

Abstract:

Essential oils (EOs) and their constituents have been the focus of several researches because of their multiple biological activities. Among these activities are antioxidant and antimicrobial, which make EOs important material in many industries. Food industries now use EOs as food additives and also incorporate them in food packages to increase the food shelf life by preventing food spoilage caused by oxidation and microbial attacks. There are many plants bearing essential oils that are yet to be investigated. Therefore, in this study, the EOs hydrodistilled from the leaves, stem, seeds and flowers of *Tecoma stans* were examined for their antioxidant and antimicrobial activities using DPPH radical-scavenging assay and Agar diffusion method respectively. Data were analyzed using Graph Pad Prism software. The seed (IC50 = 33.03 µg/ mL) and stem (IC50 = 6.44 µg/ mL) EOs exhibited higher radical-scavenging potential than the EOs from the leaves (168.62 µg/ mL) and flowers (104.94 µg/ mL) as well as that of reference compound, α-tocopherol (IC50 = 81.58 µg/ mL). There was no significant activity against the bacterial but moderate inhibitions of the fungi were observed (Zones of Inhibition, 1.8-8.1 mm). Their antimicrobial activity was lower than those of the standard drugs (gentamycin, 9.0-11.5 mm; ketoconazole, 10.3-21.0 mm). No significant difference between the activity of each of the EOs against the tested organisms (P > 0.05). This study showed that *Tecoma stans* seeds and stems EOs possess antioxidant properties which could make them useful in the food industry as food additives and food packaging materials. Keywords: Antioxidant, Antimicrobial, Food Additives, Food Packages

Tecoma stans Essential Oils: A Useful Additive in Food Industries

Adekemi Temitope Alade^{1, 2, *}, Sherifat Adeyinka Aboaba¹ , Olusegun Ekundayo¹
¹ Department of Chemistry, University of Ibadan, Ibadan, Nigeria ² Department of Chemical Sciences, Joseph Ayo Babalola University, Ikeji-Arakeji, Nigeria

Introduction

Food spoilage is a condition at which a food product becomes unsuitable to ingest by the consumer. It is majorly caused by many external factors like heat, water, ultraviolet light, pressure and microorganisms from either unhygienic production, poor storage conditions or mode of transportation (Sharma *et al.*, 2021). One of the preventive method adopted by food industry is the use of natural antioxidants and antimicrobial agents from plants which are more safe than the synthetic ones when trying to avoid the problem of toxicity (Mhone *et al.*, 2012). Many fungi and bacteria contribute up to 50 % of all food spoilage (Lorenzo *et al.*, 2018). Common examples are *Aspergillus* and yeast species for fungi and *Salmonella typhi*, *Staphylococcus*

aureus and *Escherichia coli* for bacteria. Essential oils among plants extracts have shown significant antioxidant activity and antimicrobial property against wide range of microorganisms. Besides, they have multibiological activities which make them useful in many industries such as pharmaceutical, cosmetic, food as well as medicine (Moosavy *et al.*, 2017). Many food industries now use essential oils as natural flavoring agents, natural preservatives and in food packaging material to enhance their product’s shelf life (Saeed *et al.*, 2022).

Tecoma stans (L.) Kunth of Bignoniaceae family, commonly known as the yellow trumpet tree and locally called Awun in Nigeria by yoruba tribe is a flowering plant, which originated from neotropical America and introduced to other regions like Hawaii, India, Philippines and Africa. The leaf, root, stem and flowers of the plant are all used in traditional medicine in the treatment of several human ailments like gastro-intestinal disorder, diabetes, cancer, heart disease and syphilis (Salem *et al.*, 2013). Despite a lot of reports on the plant’s extracts, there is dearth of information on the biological activities of the essential oils from the plant. Therefore, this study was designed to investigate the possibility of *Tecoma stans* essential oil as food additives by evaluating the antioxidant and antimicrobial properties of the oils extracted from the leaves, stem, seed and flowers of the plant.



Tecoma stans

Table 4: Antimicrobial activity of *T. stans* essential oils

Essential oils	Conc (µL/mL)	Zones of Inhibition (mm)				
		S. aureus	E. coli	C. albicans	F. solani	A. niger
Leaf	1	0.0a	0.0a	0.0a	0.0a	0.0a
	10	0.0a	0.0a	2.3a	2.1a	2.1a
	100	1.3a	1.7a	7.8a	4.1a	6.1a
Stem	1	0.0a	0.0a	0.0a	0.0a	0.0a
	10	0.0a	0.0a	2.2a	1.6a	1.8a
	100	0.0a	0.0a	6.1a	3.9a	4.0a
Seed	1	0.0a	0.0a	2.1a	2.1a	0.0a
	10	0.0a	0.0a	4.0a	3.9a	0.0a
	100	0.0a	0.0a	6.2a	6.0a	1.4c
Flower	1	0.0a	0.0a	3.9a	1.9a	3.9a
	10	0.0a	0.0a	6.0a	3.9a	6.0a
	100	0.0a	0.0a	8.1a	6.1a	8.1a
+ve control		11.5b	9.0b	21.0b	10.3b	10.5b
-ve control		0.0	0.0	0.0	0.0	0.0

Mean value of inhibition zone followed by different letters in the same column indicates there was significant difference between the mean (p < 0.001) while mean followed by the same letter indicates no significant difference between the mean (p > 0.005) +ve control- Gentamycin for antibacterial assay; Ketoconazole for antifungal assay -ve control- DMSO and n-hexane

Results

Table 1: Extraction result

Essential oils	Colour	% Yield
Leaves	Pale yellow	0.62
Seeds	Colourless	0.36
Stem	Colourless	0.32
Flowers	Pale yellow	0.49

Table 2: Dominant constituents of *T. stans* EOs

Constituents	l.r.i.	Percentage composition (%)			
		Leaf	Stem	Seed	Flower
1-octen-3-ol	981	24.8	3.7	5.5	7.9
3-octanol	994	6.0	7.0	6.0	-
Linalool	1101	7.7	11.4	7.4	10.8
α-terpineol	1191	0.5	5.0	11.7	1.3
β-selinene	1487	-	5.4	9.3	-
(E)-β-ionone	1487	2.7	-	-	11.2
2,6,10-trimethylpentadecane	1642	10.4	10.7	-	8.4
β-eudesmol	1650	-	5.9	-	-
Pentadecanal	1716	8.9	-	-	3.1
Total monoterpenes identified		-	0.7	4.3	-
Total monoterpenoids identified		16.1	17.3	26.3	12.1
Total sesquiterpenes identified		-	6.9	13.5	3.7
Total sesquiterpenoids identified		11.8	16.4	5.4	3.7
Percentage identified		91.5	81.4	88.5	95.8

Table 3 Antioxidant activity of *T. stans* essential oils

Test sample	Absorbance at 517 nm			IC ₅₀ (µg/ mL)
	5 µg/ mL	25 µg/ mL	100 µg/ mL	
Leaves EO	0.926	0.905	0.898	168.62
Seed EO	1.046	0.918	0.872	33.03
Stem EO	1.045	1.005	0.873	6.44
Flowers EO	1.160	1.028	1.020	104.94
α-Tocopherol	1.447	0.988	0.970	81.21

Absorbance of control (DPPH + Methanol) = 2.003

Conclusion

The present study showed that essential oils extracted from *Tecoma stans* stem and seeds possess good antioxidant properties, which could find application in the food industry as natural food additives and also incorporated in to the food packaging material to improve the food shelf life in order to prevent food spoilage by oxidation. Further study should be conducted on the antioxidant and antimicrobial potential of the essential oils in food models.