BRJ BASIC RESEARCH JOURNALS

Basic Research Journal of Microbiology ISSN 2354-4082 Vol. 4(4) pp. 42-46 July 2017
Available online http//www.basicresearchjournals.org

Full Length Research Paper

Nutritional evaluation and antimicrobial effects of aqueous extract of unripe plantain (*Musa paradisiaca*) peels

***[1]Enemchukwu, Benneth Nnanyelugo, [1]Ibiam, John Ama, [2]Onyedinma, Emmanuel Ifeanyi, [1]Nwali, Uchenna Ignatius**

[1]Department of Science Laboratory Technology, Akanu Ibiam Federal Polytechnic, Unwana, P.M.B.1007, Afikpo, Ebonyi State, Nigeria.
[2]Michael Okpara University of Agriculture, Umudike, P.M.B. 7267, Umuahia, Abia State, Nigeria.

*Corresponding Author's Email: achylesma@yahoo.com, Tel: +2348034009418

Accepted 05 April 2017

ABSTRACT

The growing prevalence of antibiotic resistance amongst clinically important pathogens necessitates the search for potential healing powers in herbal plant. In this study therefore, nutritional composition and *in vitro* antimicrobial activities of aqueous extract of unripe plantain (*Musa paradisiaca*) peels were evaluated using the disc diffusion technique against *Staphylococcus aureus, Escherichia coli, Micrococcus flavus and Pseudomonas aeruginosa.* The microorganisms were isolated after subculture and purified and preliminary antimicrobial sensitivity test of the extract was carried out with the isolated microorganisms at different dilution of the extract (6.25mg/ml, 12.5mg/ml, 25mg/ml, 50mg/ml and 100mg/ml). The results of proximate analysis revealed the following: moisture (7.47±1.25%), ash (17.59±1.05%), fat (3.67±1.20 %), protein (6.5±1.40%) and carbohydrate (64.7±1.28%) with calorific value of 277.74±2.02Kcal/100g DM. Thus, the nutritional value of *Musa paradisiaca* peels is high and as such it could be used as feed additives. The extract had antimicrobial activities against *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus* and *Micrococcus flavus* with varying degrees. The minimum inhibitory concentration of the extract was determined to be 100mg/mL and the growth inhibition zones of 5mm exhibited by the extract at 100mg/ml dilution, against *Escherichia coli* were significantly higher (P<0.05) compared to inhibition zones of 3mm for *Staphylococcus auerus,* 2mm for *Micrococcus flavus* and 2mm for *Pseudomonas aeruginosa* respectively at the same concentration. The findings in this prospective study indicated that unripe plantain peels contained appreciable amount of nutrients and antimicrobial properties and as such could be useful in ethno-medicine for the treatment of microbial infections caused by these microorganisms.

Keywords: Microorganisms, disc diffusion, growth inhibition zones.

INTRODUCTION

The importance of traditional system of medicine and certain traditional medical practices has now been recognized all over the world (Satyabati, 2006). That human beings are still dependent on nature for remedies

is well apparent from the fact that all the major systems of medicine, example Ayurreda, Unani and Homeopathy are largely based on drugs of plant origin (Chatterjee and Prakashi, 1997).

Exploring traditional herbal medicines in the context of modern science is the need for optimum and proper utilization of traditional plant drugs. In the past decade, WHO (recognizing the importance of herbal medicine) has passed many resolutions for improving the quality and efficacy of plant drugs (Subramanian, 2001). Plant drugs are frequently considered to be less toxic and free from side effects than the synthetic ones (Momin, 2007). Some of the drugs used today such as codeine, morphine, atropine, cocaine and ephedrine have originated from medicinal plants (Ajoy *et al.,* 2011).

Musa paradisiaca (plantain), a tropical plant, is one of the oldest and best known fruit of the world. It is a delicious and seedless fruit that is available in all seasons at a price which is within every body's reach. It has been consumed since many years by mankind for nutritious and delicious fruits. Different species of *Musaceae* have been discovered. These include *Musa paradisiaca (plantai*n) now called *Musa acumintum* (Banana), *Musa ornate, Musa aurantiaca*, etc (Ajoy *et al.,* 2011).

There are piles of scientific support on the efficacy of medicinal plants in the management of ulcer of different etiologies (Akah *et al.,* 2007). The medicinal properties of these plants are attributed mainly to the presence of flavonoids, but they may also contain other organic and inorganic compounds such as coumarins, alkaloids, terpenoids, tannins, phenolic acids and anti-oxidants; micronutrients like copper, manganese and zinc (Prabha *et al.,* 2011).

In the traditional medicinal systems of India, all the parts of *Musa specie* (family *Musaceae*) are used for the treatment of various diseases (Gurumaa, 2008) and extensive investigations have proved the anti-ulcerogenic, ulcer healing activities and wound healing activity (Agarwal *et al*., 2009) of *Musa paradisiaca*. Young leaves are used as a cool dressing for blisters and burns (Chopra *et al*., 2006). Aqueous extract of unripe *Musa paradisiaca* peels and leaves of *Musa paradisiaca* has been reported to show antimicrobial activity against *Staphylococcus* and *Pseudomonas* species in dehydrogenase assay. In the assay, extract of *Musa paradisiaca* peels showed activity against both bacteria strains than leaf extract. The *Musa paradisiaca* peels extract was found to be more active against *Staphylococcu* than *Pseudomonas* species (Mohammad and Saleha, 2011). Plantain flakes have also been tested and found safe and cost-effective in the treatment for diarrhea in critically ill patients (Mohammad and Saleha, 2011; Orhan, 2001).

AIMS/ OBJECTIVE

The aim of this study is to evaluate the nutritional and antimicrobial properties of aqueous extract of unripe plantain peels on different strains of microorganism; *Staphylococcus aureus, Escherichia coli*, *Pseudomonas aeruginosa* and *Micrococcus flavus.*

The objective of this study is to investigate the proximate composition and *in vitro* antimicrobial activities of aqueous extract of unripe plantain peels on different strains of microorganisms: *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Micrococcus flavus*.

MATERIALS AND METHOD

Plant Material Procurement

Mature bunch of fresh unripe plantain was purchased from Eke Market in Afikpo North Local Government Area, Ebonyi State, Nigeria. The plant material was identified and authenticated by a herbarium curator at the Science Laboratory Technology Department, Akanu Ibiam Federal Polytechnic, Unwana, Afikpo, Ebonyi State. The peels from the plantain fingers only were used.

Experimental organisms

The test organism such as *Staphylococcus aureus*, *Escherichia coli*, *Micrococcus flavus* and *Pseudomonas aeruginosa* were clinically cultured and obtained from the Microbiology Laboratory, Department of Science Laboratory Technology, Akanu Ibiam Federal Polytechnic, Unwana. All the microorganisms were isolated after subculture and were checked for purity and were maintained on Nutrient Broth at $4^{o}C$ in the refrigerator until required for analysis. The standardized cultures of the organisms were used throughout the experiment.

Extraction procedure

The peels from the plantain fingers were cut into small pieces and air dried for two weeks and then ground into powder with mortar and pestle. The extraction process was carried out using soxhlet reflux extraction technique with water and the extract was evaporated using rotary evaporator in other to concentrate the extract at the appropriate concentration and was stored in a refrigerator until the experimental analysis.

Table 1. Proximate Composition of Unripe Plantain (*Musa Paradisiaca* Peels)

Parameters	Amount (%)
Moisture	7.47±1.25
Ash	17.59±1.05
Fat	3.67±1.20
Protein	6.50±1.40
Carbohydrate	64.75±1.28
Calorific value (Kcal100g-^{1}DM)	277.74±2.02

Proximate analysis

The recommended methods of the Association of Official Analytical Chemists (AOAC, 1999) were used for the determination of moisture, ash, crude lipid, crude fibre, crude protein and carbohydrate contents.

Estimation of energy value

The sample calorific value was estimated (Kcal) by multiplying the percentage crude protein, crude lipid and carbohydrate by the recommended factor (2.44, 8.37 and 3.57 respectively) used in vegetable analysis (Asibey-Berko and Tayie, 1999).

Preparation and impregnation of *Musa paradisiaca* peel disc

Discs of about 6.0mm diameter were punched from Whatman's No. 1 filter paper (UK) by the use of a perforator. Batches of about 100 discs were arranged in a petri-dish allowing a distance of 2-4mm between each of them. And the discs were sterilized in an oven at about 121^{o}C for 15 min. About 2 drops of the different serial dilution concentrations of the aqueous extract of *Musa paradisiaca* peels were added to the different discs. The discs were arranged in separate Petri-dishes and dried in an incubator at temperature 37°C for 2-3 h for complete absorption to take place.

Bacterial sensitivity test

The level of susceptibility of each of the test organism was determined using agar disc diffusion method as outlined in Suresh *et al*. (2008).

Experimental design

A total of 45 culture plates with different strain of microorganism were used for the experiment and were divided into 9 groups designated A-I with 5 plates per group with different dilution. Groups A-D served as the test groups, E-H as negative control while group I containing standard drug (Chloramphenicol) served as the positive control.

Statistical analysis of data

Analysis of variance (ANOVA) for the data was carried out using SPSS window version 15.1 Chicago, USA and multiple comparisons performed using LSD. p-values of <0.05 were considered statistically significant.

RESULTS

The proximate composition of unripe plantain (*Musa Paradisiaca*) peels

The proximate composition of *Musa paradisiaca* peel is shown in table 1. The results revealed the following: moisture (7.47±1.25%), ash (17.59±1.05%), fat (3.67±1.20%), protein (6.50±1.40%) and carbohydrate (64.7±1.28%) with calorific value of 277.74±2.02Kcal/100g DM.

Determination of minimum inhibitory concentration (MIC)

The Minimum Inhibitory Concentration values for *Staphylococcus auerus, Escherichia coli*, *Micrococcus flavus*, *Pseudomonas aeruginosa*, by the aqueous extract of unripe plantain (*Musa paradisiaca*) peels is shown in table 2.

At low concentrations (from 6.25mg/mL to 50mg/mL), the aqueous extract was not inhibitory to the test organisms and activity was only observed at 100mg/mL. So, the Minimum Inhibitory Concentration for aqueous extracts of unripe plantain peels was determined to be 100mg/mL.

Table 2. Determination of Minimum Inhibitory Concentration of Aqueous Extract of *Musa Paradisiaca* Peels

Microorganism	Concentration (mg/mL)				
	6.25	12.5	25	50	100
Pseudomonas aeruginosa	+	+	+	+	–
Escherichia coli	+	+	+	+	–
Staphylococcus auerus	+	+	+	+	–
Micrococcus flavus	+	+	+	+	–

+ = Growth, – = No growth.

Table 3. Determination of Zone of Inhibition of Aqueous Extract of *Musa Paradisiaca* Peel.

Microorganism	Concentration (mg/mL)						
	6.25	12.5	25	50	100	w	Std*
Staphylococcus auerus	–	–	–	–	3	–	6
Escherichia coli	–	–	–	–	5	–	6
Micrococcus flavus	–	–	–	–	2	–	8
Pseudomonas aeruginosa	–	–	–	–	2	–	7

*means Standard drug (Chloramphenicol), w means negative control(distilled water), – means no growth inhibition.

Determination of zone of inhibition

The sensitivity pattern of *Staphylococcus auerus, Escherichia coli*, *Micrococcus flavus* and *Pseudomonas aeruginosa* as exhibited by the aqueous extract of *Musa paradisiaca* peels and the standard antibiotic drug (Chloramphenicol) is shown in table 3. From the results, activity was only observed at 100mg/mL concentration of extract with the growth inhibition zone of the following; 3mm, 5mm, 2mm and 2mm for *Staphylococcus auerus, Escherichia coli*, *Micrococcus flavus*, and *Pseudomonas aeruginosa* respectively and the standard antibiotic exhibited the following activity; 6mm, 6mm, 8mm and 7mm for *Staphylococcus auerus, Escherichia coli*, *Micrococcus flavus*, and *Pseudomonas aeruginosa* respectively.

DISCUSSION

Discovering and harnessing the hidden potentials of plants with medicinal properties is the basis for unleashing novel antimicrobials for the fight against antimicrobial resistance. The present study investigated the nutritional evaluation and *in vitro* antimicrobial potentials of aqueous extract of *Musa paradisiaca* (unripe plantain) peels against different strains of clinical isolates of *Staphylococcus aureus, Escherichia coli*, *Micrococcus flavus and Pseudomonas aeruginosa Musa paradisiaca* (Plantain) is a major starch of importance in the human tropical zone of Africa, Asia, Central and South America. It is undoubtedly one of the oldest cultivated fruits in west and Central Africa. It is consumed as an energy yielding food and desert. Fruits such as plantain are important contribution to the diets of many low and middle class people in many African settings (Stover and Simmonds, 2007). In the traditional medicinal systems, all the parts of *Musa specie* (family *Musaceae*) are used for the treatment of various diseases (Gurumaa, 2008). Extensive investigations have proved the antiulcerogenic, ulcer healing activities and wound healing activity (Agarwal *et al*., 2009) of plantain. The results (**table 1**) indicated that *Musa* paradisiaca peels have appreciable amount of nutrients. Similar appreciable nutritional value**s** have been reported by other researchers for similar plants (Aja *et al.,* 2010; Akubugwo *et al.,* 2007a, b). However, there were variations which could be as a result of plant species, genotype and other environmental factors (Gardens *et al.,* 1996; Ezeamuzieji *et al.,* 1994). These results have shown that *Musa paradisiaca* peels could serve as alternative source of feed for animals and humans.The result of determination of Minimum Inhibitory concentration of aqueous extract of *Musa paradisiacal* is shown in **table 2.** The Minimum Inhibitory Concentration was determined at100mg/mL against the selected strains of microorganisms. Among the controls, group I (positive control) (microorganism with chloramphenicol has the highest zones of inhibition than the group E– H(negative control) (microorganisms with distilled water) which has no zone of inhibition at all. Sensitivity to extract was observed at 100mg/mL against all the test microorganisms. Zone of inhibitions observed at 100mg/mL against all the test organisms varied tremendously which of course are different from that of

the standard drug (chloramphenicol). In this study, *Musa paradisiaca* peels extract was found to be more active against *Staphylococcus* (Gram-positive) than *Pseudomonas* species (Gram-negative) which is in agreement with the study of Mohammad and Saleha (2011).

CONCLUSION

The findings in this prospective study indicated that unripe plantain peels contained appreciable amount of nutrients and antimicrobial properties against the test organisms used in this study and as such could be useful in ethno-medicine for the treatment and management of microbial infections and related ailments caused by these bacteria.

REFERENCES

Agarwal RK, Sigh A, Gauraw K, Shalini G, Khanna HD, Goel RK (2009). Evaluation of wound healing activity of extracts of plantain banana (*Musa sapientum* var. *Paradisiaca*) in rats. *Indian J. Exper. Biol.* 47(7): 32 – 40.

Aja PM, Okaka ANC, Onu PN, Ibiam UA, Urako AJ (2010). Phytochemical composition of *Talinum triangulare* (water leaf) leaves. *Pak. J. Nutr.* 9: 527-530.

Ajoy KG, Souvar B, Halder B, Nishith RB (2011). An overview on different variety of *Musa species*: importance and its enormous pharmacological action. *Intern. J. Pharm. Herbal Formulations,* 1 (2): 1 – 10.

Akah PA, Lucy J, Nwonu CS (2007). Gastro-protective properties of the leaf extracts of *Ocimum gratissimum* L. against experimental ulcers in rats. *Intern. J. Pharm.* 3(6), 461-467.

Akubugwo EI, Obasi NA, Chinyere GC, Ugbogu AE (2007). Mineral and phytochemical contents in leaves of *Amaranthus hybridus* and *Solanum nigrum* L. subjected to different processing methods. *Afri. J. Biochem. Res.* 2: 40-44.

Akubugwo IE, Obasi NA, Ginika SC (2007). Nutritional potential of the leaves and seeds of black nightshade- *Solanum nigrum* L. Var virginicum from Afikpo-Nigeria. *Pak. J. Nutr.* 6: 323-326.

AOAC (1999). Methods of Analysis of Association of Official Analytical Chemists. 16th Edn., AOAC, Washington, DC, USA., pp: 600-679.

Asibey-Berko E, Tayie FAK (1999). Proximate analysis of some under-utilized Ghanaian vegetables. *Ghana J. Sci.* 39: 91-96.

Chatterijee A, Prakashi SC (1997). The treatise on Indian Medicinal Plants. *National Institute of Service and Communication,* 1(2): 1 – 2.

Chopra RN, Nayar SL, Chopra IC (2006). Glossary of Indian Medicinal plants. *Intern. J. Pharmacol.* 1 (3): 10 – 12.

Ezeamuzieji C, Ojimaka MC, Uzogara EO, Oji SE (1994). Anti-inflammatory, Anti-phyretic and Anti-Malaria activities of a West African Medical Plant- *Picralima nitida*. *Afri. J. Med. Med. Sci.* 23: 85-90.

Gardens AD, Menzies JRW, Macdonald A, Paterson SJ, Dowagiac M (1996). The opined activity of hacuammine, akauammicine and akalammidine alkaloids from *Picralima nitida* (from *Apocynaceae*). *Bri. J. Pharmacol.* 119: 334-339.

Gurumaa A (2008). Go Banana: banana guide benefit and nutrition facts. http://.www.gurumaa.com/health-go-bananas. (Retrieved June 28, 2014).

Mohammad ZI, Saleha A (2011). *Musa paradisiaca* L. and *Musa sapientum* L.: A phytochemical and pharmacological review. *J. Appl. Pharm. Sci.* 1(5):14–20.

Momin A (2007). Role of indigenous medicine in primary health care. *Intern. J. Pharmacol.* 1 (2): 54.

Orhan IJ (2001). Biological activities of *Musa species*. *Journal of the Faculty of .Pharmacy of Ankara,* 30(1): 39-50.

Prabha P, Karapagam T, Varalakshine B, Packiavathy AS (2011). Indigenous anti- ulcer activity of *Musa sapientum* on peptic ulcer. *Pharmacognosy Research,* 3:232-238.

Satyabati GV, Patil PN, Gulati OD, Balaraman R (2006). History of Pharmacology of Medicinal plants in India. *Indian J. Pharmacol.* 4 (2): 9 – 10.

Stover RH, Simmonds NW (1997). Bananas: Tropical Agricultural Series. New York: Longman Scientific and Technical, p.8.

Subramonian A (2001). The problems and prospects of plant drug research in India: Pharmacological evaluation of ecotypes in herbal drug development. *Indian J. Pharmacol.* 33 (4): 145 – 146.

Suresh K, Saravana BS, Harisranry R (2008). Studies on *in vitro* antimicrobial activity of ethanol extract of *Rauvolfia tetraphylla*. *Ethobotanical Leaflets,* 12: 586-590.