et.al demonstrated the antioxidant potential of *Rosa damascena* ethanol extract by FRAP and TBARS test. The extract at doses of 50, 75, 100 and 200 mg/kg showed significant ability to inhibit lipid peroxidation and has a high antioxidant power. Highest activity was observed with the dose of 200 mg/kg.

**10. Antibacterial activity**

Antibacterial activity of the both fresh flower (FF) and spent flower (SF) extracts of *Rosa damascena* flower against 15 species of bacteria: *Aeromonas hydrophila*, *B. cereus*, *Enterobacter aerogenes*, *Enterococcus feacalis*, *E. coli*, *Klebsiella pneumoniae*, *Mycobacterium smegmatis*, *Proteus vulgaris*, *P. aeruginosa*, *P. fluorescens*, *Salmonella enteritidis*, *Salmonella typhimurium*, *Staph. aureus*, *Yersinia enterocolitica* were studied. Both extracts were effective against all the bacteria except *E. coli*, although the FF extract was more effective than the SF extract. FF and SF extracts showed the strongest effects against *S. enteritidis* and *M. smegmatis*, respectively.

Shokouhinejad N et.al demonstrated the antimicrobial effect of *Rosa damascena* extract on selected endodontic pathogens. The extracts were able to kill all test microorganisms.

Khurhade B.B investigated the antibacterial effects of water and acetone extracts of *Rosa damascena* against *E.coli* and *B.subtilis*. The acetone extract shows the significant antibacterial activity compared to aqueous extract.

Halawani E M also demonstrated the antimicrobial activity of alcoholic and aqueous extract from *Rosa damascena* against 10 pathogenic microorganism; *S. aureas*, *S- aureas*
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(clinical isolate), *P. aeruginosa*, *P. aeruginosa* (clinical isolate), *E-coli*, *E-coli* (clinical isolate), *S. pneumonia*, *A-calcaoceuticus*, *S-enteritidis*, *A-niger*. Alcoholic extract showed good antimicrobial activity than aqueous extract.

11. Laxative and Prokinetic Effects\(^{177}\)

Reza Arezoomandan et.al studied the laxative and prokinetic effect of boiled extract of *Rosa damascena* (1.5g/kg). Boiled extract of *Rosa damascena* significantly increased feces number and its percentage of water, but had no effects on the transit time of intestinal ingesta. The volume of the contents in jejunum segments had significantly increased with the extract.

12. Anti-aging activity\(^{178}\)

The effects of a rose-flower extract on the mortality rate of *Drosophila melanogaster* was investigated in a recent study. Supplementing Drosophila with the plant extract resulted in a statistically significant decrease in mortality rate in male and female flies. Moreover, the observed anti-aging effects were not associated with common confounds of anti-aging properties, such as a decrease in fecundity or metabolic rate. Therefore, *Rosa damascena* can extend Drosophila life span without affecting physiological mechanisms.

13. Anti-lipase activity\(^{179}\)

In a recent study, the anti-lipase effect of the extract of several plants including *Rosa damascena* was studied. The ethanolic extract of *Rosa damascena* (50µg) showed 57 % inhibitory effect on pancreatic lipase, indicating anti-lipase effect.