

Potentials of *Mangifera indica* L. and *Jatropha curcas* Linn Essential Oils as Valuable Natural Antioxidants

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ABSTRACT

Antioxidants are chemical compounds that mitigate oxidative stress by neutralizing excess free radicals. The study aimed at investigating the antioxidant activity of the essential oils extracted from the leaves of *Mangifera indica* and *Jatropha curcas*. The essential oils from *Mangifera indica* and *Jatropha curcas* air-dried leaves were extracted through hydrodistillation method using a Clevenger-type apparatus and the antioxidant activity of both plants' essential oils were carried out using 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay with ascorbic acid as the standard. *M. indica* oil appeared as a cloudy, light-yellow liquid, whereas *J. curcas* oil was cloudy and whitish in appearance; both exhibited strong characteristic odour. The essential oils of *M. indica* and *J. curcas* afforded 0.83% and 0.41% (v/w) weight respectively. The percentage inhibition values for *M. indica* varied between 51.89% at 0.2 mg/mL and 66.65% at 2.0 mg/mL, while that of *J. curcas* was between 54.70% at 0.2 mg/mL and 78.07% at 2.0 mg/mL. Ascorbic acid showed higher inhibition compared to both plants at similar concentration. The DPPH assay indicated that both oils exhibited moderate to strong free radical scavenging activity, reflecting promising antioxidant potential. These shows that the essential oils derived from both plants could serve as valuable natural antioxidants with potential applications in pharmaceuticals, cosmetics, and food industries.

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INTRODUCTION

The therapeutic application of plants and their products could be traced to the beginning of human civilization (Panhekar and Sawant, 2019). Earliest mention of medicinal plants could be found in the oldest repository of human knowledge called "Regveda" (Narayan *et al.*, 2010; Panhekar and Sawant, 2019).

Essential oils are blends of different secondary metabolites extracted from various plant samples via different processes (Kung *et al.*, 2008; Rubiolo *et al.*, 2010). Though they represent only a small fraction of plant's composition; they confer the characteristics by which aromatic plants are used in the food, cosmetic and pharmaceutical industries on them (Pourmortazavi & Hajmirsadeghi, 2007).

The antioxidant activity of essential oils is one of the biological properties of great interest because they may preserve foods from the toxic effects of oxidants (Maestri *et al.*, 2006). Because essential oils have the capability of scavenging free radicals, this may play an important role in some disease prevention such as brain dysfunction, cancer, heart disease and immune system decline, which usually results from cellular damage caused by free radicals. (Aruoma, 1998; Kamatou & Viljoen, 2010; Miguel, 2010)

Mangifera indica is a member of the Anacardiaceae family which is native to South Asia but now widely cultivated in tropical regions (Shah *et al.*, 2010). Previous works have demonstrated that the plant possesses diverse therapeutic properties, such as antioxidant, antiviral, antidiabetic, hypolipidemic, cardioprotective, analgesic, hypotensive, anti-inflammatory, antipyretic, antispasmodic, anti-resorptive (bone), anthelmintic, antidiarrheal, antiallergic, gastroprotective,

hepatoprotective, and immunomodulatory activities, along with benefits in managing intestinal disorders (Núñez-Sellés *et al.*, 2012; Mohan *et al.*, 2013; Adeneye *et al.*, 2015; Khandare, 2016; Khan *et al.*, 2017; Quintana *et al.*, 2021; Duarte *et al.*, 2025).

Mango tree bark, which contains mangiferin with notable astringent properties, has traditionally been used for treating ailments such as rheumatism, diphtheria, lung cervical, breast, brain, and prostate cancers as well as leukemia (Amran *et al.*, 2013; Irshad *et al.*, 2024). Mango tree parts (unripe fruits, bark, stems, leaves) show antibiotic activity. Leaf decoctions are used to treat diarrhea, fever, respiratory issues, diabetes, and hypertension. Oil from the bark serves as a traditional remedy for sore throats and infections (Chetan *et al.*, 2014; Ellong *et al.*, 2015). Phytochemical studies of *Mangifera indica* leaves reveal glycosides, flavonoids, saponins, tannins, and alkaloids, but no steroids (Auwal *et al.*, 2024). Other key phytochemicals from mango include; urushiols, carotenoids, phenolic acids, benzophenones, kaempferol, catechins and terpenes such as α -pinene and myrcene (Pino *et al.*, 2005; Džamic *et al.*, 2010; Khan *et al.*, 2017; Kumar *et al.*, 2021; Jawed *et al.*, 2023).

Jatropha curcas commonly called 'ewe lapa' in southwestern Nigeria is recognized for its medicinal value and it belongs to the Euphorbiaceae family (Makkar & Becker, 2009; Gudeta, 2016; Huang *et al.*, 2020) attributed to various bioactive compounds. Its leaves contain apigenin, vitexin, and isovitexin, which help alleviate muscular pain (Agbogidi and Ekeke, 2011), while oil from its seeds is used to treat skin rashes and infections (Okoli *et al.*, 2007). The kernel oil, rich in linoleic acid, is noted for skincare applications (Shetty *et al.*, 2006). In addition, the plant's sap is used to treat ulcers

and sores, and its roots have multiple traditional uses, ranging from snakebite antidotes to treatments for various ailments including bleeding gums and scabies (Gudeta, 2016; Jongschaap *et al.*, 2007; Oliver-Beaver, 2006; Aiyelaagbe *et al.*, 2007). *J. curcas* shows a wide spectrum of biological activities such as antifungal, anti-inflammatory activity and antioxidant effects (Patil *et al.*, 2011; Prasad *et al.*, 2012; Adeosun *et al.*, 2017; Ahmed *et al.*, 2020; Solesi *et al.*, 2020; Bastos *et al.*, 2021; Saleh *et al.*, 2023). Phytochemical studies reveal that it contains significant amounts of saponins, glycosides, tannins, alkaloids, flavonoids, phenols, and other compounds in varying levels, underscoring its relevance in both traditional and modern medicine (Islam *et al.*, 2011; Karamanoli *et al.*, 2011; Sharma *et al.*, 2012; Qasim *et al.*, 2020; Zengin *et al.*, 2021; Jumare *et al.*, 2023; Oyetayo & Temenu, 2025). As part of continuation on our ongoing research on essential oils (Olubomihin *et al.*, 2024; Ogunmoye *et al.*, 2026), the present study investigates the antioxidant activity using the DPPH assay method for the essential oils extracted from the leaves of *Mangifera indica* and *Jatropha curcas*.

MATERIALS AND METHODS

Plant Materials

Fresh leaves of *M. indica* and *J. curcas* were obtained from trees within Olabisi Onabanjo University, Ago Iwoye, Ogun State, Nigeria. The leaves were identified and verified by Mr. A. O. Adeyemo at the Forestry Research Institute of Nigeria (FRIN), Ibadan, where voucher specimens (FHI-110463 and FHI-110897) were deposited in the herbarium. The leaves were then air-dried at room temperature and pulverized for subsequent analysis.

Extraction of Essential Oils

The pulverized and air-dried leaves of *Mangifera indica* (200 g) and *Jatropha curcas* (500 g) were extracted by hydrodistillation using an all-glass Clevenger-type apparatus for 4 h, following standard protocols (Ogundajo *et al.*, 2016;

Ogunwande *et al.*, 2019). The distilled essential oils were dried over anhydrous sodium sulphate (Na₂SO₄), transferred into sample bottles, and then stored in a refrigerator for subsequent analyses.

Estimation of DPPH Radical Scavenging Activity of *M. indica* and *J. curcas*

In each reaction tube, 1 mL of 0.3 mM DPPH solution in methanol was mixed with 3 mL of the extracts prepared at concentrations of 0.2 - 2.0 mg/mL. The mixtures were well shaken and kept in the dark for 30 min, after which absorbance was recorded at 517 nm against a blank. The DPPH radical scavenging activity of the essential oil was evaluated according to the method of Gülçin *et al.* (2012), with lower absorbance values indicating greater scavenging capacity. Each of the assays were carried out in triplicate, using ascorbic acid as the positive control at equivalent concentrations.

The % inhibition was calculated using the formula:

The percentage inhibition was calculated using the following formula:

$$AA = \frac{A_c - A_s}{A_c} \times 100$$

Where

A_c = the absorbance of control.

A_s = the absorbance of the test (sample).

AA = the antioxidant activity.

The standard ascorbic acid was also examined for its antioxidant activity using the same methodology for comparison.

RESULTS AND DISCUSSION

The essential oils extracted from the air-dried leaves of both plants had a strong aroma. *M. indica* oils appeared as a cloudy light yellow liquid while that of *J. curcas* was a cloudy whitish liquid. The yields from the hydrodistillation procedure were 0.83% and 0.41% (v/w) for *M. indica* and *J. curcas* respectively.

Table 1: Percentage Inhibition of *M. indica* and Ascorbic Acid

Concentration (mg/mL)	Absorbance at 517 nm			
	Ascorbic acid Absorbance (Mean ± SD)	<i>M. indica</i> Absorbance (Mean ± SD)	% Inhibition of Ascorbic acid	% Inhibition of <i>M. indica</i>
0.2	0.131 ± 0.003	0.352 ± 0.002	74.44	51.89
0.4	0.112 ± 0.002	0.335 ± 0.001	79.12	54.21
0.6	0.093 ± 0.002	0.304 ± 0.001	83.87	58.45
0.8	0.079 ± 0.002	0.272 ± 0.002	87.54	62.14
2.0	0.060 ± 0.001	0.245 ± 0.003	91.76	66.65

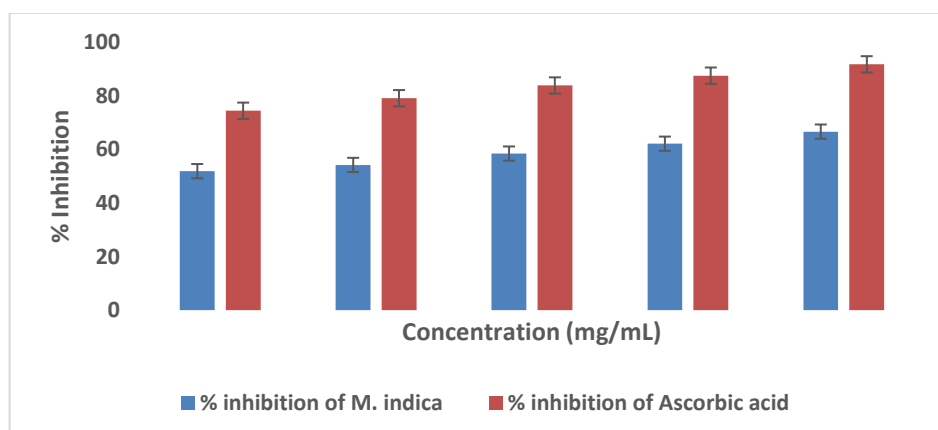
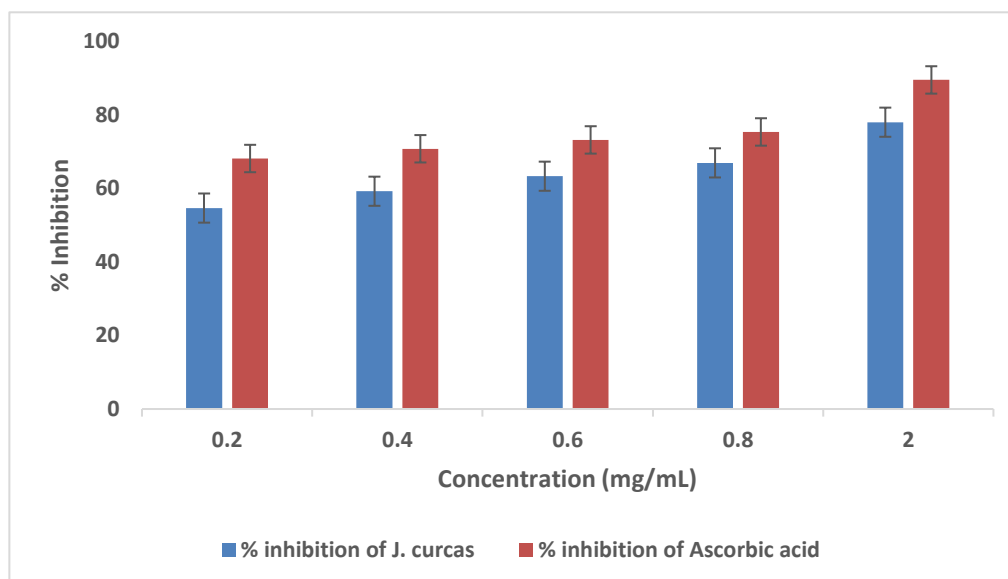


Figure 1: DPPH Radicals Scavenging Activities of *M. indica* and Ascorbic Acid

Table 2: Percentage Inhibition and the Mean Deviation of *J. curcas* and Ascorbic Acid

Concentration (mg/mL)	Absorbance at 517 nm			
	Ascorbic acid Absorbance (Mean $\pm$ SD)	<i>J. curcas</i> Absorbance (Mean $\pm$ SD)	% Inhibition of Ascorbic acid	% Inhibition of <i>J. curcas</i>
0.2	0.132 $\pm$ 0.005	0.186 $\pm$ 0.003	68.19	54.70
0.4	0.121 $\pm$ 0.003	0.167 $\pm$ 0.002	70.84	59.28
0.6	0.111 $\pm$ 0.002	0.150 $\pm$ 0.002	73.25	63.37
0.8	0.102 $\pm$ 0.002	0.135 $\pm$ 0.002	75.42	67.00
2.0	0.064 $\pm$ 0.001	0.090 $\pm$ 0.001	84.58	78.07

**Figure 2: DPPH Radicals Scavenging Activities of *J. curcas* and Ascorbic Acid**

The antioxidant potential of *M. indica* was evaluated using the DPPH free radical scavenging assay and the results are presented in Table 1 and Figure 1. The DPPH radical scavenging activity increased in a concentration-dependent manner for both the standard and the essential oil. Ascorbic acid exhibited markedly stronger antioxidant activity across all concentrations, with percentage inhibition increasing from 74.44% at 0.2 mg/mL to 91.76% at 2.0 mg/mL. Similarly, the *Mangifera indica* extract demonstrated progressive radical scavenging activity, with inhibition increasing from 51.89% to 66.65% over the same concentration range. The corresponding decrease in absorbance values with increasing concentration further confirms enhanced DPPH radical reduction. Although the antioxidant capacity of the *M. indica* extract was moderate compared to that of ascorbic acid. Its consistent dose-dependent response in this study is in tandem with earlier findings on antioxidant (Dhital, 2017; Maharaj *et al.*, 2022; Auwal *et al.*, 2024). Other studies have also reported the radical scavenging potential of mango leaf extracts using petroleum benzene, acetone, and methanol fractions via the DPPH assay (Ghosh *et al.*, 2020; Majumder *et al.*, 2022). The antioxidant properties of mango leaves are largely attributed to their phenolic and flavonoid constituents (Ali *et al.*, 2020). Also, this indicates their ability to donate hydrogen atoms or electrons to neutralize free radicals. The results of this experiment exhibited marked DPPH free radical scavenging activity in a concentration dependent manner.

In addition, the examined *J. curcas* essential oil was also able to reduce the stable, purple-colored radical DPPH into yellow-colored DPPH-H. As shown in Table 2 and Figure 2, inhibition values ranged from 54.70% - 78.07% across concentrations of 0.2 - 2.0 mg/mL. From the results, the oil

prepared at various concentrations shows different percentage inhibition which are; 0.2 mg/mL (54.70%), 0.4 mg/mL (59.28%), 0.6 mg/mL (63.37%), 0.8 mg/mL (67.00%) and 2.0 mg/mL (78.07%). The lowest inhibition is 54.70% which was observed at concentration 0.2 mg/mL, which implies that at the lowest tested concentration, the sample already inhibits 54.7% of the free radical, because it has crossed the 50% halfway mark. The highest inhibition is 78.07% which was observed at concentration 2.0 mg/mL, and in DPPH assay, breaking the 70 - 75% threshold classifies the sample's maximum capacity as excellent. This result exhibited marked DPPH free radical scavenging activity which are concentration dependent. It has been reported that extracts obtained from the leaf and stem bark of *J. curcas* and *J. gossypifolia* exhibited concentration-dependent antioxidant activity using Hydroxyl ion Scavenging and ferric ion chelating activity which agrees with the current study (Oyetayo & Temenu 2025). Other *Jathropa* species like *J. gossypifolia*, and *J. tanjorensis* have also been reported to exhibit antioxidant activity that are concentration dependent (Okoh *et al.*, 2016; Oluwakayode *et al.*, 2023). Ascorbic acid consistently exhibits higher antioxidant activity than *J. curcas*, as expected for positive controls. The extract reaches approximately 78% inhibition at 2.0 mg/mL, indicating a strong antioxidant profile. It was also observed that the absorbance decreases steadily with increasing concentration while the % inhibition increases proportionally with concentration. The antioxidant activities of the essential oils from these plants may be linked to their hydrogen-bonding ability (Ademola *et al.*, 2014; Atewolara-Odule *et al.*, 2019). Phenolic and flavonoid compounds previously reported as phytochemicals from these plants, play a major role in

neutralizing free radicals and enhancing antioxidant effects due to their structural capacity to donate hydrogen atoms (Ang et al., 2015; Kumar et al., 2021; Lenucci et al., 2022; Ogunmoye et al., 2023; Oyedayo and Temenu, 2025). The moderate antioxidant activity observed for *M. indica* and *J. curcas* in this study is consistent with earlier reports (Rathore et al., 2013; Kumar et al., 2014; Moghaddam et al., 2017; Dhital, 2017; Babahmad, 2018).

CONCLUSION

The essential oils of *Mangifera indica* and *Jatropha curcas* demonstrated moderate antioxidant activity relative to ascorbic acid, the reference standard. This activity is largely linked to their phenolic and flavonoid constituents, highlighting their potential use as natural antioxidants in food preservation, pharmaceuticals, and cosmetics. Additional antioxidant assays are recommended to further substantiate the DPPH-based results.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflict of interest.

REFERENCES

- Ademola, O. A., Oluwafemi, O. O, Nicole, L. B. (2014). *In vitro* study of the antioxidant potentials of the leaves and fruits of *Nauclea latifolia*. Hindawi Publishing Corporation, *Scientific World Journal*, 8:1-6. <https://doi.org/10.1155/2014/437081>
- Adeneye, A. A., Awodele, O., Aiyoola, S. A. and Benebo, A. S. (2015). Modulatory potentials of the aqueous stem bark extract of *Mangifera indica* on carbon tetrachloride-induced hepatotoxicity in rats. *J. Tradit Complement Med.* 5(2):106-15. <https://doi.org/10.4103/2227-9067.156949>
- Adeosun, T. E., Ogunwande, I. A., Avoseh, O. N., Raji, I. P. and Lawal, O. A. (2017). Composition and Anti-inflammatory Activity of Essential Oil of *Jatropha curcas*, 12(3): 439-440. <https://doi.org/10.1177/1934578X1701200333>
- Agbogidi, O. M. and Ekeke, E. A. (2011). *Jatropha curcas* Linn: An important but neglected plant species in Nigeria. *Journal of Biological and Chemical Research*, 8(1):52-62. <https://www.jbcr.in>
- Ahmed, A. M., Ibrahim, M. M., El-said, M. A. A. E., Elsadek, B. E. (2020). Anti-Cancer Activity of Curcumin and Latex Isolated from *Jatropha* Plant (*Jatropha Curcas* L.). *Journal of Agricultural Chemistry and Biotechnology*, 11:339-344. <https://doi.org/10.21608/jacb.2020.128902>
- Aiyelaagbe, O. O., Adeyeni, B. A., Fatunsin, O. F and Arimah, B. D. (2007). *In vitro* antimicrobial activity and Phytochemical analysis of *Jatropha curcas* roots. *Int. J. Pharmacol.*, 3(1):106-110. <https://doi.org/10.3923/ijp.2007.106.110>
- Ali, B. A., Alfa, A. A., Tijani, K. B., Idris, E. T., Unoyiza, U.S. and Junaidu, Y. (2020). Nutritional Health Benefits and

Bioactive Compounds of *M. indica* L (Mango) Leaves Methanolic Extracts. *Asian Plant Res J.*, 6:41-51. <https://doi.org/10.9734/APRJ/2020/v6i230126>

Amran, M. S., Sultan, M. Z., Rahman, A., Rashid, M. A. (2013). Antidiabetic activity of compounds isolated from the kernel of *Mangifera indica* in alloxan induced diabetic rats. *Dhaka Univ J Pharm Sci.*, 12(1):77-81. <https://doi.org/10.3329/dujps.v12i1.16304>

Ang, L. Z. P., Hashim, R., Sulaiman, S. F., Coulibaly, A. Y., Sulaiman, O., Kawamura, F., and Salleh, K. M. (2015). *In vitro* antioxidant and antidiabetic activities of Gluta torquata. *Industrial Crops and Products*, 76:755-760. <https://doi.org/10.1016/j.indcrop.2015.07.050>

Aruoma, O. I. (1998). Free radicals, oxidative stress, and antioxidants in human health and disease. *J. Am. Oil Chem. Soc.*, 75:199-212. <https://doi.org/10.1007/s11746-998-0032-9>

Atewolara-Odule, O. C., Olubomehin, O. O., Adesetan, T. O., Yussuf, S. T., Ogunmoye, A. O. and Towolawi, O. R. (2019). Isolation and Characterization of Essential Oil of *Nauclea latifolia* Leaves and its Antioxidant and Antimicrobial Activities. *International Journal of Multi-Disciplinary in Education Research and Development (IJMERD)*, 1(1):24-31.

Auwal, A., Shagal, M. H. and Milam, C. (2024). Isolation and Characterisation of Essential oils of Mango (*M. indica*) Leave, *Biology, Medicine, & Natural Product Chemistry*, 13(1):1-6. <https://doi.org/10.1111/bcn.2024.13>

Babahmad, R. A., Aghraz, A., Boutafda, A., Papazoglou, E. G., Tarantilis, P. A., Kanakis, C., Hafidi, M., Ouhdouch, Y., Outzourhit, A. and Ouhammou, A. (2018). Chemical composition of essential oil of *Jatropha curcas* L. leaves and its antioxidant and antimicrobial activities, *Industrial Crops and Products*, 121:405-410, <https://doi.org/10.1016/j.indcrop.2018.05.030>

Bastos, E. M. S., da Silva, A. B., Coelho, P. L. C., Borges, J. M. P., da Silva, V. D. A., da Cunha, V. H. M., Costa, S. L. (2021). Anti-inflammatory activity of *Jatropha curcas* L. in brain glial cells primary cultures. *Journal of Ethnopharmacology*, 264:1-12. <https://doi.org/10.1016/j.jep.2020.113152>

Chetan, S., Kulkarni, A. R., Mannasaheb, B. A, Gajare, R. (2014). Immunostimulant phytoconstituents from *Mangifera indica* L. bark oil. *J. Phytopharmacol*, 3(2):139-48. <https://doi.org/10.31254/PHYTO.2014.3210>

Dhital, K. S. (2017). Phytochemical screening of and antioxidant activities of *Mangifera indica* leaves grown in temperate region of the Nepal. *Journal of Pharmacognosy and Phytochemistry*, 6(3):205-209.

Duarte, L. G., Laurindo, L. F., Bishayee, A., Casarcia, N., Detregiach, C. R. P., Otoboni, A. M. M., de Alvares Goulart, R., Catharin, V. M. C. S., Baldi, E., Jr, Catharin, V. C. S., Guiguer, E. L., Sanches Silva, A., Barbalho, S. M. and Bishayee, A. (2025). Mango (*Mangifera indica* L.) By-products in Food Processing and Health Promotion. *Nutr*

- Rev., 83(7):1290-1313. <https://doi.org/10.1093/nutrit/nuae214>
- Džamic, A. M., Marin, P. D., Gbolade, A. A., Ristic, M. S. (2010). Chemical Composition of *Mangifera indica* Essential Oil From Nigeria. *Journal of Essential Oil Research*, 22:123-125. <https://doi.org/10.1080/10412905.2010.9700279>
- Ellong, E. , Adenet, S. and Rochefort, K. (2015). Physicochemical, Nutritional, Organoleptic Characteristics and Food Applications of Four Mango (*Mangifera indica*) Varieties. *Food and Nutrition Sciences*, 6:242-253. <https://doi.org/10.4236/fns.2015.62025>
- Ghosh, A., Majumder, S., Saha, S., Bhattacharya, M. (2020). Characterization of non polar and polar solvent extracts from some tea plantation shade tree leaves with special reference to antioxidant and antibacterial activities. *Res Plant Biol.*, 10:15-21. <https://doi.org/10.25081/ripb.2020.v10.6235>
- Gudeta, T. B. (2016). Chemical Composition, Bio-Diesel Potential and Uses of *Jatropha curcas* L. (Euphorbiaceae). *American Journal of Agriculture and Forestry*, 4(2):35-48. <https://doi.org/10.11648/j.ajaf.21060402.15>
- Gülçin, I., Elmastas, M. and Aboul-Enein, H. Y. (2012). Antioxidant activity of clove oil - A powerful antioxidant source. *Arabian Journal of Chemistry*, 5:489-499. <https://doi.org/10.1016/j.arabjc.2010.09.016>
- Huang, S. L., Wang, W. H., Zhong, X. Y., Lin, C. T., Lin, W. S., Chang, M. Y., & Lin, Y. S. (2020). Antioxidant Properties of *Jatropha curcas* L. Seed Shell and Kernel Extracts. *Applied Sciences*, 10(9):3279. <https://doi.org/10.3390/app10093279>
- Irshad, N., Naeem, H., Shahbaz, M., Imran, M., Mujtaba, A., Hussain, M., Al Abdulmonem, W., Alsagaby, S. A., Yehuala, T. F., Abdelgawad, M. A., Ghoneim, M. M., Mostafa, E. M., Selim, S., & Al Jaouni, S. K. (2024). Mangiferin: An effective agent against human malignancies. *Food Science & Nutrition*, 12:7137–7157. <https://doi.org/10.1002/fns3.4434>
- Islam, A. K. M. A., Yaakob, Z. and Anuar, N. (2011). *Jatropha*: A multipurpose plant with considerable potential for the tropics, *Scientific Research and Essays*, 6(13):2597-2605. <https://doi.org/10.5897/SRE10.611>
- Jawed, H., Azim, M. K., & Saeed, S. (2023). An Overview of Secondary Metabolites of Mango (*Mangifera Indica*) Fruit . *Pakistan Journal of Biochemistry and Molecular Biology*, 55(4):188–204. <https://www.pjmb.com/index.php/pjmb/article/view/83>
- Jongschaap, R. E., Corre, W. J., Bindraban, P. S. and Brandenburg, W. A. (2007). Claims and facts on *Jatropha curcas* L. *Plant Research International*, 7:20-28. <https://research.wur.nl/en/publications/claims-and-facts-on-jatropha-curcas-l-global-jatropha-curcas-eval/>
- Jumare, F. I., Maigandi, Z. R., Ibrahim, S. G., Zayyan, Y. M. and Musa M. I. (2023). Phytochemical and Proximate Analysis of *Jatropha curcas* Lam Leaves. *Tropical Journal of Science and Technology*, 4(1):46-51. <https://doi.org/10.47524/tjst.v4i1.47>
- Kamatou, G. P. P., Viljoen, A. M. (2010). A review of the application and pharmacological properties of α -bisabolol and α -bisabolol-rich oils. *J. Am. Oil Chem. Soc.* 87:1-7. <https://doi.org/10.1007/s11746-009-1483-3>
- Karamanoli, K., Bouligaraki, P., Constantinidou, H. I. and Lindow, S. E. (2011). Poly phenolic compounds on leaves limit iron availability and affect growth of epiphytic bacteria. *Ann. Appl. Biol.*, 159:99-108. <https://doi.org/10.1111/j.1474-2632.2011.00743.x>
- Khan, N., Khushdar, M., Ahmad, N., Hasan, N., Khan, Z., Idris, S., Ahmad, A. and Zishan, M. (2017). Nutritional importance and pharmacological activity of *Mangifera indica*. *World Journal of Pharmacy and Pharmaceutical Sciences*, 6(05):258-273. <https://doi.org/10.53893/wjpps.v6i05.258>
- Khandare, M. S. (2016). *Mangifera indica* (*Mangifera indica* Linn) A medicinal and holy plant. *Journal of Medicinal Plants Studies*, 4(4):44-46. www.plantsjournal.com
- Kumar, A., Rao, S. S. P., Anjaneyulu, P. S. R., Anjaneyulu, K. S. R. and Anjaneyulu, P. S. R. (2014). Evaluation of antioxidant and antibacterial properties of *Jatropha curcas* leaves. *International Journal of Medicinal Chemistry*, Article ID 349812.
- Kumar, M., Saurabh, V., Tomar, M., Hasan, M., Changan, S., Sasi, M., Maheshwari, C., Prajapati, U., Singh, S., Prajapat, R. K., Dhumal, S., Punia, S., Amarowicz, R. and Mekhemar, M. (2021). Mango (*Mangifera indica* L.) Leaves: Nutritional Composition, Phytochemical Profile, and Health-Promoting Bioactivities. *Antioxidants* (Basel), 16; 10(2):299. <https://doi.org/10.3390/antiox10020299>
- Kung, L. Jr., P. Williams, R. J. Schmidt, and W. Hu. (2008). A blend of essential plant oils used as an additive to alter silage fermentation or used as a feed additive for lactating dairy cows. *J. Dairy Sci.*, 91:4793-4800. <https://doi.org/10.3168/jds.2008-1402>
- Lenucci, M. S., Tornese, R., Mita, G. and Durante, M. (2022). Bioactive Compounds and Antioxidant Activities in Different Fractions of Mango Fruits (*Mangifera indica* L., Cultivar Tommy Atkins and Keitt). *Antioxidants*, 11:484. <https://doi.org/10.3390/antiox11030484>
- Maestri, D. M., Nepote, V., Lamarque, A. L. and Zygodlo, J. A. (2006). Natural products as antioxidants. In F. Imperato (Ed.), *Phytochemistry: Advances in Research* (pp. 105-135). Research Signopost: Kerala, India. <https://www.scirp.org/reference/referencespapers?referenceid=1678099>
- Maharaj, A., Naidoo, Y., Dewir, Y. H. and Rihan, H. (2022). Phytochemical Screening, and Antibacterial and Antioxidant Activities of *Mangifera indica* L. Leaves. *Horticulturae* 8:909. <https://doi.org/10.3390/horticulturae8100909>
- Majumder, S., Saha, S., Ghosh, A., Chakraborty, S., Acharyya, S., Sarkar, S. and Bhattacharya, M. (2022). Comparative in vitro biological characterization of black and

- green tea infusions fermented with brewer's yeast and SCOBY with special emphasis on antioxidant activity. *International Journal on Nutraceuticals, Functional Foods and Novel Foods*, 1:357-369. <https://doi.org/10.17470/NF-022-0045>
- Makkar, H. P. S and Becker, K. (2009). Nutritional studies on rats and fish (carp *Cyprinus carpio*) fed diets containing unheated and heated *Jatropha curcas* meal of a non-toxic provenance. *Plant Food Hum Nutr.*, 53:183-192. <https://doi.org/10.1023/A:1008087627894>
- Miguel, M. G. (2010). Antioxidant and Anti-Inflammatory Activities of Essential Oils: A Short Review. *Molecules* 15:9252-9287; <https://doi.org/10.3390/molecules15129252>
- Moghaddam, M. M., Ebrahimzadeh, M. R., Farimani, S. R, Nabavi, S. R. and Nabavi, S. M. (2017). Antioxidant activity, total phenolic and flavonoid content of *Mangifera indica* leaf extracts. *Avicenna Journal of Phytomedicine*, 7(1):41-46. <https://ajp.mums.ac.ir/>
- Mohan, C. G., Deepak, M., Viswanatha, G. L., Savinay, G., Hanumantharaju, V., Rajendra, C. E. and Halemani, P. D. (2013). Anti-oxidant and anti-inflammatory activity of leaf extracts and fractions of *Mangifera indica*. *Asian Pacific Journal of Tropical Medicine*, 6(4):311-314, [https://doi.org/10.1016/S1995-7645\(13\)60062-0](https://doi.org/10.1016/S1995-7645(13)60062-0).
- Narayan, G. R., Kartik, V., Manoj, P., Singh, P. S., and Alka, G. (2010). Antibacterial activities of ethanolic extracts of plants used in folk medicine. *International journal of research in ayurveda and pharmacy*, 1:529-535. www.ijrap.net
- Núñez-Sellés, A. J., Agüero, J. A. and Paz, L. N. (2021). GC-MS analysis of mango stem bark extracts (*Mangifera indica* L.), Haden variety. Possible contribution of volatile compounds to its health effects. *Open Chemistry*, 19:27-38. <https://doi.org/10.1515/chem-2021-0192>
- Olubomeshin, O. O., Odubote, E. O., Ogunmoye, A. O., Atewolara-Odudu, O. C., Adesetan, T. O., Ogunjimi, J. K., Ogundare, S. A., Yussuf, S. T., and Ibikunle, A. A. (2024). Chemical Constituents, Antimicrobial and Antioxidant activities of Essential Oils from Fresh and Air-Dried leaves of *Icacina trichantha* (Oliv.), *Scientia Africana*, 23(3):25-36.
- Ogundajo, A. L., Nnaemeka, C. O., Olawunmi, R. O. and Ogunwande, I. A. (2016). Chemical Constituents of Essential oil of *Ethretia cymosa* Thonn. *British Journal of Applied science and Technology*, 14(4):1-6. <https://doi.org/10.12816/0040152>
- Ogunmoye, A. O., Ibikunle, A. A., Sanyaolu, N. O., Ogundare, S. A., Yussuf, S. T., Hashimi, M. A. and Onajobi, I. B. (2023). Essential Oil Compositions and Antioxidant Activity of the Fresh Leaves of *Talinum triangulare* (Jacq.) Willd From Nigeria. *Scientia Africana*, 22(2): 125-134. <https://doi.org/10.4314/sa.v22i2.13>
- Ogunmoye, A. O., Adams, K. A., Rowaiye, G., Olubomeshin, O. O., Atewolara-Odudu, O. C. and Ogunlade E. J. (2026). Volatile Constituents from the Air-dried leaves of *Mangifera indica* LINN. *International Journal of Organic agricultural Research & Development*, 21(1):141-146.
- Ogunwande, I. A., Ascrizzi, R. and Guido, F. (2019). Essential oil composition of *Terminalia ivorensis* A. Chev. flowers from Northern Nigeria. *Trends Phytochem. Res.* 3(1):77-82
- Okoh, S. O., Iweriebor, B. C., Okoh, O. O., Nwodo, U. U. and Okoh, A. I. (2016). Antibacterial and Antioxidant Properties of the Leaves and Stem Essential Oils of *Jatropha gossypifolia* L. *Biomed Res Int.* 9392716. <https://doi.org/10.1155/2016/9392716>
- Okoli, R. I., Aigbe, O., Ohafu-Obode, J. O. and Mensah, J. K. (2007). Medicinal herbs used for managing some common ailments among Esan people Edo State, Nigeria. *Pakistan Journal of Nutrition*, 6(5):470-490. <https://doi.org/10.3923/pjn.2007.490.496>
- Oliver-Beaver, B. (2006). Medicinal plants in tropical West Africa. Cambridge University Press. London. <https://doi.org/10.2307/2806966>
- Oluwakayode, O., Ejike Onwudiegwu O., Michael, G. I., Emeka Emea, O. and Joel, O. O. (2023). Essential oil Composition, Antioxidant and Antibacterial Activities of *Jatropha tanjorensis* (Euphorbiaceae). *Ann Rev Resear.* 9(1):555751. <https://doi.org/10.19080/ARR.2023.09.555751>
- Oyetayo, V. O. and Temenu, O. E. (2025). Comparative Study on The Phytochemical, Antistaphylococcal and Antioxidant Properties of the Stem Bark of *Jatropha curcas* L. and *Jatropha gossypifolia* L, *Sultan Qaboos University Journal For Science*, 28(1):17-24. <https://doi.org/10.53539/squjs>
- Panhekar, D. and Sawant, T. P. (2019). Phytochemical Analysis of Methanolic Extract of some Medicinal Plants. *Journal in Science, Agriculture & Engineering*, 9(29):161-164. ISSN 2277-7601, <https://www.ycjournal.net>
- Patil, R. N., Patil, R. Y., Ahirwar, B. and Ahirwar, D. (2011). Evaluation of antidiabetic and related actions of some Indian medicinal plants in diabetic rats. *Asian Pac J Trop Med.*, 4(1): 20-3. [https://doi.org/10.1016/S1995-7645\(11\)60025-4](https://doi.org/10.1016/S1995-7645(11)60025-4)
- Pino, J. A., Mesa, J., Munoz, Y., Marti, M. P. and Marbot, R. (2005). Volatile components from Mango (*Mangifera indica* L.) cultivars. *J. Agric Food Chem.*, 53:2213-2223. <https://doi.org/10.1021/jf0402633>
- Pourmortazavi, S. M. and Hajimirsadeghi, S. S. (2007). Supercritical fluid extraction in plant essential and volatile oil analysis. *J. Chromatogr.* 1163:2-24. <https://doi.org/10.1016/j.chroma.2007.06.021>
- Prasad, D. M. R., Izam, A. and Maksudur Rahman Khan, M. D. (2012). *Jatropha curcas*: Plant of medical benefits. *Journal of Medicinal Plants Research*, 6(14):2691-2699. <https://doi.org/10.5897/JMPR10.977>
- Qasim, M., Islam, W., Ashraf, H.J., Ali, I. and Wang, L. (2020). Saponins in Insect Pest Control. In: Merillon, JM., Ramawat, K. (eds) Co-Evolution of Secondary Metabolites. Reference Series in Phytochemistry. Springer, Cham. https://doi.org/10.1007/978-3-319-76887-8_39-1
- Quintana, S. E., Salas, S., García-Zapateiro, L. A. (2021). Bioactive compounds of mango (*Mangifera indica*): a review

- of extraction technologies and chemical constituents. *J Sci Food Agric.*, 101(15):6186-6192. <https://doi.org/10.1002/jsfa.11455>
- Rathore, H. S., Nema, R. N., Saxena, S. K. and Singh, S. K. (2013). *In vitro* antioxidant activity of *Jatropha curcas* L. seed oil and its potential application in the food industry. *Antioxidants*, 2(3):310-316. <https://doi.org/10.3390/antioxidants2030310>
- Rubiolo, P., Sgorbini, B., Liberto, E., Cordero, C. and Bicchi, C. (2010). Essential oils and volatiles: sample preparation and analysis. A review. *Flavour Fragr. J.*, 25:282-290. <https://doi.org/10.1002/ffj.1984>
- Saleh, Z. M., Abdel Azeiz, A. Z., Mehany, A. B. M. and El-Swaify, Z. A. S. (2023). Anticancer and Antimicrobial Activity of *Jatropha*'s Leaves Extracts. *Egypt. J. Bot.*, 63(2):621-634. <https://ejbo.journals.ekb.eg/>
- Shah, K. A., Patel, M. B., Patel, R. J. and Parmar, P. K. (2010). *Mangifera indica* (*Mangifera indica*), *Phcog Rev.*, 4:42-48. <https://doi.org/10.4103/0973-7847.65325>
- Sharma, A. K., Gangwar, M., Tilak, R., Nath, G., Sinha, A. S. K., Tripathi, Y. B. and Kumar, D. (2012). Comparative *in vitro* Antimicrobial and Phytochemical Evaluation of Methanolic Extract of Root, Stem and Leaf of *Jatropha curcas* Linn. *Pharmacognosy Journal*, 4(30):34-40. <https://doi.org/10.5530/PJ.2012.30.7>
- Shetty, S., Udupa, S. L., Udupa, A. L. and Vollala, V. R. (2006). Wound healing activity of bark extract of *Jatropha curcas* L. in albino rats. *Saudi Med. J.* 27(10):1473-1476. PMID: 17013466. <https://pubmed.ncbi.nlm.nih.gov/17013466/>
- Solesi, O. A., Adesina, F. C., Adebayo-Tayo, B. C. and Abiodun, A. S. (2020). Gas chromatography/mass spectrometry (GC-MS) analysis of *Jatropha curcas* latex and its antimicrobial activity on clinical isolates. *World Journal of Advanced Research and Reviews*, 8:12-18. <https://doi.org/10.52284/wjarr.8.1.230>
- Zengin, G., Mahomoodally, M. F., Sinan, K. I., Ak, G., Etienne, O. K., Sharmeen, J. B., Brunetti, L., Leone, S., Di Simone, S. C., Recinella, L., Chiavaroli, A., Menghini, L., Orlando, G., Jekő, J., Cziáky, Z. and Ferrante, C. (2021). Chemical Composition and Biological Properties of Two *Jatropha* Species: Different Parts and Different Extraction Methods. *Antioxidants*, 10(5):792. <https://doi.org/10.3390/antiox10050792>

