Mineral and Heavy Metal of Post-Harvest *Amarantus Hybridus* Sold in Different Market in Port Harcourt

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Abstract
Studies on minerals and heavy metals of post-harvest Amarantus hybridus sold in different market in Port Harcourt were carried out in the Department of Plant Science and Biotechnology, Rivers State University. Six Markets were selected for the study Viz. Rumuokoro, Rumuokwuta, Choba, Mile 1, Slaughter and Mile 3. The control experiment was conducted in the Department of Plant Science and Biotechnology in Rivers State University, The method of Association of Analytical Chemical (AOAC 2005) was used to assess the mineral composition of all the samples while assessment of heavy metals was carried out in accordance with the Food Safety and Standard Authority of India (FSSAI, 2015). Investigation of vitamin composition shows the presence of Calcium, Iron, Magnesium, Phosphorus, Potassium and Sodium. However high values for Calcium (25.5±0.50g) were recorded in Rumuokwuta and Slaughter market. Samples from control and Rumuokwuta showed high values (4.1±0.50) and (4.05±0.05) respectively. Sample from Choba (28.5±0.50) recorded high value for magnesium while sample from Slaughter showed high value for Phosphorus (217.5±0.50). Sample from Rumuokoro recorded high value of Potassium (305.5±0.50). Eight heavy metals were recorded (Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Cyanide and Selenium) were found in the present study. Although mile 1 recorded high Arsenic (0.685), Rumuokwuta record high Cadmium (0.625), Sample from Rumuokwuta and mile 1 recorded high Lead (0.095), Sample from Choba recorded high Mercury (0.546), Sample from Slaughter and mile 1 record high Nickel (0.495) respectively. Sample from mile 3 indicated the presence of Cyanide (0.0095) while samples from mile 1 record high value for Selenium (0.195). However, Amaranthus hybridus are rich in mineral and contain harmful heavy metal which may be harmful to man when not properly handled and consumed in large quantity.

Key words: *Amarantus hybridus, Post-harvest, minerals, heavy metals*

Introduction

Green leaf (*Amaranthus hybridus*), regularly called green amaranth, thin amaranth, smooth amaranth, smooth pigweed, or red amaranth, is a type of yearly blossom, mint plant. It is a weedy animal variety of plant found in North America and brought into Europe. *Amaranthus*

hybridus develops from a short taproot and can be up to 2.5 m in tallness (Taylor., M.B, 2007)
It is a glabrous or glabrecent plant. *Amaranthus hybridus* was initially a trailblazer plant in eastern North America. It has been accounted for to have been found in each state with the exception of Utah, and Alaska. It is likewise found in numerous areas of Canada, Mexico, the West Indies, Central America, and South America. It has naturalized in various spots, including upsetting environments (Dhalla Rosa, 1993). Numerous other *Amarathus species* are accepted to be regular hybridizations or got from *A.hybridus.* It is perceived as a destructive weed of North American harvests. The plant was utilized for food and medication by a few Native American gatherings and in conventional African medication. It is among the species eaten as Quelitequinto, nilli in Mexican food markets (Agros., 2005) *Amaranthus hybridus* is a nutritious, without gluten grain that gives a lot of fibre, protein and micronutrients. It has additionally been related with various medical advantages, including decreased aggravation, lower cholesterol levels and expanded weight reduction. *Amaranthus hybridus* is exceptionally restorative with both the seed; oil and leaf are utilized as food. The whole plant is utilized for ulcers, looseness of the bowels, expanding of the mouth or throat and elevated cholesterol. (Dhalla Rosa., 1993)
In food, *Amaranthus hybridus* is utilized as a pseudocereal. The leaves are plentiful in vitamin A and a cup can meet 97% of your day by day need for this antioxidative nutrient. They are likewise loaded with flavonoid, polyphenolic, cell reinforcements like beta-carotene, zeaxanthin, and lutein which give a defensive layer against oxidative pressure brought about by free extremists. It is additionally wealthy in folate and iron as pregnant women can likewise consume and it assumes a part in mental health of child and backing the placenta (Patel., 2012)

Materials and Methods

Collection of Samples

Amaranthus hybridus was purchase from six distinct markets in Port Harcourt city, Slaughter market, Choba market, Mile 1 market, Mile 3 market, Rumuokoro market and Rukpokwu market and brought to the Department of Plant Science and Biotechnology. A control was planted at the screen house of the Department for proper comparison.

Cultivation of control sample

Seeds of *Amaranthus hybridus* were obtain from mile 3 Diobu market. The seeds were planted into polyethene bags of 10cm containing 2kg of garden soil. The bags were monitored and watered till *A. hybridus* was ready for harvest.

Nutrient analysis

The method of AOAC, (2005) was adopted for the assessment of minerals composition of *A. hybridus* collected from the various markets and the cultivated samples.

Heavy Analysis

The method of FSSAI, (2015) was adopted for assessment of cultivated *A. hybridus* and assessment of heavy metals on the samples purchased from the various markets and from the cultivated control samples.

Data Analysis

Data obtained from the above studies were subjected to analysis of variance (ANOVA). Duncan multiple range test was also used for mean separation with the aid of SPSS version 25.

Results

Table 1: Mineral Composition of *Amaranthus hybridus* from different market (%)

Location	MINERALS CONTENT (mg/100g)					
	Ca (mg/100g)	Fe (mg/100g)	Mg (mg/100g)	P+ (mg/100g)	K (mg/100g)	Na (mg/100g)
Rumuokoro	25±1.0^{c}	3.95±0.05^{c}	25.5±0.50^{ab}	204±1.00^{a}	305.5±0.50^{e}	35±1.00^{de}
Rumuokwuta	25.5±0.50^{c}	4.05±0.05^{c}	26.5±0.50^{bc}	204.5±0.50^{a}	303.5±1.50^{d}	34±1.00^{cde}
Choba	21.5±0.50^{a}	3.45±0.05^{a}	28.5±0.50^{d}	214.5±0.50^{b}	280.5±0.50^{c}	31.5±0.50^{a}
Mile 3	21.45±0.05^{a}	3.65±0.05^{b}	27±1.00^{c}	213±1.00^{b}	279±1.00^{c}	32.5±1.50^{abc}
Slaughter	25.5±0.50^{c}	3.35±0.05^{a}	26±1.00^{abc}	217.5±0.50^{c}	270.5±0.50^{b}	32±1.00^{ab}
Mile 1	24.5±0.50^{c}	3.45±0.05^{a}	26.5±0.50^{bc}	216.5±1.50^{c}	265.5±0.50^{a}	35.5±0.50^{e}
Control	22.5±0.50^{b}	4.1±0.10^{d}	25±1.00^{a}	203.5±1.50^{a}	304±1.00^{de}	33.5±0.50^{bcd}

N.B. Means within the same column with different super script (^{a,b,c,d}) are significantly different (P<0.05)

Table 2: Heavy Metals content of *Amaranthus hybridus* from different markets in Ph

Location	Arsenic (%)	Cadmium (%)	Chromium (%)	Lead (%)	Mercury (%)	Nickel (%)	Cyanide (%)	Selenium (%)
Rumuokoro	0.56b	0.54a	0.175ab	0.075b	0.0075a	0.77d	0.0055b	0.135a
Rumuokwuta	0.57b	0.625bc	0.195bc	0.095cd	0.008a	0.76d	0.007c	0.165c
Choba	0.495a	0.55a	0.15a	0.075b	0.0545b	0.43a	0.0035a	0.145b
Mile 3	0.65c	0.545a	0.196bc	0.10d	0.015a	0.455b	0.0095d	0.175c
Slaughter	0.64c	0.575ab	0.215c	0.085bc	0.125c	0.495c	0.0085d	0.175c
Mile 1	0.685d	0.575ab	0.215c	0.095cd	0.135c	0.495c	0.006bc	0.195d
Control	0.565b	0.65c	0.18abc	0.055a	0.055b	0.76d	0.0055b	0.125a

N.B. Means within the same column with different super script (^{a,b,c,d}) are significantly

Mineral Composition of *Amaranthus hybridus*

The result of Mineral Composition of *Amaranthus hybridus* has showed the presence of Iron, Magnesium, Phosphorus, Potassium, and Sodium.

Leaf Samples from Rumuokwuta market and leaf samples from Slaughter markets had highest quantity of calcium, (25.5±0.50) followed by leaf from Rumuokoro market (25±1.0) leaf tested from Mile 1 market, (24.5±0.50), leaf sample from Control (25.5±0.50), leaf tested from Choba market (21.5±50) and leaf tested from Mile 3 market, (21.45±0.0).

Iron content for control was the highest (4.1±0.10) followed by leaf samples from Rumuokwuta market which recorded (4.05±0.5), leaf samples from Rumuokoro market had (3.95±0.05), leaf samples from Mile 3 market had (3.65±0.05), leaf samples from Slaughter markets had (3.35±0.05) while leaf samples from Mile1 market and Choba market had (3.45±0.05) respectively. Magnesium content of *A. hybridus* revealed that leaf samples from Choba had most elevated value (128.5±0.50), followed by leaf samples from Mile 3 (27±1.00), leaf samples from Rumuokwuta and Mile 1 recorded (26.5±0.50), leaf samples from Slaughter market recorded (26±1.00), leaf samples from Rumuokoro recorded (25.5±0.50) and control recorded (25±1.00).

Platinum content in leaf sample from slaughter recorded highest value (217.5±0.50), followed by leaf samples from Mile 1, (216.5±1.50), leaf samples from Choba market recorded (214.5±0.50), leaf samples from Rumuokwuta market recorded (204.5±0.50), leaf sample from Rumuokoro market recorded (204±1.00) and control was (203.5±1.50).

Potassium content of *A. hybridus* purchased from Rumuokoro market had the highest value (305.5±0.50) followed by control (304±1.00), Rumuokwuta market recorded (303.5±1.5), Choba market, (280.5±0.50), Mile 3 market (279±1.00), Slaughter market (270.5±0.50) and Mile 1 market recorded (265.5±0.50). Leaf samples from Mile 1 market had Sodium value (35.5±0.50), followed by leaf samples from Rumuokoro market (35±1.00), Rumuokwuta market (34±1.00), leaf samples from control (33.5±0.50), Mile 3 market (32.5±1.50) and Choba market (31.5±0.50). The current study has shown that *A. hybridus* possess appreciable amount of Calcium, Iron, and Magnesium, Platinum, Potassium and sodium. In addition, the study has also shown the very concentration of the above mineral compositions for the different market sources as well as control. In any case, a few authors have detailed comparative substances in *A. hybridus* as well as other edible leafy vegetables Asaolu, *et al* (2012). Mahammed, and Sharif, (2011). They reported some mineral composition contents in *A. hybridus* but gave high content for calcium and low Iron. Although same study also reported the same content for sodium. The studies carried out by Usunobun *et al* (2016) showed that there were increase contents for calcium, iron, magnesium, potassium and sodium, which may be due to environmental factors and differences in location. Turan *et al* (2003) reported on the mineral composition of *A.hybridus* such as Calcium, Magnesium and Iron with extremely high values, although same study reported that sodium and phosphorus were low in value in *A.hybridus*. It was also reported that consumption of *A.hybridus* would probably reduce high blood pressure in patients (Turan *et al*, (2003). The current study has shown that *A. hybridus* possess appreciable amount of Calcium, Iron, and Magnesium, Platinum, Potassium and sodium. In addition, the study has also shown the concentration of the above mineral compositions for the different market sources as well as control. The result of heavy metals in the current studies has shown the presence of Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Cyanide, Selenium.

The result of heavy metals content of *A. hybridus* in Table 4.6 has shown the presence of Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Cyanide and Selenium. In any Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Cyamide and Selemium varied from one location to another. Mile 1 leaf samples recorded highest value for Arsenic (0.685) followed by Mile 3 market samples (0.65), samples from Slaughter (0.64), Rumuokwuta market samples (0.57), Control had (0.565), samples from Rumuokoro (0.56) and Choba market samples had (0.495).

Rumuokwuta market samples had the most elevated value for Cadmium (0.625) followed by slaughter market samples (0.575), Mile 3 market samples recorded (0.545), control (0.65), Choba market samples (0.55) and Rumuokoro (0.54).

Leaf samples from Slaughter market and leaf samples from Mile 1 had the highest value for Chromium (0.215) followed by leaf samples from Mile 3 (0.196), Rumuokwuta leaf samples recorded (13.195), Rumuokoro market samples recorded (0.175), leaf samples from control (0.18) and Choba market recorded (0.15). Leaf Samples from Rumuokwuta and leaf samples from Mile 1 market had highest Lead **(0.095)** respectively, followed by leaf samples from Slaughter market (0.085), leaf samples acquired from Rumuokoro and leaf samples from Choba recorded (0.675) while leaf samples from Control (0.055) and leaf samples from Mile 3 had (0.10). Choba market samples recorded highest Mercury (0.0545) followed by leaf samples acquired from Mile 1 (0.135), Slaughter market samples recorded (0.125), leaf samples from control recorded (0.055), Rumuokoro market samples recorded (0.0075), Mile 3 market samples recorded (0.015) and Rumuokwuta market recorded (0.008). Slaughter market leaf samples and leaf samples from Mile 1 had highest amount of Nickel (0.495) followed by leaf samples from Mile 3 which recorded (0.455), Rumuokoro leaf samples recorded (0.77), Rumuokwuta leaf

samples and leaf samples from Control yielded (0.76), while leaf samples from Choba had (0.43). Leaf samples from Mile 3 had most elevated cyanide content (0.0095) followed by Slaughter market samples (0.0085), leaf samples from Rumuokoro and leaf samples from Control had (0.0055) respectively, Choba samples (0.0035), leaf samples from Rumuokwuta had (0.007) while leaf samples from Mile 1 recorded (0.006). Leaf Samples from Mile 1 had the highest value of Selenium as (0.195), followed by leaf samples from Mile 3 market and leaf samples from Slaughter market recorded (0.175), Rumuokwuta market samples had (0.165), Choba leaf samples recorded (0.145), Rumuokoro leaf samples recorded (0.135) while leaf samples from Control had (0.125). The current study has shown the presence of Arsenic, Cadmium, Chromium, Lead, Mercury and Nickel, in surveyed *A. hybridus* leaves from the different sample areas as well as the control. In any case, a few authors have reported similar work indicating the presence of heavy metals such as Arsenic, Chromium, Cadmium, Lead, mercury and Nickel in *A.hybridus* and other leafy vegetables (Sobukan *et al* 2010). The findings of the current study have also shown that the investigated heavy metal concentrations in the leaf of *A.hybridus* are within the WHO recommendation for leafy vegetable as it indicated the following limits, Manganase, Zinc, Copper, Lead, Cadmium, Iron, Nickel, Arsenic and Mercury as 500, 60, 2.5, 0.50 - 30, < 2.4, 400 - 500, 0.35, 0.02 individually (WHO, 2004). Standard maxima for metals in Agricultural Soils, (Sobukila *et al* 2010) also reported that the concentration of Cadmium, Lead, Mercury and Nickel were absent; it has significantly fallen below the maximum value recommended by man with a substantial level of safety.
(Divriki, *et al* 2003) reported a similar research on the content of heavy metals on *A.hybridus* yet having higher content of Lead, Cadmium than that of the present study; although they reported that the Pb and Cd content are also in line with the WHO (2004).
(Atayese *et al* 2008) reported a similar research on the content of heavy metals in *Amaranthus hybridus* such as Cadmium and Chromium. This revealed that Cadmium and Chromium have a significantly low concentration and not dangerous to man. Tarina *et al* (2015) reported on his research that cadmium occurred in a low quantity in the leaves of *A. hybridus* and therefore accepted for consumption. (Chiroma *et al.*, 2014) reported a similar work on Nickel and revealed its high value in *Amaranthus hybridus*. (Alloway 1995) reported that the result obtained from the analysis of *A. hybridus* for heavy metals indicated the presence of Cadmium, Lead and little amount of Arsenic.

Conclusion

Amaranthus hybridus possesses valuable minerals such Calcium, Iron, Magnesium, Phosphorus, Potassium, and Sodium, although it still contains possible high heavy metals such as Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Cyanide and Selenium. The consumption of which may be injurious to man in high concentration. Therefore, proper measures should be adopted by market traders and consumers to protect this valuable vegetable from the absorption of dangerous metals.

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