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Effect of different solvent on phytochemical content of *Moringa oleifera* L. leaves.

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Abstract

Moringa oleifera L., commonly known as the drumstick tree, is widely recognized for its remarkable nutritional value and medicinal properties. The biological activities of M. oleifera leaves are largely attributed to the presence of secondary metabolites such as phenolic compounds, flavonoids, tannins, alkaloids, saponins, terpenoids, and glycosides the present study aims to investigate the effect of different extraction solvents on the phytochemical content of Moringa oleifera L. leaves. Qualitative detection of Alkaloids, Flavonoids Glycosides, Lignin, Phenols, Quions, Saponins, Steroids, Tannins Terpenoids and Quantitative analysis of Alkaloids, Flavonoids, Phenols, Saponins and Tannins were performed with different solvent i.e. Aqueous, Ethanol, Methanol, Diethyl ether and acetone percentage crud yield was also evaluated with above mentioned solvents and it was found that Ethanol was found most potent solvent to extract phytochemical.

Keywords: *Moringa oleifera*; Leaves Powder; Phytochemical; Solvent

1. Introduction

Moringa oleifera L., known as the drumstick tree, possesses significant nutritional value along with medicinal properties. Native to the Indian subcontinent, this species now grows across tropical and subtropical areas because of its biological resilience plus varied utility (Nobosse and et al 2018). Each plant portion holds economic and therapeutic status, yet leaves rank as the most valuable due to elevated concentrations of vitamins, minerals, proteins, and a broad range of bioactive phytochemicals. Traditionally, M. oleifera leaves served to manage diverse health issues, specifically inflammation, diabetes, high blood pressure, microbial infections, and malnutrition. Modern academic studies verify these classic applications, framing the plant as a top source of natural antioxidants and therapeutic elements (Padayachee and Baijnath 2020).

Biological activities found in M. oleifera leaves correlate with secondary metabolites such as phenolic compounds, flavonoids, tannins, alkaloids, saponins, terpenoids, and glycosides (Liga and et al 2025). Such phytochemicals maintain antioxidant, antimicrobial, anti-inflammatory, antidiabetic, and anticancer properties, marking M. oleifera as an essential specimen for pharmaceutical, nutraceutical, and food applications. During recent years, mounting consumer preference for natural products further prompted studies centered on identifying precise methods for extracting these specific valuable compounds from raw plant materials. This area remains central to science focused on plant-based wellness and health science sectors worldwide because consumer groups require better natural supplements today.

The polarity of the solvent has a significant impact on how well bioactive chemicals are extracted. While less polar solvents may preferentially extract terpenoids, sterols, lipids, and other non-polar elements, polar solvents like methanol, ethanol, and water are typically more successful for extracting phenolic chemicals and flavonoids (Azzahra, et al., 2025). As a result, the phytochemical content and biological activity of extracts made with various solvents frequently show significant variance. The creation of herbal medicines and nutraceutical products, as well as the

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selection of appropriate extraction technologies for phytochemical research, depend on an understanding of these distinctions.

The current study is to examine the impact of various extraction solvents on the phytochemical content of *Moringa oleifera* L. leaves in light of these factors. By comparing extracts prepared using solvents with different polarities, this study seeks to determine the most suitable solvent for maximizing the recovery of bioactive phytochemicals. The findings are expected to contribute to the optimization of extraction procedures and support the utilization of M. oleifera leaves in pharmaceutical, nutraceutical, and food-based applications.

2. Materials and Methods

2.1. Collection of plant Material

Plant specimen was identified and authenticated with the help of Flora of Marathwada (1998) in Department of Botany, Ghulam Nabi Azad College Barshitakli, Dist. Akola. Fresh Leaves of fully grown *Moringa oleifera* L. was collected form farm situated in Barshitakli having geological position 20.588199, 77.07173. Discolored, wilted and damaged leaves were sorted out and discarded. Only full green healthy leaves were washed gently to remove dust particles. Such leaves were shade dried for 7 days at room temperature then grinded in Bosch grinder to make fine powder of leaf. This powder then stored and used for present study.

All chemicals, reagents and solvents of analytical grade were purchased from Swastik chemicals Akola (Maharashtra)

2.2. Qualitative Phytochemical Analysis

Qualitative detection tests were carried out using standard colorimetric and precipitation methods. Alkaloids were detected by Dragendorff's Test in which 2-3 drops of Dragendorff's reagent were added in the 2 ml of extract it gives orange or reddish-brown precipitate Flavonoids were detected by Shinoda test while Glycosides were tested by Keller-Killani Test (Trease and Evans, 2009). Lignins were identified by Wiesner Testin which 1% Phloroglucinol solution and HCl were added to extract gives red coloration. Phenols were confirmed by Ferric Chloride Test while Quinones were determined by Foam test. Steroids and Terpenoids were tested by Salkowski test and Tannins were by Ferric Chloride Test (Harborne 1998, Trease and Evans 2009b).

2.3. Quantitative Phytochemical Analysis

Quantitative phytochemical analysis illustrates the distinct variation of phytochemical content in extract (Kokate and et al 2010).

2.4. Alkaloids

Extract was mixed with 10% acetic acid in ethanol and allowed to react for 4 hrs. filtrate was concentrated to one fourth using water bath. Concentrated ammonium hydroxide was added dropwise until complete ppt seen. Ppt was collected and washed with dilute ammonium hydroxide and dried at 60 °C (Harborne, 1973)

$$\% \text{ Alkaloids} = \frac{W2 - W1 x 100}{W}$$

2.5. Flavonoids (TFC)

Plant extract was mixed with methanol and 10% aluminums chloride, 1M potassium acetate and distilled water. Mixture was kept for half hour and absorbance was measured at 415 nm using UV-Visible spectrophotometer. TFC was calculated form quercetin calibration curve.

2.6. Phenol (TPC)

A 0.5 mL aliquot of extract was mixed with 2.5 mL of 10% Folin–Ciocalteu reagent. After 5 min, 2 mL of 7.5% sodium carbonate solution was added. The mixture was incubated in the dark for 30 min, and absorbance was recorded at 765 nm. Value was determined by gallic acid calibration curve.

2.7. Saponin

Saponins are extracted with aqueous ethanol, purified using diethyl ether and n-butanol, dried, and weighed gravimetrically. (Obadoni and Ochuko 2001)

Tannins: Tannins react with Folin–Denis reagent to produce a blue-colored complex that is measured spectrophotometrically.

2.8. Percentage Crude Yield

For determining the percentage crude yield Aryanti and *et al* (2025) method was followed. And the reading was expressed in percentage. It was a percentage ration between weight of the dried extract obtained after solvent evaporation and the initial dry weight of the powdered dry leaves. Procedure was followed separately for each solvent.

2.9. Statistical analysis

All the experiments were performed in triplicate and mean is considered as the reading, also standard deviation is calculated to deviation of readings form mean value (Mungikar, 2003)

3. Result and Discussion

Extraction is one of the most critical steps in phytochemical analysis because it directly influences the quantity and composition of bioactive compounds obtained from plant tissues. The efficiency of extraction depends on several factors, including the extraction method, temperature, duration, particle size, solvent-to-sample ratio, and particularly the type of solvent used. Since phytochemicals differ considerably in their chemical structures and polarities, no single solvent can efficiently extract all classes of compounds. Therefore, selecting an appropriate solvent is essential for maximizing the recovery of specific phytochemicals.

Tabel 1 illustrates Qualitative phytochemical detection in *Moringa oleifera* L. leaves. Alkaloids, Flavonoids, phenol, Quinone, saponin and Tannin were extracted in all solvents. Among lignin is only extracted by Diethyl ether. Steroid is not present in only Diethyl ether. Glycosides is absent in Diethyl ether while terpenoid is present in Aqueous, ethanol and methanol extract.

Table 1 Qualitative phytochemical detection of *Moringa oleifera* leaves in different solvents

Sr No.	Solvents	Aqueous	Acetone	Diethyl ether	Ethanol	Methanol
	Phytochemicals					
1	Alkaloid	+	+	+	+	+
2	Flavonoids	+	+	+	+	+
3	Glycosides	+	+	-	+	+
4	Lignin	-	-	+	-	-
5	Phenol	+	+	+	+	+
6	Quinones	+	+	+	+	+
7	Saponin	+	+	+	+	+
8	Steroid	+	+	-	+	+
9	Tannin	+	+	+	+	+
10	Terpenoid	+	-	-	+	+

Table 2 Quantitative Phytochemical analysis of *Moringa oleifera* leaves in different solvents

Sr No.	Solvents / Phytochemicals	Aqueous	Acetone	Diethyl ether	Ethanol	Methanol
1	Alkaloid (%)	2.91 ±0.0265	2.99 ±0.1168	2.47 ±0.1411	3.52 ±0.1002	2.87 ±0.0721
2	Flavonoids(mg/g)	6.34 ±0.0900	6.24 ±0.0611	2.32 ±0.1050	7.84 ±0.1153	6.65 ±0.4784
3	Phenol(mg/g)	4.46 ±0.1400	4.62 ±0.1222	3.90 ±0.0700	4.55 ±0.0907	4.33 ±0.1528
4	Saponin (mg/g)	5.14 ±0.0600	5.34 ±0.0902	1.05 ±0.1054	5.77 ±0.0929	5.01 ±0.1656
5	Tannin(mg/g)	2.84 ±0.0586	3.13 ±0.0709	3.06 ±0.1201	3.76 ±0.1253	3.16 ±0.1301

Note: ± value in same column is SD form mean reading.

Table 2 shows quantitative phytochemical analysis of moringa leaves. For the meticulous determination of most appropriate solvent for extraction of phytochemicals, it is very necessary to carry out quantitative phytochemical analysis by using different solvent i.e. Aqueous, Acetone, Diethyl ether, Ethanol and Methanol for phytochemicals such as Alkaloids, Flavonoids, Phenols, Saponins and Tannins. Alkaloid content ranged from 2.47 ± 0.1411 % to 3.52 ± 0.1002 mg/g. highest content of alkaloid was extracted by Ethanol. The most abundant phytochemical detected in moringa leaves is Flavonoids. *Moringa oleifera* L. leaves exhibited the richest phenolic compounds and flavonoid was reported by Al Owaisi and et al (Al Owaisi, 2014). The ethanol extract exhibited the highest flavonoid content (7.84 ± 0.1153 mg/g), and lowest in diethyl ether (2.32 ± 0.1050 mg/g). Phenolic content didn't show much variation among all used solvents. extracts, ranging from 3.90 ± 0.0700 mg/g to 4.62 ± 0.1222 mg/g. The highest saponin concentration was observed in the ethanol extract (5.77 ± 0.0929 mg/g), and lowest in diethyl ether (1.05 ± 0.1054 mg/g). Tannin concentrations ranged from 2.84 ± 0.0586 mg/g in the aqueous extract to 3.76 ± 0.1253 mg/g in the ethanol extract. These differences are primarily attributed to the polarity of the extraction solvents, which influences the solubility and recovery of various phytochemical constituents (Olotu and *et al* 2025).

Table 3 Percentage crude yield of *Moringa oleifera* leaves by different solvents.

	Wt. of Powder (mg)	Wt. of Crude Extract (mg)	Percentage Yield (%)
Acetone	500	86.57	17.31 ±0.2318
Aqueous	500	82.00	16.34 ±0.3121
Diethyl ether	500	73.72	14.72 ±0.0954
Ethanol	500	95.40	19.08 ±0.2122
Methanol	500	81.95	16.39 ±0.4550

Note: ± value in same column is SD form mean reading.

Table 3 reveals the percentage crude extract in different solvent. In this study ethanol demonstrated highest extraction percentage efficiency viz. 19.08 ±0.2122 followed by Acetone 17.31 ±0.2318, Methanol 16.39 ±0.4550, Aquous 16.34 ±0.3121 and lowest in Diethyl ether 14.72 ±0.0954. similar finding were reported by (Leone and et al 2015)

Several studies have demonstrated that methanolic and ethanolic extracts of *M. oleifera* leaves contain higher concentrations of phenolic compounds and flavonoids than aqueous extracts, resulting in enhanced antioxidant activity. However, the efficiency of a solvent is not universal and may vary depending on factors such as the geographical origin of the plant, environmental conditions, harvesting stage, drying method, and extraction protocol. Comparative evaluation of different solvents is therefore essential to identify the most effective extraction medium for obtaining phytochemical-rich extracts under specific experimental conditions. In present sturdy it was found that Methan is found most potent solvent to extract phytochemical form *Moringa oleifera* leaves.

4. Conclusion

Form the present study it is concluded that Moringa oleifera L. contains wide range of phytochemicals which makes it super food also It gained much attention by orthopedic patients to strengthened bones. This study is carried out to detect the array of phytochemicals qualitatively and quantitatively with different solvents. It was recorded that Flavonoids is the most abundant phytochemical present in moringa and tannins are present in very less quantity. It was noted that ethanol is most potent solvent to extract all type of phytochemicals followed by Acetone, Methanol, Aqueous, and Diethyl ether.

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