Proximate analyses, phytochemical screening and antibacterial potentials of bitter cola, cinnamon, ginger and banana peel

SO Fapohunda*, Mmom, J U and Fakeye, F

Department of Biosciences and Biotechnology,Babcock University,Ilishan Remo
Nigeria
*oystak@yahoo.co.uk

Abstract: The proximate and phytochemical analyses were carried out on the dried and pulverized samples of ginger; (*Zingiber officinale),* and cinnamon (*Cinnamomum verum)*, banana(*Musa acuminata*) and bitter kola(*Garcinia spp*) which were obtained from an open market in Ibadan, Lagos, and Sagamu in south west Nigeria. Carbohydrate content in ginger and cinnamon were 71.315% and 66.69% respectively while for banana peels and bitter kola values ranged from 43.08% to 74.81%. *Proteus vulgaris and Klebsiella pneumoniae* showed susceptibility to extracts from bitter kola and banana peel.
[SO Fapohunda, Mmom, J U and Fakeye, F. **Proximate analyses, phytochemical screening and antibacterial potentials of bitter cola, cinnamon, ginger and banana peel.** *Academ Arena* 2012;4(8):8-15] (ISSN 1553-992X). http://www.sciencepub.net/academia. 2

Keywords: phytochemicals,bitter cola, cinnamon, ginger, banana peel, antibacterial

INTRODUCTION

Incessant reported cases of tissue pathologies arising from metabolic disorders or microbial invasion have invited increasing interest in local herbs as alternative therapeutic focus in Africa. Dental, urinogenital tracts, gastrointestinal and other morbidities which are rampant among the hinterland settlers and uninformed have made bioprospecting of medicinal plant extracts attractive. A near breakthrough had been reported on oral infections (Topsoba and Deschanmps 2006; More *et al*, 2008; Soukos and Godson, 2000), where the significant property was the expression of good antibiofilm activity of the extracts(Silva *et al* 2012) Treatment of prostate gland enlargement using banana peels extracts (Fagbemi*et al* 2009Andrade *et al* , 2008; Akamine *et al* 2009), anti cariogenic activity and hepatoprotection with bitter kola (Uju and Obioma 2011; Oze *et al* 2010); induction of tumor cells and insulin resistance using cinnamon (Wand *et al* 2007; Shan *et al* 2007; Kwon *et al* 2010) and the suppression of osteoarthritis by ginger (Altman and Marcusse 2001; Lantz *et al* 2007, Stewart *et al* 1991; Ekwenye and Elegalam, 2005; Gur *et al* 2006; Malu*et al*. 2009; Poeloengam 2011) are all encouraging advantages of bioprospecting of plant materials for human use.

The aim of the present study was to examine the contents of the various –plant materials with a view to justifying the expected therapeutic functions of the extracted phytochemicals.

MATERIALS AND METHODS

The samples *Garcinia kola, Cinnamon, Ginger* and *Musa acuminata*, obtained from Ilishan , Ibadan and Lagos markets in south west Nigeria, were sun-dried to constant weight to remove the water content and ground in preparation for further analyses.

Proximate analyses were carried out in line with standard AOAC (1984) methods

PHYTOCHEMISTRY

Weight of lipid in sample

Principle

One gram of sample was grinded using pestle and mortar with 10mL of distilled water. The pulp was transferred into a conical flask containing 30mL chloroform-methanol (2:1, v/v) and mixed well. This was kept overnight at room temperature in the dark. The mixture was then centrifuged at 5000 rpm for 10minutes. The upper layer was then discarded and the lower lipid layer was carefully collected into another beaker. The beaker was placed in warm water (50^0C) to enable evaporation of residual chloroform.

Calculation

Weight of lipid in sample, g = (weight of beaker + chloroform extract) – Weight of beaker.

2.4.2 Determination of total phenols by spectrophotometric method:

The fat free sample was boiled with 50 ml of ether for the extraction of the phenolic component for 15minutes. 5ml of the extract was pipette into a 50 ml flask, then 10 ml of distilled water was added. 2 ml of ammonium hydroxide solution and 5 ml of concentrated amylalcohol were also added. The samples were made up to mark and left to react for 30 minutes for colour development. This was measured at 505 nm.

Tannin determination by Van-Burden and Robinson (1981) method:

500 mg of the sample was weighed into a 50 ml plastic bottle. 50 ml of distilled water was added and shaken for 1 hour in a mechanical shaker. This was filtered into a 50 ml volumetric flask and made up to the mark. Then 5 ml of the filtered mixture was pipette out into a test tube and mixed with 2 ml of 0.1 N HCl and 0.008 M potassium ferrocyanide. The absorbance was measured at 120 nm within 10 minutes.

CULTURE PREPARATION

The bacteria used in this study included *Staphylococcus aureus* ATCC 6538, *Proteus vulgaris* KZN, *Klebsiellapneumoniae* ATCC 13047, *K. pneumoniae* ATCC 4352, *Micrococcus luteus*, *Bacillus cereus* ATCC 10702, and *Enterobacter cloacae* ATCC 13047. The standard bacteria strains were obtained from the culture collections of the Department of Microbiology and Biochemistry, University of Forte Hare, South Africa and grown on Mueller Hinton agar and incubated at 35^0C for 16hrs prior to use, while slants were maintained at 4^0C.Their susceptibility to the reference antibiotics was investigated.

DETECTION OF INHIBITORY ACTIVITIES AGAINST BACTERIA

The disc diffusion technique was adapted using Whatman s filter paper. The (10^{-3} dilution) were maintained on Mueller Hinton agar. The pure culture of each bacterium was inoculated in peptone water for 18 hrs. and the growth of organisms was observed as turbidity determined by a spectrophotometer The extract was impregnated into the filter paper discs with the use of methanol and distilled water which served as the solvent at concentrations of 5mg/ml inside a Petri dish and placed in the incubator at 35^0C for 2 hours. After drying, a sterile forceps which was regularly flamed was used in picking 10 filter paper discs one at a time into each of the Petri dishes containing the different seeded organisms. The Petri dishes were incubated at 35^0C for 16-18 hours and observed for zones of inhibition.

RESULTS AND DISCUSSION

The result of proximate analysis of the sample presented in (Table1) shows that the crude protein (6.42%), crude fat (2.16%), crude fibre (17.84%), ash(3.16%) of banana peel is higher than that of bitter kola which crude protein (4.32%),crude fat (0.99%), crude fibre (1.26%), ash (1.61%). While the moisture content (17%),and the carbohydrate (74.81%) present in bitter kola is higher than that of banana peel which the moisture content (13.5%)and carbohydrate (43.08%).these values are different from what had previously been reported for bitter kola (Eleyinmi *et al*., 2006) reported a protein content of (3.95%),lipid of (4.33%), ash(1.14%),and crude fibre content of (1.14%).It has been reported that that the moisture and ash contents of banana peels ranged from 78-94% and 1.25-8.80% respectively(Ankrah, (1974, Adewuyi *et al*., 2008).The varying composition reported by researchers reflected the influence of environmental conditions on nutrient composition of these plant materials.

The phytochemical analysis of the two extracts showed that the weight of lipid of bitter kola (0.46g) is higher than that of the weight of lipid of banana peel (0.22g). The total phenols of banana peel (8.86g) is higher than that of the total phenols of bitter kola (6.3g). The tannin present in banana peel (0.32g) is higher than the tannin present in bitter kola (0.23g). The phytochemical compounds in this study are similar to the finding of (Adegboye*et al*., 2008) while investigating *G.kola*. Earlier report has proven that cinnamon can serve as a n antibacterial against *Salmonella*and*Listeria* (Shan *et al.,* 2007) suggesting that it has bioactive compounds that can serve as food preservatives.

PHYTOCHEMICAL ANALYSIS

The weight of lipid of bitter kola (0.46g) is higher than that of the weight of lipid of banana peel (0.22g). The total phenols and tannins in banana peels were higher than those in bitter cola (Table 4,5 and 6).

SPECTRA PROFILE OF PHENOLICS FROM THE OIL SAMPLE OF BANANA PEEL

In bitter cola the compounds detected were tannin, phloroglucinol and gallic acid within the stated wavelengths (Fig 3). Using the standard wavelength characteristics of phenolic compounds found in plants, the phenolics that can be found within this range were gallic acid, purpurogallin and phloroglucinol (Fig. 4).

SENSITIVITY TEST

The agar filter paper disc method showed that *Proteus vulgaris* KZN and*Klebsiellapneumoniae* ATCC 13047 were the most susceptible to the antibacterial activities of bitter kola and banana peel.

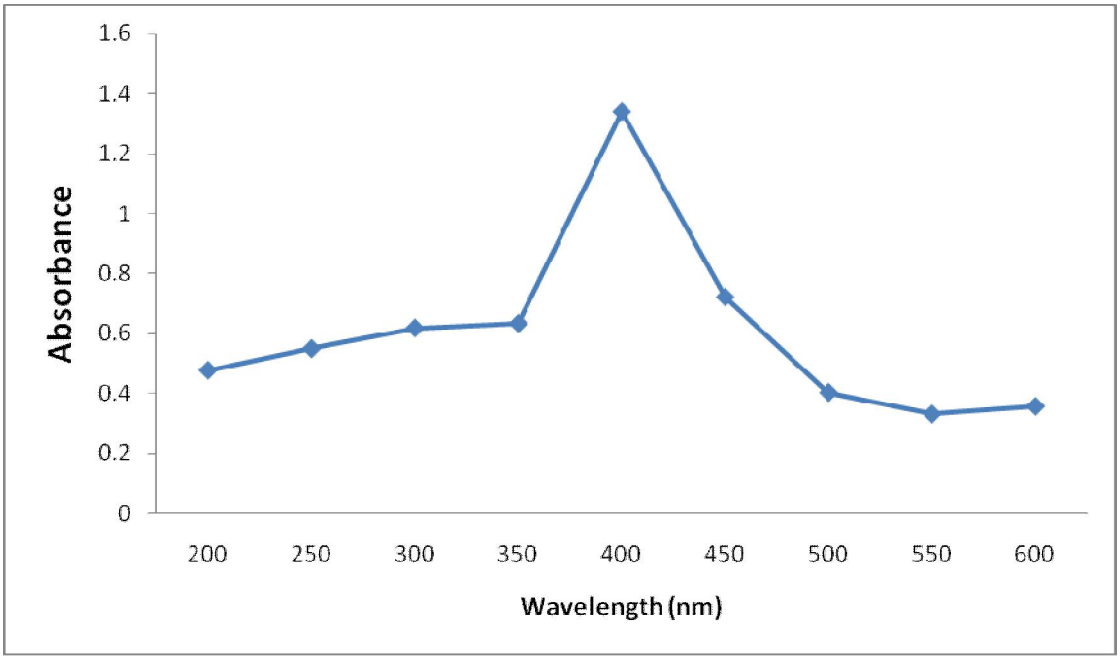

Figure 1: Spectra profile of phenolics of cinnamon

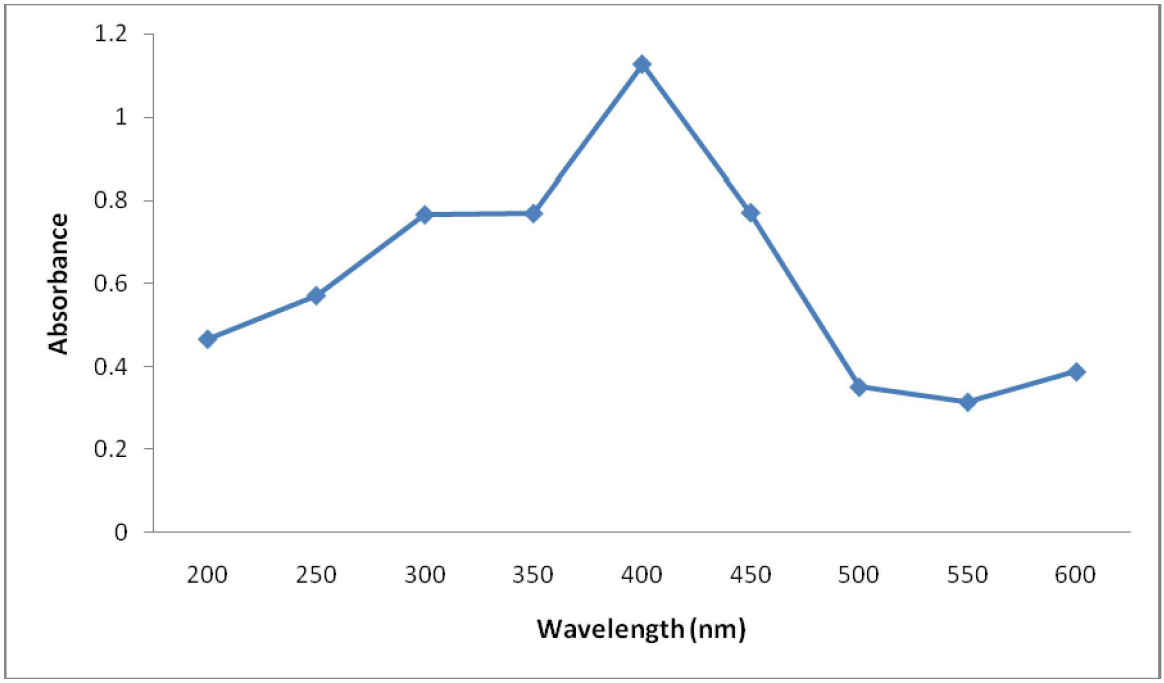

Figure 2: Spectra profile of phenolics of ginger

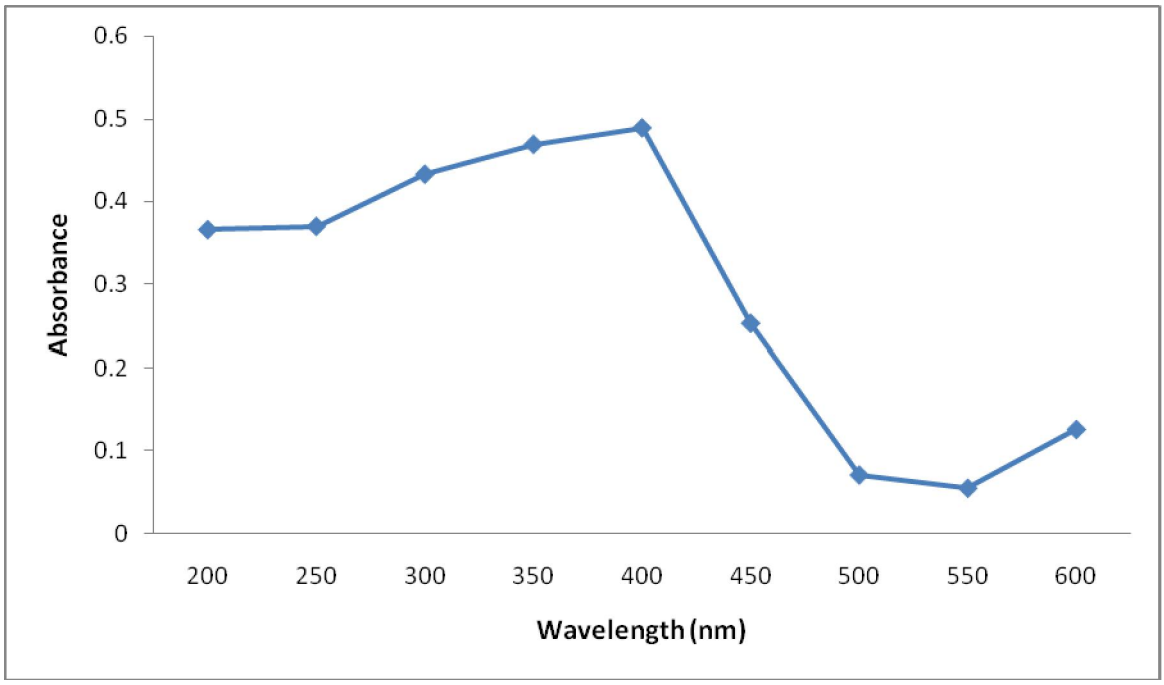

Figure 3: Spectra profile of phenolics of bitter cola

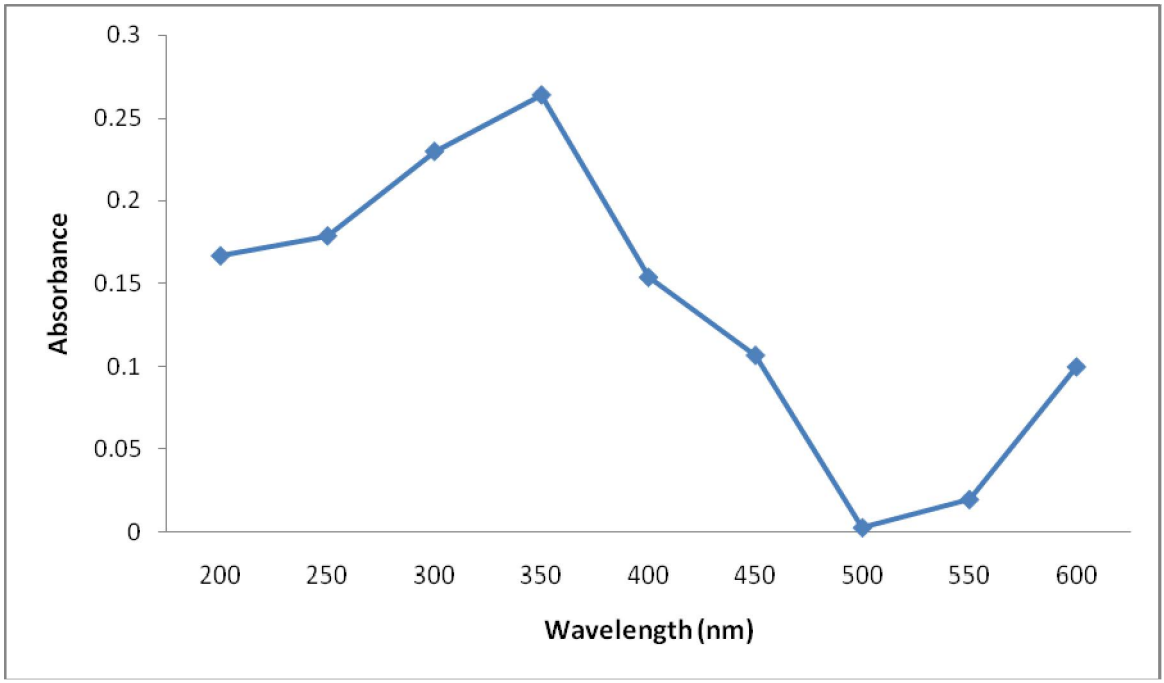

Figure 4: Spectra profile of phenolics of banana peel

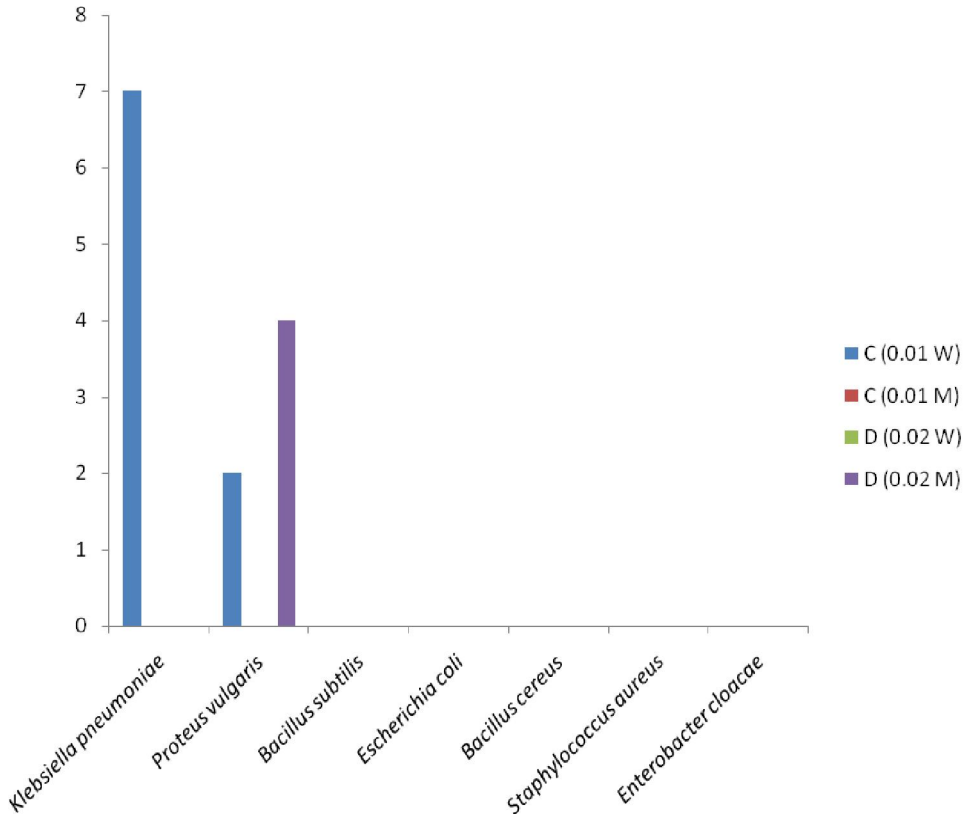

Figure 5: Antibacterial potentials of the methanolic and aqeous extracts of bitter cola (C) and banana peel (D).

TABLE 1: Proximate analyses (%)of the plant samples.

	FAT	FIBRE	ASH	MOISTURE	PROTEIN	CHO
BITTERKOLA	0.99	1.26	1.61	17	4.32	74.8
BANANA PEEL	2.16	17.84	3.16	13.5	6.42	43.08
CINNAMON	14.61	2.24	3.17	5.25	8.03	66.7
GINGER	1.41	4.6	3.60	13.55	5.54	71.3

TABLE 2: Phytochemical screening of the plant samples

	OIL CONTENT(g/g)	PHENOL (g/g)	TANNING/g
BITTERKOLA	6.3±0.36	0.46±0.01	0.236±0.002
BANANA PEEL	8.87±0.47	0.22±0.02	0.327±0.004
CINNAMON	0.45±00.1	0.496±0015	15.53±0.66
GINGER	0.37±0.005	0.447±0002	7.06±0.25

Table 3: ANTIMICROBIAL ACTIVITIES OF GINGER AND CINNAMON

BACTERIA	ZONES OF INHIBITION(mm)	
	Ginger	Cinnamon
- *Enterobacter cloacae* ATCC 13047	2.4	NIL
- *Bacillus subtilis* KZN	3.5	0.8
- *Salmonella typhi* ATCC 13311	NIL	1.2
- *Escherichia coli*	NIL	NIL
- *Klebsiella pneumoniae*	2.5	6.1
- *Staphyllococcus aureus* OK 2b	NIL	4.5
- *Bacillus cereus*	0.5	0.5
- *Proteus vulgaris*	5.8	5.5

The result of antimicrobial sensitivity on the tested organisms shows that *Proteus vulgaris* was the most susceptible to the antibacterial activities of bitter kola and banana peel and *Klebsiella pneumoniae* ATCC 13047 also were susceptible to the antibacterial activities of bitter kola and banana peel. Similar study has also shown that crude extract of *G.kola* exhibited antimicrobial activities in vitro against both Gram-positive and Gram-negative organisms (Adegboye *et al*., 2008).

It can be concluded that the extracts obtained from *Garcinia kola* and *Musa sapientum* displayed a good activity against *Proteus vulgaris* and *Klebsiella pneumonia* These extracts can be applied in antimicrobial treatment of the specific infections. *Zingiber officinale* and *Cinnamomum verum* are nutritionally and medically valuable. They contain extracts that proved effective antimicrobials Although the experiments were carried out *in vitro*, further analysis of the extracts of the 4 plant materials are needed in order to establish a "structure- function" and dose- response relationships.

Correspondence to
S O Fapohunda
Department of Biosciences and Biotechnology
Babcock University, Ilishan remo
Nigeria
Phone: 234- 8033709492
E mail:oystak@yahoo.co.uk

References

1. Adegboye, M., Akinpelu, D. and Okoh, A. The bioactive and phytochemical properties of *Garcinia kola* (Heckel) seed extract on some pathogens. African Journal of Biotechnology, 2008. 7(21): 3934-3938.
2. Adewuyi, G., Obi-Egbedi, N. and Babayemi, J. Evaluation of ten different African Wood species for potash production. International Journal of Physical Science:2008. 3(3), 63-6
3. Aiyelaagbe, I. ; Adeola, A. Fruit trees for future agro forestry initiation in the humid zone of Nigeria: the farmer priority list. Paper presented at the ICRAF meeting on prioritization of MPTs for humid lowlands of West Africa. IITA, Ibadan, Nigeria. 1993.
4. Akamine K, Koyama T, Yazawa K. Banana peel extract suppressed prostate gland enlargement in testosterone-treated mice. Biosci Biotechnol Biochem. 2009: 73(9):1911-4
5. Akinyosoye, V.).*Tropical Agriculture.* Macmillan Publishers Limited, Ibadan 1991:p. 65 – 68.
6. Altman RD, Marcussen KC Effects of a ginger extract on knee pain in patients with osteoarthritis. Arthritis Rheum. .2001, 44(11):2531-8.
7. AndradeC U B, F.F. Perazzo and E.L. Maistro :Mutagenicity of the *Musa paradisiaca* (Musaceae) fruit peel extract in mouse peripheral blood cells *in vivo* Genet. Mol. Res. 2008, 7 (3): 725-732
8. Ankrah, E. Chemical studies of some plant wastes from Ghana, Journal of the Science of Food and Agriculture 1974: 25(10), 1229-1232;
9. AOAC Association of official Analytical chemist Official Method of Analysis 17th Edition, Washington DC. 1984.
10. Barker, C. *Conservation: Peeling away.* National Geographic Magazine collection: a case study of south Cameroon. M.Sc. Thesis, Wageningen.2008
11. CRC *Handbook on Radiation Measurement and Protection,* 1978 Vol. 1 pg. 620 Table A.3.7.12, CRC Press.
12. Dalziel, J. The useful plants of west tropical Africa, being an appendix to the flora of West Africa.The Crown Agent for the Colonies. 1937.
13. Deneo-Pellegrini, H., De Stefani, E.; Ronco, A. Vegetables, fruits, and risk of colorectal cancer: a

case-control study from Uruguay. Nutrition & Cancer.1996. 25 (3): 297–304.
14. Ekwenye UN, Elegalam, NN Antibacterial activity of ginger (*Zingiber officinale* Roscoe) and garlic (*Allium sativum* L.) extracts on *Escherichia coli* and *Salmonella typhi*. Journal of Molecular Medicine and Advanced Science. 2005. 1(4): 411-416
15. Eleyinmi, A., Bressler, D., Amoo, I., Sporns, P. ; Oshodi, A. Chemical composition of bitter cola (*Garcinia kola*) seed and hulls.*Polish J. Food Nutr. Sci.* 2006.15(4): 395-400.
16. FagbemiJ F ; Ugoji E; Adenipekun T ; Adelowokan O Evaluation of the antimicrobial properties of unripe banana(*Musa sapientum* L) lemon grass (*Cymbopogoncitratus* S) and turmeric (*Curcuma longa)* on pathogens. Afr J Biotech. 2009.8 (7) 1176-1182
17. Gur S; Turgut-Balik D; Gur N Antimicrobial activities and some fatty acids of turmeric, ginger root and linseed used in the treatment of infectious disease World J Agric Sci 2006:2(4) 439-442
18. Isawumi, A. The common edible fruits of Nigeria, part II. The Nigerian Field 5:1993. 8: 1–2.
19. James, P *Vascular Plant Families*. Mad River Press. . 1977.
20. Jerry, W. The Pursuit of Happiness (A.K.A. It Appears That The Writer Wrote About Bananas After Eating A Few Too Many). The Science Creative Quarterly, University of British Columbia. 2011.
21. Kudan, M. Encyclopedia of fruits, vegetables, nuts and seeds for healthful living, Parker Publishers Inc. Hattiesburg Maryland. 1962
22. Kwon, H K, Ji-Sun Hwang, Jae-Seon So, Choong-Gu Lee, Anupama Sahoo, Jae-Ha Ryu, Won K Jeon, Byoung S Ko, Chang-Rok Im, Sung H Lee, Zee Y Park and Sin-Hyeog Im Cinnamon extract induces tumor cell death through inhibition of NFκB and AP1, BMC Cancer 2010, 10:392 doi:10.1186/1471-2407-10-392
23. Lantz RC, Chen GJ, Sarihan M, Sólyom AM, Jolad SD, Timmermann BN. The effect of extracts from ginger rhizome on inflammatory mediator production. Phytomedicine. 2007 14(2-3):123-8
24. Leslie, S. An Introduction to the Botany of Tropical Crops (2nd Edition), Longman Group Limited London pp153 – 15. 1976.
25. Malu S P;Obochi G O; Tawo E N and Nyong B E Antibacterial activity and medicinal properties of ginger(*Zingiberofficinale*) Global J. Pure and Applied Sciences :2009:15 (3) 365-8
26. More G, Tshikalange TE, Lall N, Botha F, Meyer JJM. Antimicrobial activity of medicinal plants against oral microorganisms. Journal of Ethnopharmacology. 2008;119(3):473–477
27. Ntamag, C. Spatial distribution of non-timber forest production.*Plant Breeding Abstracts*, Commonwealth Agricultural Bureaux, 1949, 1997. p.162
28. Oze, G , Iheanyi Okoro, Austin Obi Polycarp Nwoha Hepatoprotective role of Garcinia kola (Heckel) nut extract on methamphetamine: Induced neurotoxicity in mice African Journal of Biochemistry Research . 2010:4(3), 81-87
29. Poeloengan, M The effect of red ginger (*Zingiberofficinale* Roscoe) extract on the growth of mastitis causing bacterial isolates. Afr J MicrobRes 2011: 5(4) 382-9
30. Rashidkhani, B., Lindblad, P. Wolk, A. Fruits, vegetables and risk of renal cell carcinoma: a prospective study of Swedish women. International Journal of Cancer2005. 113 (3): 451–5.
31. Scott, K. and Gandanegara, S. Effect of Temperature on the Storage Life of bananas Held in Polyethylene Bags with an Ethylene Absorbent. Tropical Agriculture (1974) 51,23–26.
32. Shan B; Yi-ZhongCai,; John D. Brooks,; Harold Corke Antibacterial Properties and Major Bioactive Components of Cinnamon Stick (*Cinnamomumburmannii*): Activity against Foodborne Pathogenic Bacteria . J Agric Food Chem 2007:55(14): 5484-90
33. Silva, M S P , Deysiane O. Brandão, Thiago P. Chaves, Amaro L. N. Formiga Filho, Edja Maria M. de B. Costa, Vanda L. Santos, and Ana Cláudia D. Medeiros . Study Bioprospecting of Medicinal Plant Extracts of the Semiarid Northeast: Contribution to the Control of Oral Microorganisms Evid Based Complement Alternat Med. 2012; 2012: 681207. Published online 2012 June 6. doi: 10.1155/2012/681207
34. Solomon, C. *Encyclopedia of Asian Food* (Periplused.). Australia: New Holland Publishers. 1998
35. Soukos NS, Goodson JM. Photodynamic therapy in the control of oral biofilms. Periodontology 2011;55(1):143–166
36. Stephen, C. and Corinna, W. Everything Emits Radiation—Even You: The millirems pour in from bananas, bomb tests, the air, bedmates. *Discover: Science, Technology, and the Future.* 2007.
37. Stewart,J;Wood M J; Wood C D; Mins ME Effect of ginger on motion sickness susceptibility and gastric function. *Pharmacology* 1991: 42:111-3.

38. Tapsoba H, Deschamps JPUse of medicinal plants for the treatment of oral diseases in Burkina Faso. Journal of Ethnopharmacology. 2006:104(1-2):68–78.
39. Uju DE, Obioma NP. Anticariogenic potentials of clove, tobacco and bitter kola Asian Pac J Trop Med. 2011: 4(10):814-8.
40. Van Buren, J P ; Robinson, W B. Formation of complexes between protein and tannic acid. *J Agric Food Chem* 1981: 17: 772-777
41. Wang JG, Anderson RA, Chu MC, Sauer MV, Guarnaccia MM, Lobo RA The effect of cinnamon extract on insulin resistance parameters in polycystic ovary syndrome: a pilot study. Fertil Steril. 2007: 88(1):240-3.
42. Wath, J.; Brayer-Brand, M. *The Medicinal and Poisonous Plants of South and Easthern Africa*, E and S Livingstone Ltd.Edinburgh and London , 2009:437-442
43. Wood CD; Comparison of efficacy of ginger with various antimicrobial sickness drugs. *Clinical Research Practices and Drug Regulatory Affairs*.1988:6(2): 129 - 136.
44. Zhang, C. Greater vegetable and fruit intake is associated with a lower risk of breast cancer among Chinese women. *International Journal of Cancer* 2009: 125 (1): 181–8.

7/7/2012