Afr. J. Traditional,
Complementary and Alternative Medicines
www.africanethnomedicines.net

Research Communication

ISSN 0189-6016©2008

ANTIMICROBIAL ACTIVITY OF ESSENTIAL OILS OF *XYLOPIA AETHIOPICA*

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Abstract

Xylopia aethiopica is a medicinal plant of great repute in West Africa which produces a variety of complex chemical compounds. The fresh and dried fruits, leaf, stem bark and root bark essential oils showed various degrees of activity against the Gram positive bacteria, *Bacillus subtilis* and *Staphylococcus aureus*, the Gram negative bacteria *Pseudomonas aeruginosa* and the yeast-like fungus *Candida albicans*, using the cup plate method,. However, none of the oils showed activity against *Escherichia coli*.

Key words: *Xylopia aethiopica*, Annonaceae, Essential oils, Antimicrobial activity.

Introduction

Essential oils or their constituents are odoriferous substances from plants and are extensively used as medicinal products, in the food industry as flavours and in the cosmetic industry as fragrances (Evans, 2003). Many of these oils have been shown to exert broad spectrum antimicrobial activity (Schelz et al., 2006; Hammer et al., 1999). Xylopia aethiopica (Dunal) A. Rich (Annonaceae) is a valuable medicinal plant widely distributed in the West African rainforest from Senegal and to Sudan in Eastern Africa, and down to Angola in Southern Africa (Irvine, 1961; Burkhill, 1985). Almost every morphological part of the plant is used in traditional medicine for managing various ailments including skin infections, candidiasis, dyspepsia, cough and fever (Burkhill, 1985; Irvine, 1961; Mshana et al., 2000; Ghana Herbal Pharmacopoeia, 1992). A study recently investigated the composition of the essential oils from the leaves, stem and root barks, and fresh and dried fruits of the plant and reported their antioxidant properties, and the principal constituents as mono- and sesqui-terpene hydrocarbons (Karioti et al., 2004). Several reports on the antimicrobial activity of the essential oil of *X. aethiopica* have been made in the literature. For example, the essential oil as well as the crude extracts (both alcoholic and aqueous) of the plant have been shown to have antimicrobial property against a wide range of Gram positive and Gram negative bacteria, and *Candida albicans* (Boakye-Yiadom et al., 1977; Thomas, 1989; Tatsadjieu et al., 2003; Asekun and Adeniyi, 2004; Okigbo et al., 2005). However, all these reports are associated with the dried fruits, with no information on the oils from the other morphological parts of the plant. Recently, Adewoyin et al.. (2006) reported the mosquito repellent activity of the fruit essential oil. In continuation with our studies on *X. aethiopica* (Karioti et al., 2004) we report the antimicrobial status of the essential oils of the leaf, stem and root barks, and fresh fruits of the plant.

Materials and Methods

Plant Material

The fresh leaves, the barks of the stem and root, as well as the fruits of *X. aethiopica* were collected in January 2003 from the same plant growing in the physique garden of the Faculty of Pharmacy, Kwame Nkrumah University Science and Technology (KNUST). A voucher specimen (No. FP/PH/XE10203/TCF) has

been deposited at the Pharmacognosy Department Herbarium, KNUST. The dried fruits were obtained after air - drying the fresh fruits in shade.

Extraction

The essential oils were obtained by hydro-distillation for 3 hrs, using the BP apparatus (the Clevenger type). The oils were collected and dried over anhydrous sodium sulphate, and kept in a stoppered vial in a refrigerator until needed for analysis. Essential oil Yield ($\%^{v}/_{w}$): Fresh fruit = 3.67; Dried fruit = 3.33; Leaf = 0.46; Stem bark = 0.80; Root bark = 0.92.

Test microorganisms

The Gram – positive (*Bacillus subtilis* NCTC 10073, *Staphylococcus aureus* NCTC 10788) and Gram – negative (*Escherichia coli* NCTC 9002 and *Pseudomonas aeruginosa* NCTC 10662) bacteria, as well as the fungus, *Candida albicans* (ATCC 10231) used in this investigation were obtained from the stocks of the Pharmaceutical Microbiology Laboratory of the Department of Pharmaceutics, Faculty of Pharmacy and Pharmaceutical Sciences, KNUST, Kumasi.

Antimicrobial Sensitivity Test

The Cup-Plate Method was used to assess the antimicrobial activity using nutrient agar as the growth medium. The diameter of the well was 10mm, and the oils were tested at 0.1ml of 1% v/v solution in methanol. A 1% w/v solution of Gentamycin and Clotrimazole were used as standards for strains of bacteria and the yeast-like fungus (*Candida albicans*) respectively. Methanol was also used as negative control. The plates were incubated at 37 ºC for 24 hrs after which the zones of inhibition were measured. The test results (Table 1) are the mean of 3 replicates.

Results and Discussion

In a recent review, *X. aethiopica* was shown to have a wide range of biological activities including insecticidal, anti-tumour, anti-asthmatic, anti-inflammatory, antimicrobial, hypotensive and coronary vasodilatory effects, and these were attributed to the wide variety of secondary metabolites in the plant (Fleischer, 2003). In this study, all the morphological parts of the plant (fruit, leaf, stem bark and root bark) yielded varying amounts of essential oils, with the fresh fruits and the leaves providing the highest and the lowest yields respectively. All the oils showed various degrees of inhibitory activity against the test organisms except for *E. coli* which was not sensitive to any of the oils (Table 1). *Staph. aureus* was the most sensitive organism, while *B. subtilis* and *C. albicans* showed the least sensitivity in this study. Comparatively, the oil of the fresh fruits showed slightly higher activity than that of the dried fruits except in the case of *Staph. aureus*. This validates the use of the dried fruits in various disease conditions by traditional health practitioners which is readily obtainable from local markets.

Table 1: Antimicrobial activity of the essential oils of *X aethiopica*

	B. subtilis	*Staph. aureus*	*E. coli*	*Ps. aeruginosa*	*C. albicans*
Essential oil	Zone of Inhibition (mm)				
FFEO	19.17 ± 0.17	23.33 ± 0.33	-	17.00 ± 0.29	14.17 ± 0.17
DFEO	14.67 ± 0.17	24 .17± .073	-	16.17 ± 0.44	13.33 ±0.60
LEO	12.17 ± 0.73	23.17 ± 0.17	-	18.33 ± 0.88	15.17 ± 0.73
SBEO	13 00± 0.29	23.83 ± 0.17	-	15.17 ± 0.17	12.33 ±0.60
RBEO	11.80 ± 0.17	21.00 ± 0.00	-	16.80 ± 0.17	12.17 ± 0.44
GENT	29.00 ± 0.00	29.33 ± 0.33	27.33 ± 0.33	27.83 ± 0.44	Nt
CLOT	Nt	Nt	Nt	Nt	25.33 ± 0.17

FFEO = Fresh fruit essential oil; DFEO = Dried fruit essential oil; LEO = Leaf essential oil; SBEO = Stem bark essential oil; RBEO = Root bark essential oil; GENT = Gentamycin; CLOT = Clotrimazole; - = No inhibition; Nt = not tested; Values are means of three replicates.

Among the conditions treated with *X. aethiopica* in traditional medicine are cough (fruits and roots) bronchitis, dysentery and biliousness (fruits and stem bark) and boils and sores (leaves and bark) (Irvine, 1961; Usher, 1974; Burkill, 1985; Ghana Herbal Pharmacopoeia, 1992; Mshana et al., 2000). The results in this study suggest that the oils of the fruits, leaves, stem and root barks contribute significantly to the antimicrobial properties of the plant parts, and give credence to the use of these parts in the treatment of the disease conditions cited above. The insensitivity of *E. coli* to the oils confirms previous reports (Boakye – Yiadom et al.,. 1977; Okibgo et al., 2005) and further suggests that the essential oils of *X. aethiopica* will not be useful in the treatment of diseases caused by *E. coli*. In our previous report (Karioti et al., 2004), we showed clear variation in the composition of the oils but this was not apparent in the results of the antimicrobial activity. To our best knowledge, this is the first report on the antimicrobial activity of the essential oils of the fresh fruits, leaves, and stem and root barks of *X. aethiopica*.

References

1. Adewoyin, F. B., Odaibo, A. B. and Adewunmi, C. O. (2006), Mosquito repellent activity of *Piper guineense* and *Xylopia aethiopica* fruits oils on *Aedes aegyptii*, Afr. J. Trad., CAM **, 3(2):** 79-83
2. Asekun, O. T. and Adeniyi, B. A. (2004). Antimicrobial and cytotoxic activities of the fruit essential oil of *Xylopia aethiopica* from Nigeria , Fitoterapia, **75:** 368-370
3. Boakye-Yiadom, K., Fiagbe, N. I. Y. and Ayim, J. S. K. (1977). Antimicrobial properties of some West African Medicinal Plants. IV. Antimicrobial activity of xylopic and other diterpenes from the fruits of *Xylopia aethiopica* (Annonaceae), Lloydia, 40: 543-545.
4. Burkhill, H. M. (1985). Useful Plants of West Africa, 2nd edn., vol. 1, Royal Botanic Gardens, Kew, 130-132.
5. Evans, C. (2003). In: Trease and Evans Pharmacognosy 13th Edition, W . B. Saunders, p 253-288.
6. Fleischer, T.C. (2003) *Xylopia aethiopica* A Rich.: A chemical and biological perspective, J. Univ. Sci. Technol. **23:** 24 - 31
7. Ghana Herbal Pharmacopoeia (1992). Policy Research and Strategic Planning Institute (PORSPI) The Advent Press, Accra, 150-152
8. Hammer, K. A., Carson, C. F. and Riley, T. V. (1999) Antimicrobial activity of essential oils and other plant extracts, J Appl. Microb., **86:** 985-
9. Irvine, F. (1961). Woody Plants of Ghana, Crown Agents for Overseas Administration, London, 23-24
10. Karioti A., Hadjipavlou-Latina D., Mensah M. L. K. Fleischer T. C. and Skaltsa H. (2004) Composition and Antioxidant Activity of the Essential Oils of *Xylopia aethiopica* (Dun) A. Rich. (Annonaceae) Leaves, Stem Bark, Root Bark and Fresh and Dried Fruits, Growing in Ghana. J. Agric. Food Chem. **52:** 8094 – 8098.
11. Mshana, N. R., Abbiw, D. K., Addae-Mensah, I., Adjanouhoun, E., Ahyi, M. R. A., Ekpere, J. A., Enow-Orock, E. G., Gbile, Z. O., Noamesi, G. K., Odei, M. A., Odunlami, H., Oteng-Yeboah, A. A., Sarpong, K., Sofowora, A. and Tackie, A. N. (2000). Traditional Medicine and Pharmacopoeia, Contribution to the revision of ethnobotanical and Floristic Studies in Ghana, OAU/STRC Technical Report, 67.
12. Okigbo, R.N., C.S. Mbajiuka and C.O. Njoku (2005), Antimicrobial Potentials of (UDA) *Xylopia aethopica and Ocimum gratissimum L.* on Some Pathogens of Man, Intern. J. Mol. Med. Advance Sci. **1 (4):** 392-397
13. Schelz, Z., Molnar, J. and J. Hohmann (2006) Antimicrobial and Plasmid activities of essential oils. Fitoterapia, **77:** 279 -285
14. Tatsadjieu LN; Essia Ngang JJ; Ngassoum MB and Etoa FX (2003), Antibacterial and antifungal activity of *Xylopia aethiopica*, *Monodora myristica*, *Zanthoxylum xanthoxyloides* and *Zanthoxylum leprieurii* from Cameroon, Fitoterapia;**74:** 469-72
15. Thomas, O. O. (1989). Re-examination of the antimicrobial activities of *Xylopia aethiopica, Carica papaya, Ocimum gratissimum* and *Jatropha curcas*. Fitoterapia **60:** 147-156
16. Usher, G. (1974). A Dictionary of plants used by man, Tinling Ltd., Prescot, Lancs.