IJORP
International Journal of Research and Publications

Comparative antioxidant composition of ripe and unripe Musa acuminata.

Anizoba, G. C. and Udeh, K. U.

Department of Science laboratory Technology, Federal Polytechnic Oko, Anambra state.

Email: philipzoba@gmail.com

Abstract

Musa acuminate (plantain) is a tropical fruit and a staple food that plays a role in the nutrition and health of people worldwide. The study investigates comparatively the phytochemical and vitamin antioxidants contents of unripe and ripe *Musa acuminate* purchased from Eke Oko market, Orumba North local Government, Anambra state. The samples were identified, washed, peeled, cut into tiny pieces and blended. The antioxidants were determined by titration and spectrophotometric methods. The results obtained from the analysis show the phytochemical and vitamin antioxidants viz; the phenol, lycopene, flavonoid, β-caroetene, vitamin E and vitamin C contents, for unripe plantain (0.975±0.005mg/l, 8.720±0.07mg/kg, 0.3%, 49.105±0.40, 0.260±0.03 and 0.080 respectively.) and ripe plantain (1.085±0.005mg/l, 6.930±0.070mg/kg, 0.3%, 47.405±0.40ml/l, 0.130±0.03mg/l and 0.772±0.020mg/l respectively). Generally, the phytochemical and vitamin screening of the plantain showed decreased levels of Lycopene, β-carotene and Vitamin E, but increased levels of Phenol and Vitamin C as ripening progressed. The results obtained in this study showed that plantain irrespective of the variety and state is a good sources of antioxidants.

Keywords: *Musa acuminata*, antioxidants, phytochemicals and plantain.

Introduction

Fruits and vegetables are natural sources of useful fiber, minerals, and vitamins. They are rich sources of natural antioxidant compounds that have been linked with their health promoting effects (Patel et al., 2011). Important compounds like alkaloids, flavonoids, tannins, steroids and phenolics are found in fruits and vegetables. High antioxidant activity as well as biological effects has been associated with flavonoids

and alkaloids that are usually found in medicinal plants (Mbaebie et al., 2012). Flavonoids and phenols in plants have been reported to show antioxidant, free radical scavenging abilities, anti-inflammatory and anticarcinogenic properties (Tapas et al., 2008). Phenol compounds present in plants have proven to contribute to colour, sensory and antioxidant properties of food (Eleazu et al., 2011).

Musa acuminata is a treelike herb that grows 5 - 9 m in height. It belongs to the Musaceae family and has been available for human use for ages. The ripe fruit is sweet, juicy, and full of seeds and the peel is thicker than other banana. The fruit of *Musa paradisiaca* and *Musa acuminata* since ancient age have been used to treat abdominal distress such as constipation, diarrhoea (unripe), dysentery, intestinal lesions, unripe banana also used in curing diabetes , in uremia, nephritis, gout, hypertension, cardiac disease (Khare, 2007). Because of the low glycemic index of plantain, the unripe powder is commonly consumed by diabetics in Nigeria to reduce after-meal glucose level (Eleazu et al., 2010; Eleazu et al., 2012). Furthermore, plantain is employed in the folklore management of chronic wounds and ulcer.
Several flavonoids and related compounds (Leucocyanidin, quercetin and its galactoside) were isolated from the unripe pulp of plantain (Lewis et al., 1999). Phytochemical screening of the various aqueous, ethanolic, methanolic extracts of the plantain peel and pulp has revealed the presence of secondary metabolites like flavonoids, saponin, tannins, alkaloids, and phenols. Besides some well known secondary metabolites, banana peel and pulp also persist antibacterial properties and anti bacterial peptides activity. The flavonoid leucocyanidin has been identified as the active ingredient in plantain for its anti-ulcerogenic properties (Iweala et al., 2011). There have also been reports for its antimicrobial, anti-urolithiatic and analgesic properties (Kumar et al., 2012). Shodehinde and Oboh (2013) identified different phenolics such as apigenin, luteolin, myricetin, capsaicin and isorhaemnetin in plantain, some of which have been related with anti-thrombotic, anti-pyretic, anti-inflammatory, hypolipidemic, hypocholesterolemic and analgesic properties. The present research study investigates comparatively the phytochemical and vitamin antioxidants composition of ripe and unripe plantain (*Musa acuminata*).

Materials And Methods

Sample collection and preparation

The fresh ripe and unripe plantains were purchased from Eke Oko market, Orumba North Local Government, Anambra state. The samples were identified, washed, peeled, cut into tiny pieces and blended.

Determination of total phenol content

The total phenol content was determined according to the method of Singleton et al., (1999). Briefly, the aqueous extracts were oxidized with 2.5 mL 10% Folin-Ciocalteau's reagent (v/v) and neutralized by 2.0 mL of 7.5% sodium carbonate. The reaction mixture was incubated for 40 min at 45 °C and the absorbance was measured at 765 nm. The total phenol content was subsequently calculated as gallic acid equivalent.

Determination of total flavonoid content

The total flavonoid content of the unripe plantain extracts was determined using method of Meda et al.,(2005) The volume of 0.5 mL of sample/standard quercetin was mixed with 0.5 mL methanol, 50 µL of 10% AlCl3, 50 µL of 1 mol/L potassium acetate and 1.4 mL water. The reaction mixture was incubated at room temperature for 30 min. Thereafter, the absorbance of the reaction mixture was measured at 415 nm in the spectrophotometer. Total flavonoid content was calculated using quercetin as a standard

Determination of vitamin C content

Vitamin C content of the unripe plantain extracts was determined using the method of Guaerrant et al.,(1935). A sample weight of 10g was measured into a beaker and 20ml of distilled water was added and stirred. The supernatant was decanted through Mushin doth into a 50ml volumetric flask. Twice more were extracted using 10ml of distilled water each time and 5ml of acetone was added to make up to the mark. The 5ml of the sample was pipette into a boiling tube and 1ml of glacial acetic acid was added to it upon cooling. The mixture was titrated with indophenols dye to a permanent faint pink colour. The titre(T) values were recorded. The titration was repeated with 5ml of water for the blank (BL) and 5ml of standard ascorbic acid solution (ST). The vitamin content of the test samples were calculated using the equation viz;

Vitamin C (mg/100cm3) = (T-BL/ST-BL) × conc. of standard.

Determination of vitamin E (Tocopherol) content

The level of tocopherol (Vitamin E) was estimated spectrophotometrically by the method of Rosenberg (1992). A measured volume of 3ml each of absolute ethanol and xylene were added to an aliquot of 3ml of the filtrate obtained from the extraction of vitamin E. The mixture was thoroughly

mixed for 2 min to obtain a homogenous mixture, which was centrifuged at 1000 g for 10 min. After centrifugation, 2.0 ml of 120 mg/100 ml 2,2'-dypyridyl in propanol were added to 2.0 ml of the xylene layer, which was the supernatant and the absorbance read at 480 nm. 0.66 ml of 120 mg/100 ml ferric chloride in ethanol was added to the reaction mixture and the absorbance was read at 520nm at exactly 30 sec. 1mg/100ml vitamin E and distilled water were used as standard and blank (Control) respectively.

Determination of β-Carotene and Lycopene (Carotenoids) contents

The levels of β-Carotene and Lycopene (Carotenoids) were estimated by the method of Bortolotti et al. (2003). The ground sample was added to 20ml acetone and 30ml hexane contained in a beaker and the content was stirred with a glass rod. The mixture was poured into a separating funnel and shaken vigorously until the content became homogenous. The mixture was allowed to separate into layers and the top layer was used for the estimation. The absorbance of the top layer was taken at 453nm for β-carotene and 503 nm for lycopene. At 503 nm, lycopene has a maximum absorbance while carotene has only a negligible absorbance. (Zakaria et al., 1979).

Results

The ripening is the last phase of fruit development, which involves a series of physiological and biochemical events leading to changes in colour, flavour, aroma and texture that makes the fruit both attractive and tasty. In general, the fruit becomes sweeter, less green, more edible and softer as it ripens (Suman et al., 2011).In this study, the phytochemicals and vitamins antioxidant levels of Musa paradisciaca in unripe and ripe stages were determined and the results presented in the following table 1.

Table 1: The result of quantitative determination of phytochemicals and vitamin antioxidants in Musa acuminata

Parameters	Unripe plantain	Ripe plantain
Phenol	0.975±0.005 mg/l	1.085±0.005 mg/l
Lycopene	8.720±0.070 mg/l	6.930±0.070 mg/l
Flavonoid	0.3%	0.3%
β Carotene	49.105±0.40 mg/l	47.405±0.40 mg/l
Vitamin E	0.260±0.030 mg/l	0.130±0.030 mg/l
Vitamin C	0.080±0.040 mg/l	0.720±0.020 mg/l

The level of vitamin E in mango fruit has been reported to increase during ripening (Rajesh et al., 2011), which is dissimilar to the decrease in vitamin E that was observed

in this study in the riped plantain Agoreyo et al. (2013) has also observed an increase in vitamin E during ripening of eggplants (Solanum melongena (oval variety) and Solanum aethiopicum (round variety). Vitamin C was increased during ripening.

Discussions

Carotenoids as well as tocopherols are known to be efficient antioxidants and are capable of scavenging reactive oxygen species generated during oxidative stress (Stahl et al., 2000). Lycopene, which is a carotenoid is one of the most popular pigments accepted by the food industry as a food additive. Biologically, lycopene acts as a singlet oxygen and peroxyl radical scavenger (Stahl and Sies, 2003). From this study, lycopene and β-carotene levels of the plantains that were used decreased during ripening, which is dissimilar to the increase in the level of lycopene that was reported for Maradol papaya during ripening (Rivera -pastrana et al., 2010). Bramley (2002) also reported a significant increase in carotenoid levels in tomato during ripening due to the accumulation of lycopene. Increase in lycopene in two varieties of Carica papaya (local and agric pawpaw) during ripening has also been reported by Agoreyo et al (2013). β-carotene was found to decrease negligibly during ripening. Tomatoes have also been reported to contain high level of lycopene and low level of β-carotene (Kokuzue and Friedmann, 2003).

Generally, the phytochemical and vitamin screening of the plantain showed decreased levels of Lycopene, β-carotene and Vitamin E, but increased levels of Phenol and Vitamin C as ripening progressed. The increase in phenol content with ripening disagreed with studies by Oladele and Khokhar (2011) and Ibukun et al. (2012), who also reported that phenolic content decreased as plantain fruit ripened. Phenol compounds present in plants have proven to contribute to colour, sensory and antioxidant properties of food (Eleazu et al., 2011). It should be noted that there was no change in flavonoid content from unripe to ripe stage. However, these antioxidants are plant secondary metabolites that exist to contribute to the physiological dynamics of growth and development.

Conclusion

The unripe and ripe stages of plantains that were used in this study contained more antioxidant properties which could help to scavenge free radicals and prevent diseases in humans. They therefore, serve as important and natural sources of antioxidants. The consumption and addition of plantain to diets could help to increase the ability of the body to counteract the effect of oxidative damage,

irrespective of the cultivar. Also, consumption of these fruits in all the stages have great health benefits because they are important sources of antioxidants, which help to scavenge free radicals or reactive oxygen species (ROS) that are deleterious to health.

References

Agoreyo, B.O., Okhihie, .O. and Agoreyo, F.O. (2013). Carotenoids, Glutathione and Vitamin E contents of eggplant (Solanum spp.) during ripening. *Nigerian Journal of Pharmaceutical & Applied Science Research*.2:41-48

Guerrant, N. B. , Rasmussen, R. A. and Dutcher, R. A. (1935). The Value of the Chemical Titration Method in Determining the Vitamin C Potency of Certain Food Substances.*The Journal of Nutrition*, Volume 9, Issue 6, June, Pages 667–675, https://doi.org/10.1093/jn/9.6.667

Bortolotti, S., Boggio, S. B., Delgado, L., Orellano, E.G. and Valle, E.M.(2003). Different induction patterns of glutamate metabolizing enzymes in ripening fruits of the tomato mutant green flesh. Physiologia Plantarum, 119:384-391.

Bramley, P.N. (2002). Regulation of carotenoid formation during tomato fruit ripening and development. *Journal of Experimental Botany*, 53:2107-2113.

Eleazu, C.O. and Okafor P.N. (2012). Antioxidant effect of unripe plantain (Musa paradisiacae) on oxidative stress in alloxan induced diabetic rabbits. *Int J Med Biomed Res*. 1:232-241.

Eleazu, C.O., Okafor, P.N., and Ikpeama, A.I. (2010). Total antioxidant capacity, nutritional composition and inhibitory activity of unripe plantain (Musa paradisiacae) on oxidative stress in alloxan induced diabetic rabbits. *Pakistan J of Nutr*. 9:1052-1057.

Eleazu, C.O., Okafor, P.N., Aniago, J., Awa. E., Ikpeama, A.I., Eleazu, K.C., (2011). Chemical composition, antioxidant activity, functional properties and inhibitory action of unripe plantain (*Musa paradisiacal*) flour. *African Journal of Biotechnology* 10(**74**), 16948-16952

Ibukun, O. E., Kade, I. J., Oguntoyinbo, T. A., Ogunmoyole, T. and Johnson, O. D.(2012). Effect of ripening on the phytochemical constituents and antioxidant properties of plantain (Musa paradisiaca). *Journal of Medicinal Plants Research.* 6(**37**):5077-5085.

Iweala, E.A, Obichi IC, Omotosho OE. Biochemical and Histological responses of hepatoxic rat fed *Musa paradisiaca* L. supplemented diet. *Int J Pharmacol* 2011; 7(**4**): 471-477.

Khare, C.P. (2007). Indian Medicinal Plants–An Illustrated Dictionary. First Indian Reprint, *Springer* (India) Pvt. Ltd. New Delhi 717718.

Kozukue, N. and Friedman, M. (2003). Tomatine, chlorophyll, β-carotene and lycopene content in tomatoes during growth and maturation. *Journal of the Science of Food and Agriculture*.83: 195 -200

Kumar, R.V, Venkatrajireddy, G., Bikshapathi, T. and Reddy, M. K. (2012). Antioxidant-the

Maximum expressed activity among 63 medicinal plants. *J Phyto Pharmacol*; 1(**5**): 1-13.

Lewis, D.L., Field, W.D. and Shaw, G.P. (1999). A natural flavonoid present in unripe plantain banana pulp (Musa sapientum L. var. paradisiaca) protects the gastric mucosa from aspirin-induced erosions *J. Ethnopharmacol*., 65, 283-288.

Mbaebie, B.O., Edeoga, H.O., and Afolayan, A.J.(2012). Phytochemical analysis and antioxidants activities of aqueous stem bark extract of SchotialatifoliaJacq. *Asian Pac J Trop Biomed*. 2:118-124.

Meda A, Lamien CE, Romito M, Millogo J, Nacoulma OG. Determination of the total phenolic, flavonoid and proline contents in Burkina Faso honey, as well as their radical scavenging activity. Food Chem 2005; 91: 571-577.

Oladele, E. and Khokhar, S.(2011). Effect of Domestic Cooking on the Polyphenolic Content and Antioxidant Capacity of Plantain (Musa paradisiaca) *World Journal of Dairy and Food Sciences*,6 (**2**): 189-194.

Patel, D.K., Kumar, R., Laloo, D., and Hemalatha, S.(2014). Evaluation of phytochemical and antioxidant activities of the different fractions of Hybanthusenneaspermus (Linn.) F. Muell. (Violaceae). *Asian Pac J Trop Med*. 4, 391-396.

Rajesh, K.S., Sharique,A.A., Pravendra, N. and Vidhu ,A. (2011). Activation of ethylene-responsive p-hydroxy phenylpyruvate dioxygenase leads to increased tocopherol levels during ripening in mango, *Journal of Experimental Botany*, 62:3375-3385

Rivera-Pastrana, D.M., Yahia, E.M. and González-Aquilar, G.A. (2010). Phenolic and Carotenoids Profiles of Papaya fruit (Carica papaya L.) and their contents under low temperature storage. *J. Sci. Food Agric*., 90:2358-2365.

Rosenberg, H.R. (1992). Chemistry and physiology of vitamins.Interscience Publishers, Inc., New York, pp.452-453.

Shodehinde, S.A. and Oboh, G (2013). Antioxidant properties of aqueous extracts of unripe Musa paradisiacaonsodium nitroprusside induced lipid peroxidation in rat pancreas in vitro. *Asian Pac J Trop Biomed*. 3:449-457.

Singleton, V.L., Orthofer, R. and Lamuela-Raventos, R. M. (1999). Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin-Cioalteau reagent. Methods *Enzymol*; 299: 152-178.

Stahl , W. and Sies, H. (2003). Antioxidant activity of carotenoids. *Mol Aspects of Med*., 24:345-351.

Suman, S., Madan ,K. and Seema ,T.(2012). Application of apple as ripening agent for banana. *Indian Journal of Natural Products and Resources*, 3(**1**):61-64.

Stahl, W., Heinrich, U., Jungmann ,H., Sies ,H., and Tronnier (2000). Caroteniods and caroteniods plus vitamin E protect against ultraviolet light-induced erythema in humans. *American Journal Clinical Nutrition*,71:795-798.

Tapas, A.R., Sakarkar, D.M. and Kakde, R.B., (2008). Flavonoids as nutraceuticals: A review. *Tropical Journal of Pharmaceutical Research* 7, 1089-1099.

Zakaria, H.,Simpson,K., Brown, P.R and Krotulovic, A. (1979). Use of reserved phase HPLC analysis for the determination of provitaminA, carotenes in tomatoes. *Journal of Chromatography*,176:109-317.