

Phytochemical Profile and Antimicrobial Activities of *Memordica cymbalaria* Hook.f. Fruit Skin Extracts

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Abstract— The current study investigates the phytochemical composition, antibacterial, and antifungal activities of various solvent extracts of *Memordica cymbalaria* Hook.f., commonly known as bitter melon. The fruit skin extracts were evaluated for the presence of bioactive compounds, as well as their efficacy against common human pathogens. The findings suggest that the plant's extracts, especially the petroleum ether extract, possess significant antibacterial and antifungal properties, highlighting its potential as a natural therapeutic agent. The study emphasizes the importance of solvent choice in optimizing the extraction of bioactive compounds.

Keywords: *Memordica cymbalaria*, phytochemicals, antibacterial activity, antifungal activity, petroleum ether extract, medicinal plants.

Introduction

Memordica cymbalaria Hook.f., a member of the Cucurbitaceae family, is widely known for its therapeutic potential, especially in traditional medicine. It has been utilized for various ailments, including infections and inflammatory conditions. Despite the increasing use of

synthetic drugs, medicinal plants continue to play a significant role in combating infectious diseases due to their lower side-effect profiles and antimicrobial properties. The standardization of medicinal plant products is crucial for ensuring their reproducibility and therapeutic efficacy. In this context, the present study investigates the

phytochemical composition and the antimicrobial potential of *Memordica cymbalaria* fruit skin.

Materials and Methods

Collection of Plant Material

The fruit skin of *Memordica cymbalaria* was collected from mature fruits and authenticated by a botanist. The plant material was washed, dried, and powdered for further analysis.

Natural Habit of *Memordica cymbalaria* Hook. f.



Extraction Process

The fruit skin was subjected to extraction using different solvents: **Petroleum Ether**, **Toluene**, **Acetone**, and **Aqueous**. The extracts were prepared using standard protocols, and the extract concentrations were standardized for antimicrobial testing.

Phytochemical Screening

The presence of 15 bioactive phytochemicals was screened using standardized methods. The phytochemicals tested included alkaloids, flavonoids, saponins, terpenoids, tannins, sterols, and more.

Table No. 1: The details of selected solvents and Soxhlet unit running parameters of Fruit skin of *Memordica cymbalaria* Hook.f.

S.No.	Solvent Name	Boiling Point	Polarity	Total No. of Cycles	Soxhlet Total Running Hours
1.	Petroleum Ether	60 ⁰ C	0.1	18	3
2.	Toluene	111 ⁰ C	2.4	14	3
3.	Acetone	56 ⁰ C	5.1	09	3
4.	Aqueous	100 ⁰ C	10.2	03	3

Table No. 2: Qualitative analysis of phytochemicals constituents of Fruit skin of *Memordica cymbalaria* Hook.f.

S.NO	TEST NAME	PETROLEUM ETHER	TOLUENE	ACETONE	AQUEOUS
1.	Alkaloids	+	+	-	-
2.	Steroids	+	+	-	+
3.	Reducing sugars	+	-	-	-
4.	Tannins	-	+	+	+
5.	Saponins	-	-	+	+
6.	Coumarins	-	-	-	+
7.	Flavonoids	+	-	+	-
8.	Terpenoids	+	-	+	+
9.	Glycosides	-	+	-	-
10.	Quinones	-	-	-	-
11.	Amino acids	+	-	-	-
12.	Essential oils	-	+	-	-
13.	Aromatic acids	+	-	-	-
14.	Carbohydrates	+	-	-	-
15.	Anthocyanins	-	+	-	+
Total No. of Phytochemicals		8	6	4	6

Note: (+) Present; (-) Absent

Antibacterial Activity

Antibacterial screening was performed using the disc diffusion method. The following bacterial strains were tested: **Staphylococcus aureus**, **Escherichia coli**, **Pseudomonas aeruginosa**, and **Bacillus subtilis**.

Results

Phytochemical Composition

The phytochemical composition varied depending on the solvent used for extraction. The following compounds were identified:

Antifungal Activity

The antifungal activity of the extracts was evaluated against **Aspergillus niger** and **Penicillium notatum** using similar methods to those used for antibacterial screening.

Petroleum Ether Extract: Amino acids, Carbohydrates, Terpenoids, Steroids, Reducing sugars, Alkaloids, Flavonoids, Aromatic acids.

Toluene Extract: Alkaloids, Steroids, Tannins, Glycosides, Essential oils, Anthocyanins.

Acetone Extract: Tannins, Terpenoids, Flavonoids, Saponins.

Aqueous Extract: Tannins, Terpenoids, Steroids, Saponins, Coumarins, Anthocyanins.

These findings indicate that different solvents extract distinct phytochemicals, emphasizing the importance of solvent selection for maximizing the extraction of bioactive compounds.

Antibacterial Activity

The antimicrobial properties of the fruit skin extracts were evaluated against four bacterial pathogens. The results indicated that the

petroleum ether extract exhibited the highest antibacterial activity:

- **Staphylococcus aureus:** 16.4 mm zone of inhibition.
- **Escherichia coli:** 16 mm zone of inhibition.
- **Pseudomonas aeruginosa:** 15.2 mm zone of inhibition.
- **Bacillus subtilis:** 15 mm zone of inhibition.

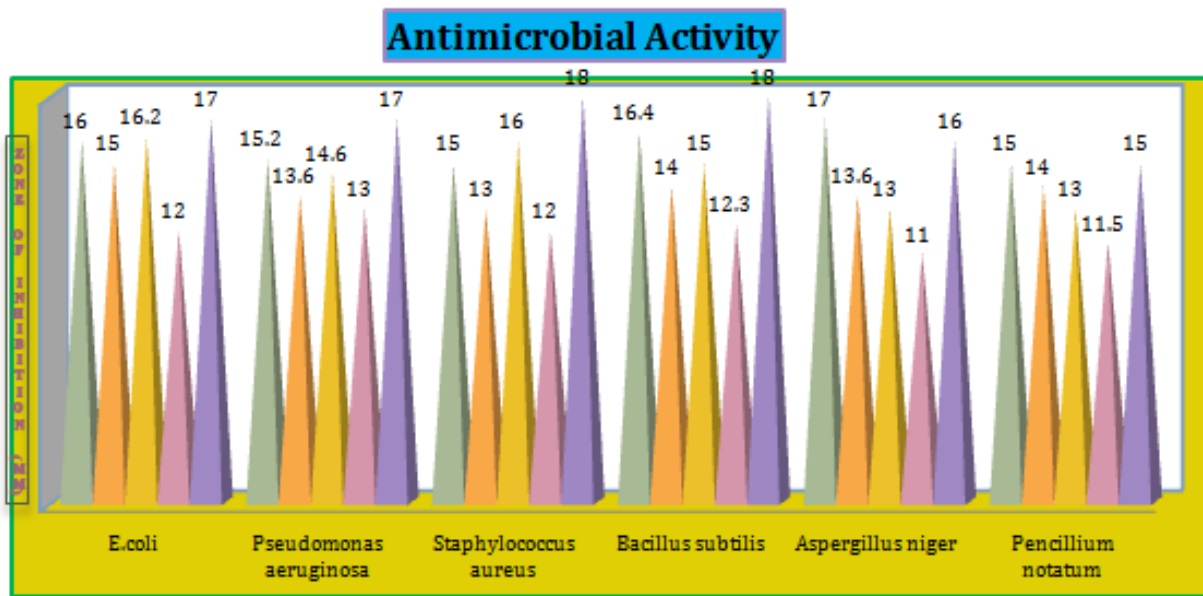
These results suggest that *Memordica cymbalaria* fruit skin, particularly the petroleum ether extract, holds promise as an effective antibacterial agent.

Table No. 3. Antimicrobial activity of leaves extracts of Fruit skin of *Memordica cymbalaria* Hook.f. using disc diffusion assay

S. No	Pathogens	Antibacterial activity - Zone of Inhibition (mm)				
		Petroleum Ether	Toluene	Acetone	Aqueous	Control (Amikacin)
1.	<i>Escherichia coli</i>	16 ± 0.5	15 ± 0.5	16.2 ± 0.3	12 ± 0.6	17 ± 0.4
2.	<i>Pseudomonas aeruginosa</i>	15.2 ± 0.2	13.6 ± 0.2	14.6 ± 0.4	13 ± 0.3	17 ± 0.5
3.	<i>Staphylococcus aureus</i>	15 ± 0.3	13 ± 0.3	16 ± 0.2	12 ± 0.2	18 ± 0.4
4.	<i>Bacillus subtilis</i>	16.4 ± 0.4	14 ± 0.4	15 ± 0.5	12.3 ± 0.5	18 ± 0.3
S. No	Pathogens	Antifungal activity - Zone of Inhibition (mm)				
		Petroleum Ether	Toluene	Acetone	Aqueous	Control (Nystatin)
1.	<i>Aspergillus niger</i>	17 ± 0.5	13.6 ± 0.5	13 ± 0.3	11 ± 0.6	16 ± 0.4
2.	<i>Pencillium notatum</i>	15 ± 0.2	14 ± 0.2	13 ± 0.4	11.5 ± 0.3	15 ± 0.5

± Standard Error, + Present, – Absent

Figure No. 3. Antimicrobial activity of leaves extracts of Fruit skin of *Memordica cymbalaria* Hook.f. using disc diffusion assay



Human Pathogens

Antifungal Activity

The antifungal activity of the fruit skin extracts was also significant:

- **Aspergillus niger:** Maximum zone of inhibition (17 mm) in the petroleum ether extract and minimum (11 mm) in the aqueous extract.
- **Penicillium notatum:** Maximum zone of inhibition (15 mm) in the petroleum ether extract and minimum (11.5 mm) in the aqueous extract.

These results demonstrate that *Memordica cymbalaria* is also effective against fungal pathogens, further supporting its therapeutic potential.

Discussion

The phytochemical screening revealed that *Memordica cymbalaria* contains a wide range of bioactive compounds, including alkaloids, flavonoids, terpenoids, and saponins. The composition of these compounds varied with the solvent used for extraction, which is consistent

with previous studies on other medicinal plants. Petroleum ether and acetone extracts, in particular, showed the presence of key bioactive compounds like alkaloids and terpenoids, known for their antimicrobial properties.

The antibacterial activity of the fruit skin extracts, especially the petroleum ether extract, was significant, particularly against **Staphylococcus aureus** and **Escherichia coli**, which are major causes of human infections. The observed antimicrobial activity aligns with other studies suggesting the potential of *Memordica cymbalaria* as a natural source of antimicrobial agents.

Similarly, the antifungal activity of the petroleum ether extract against **Aspergillus niger** and **Penicillium notatum** highlights the broad-spectrum potential of this plant in combating both bacterial and fungal pathogens. This finding is particularly important in the context of rising

fungal infections and increasing resistance to conventional antifungal agents.

Conclusion

The results of this study underscore the therapeutic potential of *Momordica cymbalaria* fruit skin, particularly its extracts in petroleum ether. The significant antibacterial and antifungal activities observed in this study suggest that the plant can be developed as a natural antimicrobial agent. Further research is needed to isolate and characterize the active compounds responsible for these activities and to explore their mechanism of action in greater detail.

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