The Health Implications of Continued Use of Aluminium Cooking Ware on Consumers

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ABSTRACT

The health implications of continued use of aluminium cooking ware on consumers are examined. Focus is primarily on mineral elements status – particularly aluminium, of selected staple foodstuffs. Atomic absorption spectroscopy was used to experiment the changes in mineral elements concentrations after cooking in aluminium cooking ware. White yam (Dioscorea rotundata), rice (Oritza sativa) and cowpea (Vigna unguiculata) were purchased from Aarada market in Ogbomoso, Nigeria. Three industrially manufactured aluminium cooking ware of the same brand were purchased from a local vendor in Ogbomoso, Nigeria. The water used was distilled using a water distillation unit (model – WSS/8, Hamilton Laboratory Glass Limited, Kent) and deionised using a deioniser – Puri – Fi XR, Fistreem. The three food stuffs purchased were cooked differently in the three aluminium pots ten times each After cooking yam in the aluminium cooking ware, it was revealed that there was increase in the concentration of aluminium ion ranging from 48.0mg/100g to51.0mg/100g. Similarly, the increase in the range of aluminium ion after cooking were 68.1mg/100g to70.8mg/100g for rice and 70.0mg/100g to16 5.0mg/100g for cowpea. The leaching from aluminium cooking ware into the foods causes increase in the concentration of aluminium ion in the cooked foods. Changes in the concentration of other elements like Fe, Zn, Cr, and Mg are not significant. This change in aluminium concentration after cooking in aluminium cooking ware deserves attention because, it has negative health implication. Aluminium has been said to alter enzymes involved with acetylcholine metabolism which affects interplay between thought processes and motor coordination resulting in ataxia, Alzheimer syndrome and other neurodegenerative diseases.

Keywords: *Aluminium, cooking ware, Alzheimer, neuro degenerative diseases*

INTRODUCTION

There have been conflicting reports in recent times about connection between aluminium and a number of neurological and physiological disorders. Because of fears concerning a possible connection between aluminium and Alzheimer's disease, Parkinsonism dementia as well as amyotrophic lateral sclerosis, some people are turning away from aluminium cooking ware (Blumenthal, 1990). Cooking ware are many and varied. Those in common use today are made from iron (cast iron and steel), stainless steel, copper, glass, plastics and aluminium (cast, rolled and anodized). More than half of all cooking ware sold today are made of aluminium usually coated with non-sticky finishes or treated in some way to harden the structure and make it more scratch resistant (Schmutz, Christenburg and Hoyle,

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1998). As a good conductor of heat, aluminium cooking ware is very widely used in cooking utensils because of its advantages of low cost, great strength and conductivity. Aluminium is a reactive metal, and its primary disadvantage is that acidic foods should not be cooked in it for any length of time (Mei and Yao, 1993). The amount of mineral elements in our diet will depend on its concentration in the foods we select, the quantity we eat as well as the method of preparation of such foods (Ojo and Ajayi, 2005). Apart from the unavoidable daily intake of mineral elements via natural foods, human may be exposed to additional mineral elements released from cooking utensils, storage containers and other materials with which foods must come in contact with during processing (Lione, 1985).

For instance, when foods are cooked or stored in aluminium containers, some of the aluminium may dissolve and be absorbed into the foods (Ojo and Ajayi, 2005). Acid rich food items such as fruit and vegetable juices, tomatoes and sauerkrauts tend to increase in aluminium content more than other foods but the extent of this depends on other factors such as cooking temperature, length of contact time and even the amount of sugar present (Lione, 1985). Sugar has been found to reduce the amount of aluminium that is dissolved (Lione, 1985). Boiling water in aluminium containers causes aluminium to leach into the water (Ojo and Ajayi, 2005). Water containing fluorides encourages the leaching process from aluminium cooking ware. Water containing 1ppm fluoride (the usual level of fluoride in public water supplies) boiled for ten minutes in an aluminium pot will increase the concentration of aluminium to 200ppm. Prolonged boiling can increase the concentration to 600ppm (Tennakone, 1987). Today, the use of aluminium cooking ware is on the increase. There is no information on changes in the aluminium content of local staple foods on continuous cooking in aluminium cooking ware. It is therefore expedient to verify the effect of its continued use in view of the fact that aluminium has been implicated in a number of neurodegenerative diseases. The information obtained will not only be novel but also will guide in recommended dietary allowance.

Health Implications of Continued Use of Aluminium Cooking Ware on Consumers

Neurotoxicity of some mineral elements has been reported. In 1986, Munoz-Garcia reports that aluminium is a selective neurotoxin and a nerve cell poison of specific affinity for the brain. Exposure of the central nervous system to aluminium salts produces a progressive encephalopathy (Munoz-Garcia, 1986). Moreover, aluminium has been described as a potent inhibitor of the uptake of choline and dopamine (Bank, 1983; Guest, 1980; Davidson, 1981). Both chemicals – choline and dopamine are vital chemicals released during nerve impulse transmission, as well as nerve impulse conduction to muscles and various glands. As a result, the presence of aluminium ions in the brain has an adverse impact on thought and reasoning processes as well as short-term memory. Furthermore, there is significant evidence that aluminium ions alter enzymes involved with acetylcholine metabolism (Wong, 1981). This alteration thereby affects the interplay between thought processes and motor coordination, resulting in ataxia and other serious problems so obvious in those with Alzheimer syndrome and other "senile" degenerative conditions (Wong, 1981).

MATERIALS AND METHOD

Foodstuffs – white yam (*Dioscorea rotundata*), rice (*Oritza sativa*) and cowpea (*Vigna unguiculata*) were purchased from Aarada market in Ogbomoso, Nigeria. Aluminium cooking wares – three industrially manufactured aluminium cooking wares of the same brand (Fig. 1) were purchased from a local vendor in Ogbomoso, Nigeria. Distilled deionised water – the water used was distilled using a water distillation unit (model – WSS/8, Hamilton Laboratory Glass Limited, Kent) and deionised using a deioniser – Puri – Fi XR, Fistreem.

Cooking of foodstuffs using aluminium cooking wares: For this investigation, one aluminium cooking ware was used to cook the peeled yam sample ten times. The second aluminium cooking ware was used to cook the rice ten times while the third aluminium cooking ware was used to cook the cowpea ten times. For each of the foodstuffs, the weight of the food sample and the duration of cooking times were kept the same. Distilled deionised water was used for all the cooking experiments. Each food sample from each of the experiments was blended in a glass blender (model – Waring blender …) and packed in a high density polyethylene bag and kept in refrigerating compartment at about 2 – 5^0C in readiness for spectroscopic analysis. The samples of the uncooked foodstuffs were also prepared for analysis. Mineral elements of interest analysed were aluminium (Al), Iron (Fe), Zinc (Zn), Chromium (Cr), Copper (Cu), Magnesium (Mg), Nickel (Ni) and Manganese (Mn).

Mineral Elements Determination by the Atomic Absorption Spectroscopy: Each of the samples of foodstuffs was dried and ashed in a muffle furnace at 550^0C. The ash was dissolved in HNO_3 and filtered through ashless filter paper using AOAC (1990) procedure. The filtrate was then analysed for Al, Mn, Mg, Fe, Cu, Zn, Cr and Ni. Atomic absorption spectrometer (Alpha, 4 AAS) was then used for the determination of Al, Mn, Mg, Fe, Cu, Zn, Cr and Ni in the filtrate using their respective resonance lines. For each element, the hollow cathode lamp of each was used and the instrument was optimised for the analysis of each element. Standard calibration was employed according to AOAC (1990) procedure. The samples and the standard solutions of the elements concern were aspirated into the atomic absorption spectrometer.

RESULTS AND DISCUSSION

Table 1: Mineral element contents of uncooked and cooked yam in aluminium cooking ware (mg/100g).

Cooking times	Al	Fe	Ni	Zn	Cr	Mn	Cu	Mg
1	48.00	0.00	2.52	51.00	0.00	21.00	3.60	0.00
2	50.00	0.00	2.52	52.00	0.00	21.60	3.60	200
3	51.00	0.00	2.50	52.60	0.00	21.20	3.60	200
4	51.00	0.00	1.90	50..80	0.00	21.30	5.80	205
5	50.00	0.00	1.95	51.00	0.00	20.60	3.80	210
6	49.00	0.00	2.00	51.00	0.00	20.70	3.70	205
7	48.00	0.00	2.40	51.00	0.00	20.80	3.90	209
8	51.00	0.00	2.45	52.40	0.00	19.50	3.90	208
9	50.00	0.00	2.20	50.70	0.00	21.00	4.00	209
10	51.00	0.00	2.50	51.20	0.00	21.90	5.80	209
CY	17.30	0.00	2.82	60.33	0.00	20.00	3.60	2206

CY=uncooked yam ***Source:*** Experimentation, 2010

Table 2: Mineral element contents of uncooked and cooked rice in aluminium cooking ware(mg/100g).

Cooking times	Al	Fe	Ni	Zn	Cr	Mn	Cu	Mg
1	70.8	3.4	0.00	70.0	0.0	20.2	1.2	107.5
2	70.5	3.0	0.00	72.0	0.0	25.0	1.0	104.0
3	68.1	3.0	0.007	73.0	0.0	21.0	1.0	104.5
4	68.1	3.5	0.00	73.5	0.0	19.0	1.0	105.0
5	68.5	3.4	0.00	73.0	0.0	20.0	1.0	103.0
6	68.6	3.4	0.00	70.0	0.0	21.0	1.5	102.8
7	69.0	3.5	0.00	70.0	0.0	22.0	1.5	104.0
8	68.4	3.3	0.00	71.0	0.0	22.0	0.8	105.5
9	68.1	3.0	0.00	74.1	0.0	21.0	1.2	105.2
10	68.4	3.5	0.00	73.5	0.0	23.0	1.2	104.6
CR	23.0	3.5	0.00	70.0	0.0	20.2	1.3	105.8

CR= uncooked rice ***Source:*** Experimentation, 2010

Table 3 : Mineral element contents of uncooked and cooked cowpea in aluminium cooking ware(mg/100g).

Cooking times	Al	Fe	Ni	Zn	Cr	Mn	Cu	Mg
1	165.0	18.0	3.8	60.0	0.0	22.2	1.0	182.0
2	162.5	19.0	4.0	61.1	0.0	23.0	1.0	181.5
3	163.0	20.4	4.0	62.1	0.0	23.0	1.0	180.6
4	162.4	21.3	4.1	62.1	0.0	22.0	0.8	182.0
5	162.0	21.0	3.8	60.0	0.0	22.2	1.0	181.8
6	164.5	19.5	3.9	60.0	0.0	21.5	0.75	183.2
7	164.5	20.1	4.2	59.7	0.0	21.4	0.8	180.7
8	164.0	17.8	4.0	61.0	0.0	20.5	0.8	181.0
9	163.0	17.5	3.8	59.6	0.0	20.5	0.5	182.8
10	164.0	19.2	4.1	59.5	0.0	20.0	0.8	183.5
CB	70.0	20.0	4.3	60.0	1.2	22.2	1.84	180.0

CB=uncooked cowpea ***Source:*** Experimentation, 2010

Figure 1: Aluminium cooking ware

The mineral element contents of uncooked and cooked yam in aluminium cooking ware are as shown on table 1. The values for uncooked yam (CY) were used as control reference. In uncooked yam, Iron (Fe) and Chromium (Cr) were not detected. Similarly, the yam sample cooked on aluminium was apparently devoid of Iron and Chromium. The Nickel (Ni) and Zinc (Zn) contents of uncooked yam were 2.82mg/100g and 60.33mg/100g respectively. As shown in table 1, there was a slight decrease in the concentration of these two elements after cooking in aluminium cooking ware. These decreases might be due to adsorption of these elements on the surface of the cooking ware and possible leaching into water used in cooking. Aluminium with the initial concentration of 17.30mg/100g in uncooked yam (CY) experienced significant increases when cooked in the aluminium cooking ware. These increases ranged from 48mg/100g for the first cooking to 51mg/100g for the tenth. The mineral element status of rice before and after cooking in aluminium cooking ware is as shown on table 2. Nickel and Chromium contents of uncooked rice were below the detection limit of the spectrometer. Similarly, the aluminium cooking ware did not impart Nickel or Chromium into the rice samples during cooking. Hence the concentrations of Nickel and Chromium in the rice before and after cooking were zero. The concentrations of Iron (Fe), Zinc (Zn), Manganese (Mn) and Copper (Cu) in the uncooked rice were 3.50mg/100g, 70.30mg/100g, 20.20mg/100g and 1.32mg/100g. As shown on table 2, these concentrations were similar throughout the 10 times. The aluminium content of uncooked rice was 23.00mg/100g. For each of the cooking experiment in aluminium cooking ware, there was an increase in the level of aluminium concentration in the rice sample ranging from 68.10mg/100g to 70.80mg/100g.

Table 3 shows the mineral elements of cowpea before and after cooking in aluminium ware. With the exception of Chromium and aluminium, the changes in the concentrations of other elements before and after cooking for the various times were similar. Chromium concentration in uncooked cowpea was 1.20mg/100g. After every cooking in aluminium cooking ware, the concentration of Chromium was below the detection limit of the spectrometer. This could be attributed to leaching of the element away from foodstuff and possibly adsorption to the surface of the cooking ware.

The contribution of aluminium cooking ware to the mineral element status of the selected foodstuff is significant. Particular attention need to be given to changes in aluminium ion in foodstuffs when the use of aluminium cooking ware is employed. The dramatic increase in the concentration of aluminium after cooking in aluminium cooking ware deserves attention. This is because aluminium has been implicated in some neuro degenerative diseases including Alzheimer’s disease, Parkinsonism dementia and amyotrophic lateral sclerosis (Muller, Steinegger and Schlatter, 1993; Ojo and Ajayi, 2005).

CONCLUSION

The purpose of this study was to examine the Health Implications of Continued Use of Aluminium Cooking Ware on Consumers. The effects of continued use of aluminium cooking ware on the mineral elements status – particularly aluminium of selected staple foodstuffs were equally examined. Atomic absorption spectroscopy is used to determine the changes in mineral elements concentrations after cooking in aluminium cooking ware. After cooking yam in aluminium cooking ware an increase in the concentration of aluminium ion was observed. In addition, the use of aluminium cooking ware for cooking on a continuous basis can cause increase in the aluminium content of food and thus the intake of aluminium ion. Thus, it is advisable to consider adjustment in dietary allowance when food is cooked in aluminium cooking wares.

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