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COMPARATIVE EVALUATION OF THE EFFECTS OF CORRUGATED ROOFING SHEETS ON RAIN WATER WITHIN AWKA METROPOLIS, ANAMBRA STATE

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ABSTRACT: *The objective of this research is to evaluate comparatively the effects of different brands of corrugated roofing sheets on rain water utilized within Awka metropolis. Different parameters were assessed in the rain water harvested between the months of June to August within Awka metropolitan city using established standard laboratory procedures. The rain water were harvested directly (control) and also collected after passing through the different brands of corrugated roofing sheets (samples). The results showed no appreciable effects on the physical appearance, observable odour and taste of the water samples from the control sample. However, slight changes were noticed in the pH at 30^{o}C. The pH of the control was 6.65, 6.61 (sample A), 6.20 (sample B), 6.86 (sample C), 6.78 (sample D), and 6.68 for sample E. The amount of the suspended solid (SS) in mg/100ml occurred at a non detectable limit for all the water samples and the control sample inclusive. The total solid (TS) was found to be 40mg/100ml in each of the samples and same for the control sample. The amount of the total dissolved solid (TDS) found in each of the samples including the control sample did not vary. This showed that the corrugated roofing sheet has no significant effect on the SS, TS and TDS on the rain water harvested within the study area. Iron, zinc and Chloride followed similar trend as SS, with **Fe** and **Zn** occurring at non-detectable limit of the instrumentation while the levels of **Cl^-** ion (3mg/100ml) did not vary in all the samples including the control sample. The alkalinity increased from 3mg to 4mg in samples A, B, C and D but remained unchanged in sample E. Samples C and D had high amount of nitrate (6mg and 7mg respectively) with sample E having the least nitrate value of 2mg compare to 3mg observed in the control sample. The results revealed that corrugated roofing sheets affect the total alkalinity and methyl orange alkalinity of harvested rain water in the study area greatly but had no impact on the physical appearance, taste and odour of the rain water. It was also observed that corrugated roofing sheet had no significant effects on the SS, TS and TDS of the harvested rain water.*

KEYWORDS: *Corrugated roofing sheet, rain water, alkalinity, total solid, nitrate and chloride.*

INTRODUCTION

The provision of water for domestic and other uses in rural and urban communities is one of the most intractable problems in Nigeria today, with over 52% of Nigerians lacking access to good quality water supply (Lekwort et al., 2010; Kun, et. Al., 2004) in which Awka metropolis is

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inclusive. Nigeria is endowed with enormous surface and ground water resources, yet the provision of portable water and safe water supply is till inadequate (Nwankwaola, 2011). Among the various catchment for harvesting of rain water, roof catchment seems to be the most common. This can be attributed to the fact that the inhabitants use existing roof of their houses to harvest the rain water in other to avoid incurring additional cost (Olaoye and Olaniyan, 2012; Orebiyi, et. al., 2010; Tobin, et. al., 2013). The amount and the quality of rain water collected depend on the area and the nature/type of the roofing material (Amadi, 2014; Dais, et.al., 2007; Martin, 2009).
This work is aimed at evaluating the effects of these roofing materials on the quality of harvested rain water that is generally utilized within Awka metropolis.

Different roofing materials that are generally used in the study area are galvanized, corrugated iron roofing sheet, corrugated plastic, asbestos cement sheet, concrete, thatch, tile or clay.
Roofs provide an ideal catchment surface for harvesting rain water (Eruola, et. Al. 2012), provided they are clean. But Chang et al (2004) reported that roofs can be a source of contamination of harvested rain water hence the need to properly assess the quality of rain water harvested from different roofing materials cannot be overemphasis.

MATERIALS AND METHODS

Five different houses of various roofing sheet material brands were located within Awka metropolis for the study. The roofing sheet material were identified by the Building Engineers on sites and labeled accordingly.

Table 1: *Roofing sheet materials used for the study*.

S/N	SAMPLE LABEL	ROOFING SHEET BRAND	DURATION OF USE (YEARS)
1	A	Swan midigal corrugated iron roofing sheet	10 - 20
2	B	Swan kam corrugated iron roofing sheet	7 - 20
3	C	Swan surn corrugated iron roofing sheet	12 - 30
4	D	Aluminium roofing sheet	12 - 30
5	E	Corrugated rusted iron roofing sheet	10 -20

The control rain water sample was rainwater harvested directly in a plastic basin without it having contact with any surface or object. The rain water samples were harvested from the five different roofing sheets and labeled samples A - E. The water samples were analyzed at water laboratory of National Agency for Food & Drug Administration and Control, NAFDAC South-East Zonal Office, Agulu, Anambra State using standard methods. The parameters tested for were substances which dissolve in rain water of which some are beneficial to humans but in excess are threat to the well being of the individual that consumed it. The harvested rain water samples were test organoleptically, quantitatively, qualitatively for appearance, odour, taste, conductivity,pH, total solid (TS), total dissolved solid (TDS), total alkalinity (TA), total hardness, Chloride, sulphate, nitrate, potassium, calcium, iron, zinc and copper. Standard Operation Procedure, SOP used in

NAFDAC was employed in the analyses of all the parameters. The nitrate, sulphate, copper, and alkalinity were examined using their test tablets and the smart spectrophotometer. The carbondioxide, total hardness and chloride were analysed using LaMotte kit from USA.

RESULTS AND DISCUSSION

The results of the harvested rain water analyses are presented below.

Table 2: Results of the harvested rain water analyses

S/N	TEST PERFORMED	ACCEPTED RANGE	CONTROL	SAMPLE A	SAMPE B	SAMPLE C	SAMPLE D	SAMPLE E
1	APPEARAN	---	Clear	Clear	Clear	Clear	Clear	Clear
2	ODOUR	—	odourless	odourless	odourles	odourless	odourless	odourless
3	TAS I'E	---	Tasteless	Tasteless	Tasteles	Tasteless	Tasteless	tasteless
4	PH	6.5-8.5	6.65	6.61	6.20	6.86	6.78	6.68
5	TS	500mg	40	40	40	40	40	40
6	TDS	500mg max	40	40	40	40	40	40
7	SS	Nil	Nil	Nil	Nil	Nil	Nil	Nil
8	CO_2	50mg max	5	4.5	3	3.5	4	3
9	MOA	100mg max	26	113	Out of	Out of	122	121
10	TA	100mg max	26	113	Oul of	Out of	122	121
11	TH	100mg max	3	4	4	4	4	3
12	CHLORIDE	200mg	3	3	3	3	3	3
13	SULPHATE	200mg	9	6	8	5	6	9
14	NITRATE	50mg max	4	3	6	7	5	2
15	POTASSIU	10mg max	0.7	09	0.7	0.2	0.7	0.8
16	CALCIUM	75mg max	2	2.7	2.35	2.7	2.7	2
17	MAGNESIU	30mg max	1	1.35	1.35	1.35	135	1
18	IRON	0.3mg	0	0	0	0	0	0
19	ZINC	5.0mg max	0	0	0	0	0	0
20	COPPER	Img max	0.46	1,42	1.40	0.85	0.28	1.82

TS =Total Solid, TDS=Total Dissolved Solid. *ss* ***=Suspended Solid. CO_2 = Carbon Dioxide.*** *MOA =Methyl Orange Alkalinity.* ***TA =*** ***Total alkalinity.*** *TH = Total Hardness..*

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The six samples including the control with respect to organoleptics met the required standard (Table 2). They were clear as to sight, tasteless as to the taste, odourless as to the odour. Since the WHO standard requires that drinking water should be tasteless, odourless and colourless, hence they were within the WHO standard.. The accepted WHO for pH 6.5 - 8.5 for the five corrugated roofing sheet with the control all have varying pH with swan sumo corrugated roofing sheet having the least acidic value with pH of 6.86 at 30°C but within the WHO accepted range while swan midigal corrugated value of 6.61 at 30°C. With the decreased pH of swan sumo it was clear when compared with the control that some alkaline substance was washed into the water sample about 0.21 (6.86 - 6.65). Both values were within values obtained by Olaoye and Olaniyan whose values for asbestos roof fall within 6.58 - 6.94 and above that they obtained for aluminium roof which fell between 6.13 - 6.3. The accepted WHO total dissolved solid (TDS) for drinking water is 500mg/l. The water samples including the control had a recurring maximum total dissolved solid content of 40mg/l each. This was within the accepted WHO standard. The maximum accepted world health organization standard of carbon dioxide content for drinking water is 50mg/l. In the parametric analyses carried out, the control had the highest carbon dioxide content of 5mg while swan kam corrugated iron roofing sheet and the rusted corrugated iron roofing sheet had the lowest, 3mg/l for both. Both the control and swan kam corrugated iron roofing sheet and the rusted corrugated iron roofing sheet were very low within the maximum objectionable carbon dioxide content of drinking water. Some carbon dioxide content of the harvested water may be lost to the atmosphere or to the corrugated roofing sheet. Control (5mg/l) - the content of rusted roofing sheet (3mg/l) - 2mg/l was the largest amount of carbon dioxide lost. The WHO standard for total alkalinity content of drinking water is 100mg/l with the exception of the control which was 26mg/l within the acceptable maximum limit. Swan midigal, aluminium, rusted corrugated sheets were above the maximum WHO standard which were 122 and 121 respectively while swan kam and swan sumo both read out of range and judging by the control should have been above 100mg/l. The value obtained by Olaoye and Olaniyan was far below what was obtained. The lowest dissolution was from swan midigal 87mg/l (133 -- 26) and the highest was from aluminium roofing sheet 96mg/l (122 - 26) above the control. The standard WHO total hardness content for drinking water acceptable to WHO is 100mg/l, but 3mg/l was the value obtained for the control and the rusted corrugated iron sheet. 4mg/l was the total hardness content for the rest of the samples in the total hardness (parametric) test. Olaoye and Olaniyan obtained 31 - 39mg/l for aluminium and 29 - 31 mg/1 for the concrete roof. The maximum chloride content of drinking water acceptable to WHO is 200mg/l. All the samples, on which the chloride parametric analyses were performed, had chloride contents of 3 mg/1 which is very much negligible. The analysis by Olaoye and Olaniyan had a chloride content of 90mg/l for asbestos, concrete roof and corrugated plastic roof. While the value obtained for aluminium roof was 8mg/l which was very much above the obtained value. The maximum sulphate content of drinking water acceptable to WHO is 200mg/l. The control and the rusted corrugated iron sheet had sulphate content of 9mg/l which are the maximum obtained. Swan sumo corrugated iron roofing sheet had the least sulphate content of 5mg/l. The maximum nitrate content of drinking water acceptable to WHO is 50mg/I. The control had a nitrate content of 4mg/l while the maximum nitrate content contained by swan sumo corrugated iron roofing sheet was 7mg/l

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while 2mg/l was implicated in the nitrate content of the rusted corrugated iron roofing sheet. The maximum potassium content of drinking water acceptable by WHO standard is 10mg/l. The control had a potassium content of 0.7mg/l, while swan sumo had the minimum potassium content of 0.2mg/I, with swan midigal recording a value of 0.9mg/I.

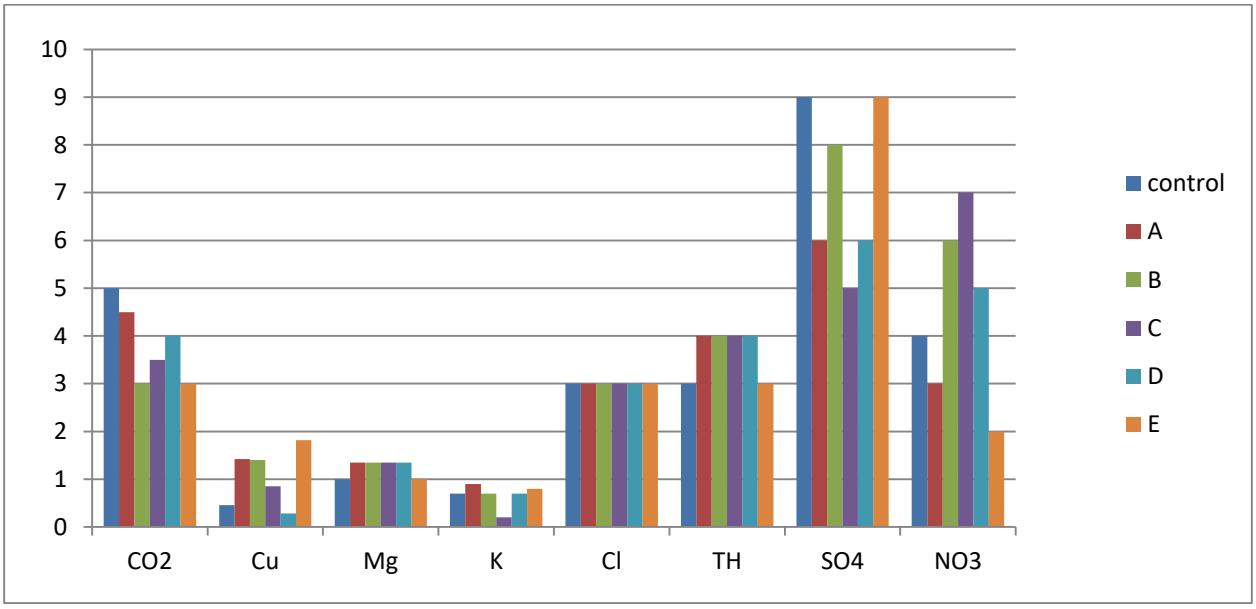

Fig: 1 : Variation in the rainwater parameters.

The fig 1 showed the variation in the harvested rainwater parameters. It was observed that CO_2 levels decreased in varying degrees with the different roofing sheets indicative that the roofing sheet act as absorbent thereby reducing the amount of CO_2 as rainwater passes through them. This may be attributed to the presence of micro pores of the roofing sheet materials where the CO_2 were adsorbed. Similar trend was observed in the SO_4^{2-} ions levels with the exception noticed in sample E. The total hardness levels increased as the rainwater were harvested from the different roofing sheets compare to the value obtained fron the control sample. There were also significant increase in the levels of copper and nitrate ions as the rainwater were harvested from the different roofing sheet materials (Fig 1).

CONCLUSION

There was no significant change in the values of **K**, samples A(0.9mg), B(0.7mg), C(0.2mg), D(0.7mg) and E(0.8mg). **Cu** content was 0.46mg in the control while 1.82mg was found in sample E. There was appreciable effect of the corrugated roofing sheet on the total alkalinity of the water samples as the value increased from 26mg (control), 113mg (sample A), 121mg (sample E), to 122mg(sample D). The values obtained in samples B and C were so high to be out of range of the instrumentation. Similar trend as for total alkalinity was observed for the methyl orange alkalinity. The results showed that the corrugated roofing sheet had no significant effects on the SS, TS and TDS of the harvested rain water. However, the corrugated roofing sheets affect the total alkalinity

and methyl orange alkalinity of harvested rain water in the study area greatly but had no impact on the physical appearance, taste and odour of the rain water.

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