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Research Article

Investigating The Antioxidant Potential of Selected Medicinal Plant: A Comparative Study

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ABSTRACT

The present study focuses on the Herbalism, the use of plants and plant extracts in traditional medicine, continues to play a crucial role in healthcare, especially in developing countries. Plants are rich in bioactive secondary metabolites, many of which exhibit potent antioxidant properties. This study focuses on two important medicinal plants: Aegle marmelos (Bael) from the Rutaceae family and Gmelina arborea (Gambhari) from the Verbenaceae family to evaluate and compare their antioxidant potential through in vitro analysis. Aegle marmelos, a sacred tree in Indian culture, is known for its therapeutic use in indigenous medicine, while Gmelina arborea is recognized for both its medicinal and commercial value. By conducting a comparative antioxidant assessment, this study aims to highlight the potential of these plants as natural sources of antioxidants and contribute to the growing field of herbal-based therapeutic development.

INTRODUCTION

Herbalism is a traditional medicinal or folk medicine practice based on the use of plants and plant extracts. Herbalism is also known as botanical medicine, medical herbalism, herbal medicine, herbology, herblore, and phytotherapy. Plants are considerably useful and economically essential. They contain active constituents that are used in the treatment of many diseases. Plants are rich source of ecologically developed secondary metabolites, which are potential remedies for different ailments. Aegle marmelos (L.) Correa commonly known as Bael or Bilva belonging to the family Rutaceae has been widely used in indigenous systems of Indian medicine due to its various medicinal properties. Aegle marmelos (L.) tree is held sacred by Hindus and offered in prayers to deities Lord Shiva and Parvati and thus the tree is also known by the name Shiva duma (the tree of Shiva). The Bael tree has its origin from Eastern Ghats and Central India. It is Indigenous to Indian

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subcontinent and mainly found in tropical and subtropical regions. The tree is also found as a wild tree, in lower ranges of Himalayas up to an elevation of 500 meters. Bael is found growing along foothills of Himalayas, Uttaranchal, Jharkhand, Madhya Pradesh, and the Deccan Plateau and along the East coast.For centuries, the medicinal plants are the basis for treatment of various diseases. Nearly 80% of peoples living in developing countries still depend on plant based traditional medicine for their preliminary health care and almost three-fourths of the herbal drugs used worldwide is derived from medicinal plants. Medicinal plants are believed to be an important source of new chemical substances with potential therapeutic effects. arborea belonging to family Verbenaceae locally named as Gambhari (Oriya), Gambhar (Hindi), Gambhar (Bengali), Sriparni (Sanskrit) and Gummadi (Telgu). Bark light grey colored exfoliating in light colored patches when old, blaze thick, a chlorophyll layer just under the outer bark, pale yellow white inside. The yellow flower, tinged with brown, is trumpet shaped, 3-4 cm long. The trumpets flare open into a gaping mouth with 5 distinct lobes. The fruit is oval in shape, 3/4 inches in length and is yellow in color. The fruit taste sweet and astringent. Leaves are 4 to 9 inches in length and 2%2 inches in breadth. These are of heart shape; petioles are 2 to 6 inches in length. The wood is used planking, paneling, carriages, furniture, carpentry of all kinds, in Myanmar for carving images and canoes, match manufacture, packing cases, in all ornamental work, for making quality toys and picture frames. Therefore, this study is conducted to access antioxidant in vitro study activities of Aegle marmelos and Gmelina arborea.

Drug Profile:

Aegle marmelos:

The *Aegle marmelos* (L.) tree, which is worshipped by Hindus and offered in the prayers of Lord Shiva and Parvati, is also known as Shivaduma (The Tree of Shiva). In India, *Aegle marmelos* L. is a plant that is readily accessible in many locations. Also called the “Bale fruit tree,” Bael (*Aegle Marmelos* (Linn)) is a moderately sized, slender, aromatic tree.

Habitat: The *A. marmelos* tree is mostly found in the foothills of the Himalayas, Uttar Pradesh, Madhya Pradesh, Rajasthan, Chhattisgarh, and Bihar.

Use of Bael:

Leaves: The leaves are most effective in treating fever, nausea, vomiting, swellings, dysentery, dyspepsia, seminal weakness, and intermittent fever.

Root: The roots of bael are thought to be effective in treating urinary problems, preventing heart palpitations, and curing fevers. They are also said to relieve abdominal pain. The medical properties of dashamula lie in its root to treat fever, diarrhea, and flatulence.

Flower: An anti-dysenteric, antidiabetic, diaphorectic, and local anesthetic medication can be produced by distilling flowers. It is utilized as a tonic for the stomach and intestine. Along with being used as an expectorant, it is also helpful in epilepsy.

Figure 1: Plant of *Aegle marmelos*

Gmelina arborea:

Gmelina arborea is known as Kashmiri (as it grows in Kashmir), this tree is native to Asia and found in India, It is mostly found in deciduous and moist deciduous forests. Gambhari has many uses. It is a fast-growing tree from teak family. Gambhari is also a medicinal tree and its roots, stem, stem bark, fruits, leaves, flowers all are used for medicinal purpose in India since ancient times. Its mention is found in all classical texts of Ayurveda.

Vernacular Name:

Gambhara (Hindi), Peggumudu (Telugu), Gambhari (Punjabi)

Medicinal uses:

The root and bark of Gmelina arborea are stomachic, galactagogue laxative and anthelmintic; improve appetite, useful in hallucination, piles, abdominal pains, burning sensations, fevers, 'tridosha' and urinary discharge. Leaf paste is applied to relieve headache and juice is used as wash for ulcers.In snake – bite a decoction of the root and bark is given internally

Figure 2: Leaves, fruits and flowers of *Gmelina arborea*

MATERIALS AND METHODS:

Collection of plant: The leaves of *Aegle marmelos* and *Gmelina arborea* were collected locally from Sawantwadi, Maharashtra, in the month of February. They were separated, washed thoroughly with tap water and shade dried.

Authentication of plant: The plants were authenticated by Head of PG Department and research Center of Botany of SPK Mahavidyalaya, Sawantwadi, Maharashtra via Ref. No. 12-B/834/2025 date: 27-02-2025, by comparing morphological features of crude drug sample.

Drying and size reduction of plant material: The leaves of *Aegle marmelos* and *Gmelina arborea* were dried under shade then dried leaves were pulverized to coarse powder. The coarse powder of leaves was passed through sieve No.40 to maintain uniformity and stored in cool and dry place.

Physiochemical screening of powders:

(A) Loss on drying
(B Total ash value
(C) Acid insoluble ash value
(D) Water soluble ash value
(E) Foaming index

Preparation of Extracts:

Extraction procedure: Extraction of leaves powder of *Aegle marmelos* and *Gmelina arborea* were done by Soxhlet extraction method.

Macroscopic characteristics of extracts of *Aegle marmelos* and *Gmelina arborea*: Macroscopic characters e.g. color, odor, test, apperence etc. was observed.

Qualitative Phytochemical Analysis of Crude Extracts: The crude extract obtained by solvent extraction was subjected to various qualitative tests to detect presence of common chemical constituents as: Alkaloids, Glycosides, Carbohydrates, Phytosterols, Saponins, Tannins, and Flavonoids Proteins etc.

Antioxidant Activity:

Free radical scavenging by DPPH scavenging method: Free radical scavenging activity of samples was measured using the 2,2-diphenyl-1-picrylhydrazyl (DPPH). Briefly, 1.0 ml of sample solution with different concentrations (0.1, 0.2, 0.3, 0.4, 0.5 and 0.6 mg/ml) was added to a 4 ml of 0.004% methanolic solution of DPPH.

Reducing power by ABTS radical scavenging method: The ABTS radical (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) scavenging activity was carried out based on the method of Gan and Latiff with some modifications.

Ferric Reducing/Antioxidant Power (FRAP) assay method: The FRAP assay was conducted following the method described. Aliquots of 0.2 mL of ethanolic extract

Statistical Analysis: Results were expressed as the mean SD (n = 3) for each analysis. Differences were estimated by analysis of variance (ANOVA) followed by LSD test and differences were designated as statistically significant when $p<0.05$.

Result and Discussions:

1. Preliminary Study:

Table No. 1: Morphological parameter of leaves of *Aegle marmelos* and *Gmelina arborea*

Plant part	Parameter	No. of sample (n)	Average value
***Aegle marmelos* Leaves**	**Color**	10	Green
	Odor	10	Aromatic, mildly citrusy
	Taste	10	Slightly pungent
	Leaves	10	Trifoliate
	Terminal Leaflet	10	5 - 6 cm (long) 2.3 - 2.8cm (wide)
	Lateral Leaflet	10	4.2 – 3.0 cm (long) 2.1.-2.7 cm (wide)
	Leaf shape	10	Ovate to lanceolate
***Gmelina arborea* Leaves**	**Color**	10	Green
	Odor	10	Mild Herbal scent
	Taste	10	Bitter with astringent
	Leaf length (mm)	10	10-25 cm
	Leaf width (mm)	10	7-20 cm
	Leaf shape	10	Broadly Ovate
	Leaf arrangement	10	Opposite Decussate

2. Physiochemical screening of powders:

Table No. 2: Physiochemical screening of Leaves powders of selected plants

S. No.	Parameters	*Aegle marmelos*	*Gmelina arborea*
1	Loss on drying (%)	1.68	2.23
2	Total ash value (%)	6.31	7.25
3	Acid insoluble ash value (%)	2.72	3.14
4	Water soluble ash value (%)	2.68	3.11
5	Foaming index	14 (ml)	16 (ml)

3. Extraction of *Aegle marmelos* and *Gmelina arborea* Leaves: Macroscopic character of extracts of *Aegle marmelos* and *Gmelina arborea* Leaves

Table No. 3: Macroscopic character of extracts

S. No.	Parameters	EEAM	AEAM	EEGA	AEGA
1	Color	Dark Green	Greenish	Dark Green	Green
2	Odor	Aromatic	Aromatic	Herbal	Herbal
3	Test	Pungent	Pungent	Bitter	Astringent
4	Physical Appearance	Semisolid	Semisolid	Semisolid	Brittle cake
5	State	Greasy	Non greasy	Greasy	Non greasy

4. Yields of extracts of *Aegle marmelos* and *Gmelina arborea* Leaves:

Table No. 4: % Yields of extracts

S. No.	Parameters	EEAM	AEAM	EEGA	AEGA
1	Yield (%)	57.3 %	23.1%	48.8%	19.2%

5. Phytochemical screening of extracts of *Aegle marmelos* and *Gmelina arborea* Leaves:

Table No. 5: Phytochemical screening of extracts

Chemical Tests	EEAM	AEAM	EEGA	AEGA
Alkaloids	(+)	(+)	(+)	(+)
Dragendorff's Test	(+)	(+)	(+)	(+)
Mayer's Test	(+)	(+)	(+)	(+)
Hager's Test				
Glycosides	(+)	(+)	(+)	(+)
Legal Test	(-)	(+)	(-)	(+)
Baljet Test	(-)	(+)	(-)	(+)
Borntrager's Test				
Carbohydrates	(-)	(-)	(-)	(-)
Molisch's Test	(-)	(-)	(-)	(-)
Benedict's test	(+)	(+)	(+)	(+)
Fehling's Test				

Steroids and Sterols Salkowski Test Libermann-Burchard	(+) (+)	(-) (-)	(+) (+)	(-) (-)
Proteins and Amino Acids Biuret Test Ninhydrin Test Millon's Test	(-) (-) (-)	(+) (-) (+)	(-) (-) (-)	(-) (+) (+)
Tannins 5%ferric chloride solution 10% aqueous $K_2Cr_2O_7$ solution 10% lead acetate solution	(-) (-) (-)	(-) (-) (-)	(-) (-) (+)	(-) (-) (+)
Flavonoids Shinoda's Test Alkaline reagent test Lead acetate test	(+) (+) (+)	(+) (+) (+)	(+) (+) (+)	(+) (+) (+)
Saponins Foam taste	(-)	(+)	(-)	(+)

6. Antioxidant Activity: Free radical scavenging by DPPH scavenging method:

Table No. 6: % Inhibition of DPPH by leaves extract of *Aegle marmelos*

Conc. (µg/ml)	% Inhibition of DPPH by		
	Ascorbic acid	EEAM	AEAM
100	57.21 ± 0.31	32.77 ± 0.23	39.35 ± 0.62
200	67.82 ± 1.27	43.26 ± 1.27	50.01 ± 0.66
300	78.27 ± 1.02	58.26 ± 0.53	62.17 ± 1.32
400	89.16 ± 0.52	68.32 ± 0.24	75.28 ± 0.62
500	96.27 ± 0.42	76.24 ± 1.35	89.27 ± 1.41
600	98.43 ± 1.72	83.66 ± 0.62	91.82 ± 0.16

Table No. 7: % Inhibition of DPPH by leaves extract of *Gmelina arborea*

Conc. (µg/ml)	% Inhibition of DPPH by		
	Ascorbic acid	EEGA	AEGA
100	57.21 ± 0.31	25.84 ± 1.47	34.95 ± 0.63
200	67.82 ± 1.27	37.84 ± 0.62	45.83 ± 1.05
300	78.27 ± 1.02	47.52 ± 1.73	53.06 ± 1.73
400	89.16 ± 0.52	58.83 ± 2.01	61.93 ± 1.67
500	96.27 ± 0.42	69.83 ± 1.86	73.63 ± 0.82
600	98.43 ± 1.72	78.63 ± 0.63	80.62 ± 0.53

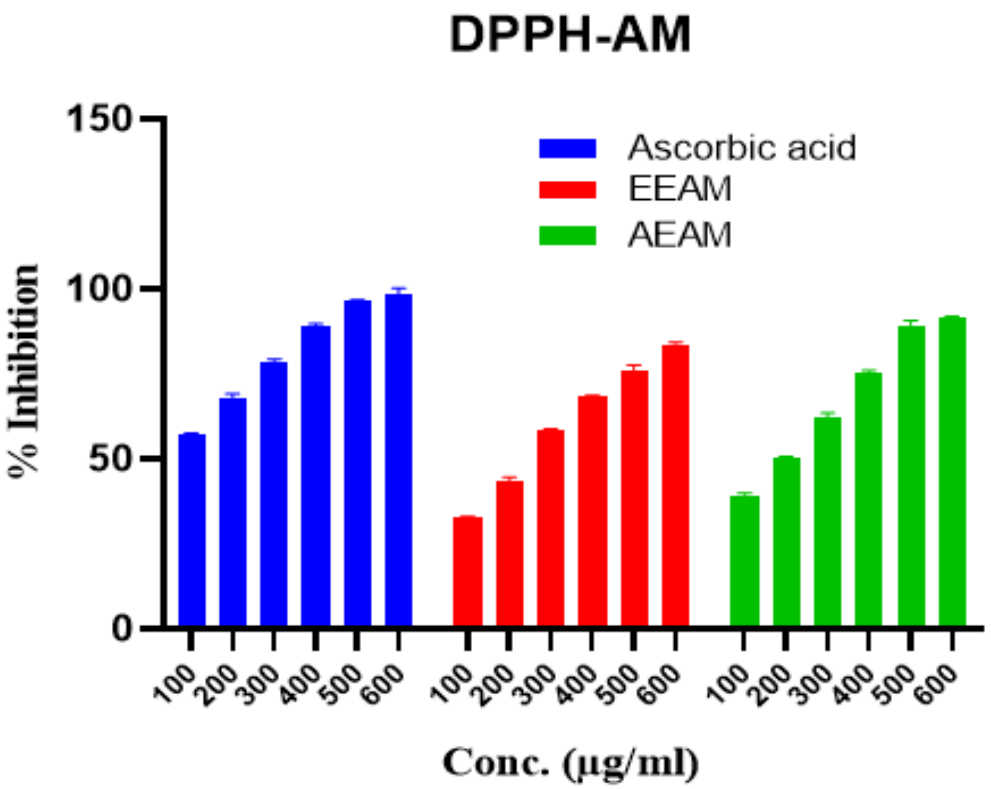

Figure 3: % Inhibition of DPPH by leaves extract of *Aegle marmelos*

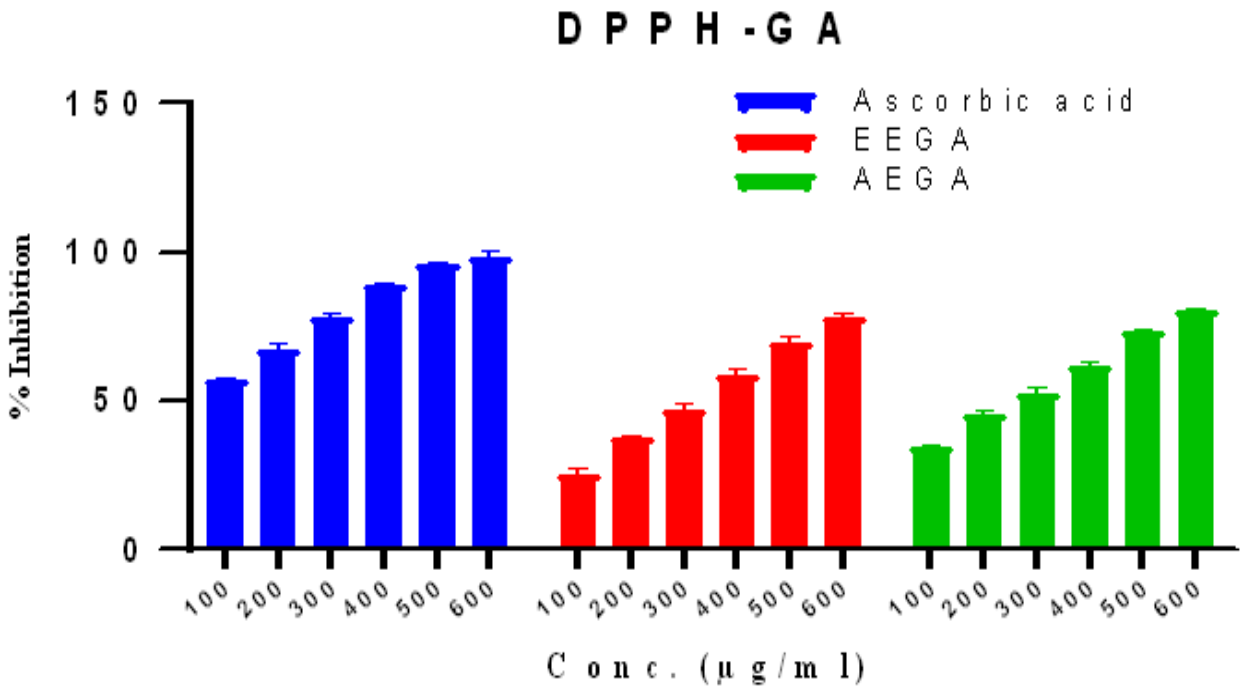

Figure 4: % Inhibition of DPPH by leaves extract of *Gmelina arborea*

7. Free radical scavenging by ABTS scavenging method:

Table No. 8: % Inhibition of ABTS by leaves extract of *Aegle marmelos*

Conc. (µg/ml)	% Inhibition of ABTS by		
	Ascorbic acid	EEAM	AEAM
100	52.84 ± 0.64	27.04 ± 0.98	36.06 ± 0.74
200	63.86 ± 1.03	36.05 ± 0.45	48.94 ± 0.99
300	74.94 ± 0.69	47.94 ± 1.18	58.04 ± 1.73
400	82.36 ± 1.04	58.07 ± 1.04	69.72 ± 0.85
500	93.84 ± 0.74	69.95 ± 0.84	80.71 ± 1.23
600	97.37 ± 1.14	82.85 ± 1.23	86.27 ± 0.42

Table No. 9: % Inhibition of ABTS by leaves extract of *Gmelina arborea*

Conc. (µg/ml)	% Inhibition of ABTS by		
	Ascorbic acid	EEGA	AEGA
100	52.84 ± 0.64	30.74 ± 0.74	38.83 ± 1.93
200	63.86 ± 1.03	41.84 ± 0.57	54.17 ± 1.28
300	74.94 ± 0.69	56.43 ± 1.63	67.38 ± 0.95
400	82.36 ± 1.04	69.85 ± 0.81	79.96 ± 1.26
500	93.84 ± 0.74	78.63 ± 1.67	88.17 ± 1.18
600	97.37 ± 1.14	85.83 ± 0.92	94.76 ± 2.52

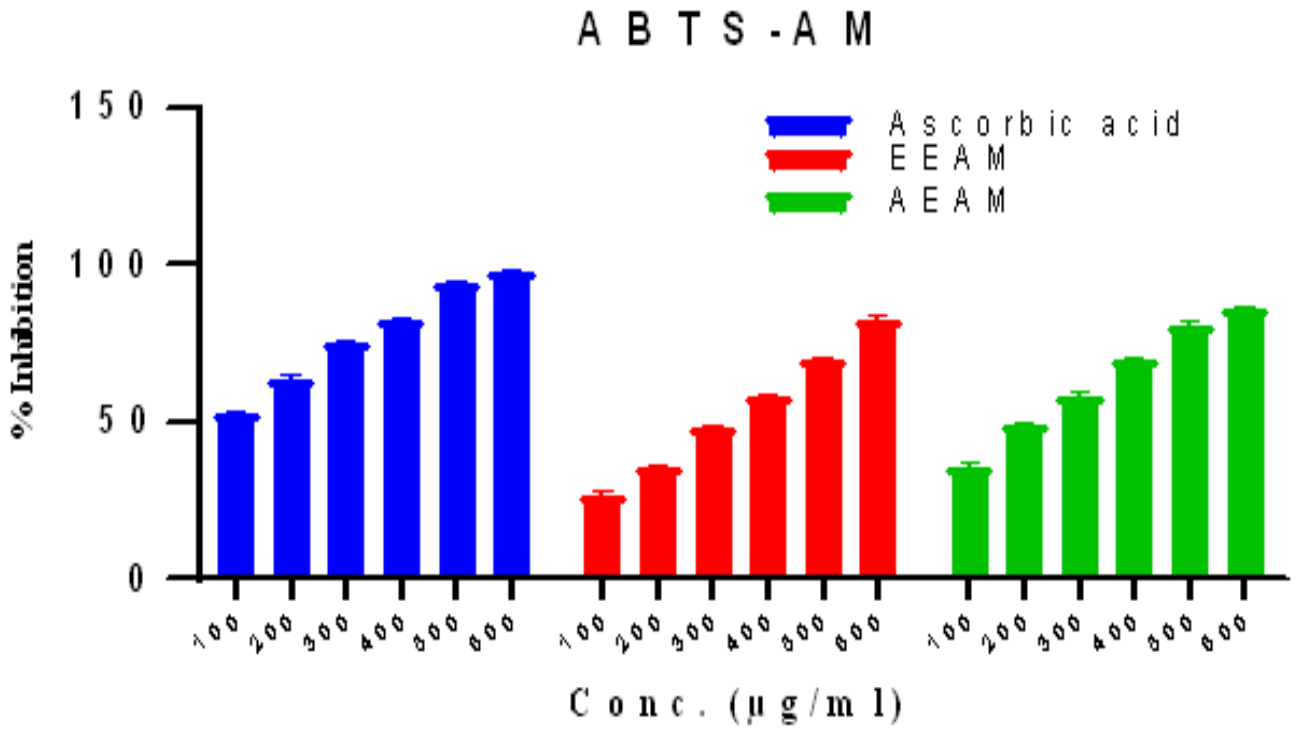

Figure 5: % Inhibition of ABTS by leaves extract of *Aegle marmelos*

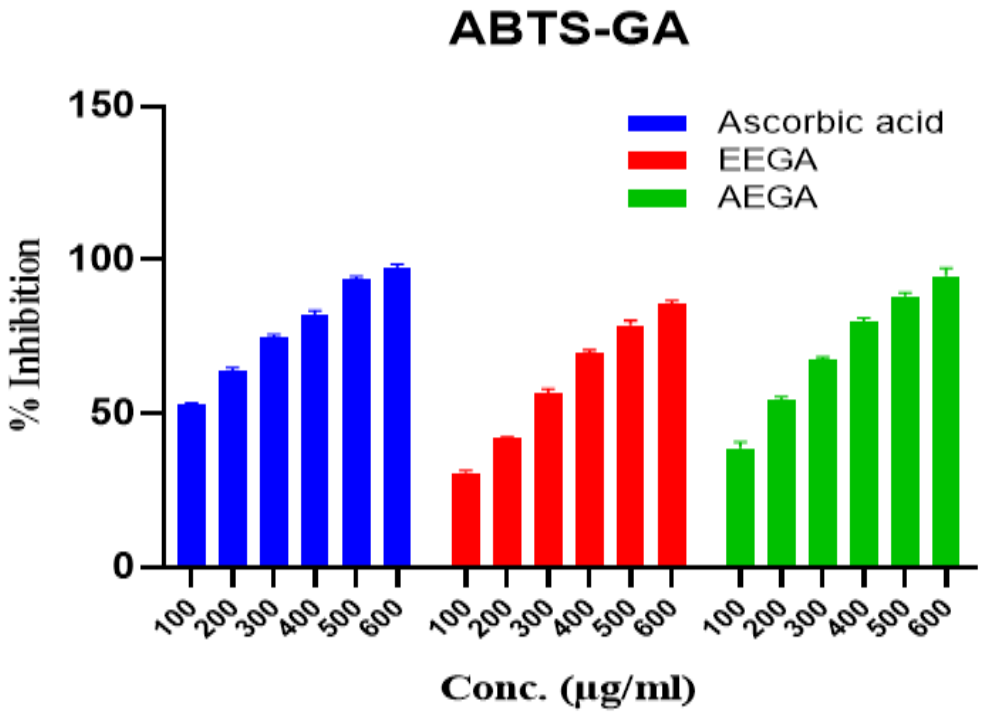

Figure 6: % Inhibition of ABTS by leaves extract of *Gmelina arborea*

8. Free radical scavenging by FRAP Assay method:

Table No. 10: % Reduction of Ferric ions by leaves extract of *Aegle marmelos*

Conc. (µg/ml)	% Reduction of Ferric ions by		
	Ascorbic acid	EEAM	AEAM
100	55.68 ± 1.16	28.07 ± 0.73	34.73 ± 1.85
200	64.74 ± 1.34	39.05 ± 1.20	50.72 ± 0.73
300	73.73 ± 0.76	50.93 ± 0.53	63.27 ± 1.82
400	82.83 ± 1.17	63.74 ± 0.72	74.27 ± 0.94
500	93.84 ± 0.95	76.93 ± 0.35	82.26 ± 1.26
600	97.84 ± 1.63	87.94 ± 0.63	90.26 ± 2.12

Table No. 11: % Reduction of Ferric ions by leaves extract of *Gmelina arborea*

Conc. (µg/ml)	% Reduction of Ferric ions by		
	Ascorbic acid	EEGA	AEGA
100	55.68 ± 1.16	27.16 ± 0.72	32.72 ± 2.12
200	64.74 ± 1.34	38.29 ± 1.26	48.26 ± 1.26
300	73.73 ± 0.76	50.11 ± 2.10	61.64 ± 1.17
400	82.83 ± 1.17	63.27 ± 0.62	74.27 ± 1.92
500	93.84 ± 0.95	76.94 ± 1.35	87.17 ± 2.01
600	97.84 ± 1.63	84.26 ± 1.63	95.26 ± 1.02

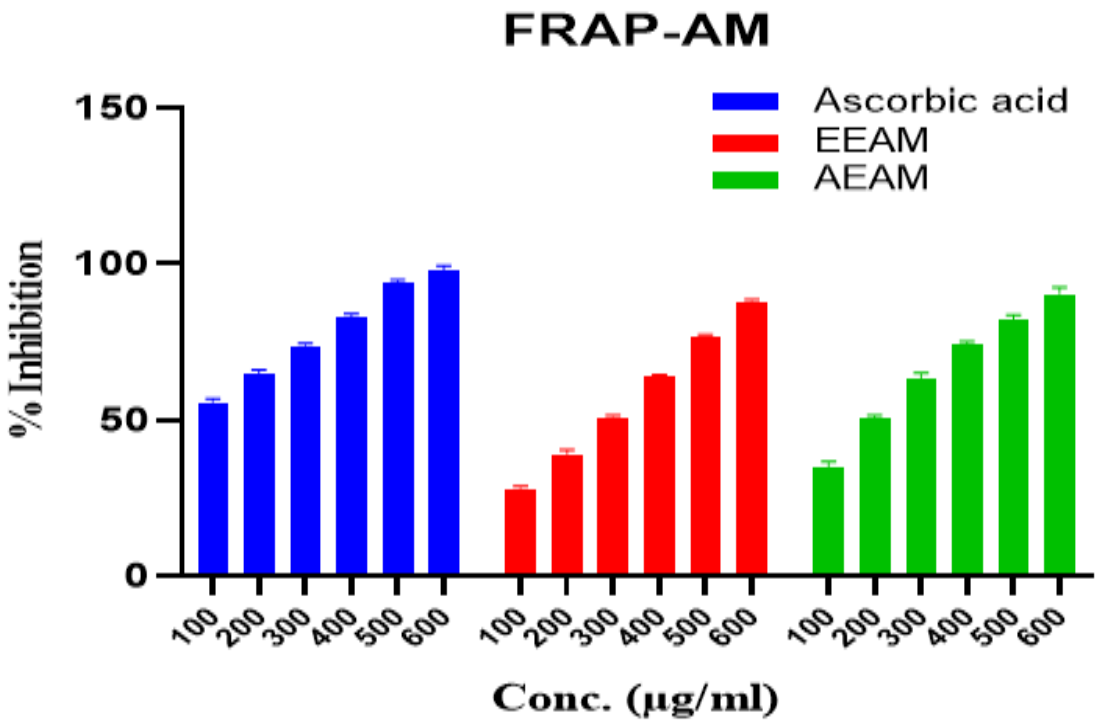

Figure 7: % Reduction of Ferric ions by leaves extract of *Aegle marmelos*

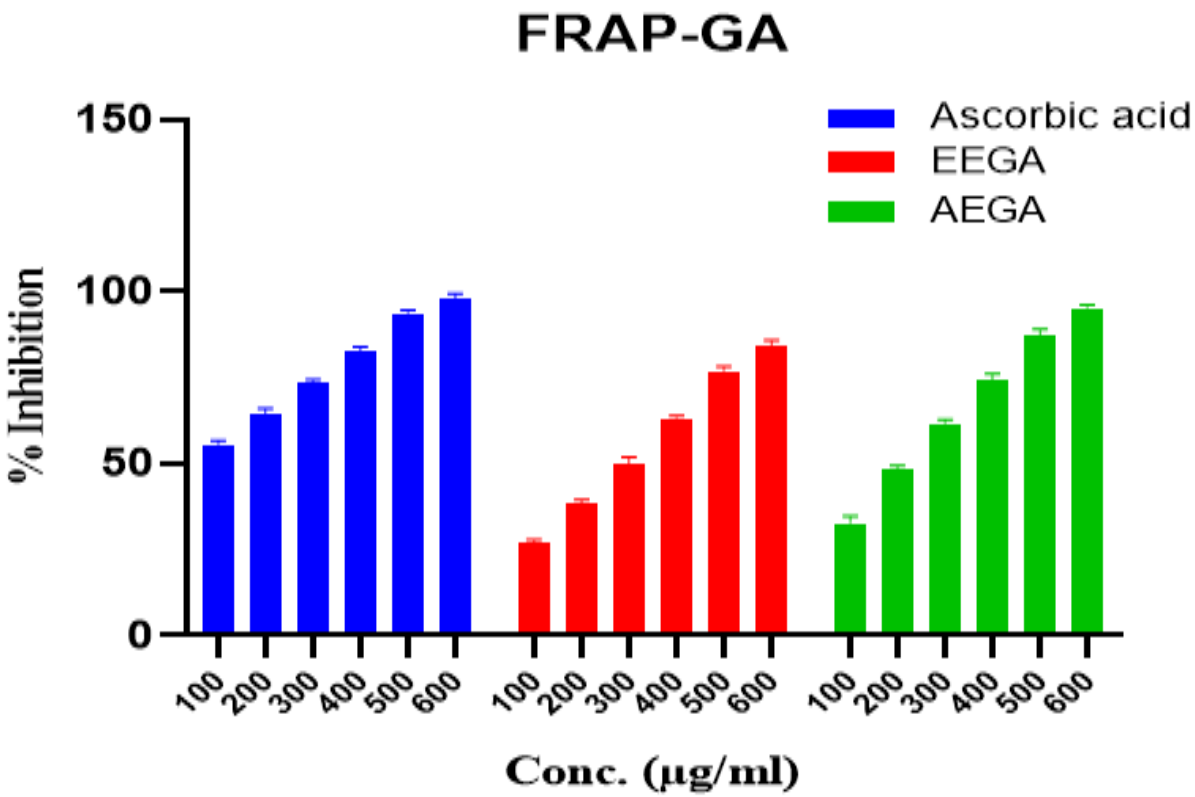

Figure 8: % Reduction of Ferric ions by leaves extract of *Gmelina arborea*

DISCUSSION:

Antioxidant potential of *AegleMarmelos* and *Gmelina Arborea* were investigated and compared. The leaves of *Aegle marmelos* and *Gmelina arborea* were collected locally from Sawantwadi, Maharashtra, in the month of February. They were separated, washed thoroughly with tap water and shade dried. The plants were authenticated by Head of PG Department and research Center of Botany of SPK Mahavidyalaya, Sawantwadi, Maharashtra via Ref. No. 12-B/834/2025 date: 27-02-2025, by comparing morphological features of crude drug sample. The leaves of *Aegle marmelos* and *Gmelina arborea* were dried under shade then dried leaves were pulverized to coarse powder. Coarse powder of leaves was passed through sieved to maintain uniformity and stored in cool and dry place. Preliminary plant materials were morphologically studied as the leaves of *Aegle marmelos* were green in color, Aromatic, mildly citrusy in odor, slightly pungent in taste, leaves were trifoliate, Terminal Leaflet were 5-6 cm (long), 2.3-2.8cm (wide) and Lateral Leaflet were 4.2-3.0 cm (long) 2.1-2.7 cm (wide) and Ovate to lanceolate in shape. The leaves of *Gmelina arborea* were green in color, mild herbal scent, bitter with astringent in taste. Leaves were broadly ovate in shape with opposite decussate having 10-25 cm in length and 7-20 cm in width. Physiochemical screening of dried leaves powders of *Aegle Marmelos* and *Gmelina Arborea* was performed for standardization purpose. Extraction of leaves powder of *Aegle marmelos* and *Gmelina arborea* were done by Soxhlet extraction method. Macroscopic characters e.g. color, odor, test, apperence etc. was observed. The crude extract

obtained by solvent extraction was subjected to various qualitative tests to detect presence of common chemical constituents as: Alkaloids, Glycosides, Carbohydrates, Phytosterols, Saponins, Tannins, Flavonoids Proteins etc. The ethanolic extract of *Aegle marmelos* leaves (EEAM) possessed alkaloids, steroids and sterols and flavonoids. The aqueous extract of *Aegle marmelos* leaves (AEAM) having alkaloids, glycosides, and flavonoids. The ethanolic extract of *Gmelina arborea* leaves (EEGA) possessed alkaloids, steroids and sterols and flavonoids. The aqueous extract of *Gmelina arborea* leaves (AEGA) having alkaloids, glycosides, carbohydrates, proteins, saponins and flavonoids. Overall, alkaloids and flavonoids were found in all four extracts. Antioxidant activity was obtained by using three methods. Free radical scavenging activity of samples was measured using the 2,2-diphenyl-1-picrylhydrazyl (DPPH). It was observed that the IC_{50} value of AEAM (= 200 µg/ml), EEAM (< 300), AEGA (< 300) and EEGA (> 300). The ABTS radical (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) scavenging activity was carried out based on the method reducing power by ABTS radical scavenging method observed as the IC_{50} value of AEAM (> 200 µg/ml), EEAM (> 300), AEGA (< 200) and EEGA (< 300). Ferric Reducing/Antioxidant Power (FRAP) assay method was conducted and observed as the IC_{50} value of AEAM (< 200 µg/ml), EEAM (< 300), AEGA (> 200) and EEGA (< 300).

CONCLUSION:

It can be concluded that the leaves extract of *AegleMarmelos* and *Gmelina Arborea* possessed antioxidant activities. The aqueous extracts of both plants showed most antioxidant activities. The plants may be considered as a source of natural antioxidants for medicinal use. However, the components responsible for antioxidant activities are currently unclear. Therefore, further investigation is needed to isolate and identify the constituents present in the fruit's extracts. Furthermore, the in-vivo antioxidant activity of this extract needs to be assessed prior to clinical use. Given the results obtained in this study, it can be concluded that the three methods used can assay the antioxidant activity of the 2 selected plant species, although the categorization established among the species depends on the method used. The methods also differ in sensitivity when establishing differences in the antioxidant activity of the species. These results show the importance of selecting the right method to Assay the antioxidant activity of plant extracts, especially when selecting among a group of potential species.

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