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Antibacterial and phytochemical activities of *Monodora myristica* (African nutmeg) seeds

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Abstract
Monodora myristica (African nutmeg) seeds are used as spices for seasoning in traditional African cuisine due to their aroma. The antibacterial effect of *Monodora myristica* was tested against some bacterial isolates. The susceptibility testing and phytochemical analyses were carried out using standard methods. The minimum inhibitory concentrations of the extracts obtained from water, ethanol and methanol were within 12.5-50mg/ml. Phytochemical content included 858.11mg/100g for alkaloids, 124.8mg/100g for tannins, 153.80mg/100g for terpenoids and 558.10mg/100g for flavonoids and absence of anthraquinones, saponins, cardiac glycosides, steroids and carotenoids. *Staphylococcus aureus, Acinetobacter baumannii, Enterococcus* spp. and *Streptococcus* spp. were susceptible to extracts of *M. myristica*. Plant could be used as source of therapeutic agent in addition to its usefulness in food.

Keywords: Spices, *Monodora myristica*, antibacterial, phytochemical activities

1. Introduction

Spices are valuable plants used to enhance flavour and taste of foods. They are different from herbs in having stronger aroma and flavour. Spices are utilized in food preparation as taste enhancers, preservatives, for flavour and other features. Herbs are utilized more in terms of medicines. Spices are available in several forms, fresh or dried (Peter,2004), often derived from plant parts including twigs, leaves, flower, bud, nuts, seeds, outer layers of stems and roots while herbs are usually gotten from leaves (Ahmad et al., 2021; Herman, 2015).

Monodora Myristica

The plant *Monodora myristica*, African nutmeg, the calabash nutmeg and "erhe" in Urohbo language is a tropical tree of the family Annonaceae or custard apple family of flowering plants. *Monodora myristica* seeds are commonly used as therapy for hypertension and headache in Central African Republic while the stem bark is important for curing eye diseases, hemorrhoids, fever and stomach pain. The nut obtained after the seeds are cracked is a popular condiment used as a spicing agent in both Africa and continental cuisines in Nigeria. African nutmeg are aromatic and often used as a condiment in food. The flavour produced by the spice when ground to powder resembles that of nutmeg (*Myristica fragrans*), When milled to powder, they are used as aromatic stimulant and added to snuff, relieve constipation and sometimes sprinkled on wounds caused by guinea worm (Burkill, 1985; Irvine, 2000). The kernel, when ground to powder, is used to prepare pepper soup as a stimulant to relieve constipation and to control passive uterine haemorrhage in women immediately after child birth (Okafor, 1987). Traditionally, the plant is used to relieve toothache and in the treatment of dysentery. The seeds when roasted and ground are chewed, spat into the hand and then rubbed across the forehead to relieve headache. The powdered seeds are used as insecticide and the root relieves toothache when ground (Oguntimein *et al.*, 1999). Essential oil from the seed is used in

dental preparation in the pharmaceutical industry. (Talalaji, 1999). The seeds when roasted and ground are rubbed on the skin for treatment of unspecified skin diseases, which implies that the seeds of *Monodora myristica* plant could be germicidal or antiseptic. Also, they are used to treat constipation, guinea worm, anaemia, impotence, arthritis and sores. It also has anthelmintic properties (Ekeanyanwu and Etienajirhevwe, 2012) and anti-bacterial properties (Adewole *et al.*, 2013). *Monodora myristica* wood is suitable and used for house fittings, carpentary and joinery.

2. Materials and Methods

2.1. Plant collection

Monodora myristica seed was procured from the market and a part of the spice was taken for identification at Botany Department, Faculty of Science, Delta State University Abraka. Voucher number DELSUH 103, was raised for the plant. The active components of spice was extracted according to method described by Maharjan *et al*. (2019) with little modification, water, 70% ethanol and methanol were used for extraction. The outer shell was removed manually by peeling, the seeds obtained were blended with warring blender. Three hundred grams of powdery seeds was extracted with soxhlet extractor apparatus. The extracts were reduced to smaller volume using rotary evaporator. The percentage yield of extract obtained was noted and extracts were stored.

2.2 Antibacterial susceptibility testing

Antibacterial activity was carried using standard method (Cheesebrough, 2004). Clinical bacterial isolates were grown in broth culture for 6-8 hours then diluted with sterile broth then compared with MacFarland Standard. The inoculum was streaked onto the Mueller hinton plate. Holes were introduced into solidified agar using sterile cork borer 6mm, 1ml of extract was introduced into hole. Plates were allowed to stand on the laboratory desk to ensure diffusion of extracts then incubate aerobically at 37^{o}C.

Minimum inhibitory concentration and Phytochemical test were carried out using standard methods (NCCLS, 2002: Trease and Evans, 2002).

3. Results and Discussion

3.1. Results

Table 1: Percentage Yield of Crude Extracts

Plant extract	Colour extract	Water (%) W/V	Ethanol (%) W/V	Methanol (%) W/V
Monodora myristica	Brown	5.10	3.45	3.20

Table 2: Inhibition zones of crude extracts of *Monodora myristica* against pathogenic bacteria at 50mg/ml in milimetres

Plant extracts	Diameter of inhibition (mm)	*S. aureus*	*E. coli*	*P. Aeruginosa*	*A. baumanii*	*Enterococcus*	*Streptococcus* spp.
Monodora myristica							
	Water	10	0	0	10	10	10
	Ethanol	10	0	0	10	10	0
	Methanol	10	0	0	14	0	0

Table 3: MIC in mg/ml of crude extracts of *Monodora myristica*

Plant extracts		*S. aureus*	*Enterococcus*	*Streptococcus* spp.	*B. subtilis*	*A. baumanii*
Monodora myristica						
	Water	50	50	50	-	50
	Ethanol	25	25	-	-	25
	Methanol	25	-	-	-	12.5

Table 4: Phytochemical analysis of *Monodora myristica*

Plants	Qualitative and quantitative phytochemical compounds in spices (mg/100g)									
	1	2	3	4	5	6	7	8	9	10
Monodora Myristica	++, 858.11	-	-	+.124.81	-	-	-	+, 153.80	++, 558.10	-

Key: - = negative , + = positive, 1-Alkaloids, 2-Anthraquinine, 3saponins, 4-tannins, 5-phenols, 6- cardiac glycoside, 7-steriods, 8- terpenoids, 9, flavonoids, 10- carotenoids

Percentage yield of extracts are presented in the (table 1), the lowest percentage yield was obtained for methanol extract of *Monodora Myristica* ((3.20%)) while water extract had the highest. Table 2 indicated the antibacterial effect of *Monodora myristica* at 50mg/ml. Water extract was active against *Staphylococcus aureus, Acenetobacter baumanii, Enterococcus spp.* and *Streptococcus* spp. Ethanol extract was active against *S. aureus, Acinetobacter baumannii and Enterococcus* spp. Methanol was active against *S. aureus* and *Acinetobacter baumannii (*14mm*).* The minimum concentration for active spices was within 12.5-50mg/ml (Table 3). Table 4 shows the phytochemical test results for the seeds. The quantity included 858.11mg/100g, 124.8mg/100g, 153.80mg/100g and 558.10mg/100g for alkaloids, tannins, terpenoids and flavonoids for *M. myristica* while absence of anthraquinones, saponins, cardiac glycosides, steroids and carotenoids.

3.2. Discussion

Spices are important ingredients in food preparation. Spices contains phytochemical compounds which elicit sensory qualities thus their use as flavour and taste enhancers in food. Previous researches (Adomi, 2006, Adomi, 2008; Adomi and Umukoro, 2010, Adomi et al., 2017; Adomi, 2020; Adomi, 2020; Adomi, 2021, Adomi, 2021) centred on the use of medicinal herbs against pathogens. However, this study focuses on antibacterial and phytochemical effects of *Monodora myristica* spice against clinical bacteria. Water, ethanol and methanol extracts showed some degree of potency against gram positive clinical isolates which included *Staphylococcus aureus, Enterococcus* spp and *Streptococcus* spp. but were not active against gram negative bacteria, (*E. coli* and *P. aeruginosa*) in this study. Similar result was obtained from previous study where gram positive bacteria were susceptible to crude extracts of fresh onions (*Allium cepa*) than gram negative bacteria (Adomi and Nana, 2023). The structure of gram positive bacteria cell walls are simpler than the complex ones of gram negative bacteria. This result contrasted that of Enemchukwu et al. (2022) in which *M. myristica* was active against both grams positive and gram negative bacteria. In addition, the MIC of their extracts ranged from 2.5-3.5mg/ml for *M. myristica* in their study while in this study the MIC was within 12.5-50mg/ml though both studies used clinical isolates. The phytochemical compounds present in this spice are responsible for the activity, sensory and medicinal properties of spice.

Conclusion

The study investigated the antibacterial and phytochemical activities of *Monodora myristica*. The spices were active against gram positive bacteria than gram negative bacteria. The mimimum inhibitory concentration of *M. myristica* extracts was within 12.5mg/ml and 50mg/ml Phytochemical compounds present in *M. myristica* included alkaloids, tannins, terpenoids and flavonoids. *Monodora myristica* in addition of their important function in food preparation, they could be used against ailments caused by gram positive organisms.

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