Carica papaya stem: A Promising Bioresource for Crop Protection

A PAPER PRESENTED

BY

I. A. Adeniyi [1, 4*], A. A. Inyinbor[1], O. A. Owolabi [2], C. O. Aremu[3], O. S. Oluwole [1],

A. P. Oluyori[1*]

1 Industrial Chemistry Programme, Physical Sciences Department, Landmark University, Omu-Aran, Kwara State, Nigeria

2 Department of Food Science and Microbiology, Landmark University, Omu-Aran, Kwara State, Nigeria

3 Crop Science Programme, Agricultural Science Department, Landmark University, Omu-Aran, Kwara State, Nigeria

4 Department of Chemical Sciences, Thomas Adewumi University, P.M.B. 1050, Oko, Kwara State, Nigeria

Corresponding author's email: oluyori.abimbola@lmu.edu.ng; isaac.adeniyi@tau.edu.ng

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OUTLINES

- Introduction
- Materials and Methods
- Results and discussion
- Conclusion
- References

INTRODUCTION

❖ Cost of food supply has been estimated to be about $1 trillion by 2030 due to crop loss in the farm (Eloff et al., 2017). Furthermore, fungi pathogen were suggested as the major causes of crop diseases leading to massive crop losses (Pane *et al*., 2013; Eloff *et al*., 2017) and food spoilage (Lateef et al., 2023)

Figure 1 : symptoms of fungi diseases: a (damages of crop); b (damages of maize cob)
Source: snapshot

Introduction cont.

❖ The use of synthetic chemicals to control fungi pathogen and diseases have contributed to degenerating diseases on farmers' health and environmental issues (Adekunle *et al*., 2017).

❖ Extracts from plant that contain certain abundant phytochemicals have been suggested for management of crop diseases and food preservation as an alternative to synthetic chemicals (Palou *et al*., 2016; Ogunnupebi *et al*., 2020). Recently, promising phytochemicals from agro-waste were reported by some authors (Bankole *et al*., 2022: Lateef *et al*., 2023). Moreover, agro-waste (peel and seed) from *Carica papaya* (Pathak *et al*., 2018). Joseph *et al* (2016) demonstrated application of aqueous extract of *Carica papaya* leaves for protection of tomato plant against early blight diseases.

❖ However, despite the medicinal and agricultural applications of *Carica papaya*, little is known about the active components of its stem.

AIM OF THE STUDY

❖ The present study aimed to extract the phytochemical of *Carica papaya* stem, identified the major phytochemicals in the aqueous *Carica papaya* stem extract (ACPSE), its fractions and evaluate antifungal activity of ACPSE respectively.

MATERIALS AND METHODS

❖ Preparation of plant material

a

b

c

- Figure 1a: *Carica papaya* stem Figure 1b and 1c (*Carica papaya* diced stem)

Source: Snapshot

Materials and Methods cont.

❖ **Extraction of plants material;** About 0.5 kg of ground plant material was soaked in 1.5 liter for 3 days at room temperature, filtered with the aid of Number one Whatman filter paper. The filtrate was concentered using rotary evaporator at $45^{O}C$.

❖ **Antifungal Assay of the crude extract ;** *Aspergillus fumigatus* (ATCC, 46829) and *Fusarium solani* (ATCC, 204305). In-vitro antifungal activity of ACPSE was carried out in five percent (5 % DMSO) by agar well diffusion method (Baskaran *et al*., 2012). The activity of Fluconazole as standard was compared with activities of each extracts (Pedro Chavez-Quintal *et al*., 2011). At the end of 7 days the zone of inhibition were measured in millimeter (mm) using Vernier caliper respectively. The percentage growth inhibition of each extract were calculate by the method described in the studied of Rashid et al. (2018) respectively.

❖ Percentage inhibition = [growth in control – growth in sample/growth in control] x 100.

Material and methods cont.

❖**Solvent-solvent partitioning of extract (**ACPSE**):** 2.0 g of dried aqueous extract of *Carica papaya* stem was re-suspended in distilled water in a separating funnel (500 ml). Hexane and ethyl acetate were used for the partitioned. Each solvent fractions (Hexane-fraction, ethyl acetate-fraction and residual-fraction) were concentrated on the water bath at 45^{O}C, labeled as CP-HF (hexane-fraction), CP-EF (ethyl acetate fraction) and CP-RF (residual fraction) and then kept in an air tight container until further use.

❖**Preliminary and quantitative phytochemical analysis:** Preliminary phytochemical screening of ACPSE and its fractions (Harbourne, 1973), total phenolic content was calculated and expressed as Gallic acid equivalent in mg/100g of the sample (Ben Yakoub *et al*., 2018) and total flavonoids content of the samples were expressed as mg of Quercetin equivalent per 100 g (Asghar *et al*.,2016).

❖ **Chromatography analysis:** A GC-MS – was used for the determination of phytochemical constituents in ACPSE and its fractions CP-HF, CP-EF and CP-RF using already established method. The result of identified compounds was compared with National Institute of Standard and Technology (NIST) library. Major compounds, retention time, molecular formula and percentage (%) were recorded.

RESULTS AND DISCUSSION

❖Preliminary phytochemical analysis of ACPSE and its fractions : Total phenolic content and total flavonoids content of ACPSE were mg 5. 00 mg GAE/100g and 45.00 mg QE/100g respectively.

Phytochemicals	ACPSE	Fractions		
		Hexane fraction	Ethyl acetate fraction	Residual fraction
Saponins	+	++	-	+++
Tannins	+	-	-	-
Steroids	+	-	+	-
Flavonoids	+	-	-	+
Alkaloids	+	-	+	-
Phenols	+	-	-	+
Terpenoid	+	+	-	-

Results and discussion cont.

❖GC- MS results of ACPSE and its fractions (hexane, ethyl acetate and residual)

Extract/Fractions	Major compounds	Retention time	Molecular Formula	Percentage (%)
ACPSE	Butanoic acid	4.182	$C_4H_8O_2$	21.98
Hexane fraction	5-Eicosene	6.272	$C_{20}H_{40}$	9.63
Ethyl acetate fraction	β-Sitosterol	21.499	$C_{29}H_{50}O$	20.57
Residual fraction	2,6-di-ter-butyl-4-(dimethlaminomethyl)phenol	16.204	$C_{17}H_{29}NO$	36.40

Results and discussion cont.

❖ GC-MS chromatogram of ACPSE and its fractions (hexane, ethyl acetate and residual fractions)

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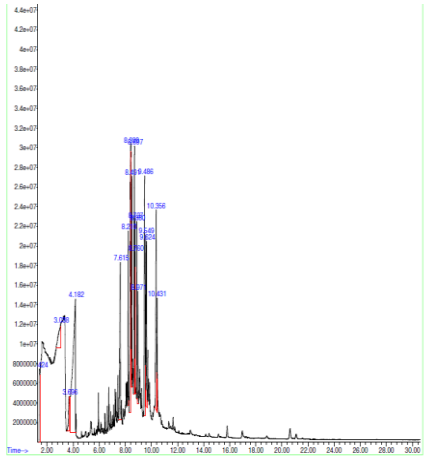

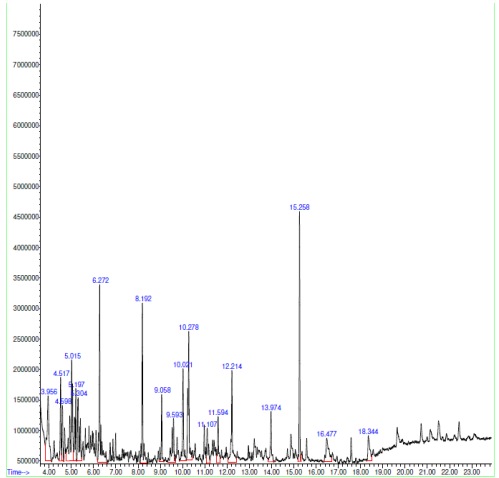

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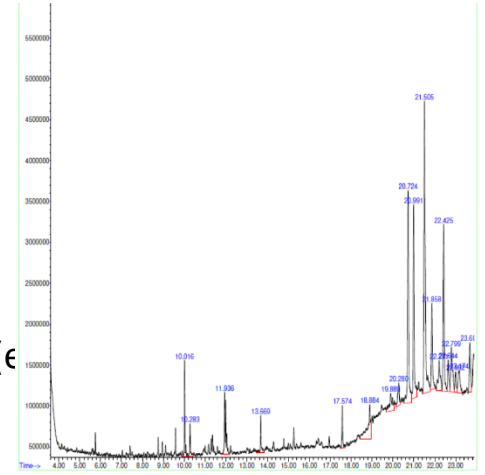

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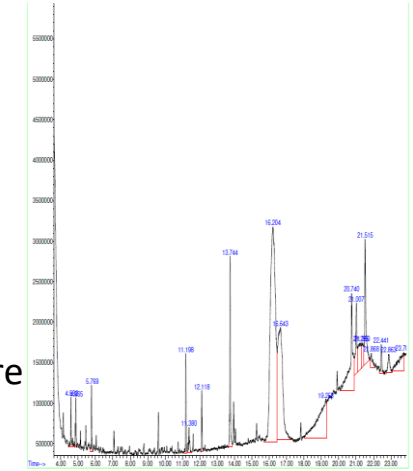

Results and discussion cont.

❖ Antifungal activity of ACPSE significantly inhibited mycelia growth of *Fusarium solani* of 19.8 mm (69.96 %) compared to *Aspergillus fumigatus* with inhibition zone 14.3 mm (47.51 %) at 50 mg/ml.

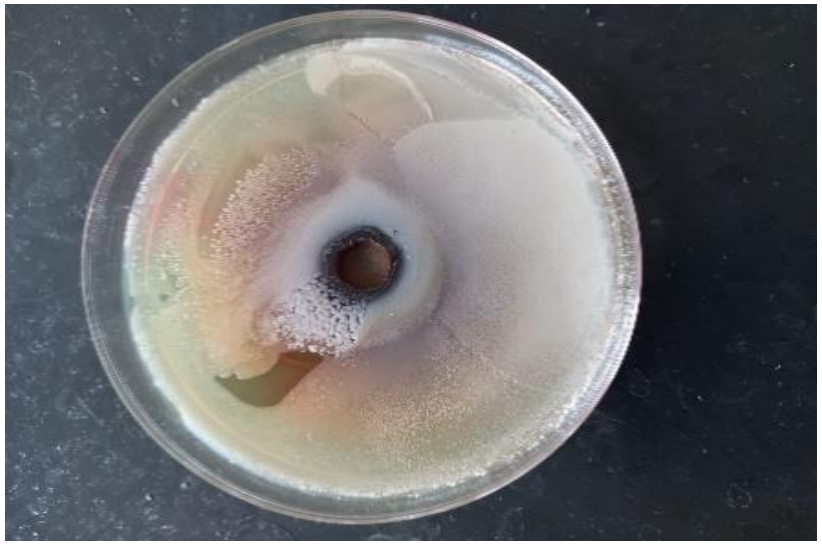

Figure 3: Mycelial inhibition plates of ACPSE against *Fusarium solani*.

Results and discussion cont.

❖The significant antifungal activities of ACPSE may be as a results of phytochemicals observed from the result of preliminary phytochemical screening (Table 1) viz: flavonoids (Pane *et al*., 2013), saponins (Chapain and Wiesman, 2006) and tannins (Morey *et al*., 2016). In addition, 2, 6-di-ter-butyl-4-(dimethlaminomethyl) phenol (Zeng *et al*., 2007) and β-steroid (Oloyede *et al*., 2005; Husin *et al*., 2019), identified via GC-MS analysis have been established as antioxidant. Butanoic acid and 5-Eicosene) as an antifungal-molecules (Mari *et al*., 2016). Furthermore, the present study agreed with the previous authors that extracts from *Carica papaya* possesses antifungal activity (Giordani *et al*., 1996; Pedro Chavez-Quintal *et al*., 2011).

CONCLUSION

❖The present study justified that *Carica papaya* stem (agro-waste) contained some important phytochemicals. Moreover, phenolic compound may be responsible for the antifungal activity of aqueous extract of *Carica papaya* stem because of its abundance and antifungal activity. Therefore, the presence of the identified phytochemicals indicates that *Carica papaya* stem is a promising source of antifungal phytochemicals which can find important application in food preservation and crop protection. Isolation of secondary metabolites from *Carica papaya* stem is therefore suggested.

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