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Mineral Concentrations of *Cocos nucifera* Tree Parts Ashed At 1000⁰C and 650⁰C for the Production Dietary of Minerals

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Abstract

Various parts of the coconut tree (inflorescence, bunch and shell) were ashed at different temperatures (1000⁰C and 650⁰C) to determine their mineral concentration. In the result obtained, coconut bunch 650⁰C recorded significantly higher values ($p<0.05$) for Ca, Mg and Cr than the other samples of the coconut tree. The concentrations of K, Na, Fe, Cu, and Ni were significantly higher ($p<0.05$) in coconut inflorescence 650⁰C than in the other samples of the coconut tree. Coconut bunch 1000⁰C recorded a significantly higher ($p<0.05$) concentrations of P and My. In coconut tree parts, coconut bunch 650⁰C (2.58) and coconut inflorescence 650⁰C (0.34) recorded the best Ca/P and Na/K ratio respectively. Ashed inflorescence and bunch of coconut tree could be incorporated into animal feed especially in the rural environment were mineral deficiency normally occur.

Keywords: *Cocos nucifera,* coconut tree, dietary ash, minerals

Introduction

Coconut (*Cocos nucifera*) belongs to the family Palmae and tribe cocoideae. It is a monocotyledonous tree with the inflorescence carrying both the male and the female flowers. The inflorescence is composed of the main axis and side branches. Coconut wastes are readily available agro-residues that have found limited application in their production zones where they are currently used as biofuel and their ash residues discarded as waste material. A limited amount of these ash residues have been used traditionally in certain food preparations, black soap production and as fertilizer (Kyarisiima *et al.,* 2004; Webber, 2011).

In producing ash from plant materials, the organic components of the material which ordinarily interact with the mineral molecule to reduce their bioavailability (Scheideler, 2008) are completely eliminated. The end product may therefore successfully replace intact plant and rock mineral sources in animal and human diets when properly processed (Ndhlovu, 2007). Iwu *et al.* (2012) reported the major mineral profile of coconut shell ash to be Ca>Fe>Na>Mg>Mn, etc.

This study, therefore, determined the mineral concentrations of different parts of *Cocos nucifera* ashed at 1000⁰C and 650⁰C as possible sources of dietary minerals.

Materials and Methods

The parts of the coconut tree studied were collected from different markets and households at Owerri Urban and environ. Each collected sample type was pooled in order to homogenize them, and thereafter they were sun-dried to reduce their moisture content. The samples were carefully bagged and labeled for easy identification. The analysis for their mineral concentrations was carried out at the laboratory unit of JaaGee limited, Ibadan, Oyo state. The samples were first oven-dried and then incinerated for four hours at two different temperatures 650⁰C and 1000⁰C using a calibrated muffle furnace. The ashes were digested and the resulting digestion solutions analyzed for metals according to the methods of AOAC (1990) using the Atomic Absorption Spectrophotometer (Bulk Scientific, 205).

Data were generated in triplicates and subjected to analysis of variance (ANOVA). Significant means were separated using the Least Significant Difference (LSD) method.

Result and Discussion

Table 1 showed that at 1000⁰C ashing temperature, macromineral contents of the coconut bunch (CB) were significantly higher ($p<0.05$) than those of the coconut shell (CS), but similar to the values recorded in the coconut inflorescent (CInf). The order of mean mineral values was K>Na>P>Mg>Ca. The trend was different at 650⁰C ashing temperature (Table 2), with K, Na and P values of CInf being significantly higher ($p<0.05$) than the CS values, while Ca and Mg values of CB and CS were also significantly higher than the CInf values. Again, the order of mean mineral values at the lower ashing temperature was K>Na>Ca>Mg>P. There mineral concentration orders were different from that reported by Iwu *et al.* (2012) coconut shell ash.

Table 3 again showed that CB yielded significantly higher ($p<0.05$) micro mineral values than CS at 1000⁰C ashing temperature, however, CS and CInf values of Mn were similar ($p>0.05$). The mean order of micro mineral concentration was Fe>Mn>Zn>Cu>Cr>Ni. At 650⁰C ashing temperature (Table 4) the order of mean mineral concentration was different; Fe>Zn>Cu>Mn>Cr>Ni indicating that ashing temperature influences ash mineral contents.

Table 1: macro minerals in different parts of coconut tree ashed at 1000⁰C

Minerals (mg/kg)	CInf	CB	CS	Mean	SEM
Ca	501.80[ab]	1830.41[a]	60.75[b]	797.65±921.18	531.84
Mg	1001.10[ab]	1882.22[a]	104.31[b]	994.88±890.47	514.11
K	1909.12[ab]	5283.87[a]	429.95[b]	2540.98±2487.88	1436.38
Na	1361.66[ab]	2054.11[a]	588.18[b]	1334.65±733.34	423.39
P	943.21[ab]	1956.46[a]	709.49[b]	1204.05±664.56	383.68

[ab] within the same rows show that means are significantly different ($p<0.05$). SEM=Standard Error of Mean; CInf=Coconut Inflorescence; CB=Coconut Bunch; CS=Coconut Shell.

Table 2: Macro mineral in different parts of coconut tree ashed at 650⁰C

Minerals (mg/kg)	CInf	CB	CS	Mean	SEM
Ca	459.45[b]	3555.19[a]	3709.17[a]	2574.60±1833.39	1058.31
Mg	702.49[b]	2513.40[a]	703.48[b]	1306.46±1045.24	603.47
K	21275.12[a]	9343.86[ab]	3177.75[b]	11265.56±9206.46	5311.89
Na	7253.23[a]	3735.61[ab]	1815.00[b]	4267.95±2757.92	1592.29
P	1290.30[a]	1373.09[a]	876.29[b]	1179.89±266.17	153.67

[ab]within the same rows show that means are significantly different ($p<0.05$). SEM=Standard Error of Mean; CInf=Coconut Inflorescence; CB=Coconut Bunch; CS=Coconut Shell

Table 3: micro minerals in different parts of coconut tree ashed at 1000⁰C

Minerals (mg/kg)	CInf	CB	CS	Mean	SEM
Mn	12.98[b]	38.11[a]	12.11[b]	21.07±14.77	8.53
Fe	148.72[ab]	185.83[a]	45.71[b]	126.75±12.66	41.91
Cu	8.73[ab]	14.95[a]	4.69[b]	9.46±5.17	2.98
Zn	6.24[ab]	20.18[a]	2.15[b]	9.52±9.45	5.46
Cr	4.74[a]	3.49[a]	0.00[b]	2.74±2.46	1.42
Ni	0.50[b]	2.49[a]	1.17[ab]	1.39±1.01	0.58

[ab]within the same rows show that means are significantly different ($p<0.05$). SEM=Standard Error of Mean; CInf=Coconut Inflorescence; CB=Coconut Bunch; CS=Coconut Shell.

Table 4: Micro minerals in different parts of coconut tree ashed at 650⁰C

Minerals (mg/kg)	CInf	CB	CS	Mean	SEM
Mn	17.91[ab]	30.52[a]	10.49[b]	19.64±10.13	5.85
Fe	613.18[a]	179.67[b]	479.97[a]	424.27±222.06	128.20
Cu	47.51[a]	12.16[b]	15.23[b]	24.97±19.58	11.31
Zn	20.65[b]	203.74[ab]	412.80[a]	212.40±196.22	113.29
Cr	13.68[ab]	23.08[a]	8.24[b]	15.00±7.51	4.33
Ni	2.49[a]	0.99[b]	1.50[ab]	1.66±0.76	0.44

[ab]within the same rows show that means are significantly different ($p<0.05$). SEM=Standard Error of Mean; CInf=Coconut Inflorescence; CB=Coconut Bunch; CS=Coconut Shell.

Table 5 shows the Ca/P and Na/K ratios of the different parts of a palm tree. At 1000⁰C ashing temperature, CB yielded the highest Ca/P ratio nearing to one and lowest Na/K ratios. At 650⁰C ashing temperature, the CS yielded the highest Ca/P and Na/K ratios. The 4.233 Na/K ratio recorded in CS at 650⁰C ashing temperature shows serious imbalance that may result in Na accumulation and hypokalemia (Joseph, 2013).

Table 5: Ca/P and Na/K ratios of the different parts of coconut tree

Temperature	1000⁰C	1000⁰C	650⁰C	650⁰C
Tree parts	Ca/P Ratios	Na/K Ratios	Ca/P Ratios	Na/K Ratios
CInf	0.532	0.713	0.341	0.356
CB	0.936	0.389	0.410	2.589
CS	0.086	1.368	0.571	4.233

CInf=Coconut Inflorescence; CB=Coconut Bunch; CS=Coconut Shell

Conclusion

Ashing at 650⁰C should be adopted as the ideal for producing dietary ash from different parts of a coconut tree since both the macro and micro mineral values of the different parts generally increased at this temperature. The order of mineral concentration were K>Na>P>Mg>Ca> Fe>Mn>Zn>Cu>Cr>Ni and K>Na>Ca>Mg>P> Fe>Zn>Cu>Mn>Cr>Ni at 1000⁰C and 650⁰C respectively. Mineral concentrations were generally higher in the coconut bunch and inflorescent than in the shell.

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