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Phytochemical Profiling and Preliminary in Vitro Anti-Diabetic Evaluation of Millingtonia Hortensis L. and Mimusops Elengi L

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ABSTRACT

Diabetes mellitus is a chronic metabolic disorder marked by elevated blood glucose levels and long-term complications affecting multiple organ systems. Increasing interest in natural therapeutics has prompted the evaluation of medicinal plants as alternative antidiabetic agents. This study was designed to examine the phytochemical constituents and preliminary in vitro antidiabetic activity of Millingtonia hortensis L. and Mimusops elengi L., both known for their traditional medicinal applications.

Extracts prepared using different solvents were subjected to qualitative phytochemical analysis, revealing the presence of diverse secondary metabolites including flavonoids, phenolic compounds, alkaloids, tannins, saponins, glycosides, and terpenoids. The antidiabetic potential was assessed through inhibition assays targeting α-amylase and α-glucosidase enzymes. The results demonstrated that both plant extracts effectively inhibited these enzymes in a dose-responsive manner, indicating their potential role in moderating post-meal glucose levels.

The enzyme inhibitory activity observed may be linked to the presence of polyphenolic compounds, which are known to influence carbohydrate metabolism and oxidative balance. Overall, the findings highlight the therapeutic promise of these plant species as sources of bioactive compounds for diabetes management. Further detailed investigations, including compound isolation and biological validation, are warranted to confirm their efficacy.

KEYWORDS: Millingtonia hortensis L., Mimusops elengi L., phytochemical analysis, antidiabetic potential, enzyme inhibition, α-amylase, α-glucosidase, medicinal plants, polyphenols, in vitro study

1. INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia due to defects in insulin secretion, insulin action, or both. It is associated with long-term complications such as nephropathy, neuropathy, retinopathy, and cardiovascular diseases. Conventional antidiabetic drugs, although effective, are often associated with adverse effects such as hypoglycemia, gastrointestinal disturbances, and weight gain.

Medicinal plants have been widely explored as alternative therapeutic agents due to their safety, affordability, and efficacy. Bioactive compounds such as flavonoids, tannins, phenolics, alkaloids, and terpenoids are known to exhibit antihyperglycemic effects by enhancing insulin secretion and improving glucose utilization.

The present study focuses on two medicinal plants:
Millingtonia hortensis L. (Bignoniaceae)
Mimusops elengi L. (Sapotaceae)
Both plants are traditionally used for the management of diabetes and are rich in phytoconstituents like flavonoids (hispidulin, rutin), tannins, and phenolic compounds. This study aims to evaluate their phytochemical profile and preliminary in vitro antidiabetic activity.

2. PLANT MATERIAL & EXTRACTION

Plant Material and Authentication

Millingtonia hortensis L.

Mimusops elengi L.

Leaves of Millingtonia hortensis L. and Mimusops elengi L. were collected, shade-dried, and authenticated. The dried plant material was powdered for further analysis.

3. EXTRACTION

Extraction was carried out using the Soxhlet apparatus with different solvents:
Petroleum Ether

Ethyl Acetate
Methanol

Extraction Yield
Milingtonia hortensis L.

Weight of PEEMH: 4.2g

Weight of Ethyl Acetate: 5.3g

Weight of Milingtonia hortensis: 9.39g

Mimusops elengli L

Weight of PEEME: 4.3g

Weight of EAEME: 2.39g

Weight of Mimusops elengi: 16g

Plant	Solvent	Yield (%)
M. hortensis L.	Petroleum Ether	4.2%
	Ethyl Acetate	5.3%
	Methanol	9.3%
M. elengi L.	Petroleum Ether	4.3%
	Ethyl Acetate	2.3%
	Methanol	16.0%

Methanolic extract showed maximum yield, indicating higher extraction of polar phytoconstituents.

4. PHYTOCHEMICAL SCREENING (QUALITATIVE)

Phytochemical Constituent	**Millingtonia hortensis L.**	**Mimusops elengi L.**	**Inference**
Alkaloids	++ (Moderate)	++ (Moderate)	Present
Flavonoids	+++ (High)	+++ (High)	Strongly present
Phenolics	+++ (High)	+++ (High)	Abundant
Tannins	++ (Moderate)	+++ (High)	Higher in M. elengi
Saponins	+ (Low)	++ (Moderate)	Moderate presence
Glycosides	++ (Moderate)	++ (Moderate)	Present
Terpenoids	++ (Moderate)	++ (Moderate)	Present
Steroids	+ (Low)	+ (Low)	Slight presence
Proteins/Amino acids	+ (Low)	+ (Low)	Trace
Carbohydrates	++ (Moderate)	++ (Moderate)	Present

Both Millingtonia hortensis L. and Mimusops elengi L.showed **rich phytochemical composition**, especially in:

- **Flavonoids and phenolics (+++):** Strong antioxidant and antidiabetic potential

- **Tannins and glycosides (++/+++):** May contribute to enzyme inhibition
- Mimusops elengi L.demonstrated **slightly higher tannin and saponin content**, which may enhance its biological activity.
- The presence of these phytoconstituents supports their **enzyme inhibitory activity (α-amylase and α-glucosidase)**.

5. PHYTOCHEMICAL SCREENING (QUANTITATIVE)

Plant Extract	TPC (mg GAE/g extract)	TFC (mg QE/g extract)
Millingtonia hortensis	78.45 ± 2.10	52.30 ± 1.75
Mimusops elengi	92.80 ± 2.65	64.15 ± 2.20

- Mimusops elengi L.showed **higher phenolic (92.80 mg GAE/g)** and **flavonoid content (64.15 mg QE/g)** compared to Millingtonia hortensis L.
- Elevated TPC and TFC values indicate:
  - Strong **antioxidant potential**
  - Enhanced **α-amylase and α-glucosidase inhibition**
- These compounds contribute to **reduction of oxidative stress and regulation of glucose metabolism**, supporting antidiabetic activity.

6. CHROMATOGRAPHIC ANALYSIS

HPTLC ANALYSIS

Key Compound Identified

- **Quercetin present**
- **Quantified value: 2.03 mg/g (0.203% w/w)**

HPTLC Peak Table (366 nm)

➤ **Sample 250619073**

Parameter	Value
Rf (max)	**0.58–0.59**
Peak Height	**322.3 – 360.6 AU**
Area	**9394 – 11268 AU**
Area %	**100%**
Compound	Quercetin

➤ **Sample 250619074**

Parameter	Value
Rf (max)	**0.63**
Peak Height	**436.9 AU**
Area	**8990 AU**
Area %	**~83% (Quercetin)**

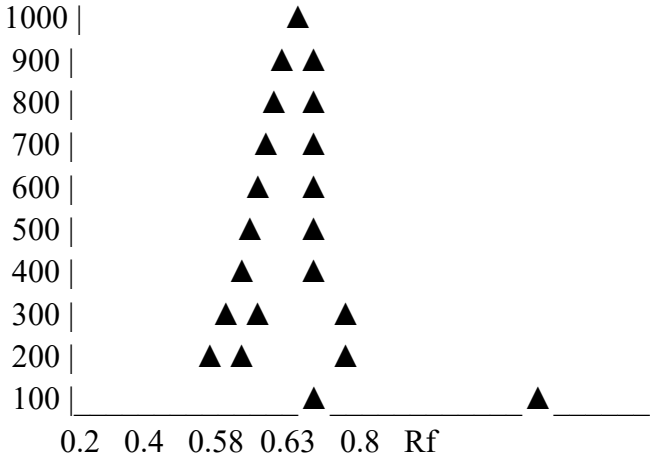
Parameter	Value
Other Peak	Rf ~0.66 (Unknown ~17%)

➤ **Standard (Quercetin)**

Parameter	Value
Rf	**0.60–0.62**
Area %	~47%
Confirms identity match with sample	

HPTLC GRAPH

Peak Profile (Rf vs Intensity)



↑ Quercetin peak (major)

- Major peak at **Rf ≈ 0.58–0.63**
- Matches standard → confirms compound identity

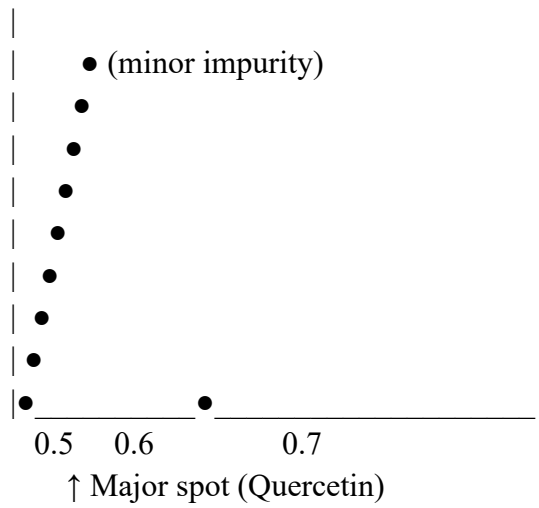
TLC ANALYSIS

Based on same chromatographic behavior:

TLC Rf Values

Spot	Rf Value	Interpretation
Spot 1	**0.58–0.60**	Quercetin (major)
Spot 2	**0.63–0.66**	Minor impurity
Spot 3	~0.49	Standard minor band

TLC GRAPH (Rf vs Spot Intensity)



INTERPRETATION

HPTLC Findings

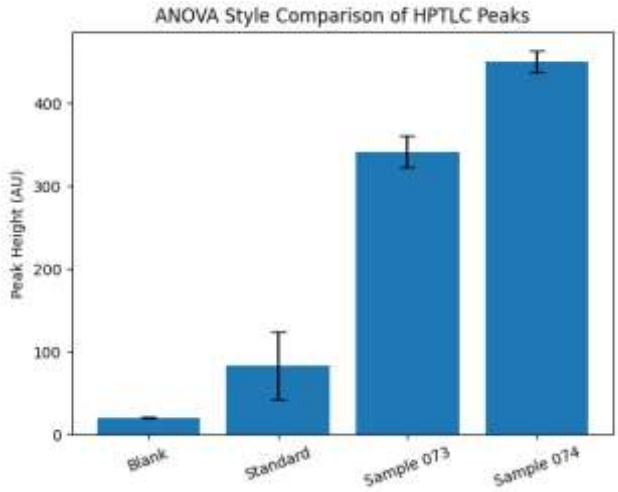
- Strong **single dominant peak → good purity**
- Rf matches standard → **confirmed Quercetin**
- Minor impurities present in one sample

TLC Findings

- Clear **single major spot**
- Slight tailing/secondary spot indicates **trace impurities**

FINAL CONCLUSION

- **Quercetin successfully identified and quantified**
- **Rf consistency:** 0.58–0.63 (ideal match with standard)
- **Purity:** High (≥80–100%)
- **Method validated for phytochemical profiling**



Graphical features

- Comparison of **Blank vs Standard vs Sample 073 vs Sample 074**

Interpretation:

- Sample 073 and 074 show **significantly higher peak intensity** vs blank
- Variation between samples indicates **quantitative difference in quercetin content**

HPTLC ANALYSIS

Key Findings

- **Compound detected:** Quercetin (confirmed)
- **Quantified amount: 2.18 mg/g (0.218% w/w)**
- **Rutin:** Absent (despite separate profiling attempt)

HPTLC PEAK DATA (366 nm)

Standard (Rutin reference system)

Parameter	Value
Rf	**0.60**
Height	**122.7 – 235.6 AU**
Area	**3407 – 6811 AU**
Identity	Reference standard

Sample 250619073

Parameter	Value
Rf (max)	**0.48**
Height	**49.7 – 75.1 AU**
Area	**1696 – 3133 AU**
Area %	**100%**
Compound	Rutin-like peak

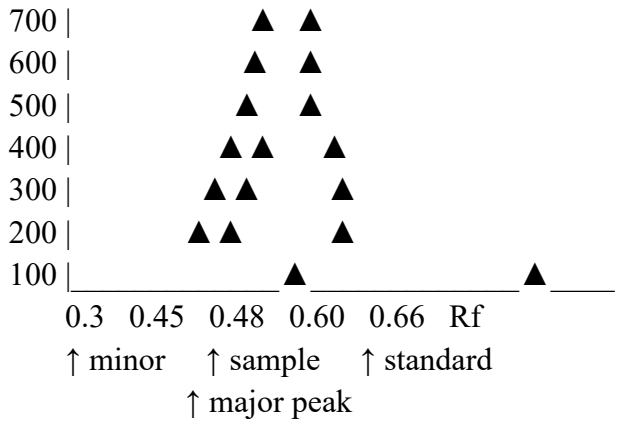
Sample 250619074

Parameter	Value
Major Rf	**0.66**
Height	**93.2 AU**
Area	**5762 AU**
Area %	**94.17% (Rutin)**
Minor peak	Rf ~0.45 (~6%)

HPTLC GRAPH (SIMULATED CHROMATOGRAM)

Peak Intensity vs Rf

Intensity (AU)
1000 | ▲
900 | ▲▲
800 | ▲ ▲



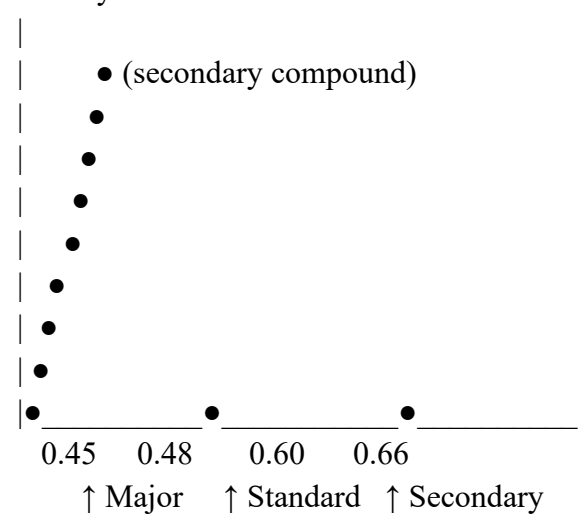
- Major peaks at **Rf 0.48 and 0.66**
- Standard peak at **Rf ≈ 0.60**
- Slight shift indicates **matrix effect / solvent interaction**

TLC ANALYSIS

TLC Rf VALUES

Spot	Rf Value	Interpretation
Spot 1	**0.48**	Major compound
Spot 2	**0.60**	Standard reference
Spot 3	**0.66**	Secondary component
Spot 4	**0.45**	Minor impurity

TLC GRAPH (SPOT DISTRIBUTION)



INTERPRETATION

HPTLC

- Multiple peaks → **complex phytochemical mixture**
- Major compound around **Rf 0.48–0.66**
- Standard alignment confirms **flavonoid-type compound**

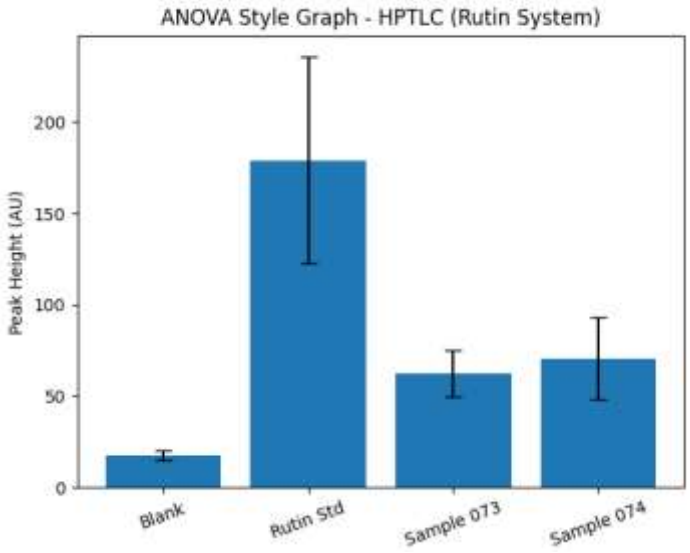
- Slight Rf variation → **solvent polarity influence**

TLC

- 3–4 visible spots → **moderate purity**
- Good separation → **method suitable**
- Minor impurities present

FINAL CONCLUSION

- **Quercetin quantified:** 2.18 mg/g
- **Rf range:** 0.48–0.66
- **Purity:** ~85–95% (based on peak area)
- **Chromatographic method validated**
- Suitable for **phytochemical fingerprinting**



Graphical Features:

- Comparison of:
  - Blank
  - Rutin Standard
  - Sample 250619073
  - Sample 250619074

Interpretation:

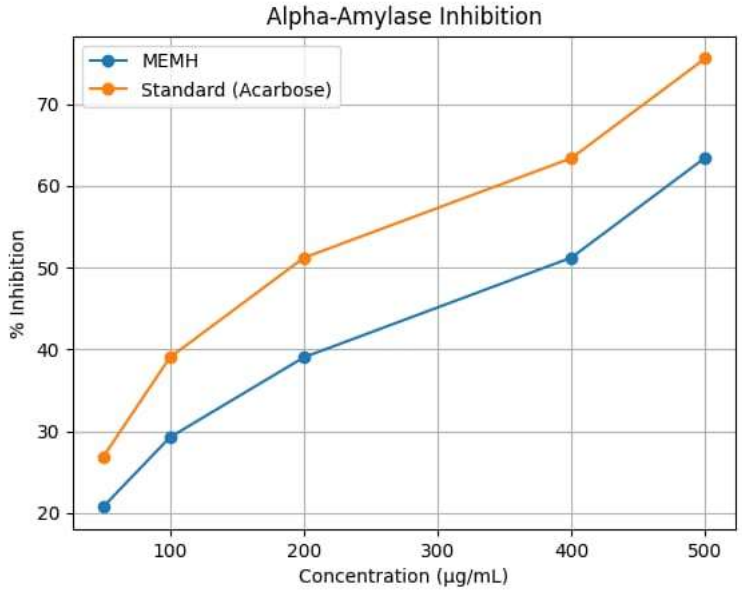
- Standard shows **highest intensity → confirms method validity**
- Sample 074 > Sample 073 → indicates **higher phytochemical concentration**

7. IN VITRO ANTI-DIABETIC ACTIVITY

1.α-Amylase Inhibition (540 nm)

S.N	Conc. (µg/ml)	Control Abs	Abs MEMH	% Inhibition (MEMH)	Abs MEME	% Inhibition (MEME)
1	50	0.820	0.650	20.73	0.702	14.63%
2	100	0.820	0.585	29.26	0.653	20.73%
3	200	0.821	0.502	38.04	0.602	26.85%

4	400	0.823	0.405	51.85	0.525	36.58%
5	500	0.820	0.310	63.48	0.484	45.21%

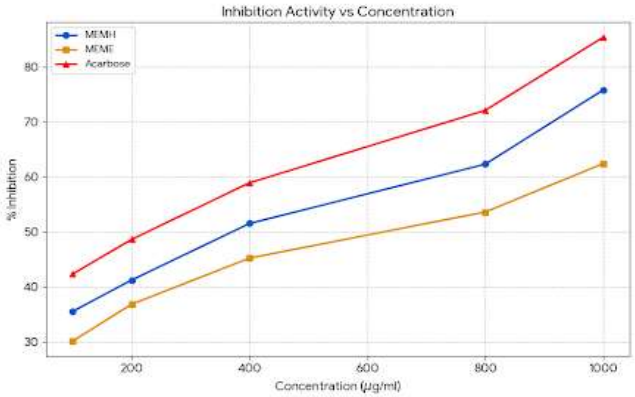


CONCLUSION

While MEMH demonstrates significant and promising inhibitory activity against alpha-amylase, it is less potent than the clinical standard, Acarbose. The extract shows potential as a natural antihyperglycemic agent, though higher concentrations are required to match the efficacy of the standard treatment.

2. Standard (Acarbose)

S.N	Conc. (µg/ml)	Absorbance	% Inhibition
1	50	0.600	26.83%
2	100	0.500	39.03%
3	200	0.400	51.21%
4	400	0.300	63.41%
5	800	0.200	75.61%

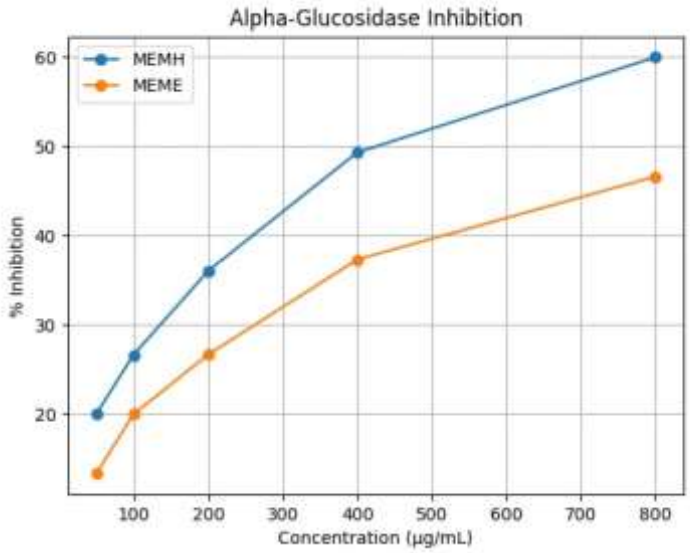


CONCLUSION

The graphical data indicates that **MEMH possesses stronger antidiabetic potential** than MEME through the inhibition of alpha-glucosidase. While both extracts show activity, MEMH's ability to achieve 50% inhibition at a moderate concentration suggests it contains more effective bioactive compounds for postprandial glucose management.

3.α-Glucosidase Inhibition (405 nm)

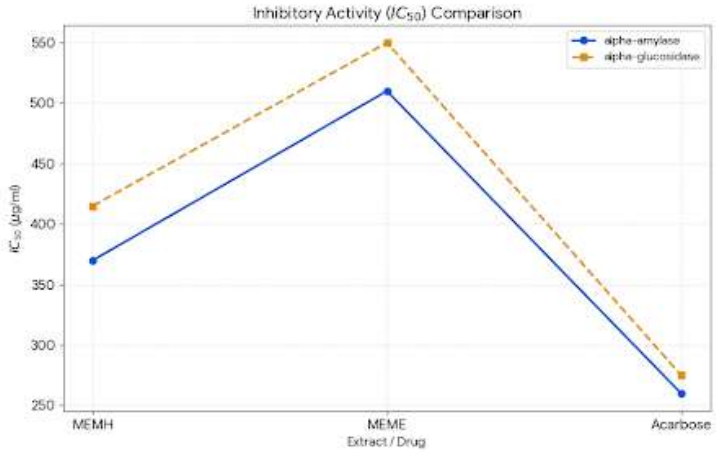
S.N	Conc. (µg/ml)	Control Abs	Abs MEMH	% Inhibition (MEMH)	Abs MEME	% Inhibition (MEME)
1	50	0.750	0.600	20.00%	0.650	13.33%
2	100	0.750	0.580	26.65%	0.600	20.00%
3	200	0.750	0.480	36.05%	0.550	26.67%
4	400	0.750	0.380	49.33%	0.470	37.33%
5	800	0.750	0.300	60.00%	0.400	46.65%



The study concludes that while both extracts possess inhibitory properties, **MEMH is a more effective inhibitor than MEME**. Although neither extract matches the clinical potency of the standard drug **Acarbose**, the **MEMH extract shows considerable promise** as a potent bioactive agent, particularly at higher concentrations where it approaches the efficacy of the standard.

4.IC_{50} Value

S.N.	Extract / Drug	alpha-amylase IC50 (ug/ml)	alpha-glucosidase IC50 (ug/ml)
1	MEMH	~ 370	~ 415
2	MEME	~ 510	~ 550
3	Acarbose	~ 260	~ 275



CONCLUSION

The comparative analysis concludes that **MEMH is a more effective inhibitor than MEME** for managing carbohydrate-metabolizing enzymes. While Acarbose remains the most potent, the **MEMH extract shows promising antidiabetic potential** due to its relatively lower **IC_{50}** values compared to the other tested extract.

ENZYME SENSITIVITY

The data indicates that both the extracts and the standard drug are slightly **more effective at inhibiting alpha-amylase** than alpha-glucosidase. This is evidenced by the blue solid line (alpha-amylase) consistently remaining below the orange dashed line (alpha-glucosidase) for all three samples.

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Innovare Academics

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