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Short Communication

Proximate analysis and antimicrobial activities of *Bambusa vulgaris L.* leaves' beverage

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Nutrient analysis of aqueous extract (100 ml) of *Bambusa vulgaris L*. (Bambusoideae) leaves, (50 g) and the fortified extract of the leaves (fortified with orange and pineapple juices in varying proportion of 50 to 90%) together with their mineral and antimicrobial effect were carried out. The antimicrobial effect was determined with respect to their inhibitory effect on the growth of *Bacillus cerise*, *Escherichia coli*, *Lactobacillus* spp. and a fungus *Aspergilus niger*. The results revealed that the leaves contained 10.75% moisture, 10.34% ash, 8.45% crude protein, 13.13% crude fat, 37.60% crude fibre and 19.73% carbohydrate content. The fortified bamboo extract with orange juice had higher value of vitamin C compared with extracts fortified with pineapple juice. The extract fortified with pineapple juice however had best general acceptability. Mineral analysis revealed that Mg, Na, K and Ca were generally high while Fe, Mn and Cu were low but Pb was not detected. Antimicrobial screening showed that the bamboo's leave extract was active against *Lactobacillus* spp. Fortification with orange and pineapple juices enhanced the inhibitory effect against *E. coli* and *Lactobacillus* spp.

Key words: Proximate, mineral, *Bambusa vulgaris L*., antimicrobial, fruit juice.

INTRODUCTION

Bambusa vulgaris L. (Bambusoideae) leaves' beverage is as a result of the long history of bamboo food value and its medicinal use especially in China. The effective ingredients of bamboo leaf includes flavones, phenolic acid, lactones, amino acids and micronutrient (Sahbuti, 2004, 2004). Bamboo leaf has ingredients effective against fever, epilepsy, alcohol poison, asthma, palsy and pain (Bingshan et al., 1993). Bamboo, commonly known as "Oparun" in southwestern Nigeria is an evergreen tall plant of the family Bambusiodeae which occurs mainly in tropical and subtropical part of Asia and African. They produce seeds mostly once in their lifetime of about 100 years. They also reproduce asexually by the production of rhizomes or seedless clones (Grolier, 1991). Bamboo occupies an important phylogenetic node in the grass family and plays a significant role in forest industry. The content of repetitive elements in bamboo have been found to be similar to that in rice and sorghum, thus rice and sorghum may be useful as models for determining Bambusoideae gerones (Gui et al., 2010). The antibacterial and antioxidant activities of the essential oils isolated from the leaves of *Phyllostachys heterocycla cv. Pubescens* and three more species of bamboo have been demonstrated. The oils showed marked antimicrobial and antioxidant activities. The result equally showed that there were no significant differences among varieties and related with respect to their antioxidant and antimicrobial activities (Jin et al., 2011). Similarly, antioxidants from bamboo leaves have been demonstrated to have a promising capacity of reducing blood lead level in exposed mice up to 65% (Jiao et al., 2011). However, toxicological investigations into aqueous extracts of *B. vulgaris L*. leaves in pregnant rabbits, show certain alteration in biochemical parameters which may suggest some kind of effect on the rabbits body organs, but clinical toxicity was not observed in this study (Yakubu et al., 2009). All these advantages notwithstanding, Bamboo is used mainly in Nigeria for roofing, fencing and yam staking. In view of this, the present study is undertaken to establish the food value and the antimicrobial efficacy of the leaves extract (bamboo tea) of *B. vulgaris L*. growing wide in South Western Nigeria.

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Table 1. Proximate composition of bamboo leaf.

Parameter	% Mean±SD
Moisture content	10.34±0.01
Ash	10.75±0.01
Crude fat	8.45±0.04
Crude protein	13.13±0.1
Crude fibre	37.60±0.2
Carbohydrate	19.73±0.8

SD = Standard deviations.

Table 2. The Vitamin C and mineral content (mg/ml) of bamboo leaf extract.

Bamboo	Vitamin C	Fe	Na	Zn	Ca	K	Mn	Cu	Mg
					mg/ml				
Leaf extract	0.15± 0.1	0.68± 0.1	2.50± 0.1	0.05± 0.1	0.19± 0.1	9.11± 0.1	nd	nd	8.16± 0.1
Orange juice added (%)									
50	1.0± 0.1	1.36± 0.1	9.81± 0.1	1.69± 0.1	2.23± 0.1	9.24± 0.1	0.02±0.1	0.02±0.1	9.15± 0.1
60	1.37± 0.1	1.40± 0.1	9.85± 0.1	1.87± 0.1	4.10± 0.1	9.45± 0.1	nd	0.01± 0.1	9.17± 0.1
70	1.58± 0.1	1.52± 0.1	9.91± 0.1	2.10± 0.1	4.28±0.1	9.63±0.1	nd	nd	9.44± 0.1
80	1.97± 0.1	2.40±0.1	10.01± 0.1	2.23± 0.1	4.84±0.1	9.80± 0.1	0.03± 0.1	0.01± 0.1	9.66± 0.1
90	2.32± 0.1	3.34± 0.1	10.18± 0.1	2.47± 0.1	5.14± 0.1	9.93± 0.1	nd	nd	9.54±0.1
Pineapple juice added (%)									
50	0.39±0.1	1.20± 0.1	10.0± 0.1	0.05± 0.1	9.50± 0.1	8 .38± 0.1	nd	nd	9.68± 0.1
60	0.54± 0.1	0.62± 0.1	10.74± 0.1	0.05± 0.1	9.50± 0.1	8.38± 0.1	nd	nd	9.78±0.1
70	0.66± 0.1	0.45± 0.1	10.25± 0.1	1.09± 0.1	11.53± 0.1	8.40±0.1	0.02±0.1	nd	9.88±0.1
80	0.96± 0.1	0.45± 0.1	11.00±0.1	0.14± 0.1	12.19± 0.1	8.48 ±0.1	0.02± 0.1	0.02±0.1	9.90± 0.1
90	1.20± 0.1	0.43± 0.1	11.18± 0.1	0.10± 0.1	12.51± 0.1	8.50± 0.1	nd	nd	9.97± 0.1

nd = Not detected.

MATERIALS AND METHODS

Fresh *B. vulgaris L.* leaves were harvested within the campus of the Federal University of Technology, Akure, Nigeria. Pineapple and orange fruits were purchased at Iwaro-Oka Market in Akoko, Ondo State, Nigeria. *Escherichia coli, Bacillus cereus, Lactobacillus* spp and *Aspergilus niger* were collected from the Department of Microbiology, Federal University of Technology, Akure. All chemicals were analar and obtained from supplier of standard laboratory chemicals.

Fresh leaves of *B. vulgaris L.* were dried indoor and chopped into small sizes using a pair of scissors. The proximate analysis was carried out using the AOAC (1990) method. The tea was prepared using the method of Oboh et al. (2004). About 50 g of the dried and chopped bamboo leaves were boiled in 100 ml of deionized water for 40 min. Juices from orange and pineapple were prepared by peeling the fruits and thereafter, blend the pulp cut to sizes using warring blender which was then sieved to collect the clear juices. The aqueous bamboo extracts were also sieved. The extracts were then mixed with orange and pineapple juices at 50, 60, 70, 80 and 90% vol/vol. Minerals were analyzed after dry-ashing at 550°C and dissolving in deionized water. The minerals; Na, K, Mg, Fe, Zn, Mn and Cu were determined using a Bulk-scientific atomic absorption spectrophotometer (model 200 A). The vitamin C content was determined using the dichlorophenolindole phenol method (Akany et al., 1997) while the antimicrobial activity was established using the agar diffusion bioassay (Oboh, 2001). The taste panel was made up of 10 members and was asked to indicate their preference for the different beverage preparations.

RESULTS AND DISCUSSION

The values of proximate composition are shown in Table 1. The table shows that bamboo leaf had high food value with carbohydrate content of 19.73% and crude fibre of 37.6% which would make bamboo tea a very good food supplement. The crude fat and protein averaged 8.45 and 13.13% respectively. These values compare well with data compiled by Scurlock et al. (2000) in which 5 years old bamboo species was found to contain 21.97% moisture,12.14% carbon content. Thus, bamboo leaf is a definite source of cheap protein and energy (AOAC, 1990) subject to a high level intake; it is conceivable that a large proportion of animal protein requirements could be met by bamboo leaf protein. The proximate values earlier mentioned compared favorably with those of mushrooms (Alector et al., 1995), which indicates its potential for use as a source of good quality food. Table 2 shows the mineral content of the fortified and unfortified bamboo leaves' extract. Fortification of the extract with

Table 3. Zones of inhibition of some microbes by bamboo leave's extract in mm.

Sample	*E. coli*	*Bacillus cereus*	*Lactobacillus* spp.	*Aspergilus niger*
Leave's extract	0.00	0.00	10.00 ± 0.2	0.00
Fortified with:				
50% Orange juice	22.0± 0.1	0.00	26.00± 0.1	0.00
50% Pineapple juice	20.0± 0.2	0.00	17.00± 0.2	0.00

orange and pineapple juices increased the level of mineral composition of Na, Ca, Mg and K present. This implies that the pineapple and the orange juices apart from providing the needed favourable taste, also served to increase the mineral content of the beverage, thus its food value.

In the assessment of the bamboo leave's extract for antimicrobial activity (Table 3), it was found that the unfortified bamboo leave's extract had inhibition on the growth of *Lactobacillus* spp. (10.00 mm). This was however low when compared with the orange (26.00 mm) and pineapple (17.00 mm) fortified extract. The same trend was recorded for *E. coli* but the leave's extract (fortified or unfortified) had no effect on *B. cereus* and *A. niger* – the only fungi candidate for this test. The bamboo extract had its sweet-bitter taste improved when fortified with the orange and pineapple juice. The vitamin C content (Table 2) of the bamboo tea fortified with pineapple juice was low in vitamin C, in comparison with the extract fortified with orange juice, which should be expected since orange is known to have a higher proportion of vitamin C than pineapple.

Finally, from the results obtained in this work, *B. vulgaris L*. leaf is rich in protein, fat, and carbohydrate and nutritionally valuable minerals like Ca, Fe, Mg and Na. The bamboo teas fortified with orange and pineapple juices were very rich in vitamin C and possess antimicrobial activity against some microbes, which will be of a great health benefit. Since bamboo is a common plant in Nigeria, beverage from bamboo leaves can be cheaply made and may serve as a ready replacement for beverages from imported raw materials.

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